24-26 RAILWAY PARADE, WESTMEAD

SOLAR LIGHT REFLECTIVITY ANALYSIS

WD898-02F02(REV0)- SR REPORT

DECEMBER 12, 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 located at 24-26 Railway Parade, Westmead. This study identifies any possible adverse reflected solar glare conditions affecting motorists, pedestrians, and to occupants of neighbouring buildings. If necessary, recommendations are made to mitigate any potentially adverse effects. This study assesses compliance with the controls for solar glare from the State Environmental Planning Policy No. 65 (SEPP65, Part 04 (Designing the Building) for Amenity), which contains the Apartment Design Guide (ADG), and the Parramatta Development Control Plan 2011.

A site survey has been undertaken to obtain photographs of the critical sightlines of motorists on the surrounding streets, and train drivers on the adjacent railway line. 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, occupants of neighbouring buildings, and to comply with the abovementioned planning control requirements, it is recommended that the following restrictions be applied to the maximum normal specular reflectance of visible light of the glazing used on the external façade of the development:

- Maximum normal specular reflectance of 12% for the glazing on the southern aspect of the development on Levels 4 and 5.
- Maximum normal specular reflectance of 11% for the glazing on the eastern aspect of the south-eastern corner apartments on Levels 9 to 12.
- Maximum normal specular reflectance of 20% for all other glazing used on the external façade of the development.

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 recommendations, the results of this study indicate that the subject development will not cause adverse solar glare to pedestrians or motorists in the surrounding area, to train drivers on the adjacent railway line, or to occupants of neighbouring buildings, and will comply with the planning controls regarding reflectivity from SEPP65 and the Parramatta DCP 2011.

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 Parramatta Development Control Plan 2011.

The reflectivity analysis of the subject development has been carried out using the technique published by Hassall (1991). The limiting veiling luminance of 500 cd/m^2 for the comfort of motorists, as suggested in Hassall (1991), has been adopted as a basis of assessing the glare impact from the subject development. In meeting this criterion for vehicle motorists, conditions will also be satisfactory for pedestrians and train drivers. 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 or train drivers 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, pedestrians, or train drivers, and hence to allow the subject development to comply with the relevant planning control requirements.

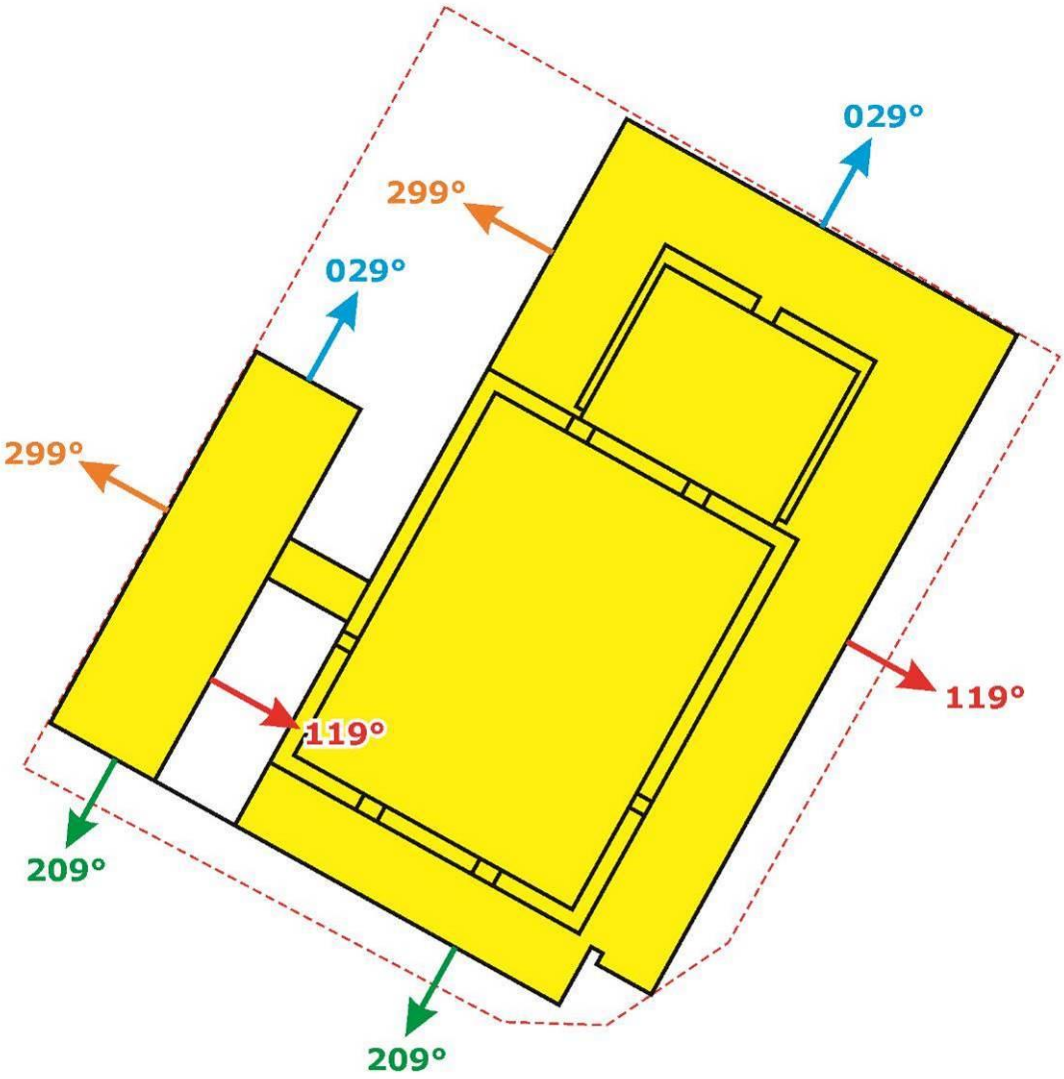

Figure 1: Critical Glazed Aspects of the Development

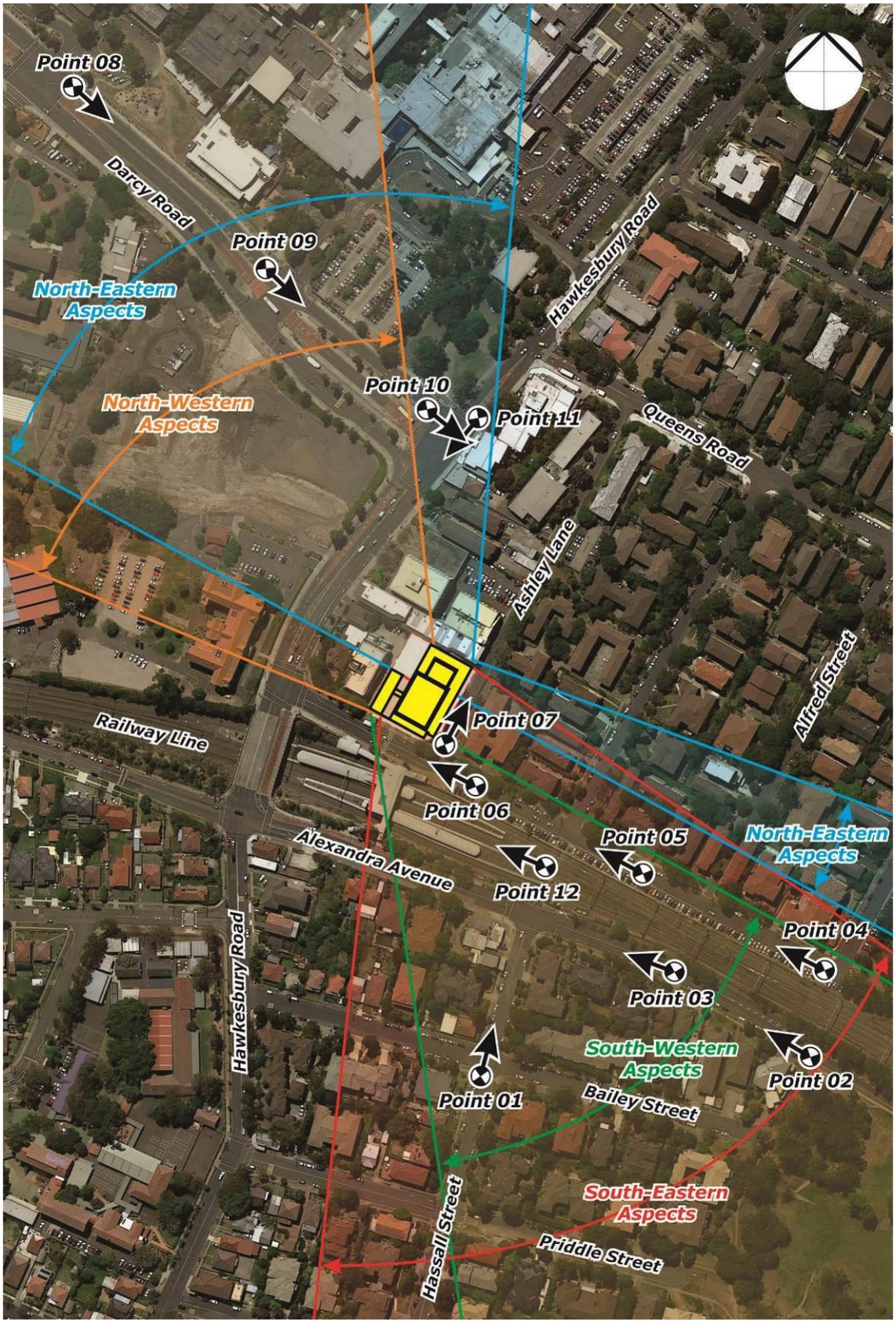

Figure 2: Check Zones and Study Point Locations
(the check zones are the areas where glare could potentially be observed)

