# SOLAR LIGHT REFLECTIVITY STUDY

# PARRAMATTA LEAGUES CLUB HOTEL

WE491-01F03(REV1)- SR REPORT

NOVEMBER 14, 2018

Prepared for:

Parramatta Leagues Club

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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 Parramatta Leagues Club Hotel development, located at Parramatta. This development involves a new 16 storey hotel and ancillary uses, with associated access and public domain works. The proposed development is depicted within the conceptual plans by Hassell, received October, 2018. This study identifies any possible adverse reflected solar glare conditions affecting motorists, pedestrians, and to occupants of neighbouring buildings. Recommendations are made to mitigate any potentially adverse effects. This study assesses compliance with the controls for solar glare from the Parramatta Development Control Plan 2011 and Part 4 of the Secretary's Environmental Assessment Requirements (SEAR) issued by the NSW Department of Planning and Environment (DPE) for the State Significant Development (SSD).

A site survey has been undertaken to obtain photographs of the critical sightlines of motorists on the surrounding streets. These photographs are calibrated and are able to be overlaid with a glare meter, which allows the extent, if any, of potential solar glare reflections from the subject development to be determined.

The results of the study indicate that, to avoid any adverse glare to motorists and pedestrians on the surrounding streets, occupants of neighbouring buildings, and to comply with the abovementioned planning control requirements, the following is recommended:

- The maximum normal specular reflectance of visible light for any glazing used on the $105^{O}$ aspect on Levels 6 and above should be 11%.
- The maximum normal specular reflectance of visible light for any glazing used on the $285^{O}$ aspect on Levels 11 and above should be 15%.
- All other glazing should have a maximum normal specular reflectance of visible light of 20%.

It should be noted that the most reflective surface on the façade of a building is the glazing. Reflected solar glare from concrete, brickwork, timber, etc. is negligible (i.e. less than 1% normal specular reflectance) and hence will not cause any adverse solar glare effects. Note also that, for any painted or powder-coated metallic surfaces on the exterior façade of the development, the maximum normal specular reflectance of visible light for those types of surfaces is in the range of 1% to 5%, which is well within the abovementioned limit.

With the incorporation of these recommendations, the results of this study indicate that the subject development will not cause adverse solar glare to motorists, or pedestrians in the surrounding area, or to occupants of neighbouring buildings, and will comply with the planning controls regarding reflectivity from the Parramatta Development Control Plan 2011 and Part 4 of the SEARs issued by the NSW DPE for the SSD.

## CONTENTS

# 1 GLARE OBSERVED BY MOTORISTS

## 1.1 Methodology

This study assesses compliance with the controls for solar glare from the Parramatta Development Control Plan 2011 and Part 4 of the Secretary's Environmental Assessment Requirements (SEAR) issued by the NSW Department of Planning and Environment (DPE) for the State Significant Development (SSD). Item P.8 of Section 3.2.2 of the Parramatta Development Control Plan 2011 states:

> *New buildings and facades should not result in glare that causes discomfort or threatens safety of pedestrians or motorists. A Reflectivity report that analyses the effects of potential glare from the proposed new development on pedestrian and motorists may be required.*

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 of the development were determined and are shown in Figure 1, based on the drawings received in October,2018. 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 solar chart of each critical aspect is determined from the standard sun chart of the region, provided in Appendix C (Phillips, 1992), using the method detailed in Hassall (1991). 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 1.2 of this report.

Study point locations are selected within the check zone areas where motorists are facing the general direction of the subject development (within ±10° of the direct sight-line). These are shown in Figure 2, and summarised in Table 1. Photographs have been taken from the viewpoint of motorists at each study point location using a calibrated camera. A scaled glare protractor has been superimposed over each viewpoint image.

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$^2$, to ensure that solar glare will not cause discomfort or threaten the safety of motorists and hence to enable the subject

development to comply with the relevant planning control requirements regarding solar light reflectivity.

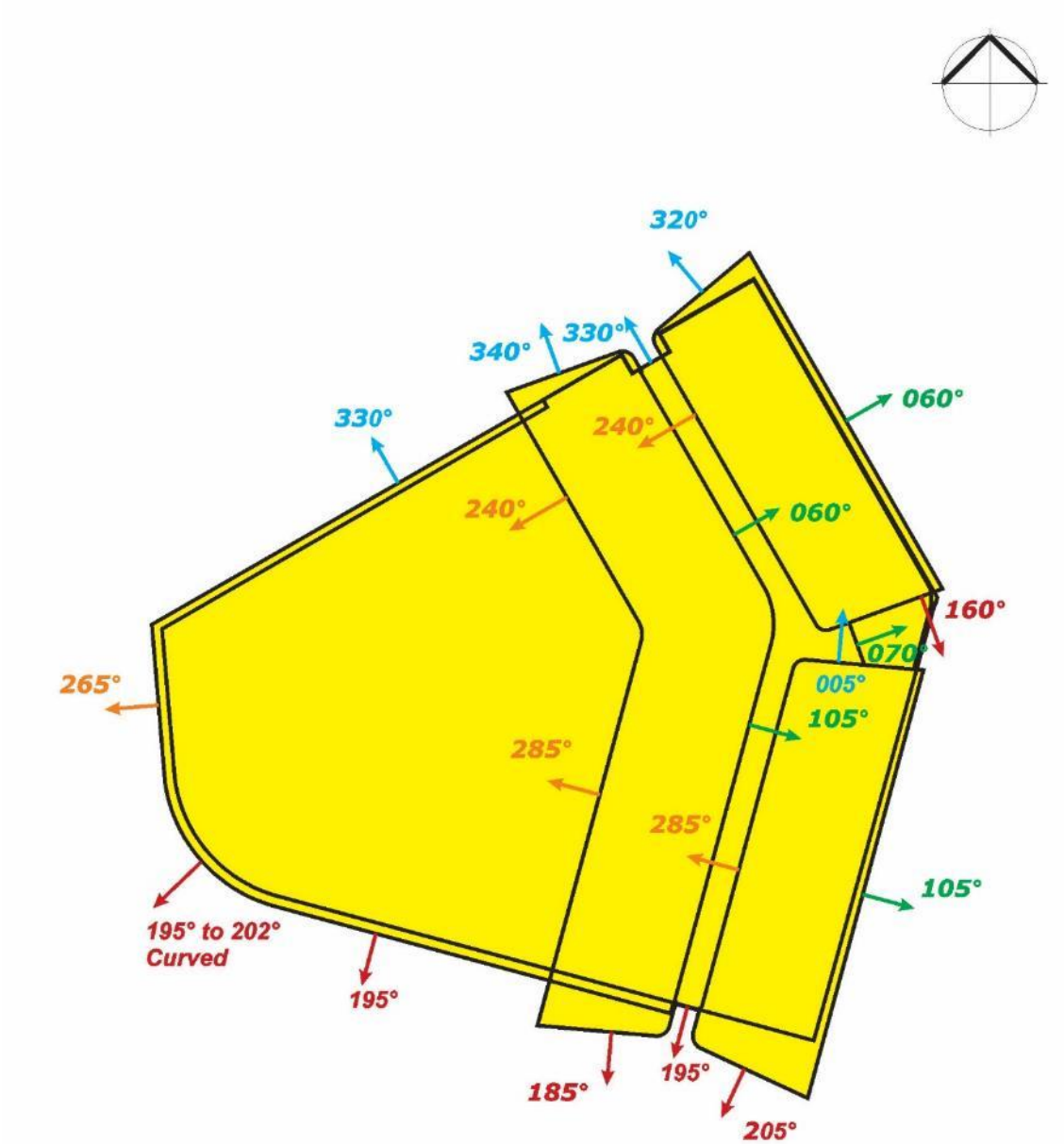


**Figure 1: Critical Glazed Aspects of the Development (plan view)**

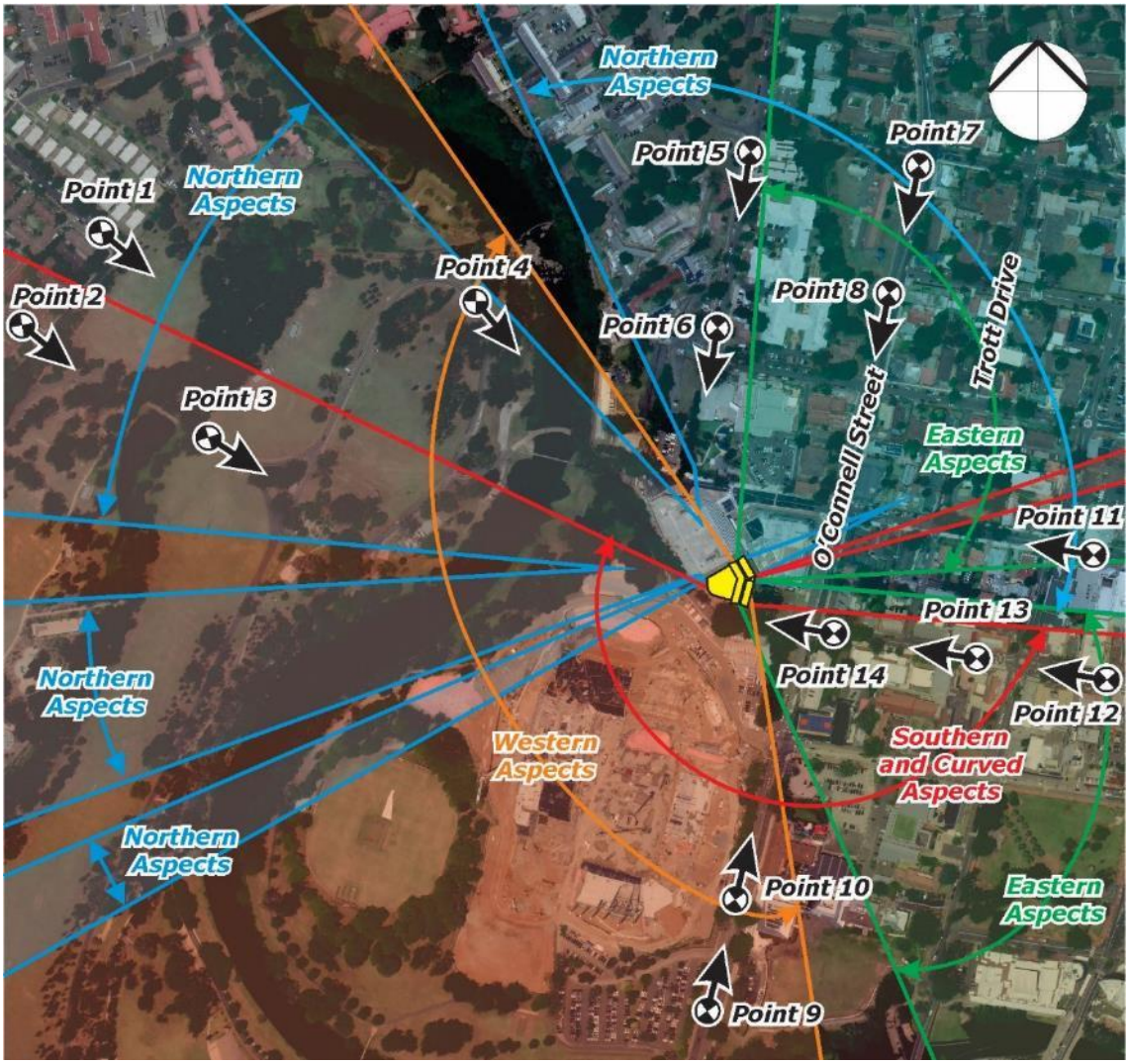


**Figure 2: Check Zones and Study Point Locations**
**(the check zones are the areas where glare could potentially be observed)**

**Table 1: Aspects of the Development that could reflect Solar Glare to Each Study Point for Motorists**

| Study Point | Location and Viewpoint | Aspect(s) of the Development |
|---|---|---|
| 01 | Hainsworth Street – Heading south-east | Northern and western aspects |
| 02 | Jessie Street – Heading south-east | Northern and western aspects |
| 03 | Railway Parade – Heading south-east | Northern, western and southern aspects |
| 04 | Byrnes Avenue – Heading south-east | Northern and western aspects |
| 05 | Fleet Street – Heading south | Northern aspects |
| 06 | Fleet Street – Heading south | Northern aspects |
| 07 | O'Connell Street – Heading south | Northern and eastern aspects |
| 08 | O'Connell Street – Heading south | Northern and eastern aspects |
| 09 | O'Connell Street – Heading north | Eastern and southern aspects |
| 10 | O'Connell Street – Heading north | Eastern and southern aspects |
| 11 | Grose Street – Heading west | Northern and eastern aspects |
| 12 | Ross Street – Heading west | Eastern and southern aspects |
| 13 | Ross Street – Heading west | Eastern and southern aspects |
| 14 | Ross Street – Heading west | Eastern and southern aspects |

## 1.2 Analysis and Discussion

The amount of solar glare observed by motorists from the façade of the development at each study point location is presented in this section. Treatment options are provided if excessive solar glare conditions are observed.

### 1.2.1 Motorists heading south-east along Hainsworth Street

Point 01 is located along Hainsworth Street, to the north-west of the development site. This points represent the critical sightlines of motorists heading south-east along Hainsworth Street at this location. A site survey of this point has been undertaken, and a photograph showing the typical 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 this image, as shown in Appendix A.

An analysis of the viewpoint at Point 01 indicates that the subject development is not visible at this location. Therefore, no adverse solar glare will be observed by motorists heading south-east along Hainsworth Street from the façade of the proposed development.

### 1.2.2 Motorists heading south-east along Jessie Street

Point 02 is located along Jessie Street, to the north-west of the development site. This point represents the critical sightlines of motorists heading south-east along Jessie Street at this location. A site survey of this point has been undertaken, and a photograph showing the typical 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 images, as shown in Appendix A.

