

## **Additional Points of Assessment for Reflectivity**

**Sydney Modern Art Gallery of NSW**

**AGNSW**

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**Prepared for**

Client

Date: 13 April 2018

Reference: 17033

Revision: 03

**Surface Design**

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#### Document control

Revision	Date	Revision details	Author	Signed	Verifier	Signed	Approver	Signed
00	27/02/2018	Initial Issue	BMD		JR		BMD	
01	08/03/2018	Updated with Vertical Bearing angles	JR		BMD		BMD	
02	26/03/2018	Final Issue	GMC					
03	13/04/2018	Conclusion updated	GMC					

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## 1. Executive Summary

Surface Design have been engaged by the Art Gallery of NSW to prepare this reflectivity assessment.

The findings of the assessment are included in this report which is additional to the reflectivity study included in the SSDA submission that was prepared for the impact of disability glare of pedestrians and motorists.

Various concerns have been raised by the neighbouring building occupants with respect to the new façades reflecting light onto nearby businesses and residences.

There are no agreed metrics for assessing the impact of reflected light onto occupants of buildings, especially where they can adjust their position or view direction or draw shades to shield the reflected light.

The metrics used in the previous report are established for safety where the viewer cannot avert their direction of view.

In preparing this extended study we have taken a practical approach to assessing the amount of time that light may be reflected onto the adjacent locations as requested by the Art Gallery of NSW

Seven additional points of interest have been requested and these are listed as follows.

1. Wharf Terraces gym (level 1 above ground)
2. Wharf Terraces lobby (Lobby entry ground Level)
3. Wharf Terraces resident car park exit (ground Level)
4. OTTO restaurant on Woolloomooloo Finger Wharf (street level – on wharf)
5. Finger Wharf apartment 108
6. Finger Wharf apartment 415
7. Finger Wharf apartment 507

Each point of interest has been checked against the elevations which may cause discomfort due to glare. These results are summarised in Table 1 overleaf.

Table 1 – Summary of Glare Analysis

Location	View Point Façade Aspect Angle	Point 1 - Wharf Terraces gym (level 1 above ground)	Point 2 - Wharf Terraces lobby (Lobby entry ground Level)	Point 3 - Wharf Terraces resident car park exit (Ground Level – Lincoln Crescent)	Point 4 - OTTO restaurant on Woolloomooloo Finger Wharf (street level – on wharf)	Point 5 - Finger Wharf apartment 108	Point 6 - Finger Wharf apartment 415	Point 7 - Finger Wharf apartment 507
		1	2	3	4	5	6	7
Entrance Level								
Northern wall of Entry Level of Entry Pavilion	35	NA	No Impact	No Impact	No Impact	No Impact	No Impact	No Impact
Eastern wall of Entry Level of Entry Pavilion	125	No Impact	No Impact	No Impact	No Impact	No Impact	No Impact	No Impact
Lower Level 1								
Northern wall of Level 1 of café	35	NA	No Impact	NA	NA	No Impact	No Impact	No Impact
Eastern wall of Level 1 of café	100	No Impact, cut-off from Gallery 3 structure	No Impact	No Impact	Limited Impact	Very limited Impact	No Impact	No Impact
Eastern wall of Level 1 of shop	145	NA	NA	NA	No Impact	NA	NA	NA
Lower Level 2								
North-eastern glazed wall of Level 2 Multi-Purpose Hall	55	NA	No Impact	Some Impact, managed through reflectivity of materials	NA	No Impact	No Impact	No Impact

From the seven points of interest included in study we have studied thirty individual cases for the possibility of sunlight reflecting onto one of those seven locations.

From these studies two cases result in very limited periods of reflected light reaching the study points and one case where it is recommended to modify glazing properties to reduce impact on the garage exit.

Refer to individual points in the body of the report for full analysis information.

## 2. Initial Reflectivity Assessment for Additional seven points on interest

### 2.1 Introduction / Outline

Surface Design have been engaged by the Art Gallery of NSW to prepare this reflectivity assessment.

The findings of the assessment are included in this report which is additional to the reflectivity study included in the SSDA submission that was prepared for the impact of disability glare of pedestrians and motorists.

Various concerns have been raised by the neighbouring building occupants with respect to the new façades reflecting light onto nearby businesses and residences.

There are no agreed metrics for assessing the impact of reflected light onto occupants of buildings, especially where they can adjust their position or view direction or draw shades to shield the reflected light.

The metrics used in the previous report are established for safety where the viewer cannot avert their direction of view.

In preparing this extended study we have taken a practical approach to assessing the amount of time that light may be reflected onto the adjacent locations as requested by the Art Gallery of NSW.

While no actual coordinates or Relative Levels (RL) of the points in question have been provided we have made the best from information available to determine the locations of each point and incorporate these in the assessment. By definition the assessment is an approximation and will not accurately provide the amount of time or conditions experienced by the locations.

It is to be noted that the method undertaken and results below are an approximation of the period of year that the sun will be reflected from the proposed development toward these locations.

This assessment is conservative and treats all façades as equally exposed and does not take benefit from roof overhangs or shading from adjacent structures, planting or the local area topology.

