Solar Light Reflectivity Analysis

F01 Chau Chak Wing Museum, The University Of Sydney

Executive Summary

This report presents the results of a detailed study for the effect of potential solar glare from the proposed development called Chau Chak Wing Museum at The University of Sydney. The analysis has been undertaken based on the architectural drawings prepared by the project architect Johnson Pilton Walker Pty Ltd, received in February 2017.

This study identifies any possible adverse reflected solar glare conditions affecting motorists, pedestrians within the local surrounding area, 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, occupants of neighbouring buildings, and to comply with the abovementioned planning control requirements, it is recommended that glazing used on the external façade of the development should have a maximum normal specular reflectance of visible light of 20%.

It should be noted that the most reflective surface on the façade of a building is the glazing. Reflected solar glare from concrete, brickwork, timber, etc, is negligible (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, or to occupants of neighbouring buildings, and will comply with the planning controls regarding reflectivity for the City of Sydney Development Control Plan (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, 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.

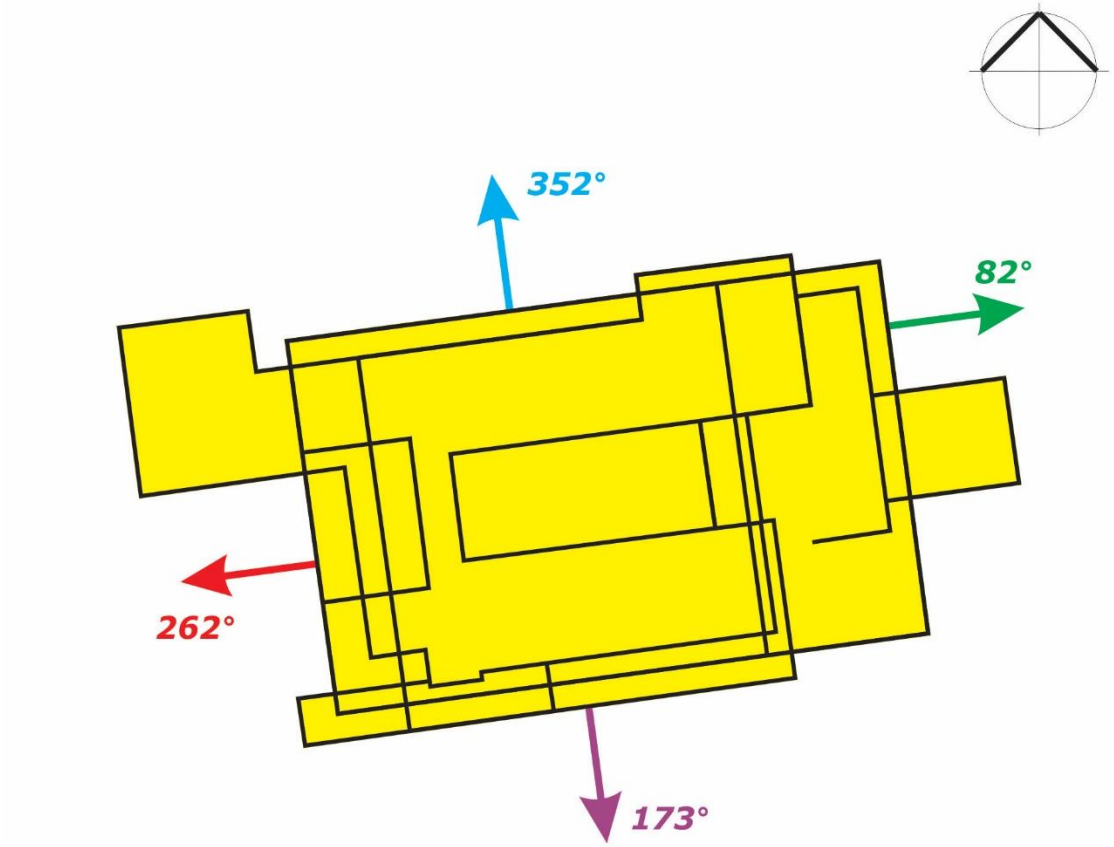

Figure 1: Critical Vertical Glazed Aspects of the Development

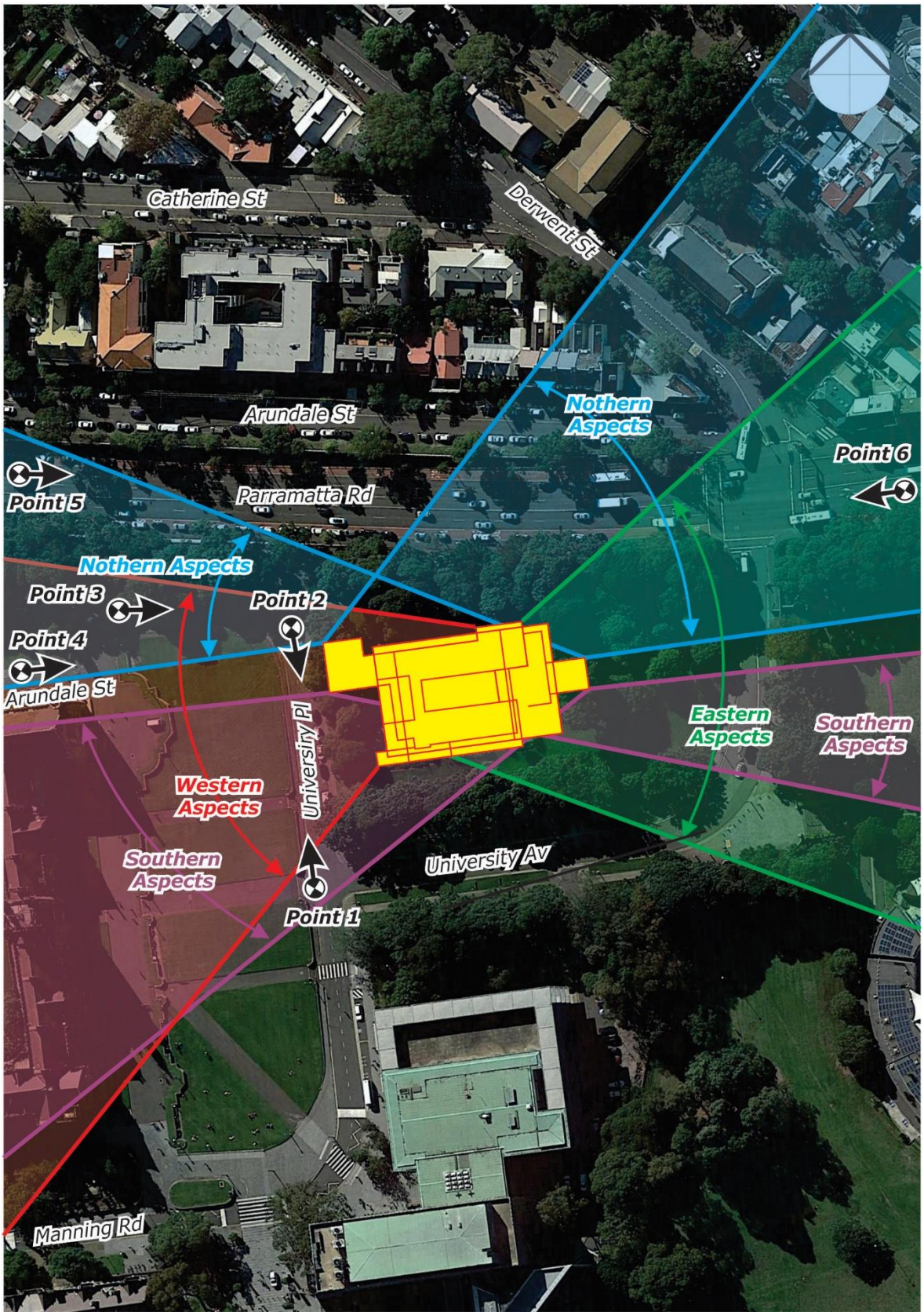

Figure 2: Check Zones and Study Point Locations (the check zones are the areas where glare could potentially be observed from vertical glazed aspects)

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.

2. Analysis

2.1 Impact onto Drivers and Pedestrians

From the study of the check zones shown in Figure 2, a total of 6 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	University Pl, heading north	Southern Aspects
2	University Pl, heading south	Northern and Western Aspects
3	University Pl, heading east	Northern and Western Aspects
4	Arundale St, heading east	Northern and Western Aspects
5	Parramatta Rd, heading east	Northern Aspects
6	Parramatta Rd, heading west	Northern and Eastern Aspects

2.1.1 Drivers heading north along University Pl

Point 1 is located along University Pl, to the west of the development site. This point represents the critical sightlines of drivers heading north along University Pl 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 is visible at this location, however is not 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 along University Pl from the façade of the subject development.

2.1.2 Drivers heading north south University Pl

Point 2 is located along University Pl, to the west of the development site. This point represents the critical sightlines of drivers heading south along University Pl 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 A2 of Appendix A.

An analysis of the viewpoint at Point 2 indicates that the subject development is not visible and is not 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 University Pl from the façade of the subject development.

2.1.3 Drivers heading east south University Pl