An analysis of the viewpoint at Point 2 indicates that the subject development is not visible at this location. Therefore, no adverse solar glare will be observed by motorists heading south-east along Jessie Street from the façade of the proposed development.

### 1.2.3 Motorists heading south-east along Railway Parade

Point 03 is located along Railway Parade, to the north-west of the development site. This point represents the critical sightlines of motorists heading south-east along Railway Parade at this location. A site survey of this point has been undertaken, and a photograph showing the typical 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 Appendix A.

An analysis of the viewpoint at Point 03 indicates that the view of the proposed development will not be visible within the zone of sensitive vision from this location. Hence there will be no adverse solar glare observed by motorists heading south-east along Railway Parade.

### 1.2.4 Motorists heading south-east along Byrnes Avenue

Point 04 is located along Byrnes Avenue, to the north-west of the development site. This point represents the critical sightlines of motorists heading south-east along Byrnes Avenue at this location. A site survey of this point has been undertaken, and a photograph showing the typical 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 Appendix A.

An analysis of the glare meter overlaid onto the viewpoint image at Point 04 indicates that the portions of the $240^{O}$ and $285^{O}$ aspects of the proposed development will be visible through the trees and within the zone of sensitive vision. However, further analysis indicates that Point 04 does not lie within the check zone for the $240^{O}$ aspect of the development and hence no solar glare will be observed from that aspect of the development at Point 04.

Point 04 falls within the check zones of the $285^{O}$ aspect of the proposed development, and hence solar glare can potentially be observed from that façade at Point 04. To ensure that adverse solar glare does not affect motorists heading west along Ross Street at Point 04 it is recommended that the maximum normal specular reflectance of visible light for any glazing used on the $285^{O}$ aspect from Level 11 and above should be 15%.

### 1.2.5 Motorists heading south along Fleet Street

Points 5 and 6 are located along Fleet Street, to the north of the development site. These points represent the critical sightlines of motorists heading south along Fleet Street at these locations. A site survey of these points has been undertaken, and photographs showing the typical viewpoint 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 Appendix A.

An analysis of the viewpoint at Point 05 indicates that the view of the proposed development will not be visible from this location due to the obstruction from the local densely foliating vegetation. Hence there will be no adverse solar glare observed by motorists heading south along Fleet Lane at this location.

An analysis of the glare meter overlaid onto the viewpoint at Point 06 indicates that the view of the proposed development will not be visible within the zone of sensitive vision from this location. Hence, there will be no adverse solar glare observed by motorists heading south along Fleet Street at this location.

### 1.2.6 Motorists heading south along O'Connell Street

Points 7 and 8 are located along O'Connell Street, to the north of the development site. These points represent the critical sightlines of motorists heading south along O'Connell Street at these locations. A site survey of these points has been undertaken, and photographs showing the typical viewpoint 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 Appendix A.

An analysis of the glare meter overlaid onto the viewpoints at Points 07 and 08 indicates that the view of the proposed development will not be visible within the zone of sensitive vision from these locations. Hence, there will be no adverse solar glare observed by motorists heading south along O'Connell Street at these locations.

### 1.2.7 Motorists heading north along O'Connell Street

Points 9 and 10 are located along O'Connell Street, to the south of the development site. These points represent the critical sightlines of motorists heading north along O'Connell Street at these locations. A site survey of these points has been undertaken, and photographs showing the typical viewpoint 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 Appendix A.

An analysis of the glare meter overlaid onto the viewpoint image at Point 09 indicates that small portions of the $105^{O}$, $160^{O}$ and $205^{O}$ aspects are visible and within the zone of sensitive vision. However, further analysis indicates that Point 09 does not lie within the check zone for these aspects of the development. Hence there will be no adverse solar glare observed by motorists heading north along O'Connell Street at this location.

An analysis of the glare meter overlaid onto the viewpoint at Point 10 indicates that the view of the proposed development will not be visible within the zone of sensitive vision from this location. Hence, there will be no adverse solar glare observed by motorists heading north along O'Connell Street at this location.

### 1.2.8 Motorists heading west along Grose Street

Point 11 is located along Grose Street, to the east of the development site. This point represents the critical sightlines of motorists heading west along Grose Street at this location. A site survey of this point has been undertaken, and a photograph showing the typical 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 Appendix A.

An analysis of the viewpoint at Point 11 indicates that the view of the proposed development is not visible within the zone of sensitive vision from this location. Therefore, no adverse solar glare will be observed by motorists heading west along Grose Street from the façade of the proposed development.

### 1.2.9 Motorists heading west along Ross Street

Points 12, 13 and 14 are located along Ross Street, to the east of the development site. These points represent the critical sightlines of motorists heading west along Ross Street at these locations. A site survey of these points has been undertaken, and photographs showing the typical viewpoint 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 Appendix A.

An analysis of the glare meter overlaid onto the viewpoint images at Points 12 and 13 indicates that the $60^{O}$, $70^{O}$, $105^{O}$ and/or $160^{O}$ aspects are visible and within the zone of sensitive vision. However, further analysis indicates that Points 12 and 13 do not lie within the check zone for the $60^{O}$, $70^{O}$ and $160^{O}$ aspects of the development. Points 12 and 13 do fall within the check zone of the $105^{O}$ aspect of the proposed development, and hence solar glare from that aspect can potentially be observed from Points 12 and 13. To ensure that adverse solar glare does not affect motorists heading west along Ross Street, it is recommended that the maximum normal specular reflectance of visible light for any glazing used on the $105^{O}$ aspect on Levels 6 and above should be 11%.

An analysis of the glare meter overlaid onto the viewpoint at Point 14 indicates that the view of the proposed development will not be within the zone of sensitive vision due to the obstruction from the local densely foliating vegetation. Hence there will be no adverse solar glare observed by motorists heading west along Ross Street at this location.

# 2 GLARE OBSERVED BY PEDESTRIANS AND 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 pedestrians and 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 pedestrians and occupants of neighbouring buildings.

# 3 TYPICAL NORMAL SPECULAR REFLECTANCE OF 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.

## 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%

## 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.

# 4 CONCLUSION

A detailed study for the effect of potential solar glare from the proposed Parramatta Leagues Club Hotel development, located at Parramatta. This development involves a new 16 storey hotel and ancillary uses, with associated access and public domain works. The proposed development is depicted within the conceptual plans by Hassell, received October, 2018. This study identifies any possible adverse reflected solar glare conditions affecting motorists, pedestrians, and to occupants of neighbouring buildings. Recommendations are made to mitigate any potentially adverse effects. This study assesses compliance with the controls for solar glare from the Parramatta Development Control Plan 2011 and Part 4 of the Secretary's Environmental Assessment Requirements (SEAR) issued by the NSW Department of Planning and Environment (DPE) for the State Significant Development (SSD).

A site survey has been undertaken to obtain photographs of the critical sightlines of motorists on the surrounding streets. These photographs are calibrated and are able to be overlaid with a glare meter, which allows the extent, if any, of potential solar glare reflections from the subject development to be determined.

The results of the study indicate that, to avoid any adverse glare to motorists and pedestrians on the surrounding streets, occupants of neighbouring buildings, and to comply with the abovementioned planning control requirements, the following is recommended:

- The maximum normal specular reflectance of visible light for any glazing used on the $105^{O}$ aspect on Levels 6 and above should be 11%.
- The maximum normal specular reflectance of visible light for any glazing used on the $285^{O}$ aspect on Levels 11 and above should be 15%.
- All other glazing should have a maximum normal specular reflectance of visible light of 20%.

It should be noted that the most reflective surface on the façade of a building is the glazing. Reflected solar glare from concrete, brickwork, timber, etc. is negligible (i.e. less than 1% normal specular reflectance) and hence will not cause any adverse solar glare effects. Note also that, for any painted or powder-coated metallic surfaces on the exterior façade of the development, the maximum normal specular reflectance of visible light for those types of surfaces is in the range of 1% to 5%, which is well within the abovementioned limit.

With the incorporation of these recommendations, the results of this study indicate that the subject development will not cause adverse solar glare to motorists, or pedestrians in the surrounding area, or to occupants of neighbouring buildings, and will comply with the planning controls regarding reflectivity from the Parramatta Development Control Plan 2011 and Part 4 of the SEARs issued by the NSW DPE for the SSD.

# 5 REFERENCES

City of Parramatta, 2011 "Parramatta Development Control Plan 2011".