2 ANALYSIS

2.1 Impact onto Motorists, Pedestrians and Train Drivers

From the study of the check zones shown in Figure 2, a total of 12 locations have been identified for detailed analysis. A summary of the location of each study point, and the aspects of the subject development which 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
01	Hassall Street, heading north.	119°, 209°
02	Alexandra Avenue, heading west.	119°, 209°
03	Alexandra Avenue, heading west.	119°, 209°
04	Railway Parade, heading west.	119°, 209°
05	Railway Parade, heading west.	119°, 209°
06	Railway Parade, heading west.	119°, 209°
07	Ashley Lane, heading north.	119°, 209°
08	Darcy Road, heading east.	029°, 299°
09	Darcy Road, heading east.	029°, 299°
10	Darcy Road, heading east.	029°
11	Hawkesbury Road, heading south.	029°
12	Railway Line, heading west.	119°, 209°

2.1.1 Motorists heading north along Hassall Street

Point 01 is located along Hassall Street, to the south of the development site. This point represents the critical sightline of motorists heading north along Hassall Street at this location. A site survey of this point has been undertaken, and a photograph showing the viewpoint of motorists 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 A01 of Appendix A.

An analysis of the glare meter overlaid onto the viewpoint at Point 01 indicates that the development will not be visible within the zone of sensitive vision. Hence there will be no adverse solar glare observed by motorists or pedestrians heading north along Hassall Street at this location.

2.1.2 Motorists heading west along Alexandra Avenue

Points 02 and 03 are located along Alexandra Avenue, to the south-east of the development site. These points represent the critical sightlines of motorists heading west along Alexandra Avenue at these locations. A site survey of these points has been undertaken, and photographs showing the viewpoints of motorists 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 A02 and A03 of Appendix A.

An analysis of the glare meter overlaid onto the viewpoints at Points 02 and 03 indicate that the development will not be visible within the zone of sensitive vision. Hence there will be no adverse solar glare observed by motorists or pedestrians heading west along Alexandra Avenue at these locations.

2.1.3 Motorists heading west along Railway Parade

Points 04, 05 and 06 are located along Railway Parade, to the south-east of the development site. These points represent the critical sightlines of motorists heading west along Railway Parade at these locations. A site survey of these points has been undertaken, and photographs showing the viewpoints of motorists 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 A04, A05 and A06 of Appendix A.

An analysis of the glare meter overlaid onto the viewpoint at Point 04 indicates that a portion of the eastern and southern aspects of the tower component of the development will be visible within the zone of sensitive vision. Point 04 is located within the check zone for the eastern and southern aspects, and hence solar glare can potentially be observed from these portions of the façade at Point 04.

Further analysis of the viewpoint at Point 04 indicates that the view of the southern aspect from Point 04 is very narrow (less than 0.5deg arc). Hence the intensity of solar glare observed from Point 04 from that aspect will be less than 500cd/m^2 (provided that the maximum normal specular reflectance of visible light of the glazing used on that aspect is 20%), which is suitable for motorists and pedestrians. Hence there will be no adverse solar glare observed from the southern aspect of the development at Point 04.

To ensure that no adverse solar glare is observed from Point 04 from the eastern aspect of the development, the glazing used on the eastern aspect façade of the apartments located at the south-eastern corner of Levels 9 to 12 should be limited to a maximum normal specular reflectance of visible light of 11%.

An analysis of the glare meter overlaid onto the viewpoint at Point 05 indicates that a portion of the southern aspect of the tower component of the development will be visible within the zone of sensitive vision. Point 05 is located within the check zone for the southern aspect, and hence solar glare can potentially be observed from this portion of the façade at Point 05. To ensure that no adverse solar glare is observed from Point 05 from the southern aspect of the

development, the glazing used on the southern aspect façade of Levels 4 and 5 should be limited to a maximum normal specular reflectance of visible light of 12%.

An analysis of the glare meter overlaid onto the viewpoint at Point 06 indicates that the development will not be visible within the zone of sensitive vision. Hence there will be no adverse solar glare observed by motorists or pedestrians heading west along Railway Parade at this location.

2.1.4 Motorists heading north along Ashley Lane

Point 07 is located along Ashley Lane, to the easy of the development site. This point represents the critical sightline of motorists heading north along Ashley Lane at this location. A site survey of this point has been undertaken, and a photograph showing the viewpoint of motorists 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 A07 of Appendix A.

An analysis of the glare meter overlaid onto the viewpoint at Point 07 indicates that a portion of the northern end of the eastern aspect of the development will be visible within the zone of sensitive vision. Point 07 is located within the check zone for the eastern aspect, and hence solar glare can potentially be observed from this portion of the eastern aspect at Point 07. However, further analysis indicates that Point 07 will not be within the check zone of the portion of the eastern aspect within the zone of sensitive vision. Hence there will be no adverse solar glare observed by motorists or pedestrians heading north along Ashley Lane at this location.

2.1.5 Motorists heading east along Darcy Road

Points 08, 09 and 10 are located along Darcy Road, to the north-west of the development site. These points represent the critical sightlines of motorists heading east along Darcy Road at these locations. A site survey of these points has been undertaken, and photographs showing the viewpoints of motorists 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 A08, A09 and A10 of Appendix A.

An analysis of the glare meter overlaid onto the viewpoints at Point 08, 09 and 10 indicates that the development will not be visible within the zone of sensitive vision. Hence there will be no adverse solar glare observed by motorists or pedestrians heading east along Darcy Road at these locations.

2.1.6 Motorists heading south along Hawkesbury Road

Point 11 is located along Hawkesbury Road, to the north of the development site. This point represents the critical sightline of motorists heading south along Hawkesbury Road at this location. A site survey of this point has been undertaken, and a photograph showing the viewpoint of motorists 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 development will not be visible within the zone of sensitive vision. Hence there will be no adverse solar glare observed by motorists or pedestrians heading south along Hawkesbury Road at this location.

2.1.7 West-bound Train Drivers

Point 12 is located at Westmead Railway Station, to the south-east of the development site. This point represents the critical sightline of west-bound train drivers. 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 A12 of Appendix A.

An analysis of the glare meter overlaid onto the viewpoint at Point 12 indicates that the development will not be visible within the zone of sensitive vision. Hence there will be no adverse solar glare observed by west-bound train drivers at this location.

The analysis of the glare meter over the viewpoints of Points 02, 03, 04 and 05, which are located either side of the railway line, also provides an indication of the viewpoint of train drivers on the adjacent railway line. The recommendations made for limiting glare from the eastern and southern aspects at Points 04 and 04 respectively will also be effective in ensuring that no adverse solar glare affects west-bound train drivers.

2.1.8 East-bound Train Drivers

Examination of the check zone diagram presented in Figure 2 indicates that east-bound train drivers will not be within the check zones for solar glare from the façade of the development when the view of the development is within the zone of sensitive vision. Hence there will be no adverse solar glare from the development to east-bound train drivers.

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 powder-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 located at 24-26 Railway Parade, Westmead. This study identifies any possible adverse reflected solar glare conditions affecting motorists, pedestrians, and to occupants of neighbouring buildings. If necessary, recommendations are made to mitigate any potentially adverse effects. This study assesses compliance with the controls for solar glare from the State Environmental Planning Policy No. 65 (SEPP65, Part 04 (Designing the Building) for Amenity), which contains the Apartment Design Guide (ADG), and the Parramatta Development Control Plan 2011.

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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 the following restrictions be applied to the maximum normal specular reflectance of visible light of the glazing used on the external façade of the development:

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- Maximum normal specular reflectance of 20% for all other glazing used on the external façade of the development.

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 recommendations, the results of this study indicate that the subject development will not cause adverse solar glare to pedestrians or motorists in the surrounding area, to train drivers on the adjacent railway line, or to occupants of neighbouring buildings, and will comply with the planning controls regarding reflectivity from SEPP65 and the Parramatta DCP 2011.

REFERENCES

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

Parramatta Development Control Plan 2011.