Point 3 is located along University Pl, to the west of the development site. This point represents the critical sightlines of drivers heading east along University Pl 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 viewpoint at Point 3 indicates that the subject development is visible at this location, however is not 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 east along University Pl from the façade of the subject development.

2.1.4 Drivers heading east along Arundale St

Point 4 is located along Arundale St, to the west of the development site. This point represents the critical sightlines of drivers heading east along Arundale St 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 A4 of Appendix A.

An analysis of the viewpoint at Point 4 indicates that the subject development is visible at this location, however is not 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 east along University Pl from the façade of the subject development.

2.1.5 Drivers heading east along Parramatta Rd

Point 5 is located along Parramatta Rd, to the west of the development site. This point represents the critical sightlines of drivers heading east along Parramatta Rd 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.

An analysis of the viewpoint at Point 5 indicates that the subject development is not visible and is not 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 east along Parramatta Rd from the façade of the subject development.

2.1.6 Drivers heading west along Parramatta Rd

Point 6 is located along Parramatta Rd, to the east of the development site. This point represents the critical sightlines of drivers heading west along Parramatta Rd 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 viewpoint at Point 5 indicates that the subject development is not visible and is not 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 Parramatta Rd from the façade of the subject development.

2.2 Occupants of Neighbouring Buildings

Our past experience involving more than 250 projects, and also research by A.W. Rofail and B. Dowdle (2004), tends to indicate that buildings which cause a nuisance to occupants of neighbouring buildings are those which incorporate vertical external facade materials 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. For external façade materials which are inclined, there is sufficient evidence that nuisance glare can be caused even from materials which have a normal specular reflectance less than 20%.

The subject development includes a glazed skylight at the plant level, which could potentially cause a glare nuisance to occupants of the neighbouring buildings which are taller than the subject development. However, the skylight is significantly recessed below the roof level, and the neighbouring buildings within the immediate vicinity of the subject development are only a few stories higher at most that the subject development. As such, from locations where the skylight is within the zone of sensitive vision of occupants of neighbouring buildings, the skylight will be either overshadowed or completely blocked from view by the subject development itself at the times of day when adverse glare could otherwise be observed. Therefore there will be no adverse glare observed by occupants of neighbouring buildings from the inclined skylight of the subject development.