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 A GLARE OVERLAYS FOR THE CRITICAL SIGHT-LINES

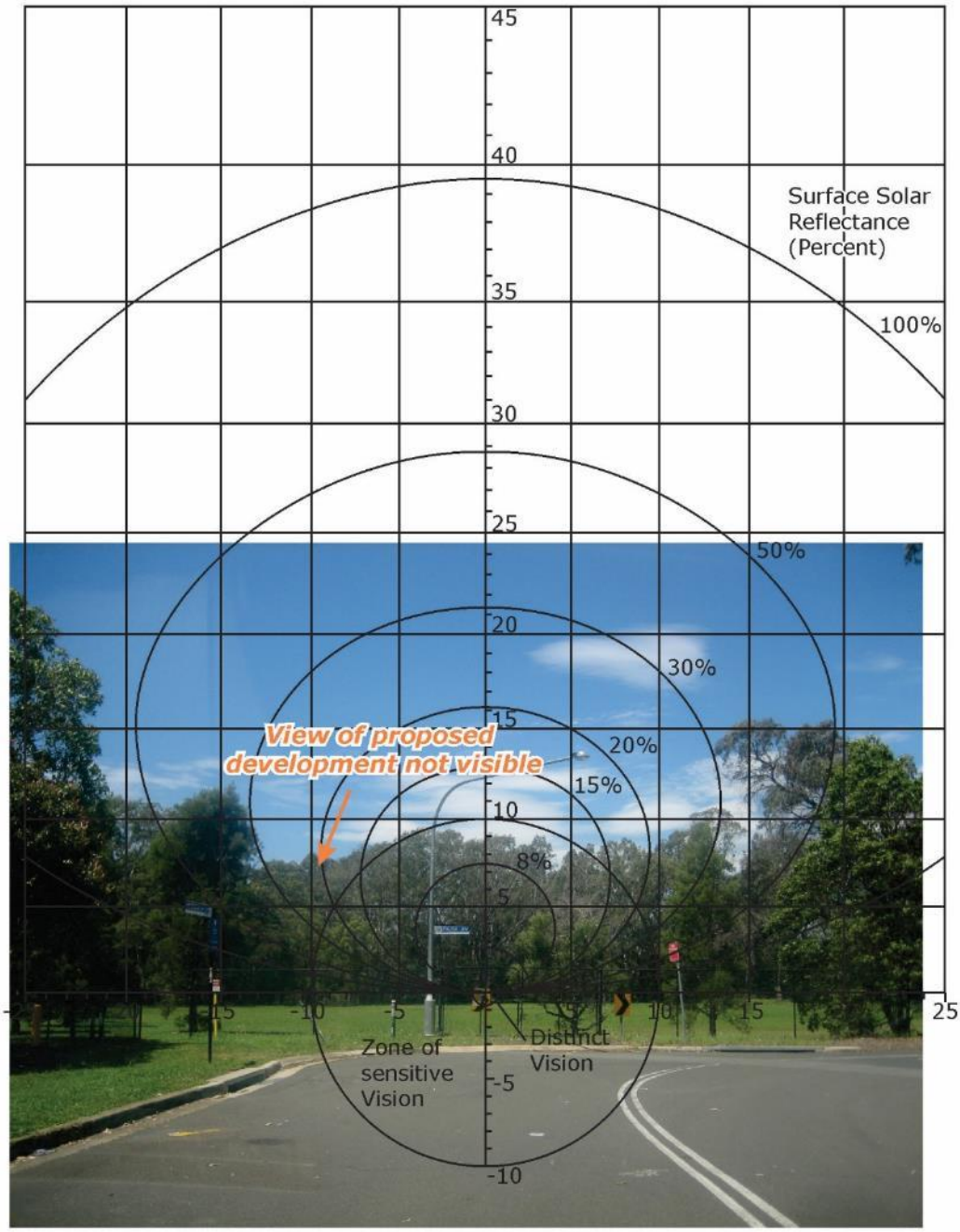


**Figure A.1: Glare Overlay of the Viewpoint at Point 01**

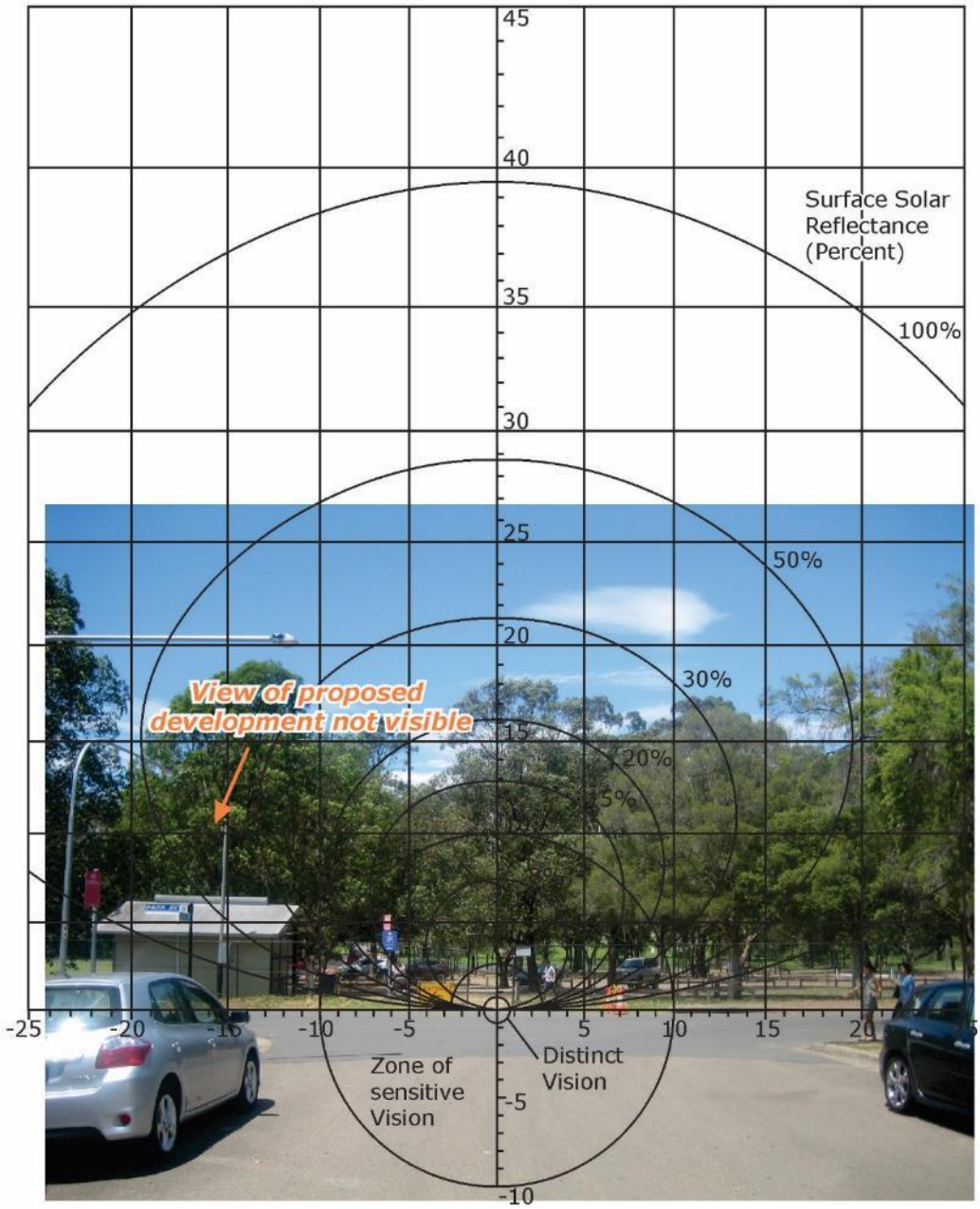


**Figure A.2: Glare Overlay of the Viewpoint at Point 02**

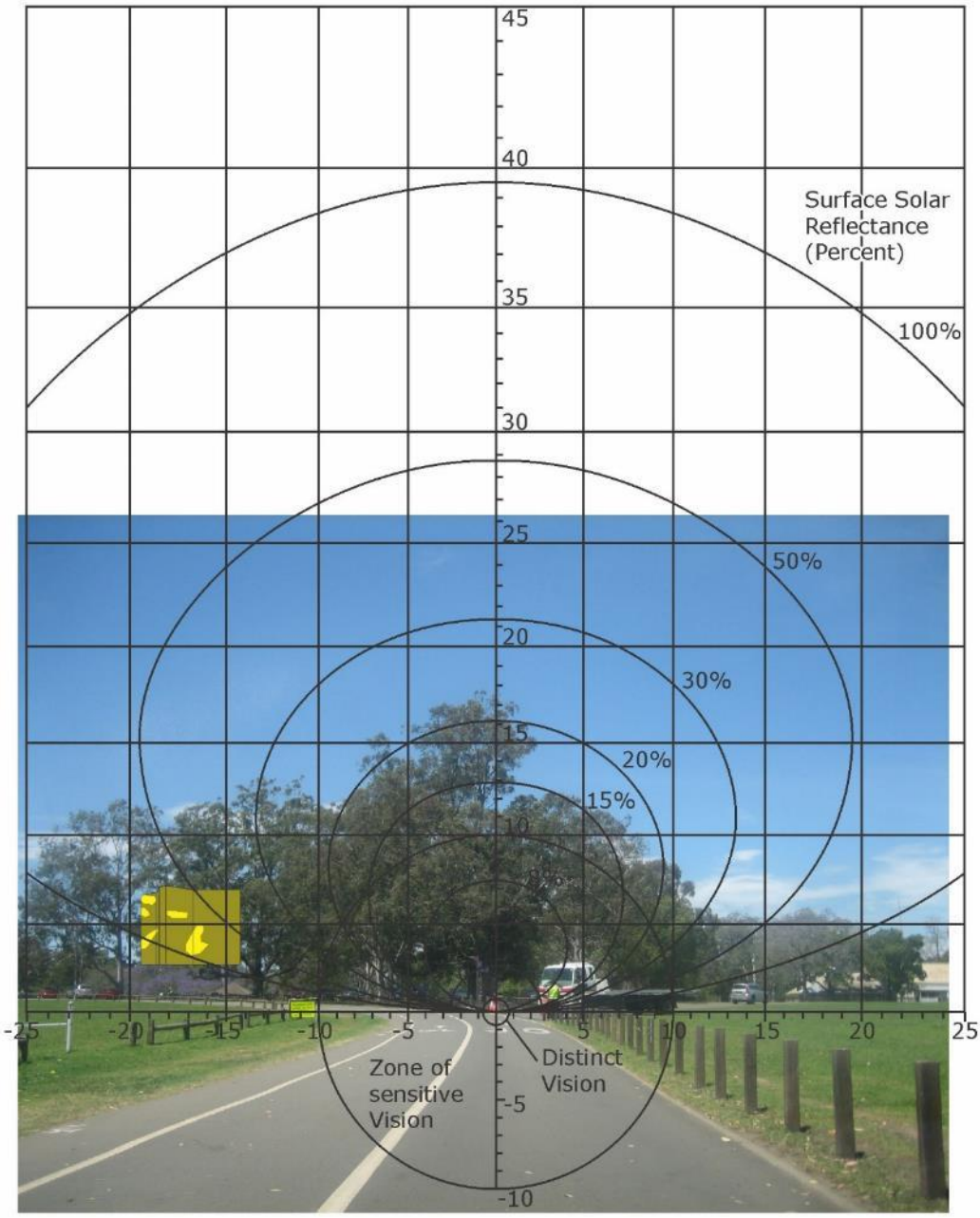


**Figure A.3: Glare Overlay of the Viewpoint at Point 03**

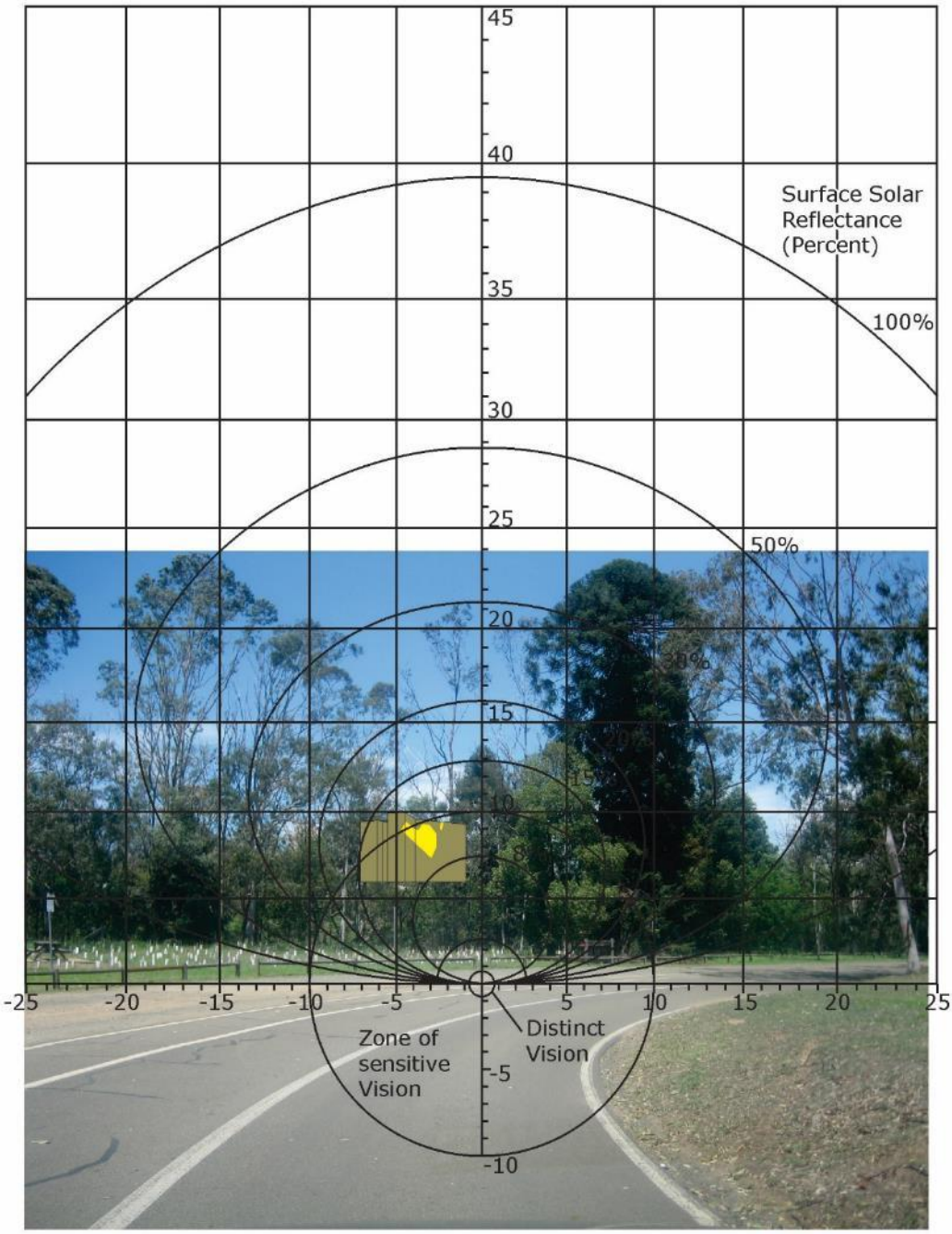


**Figure A.4: Glare Overlay of the Viewpoint at Point 04**

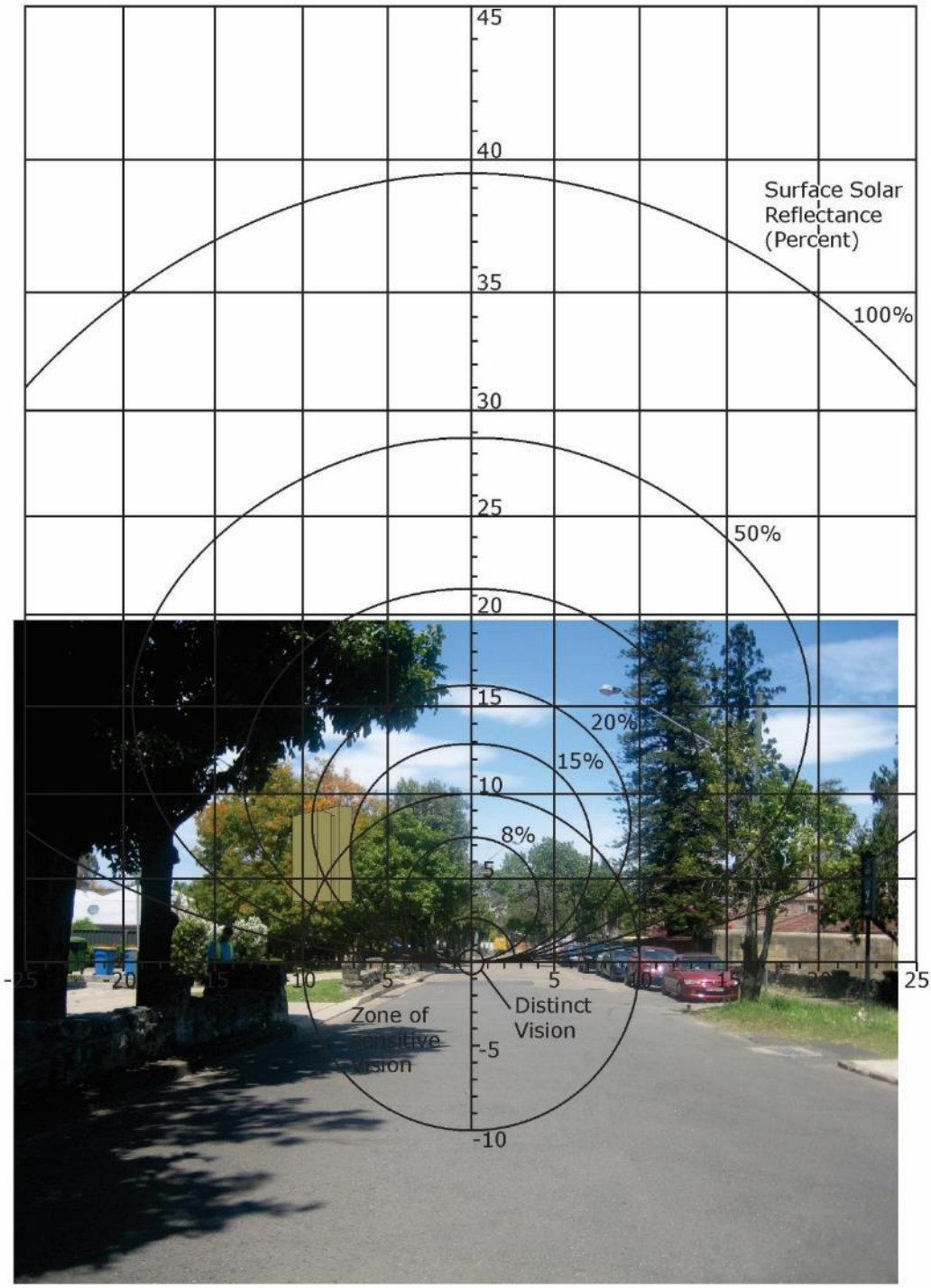


