SOLAR LIGHT REFLECTIVITY ANALYSIS

EASTWOOD CENTRE

WD135-01F03(REV0)- SR REPORT

JULY 21, 2016

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 Eastwood Centre development, located at 144-186 Rowe Street, Eastwood. The analysis has been undertaken based on the architectural drawings prepared by the project architect Rice Daubney, received in May 2016.

This study identifies any possible adverse reflected solar glare conditions affecting motorists, train drivers, 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 State Environmental Planning Policy No. 65 (SEPP65, Part 04 (Designing the Building) for Amenity), which contains the Apartment Design Guide (ADG) and the City of Ryde Development Control Plan 2014.

A site survey has been undertaken to obtain photographs of the critical sightlines of motorists on the surrounding streets. Viewpoints of train drivers from the adjacent railway line are also analysed. The 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 motorists and pedestrians on the surrounding streets, train drivers, occupants of neighbouring buildings, and to comply with the abovementioned planning control requirements, it is recommended that:

- All western aspect windows of Penthouse AA0601 have a maximum normal specular reflectance of visible light of 11%.
- The glazed portions of the western aspect of the commercial suites located at the south-western corner of the development (on Levels 2 to 5) have a maximum normal specular reflectance of visible light of 11%.
- The glazing used on the southern-aspect balustrades of the following balconies be restricted to have a maximum normal specular reflectance of visible light of 8%:
    - Level 6: DA0603, DA0602
    - Level 7: DB0704, DA0703, DA0702
    - Level 8: DB0804, DA0803, DA0802
    - Level 9, DB0904, DA0903, DA0902
    - Level 10: DA1003, DA1002
    - Level 11: DA1103, DA1102

- The glazing used on the northern aspect of Apartments BB0410 and BB0510 (including on the balcony balustrade) have a maximum normal specular reflectance of visible light of 13%.
- All other glazing have a maximum normal specular reflectance of visible light of 18%.

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, train drivers, or to occupants of neighbouring buildings, and will comply with the planning controls regarding reflectivity from SEPP65 and the City of Ryde Development Control Plan 2014.

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) and the City of Ryde Development Control Plan 2014.

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 Figures 2a & 2b. The check zones highlight the areas that are potentially affected by solar reflections from each critical glazed aspect. It should be noted that the check zones shown in Figures 2a & 2b do not take into account the effect of overshadowing by neighbouring buildings or the shielding effect of any existing trees or other obstructions. These effects are examined in the detailed analysis described in Section 2 of this report.

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

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

If it is found that a section of the subject development will be within the zone of sensitive vision of a motorist or train driver 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, train drivers 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

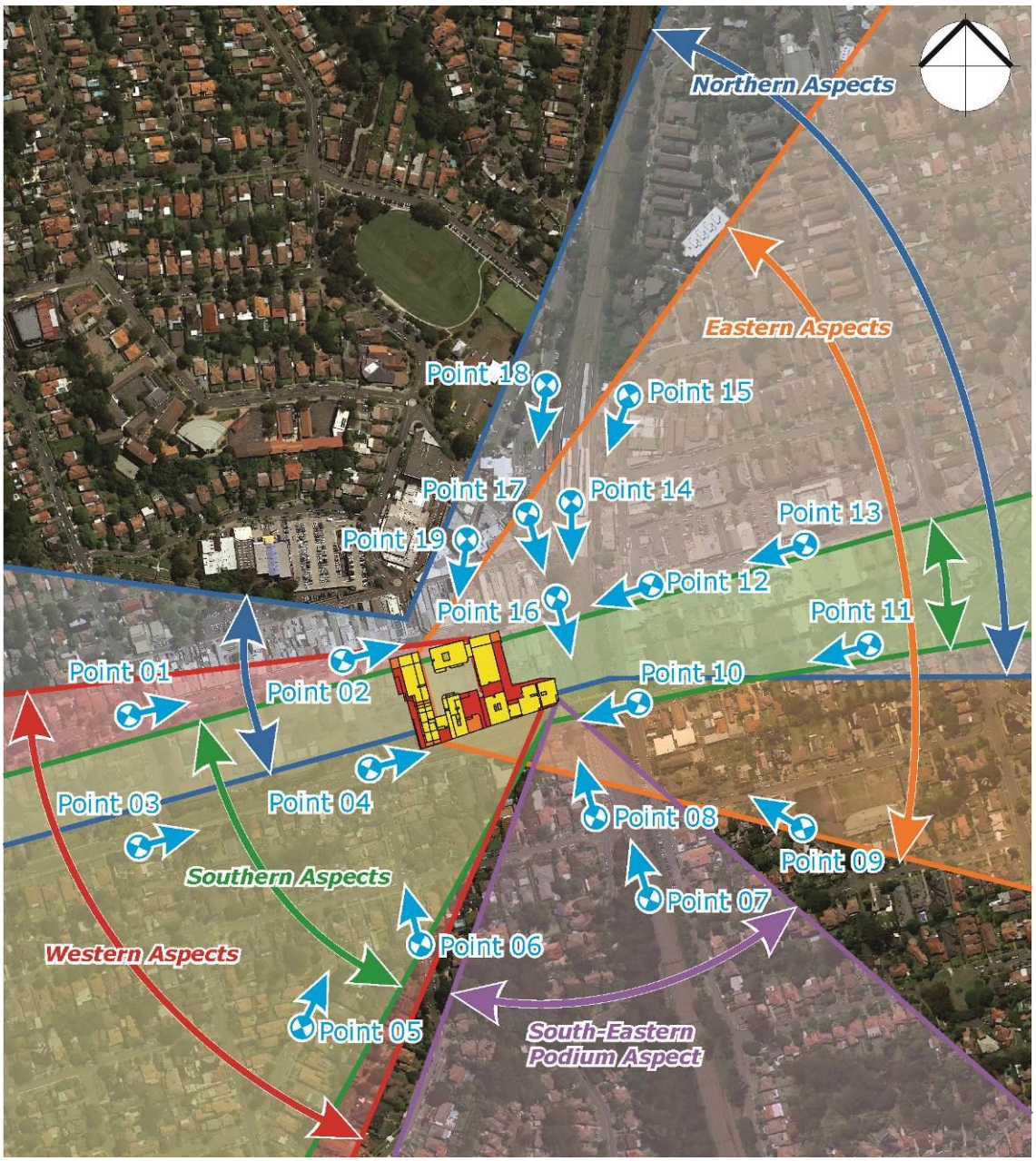

Figure 2a: Check Zones and Study Point Locations (excluding angled bay windows) (the check zones are the areas where glare could potentially be observed)

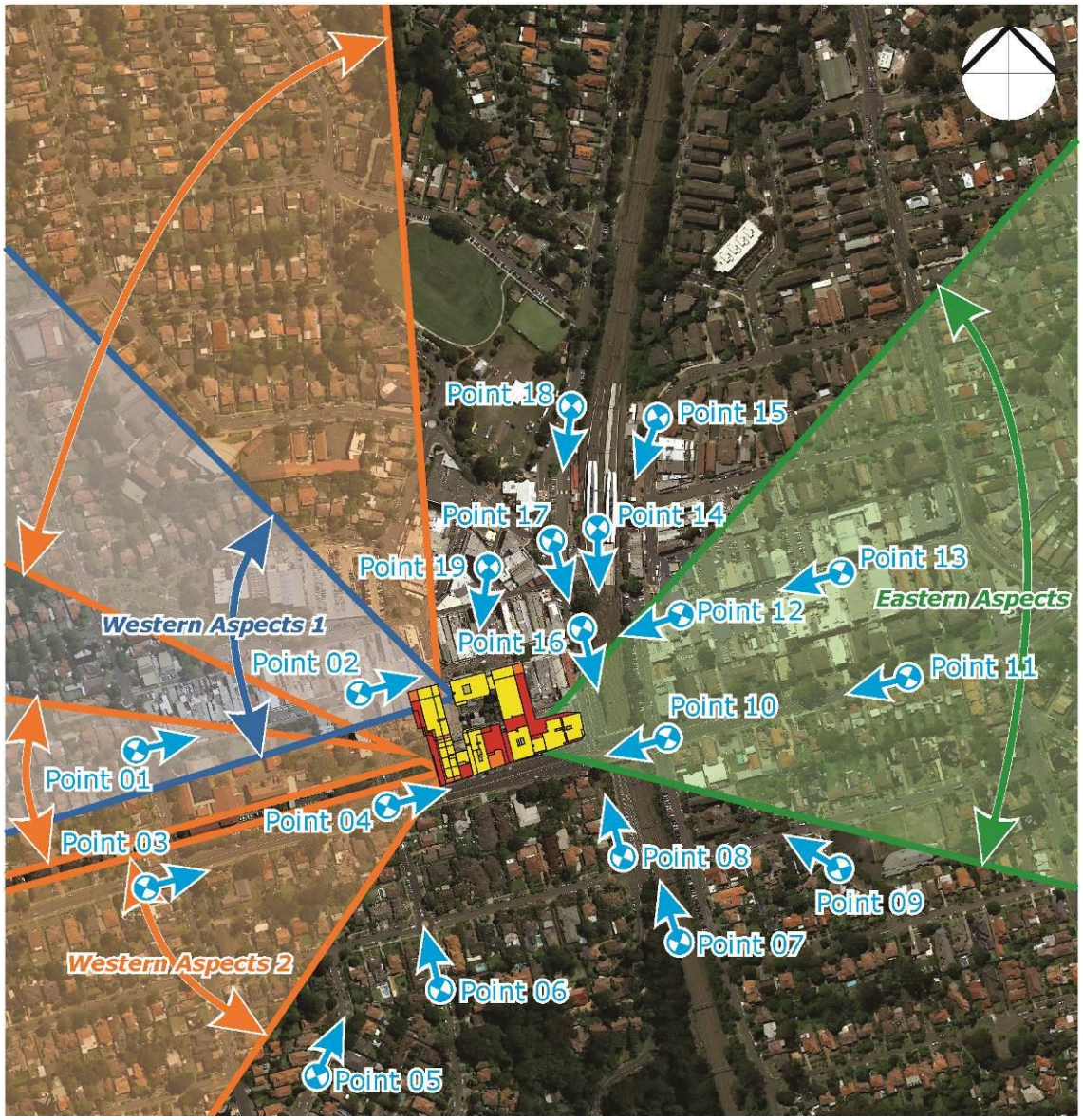

Figure 2b: Check Zones and Study Point Locations (for the angled bay windows only) (the check zones are the areas where glare could potentially be observed)

2 ANALYSIS

2.1 Impact onto Motorists, Train Drivers and Pedestrians

From the study of the check zones shown in Figures 2a & 2b, a total 17 street level locations and 2 railway 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 Figures 2a & 2b do not take into account the effect of overshadowing by neighbouring buildings or the shielding effect of any existing trees or other obstructions. These effects are examined in the detailed analysis described in 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	Rowe Street – heading east	Northern and Western Aspects
2	Rowe Street – heading east	Northern and Western Aspects
3	Rutledge Street – heading east	Southern and Western Aspects
4	Rutledge Street – heading east	Southern and Western Aspects
5	Stewart Street – heading north-east	Southern and Western Aspects
6	Trelawney Street – heading north	Southern and Western Aspects
7	T1 Northern Train Line – heading north	Southern and Eastern Aspects
8	West Parade – heading north	Southern and Eastern Aspects
9	Young Parade - heading north-west	Southern and Eastern Aspects
10	First Avenue - heading west	Southern and Eastern Aspects
11	First Avenue - heading west	Southern and Eastern Aspects
12	Rowe Street - heading west	Northern and Eastern Aspects
13	Rowe Street - heading west	Northern and Eastern Aspects
14	T1 Northern Train Line – heading south	Northern and Eastern Aspects
15	Railway Parade – heading south-west	Northern and Eastern Aspects
16	West Parade – heading south	Northern and Eastern Aspects
17	West Parade – heading south	Northern and Eastern Aspects
18	West Parade – heading south	Northern and Eastern Aspects
19	Coolgun Lane – heading south-west	Northern and Eastern Aspects

2.1.1 Drivers heading east along Rowe Street

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

At Point 1, a narrow view of the northern aspect of the north-western building, and portions of the western aspect of the north-western building, are visible and within the zone of sensitive vision. Point 1 is located within the check zone for both of these aspects, and hence solar glare can potentially be observed at Point 1 from of these aspects. However, the view of the northern aspect of the north-western building is very narrow (less than half a degree of arc) and hence the intensity of glare will be less than 500cd/m^2. Therefore there will be no adverse glare observed from the northern aspect of the development at Point 1. Most of the windows on the western aspect of the north-western building which are visible within the zone of sensitive vision at Point 1 are quite narrow and will appear to be less than half a degree of arc, and hence no adverse glare will be observed at Point 1 from those windows. A tree on the southern side of Rowe Street also assists with blocking the view of some of those windows. However, to ensure that no adverse solar glare affects motorists heading east at Point 1 it is recommended that all western aspect windows of Penthouse AA0601 have a maximum normal specular reflectance of visible light of 11%.

At Point 2, much of the northern aspect of the development, and small parts of the western aspects, are visible and within the zone of sensitive vision. Point 2 is located within the check zone for both of these aspects, and hence solar glare can potentially be observed at Point 2 from of these aspects. However, the visible portions of the western aspect will be overshadowed by other portions of the subject development at the times when glare could have otherwise been observed, and hence no adverse glare will be observed at Point 2 from those visible western aspects. The ground level portions of the northern aspect will benefit from overshadowing provided by the proposed pedestrian awning along Rowe Street, and hence adverse solar glare from those portions of the northern aspect of the development will not affect motorists at Point 2. For the times when solar glare could be observed at Point 2 from the remainder of the portions of the northern aspect that are visible within the zone of sensitive vision, the sun itself will be directly ahead of the observer (low in the sky), and hence glare from the façade of the development will be negligible compared to the direct view of the sun. Hence there will be no adverse solar glare observed at Point 2 from the façade of the subject development.

2.1.2 Drivers heading east along Rutledge Street

Points 3 and 4 are located along Rutledge Street, to the west of the development site. These points represent the critical sightlines of drivers heading west along Rutledge Street at this location. 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 Figures A3 and A4 of Appendix A.

At Point 3, portions of the western aspects of the development are visible and within the zone of sensitive vision. Point 3 is located within the check zone for these aspects, and hence solar glare can potentially be observed at Point 3 from of these aspects. Further analysis indicates that only the glazed portions of the western aspect of the commercial suites located at the south-western corner of the development (on Levels 2 to 5) can potentially cause adverse glare to be observed at Point 3. Although the small sunshades may provide some shading, it is recommended that this glazing be restricted to have a maximum normal specular reflectance of visible light of 11%.

At Point 4, a narrow view of the lower levels of the southern aspects of the development, and a small portion of the western aspect of the south-western corner of the development, are visible and within the zone of sensitive vision. Point 4 is located within the check zone for both of these aspects, and hence solar glare can potentially be observed at Point 4 from of these aspects. However, the view of the southern aspects of the development are very narrow (less than half a degree of arc each) and hence the intensity of glare will be less than 500cd/m^2. Therefore there will be no adverse glare observed from the southern aspects of the development at Point 4. The visible portion of the western aspect of the south-western corner of the development which is within the zone of sensitive vision at Point 4 does not include any glazing, and hence there will be no adverse solar glare observed at Point 4.

2.1.3 Drivers heading north-east along Stewart Street

Point 5 is located along Stewart Street, to the south-west of the development site. This point represents the critical sightlines of drivers heading north-east along Stewart 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 A5 of Appendix A.