#### 2.1.1 Additional Points of Interest

Seven additional points of interest have been requested and these are listed as follows,

1. Wharf Terraces gym (level 1 above ground)
2. Wharf Terraces lobby (Lobby entry ground Level)
3. Wharf Terraces resident car park exit (ground Level)
4. OTTO restaurant on Woolloomooloo Finger Wharf (street level – on wharf)
5. Finger Wharf apartment 108
6. Finger Wharf apartment 415
7. Finger Wharf apartment 507

These viewpoints have been approximated on the Google maps view below.

## 2.2 Glazed Elevations, Viewpoints and Method of Assessment

### 2.2.1 Glazed Elevations

The images below show the external glazed elevations facing the additional viewpoints

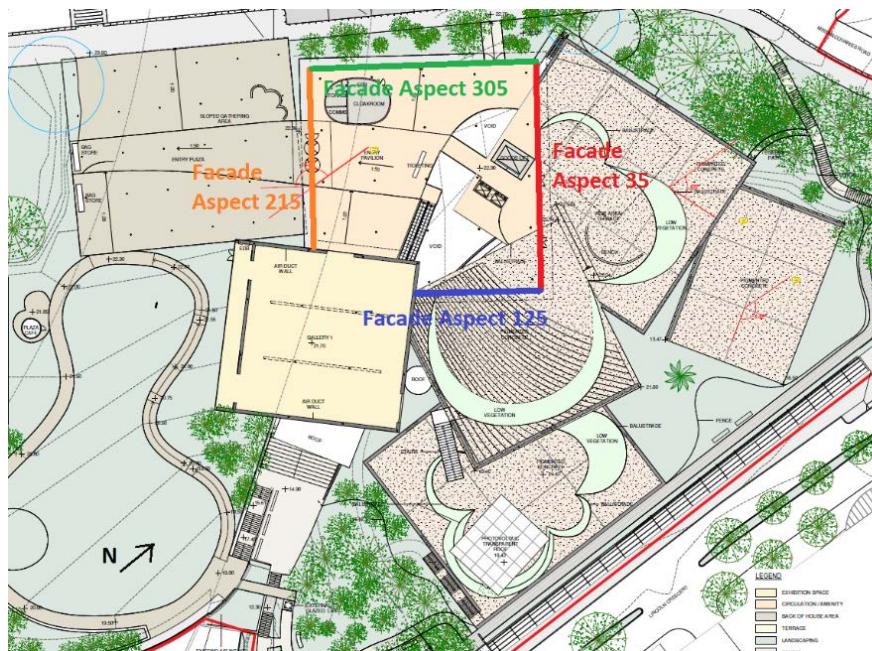


Figure 1 Entry Level Glazing



Figure 2 Lower Level 1 Glazing

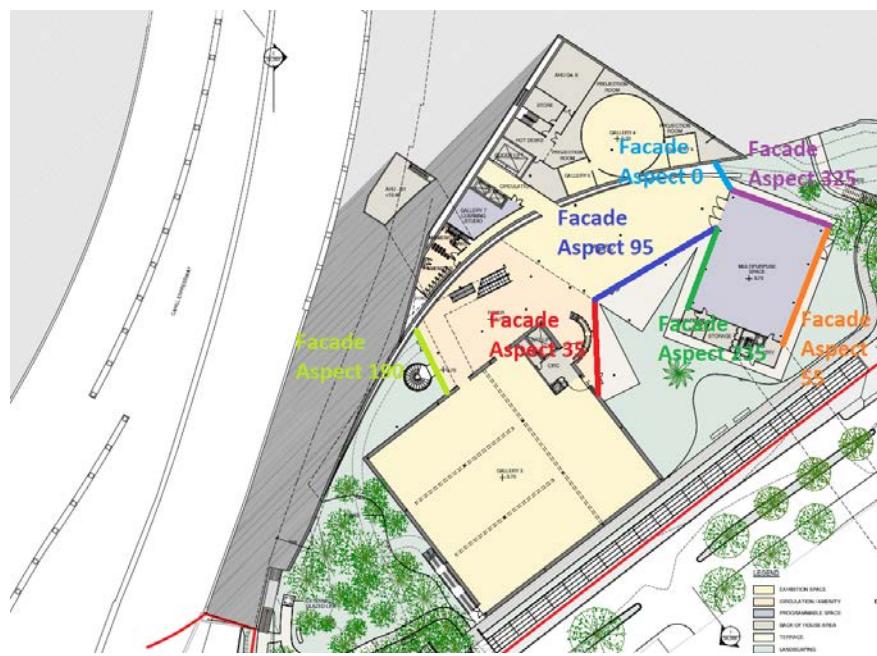


Figure 3 Lower Level 2 Glazing

## 2.2.2 Viewpoints

The image below is a consolidated set of viewpoints and view angles these viewpoint have of the facades.