**Figure A.5: Glare Overlay of the Viewpoint at Point 05**

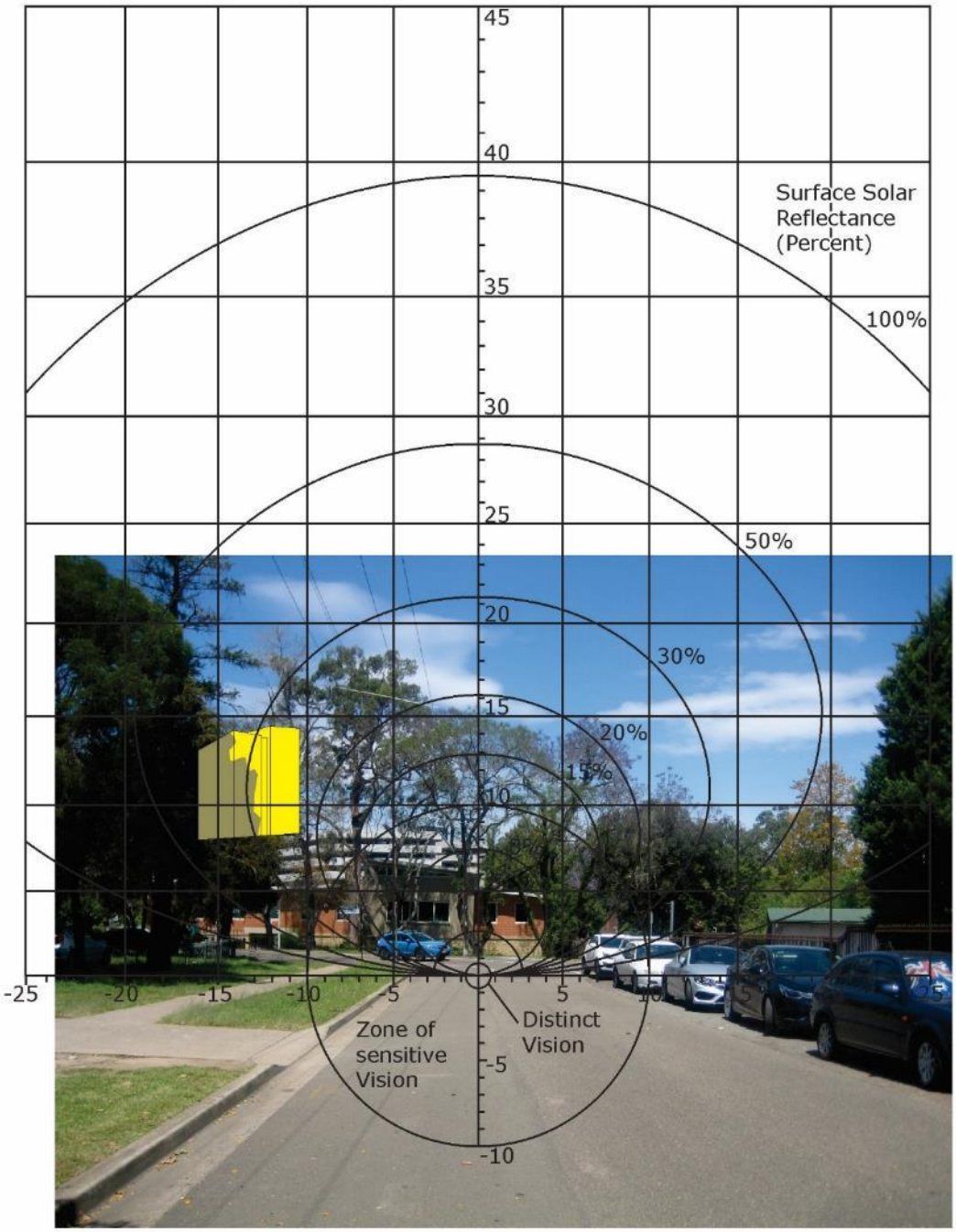


**Figure A.6: Glare Overlay of the Viewpoint at Point 06**

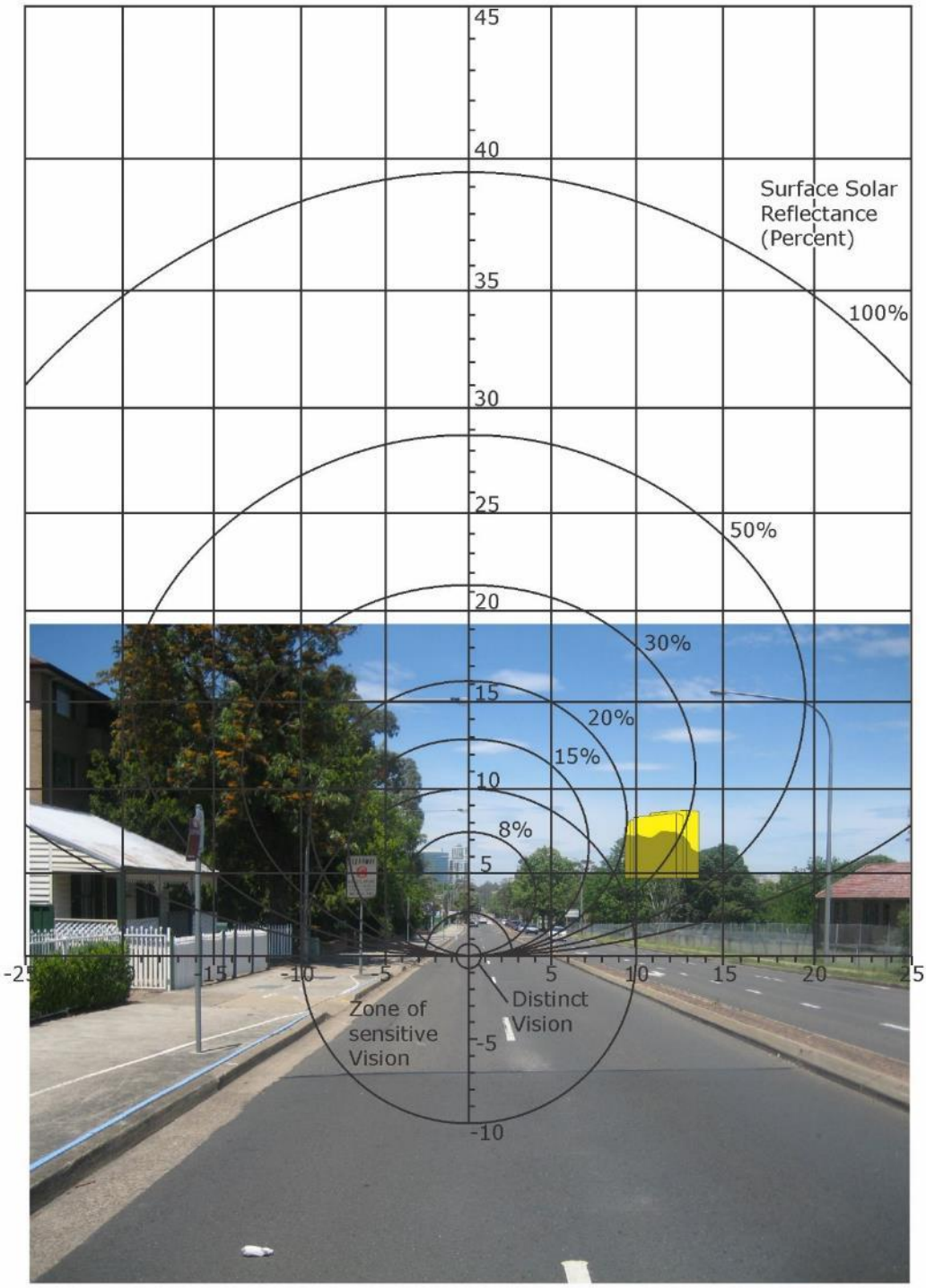


**Figure A.7: Glare Overlay of the Viewpoint at Point 07**

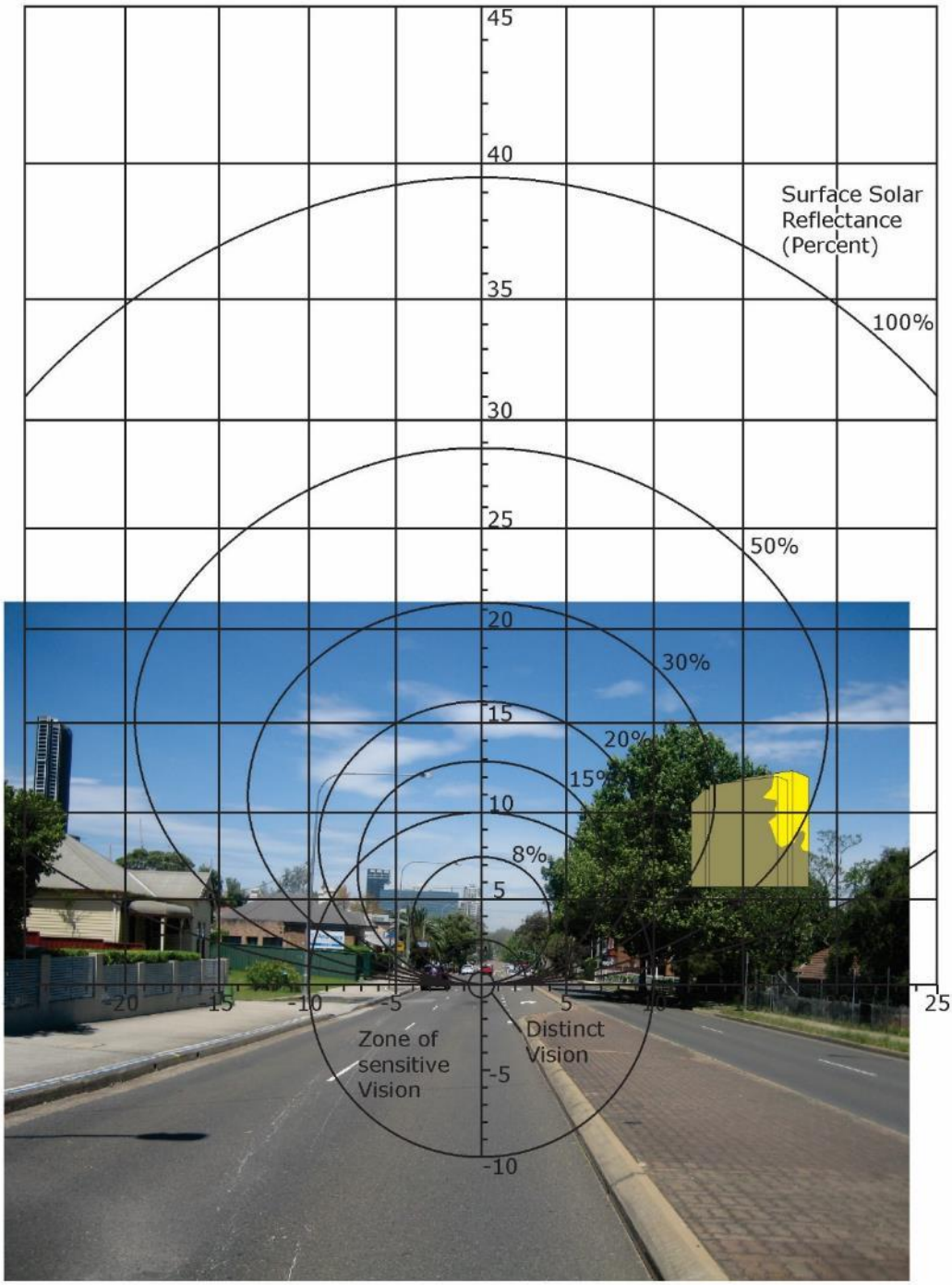


**Figure A.8: Glare Overlay of the Viewpoint at Point 08**

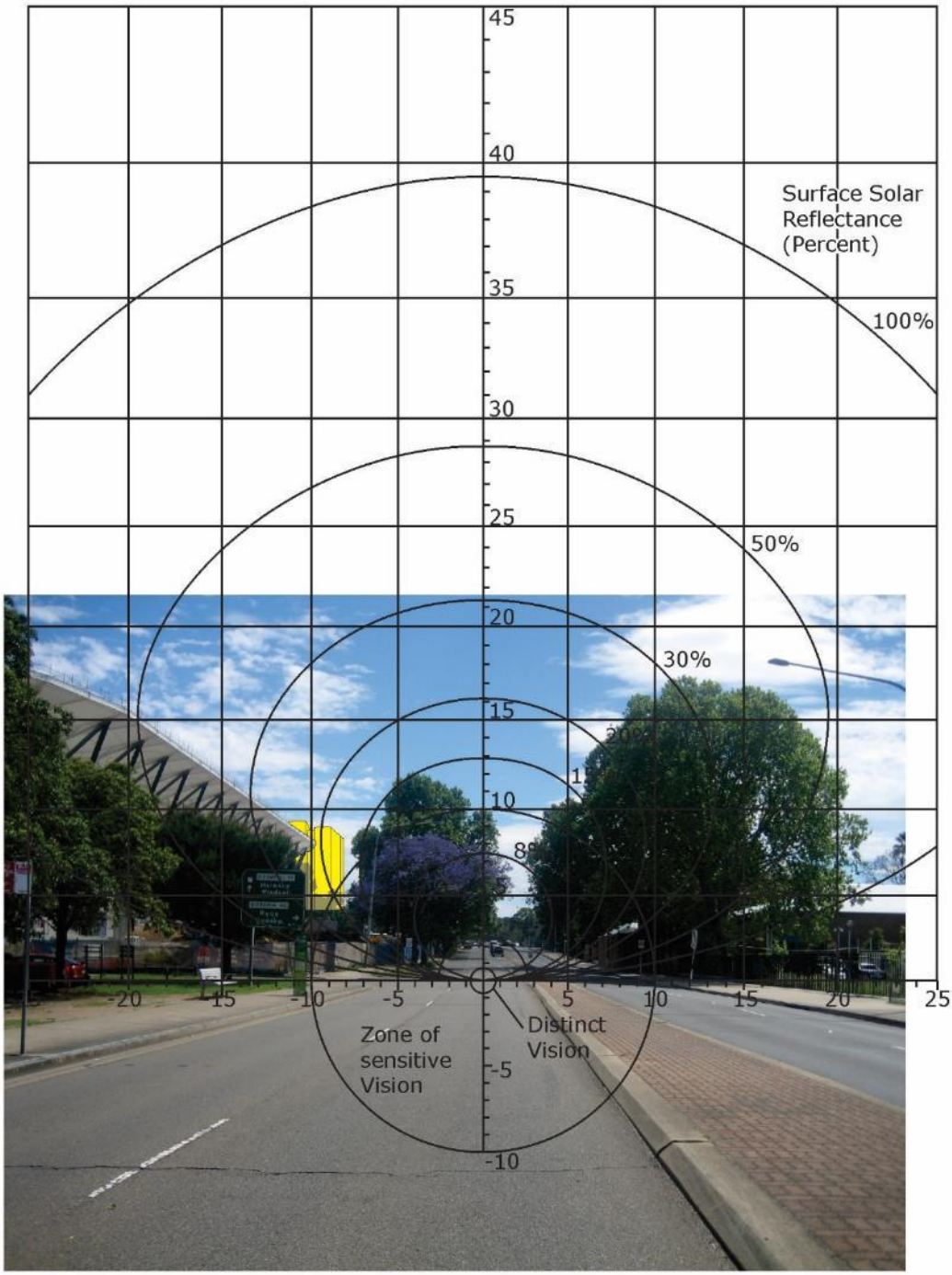


