Australian Jockey Club

Spectator Precinct

Environmental and Residential Amenity, Reflectivity

220759

Issue 3 | September 2010

Arup
Arup Pty Ltd ABN 18 000 966 165

Arup
Level 10 201 Kent Street
Sydney NSW 2000
arup.com.au

Job number 220759

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Document Verification

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Job title	Spectator Precinct	**Job number** 220759	
Document title	Environmental and Residential Amenity, Reflectivity	**File reference**	
Document ref	220759		

Revision	**Date**	**Filename**	0001Reflectivity Report Spectator Precinct Master.docx		
Issue	21/09/10	**Description**	Issue		
			Prepared by	Checked by	Approved by
		Name	JM	NH	NH
		Signature			
Issue 2	22/09/10	**Filename**	0001Reflectivity Report Spectator Precinct Issue 2 (JCM V2).docx		
		Description	Issue		
			Prepared by	Checked by	Approved by
		Name	JM	NH	NH
		Signature			
Issue 3	23/09/10	**Filename**	0001Reflectivity Report Spectator Precinct Issue 3 (JCM V2).docx		
		Description	Issue		
			Prepared by	Checked by	Approved by
		Name	JM	NH	NH
		Signature	[signature]	[signature]	[signature]
		Filename			
		Description			
			Prepared by	Checked by	Approved by
		Name			
		Signature			

Issue Document Verification with Document ✓

Contents

1 Executive Summary

This report has been produced in response to the Director Generals Part 3A Planning requirements MP 10-0097 for the redevelopment of the Spectator Precinct located on the Western side of the Royal Randwick Racecourse property.

It addresses DGR 6 of the *Project Application for the refurbishment of the Spectator Facility (App N^o MP_100097)* in regards to waste;

- DGR 6. Environmental and Residential Amenity

  The EA must address any likely solar access, acoustic privacy, visual privacy, view loss, odour issues and light spill and identify mitigation measures necessary to achieve a high level of environmental and nearby residential amenity including the future development of 66A Doncaster Avenue (the former Tramways Land)

- Appendix B Plans and Documents to accompany the Application

  20. Lighting Assessment

  Desk top assessment of the impact of lighting and light spill including the reflectivity from the glazed surfaces from the proposed development on surrounding residential development including the 66A Doncaster Avenue (the former Tramways Land).

In particular it addresses rogue solar reflections that are likely to occur off the facade of the proposed development and their affect on surrounding observers.

The reflectivity analysis assesses the effect of the main façade facing north-west as well as the curved façade elements that enclose the stairwells at either end of the proposed development. Observers on the nearby roads and occupants of the future development at 66A Doncaster Avenue are considered as part of the assessment.

In conclusion the reflectivity analysis for the precinct has shown that generally the new developments do not pose any significant issues on road users or the adjacent residential development at 66A Doncaster Avenue and makes the following recommendations with respect the ongoing design of the buildings.

The analysis indicates that the curved façade elements enclosing the stairwells are likely to cause intermittent veiling reflections for observers located in the future development at 66A Doncaster Avenue. These reflections could be reduced and potentially eliminated through careful selection of cladding system and materials. Some potential strategies to be investigated during the design development include:

- Treatment of the external glass surface such as fritting, etching, anti-reflective coatings etc.
- Use of external shading elements
- Reduced area of reflecting surface using non-reflective panels or ensuring adequate openness of perforated cladding
- Tilting of façade panels to re-direct reflections downwards