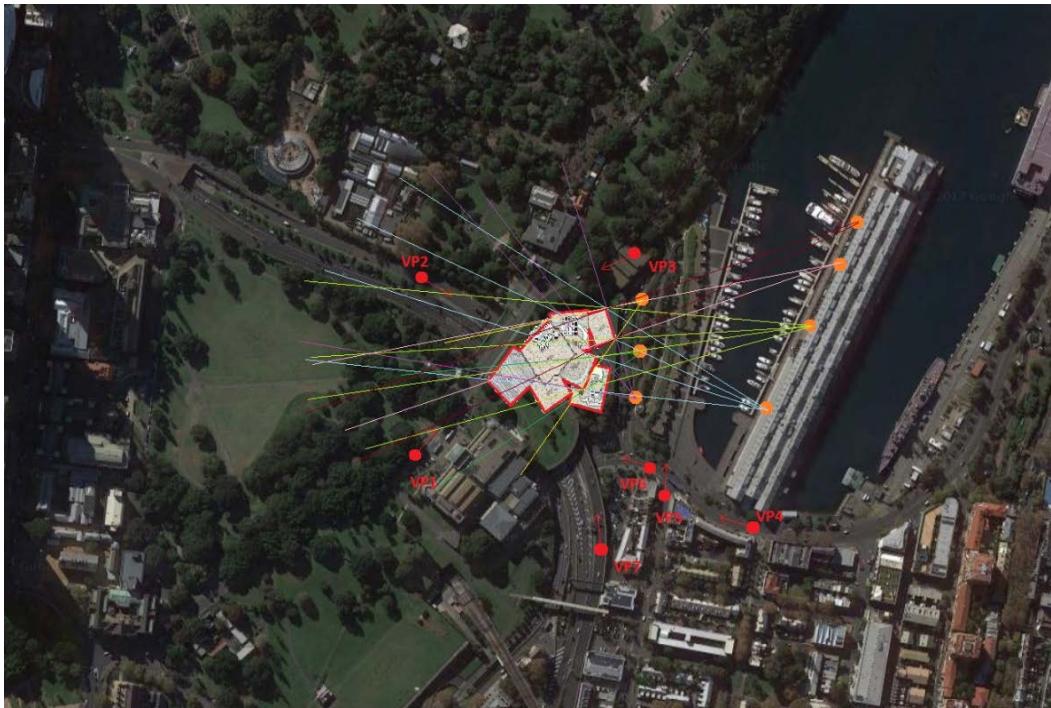
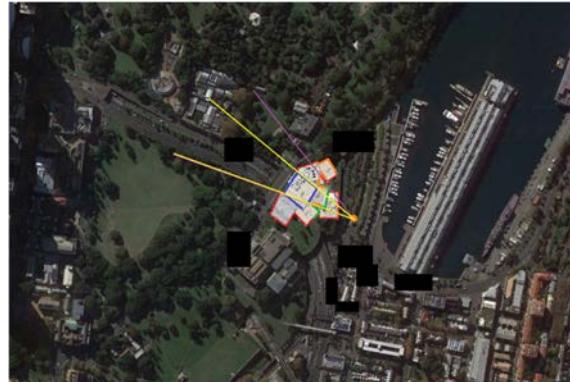


Figure 4 Consolidated Viewpoints including those from Pedestrian and Traffic Reflectivity Assessment

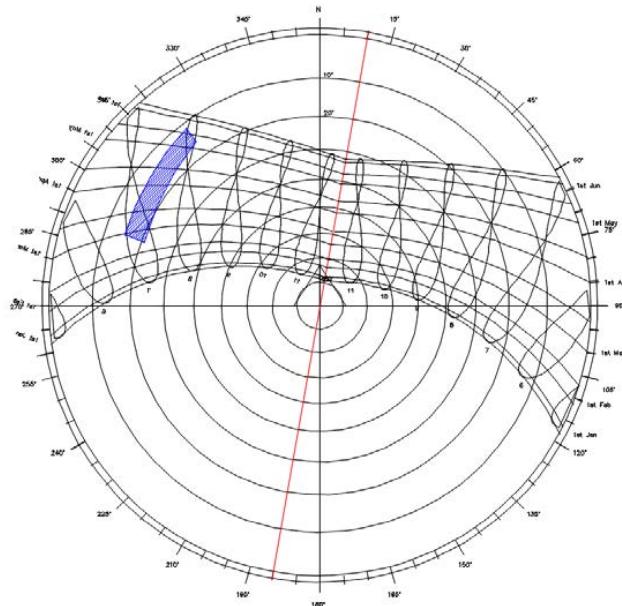
### 2.2.3 Method of Assessment

The following method has been used in the assessment below:

- The orientation of each of the glazed facades has been determined and is identified on the image above as the Façade Aspect. These angles are used in the generation of the reflected image stereographic diagram.
- Each of the glazed façades visible from the viewpoint have been identified and are shown in the images for each location. These angles are recorded for each location in the relevant table.



- The extent of façade visible from the viewpoint has been determined as both vertical and horizontal bearing angle. These bearing angles are overlayed on the reflected stereographic diagram and where the reflected sunpath and intersect align the sun maybe be visible to the viewpoint.



### 2.2.4 Interpretation

The intersection does not guarantee a reflected light will be visible or cause nuisance as obstruction and actual viewpoint may result in the sun not being visible.

The sun's position on the glazed elevation will vary in time, appearing in different position through the period it may be visible, it is not a static image

The material of the façade is important and the focus of this review has been for the glazed elevations as the material property of interest is the specular reflectivity of the glass. Other solid materials have different properties.