**Figure A.9: Glare Overlay of the Viewpoint at Point 09**

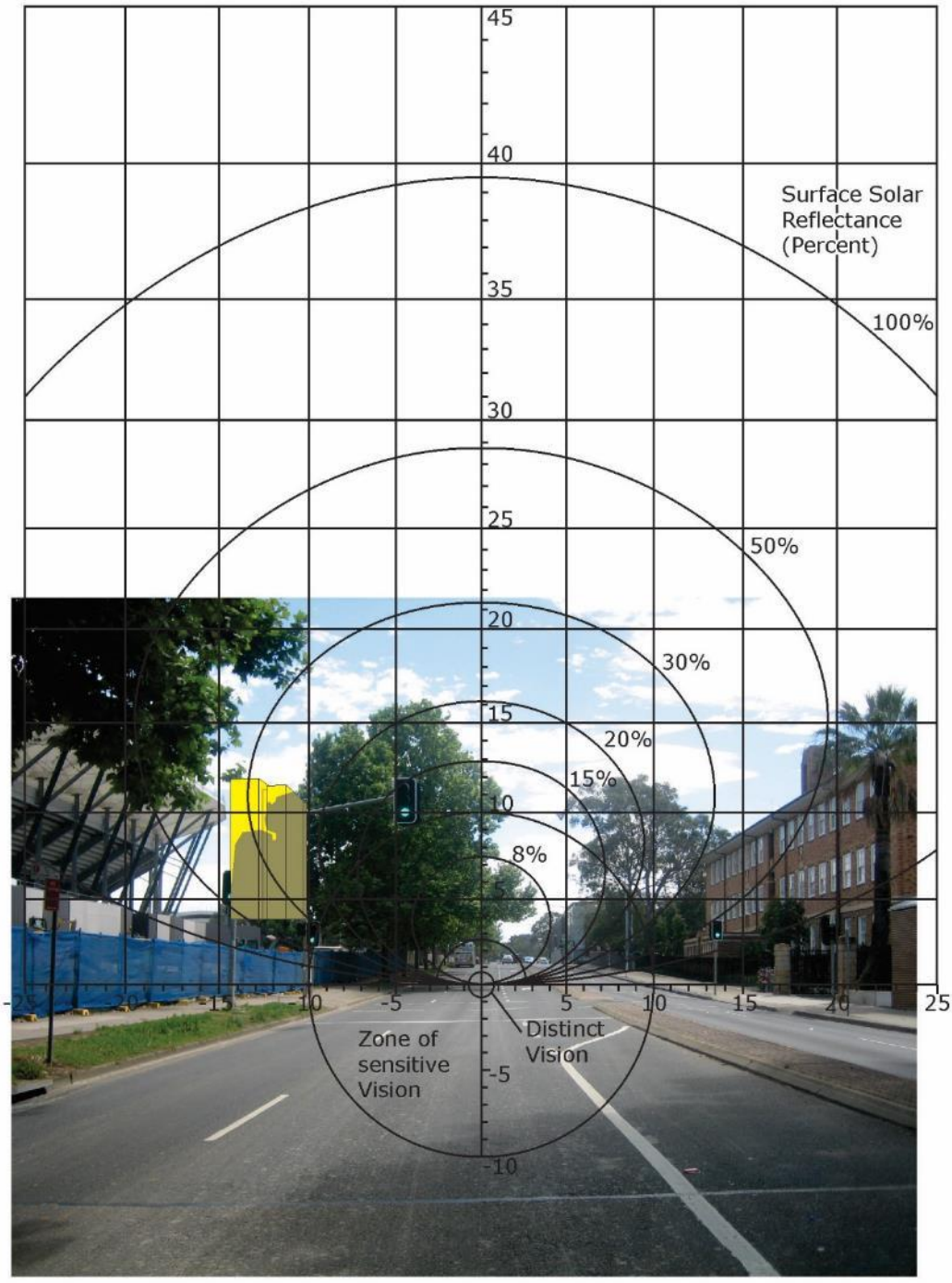


**Figure A.10: Glare Overlay of the Viewpoint at Point 10**

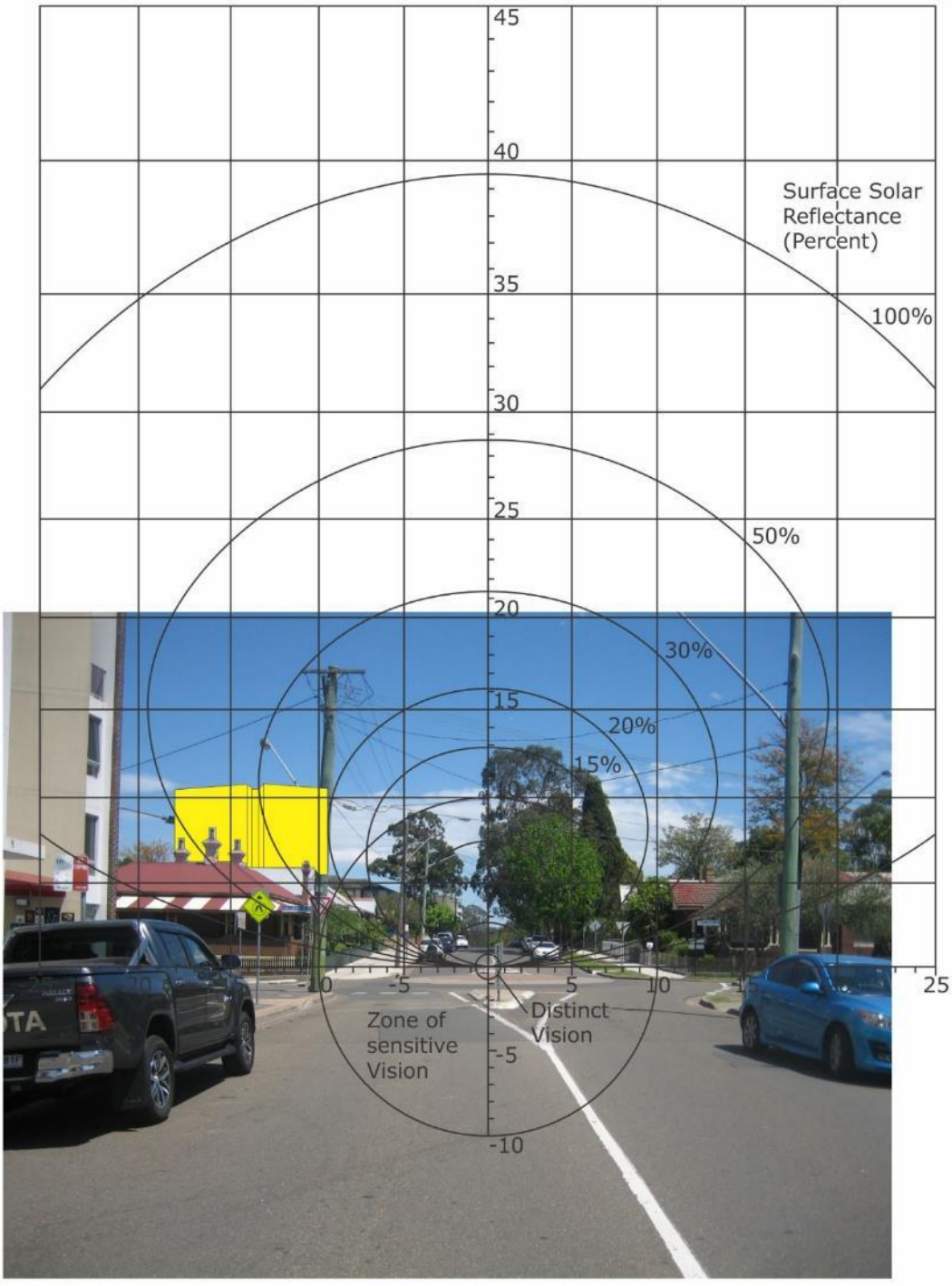


**Figure A.11: Glare Overlay of the Viewpoint at Point 11**

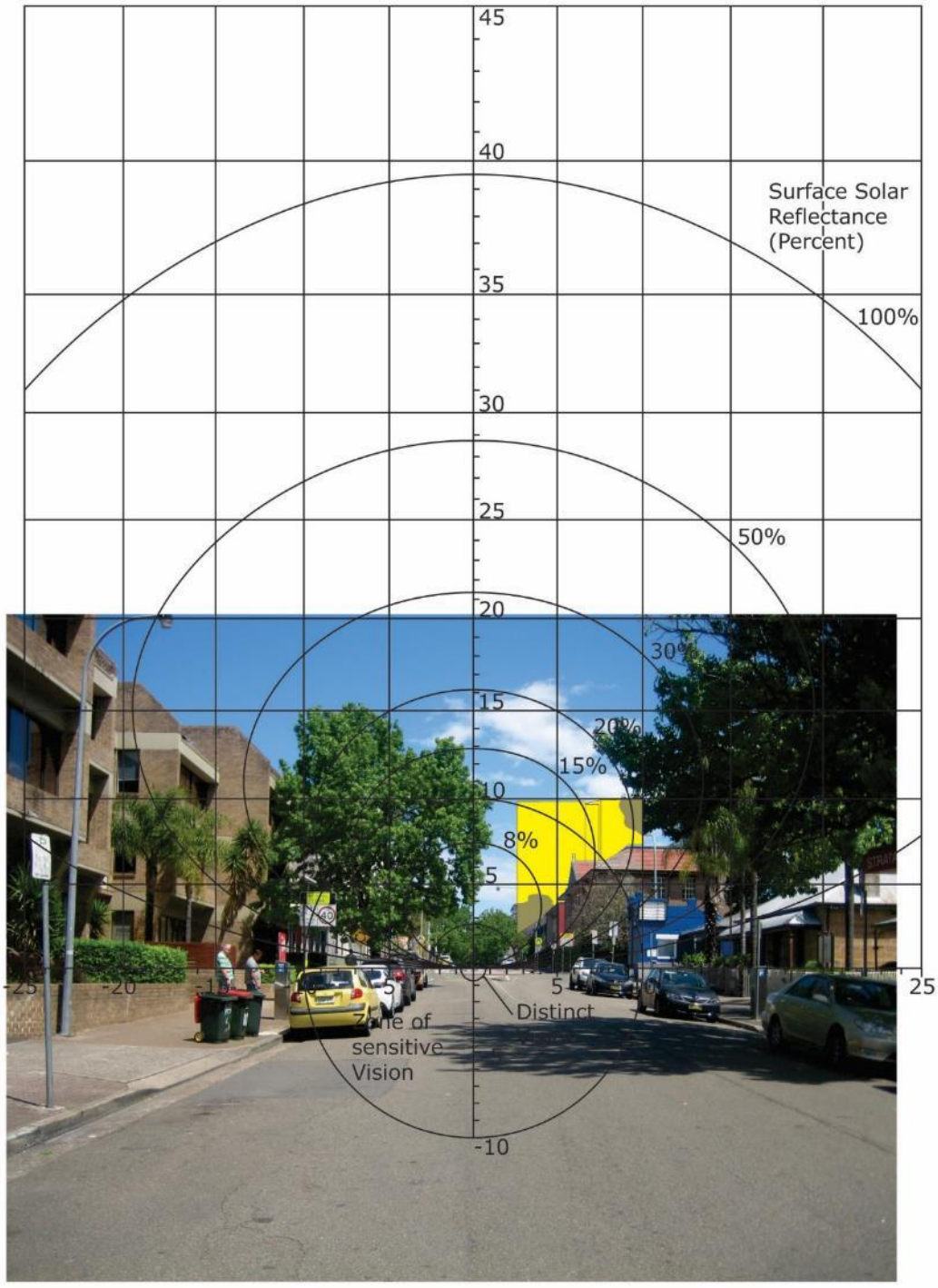


**Figure A.12: Glare Overlay of the Viewpoint at Point 12**

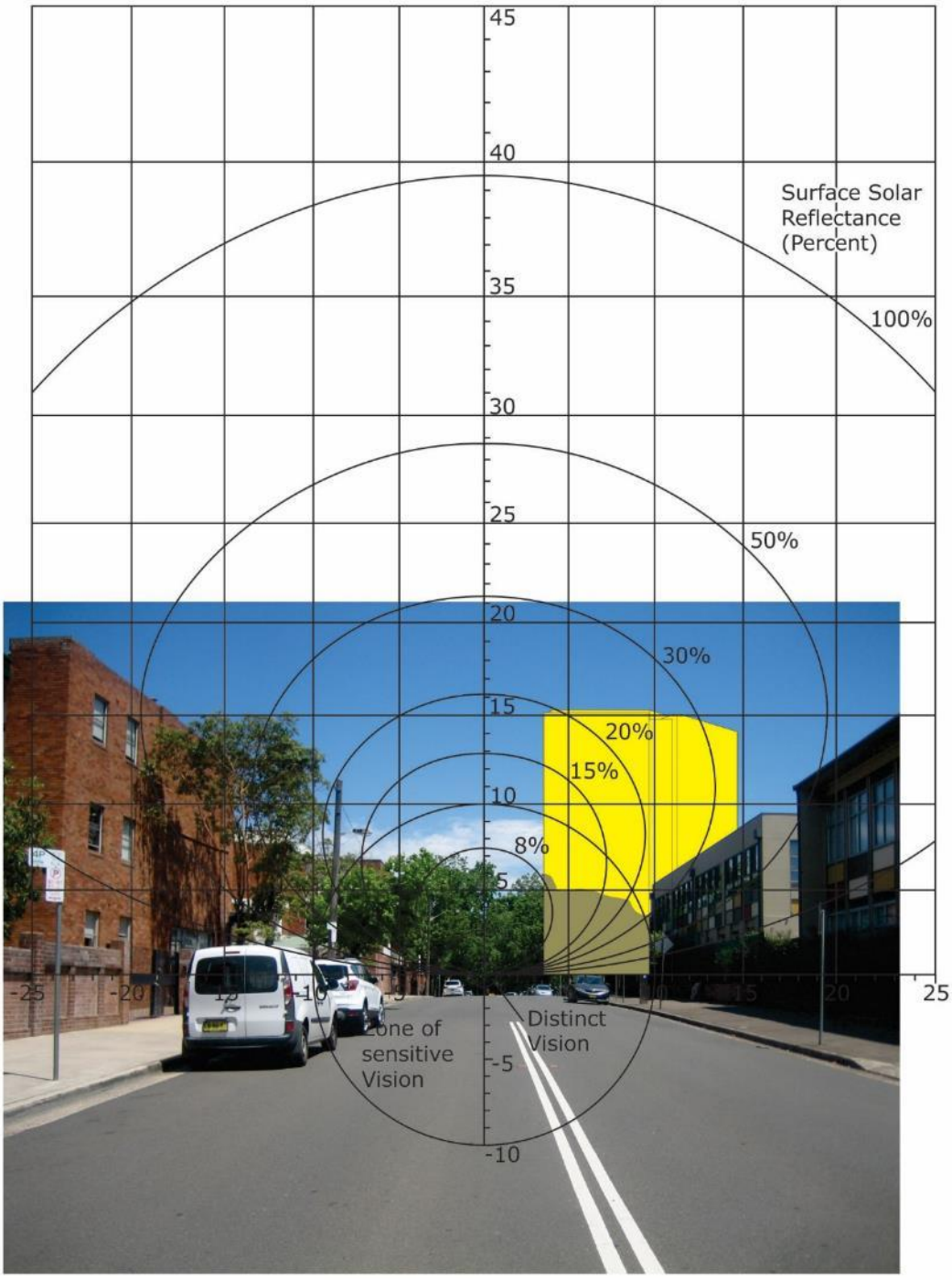


**Figure A.13: Glare Overlay of the Viewpoint at Point 13**

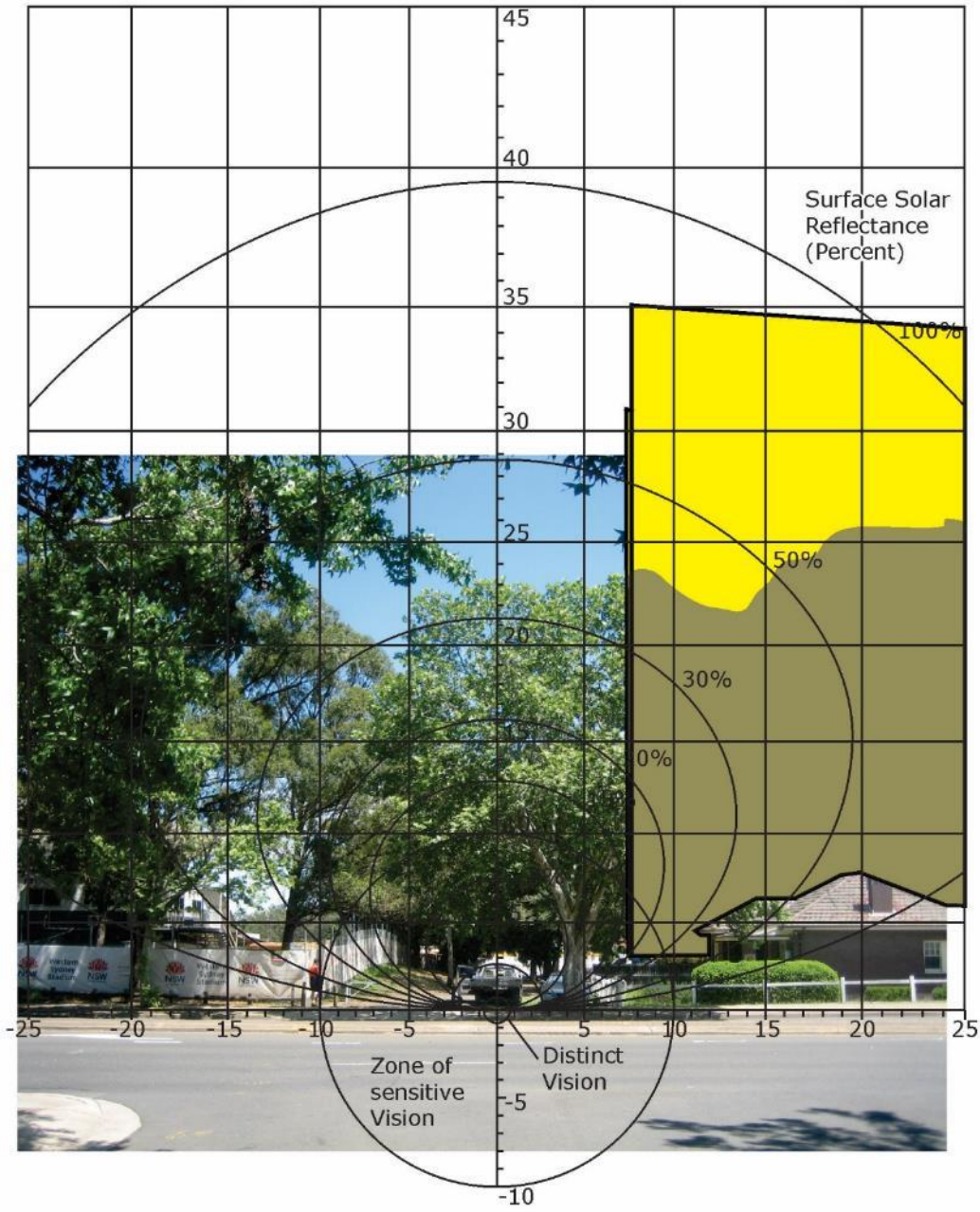