The top half of the south-western and southern buildings of the development are visible and within the zone of sensitive vision at this location. The southern aspect of each building is visible, and the western aspect of the southern building is also visible. Point 5 is located within the check zone for both of these aspects, and hence solar glare can potentially be observed at Point 5 from of these aspects. However, further analysis indicates that the windows on these areas of the façade are quite narrow (with the exception of the larger balcony windows/doors), and when viewed from Point 5 the angular width of the narrow windows will be less than 0.5 degrees of arc, and hence there will be no adverse solar glare observed at Point 5 from those narrow windows. The larger balcony windows/doors on the southern aspect of the southern and south-western buildings benefit from being recessed into the overall building footprint and will be overshadowed at the times when solar glare could otherwise have been observed.

Nonetheless, the balustrades of the southern aspect balconies will not benefit from overshadowing, and hence it is recommended that the glazing used on the southern-aspect balustrades of the following balconies be restricted to have a maximum normal specular reflectance of visible light of 8%:

- Level 6: DA0603, DA0602
- Level 7: DB0704, DA0703, DA0702
- Level 8: DB0804, DA0803, DA0802
- Level 9, DB0904, DA0903, DA0902
- Level 10: DA1003, DA1002
- Level 11: DA1103, DA1102

2.1.4 Drivers heading north along Trelawney Street

Point 6 is located along Trelawney Street, to the south of the development site. This point represents the critical sightlines of drivers heading north along Trelawney 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 this viewpoint 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 north along Trelawney Street.

2.1.5 Train Drivers heading north along the T1 Northern Line

Point 7 is located on T1 Northern Line to the South of the development site. This point represents the critical sightline of train drivers heading north along the T1 Northern Line at this location.

A survey of this point has been undertaken using various online resources, which indicates that the view of the subject development will be at least 9 degrees to the left of the line of vision of train drivers at this location. Furthermore, the development will appear above the cutting which the railway line passes through at this location. Hence the subject development will not appear within the zone of sensitive vision of train drivers at this location (since the zone of sensitive vision has a size of ±10° around the focal point of the observer). Furthermore, only glare from the chamfered south-eastern ground level corner of the development could affect train drivers heading north on the T1 Northern Line, and that portion of the development will be blocked from view by the various other obstructions (buildings, trees, etc). Therefore there will be no adverse solar glare observed by train drivers heading north on the T1 Northern Line.

2.1.6 Drivers heading north along West Parade

Point 8 is located along West Parade, to the south of the development site. This point represents the critical sightlines of drivers heading west along West Parade 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.

The southern aspect of the lower-half of the south-eastern building is visible and within the zone of sensitive vision at Point 8. However, Point 8 is only located within the check zone for the chamfered south-eastern ground level corner of the development, which is not visible from Point 8. Hence there will be no adverse solar glare observed from the façade of the development at Point 8.

2.1.7 Drivers heading north-west along Young Parade

Point 9 is located along Young Parade Parade, to the south-east of the development site. This point represents the critical sightlines of drivers heading north-west along Young Parade 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 this viewpoint 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 north-west along Young Parade.

2.1.8 Drivers heading west along First Avenue

Points 10 and 11 are located along First Street, to the east of the development site. These points represent the critical sightlines of drivers heading west along First Street at this location. 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 Figures A9 and A10 of Appendix A.

At Point 10, parts of the southern aspect of the western end of the development, and small parts of the eastern aspects, are visible and within the zone of sensitive vision. Point 10 is located within the check zone for both of these aspects, and hence solar glare can potentially be observed at Point 10 from of these aspects. However, the visible portions of the eastern aspect will be overshadowed by other portions of the subject development at the times when glare could have otherwise been observed, and hence no adverse glare will be observed at Point 10 from those visible eastern aspects. The ground level portions of most of the southern aspect will benefit from overshadowing provided by the proposed pedestrian awning along Rutledge Street, and hence adverse solar glare from those portions of the southern aspect of

the development will not affect motorists at Point 10. For the times when solar glare could be observed at Point 10 from the remainder of the portions of the southern aspect that are visible within the zone of sensitive vision, the large trees on the southern side of Rutledge Street will provide effective overshadowing at the times when glare could have otherwise been observed. Furthermore, the glazing used on the development on the southern aspect of the south-western and southern buildings is mostly narrow windows, which will appear from Point 10 as being less than half a degree of arc and hence there would be less than 500cd/m^2 of glare. Hence there will be no adverse solar glare observed at Point 10 from the façade of the subject development.

An analysis of the glare meter overlaid onto the viewpoint at Point 11 indicates that the subject development is visible and outside the zone of sensitive vision for this location.

2.1.9 Drivers heading west along Rowe Street

Points 12 and 13 are located along Rowe Street, to the east of the development site. These points represent the critical sightlines of drivers heading west along Rowe Street at this location. 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 Figures A11 and A12 of Appendix A.

At Points 12 and 13, portions of the eastern aspect of the north-eastern building are visible and within the zone of sensitive vision. Points 12 and 13 are located within the check zone for this aspect, and hence solar glare can potentially be observed at Points 12 and 13 from of this aspect. However, the glazing used on this portion of the eastern aspect of the north-eastern building is only narrow windows, which will appear from Points 12 and 13 as being less than half a degree of arc and hence there would be less than 500cd/m^2 of glare. Hence there will be no adverse solar glare observed at Points 12 and 13 from the façade of the subject development.

2.1.10 Train Drivers heading south along the T1 Northern Line

Point 14 is located on the T1 Northern Line to the north of the development site. This point represents the critical sightline of train drivers heading south along the T1 Northern Line at this location. A site survey of this point has been undertaken, and a photograph showing the viewpoint of train 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 A13 of Appendix A.

An analysis of the glare meter overlaid onto the viewpoint at Point 14 indicates that the subject development is visible and outside the zone of sensitive vision for this location. Hence, there will be no adverse solar glare observed by train drivers heading south along the T1 Northern Line.

2.1.11 Drivers heading south-west along Railway Parade

Point 15 is located along Railway Parade, to the north-east of the development site. This point represents the critical sightlines of drivers heading south-west along Railway Parade 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 A14 of Appendix A.

An analysis of the glare meter overlaid onto the viewpoint at Point 15 indicates that the subject development is visible and outside the zone of sensitive vision for this location. Hence, there will be no adverse solar glare observed by drivers heading south-west along Railway Parade.

2.1.12 Drivers heading south along West Parade

Points 16, 17 and 18 are located along West Parade, to the north of the development site. These points represent the critical sightlines of drivers heading south along West Parade at this location. 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 Figures A15, A16 and A17 of Appendix A.

An analysis of the glare meter overlaid onto the viewpoint at Points 16 and 17 indicates that the subject development is visible and outside the zone of sensitive vision for these locations.

At Point 18, the many of the northern and eastern aspects of development are visible and within the zone of sensitive vision. However, Point 18 is only located within the check zone for the northern aspect of the development, and hence there will not be any adverse solar glare from the visible eastern aspects of the development at Point 18. Further analysis indicates that Point 18 is not located within the check zone for the northern aspects of the south-eastern and southern buildings of the development (which are visible within the zone of sensitive vision at Point 18), and glare can only be potentially observed from the northern aspect of the north-eastern building. Hence to mitigate any potentially adverse solar glare observed from Point 18, it is recommended that the glazing used on the northern aspect of Apartments BB0410 and BB0510 (including on the balcony balustrade) be restricted to have a maximum normal specular reflectance of visible light of 13%.

2.1.13 Drivers heading south-west along Coolgun Lane

Point 19 is located along Coolgun Lane, to the north of the development site. This point represents the critical sightlines of drivers heading south-west along Coolgun Lane at this location. A site survey of this point has been undertaken, and a photograph showing the viewpoint of drivers at this location was obtained using a calibrated camera. The photograph has been scaled to enable the glare meter to be overlaid onto the image, as shown in Figure A18 of Appendix A.

An analysis of the glare meter overlaid onto the viewpoint at Point 19 indicates that the subject development is visible and outside the zone of sensitive vision for this location. Hence, there will be no adverse solar glare observed by drivers heading south-west along Coolgun Lane.

2.2 Curved Surfaces

Reflective concave surfaces have the potential to intensify glare if the observer is located at the focal point. However, for this development it is noted that all concave surfaces are either overshadowed or are too small to cause an adverse glare effect. Reflective convex surfaces tend to disperse solar reflections.

2.3 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.

2.4 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.

2.4.1 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%

2.4.2 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.

2.5 City of Ryde Development Control Plan 2014

Section 3.7.5 of the City of Ryde Development Control Plan 2014 (Part 4.1, Eastwood Town Centre) requires that glare from a new building façade should not cause discomfort or threaten the safety of pedestrians or drivers. The implementation of the treatments listed in the previous sections of this report will ensure that this is achieved. However, there is a further recommendation that the maximum reflectance of materials used on the building façade should be 18%, and this is generally in-line with our recommendation of a limit of 20% as listed in Section 2.3 of this report. Nonetheless, for compliance with the planning controls from the City of Ryde DCP 2014 it is recommended that a maximum limit of 18% reflectance is to be used for all building façade materials of this development.

3 CONCLUSION

An analysis has been undertaken to assess the potential for solar glare from the proposed Eastwood Centre development, located at 144-186 Rowe Street, Eastwood. The analysis has been undertaken based on the architectural drawings prepared by the project architect Rice Daubney, received in May 2016.

This study identifies any possible adverse reflected solar glare conditions affecting motorists, train drivers, 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 State Environmental Planning Policy No. 65 (SEPP65, Part 04 (Designing the Building) for Amenity), which contains the Apartment Design Guide (ADG) and the City of Ryde Development Control Plan 2014.

A site survey has been undertaken to obtain photographs of the critical sightlines of motorists on the surrounding streets. Viewpoints of train drivers from the adjacent railway line are also analysed. The 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 motorists and pedestrians on the surrounding streets, train drivers, occupants of neighbouring buildings, and to comply with the abovementioned planning control requirements, it is recommended that:

- All western aspect windows of Penthouse AA0601 have a maximum normal specular reflectance of visible light of 11%.
- The glazed portions of the western aspect of the commercial suites located at the south-western corner of the development (on Levels 2 to 5) have a maximum normal specular reflectance of visible light of 11%.
- The glazing used on the southern-aspect balustrades of the following balconies be restricted to have a maximum normal specular reflectance of visible light of 8%:
    - Level 6: DA0603, DA0602
    - Level 7: DB0704, DA0703, DA0702
    - Level 8: DB0804, DA0803, DA0802
    - Level 9, DB0904, DA0903, DA0902
    - Level 10: DA1003, DA1002
    - Level 11: DA1103, DA1102

- The glazing used on the northern aspect of Apartments BB0410 and BB0510 (including on the balcony balustrade) have a maximum normal specular reflectance of visible light of 13%.
- All other glazing have a maximum normal specular reflectance of visible light of 18%.

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, train drivers, or to occupants of neighbouring buildings, and will comply with the planning controls regarding reflectivity from SEPP65 and the City of Ryde Development Control Plan 2014.

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City of Ryde, 2014, "City of Ryde Development Control Plan 2014", Part 4.1, Eastwood Town Centre.