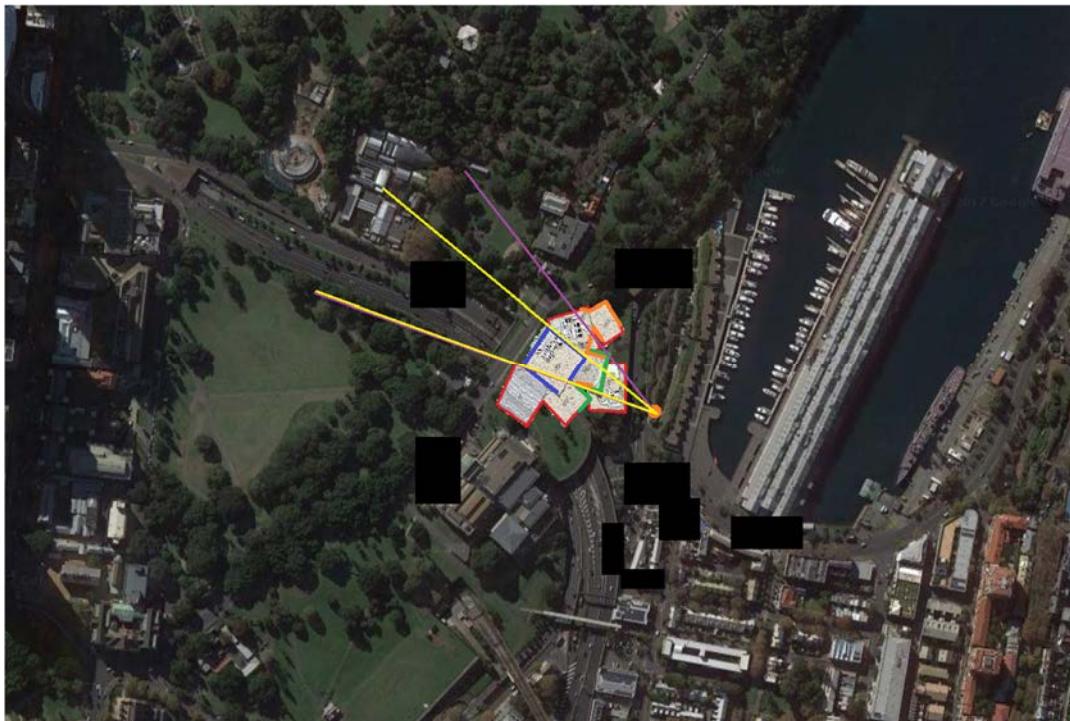
### 3. Impact on Wharf Terraces

#### 3.1 Point 1 - Wharf Terraces gym (level 1 above ground)

The image below identifies the glazed façades visible from the viewpoint in question.

There are two glazed facades visible from this viewpoint:

- o Eastern wall of Entry Level of Entry Pavilion
- o Eastern wall of Level 1 of café



From these viewpoints the following bearing angles have been calculated. These angles and the Façade Aspect angle which are used in the reflected stereographic protractor to develop the reflected solar path and views extents.

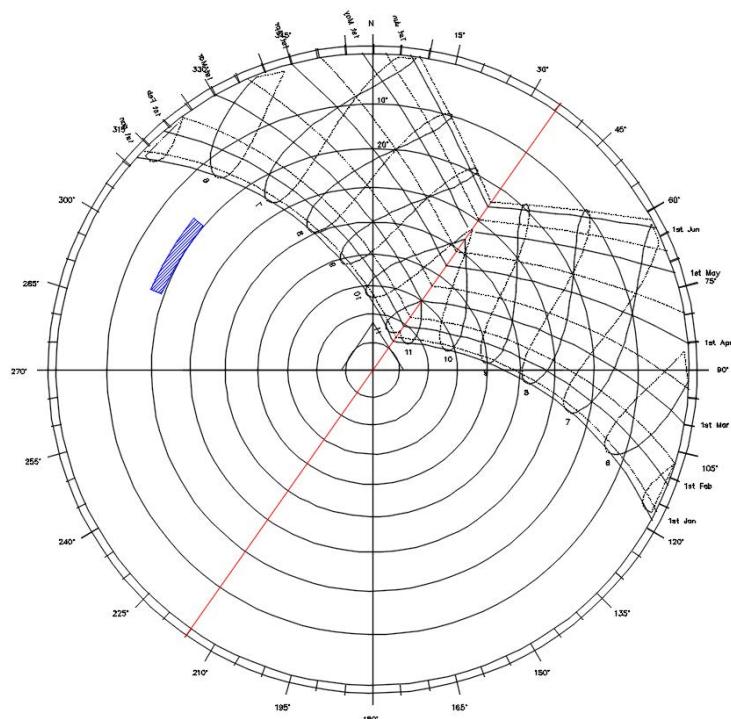
Lincoln Crescent is at 3m RL to the Art Gallery. The bottom of the Lower Level 2 glazing is at 9.7m RL, the top of the Lower Level 2 glazing is at 16.42m RL; the top of Lower Level 1 glazing is at 22.0m RL and the top of the Entry Level glazing is at 25.4m RL. The Vertical bearing angles have been calculated based on these heights.