**Figure A.14: Glare Overlay of the Viewpoint at Point 14**

## APPENDIX B SOLAR CHARTS FOR THE VARIOUS CRITICAL ASPECTS

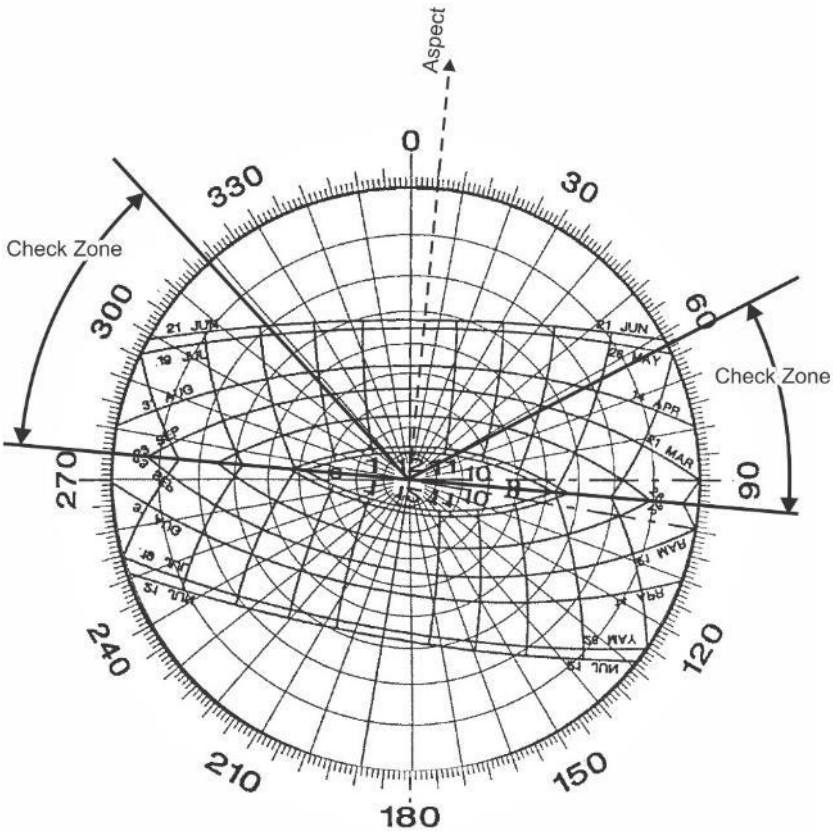


**Figure B.1: Sun Chart for the 005° Aspect**

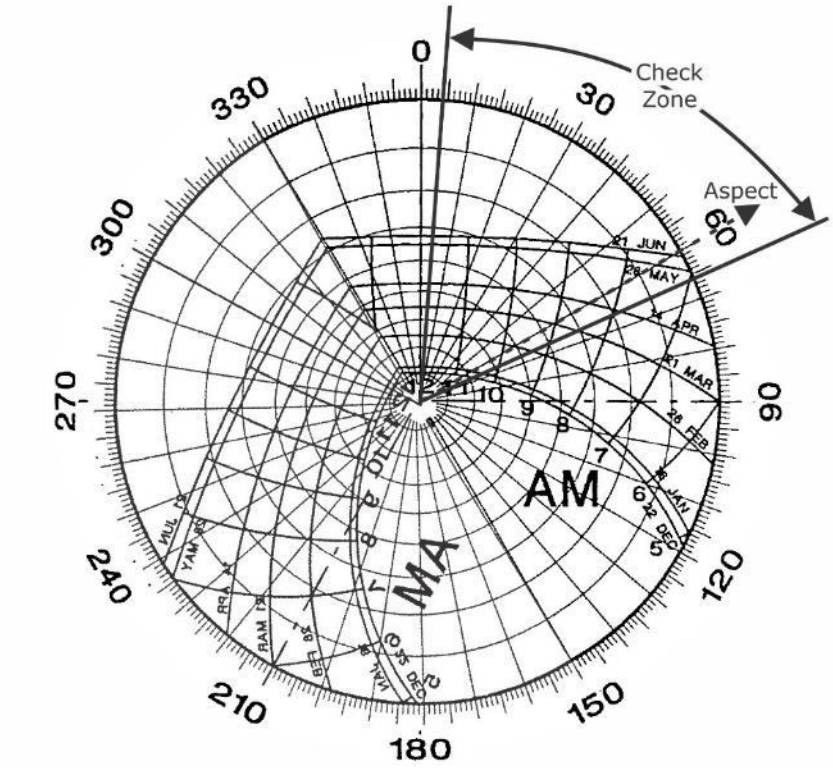


**Figure B.2: Sun Chart for the 060° Aspect**

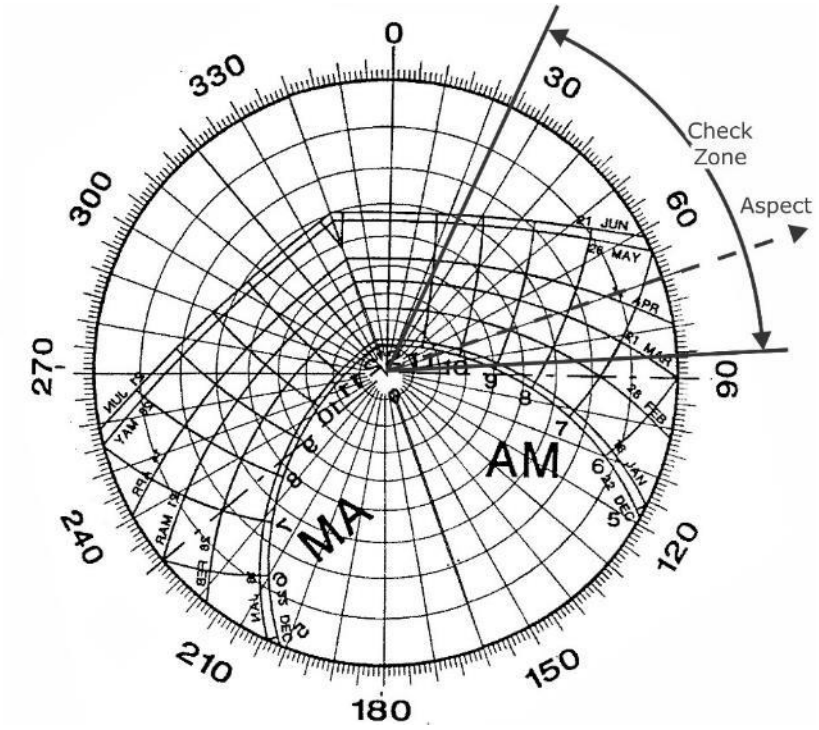


**Figure B.3: Sun Chart for the 070° Aspect**

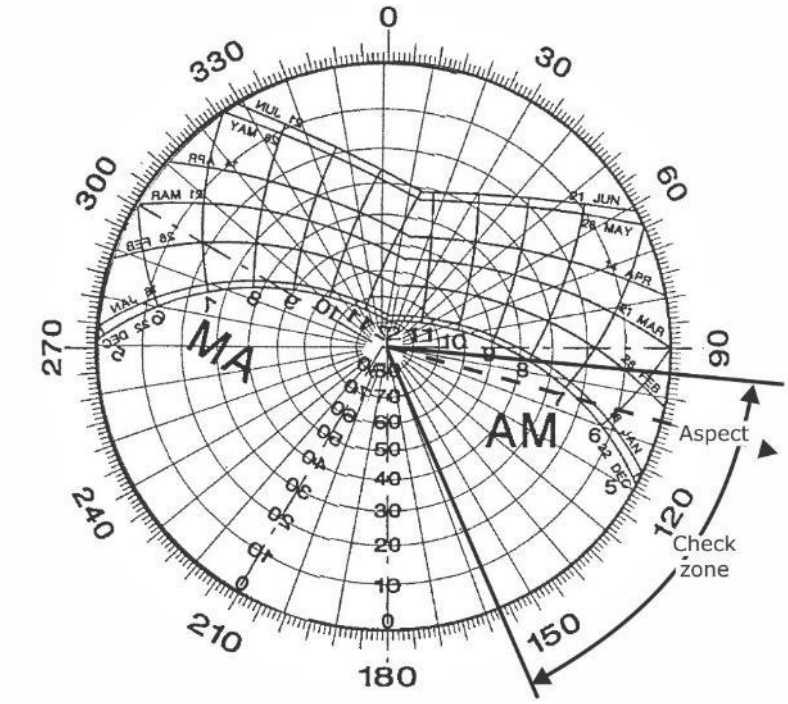


**Figure B.4: Sun Chart for the 105° Aspect**

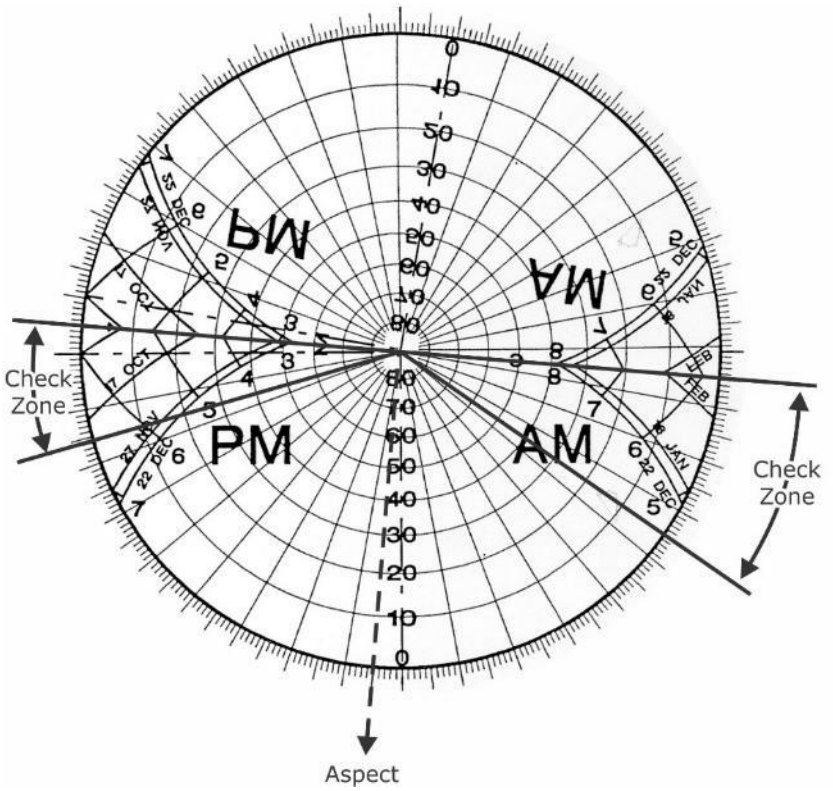