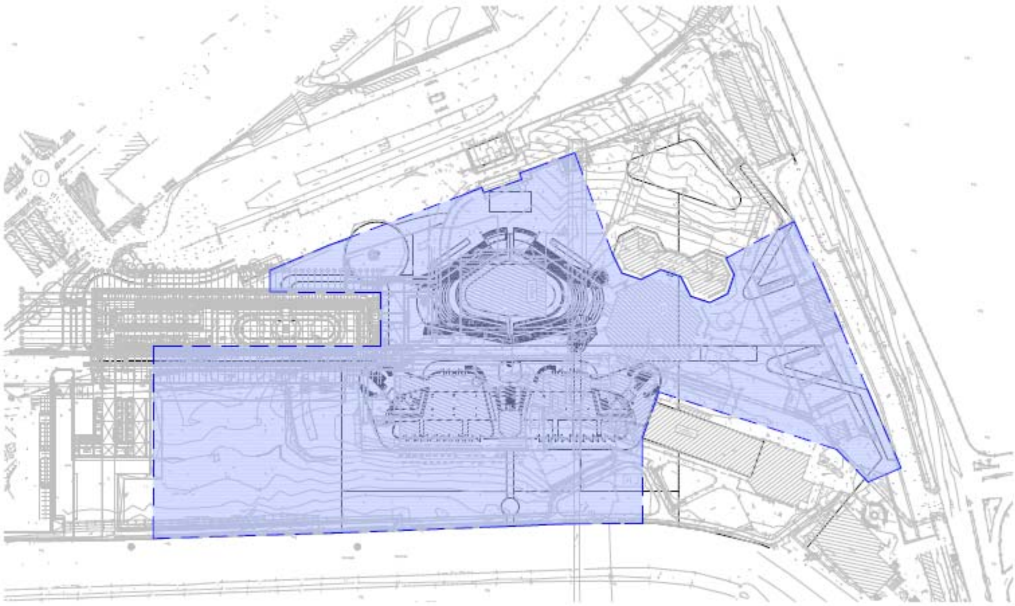
The main façade is not predicted to create reflections above the acceptance threshold; however, lower intensity reflections from this façade are predicted to be directed towards 66A Doncsaster Avenue. These are within the acceptability criteria.

Neither the main façade nor the curved stairwell façades are predicted to cause significant solar reflections towards road users on Doncaster Avenue or Alison Road.

2 Introduction

The redevelopment of the existing Spectator Precinct will see the existing Queen Elizabeth II Grandstands refurbished and a new Paddock Grandstand Pavilion constructed, including basement levels, a new parade ring and spectator amenities such as Kiosks and landscaped areas.

The site overlay below shows the spectator precincts location on site near the intersection of Alison road and Doncaster Avenue.



This Reflectivity Report assesses the impact of solar reflections off the proposed development on surrounding drivers and occupants of nearby buildings, in terms of reduced visibility of visual tasks. This assessment is performed following the methodology of David N.H. Hassell of the University of New South Wales. Drivers and neighbouring building occupants will observe the building's facades.

The following section provides context for drivers and neighbouring buildings, including the future development at 66A Doncaster Avenue.

3 Veiling Reflection

3.1 Criteria for Assessment

This report assesses the likelihood of rogue solar reflections onto occupants of nearby buildings, public areas and roadways. The assessment follows the methodology of David N. H. Hassall of the University of New South Wales. This methodology is detailed in section 3.2 of this report.

Solar reflections are likely in many directions at any time at which the sun is visible. This study assesses the importance of these reflections in terms of 'discomfort glare' and 'disability glare'. These terms are defined below:

- Disability glare – causing the observer to be unable to perform a visual task such as reading or driving without taking evasive action (such as turning away or raising a hand to shield the eyes)
- Discomfort glare – causing the observer psychological annoyance

These are scientific terms derived from the study of optics and human perception. It does not lead to long-term disability in any form. Thus, some scope is allowed for interpretation of results.

Calculations following this method provide equivalent veiling luminance in the eyes of observers, due to solar reflections. Luminance is measured in cd/m² (candela per meter squared) and is a representation of how bright a surface will appear to the human eye. For occupants of surrounding buildings, discomfort glare can be caused by any reflection, therefore the objective is to minimise the period and intensity of reflections that reach surrounding developments. For drivers, where the equivalent veiling luminance exceeds the level 500 cd/m², the solar reflection is considered excessive.