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

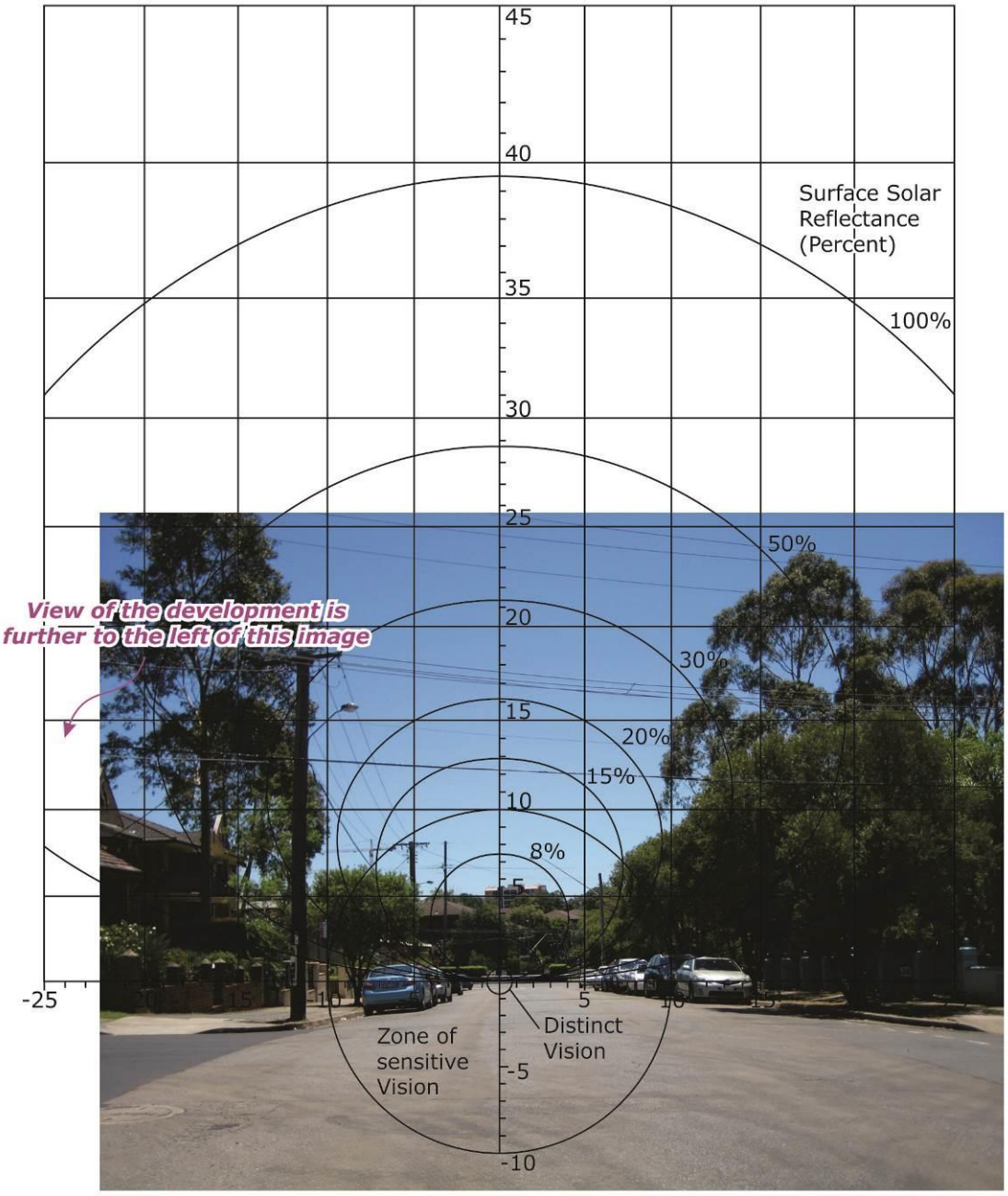

Figure A01: Glare Overlay for Point 01

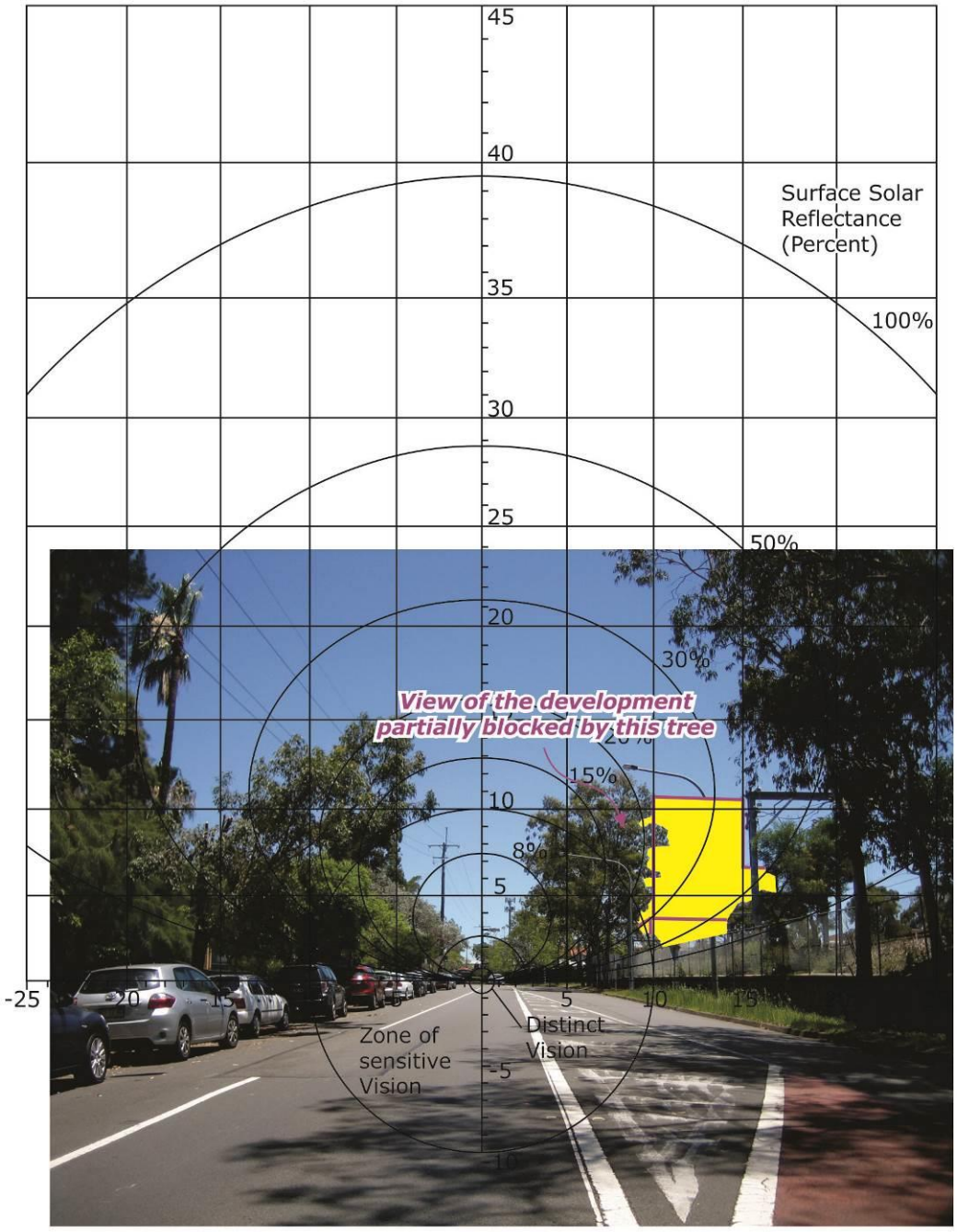

Figure A02: Glare Overlay for Point 02

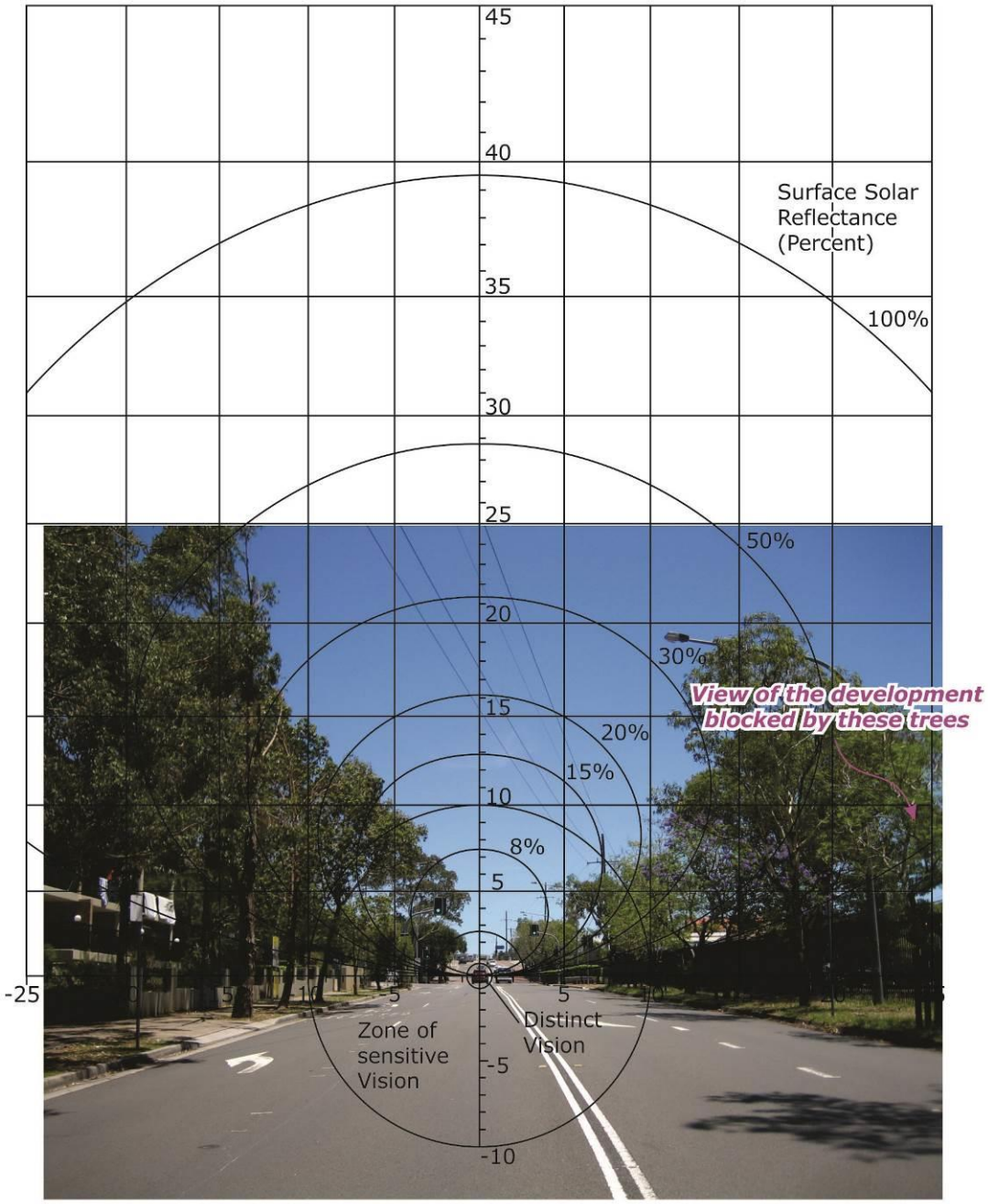