**Figure B.5: Sun Chart for the 185° Aspect**

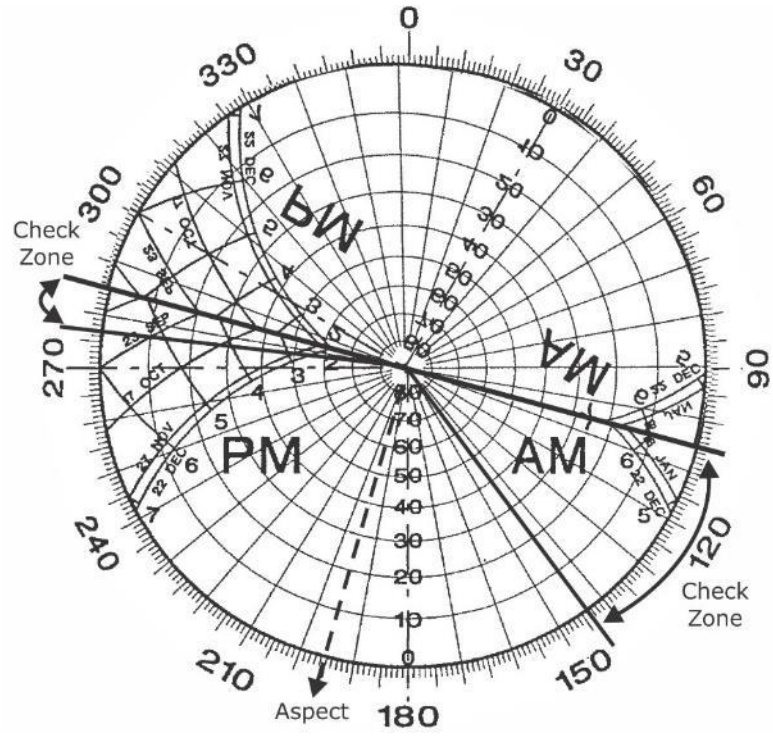


**Figure B.6: Sun Chart for the 195° Aspect**

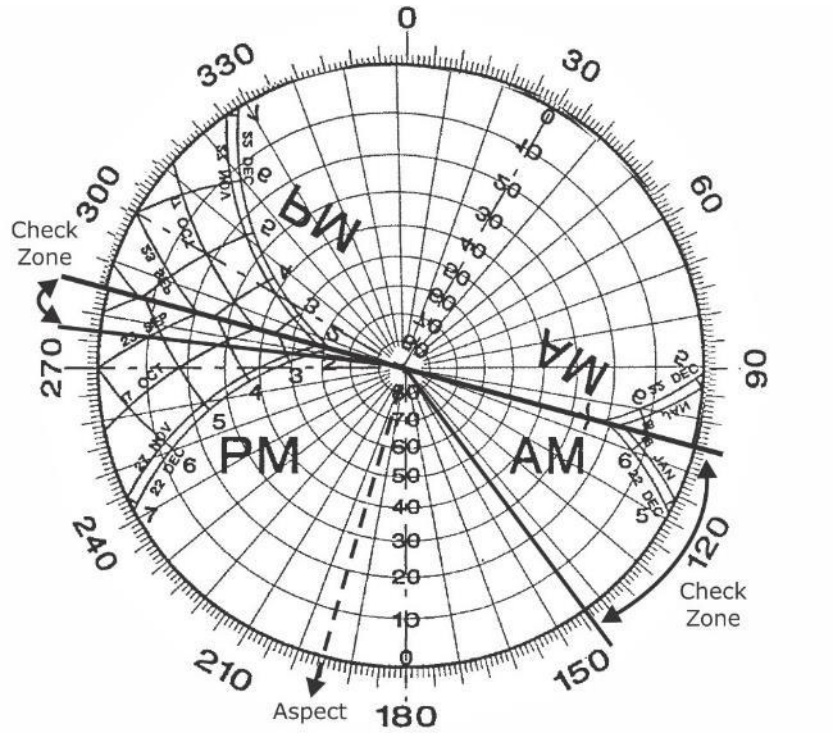


**Figure B.7: Sun Chart for the 202° Aspect**

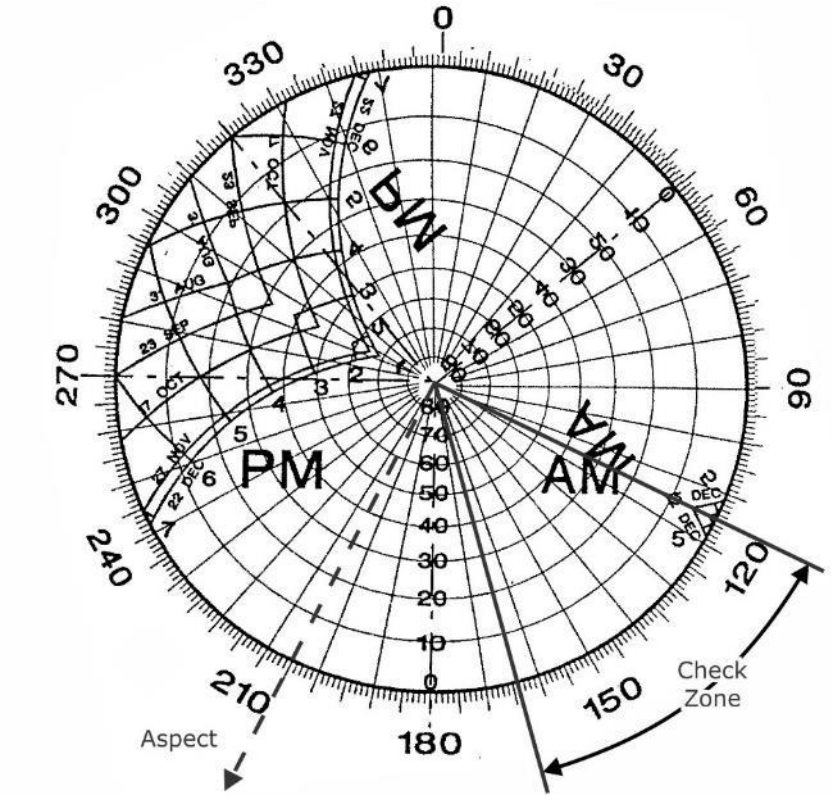


**Figure B.8: Sun Chart for the 205° Aspect**

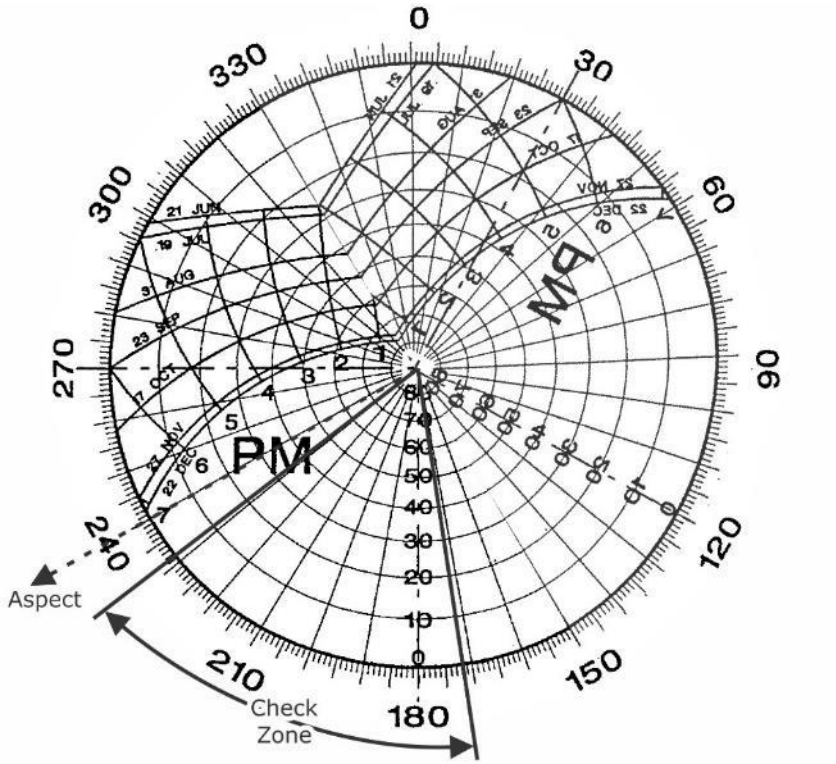


**Figure B.9: Sun Chart for the 240° Aspect**

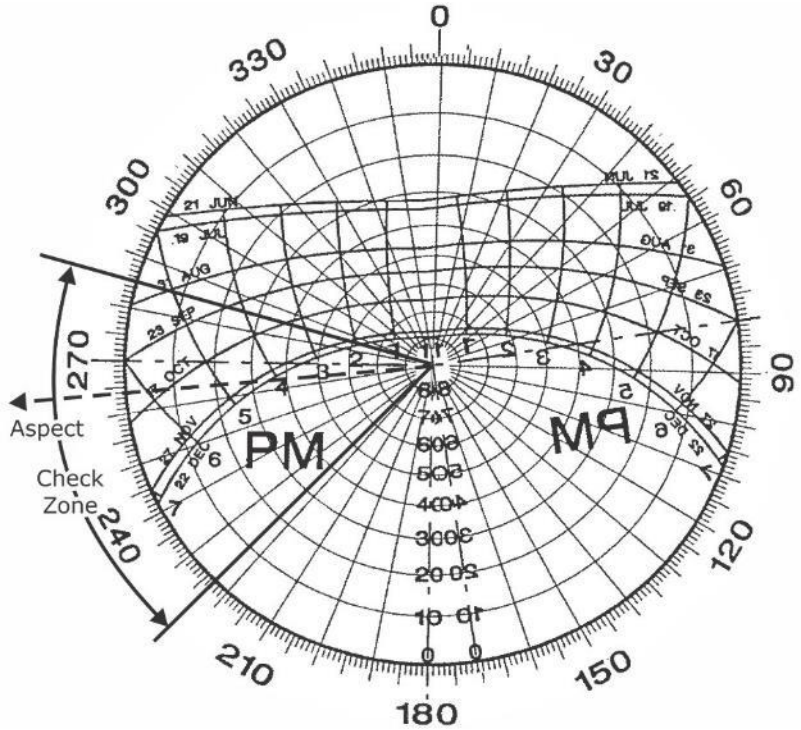


**Figure B.10: Sun Chart for the 265° Aspect**

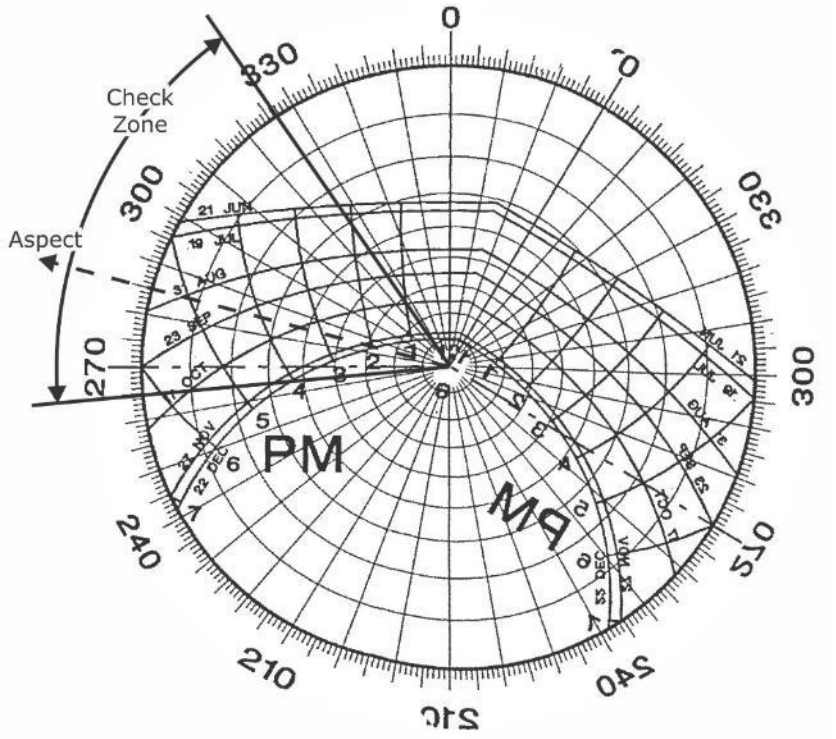