	Vertical Bearing Angle		Horizontal Bearing Angle (0° at North)	
	Lower Bound	Upper Bound	Lower Bound	Upper Bound
Façade Aspect 125 (70m distant) Eastern wall of Entry Level of Entry Pavilion	17.5°	19.9°	290°	310°
Façade Aspect 100 (58m distant) Eastern wall of Level 1 of café	15.8°	20.77°	290°	323°



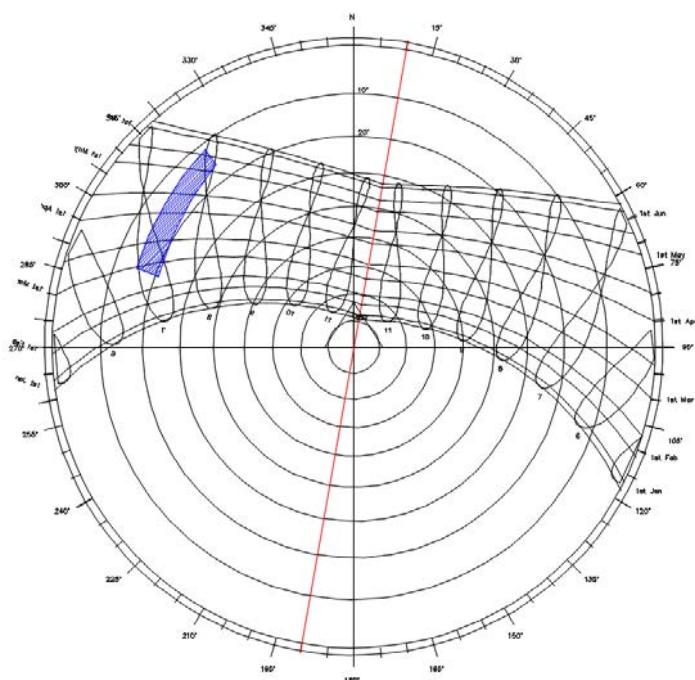
View image above, reflected sun image and view angle – blue lines (below)

### 3.1.1 Point 1 -Façade Aspect 125 - Eastern wall of Entry Level of Entry Pavilion



There is no reflection from this façade to this viewpoint.

3.1.2 Point 1- Façade Aspect 100 - Eastern wall of Level 1 of café



There is the potential for light being reflected between 6am and 9am in the summer months through to 7am and 8am in winter.

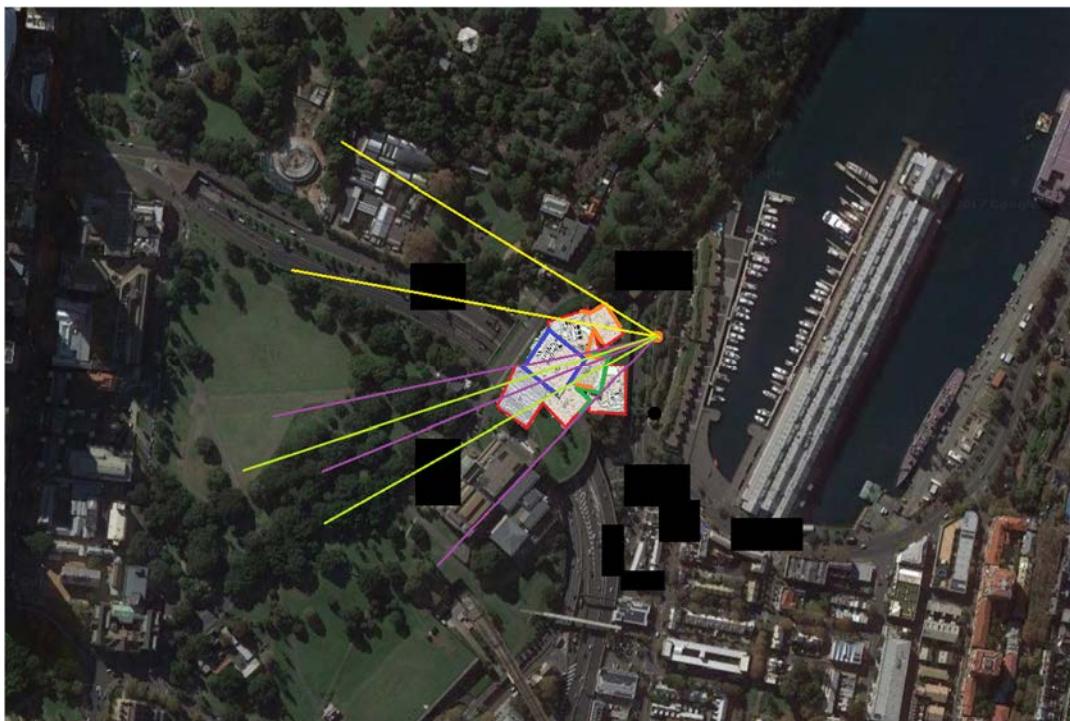
The vertical view angle may be impacted by the embankment and cut off the view of café due to the terrace area over Gallery 3.

### 3.2 Point 2 - Wharf Terraces lobby (Lobby entry ground Level)

The image below identifies the glazed façades visible from the viewpoint in question.