Figure A03: Glare Overlay for Point 03

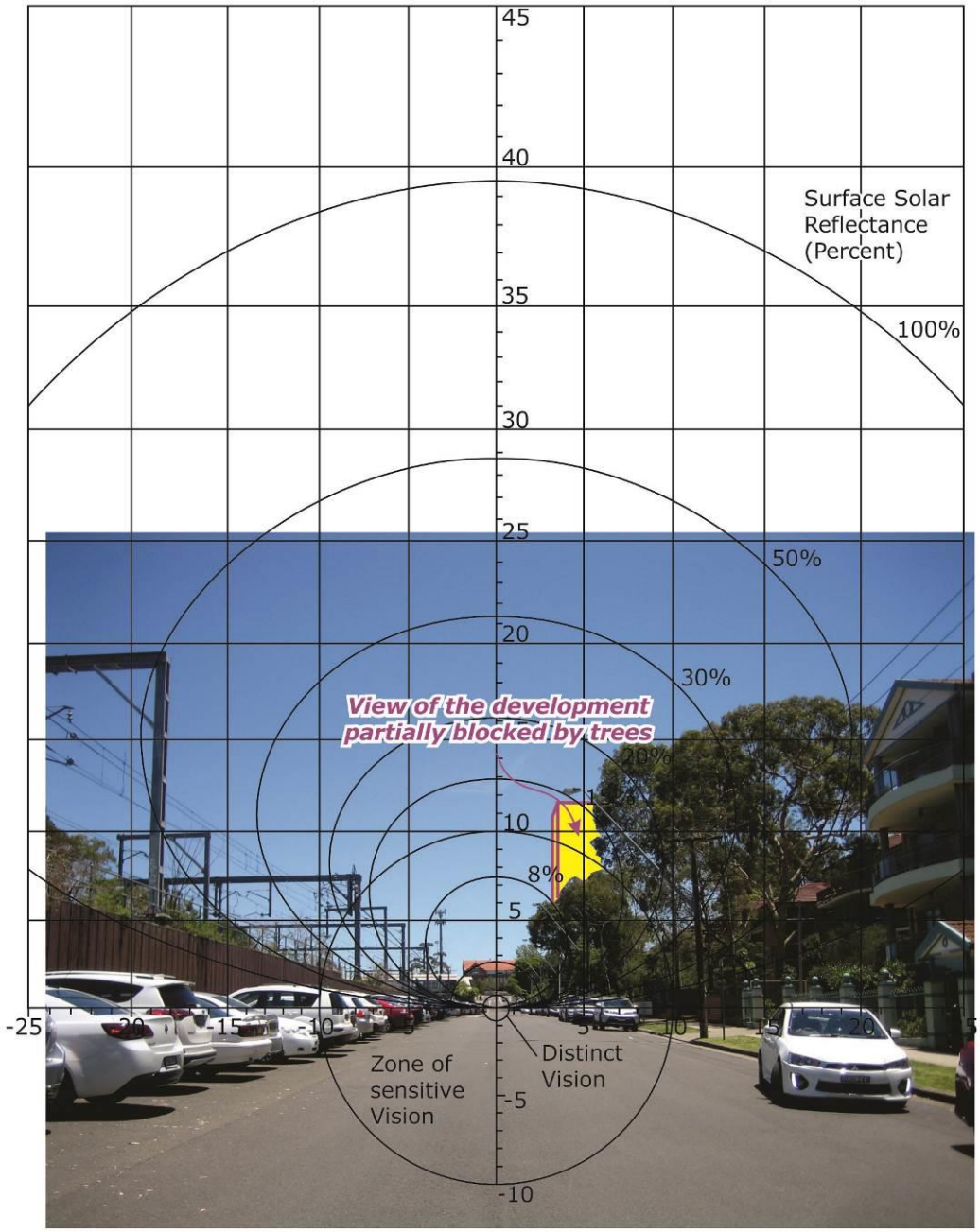

Figure A04: Glare Overlay for Point 04

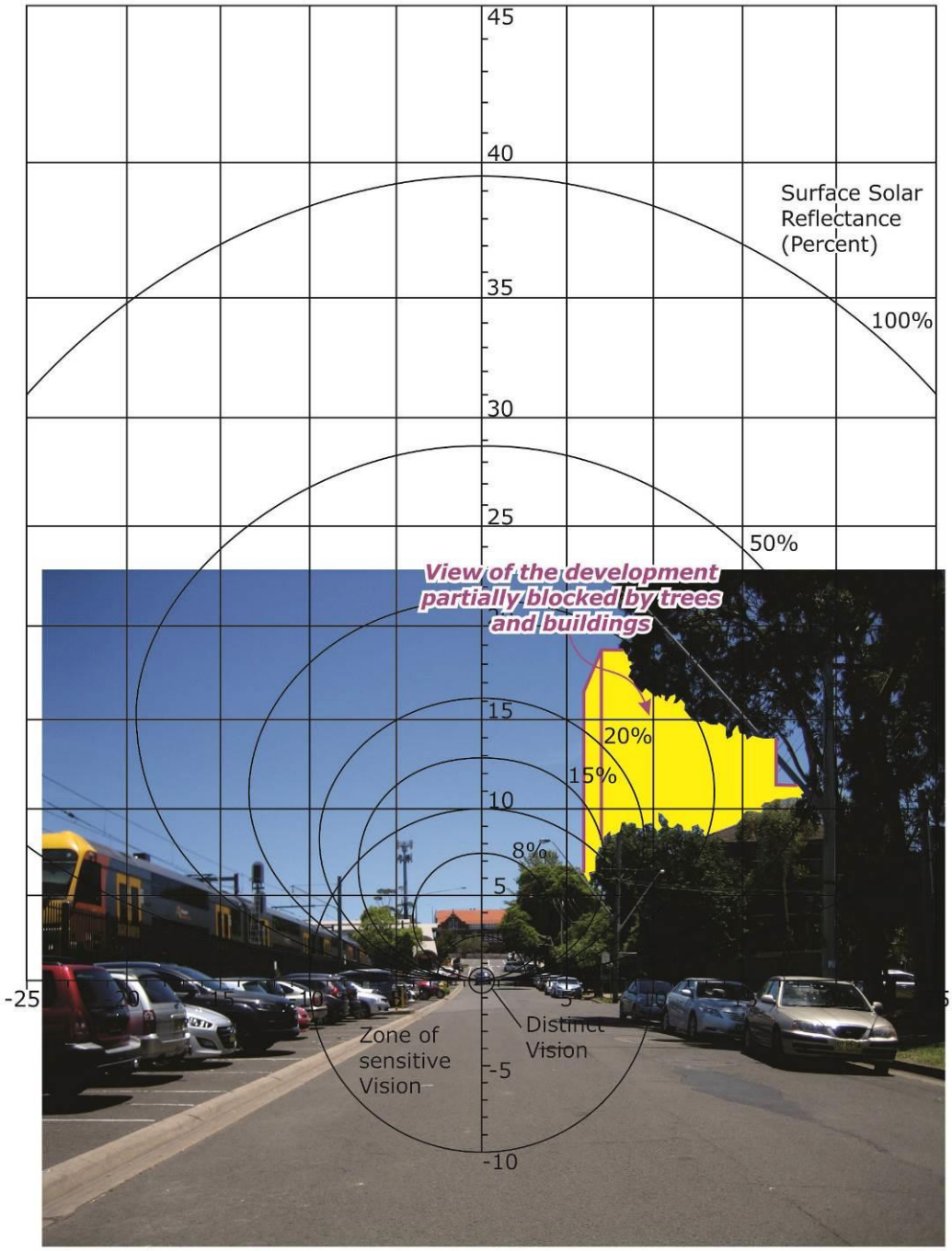

Figure A05: Glare Overlay for Point 05

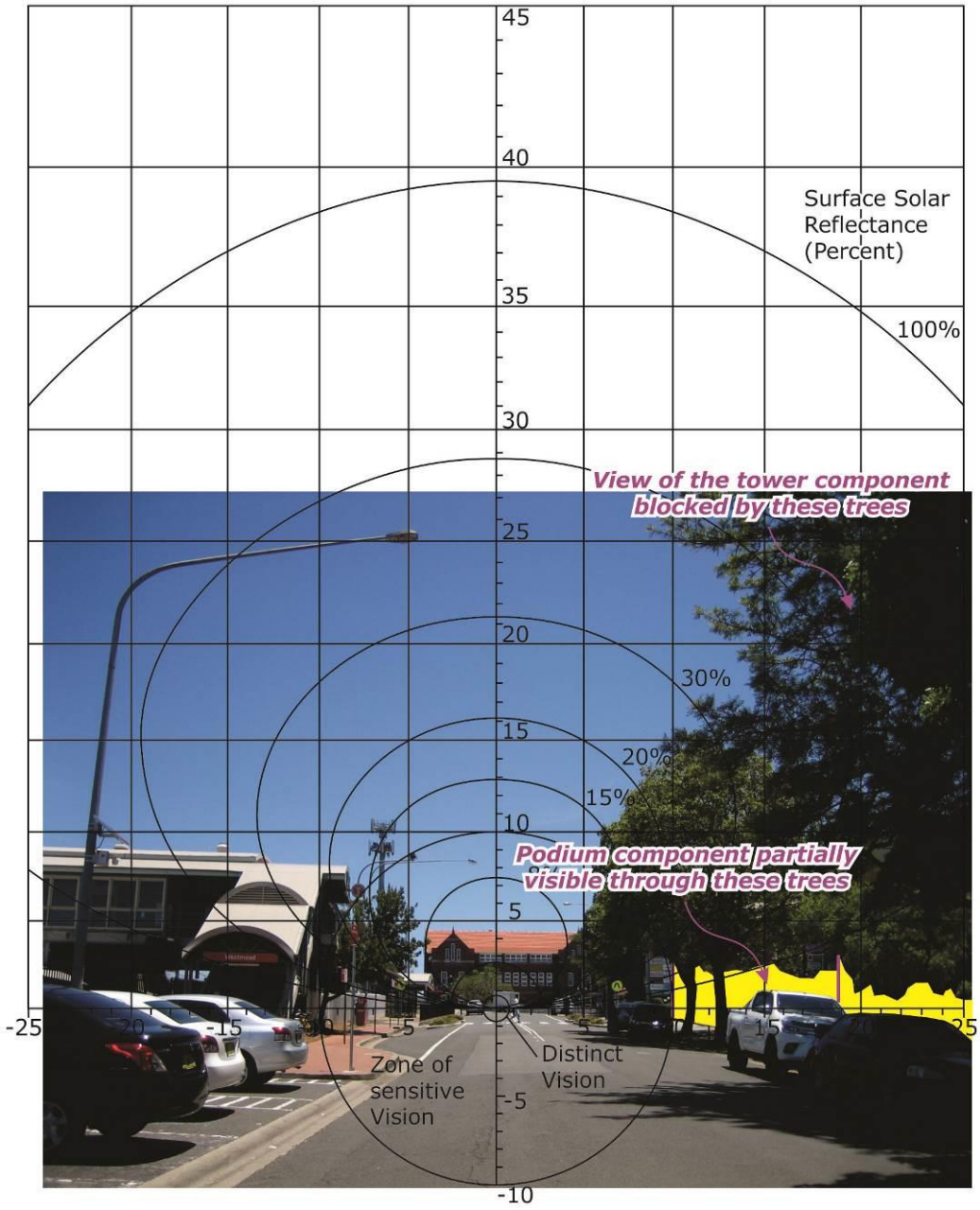

Figure A06: Glare Overlay for Point 06