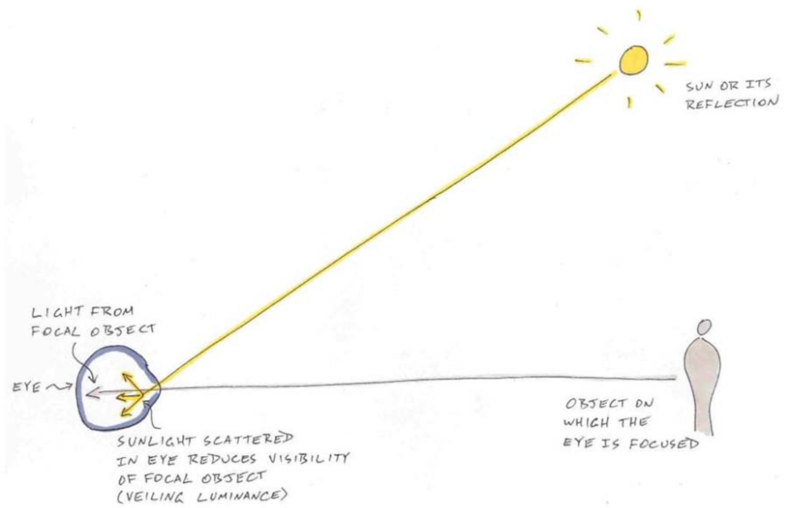


Figure 1 Light scattering within the eye causing veiling glare

3.2 Methodology

The assessment of rogue solar reflections is based on the methodology described by David N. H. Hassall in the publication, ‘Reflectivity: Dealing with Rogue Solar Reflections’. This involves several steps, outlined below.

1. The size, orientation and extent of reflective objects on each façade are determined by examination of drawings provided by the architect, the site and surrounds and expected glazing materials.
2. A range of observer directions are chosen for each reflecting panel, representing motorists, pedestrians and occupants of nearby buildings as appropriate.
3. Times at which the sun is reflected off the façade are determined, as well as the directions into which it is reflected.
4. For each observer direction, the equivalent veiling luminance in the eye of the observer is calculated to determine if the proposed observer angle is likely to result in disability glare. This involves calculations of the strength of solar illumination, the position of the sun in front of the reflecting panel, the apparent position of the sun reflected in the panel and the reflected solar illumination received by the observer.
5. The calculated equivalent veiling luminance is compared with the maximum allowed level of 500 cd/m².
6. For situations where the maximum level is exceeded, the case is further investigated to assess whether the offending panel is shaded by external shading devices and presents a sufficiently large solid angle to the observer. If the offending façade section is shaded or too small to reflect the sun to the observer, the case is disregarded.
7. In some situations, high veiling luminance may be caused by grazing reflections, when the sun itself is close to its reflection in the observer’s field of view. In this case the impact of the reflection is considered minimal when compared to that of the actual sun. Consequently, grazing reflections, where the angle between the observer direction and the real sun is less than 20°, are not included in the results. Reflections, where the angle is greater than 20° are included and are considered on an individual basis.

To allow calculations to proceed, several assumptions were required:

- Nominal glazing reflectance of 10% and 20% have been considered in the study, the results of which can extrapolated to assess the performance of the actual glazing specification. Where the results show that no disabling reflections are provided by this glass, then no disabling reflections will be provided by glass of lower reflectance.
- Each façade is assumed to be 100% glazed, the impact of a reduced glazing percentage is discussed if significant veiling reflections are identified.
- Drivers and pedestrians face horizontally, and parallel to their direction of travel.

- Occupants of nearby buildings face horizontally, directly out of their windows.
- Each of the above assumptions was considered acceptable, and the Hassall methodology is considered best practice for such analysis.

3.3 Model

The following image shows the 3d model used for the reflectivity assessment. The reflecting surfaces are indicated in blue, including the north-west facing flat façade elements as well as the curved façade elements on either end of the proposed development.

The accuracy of this reflectivity analysis depends on the quality of the input information including building geometry and material specifications. The 3d model is based on the latest geometry and the results of this assessment will be different if there are significant changes to the proposed design.