**Figure B. 11: Sun Chart for the 285° Aspect**

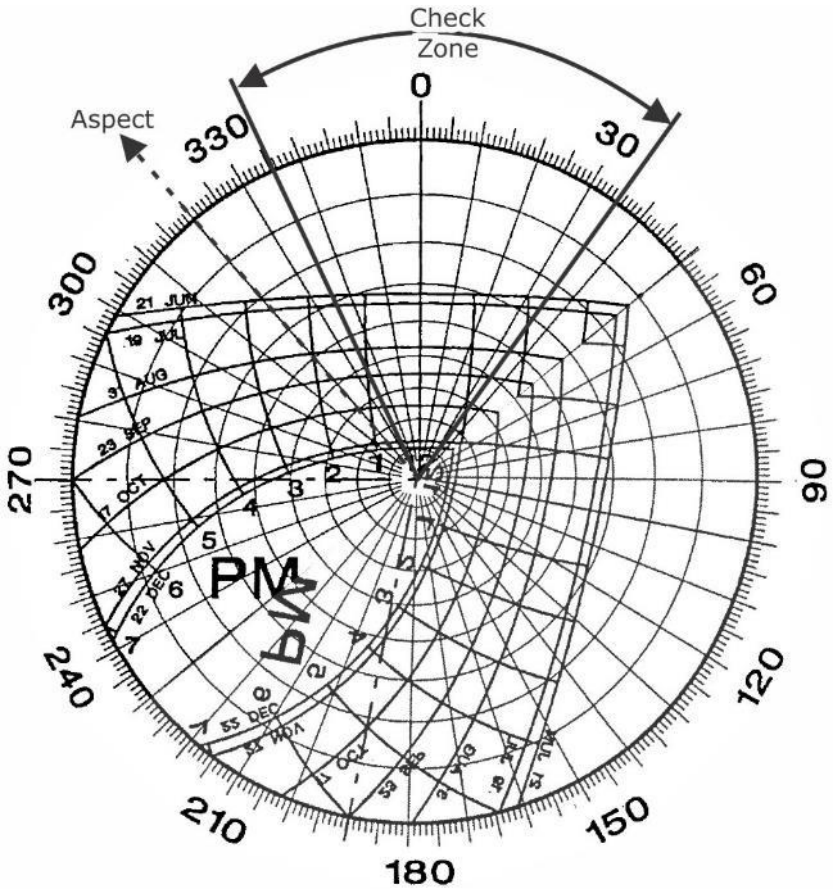


**Figure B. 12: Sun Chart for the 320° Aspect**

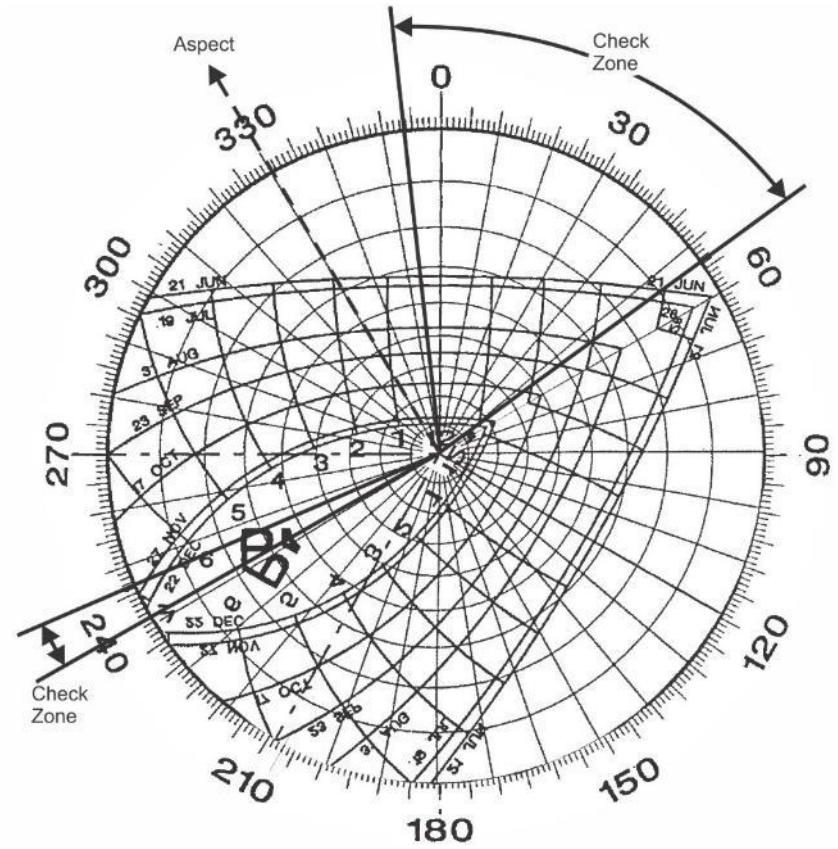


**Figure B. 13: Sun Chart for the 330° Aspect**

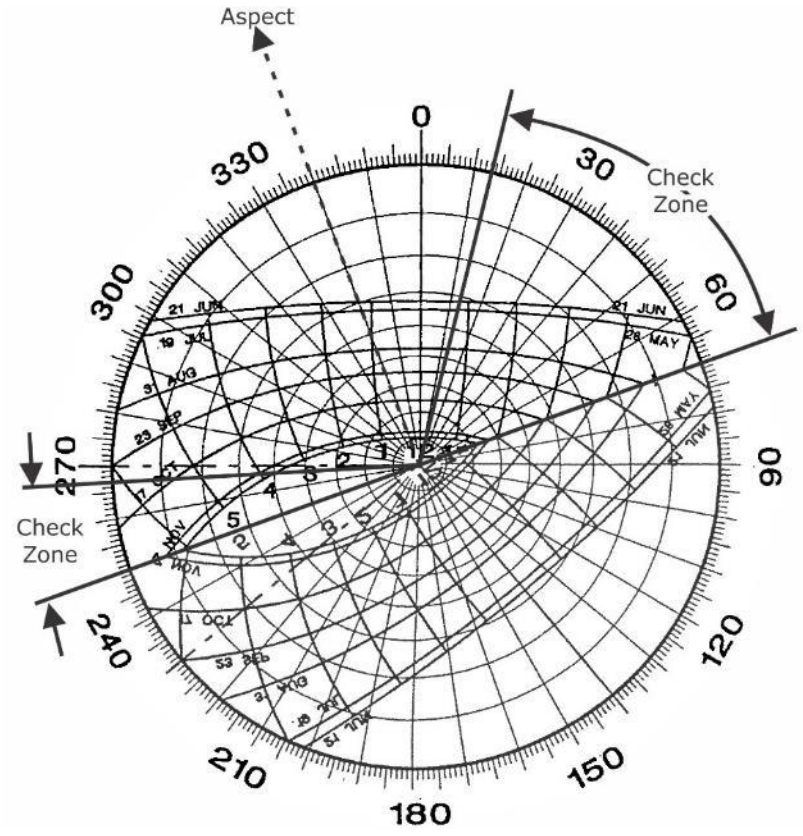


**Figure B. 14: Sun Chart for the 340° Aspect**

## APPENDIX C STANDARD SUN CHART FOR THE SYDNEY REGION

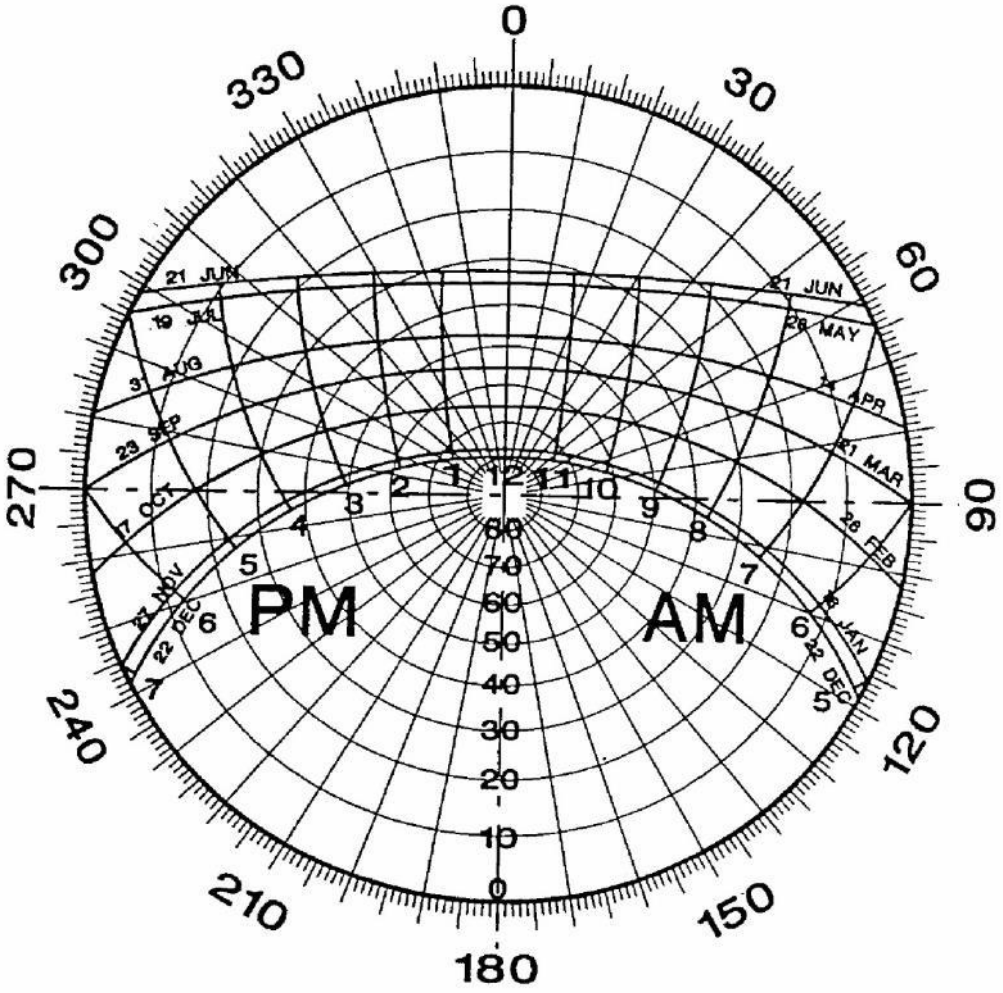


**Figure C.1: Standard Sun Chart for the Sydney Region**