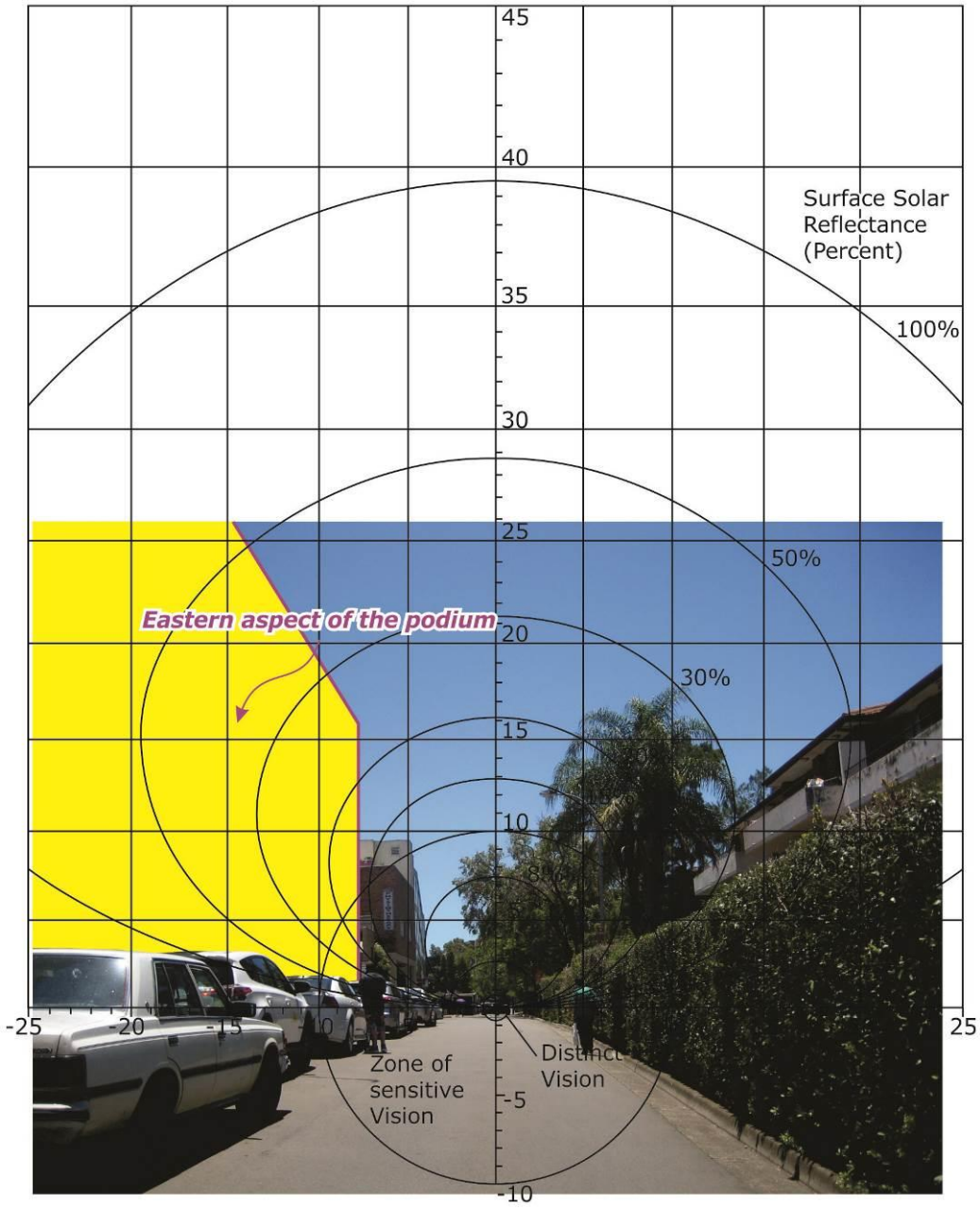

Figure A07: Glare Overlay for Point 07

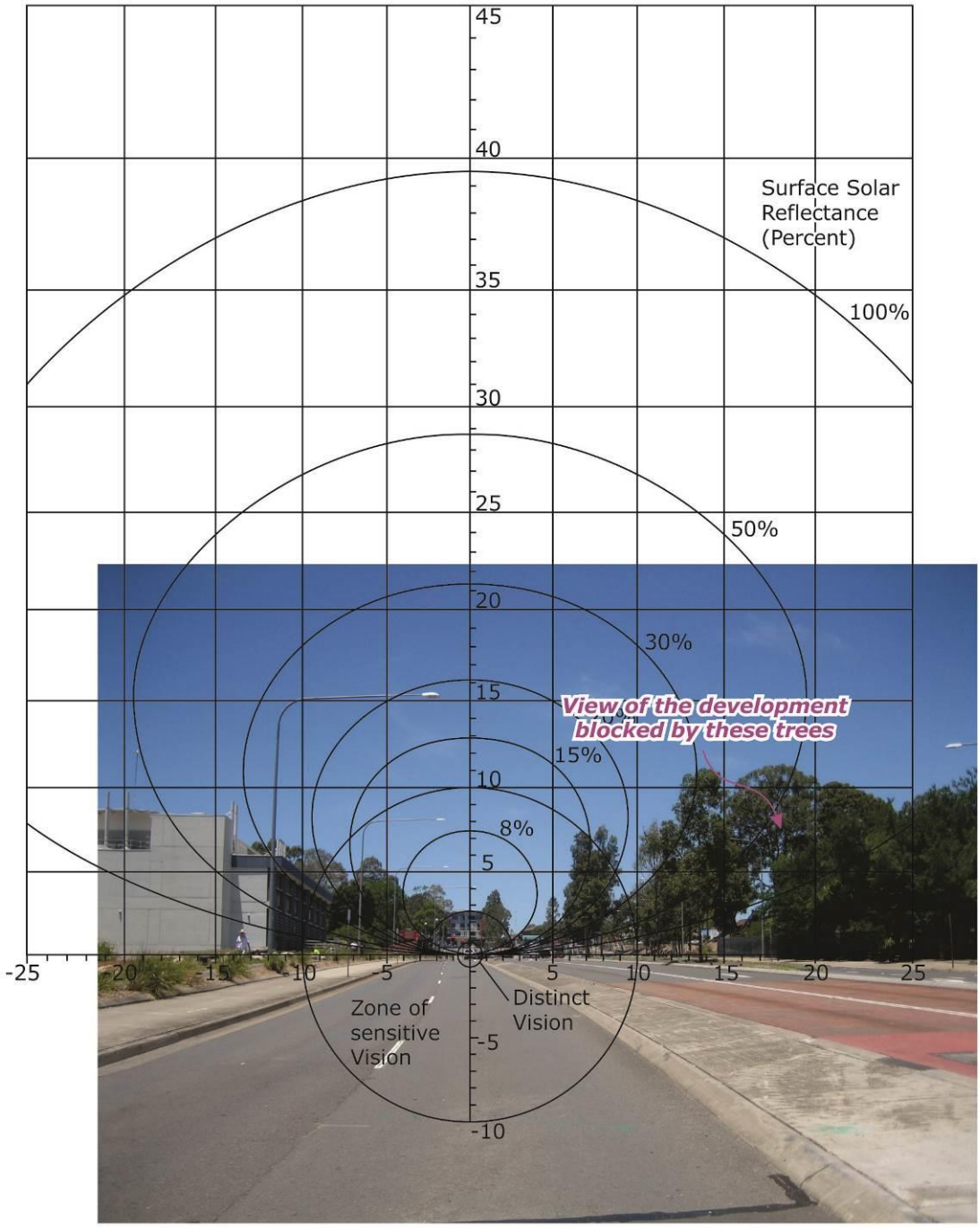

Figure A08: Glare Overlay for Point 08

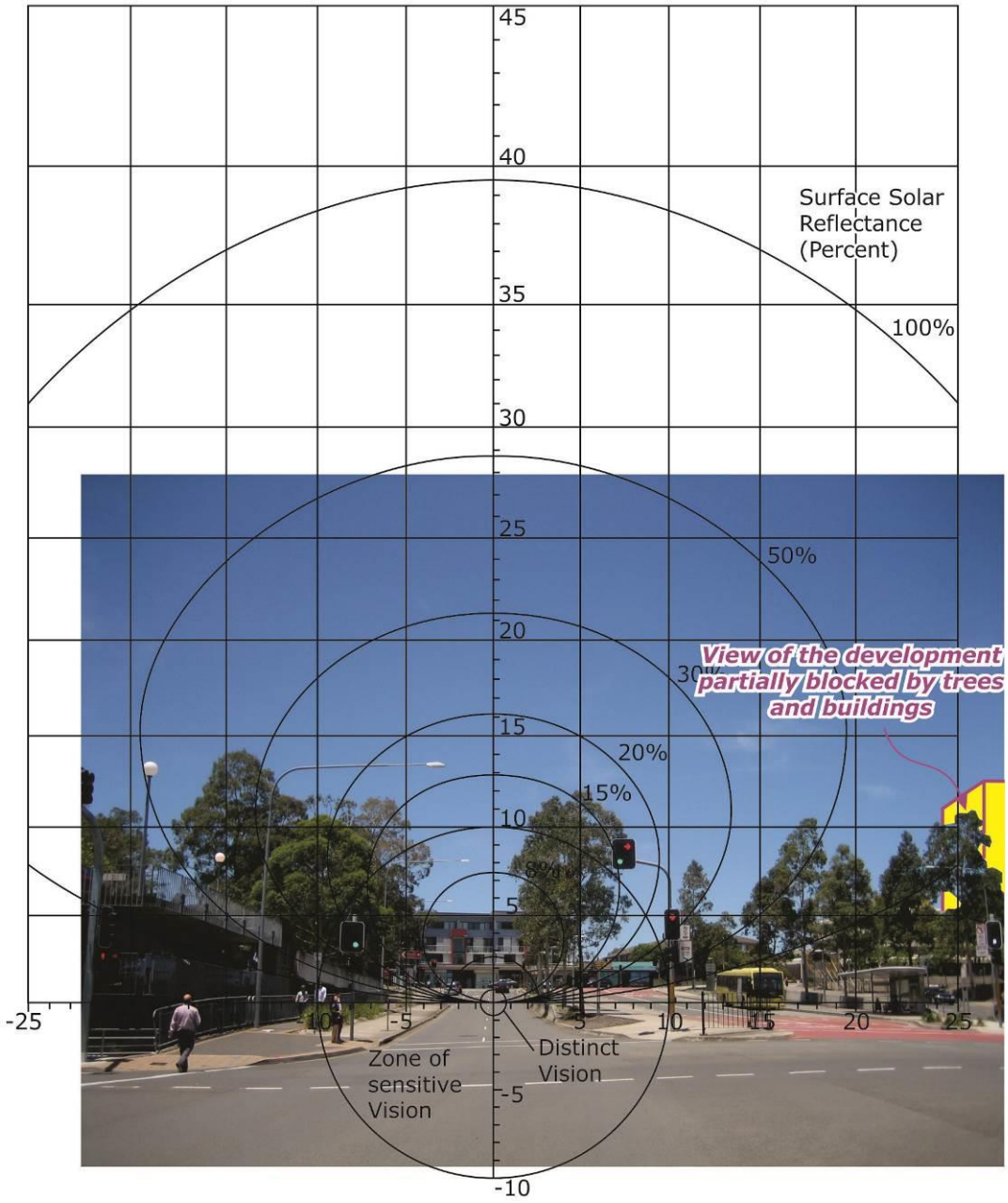

Figure A09: Glare Overlay for Point 09