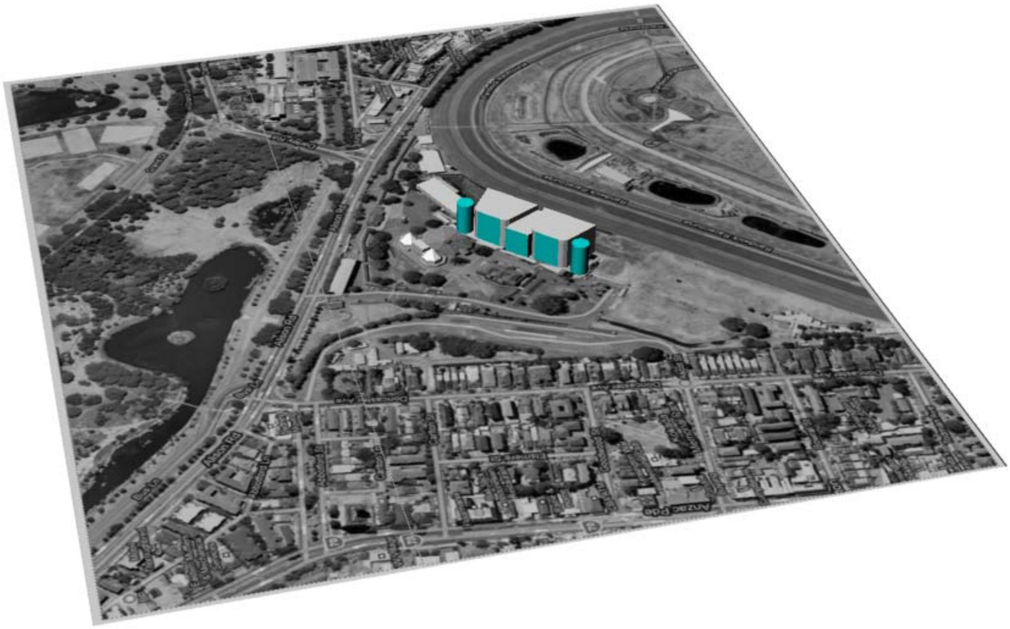


Figure 2 Model used for reflectivity assessment

3.4 Observer Directions

The selection of viewing directions considered surrounding streets and buildings that would allow observers to visualize a glazed portion of at least one facade. Figures 3 and 4 illustrate the observer locations and directions, which are also summarised below.

- Observers travelling south on Doncaster Avenue, bearing 189° clockwise from North
- Observers travelling east on Alison Road, bearing 116° clockwise from North
- Observers located in the 66A development looking generally eastward, bearing between 70° and 160° from North