APPENDIX A - GLARE OVERLAYS FOR THE CRITICAL SIGHT-LINES

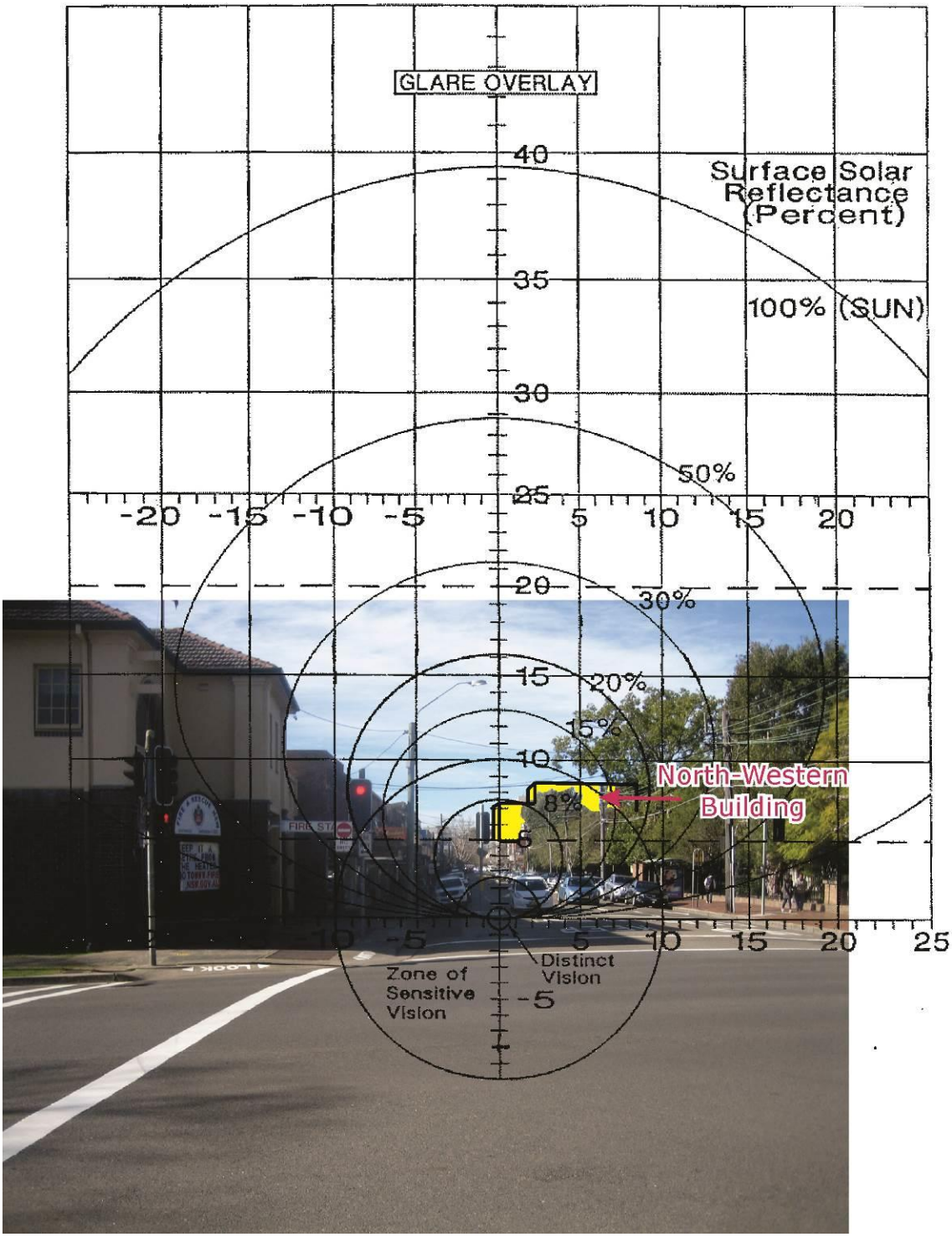

Figure A1: Glare Overlay for Point 1

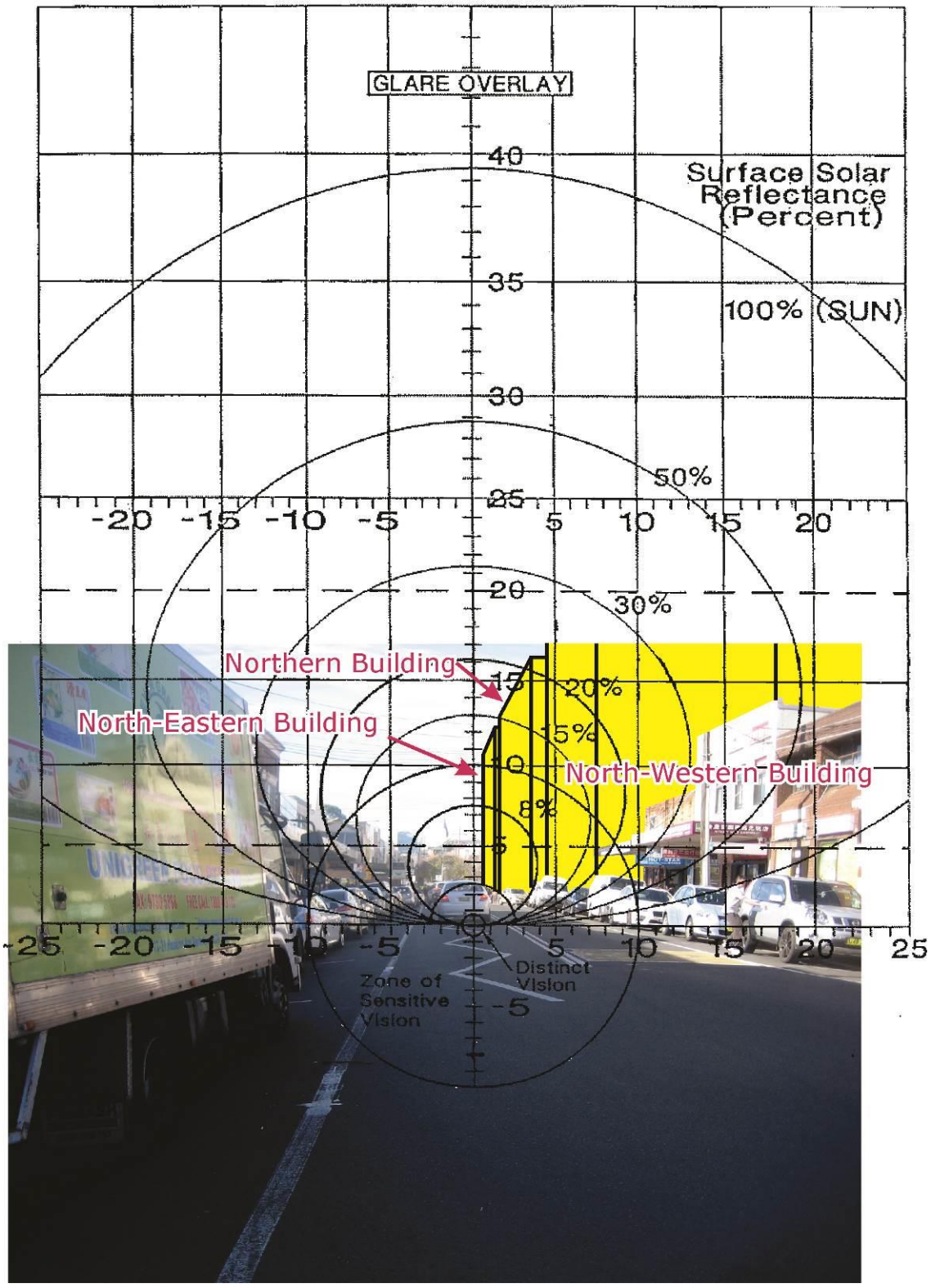

Figure A2: Glare Overlay for Point 2

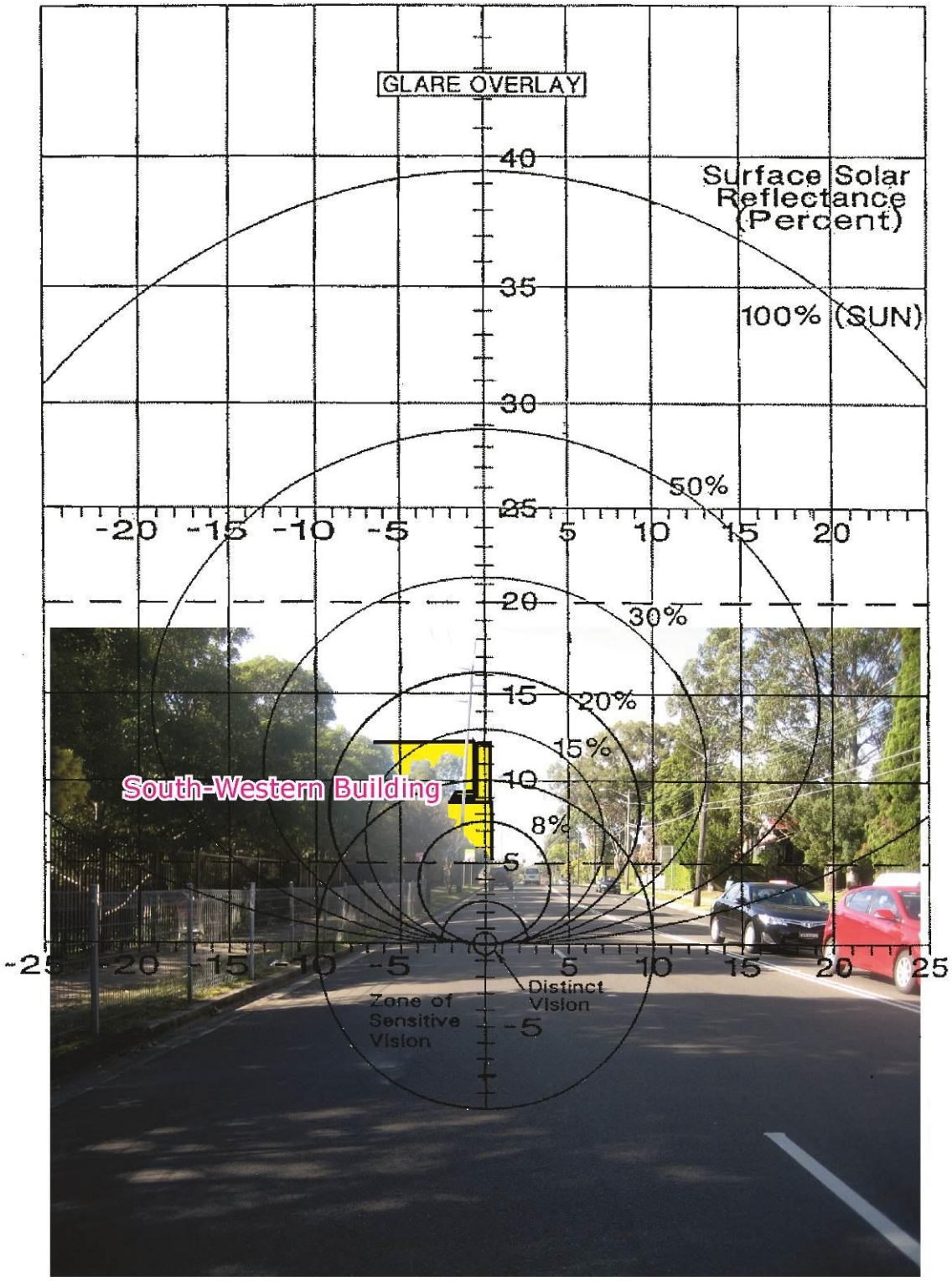

Figure A3: Glare Overlay for Point 3

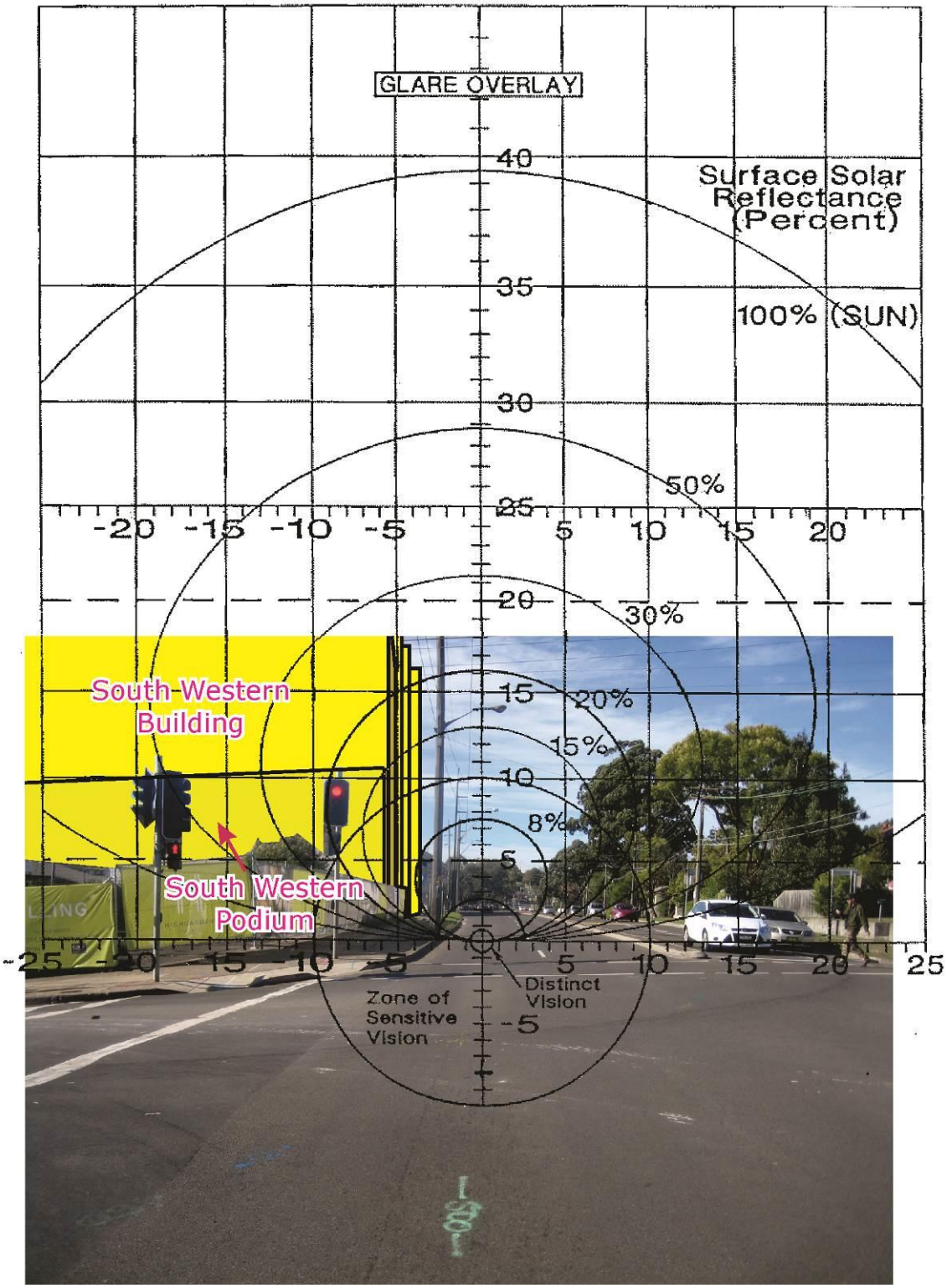

Figure A4: Glare Overlay for Point 4

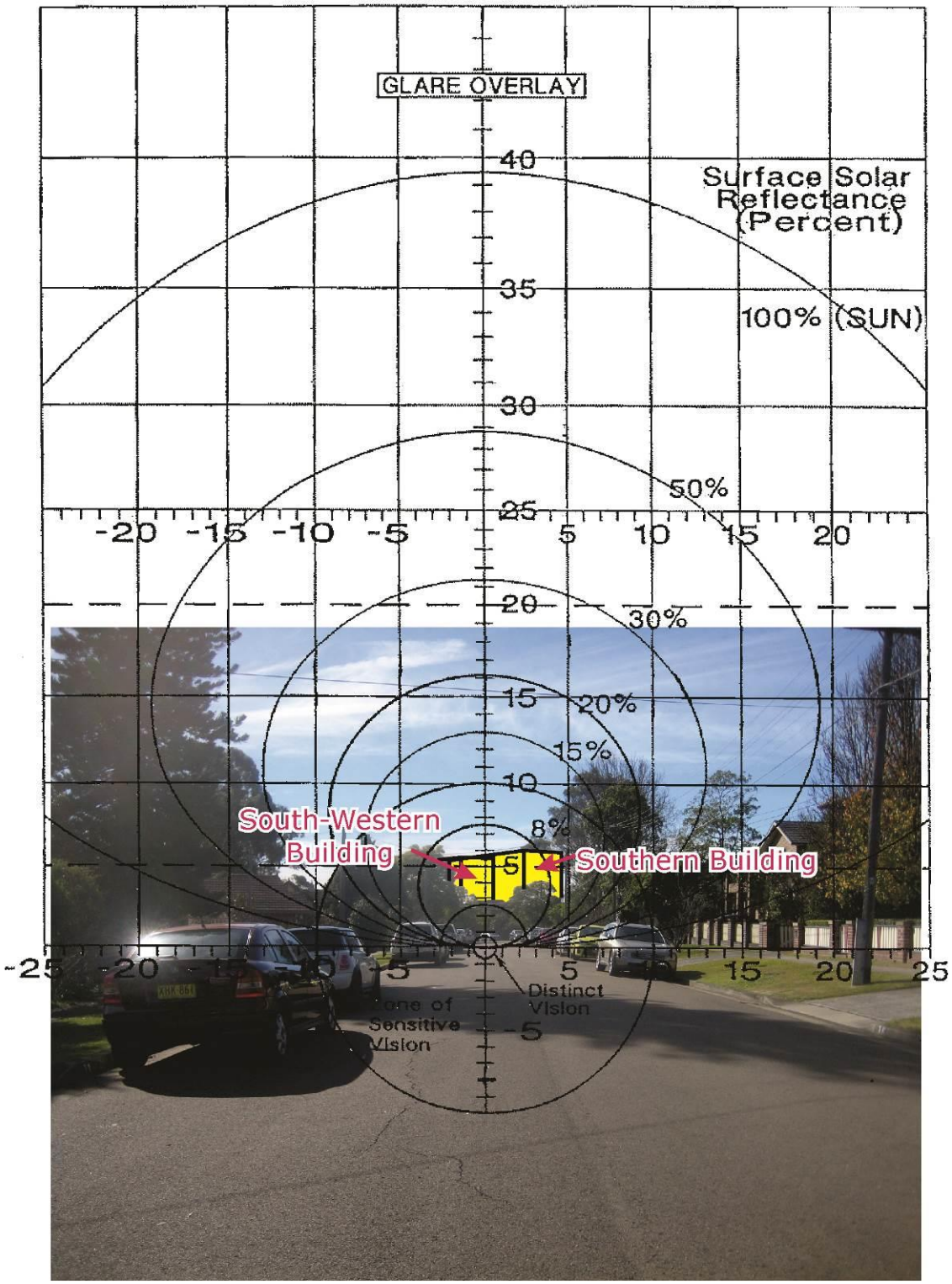

Figure A5: Glare Overlay for Point 5