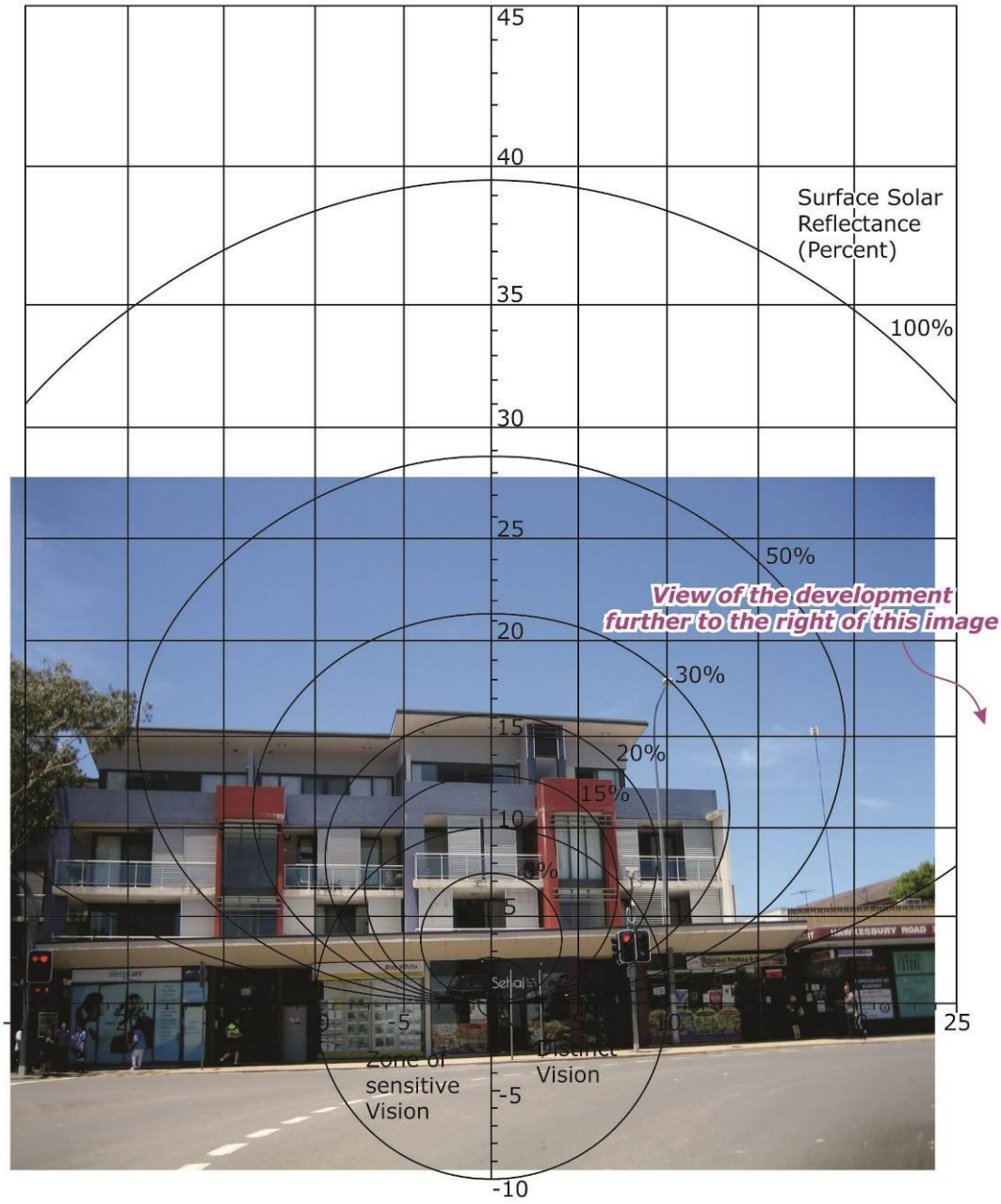

Figure A10: Glare Overlay for Point 10

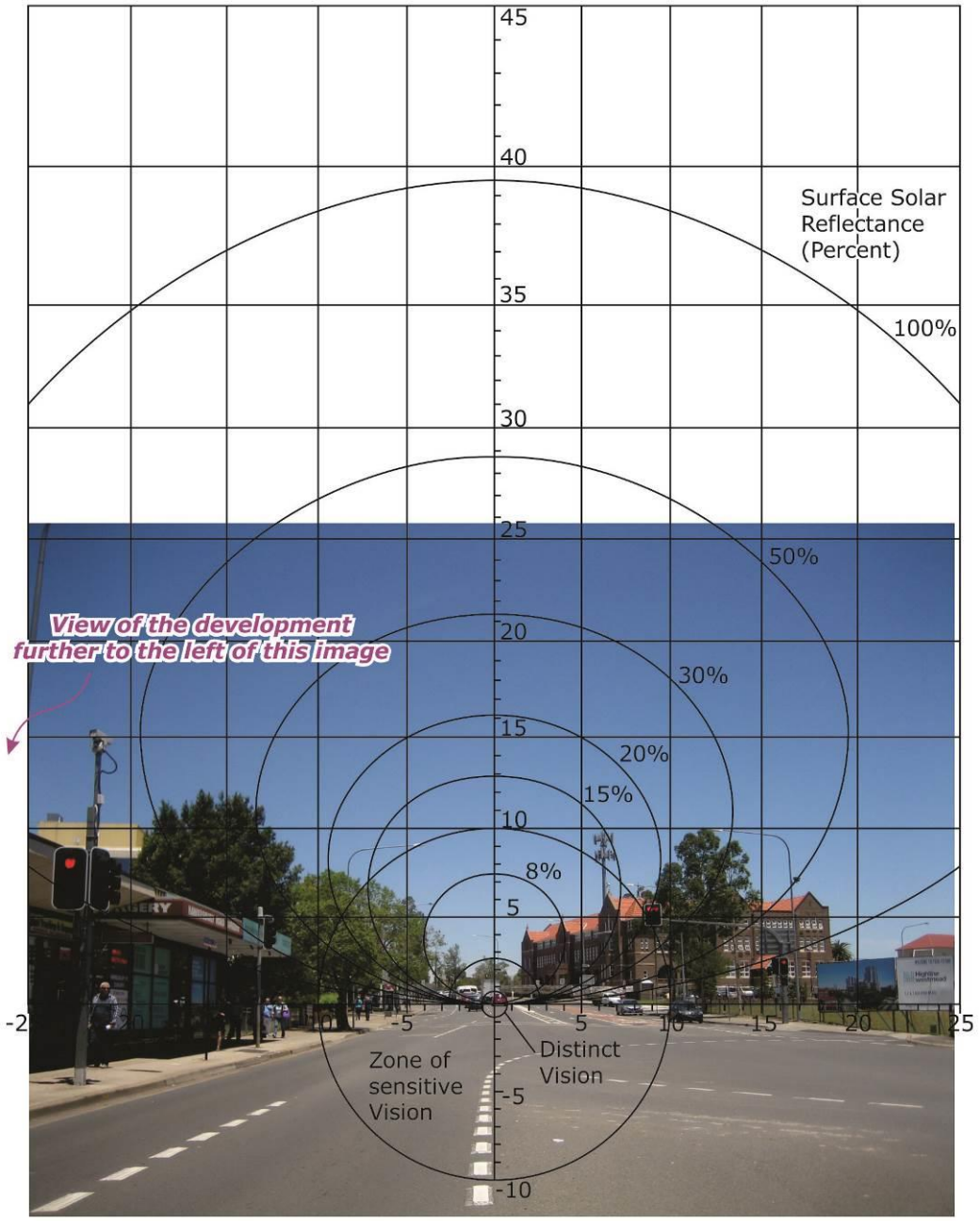

Figure A11: Glare Overlay for Point 11

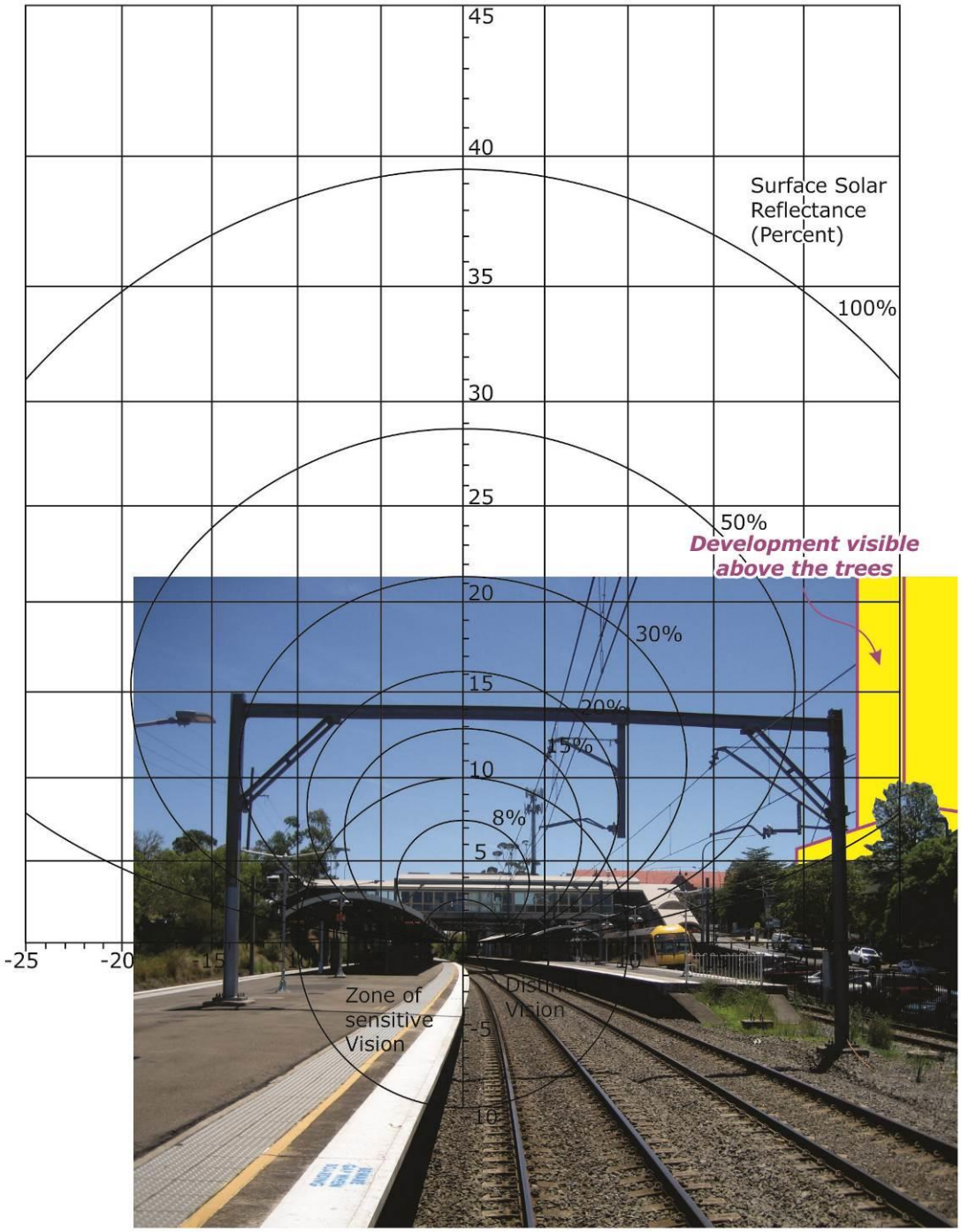

Figure A12: Glare Overlay for Point 12