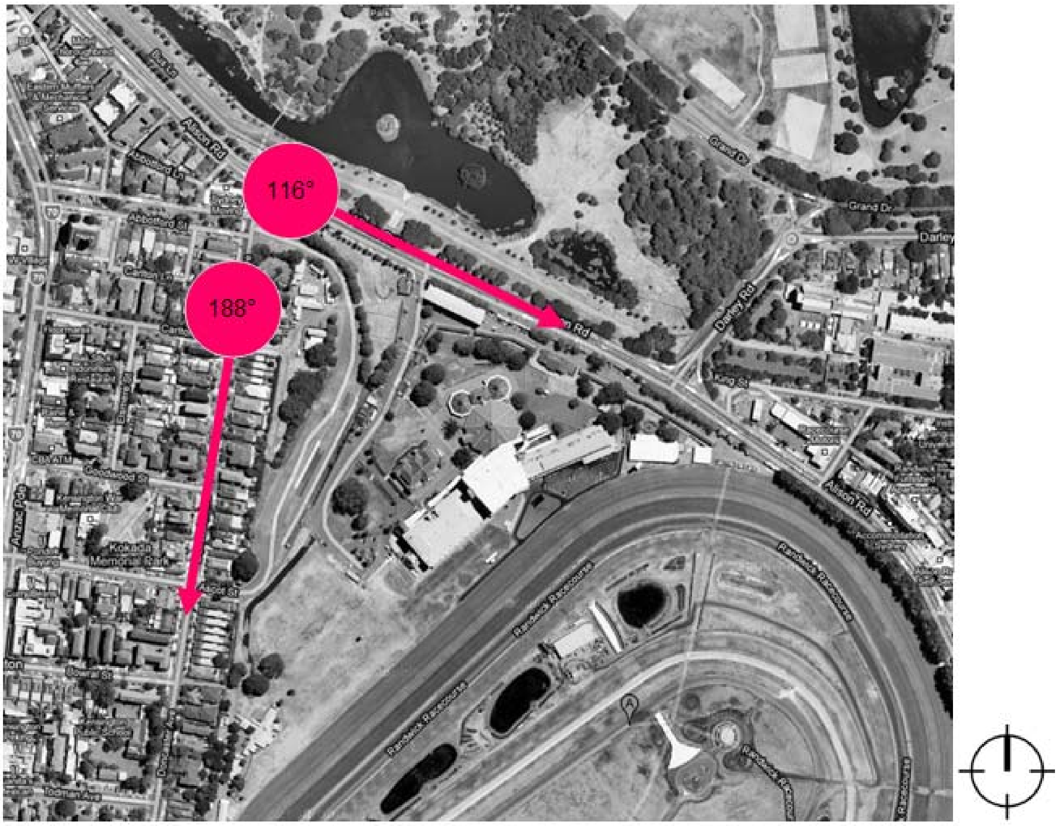


Figure 3: Orientation of selected viewing directions (road users)

Figure 4 Orientation of selected viewing directions (occupants of 66a)

Calculations are performed based on the formulas used in the Hassall methodology for each combination of facade aspect and viewer direction. If these calculations resulted in no reflections above the limit of 500cd/m², the assessment was finalised, concluding that no disability glare will be produced towards a driver's eye. If the calculations determined that reflections above 500cd/m² are likely to occur then a detailed assessment is undertaken to identify the time of the year and duration of exposure to veiling reflections.

3.5 Results

This section presents the results of the analysis and refers to solar reflections visible to observers of the proposed facades for the selected observer directions.

Each of the diagrams in this section comprises a time-lapse series of six images indicating the direction of solar reflections from all reflective panels. The areas coloured in blue are below the threshold of 500 cd/m^2 and those in yellow are above the threshold.

This type of analysis was completed for each month to determine the time and duration of reflections throughout the year.

Observer on Doncaster Avenue (bearing 188°)

Figure 5 shows the results of the analysis for a bearing of 188°. The results indicate that veiling reflections could be experienced due to late afternoon/evening sun from a low altitude in the west. These reflections would be directed northward and therefore experienced by people looking in a southerly direction; however, they do not coincide with Doncaster Avenue and are not a risk to these road users.

The time and duration of these reflections is summarised as follows:

- Approximately 45 minutes to 1 hour before sunset during March, April, September and October.

Reducing the glass reflectivity to 10% results in a smaller affected area and reduced period of impact as follows:

- Approximately 30 minutes before sunset for the months of April and September.

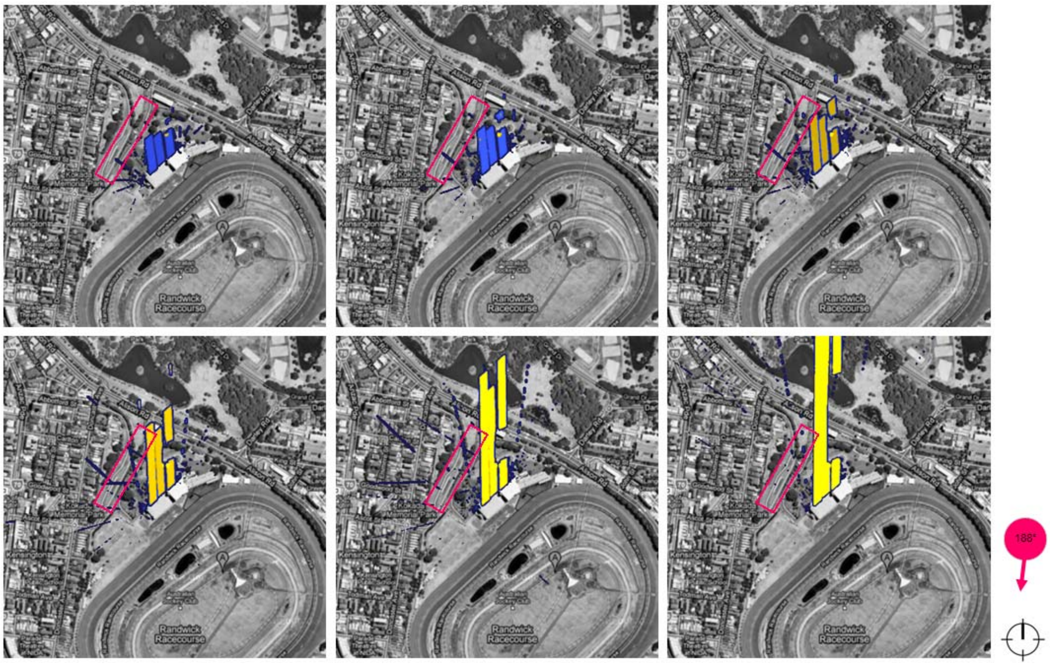


Figure 5: Typical location of veiling reflections for south-looking observer (April, 5:30pm to 6:45pm in 15 minute increments)

Observer travelling on Alison Road (bearing 116°)

No significant veiling reflections were identified for observers heading east on Alison Road.