Hence, a general recommendation is made that all glazing and other reflective materials used on the façade of the subject development, including the skylight, 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 the effect of solar glare from the proposed development called Chau Chak Wing Museum at the University of Sydney. The analysis has been undertaken based on the architectural drawings prepared by the project architect Johnson Pilton Walker Pty Ltd, received in February 2017.

This study identifies any possible adverse reflected solar glare conditions affecting motorists, pedestrians within the local surrounding area, 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).

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The results of the study indicate that, to avoid any adverse glare to motorists and pedestrians on the surrounding streets, occupants of neighbouring buildings, and to comply with the abovementioned planning control requirements, it is recommended that glazing used on the external façade of the development should have a maximum normal specular reflectance of visible light of 20%.

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With the incorporation of these recommendations, the results of this study indicate that the subject development will not cause adverse solar glare to pedestrians and motorists in the surrounding area, or to occupants of neighbouring buildings, and will comply with the planning controls regarding reflectivity for the City of Sydney Development Control Plan (2012).

4. References

City of Sydney Council, 2012, “City of Sydney Development Control Plan 2012”

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.

Appendix 1
Glare Overlays for the Critical Sight-Lines

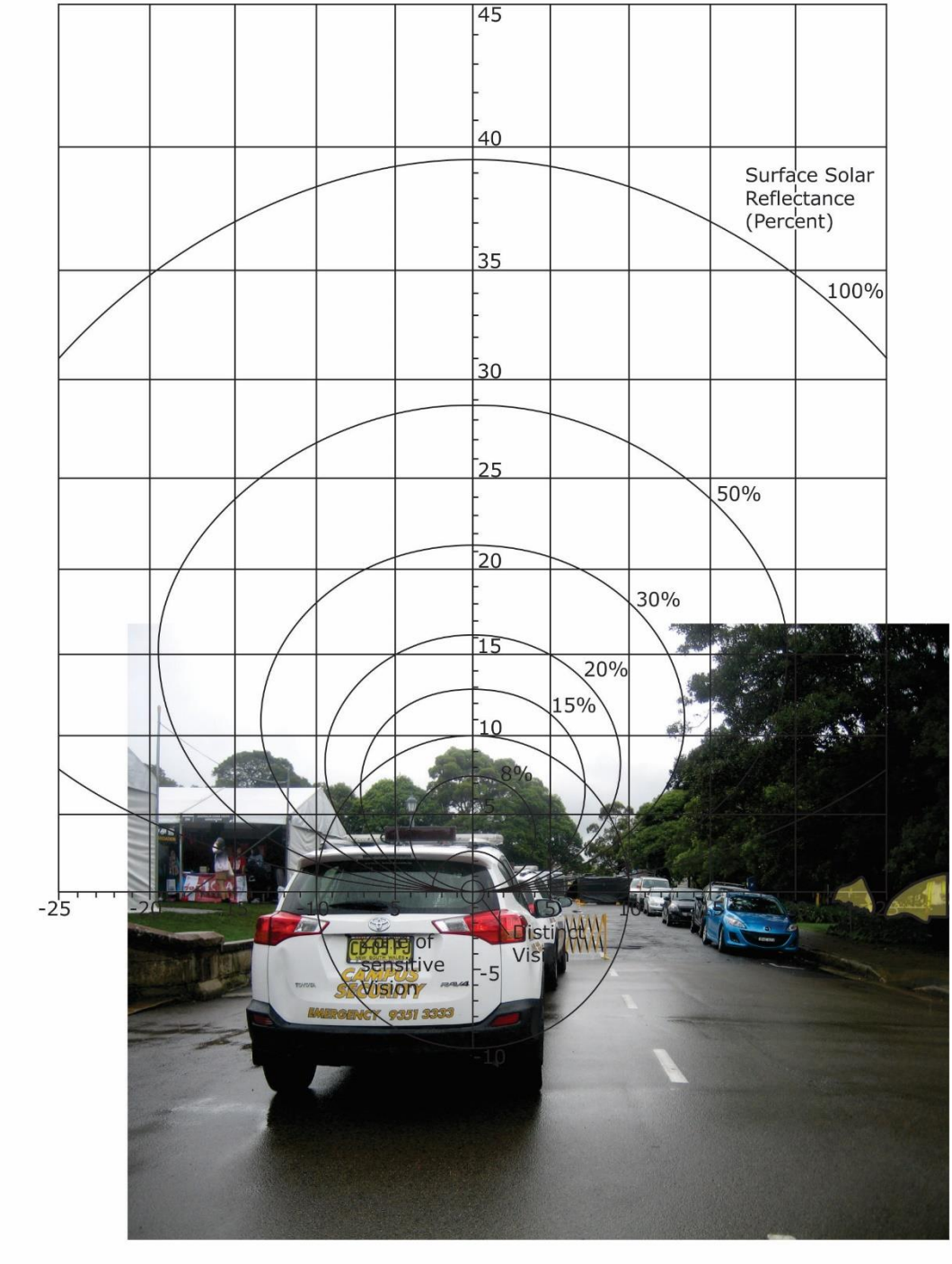

Figure A1-1: Glare Overlay for Point 1

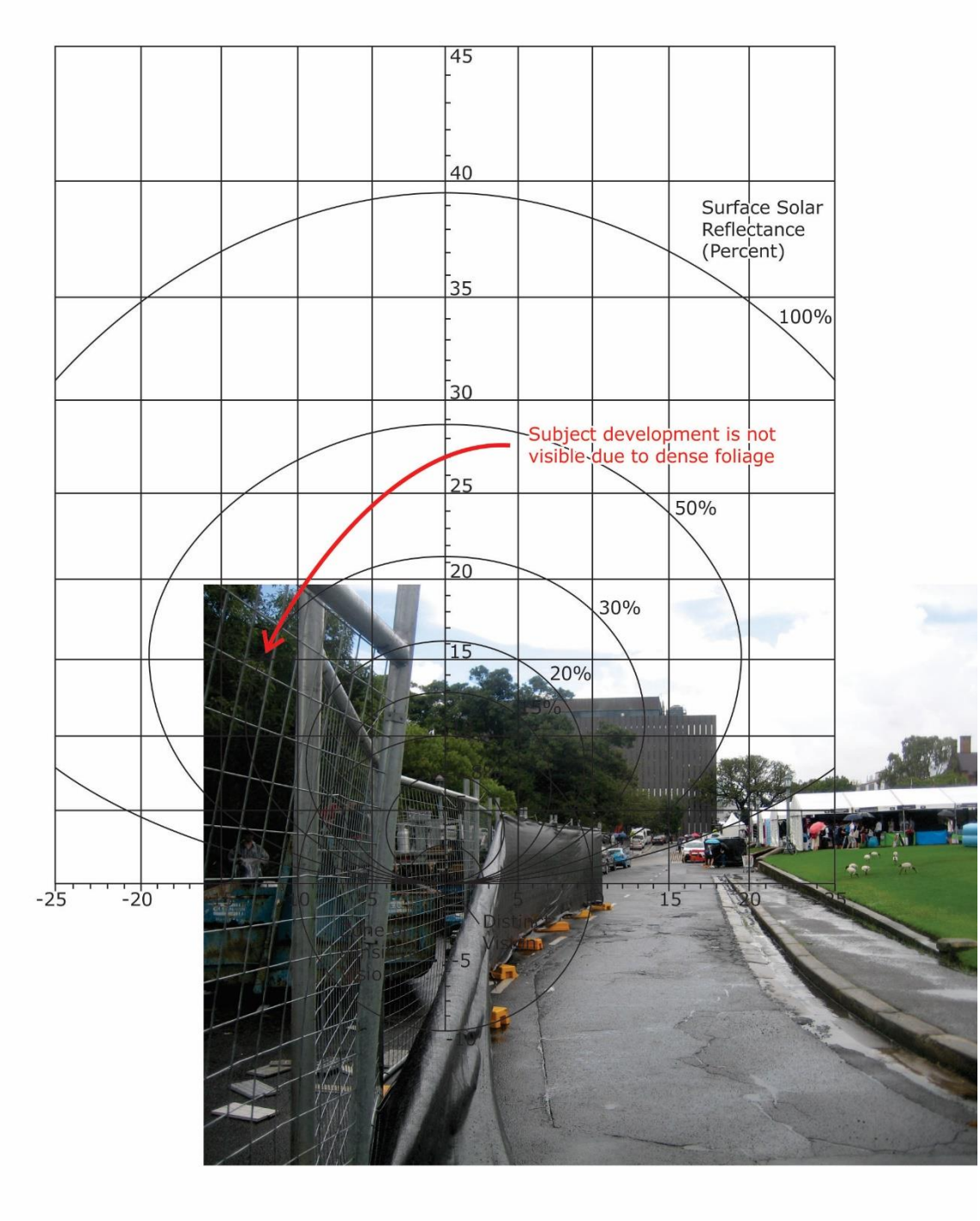