APPENDIX B - SOLAR CHARTS FOR THE VARIOUS CRITICAL ASPECTS

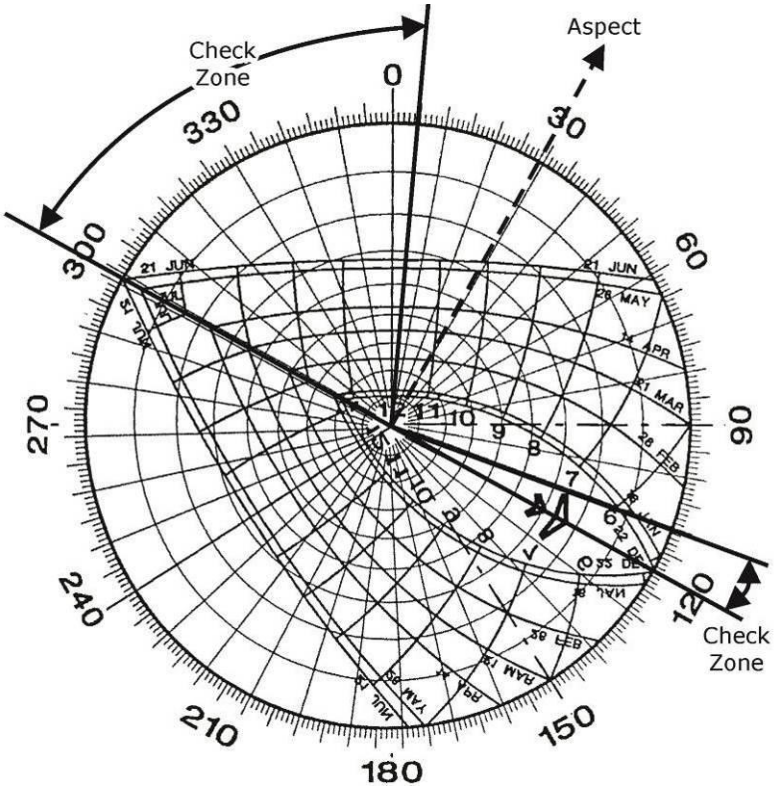

Figure B01: Sun Chart for Aspect 029^{o}

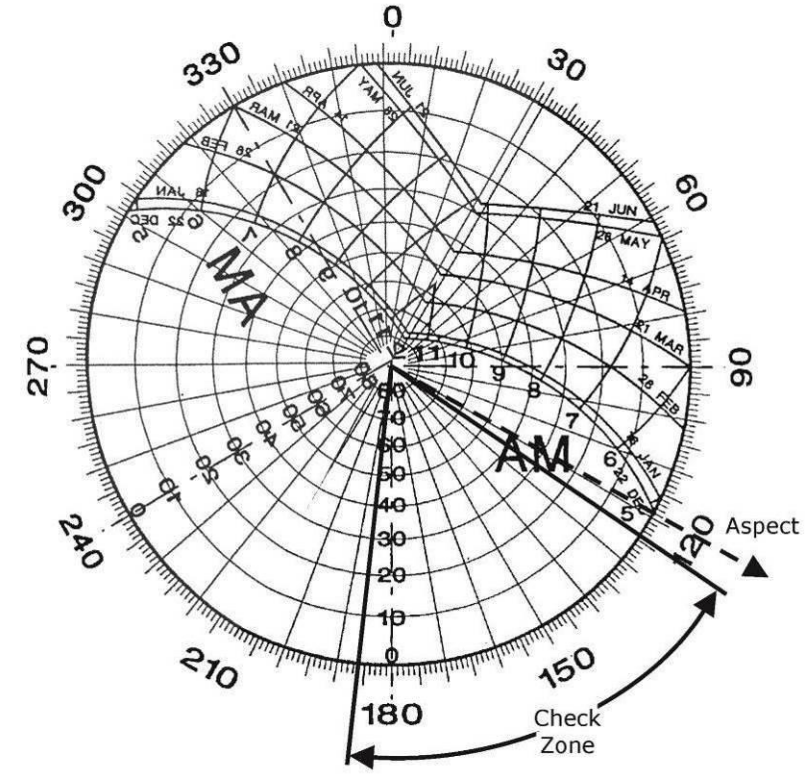

Figure B02: Sun Chart for Aspect 119^{o}

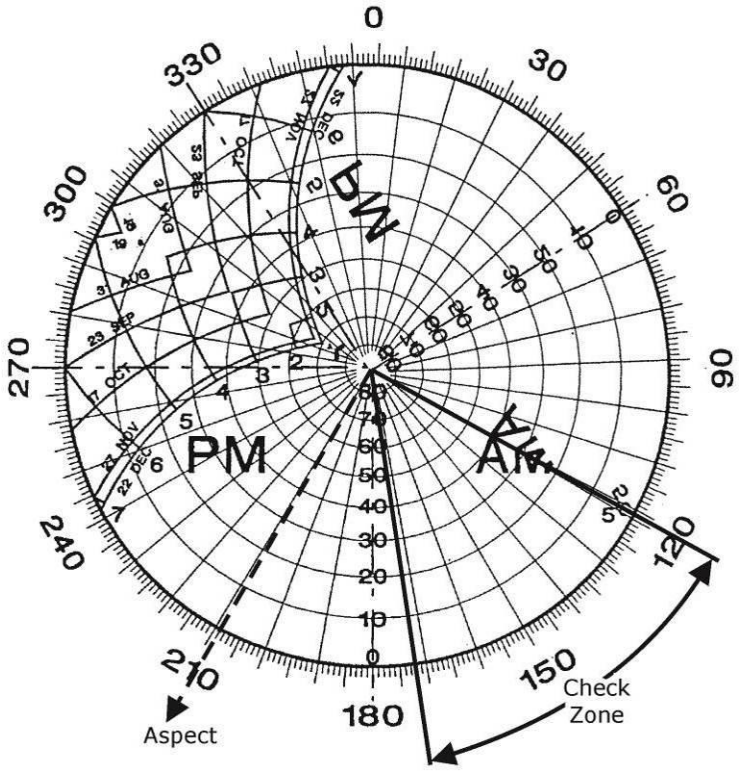