Observers in 66A Doncaster Avenue (bearing between 70° and 160°)

Figures 6 and 7 show the results of the analysis for observer bearings of 70° and 115°, which will be typical of the observer directions from 66A Doncaster Avenue.

The results indicate that veiling reflections could be experienced due to late afternoon/evening sun from a low altitude in the west. The reflections are not from the main façade; rather they are from the curved stairwells on either end of the development. The reflections are scattered in many directions due to the curved design of these façade elements and at times are directed towards observers in 66A.

The time and duration of these reflections is summarised as follows:

- Approximately 30 minutes to 1 hour before sunset for all months of the year
- Reflections are scattered and move quickly

Reducing the glass reflectivity to 10% results would result in a smaller affected area and reduced period of impact.

Reflections from the main façade are directed towards the north end of 66A although these are predicted to be below the threshold luminance of 500 cd/m^2.

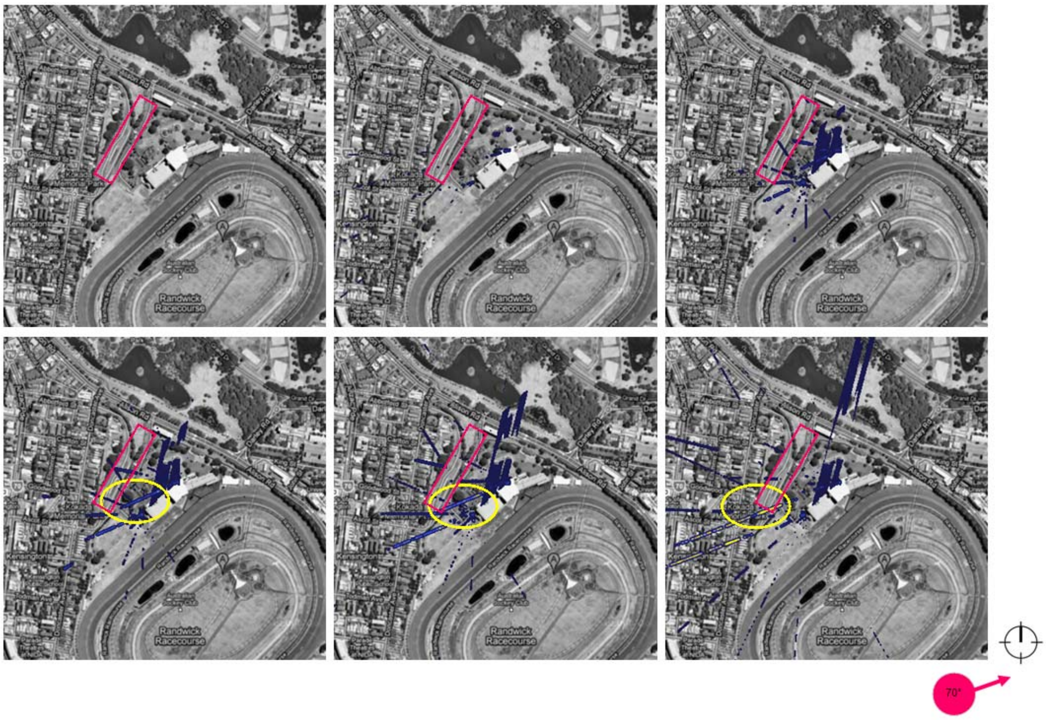


Figure 6: Typical location of veiling reflections for east-looking observer (October, 5:30pm to 6:45pm in 15 minute increments)