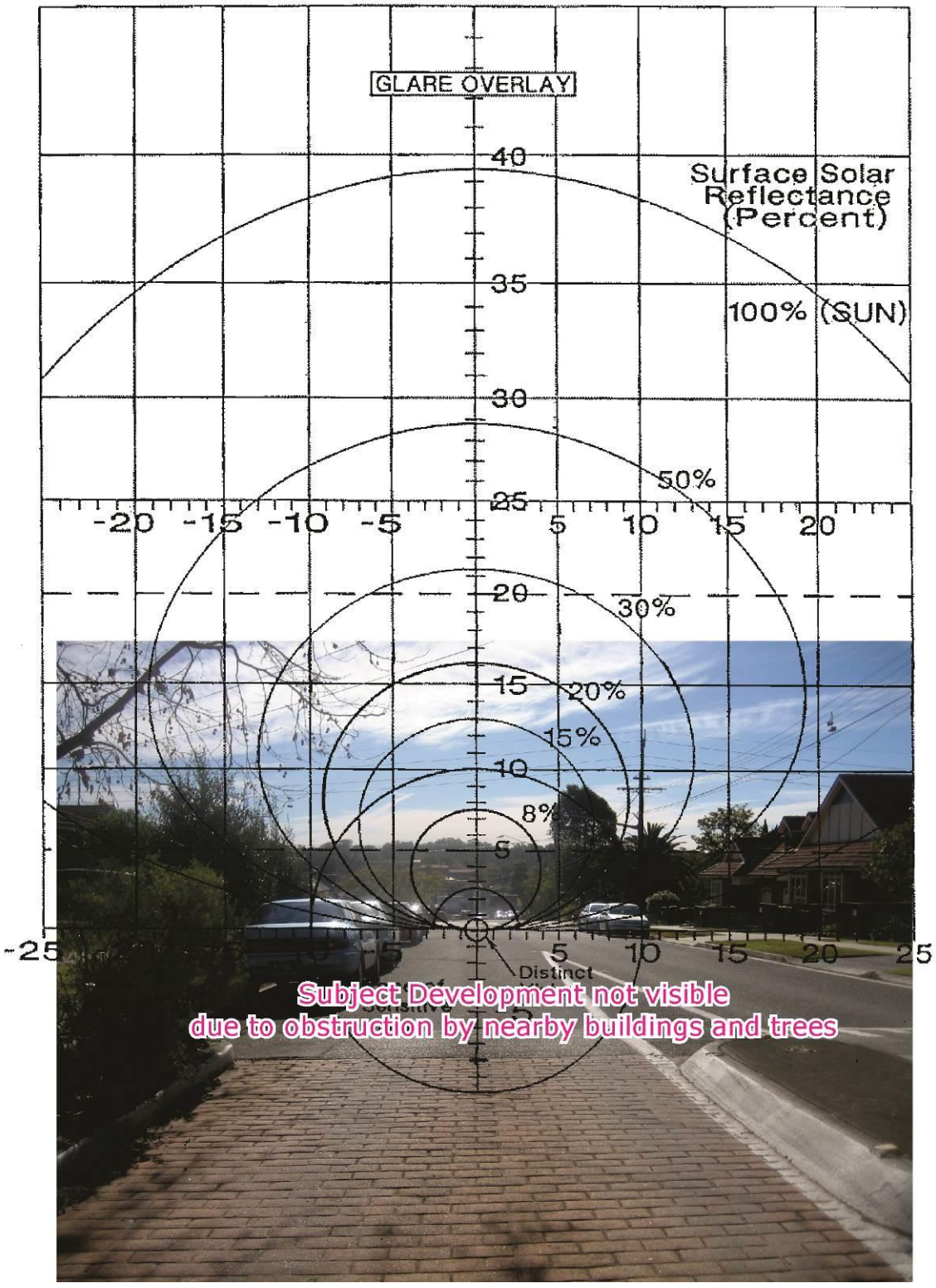

Figure A6: Glare Overlay for Point 6

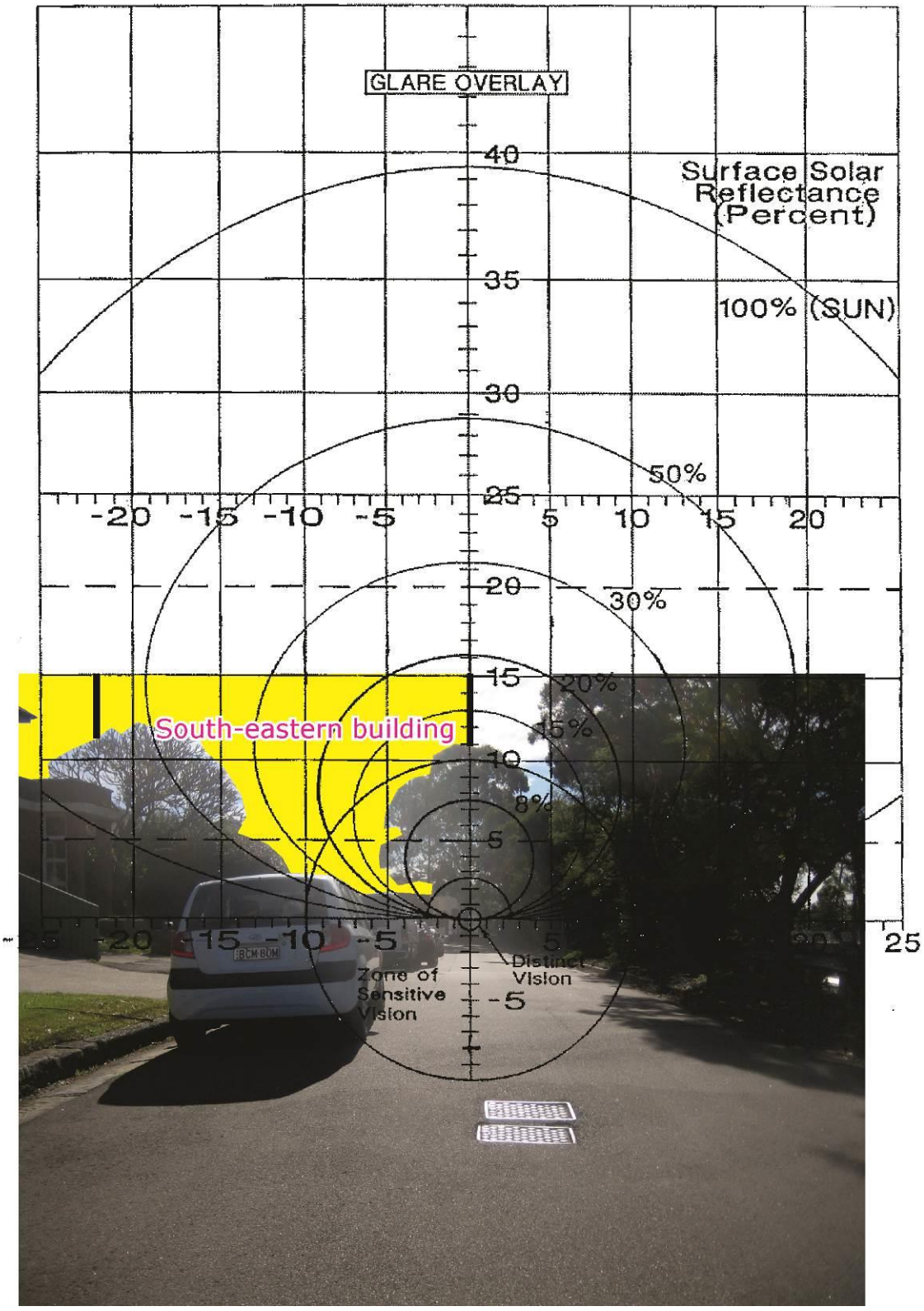

Figure A7: Glare Overlay for Point 8

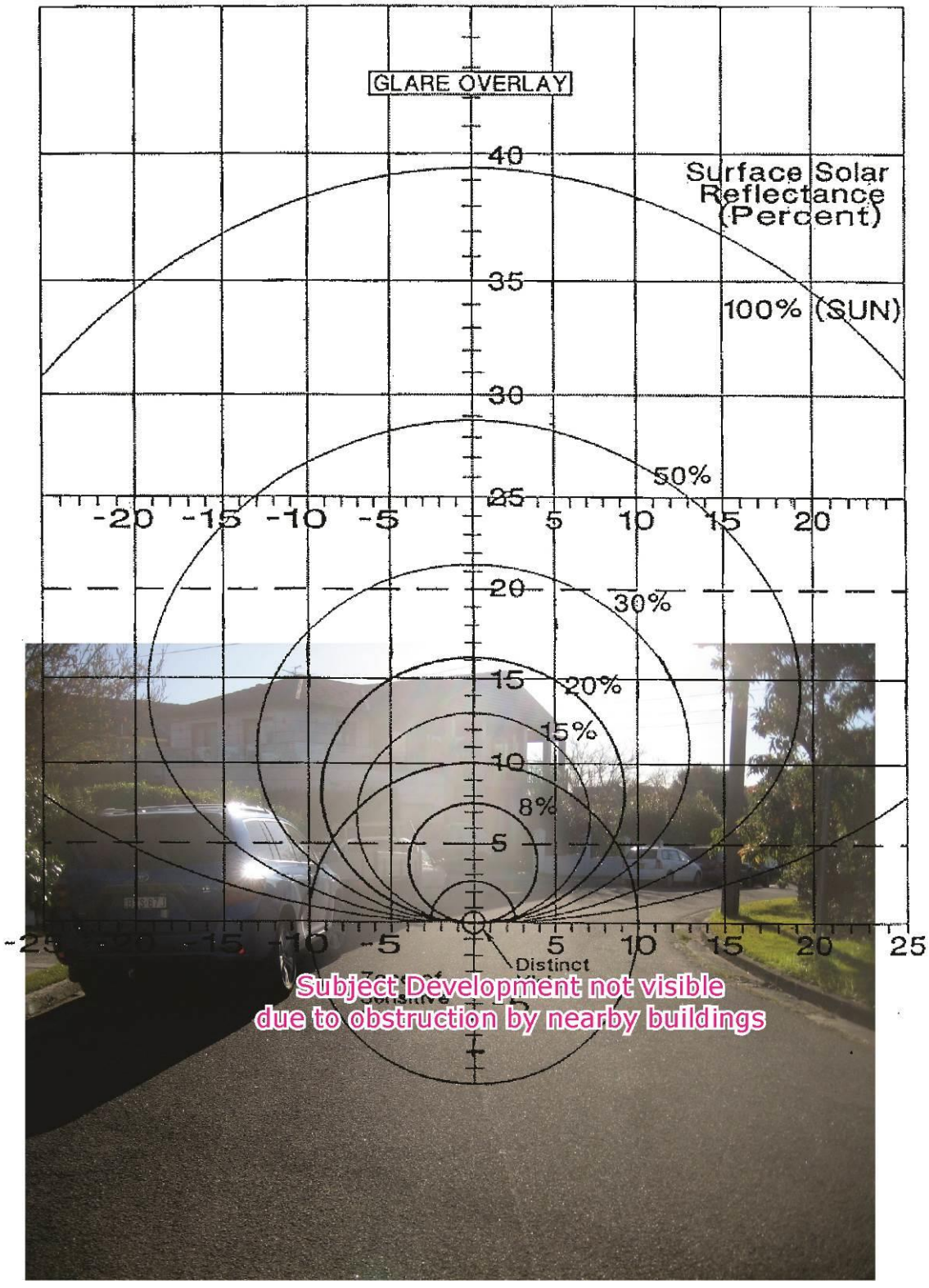

Figure A8: Glare Overlay for Point 9

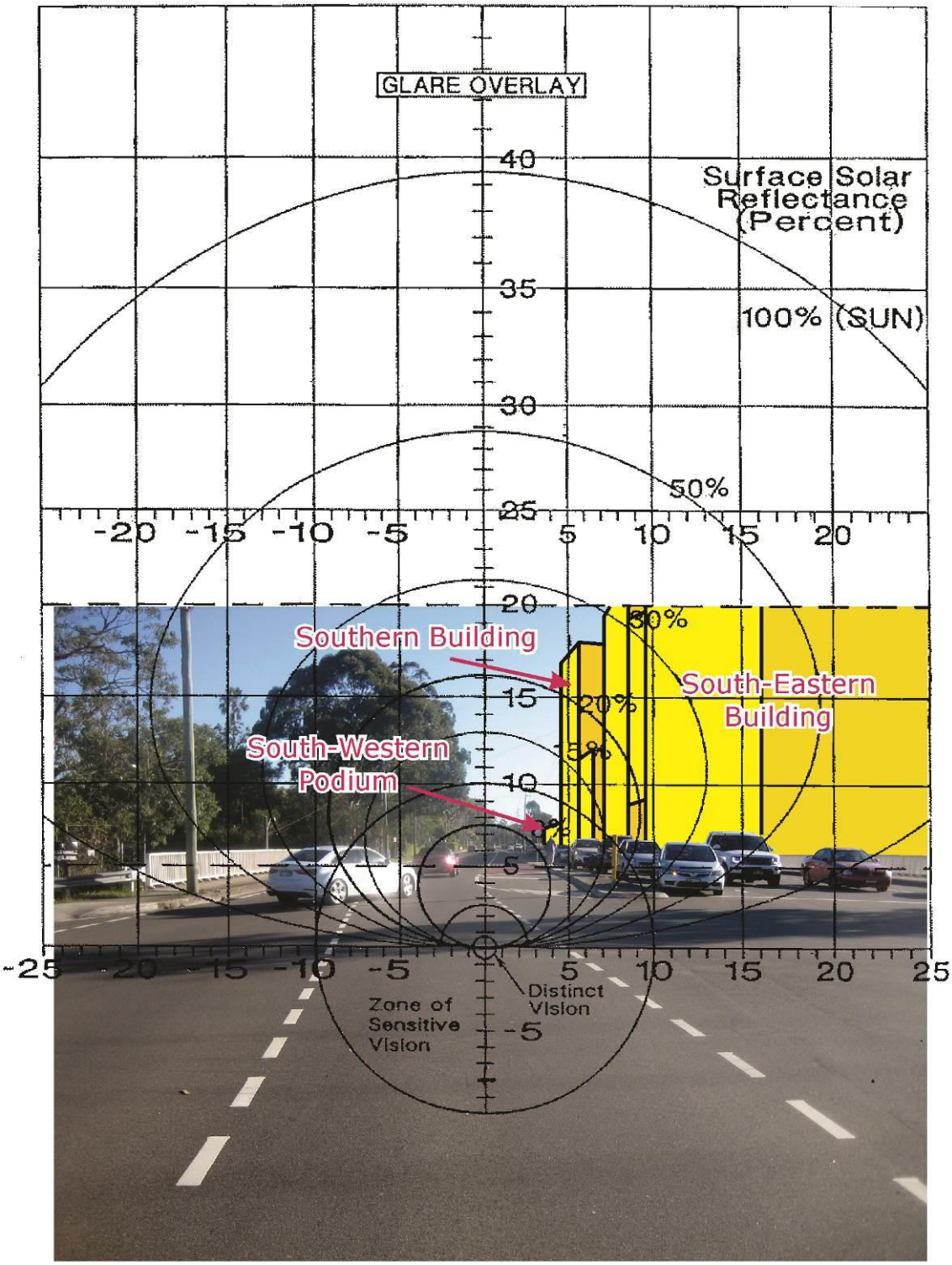

Figure A9: Glare Overlay for Point 10

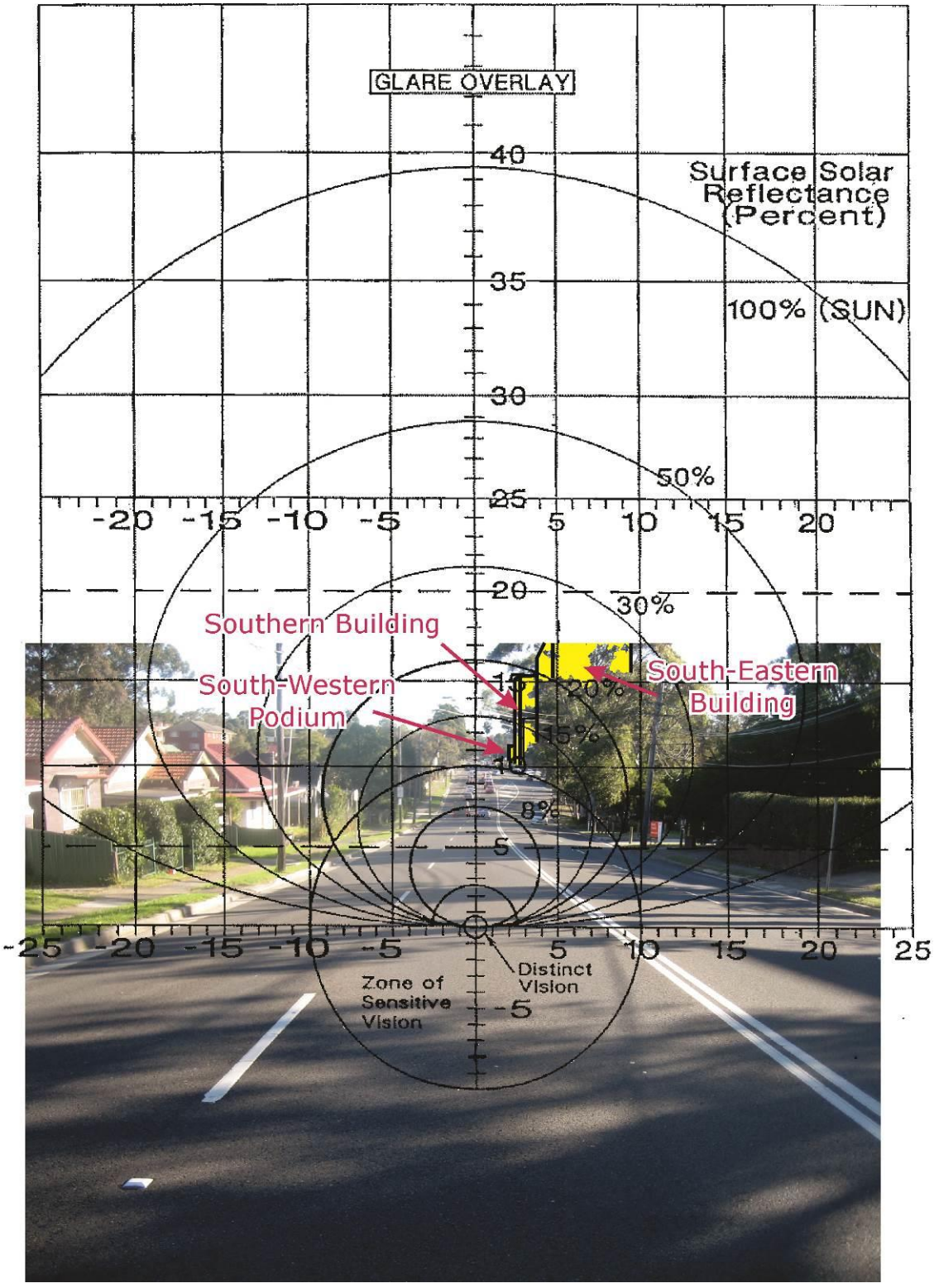

Figure A10: Glare Overlay for Point 11

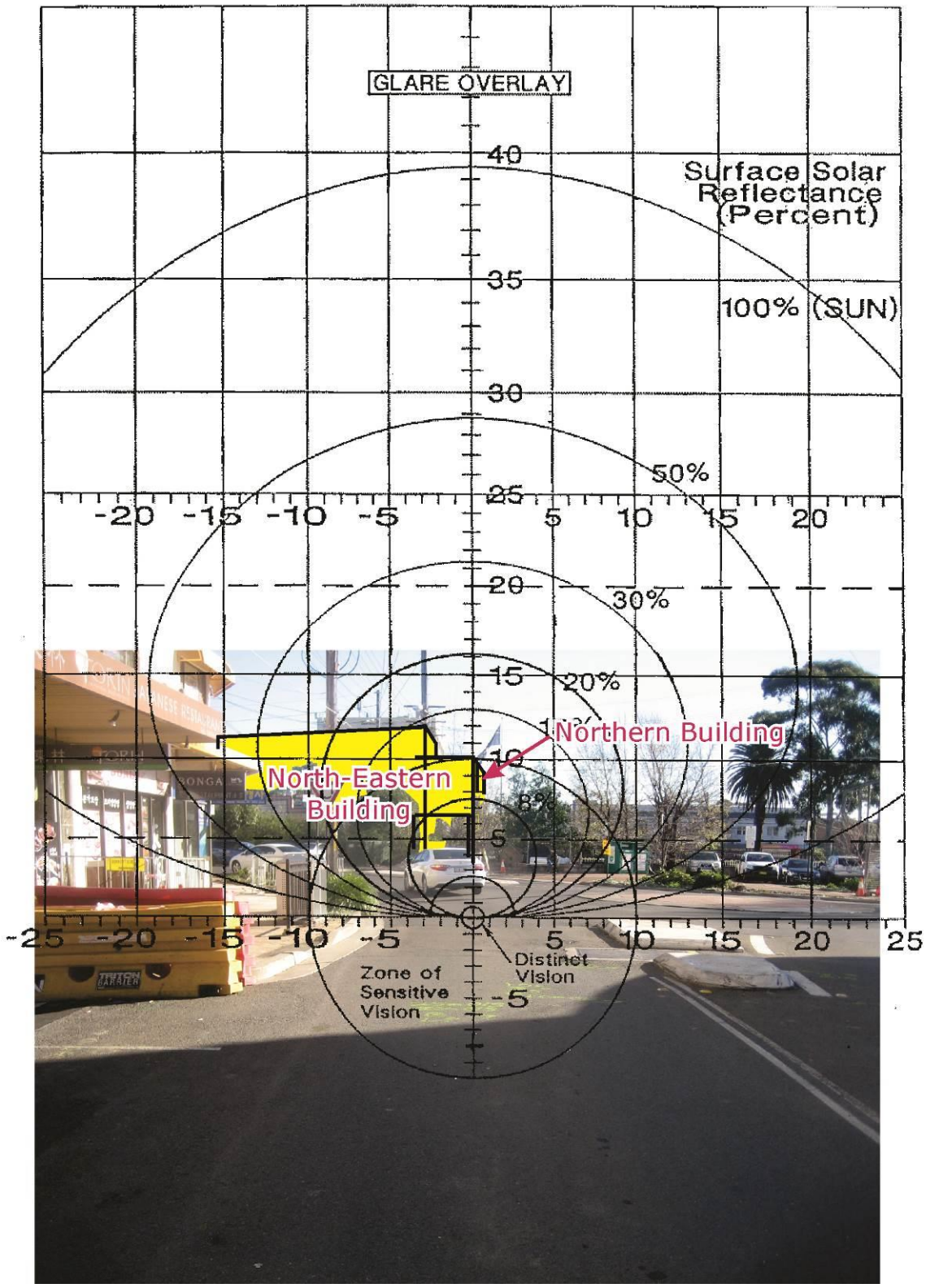