There are 5 façade elevations visible from this viewpoint:

- o North-eastern glazed wall of Level 2 Multi-Purpose Hall
- o Northern wall of Entry Level of Entry Pavilion
- o Eastern wall of Entry Level of Entry Pavilion
- o Eastern wall of Level 1 of café
- o Northern wall of Level 1 of café



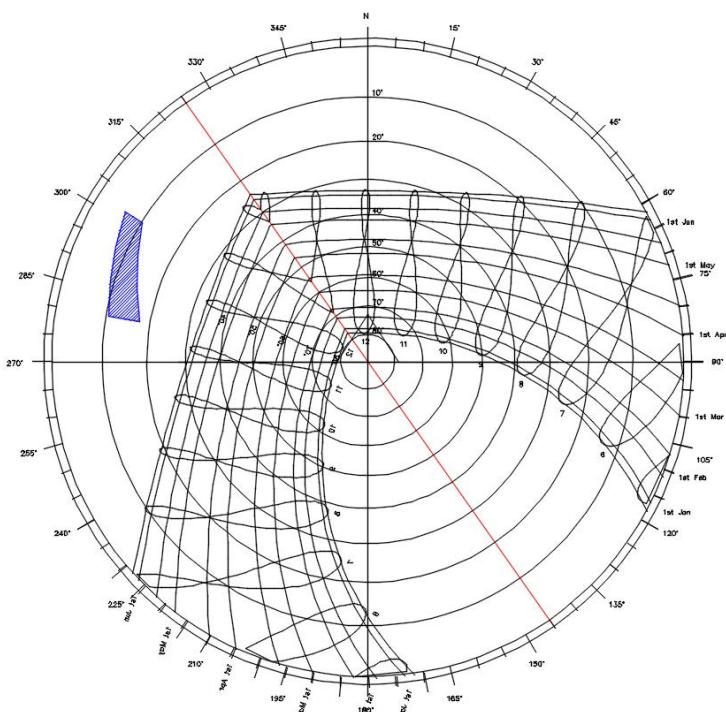
Lincoln Crescent is at 3m RL to the Art Gallery. The bottom of the Lower Level 2 glazing is at 9.7m RL, the top of the Lower Level 2 glazing is at 16.42m RL; the top of Lower Level 1 glazing is at 22.0m RL and the top of the Entry Level glazing is at 25.4m RL. The Vertical bearing angles have been calculated based on these heights.

	Vertical Bearing Angle		Horizontal Bearing Angle (0° at North)	
	Lower Bound	Upper Bound	Lower Bound	Upper Bound
Façade Aspect 55 (40m) North-eastern glazed wall of Level 2 Multi-Purpose Hall	13.6°	22.3°	280°	302°
Façade Aspect 35 (80m) Northern wall of Entry Level of Entry Pavilion	15.4°	17.6°	252°	275°
Façade Aspect 125 (80m) Eastern wall of Entry Level of Entry Pavilion	15.4°	17.6°	240°	252°
Façade Aspect 100 (55m) Eastern wall of Level 1 of café	16.6°	21.8°	243°	253°
Façade Aspect 35 (55m) Northern wall of Level 1 of café	16.6°	21.8°	218°	243°



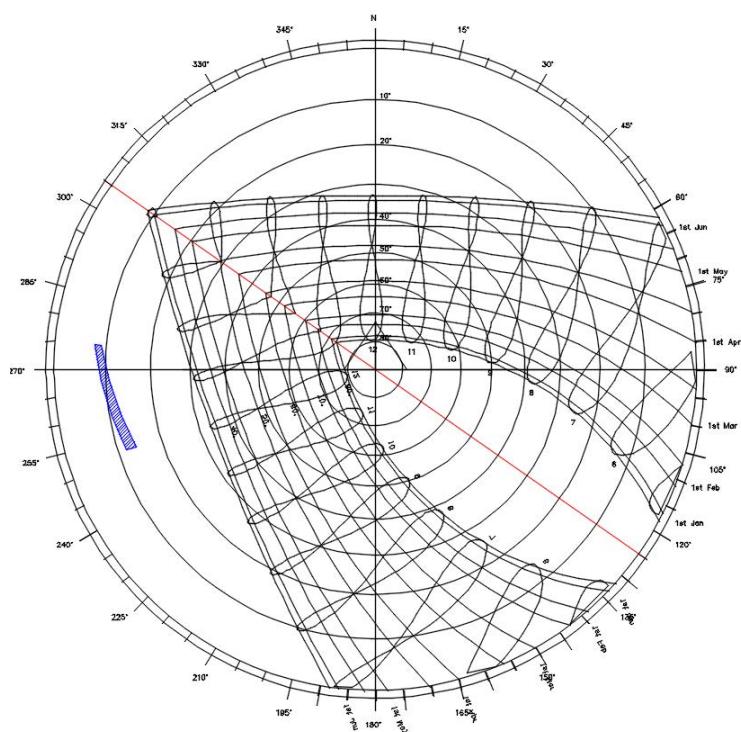
View image above, reflected sun image and view angle – blue lines (below)