Figure A1-2: Glare Overlay for Point 2

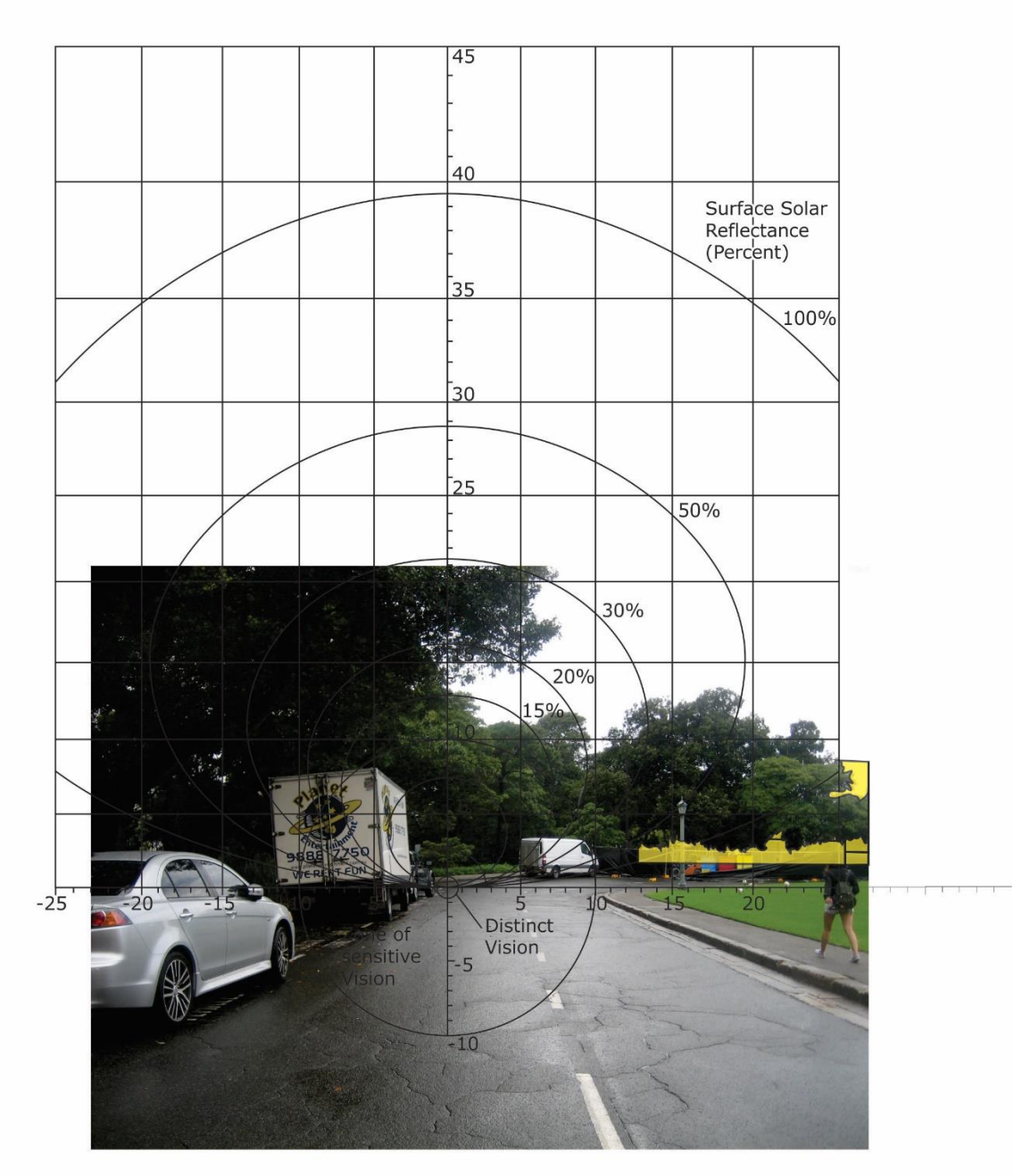

Figure A1-3: Glare Overlay for Point 3

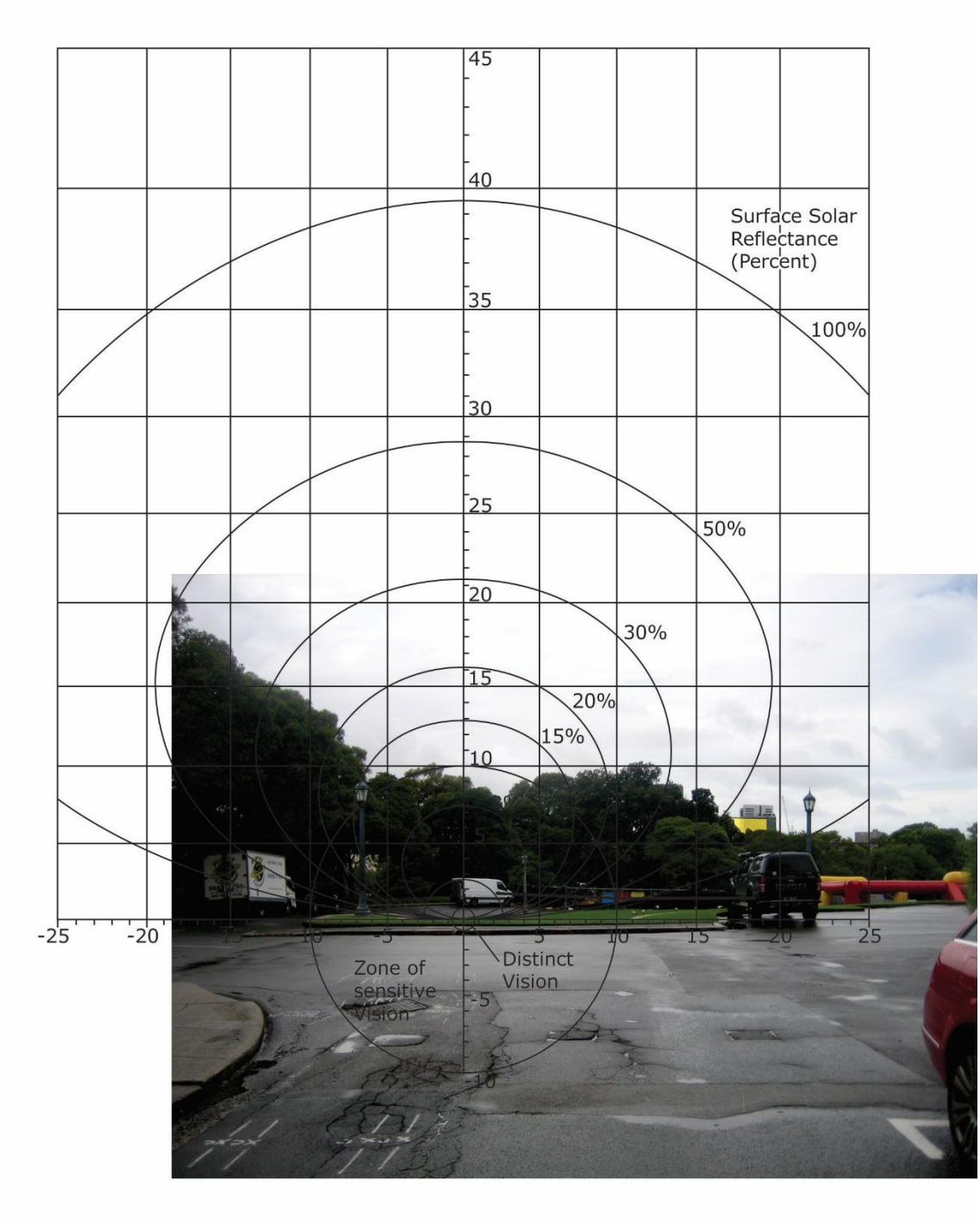

Figure A1-4: Glare Overlay for Point 4

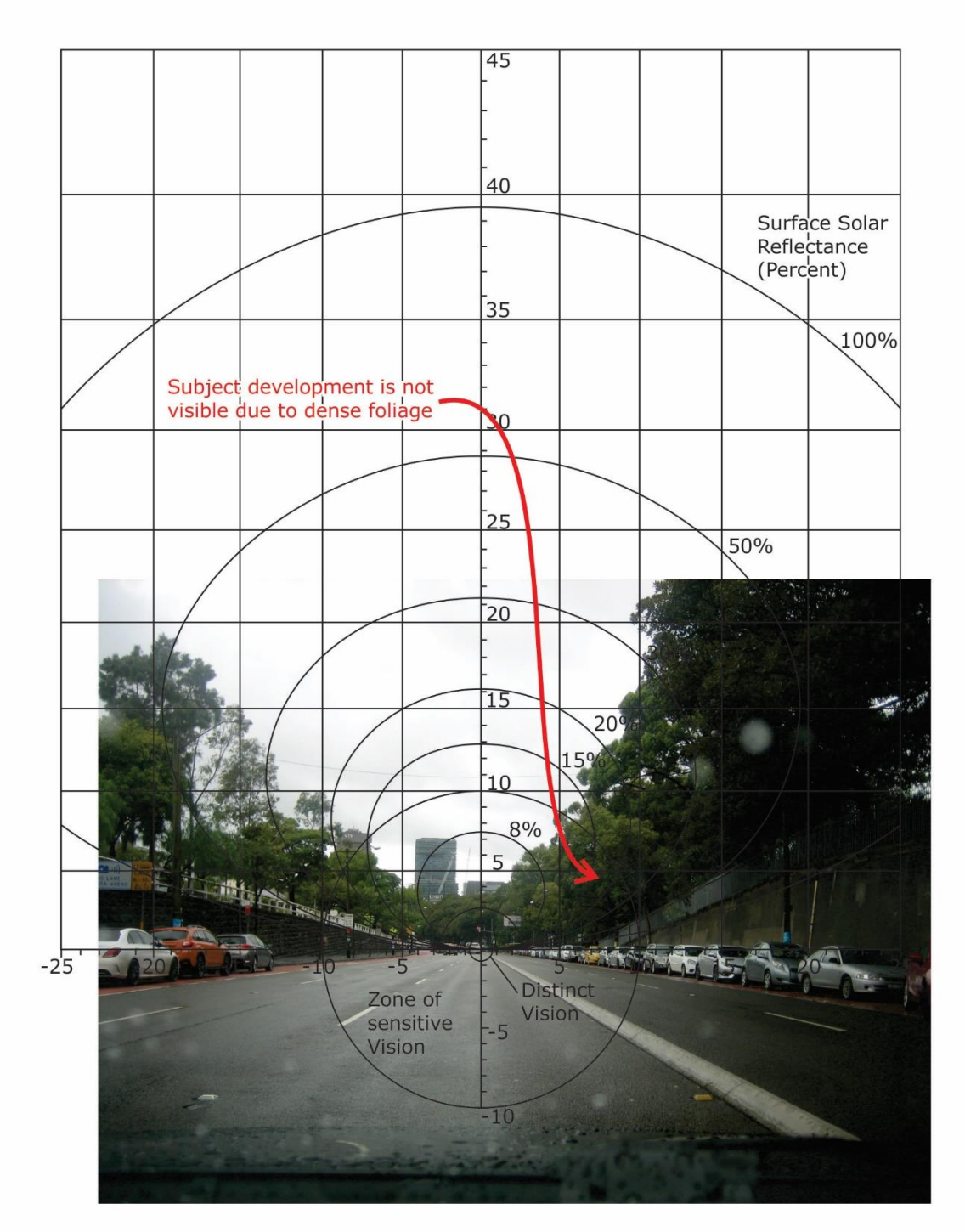

Figure A1-5: Glare Overlay for Point 5

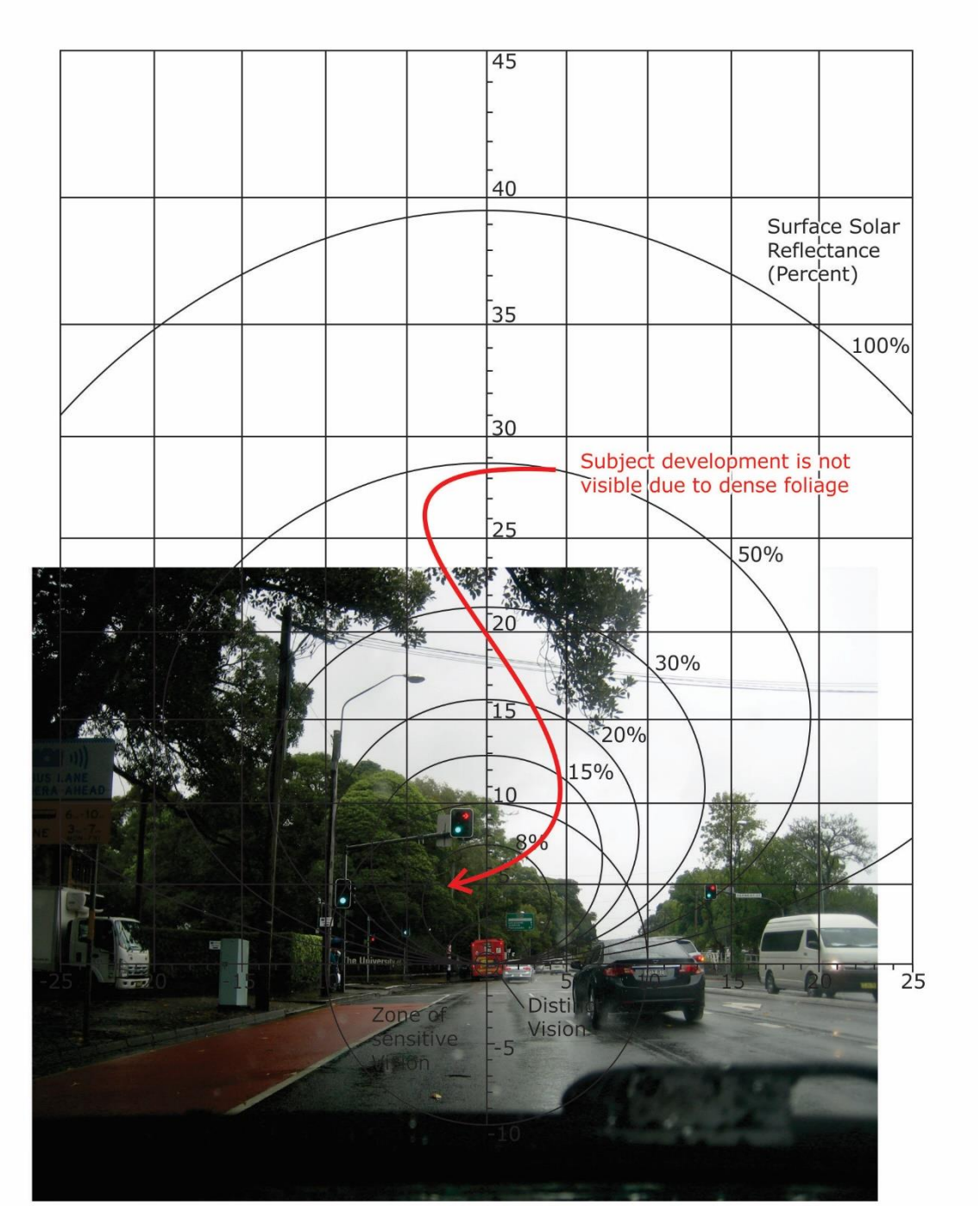

Figure A1-6: Glare Overlay for Point 6

Appendix 2
Solar Charts for the Various Critical Aspects

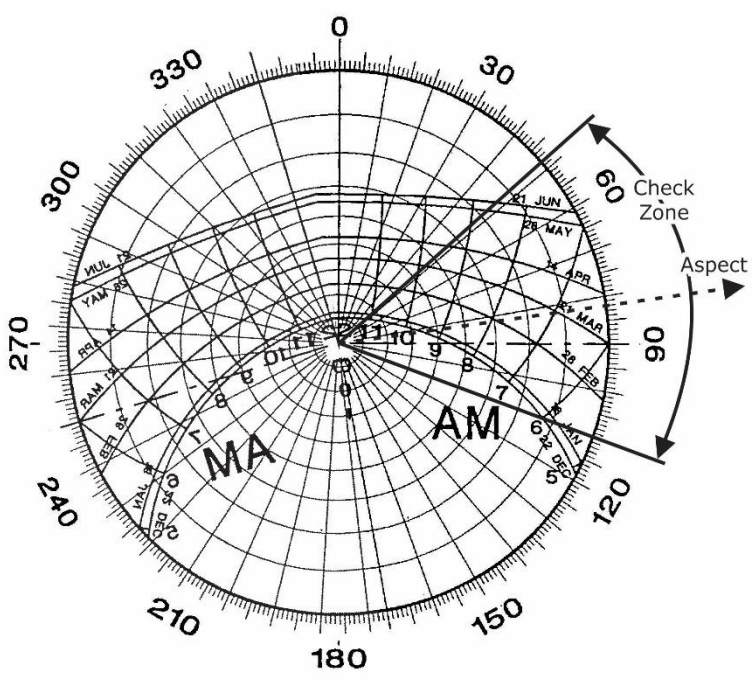