Figure A11: Glare Overlay for Point 12

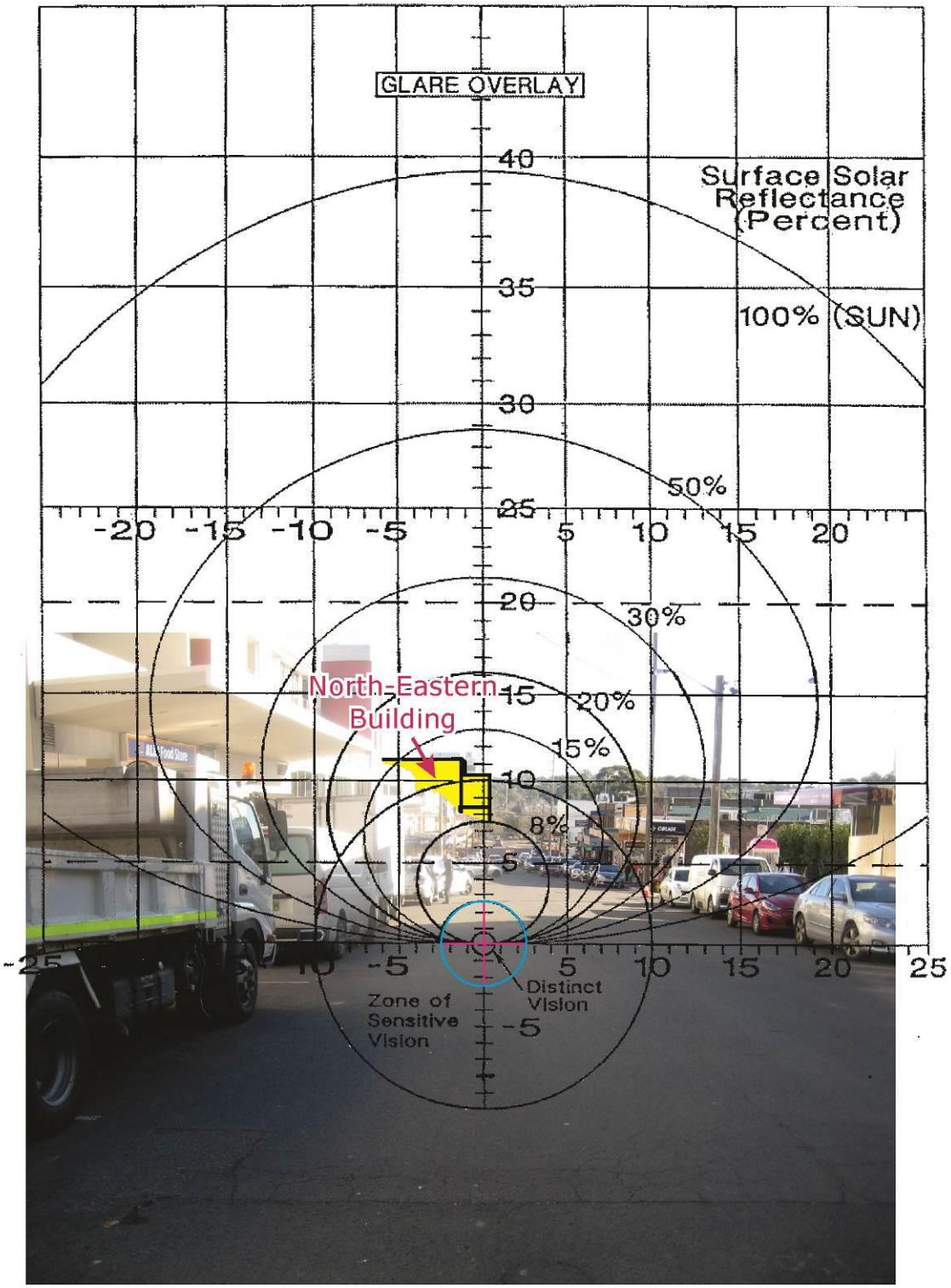

Figure A12: Glare Overlay for Point 13

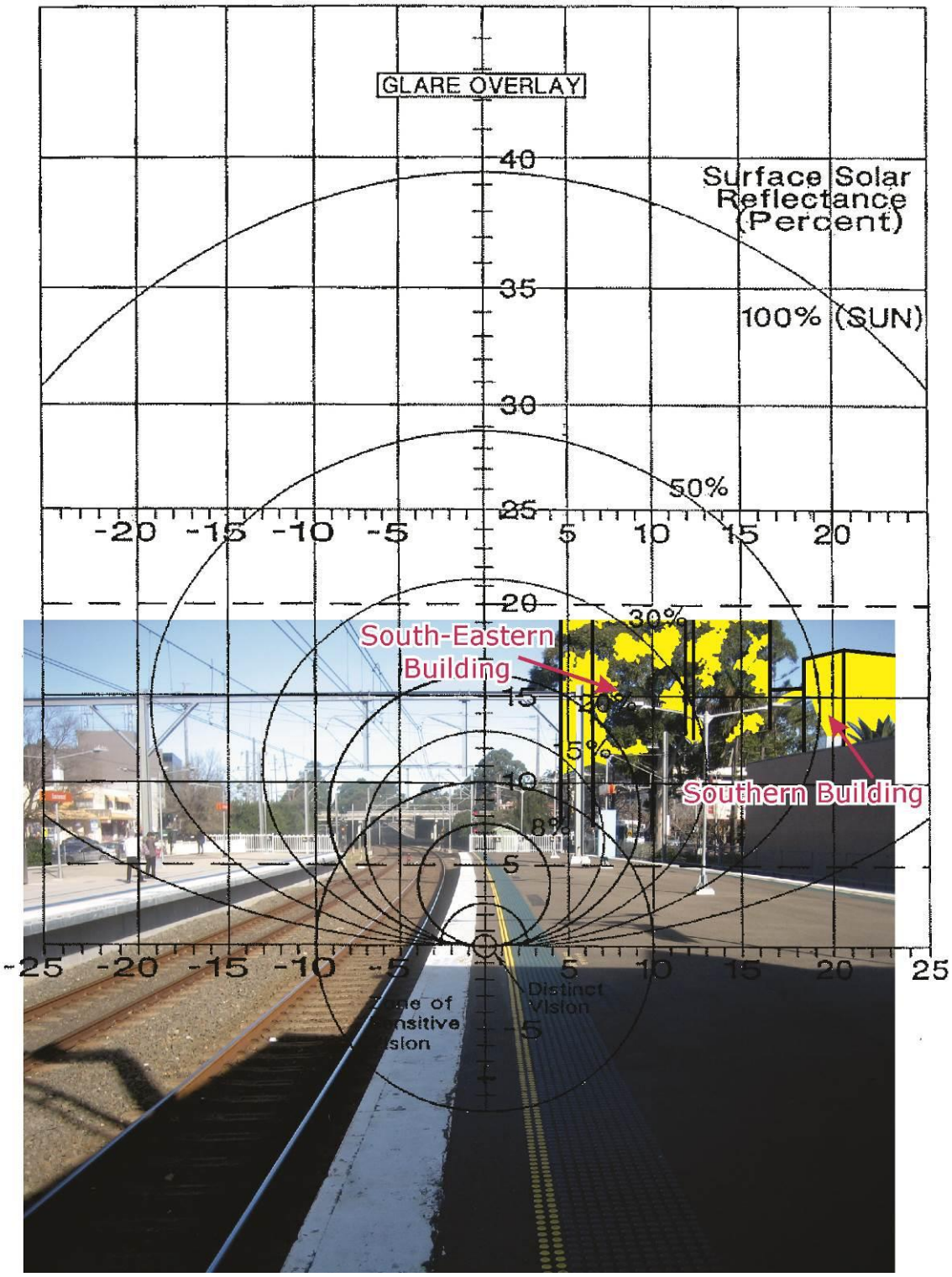

Figure A13: Glare Overlay for Point 14

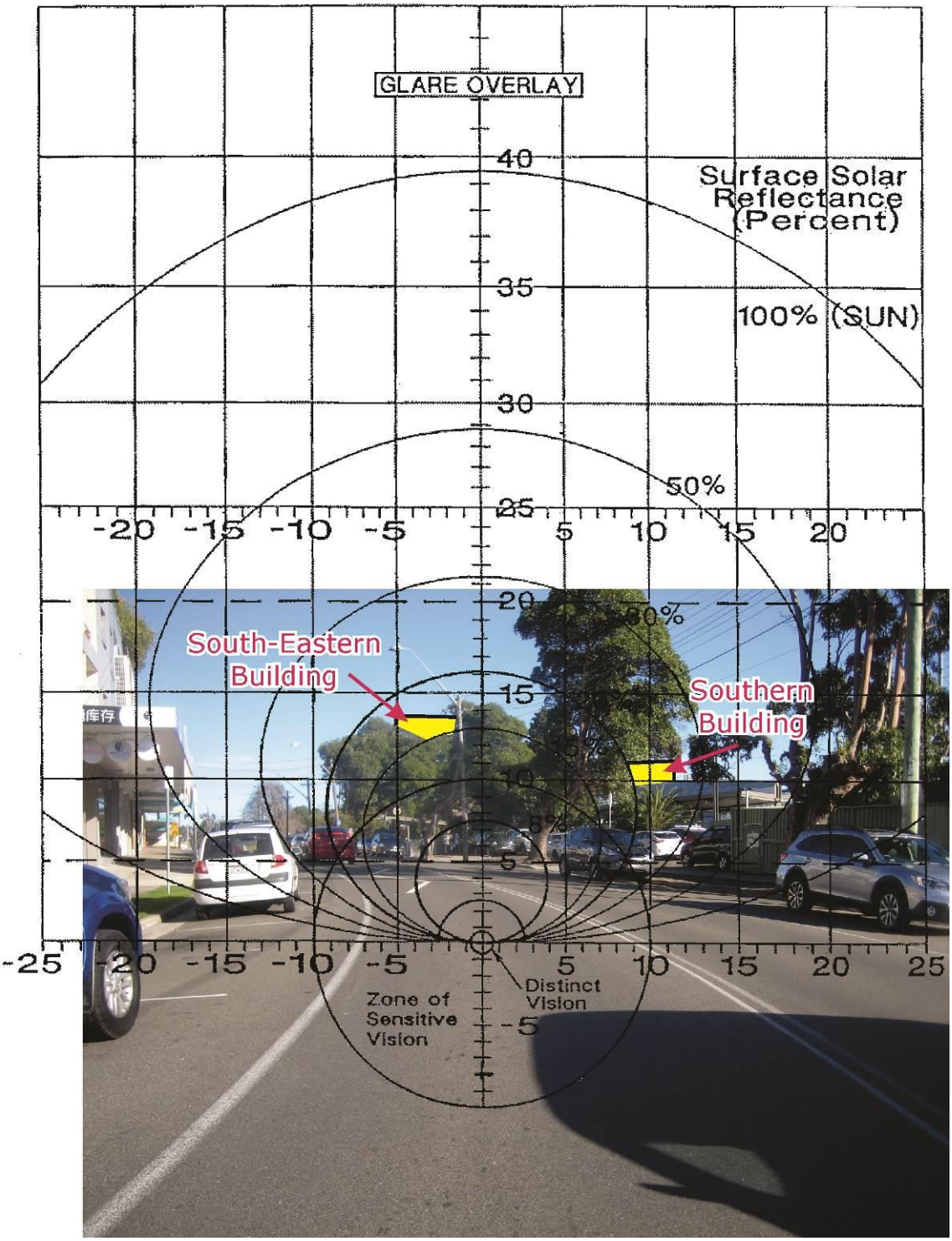

Figure A14: Glare Overlay for Point 15

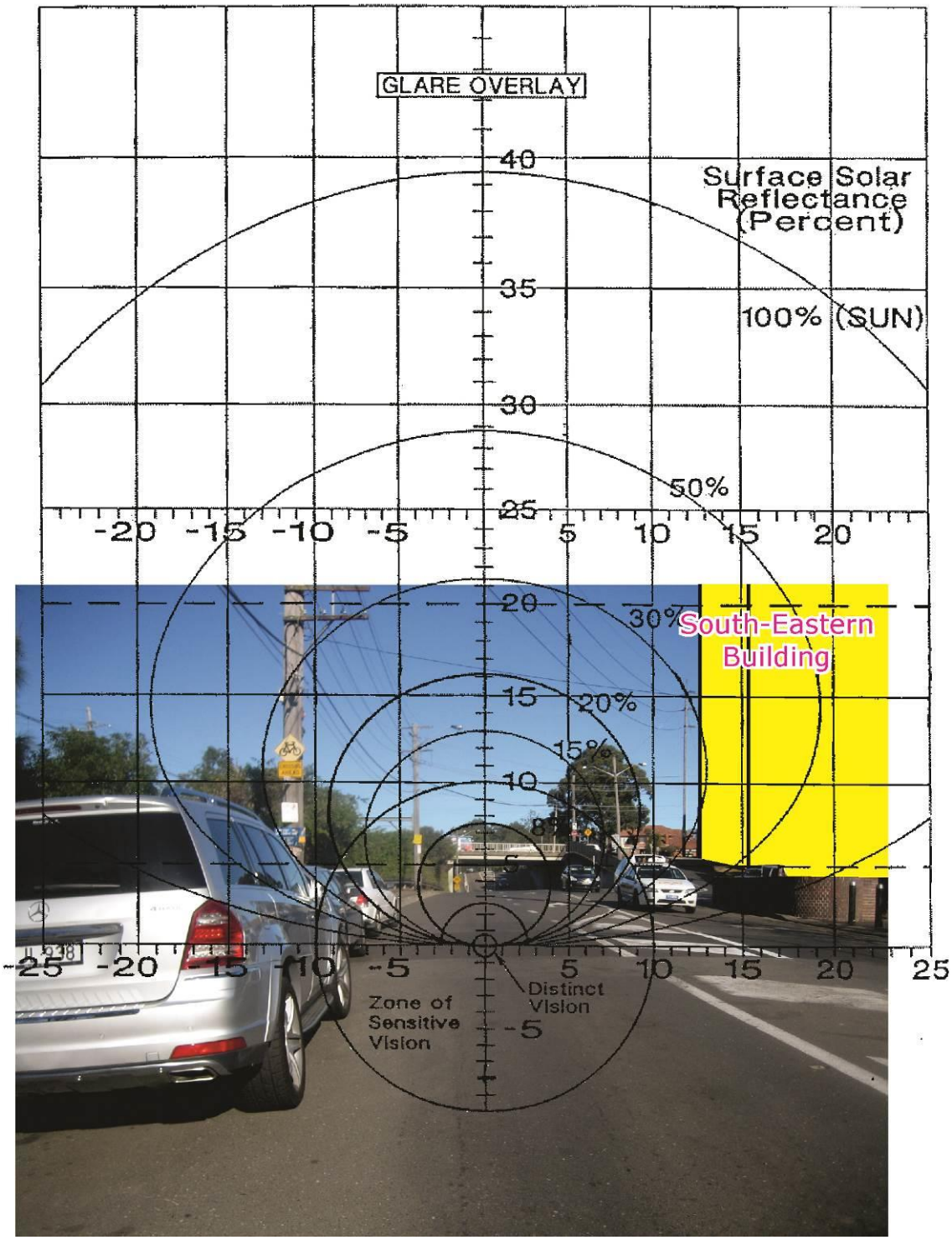

Figure A15: Glare Overlay for Point 16

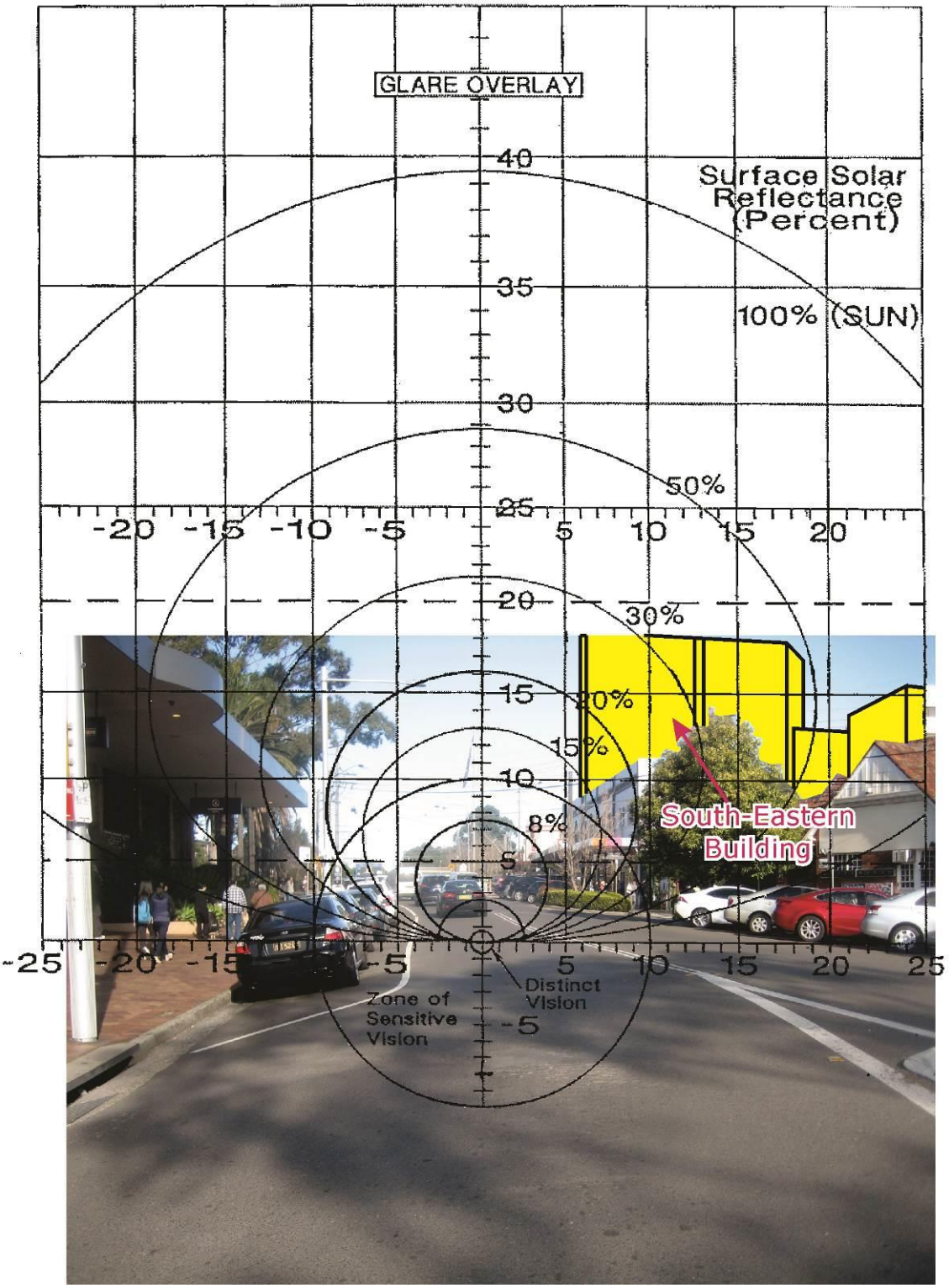

Figure A16: Glare Overlay for Point 17

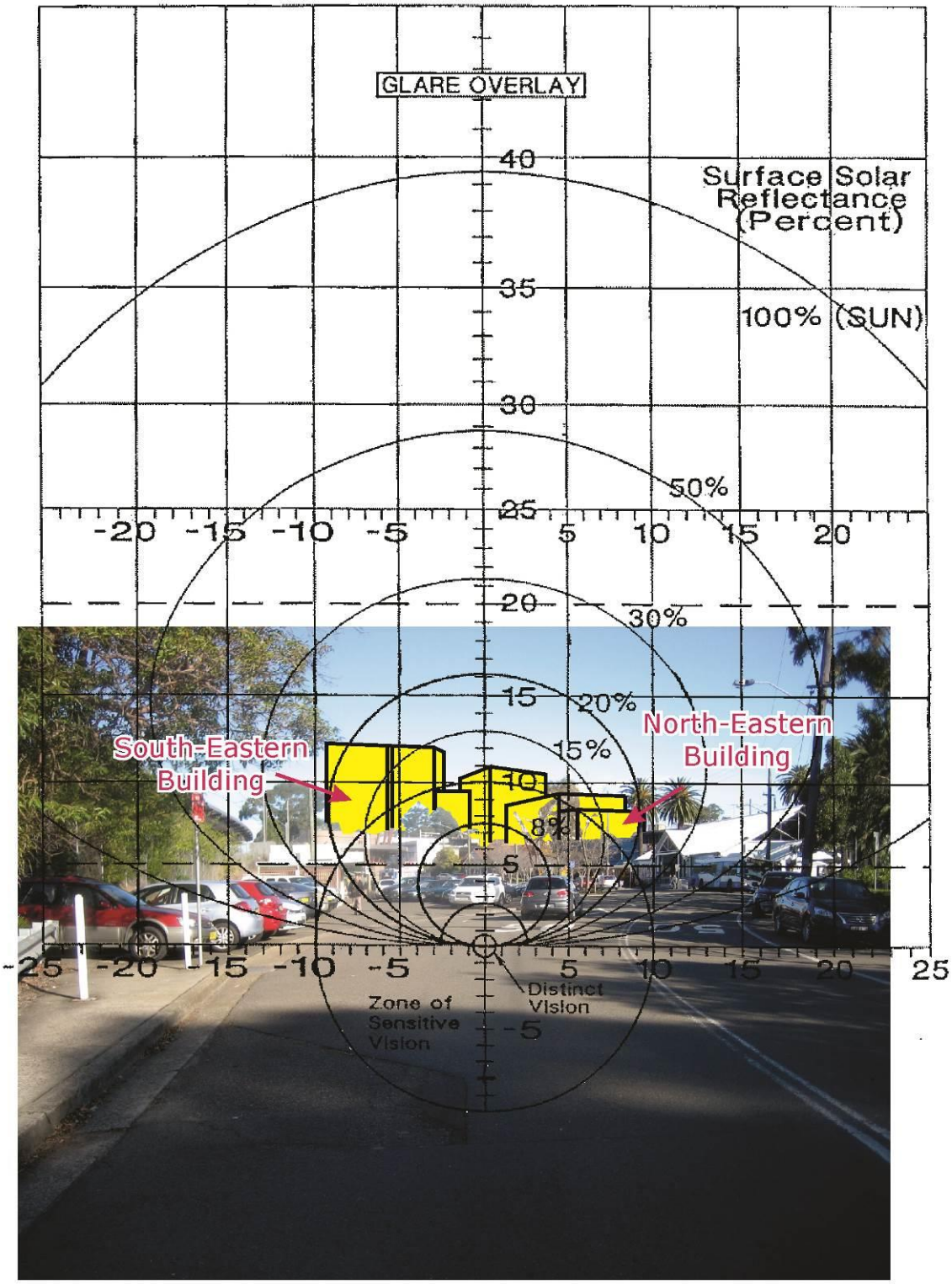