### 3.2.1 Point 2 - Façade Aspect 55 - North-eastern glazed wall of Level 2 Multi-Purpose Hall



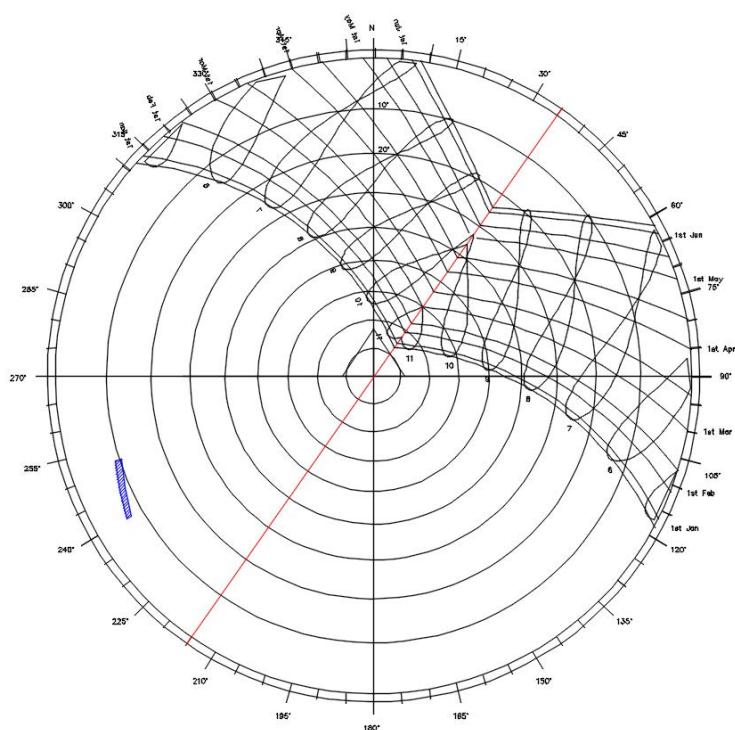
There is no risk of rogue reflections from this façade to this viewpoint.

### 3.2.2 Point 2- Façade Aspect 35 - Northern wall of Entry Level of Entry Pavilion



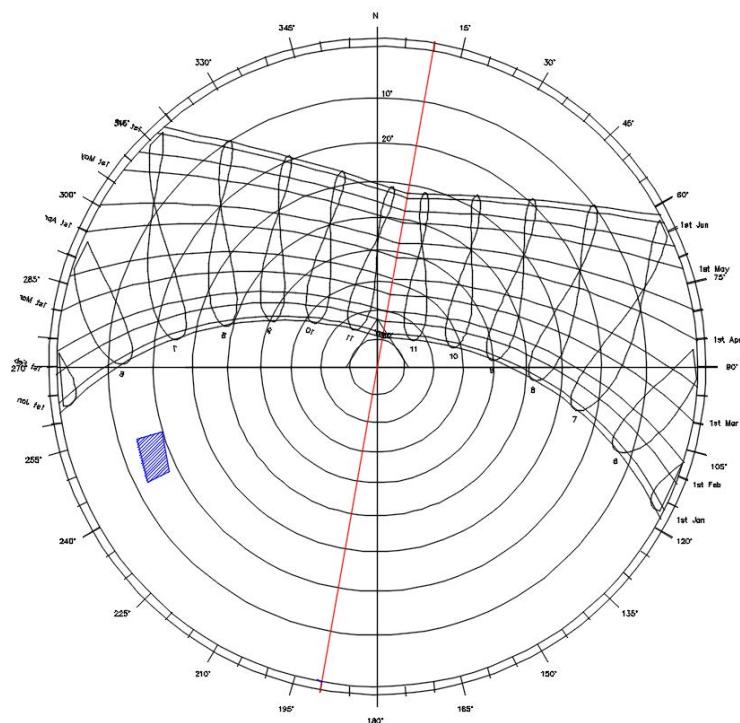
There is no risk of rogue reflections from this façade to this viewpoint.

### 3.2.3 Point 2 -Façade Aspect 125 - Eastern wall of Entry Level of Entry Pavilion



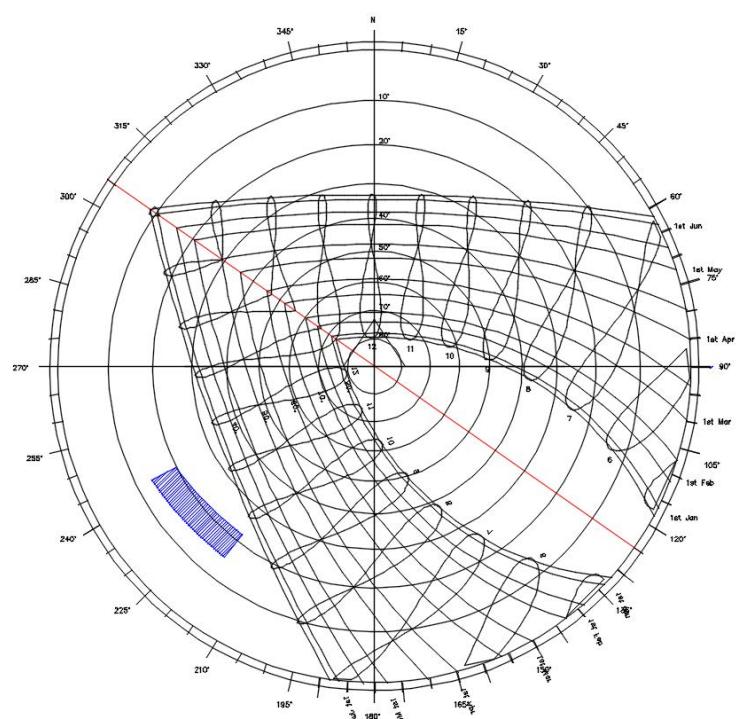
There is no risk of rogue reflections from this façade to this viewpoint.

**3.2.4 Point 2 -Façade Aspect 100 - Eastern wall of Level 1 of café**



There is no risk of rogue reflections from this façade to this viewpoint.