Figure A2-1: Sun Chart for Aspect 082^{O}

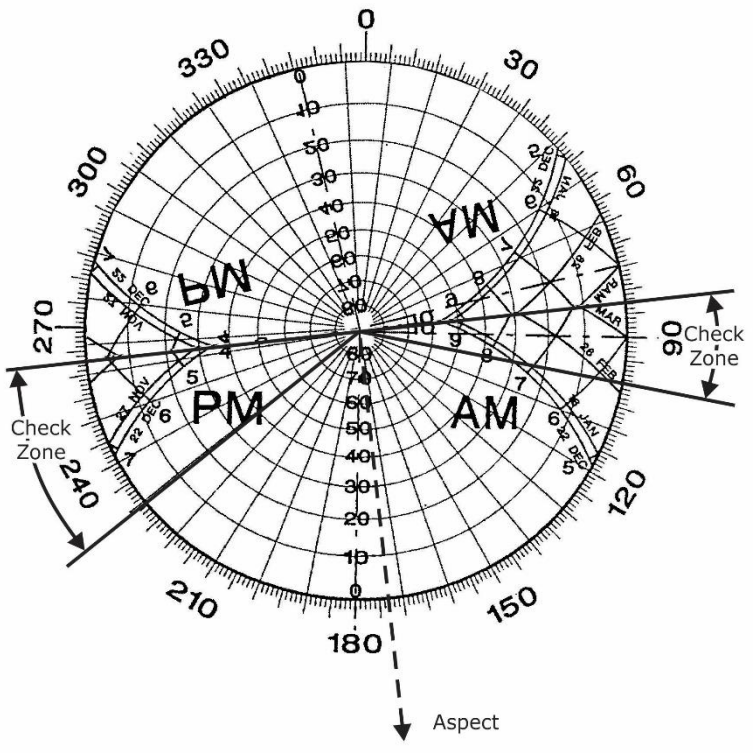

Figure A2-2: Sun Chart for Aspect 173^{O}

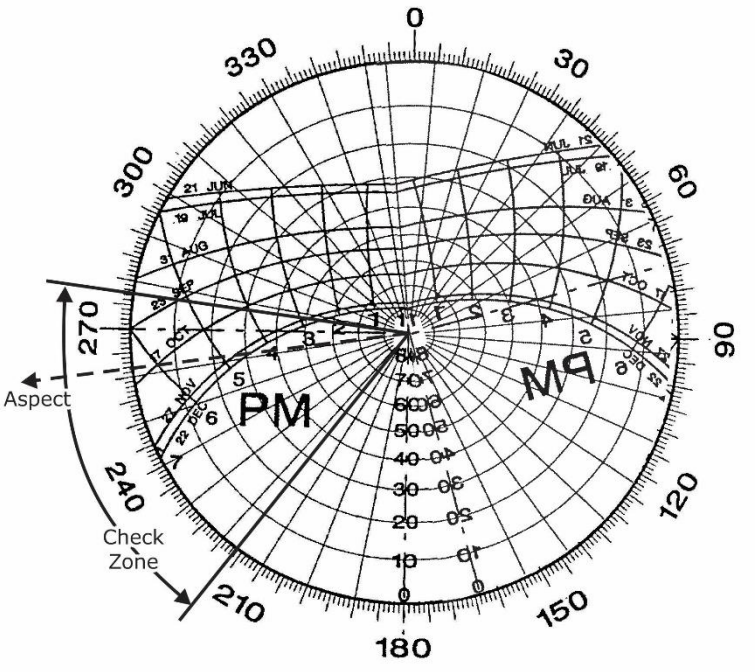

Figure A2-3: Sun Chart for Aspect 262^{O}

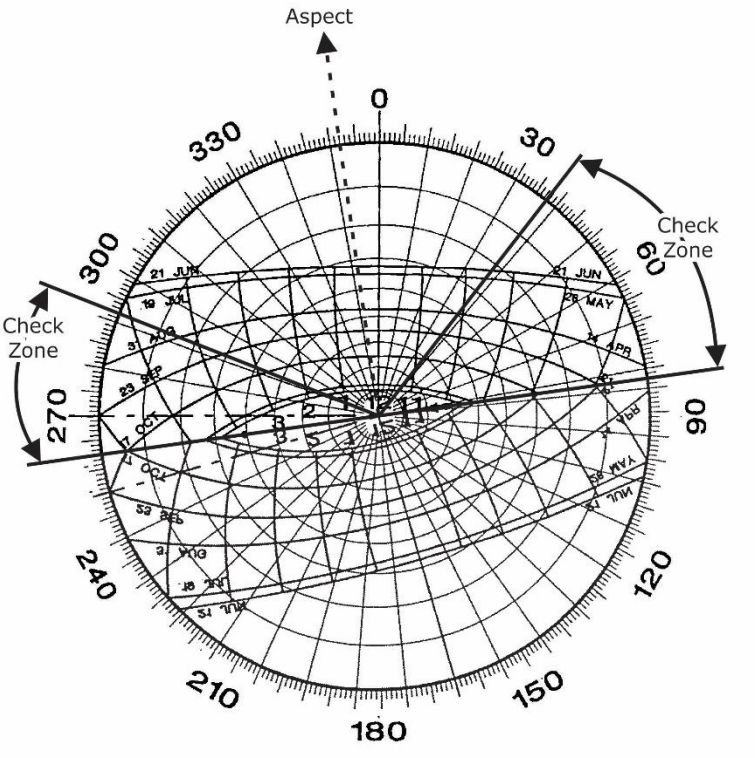

Figure A2-4: Sun Chart for Aspect 352^{O}

Appendix 3
Standard Sun Chart for the Sydney Region

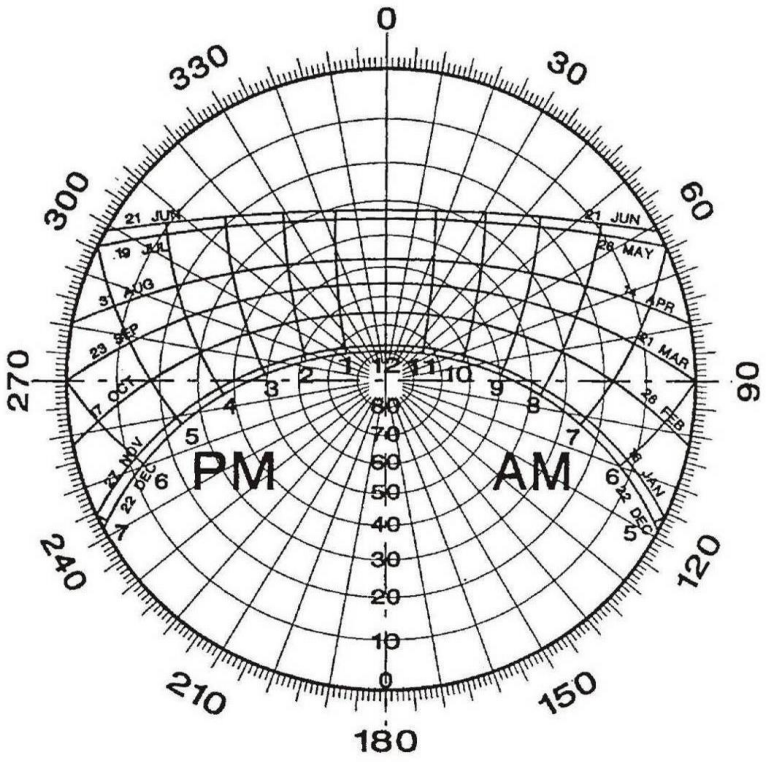

Figure A3-1: Standard Sun Chart for the Sydney Region