Figure A17: Glare Overlay for Point 18

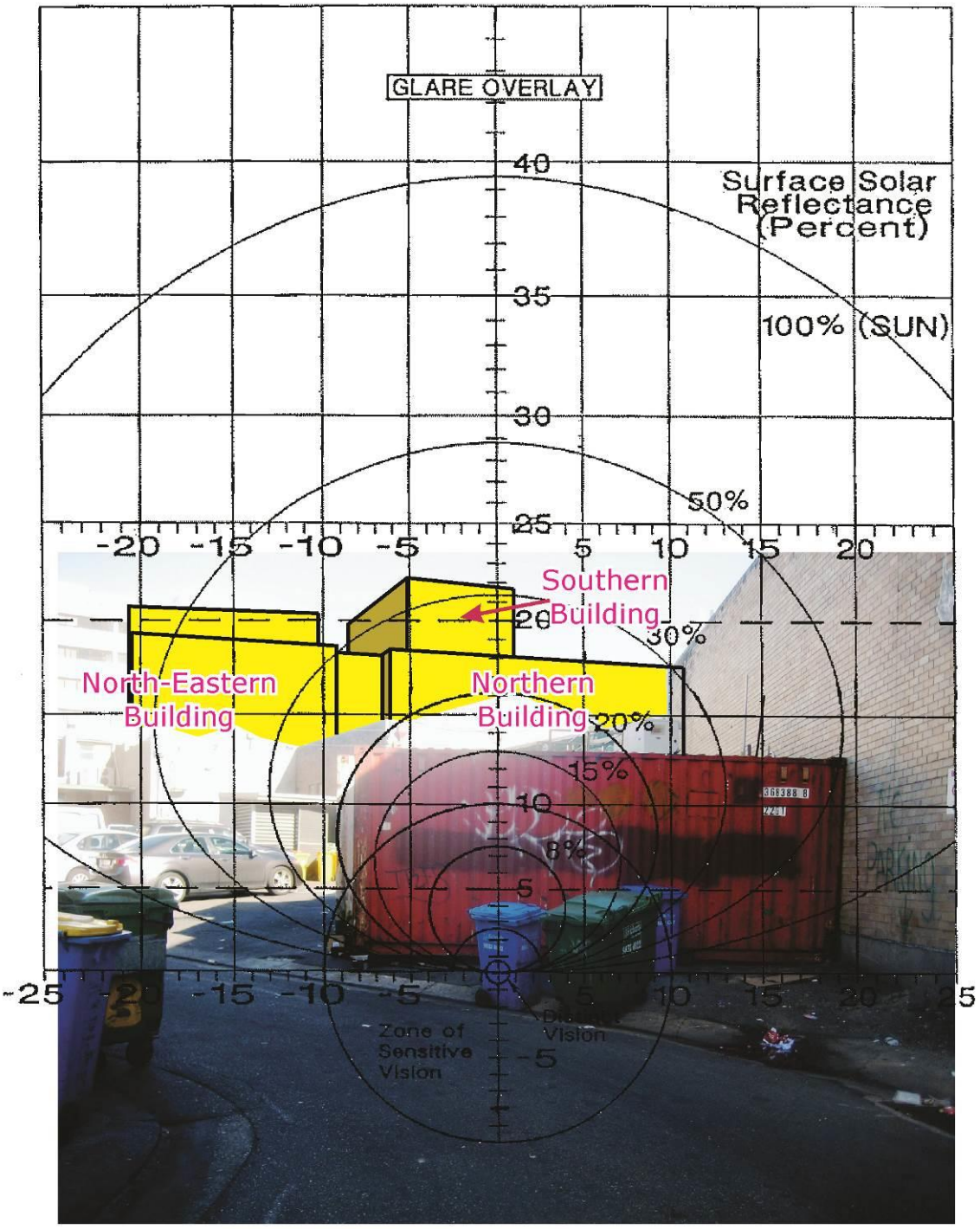

Figure A18: Glare Overlay for Point 19

APPENDIX B - SOLAR CHARTS FOR THE VARIOUS CRITICAL ASPECTS

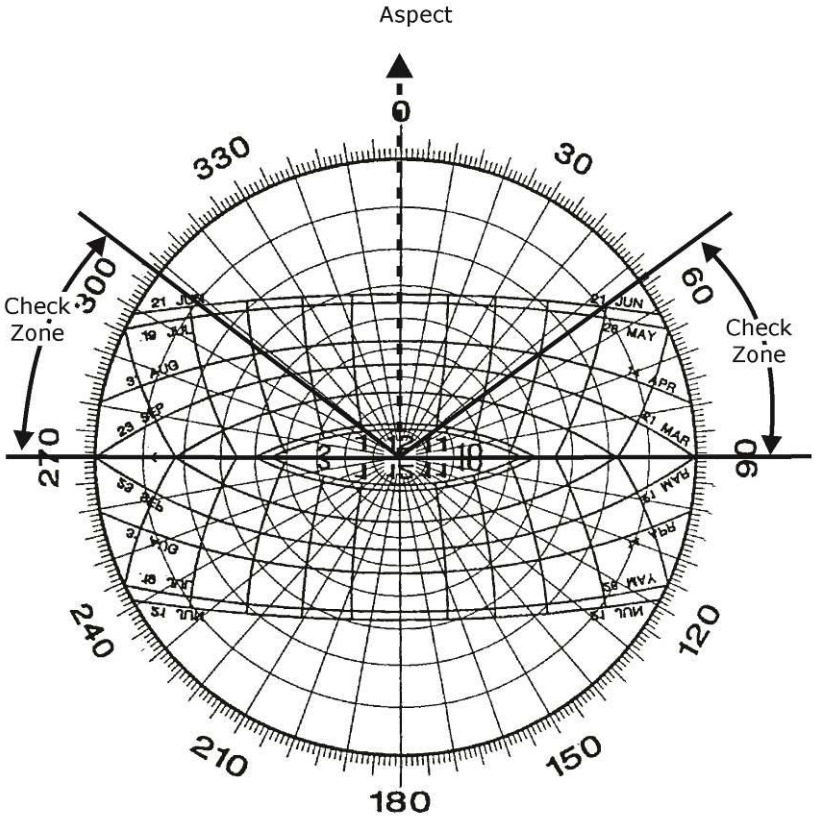

Figure B1: Sun Chart for Aspect 000º

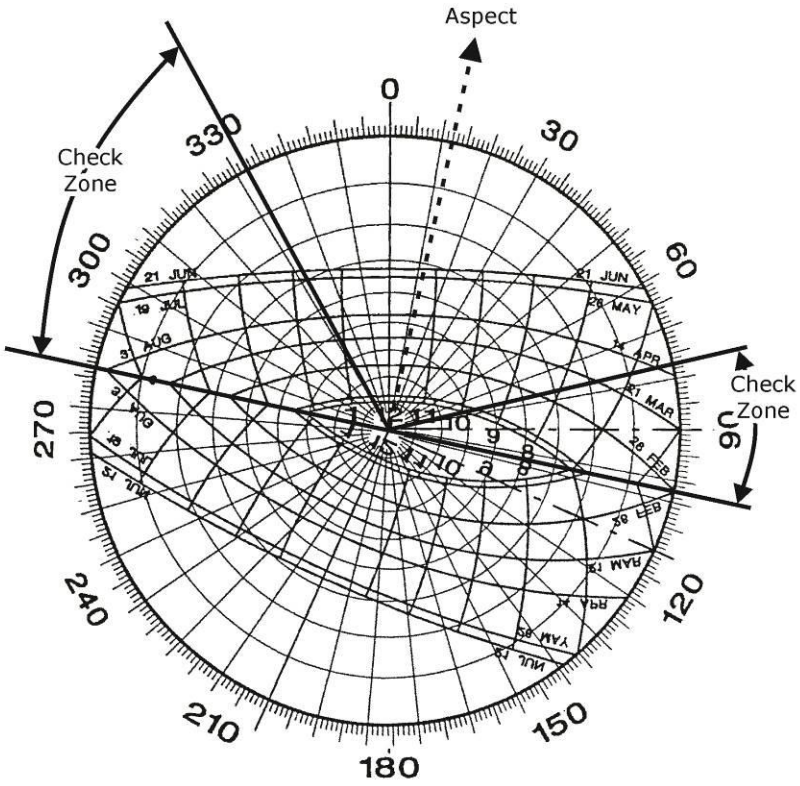

Figure B2: Sun Chart for Aspect 012º

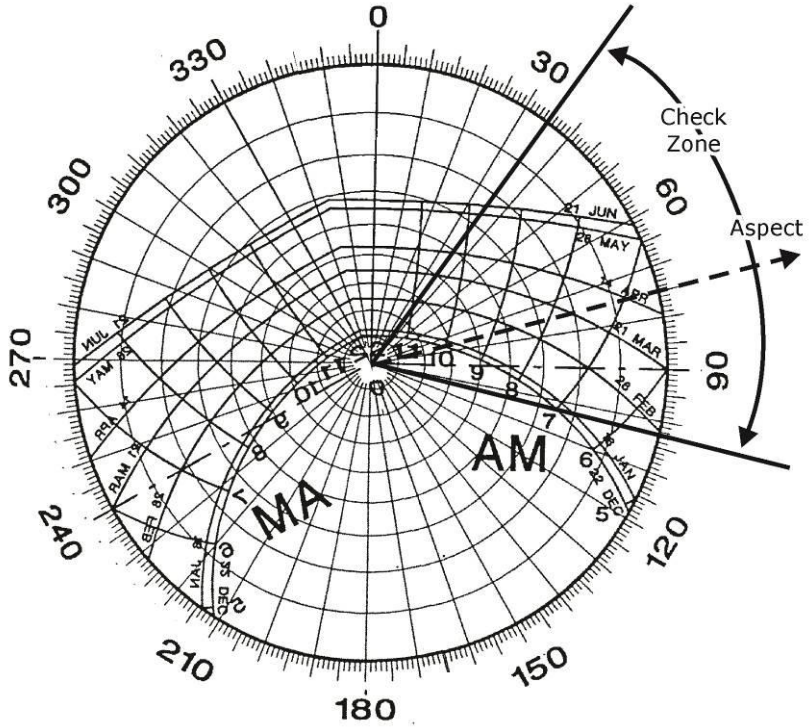

Figure B3: Sun Chart for Aspect 075º

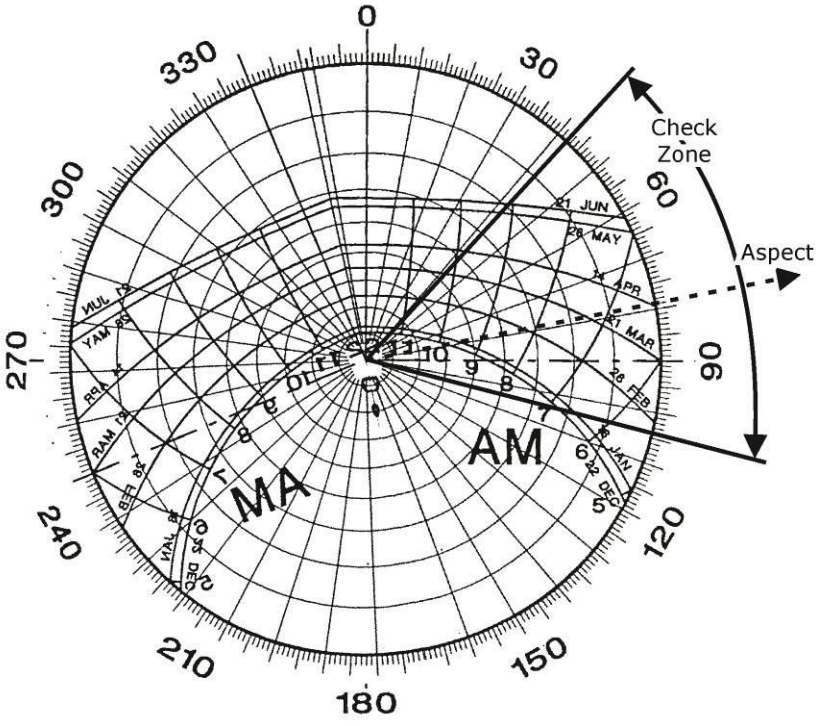