Figure B03: Sun Chart for Aspect 209^{o}

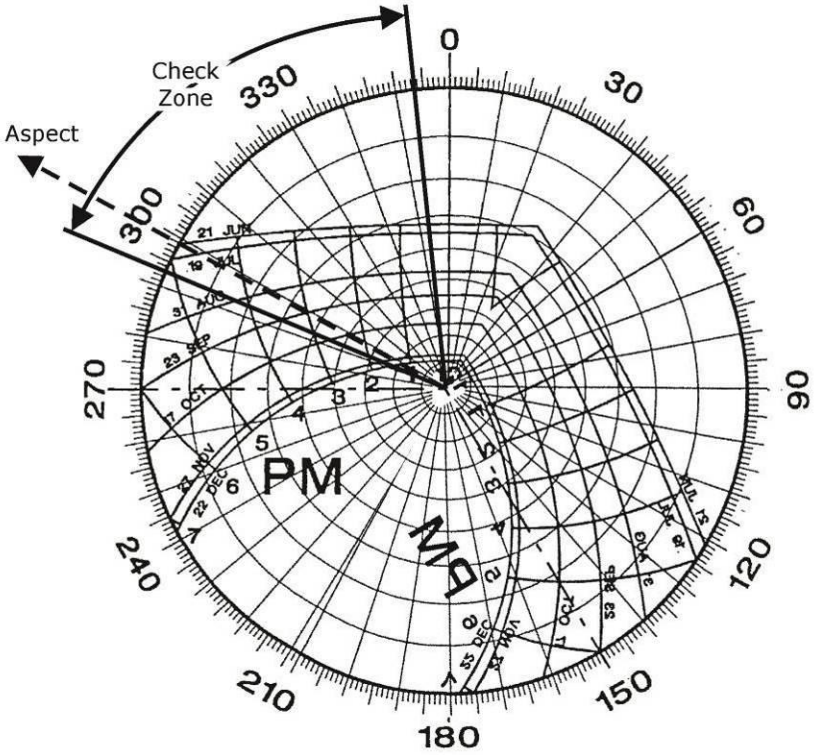

Figure B04: Sun Chart for Aspect 299^{o}

APPENDIX C - STANDARD SUN CHART FOR THE SYDNEY REGION

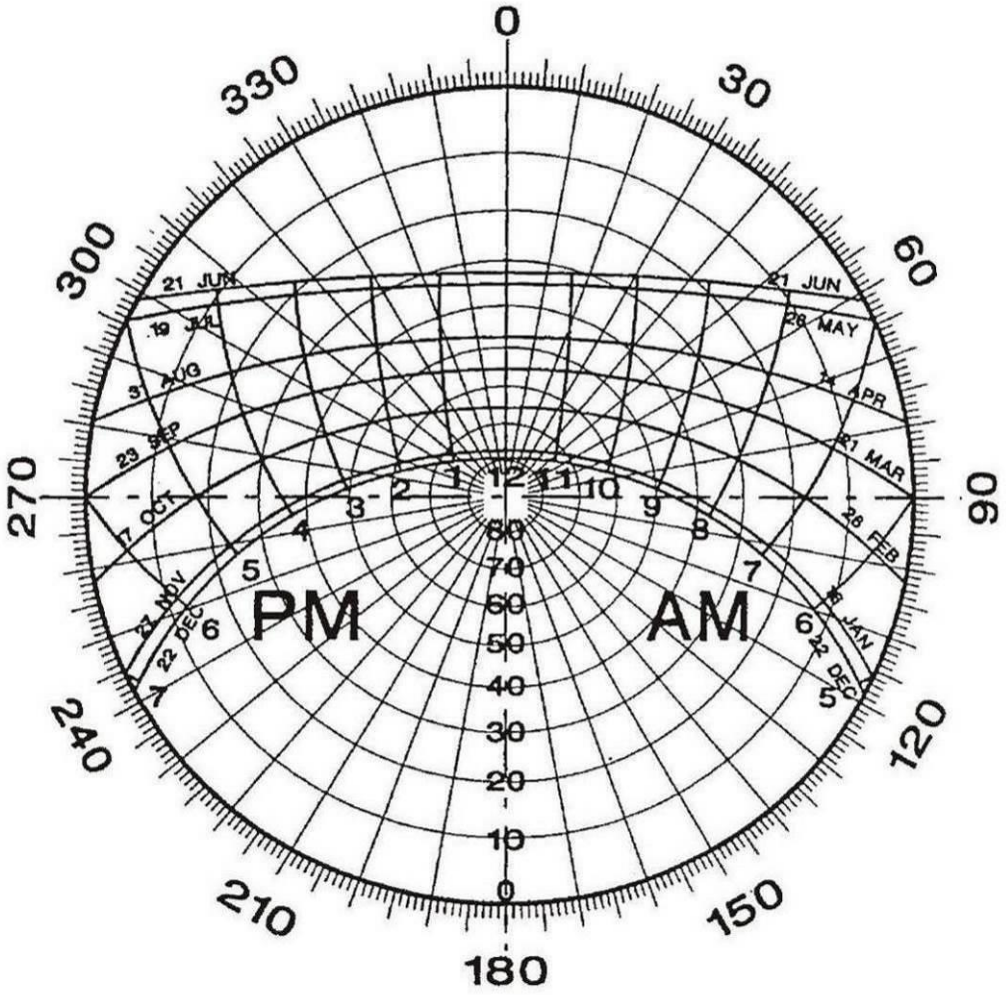

Figure C1: Standard Sun Chart for the Sydney Region