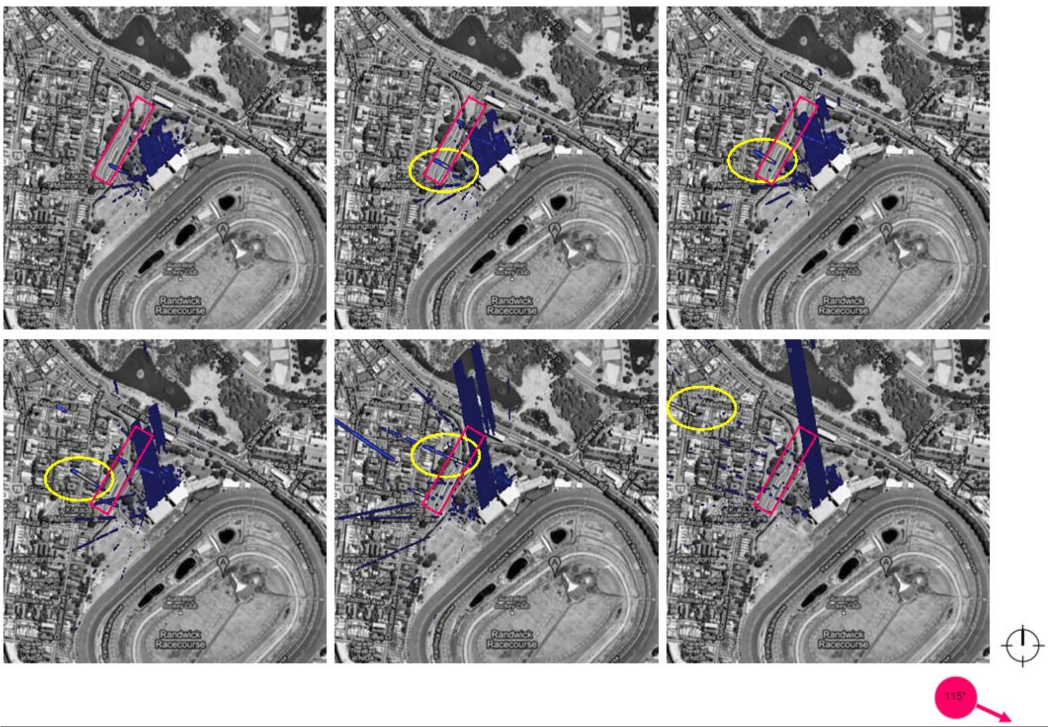


Figure 7: Typical location of veiling reflections for east -looking observer (August, 5:15pm to 6:30pm in 15 minute increments)

4 Discussion

No veiling reflections have been identified for road-users travelling south along Doncaster Avenue or east along Alison Road.

Significant reflections may be experienced by people located within the Spectator Precinct although these reflections are unlikely to present a significant concern. Observers in this location will be able to shade their eyes or change their viewing direction to avoid any unwanted glare effects.

It is possible that veiling reflections will be experienced for observers in 66A, which is located west of the proposed development; however, the strength of these reflections will depend on the design of the curved façade elements that enclose the stairwells. Significant reflections are not expected to come from the main façade towards 66A Doncaster Avenue.

In general, the curved façade has a scattering effect that causes reflections to be relatively short lived and to move quickly across an observer's field of view (the current analysis assumes that the stairwell façades are comprised of a series of flat cladding panels rather than being continuously curved).

The strength of reflections from the stairwell façade elements can be reduced through careful selection of cladding system and materials. Some of the potential strategies to be investigated during the design development include:

- Treatment of the external glass surface such as fritting, etching, anti-reflective coatings etc.
- Use of external shading elements
- Reduced area of reflecting surface using non-reflective panels or ensuring adequate openness of perforated cladding
- Tilting of façade panels to re-direct reflections downwards

5 Conclusions

The reflectivity analysis predicts that no high-risk solar reflections are to be expected for road users on Doncaster Avenue or Alison Road.

The main façade is not predicted to create reflections above the acceptance threshold; however, lower intensity reflections from this façade are predicted to be directed towards 66A Doncsaster Avenue. These are within the acceptability criteria.

Neither the main façade nor the curved stairwell façades are predicted to cause significant solar reflections towards road users on Doncaster Avenue or Alison Road.