Figure B4: Sun Chart for Aspect 079º

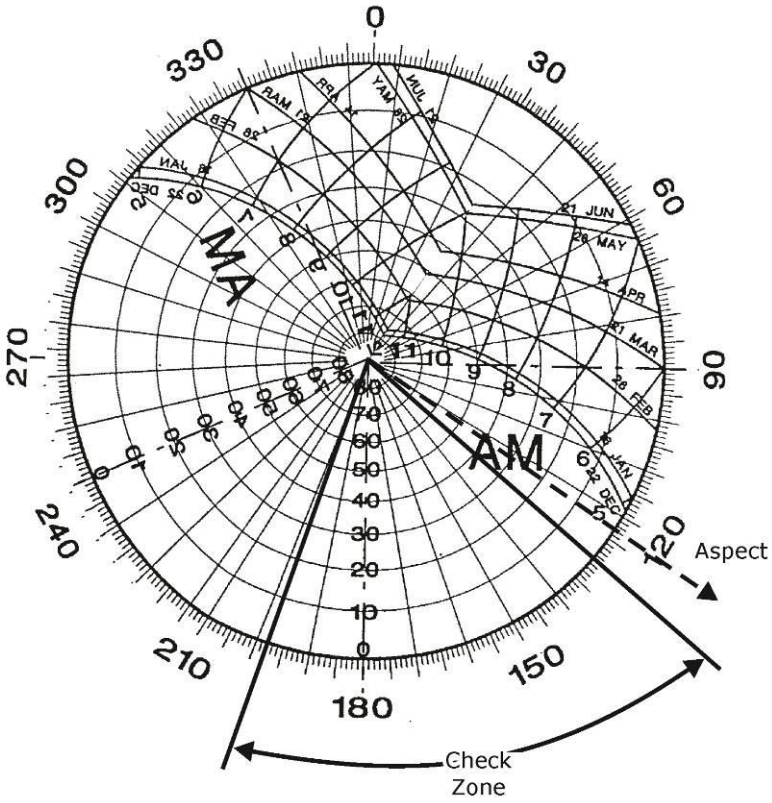

Figure B5: Sun Chart for Aspect 123°

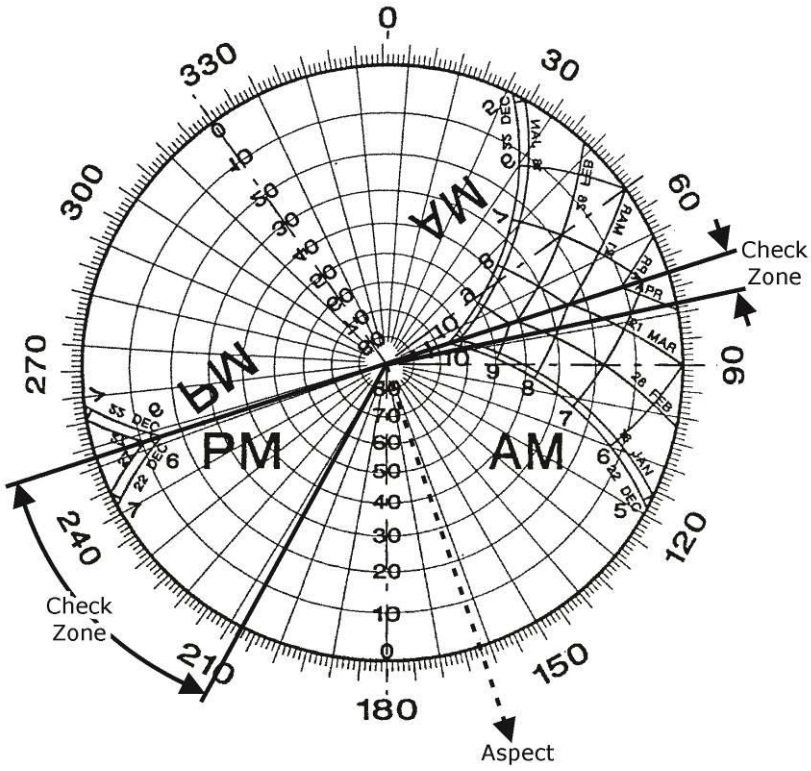

Figure B6: Sun Chart for Aspect 162°

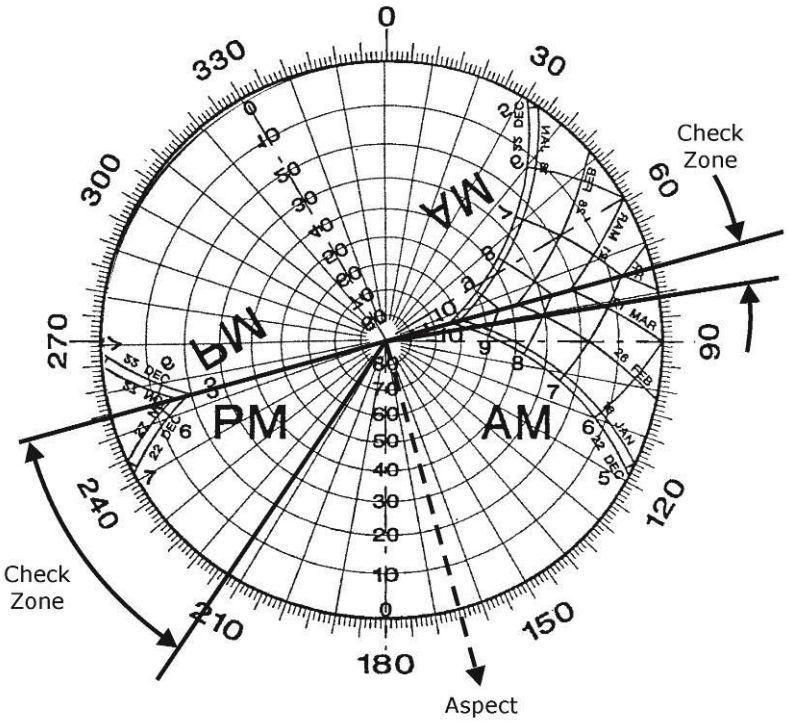

Figure B7: Sun Chart for Aspect 165°

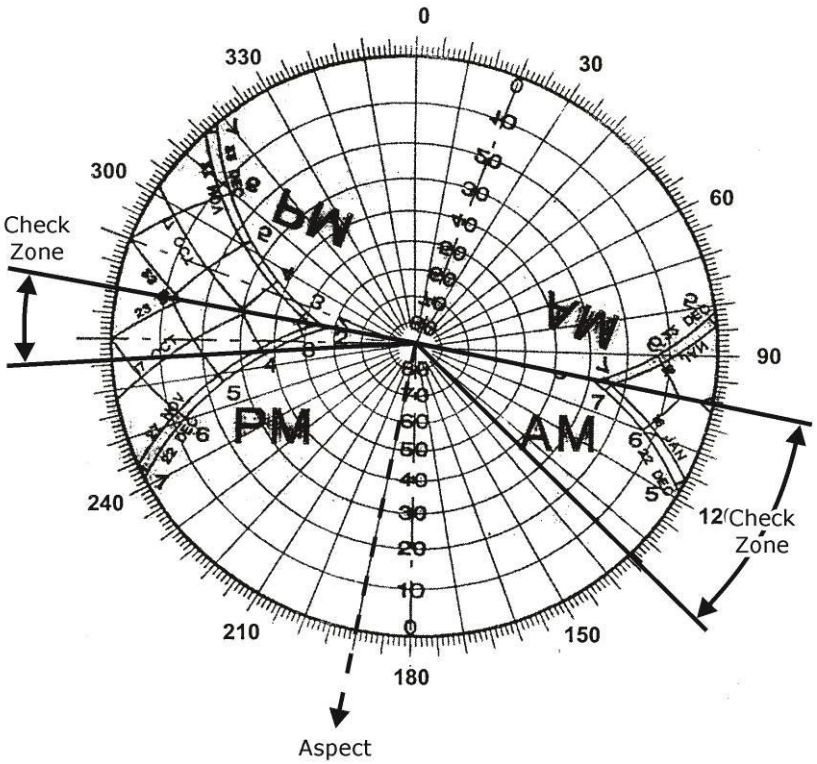

Figure B8: Sun Chart for Aspect 190°

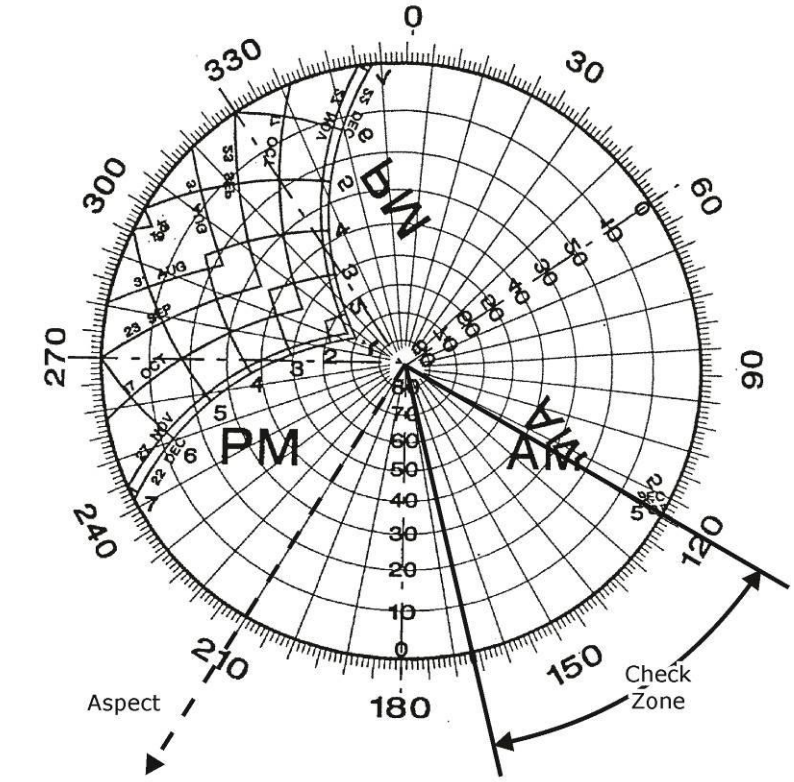

Figure B9: Sun Chart for Aspect 210°

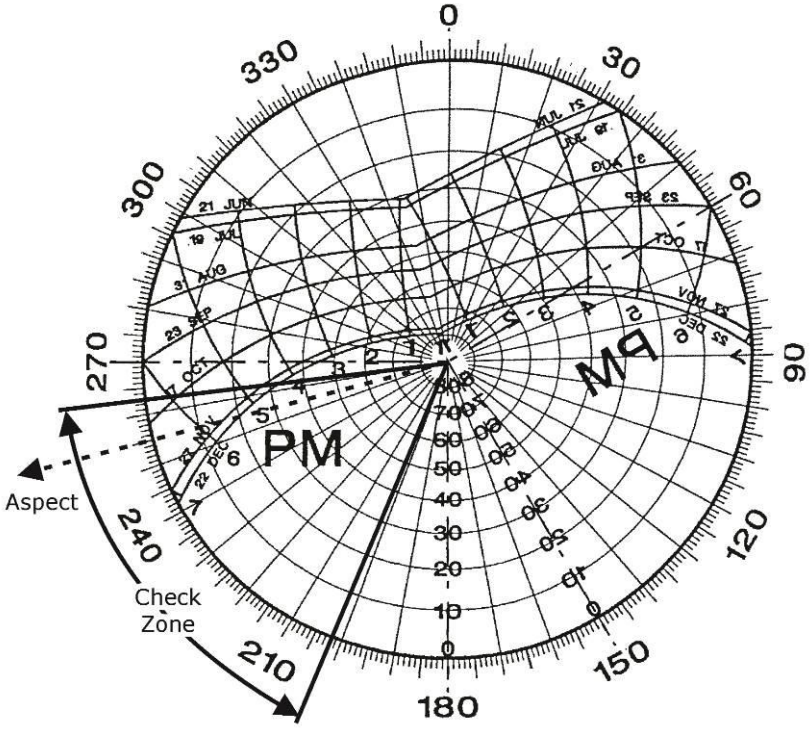

Figure B10: Sun Chart for Aspect 255°

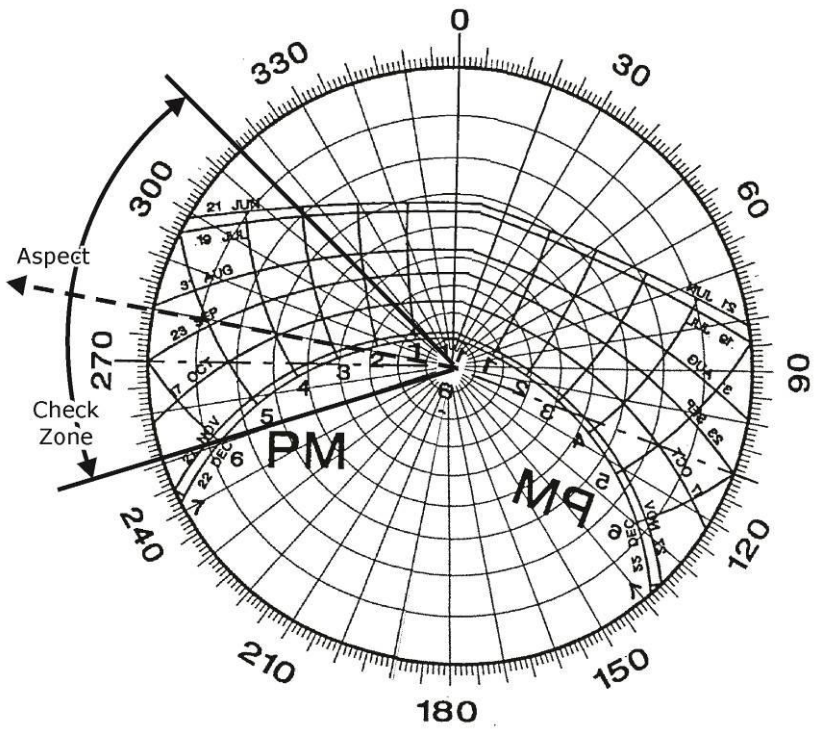

Figure B11: Sun Chart for Aspect 280

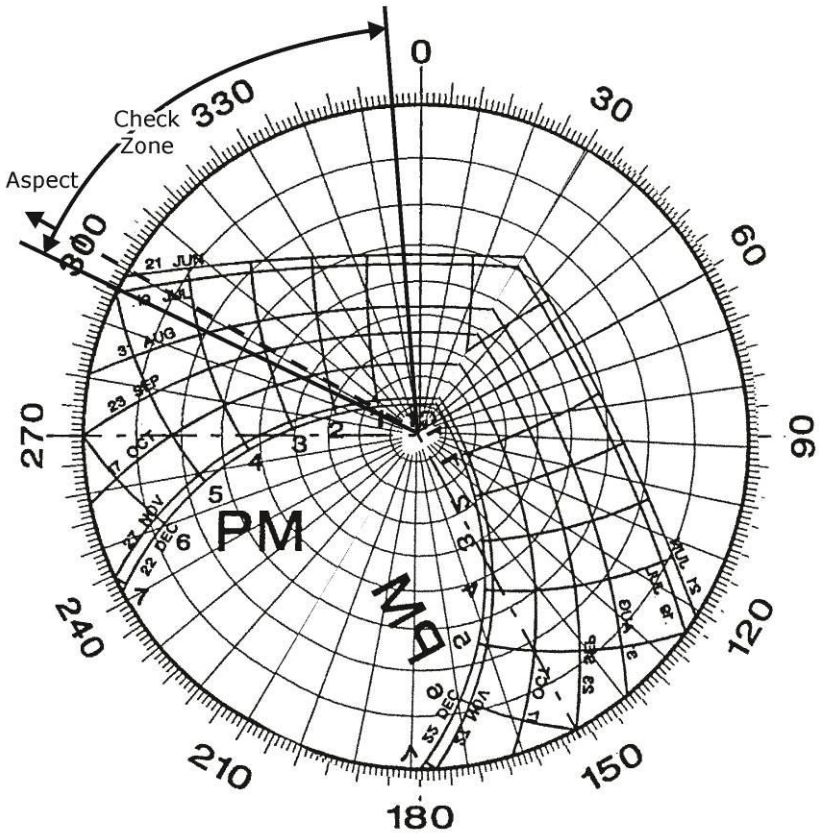

Figure B11: Sun Chart for Aspect 300

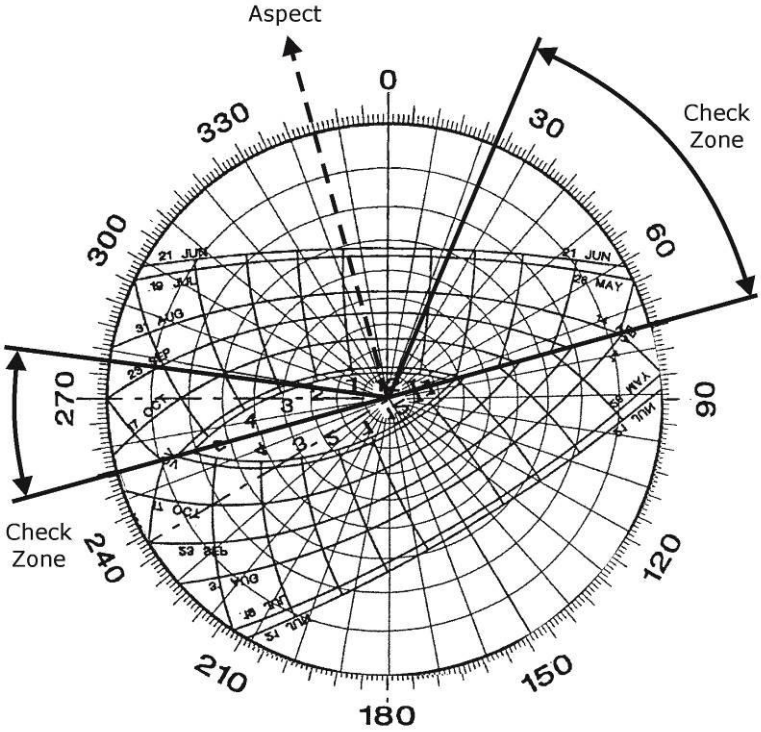

Figure B11: Sun Chart for Aspect 345

APPENDIX C - STANDARD SUN CHART FOR THE SYDNEY REGION

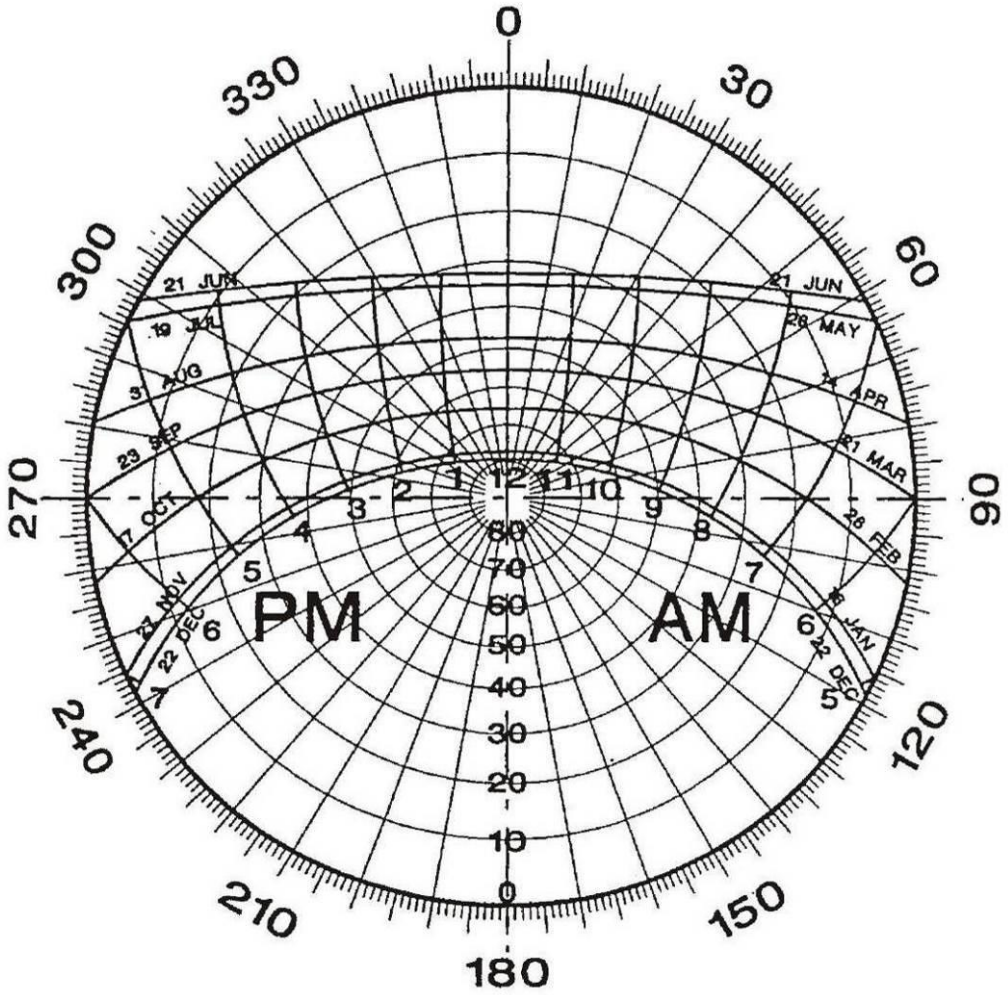

Figure C1: Standard Sun Chart for the Sydney Region