**3.2.5 Point 2- Façade Aspect 35 - Northern wall of Level 1 of café**

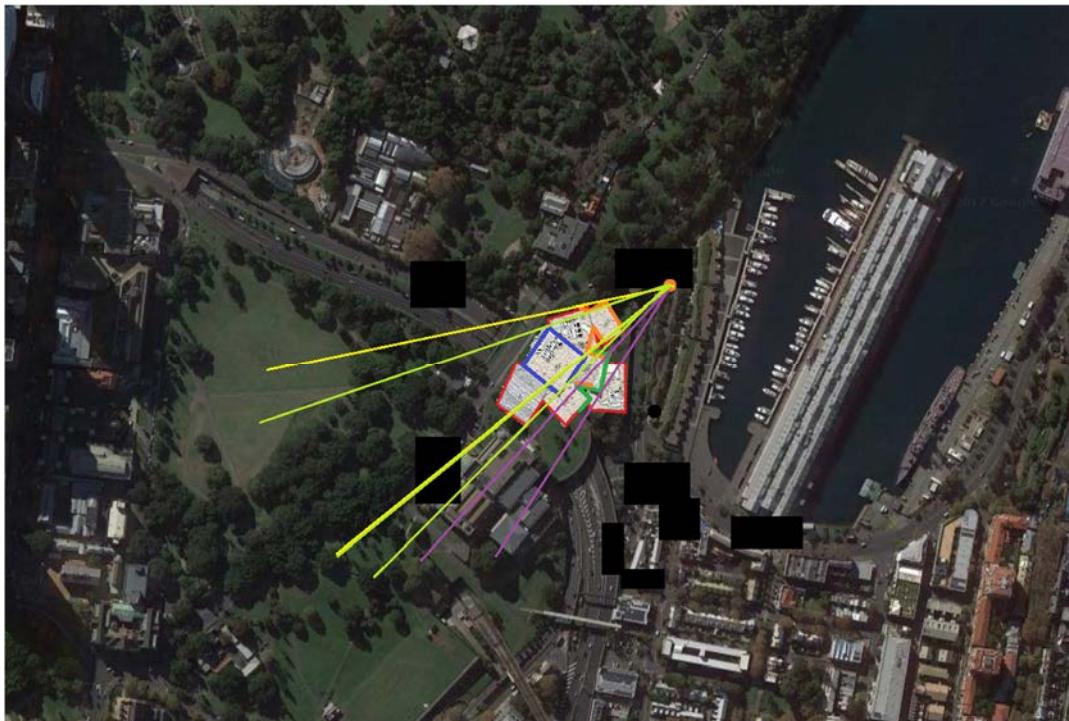


There is no risk of rogue reflections from this façade to this viewpoint.

### 3.3 Point 3 - Wharf Terraces resident car park exit (Ground Level – Lincoln Crescent)

The image below identifies the glazed façades visible from the viewpoint in question. There are potentially 4 glazed façade elevations visible from this viewpoint. The substation may obstruct some views.

- North-eastern glazed wall of Level 2 Multi-Purpose Hall
- Northern wall of Entry Level of Entry Pavilion
- Eastern wall of Entry Level of Entry Pavilion
- Eastern wall of Level 1 of café



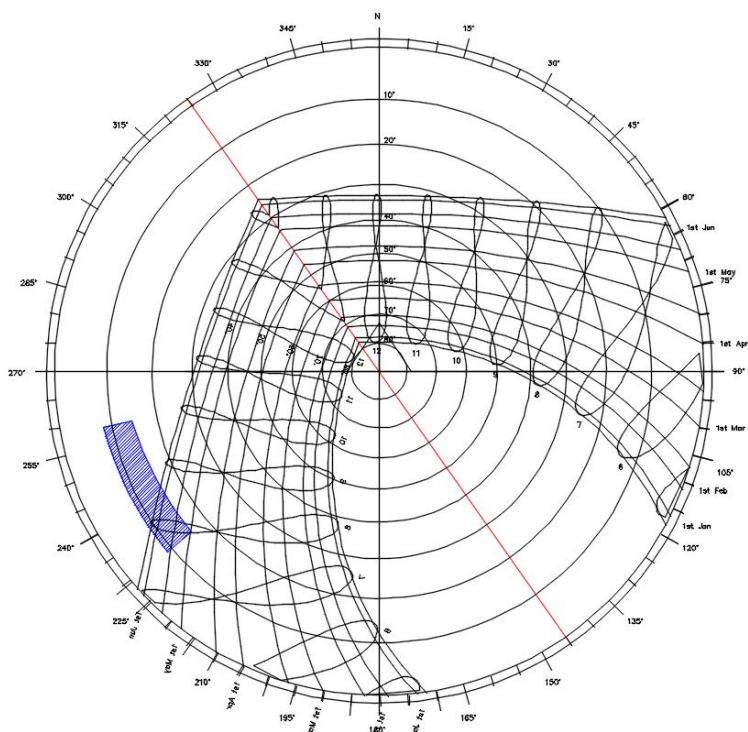
Lincoln Crescent is at 3m RL to the Art Gallery. The bottom of the Lower Level 2 glazing is at 9.7m RL, the top of the Lower Level 2 glazing is at 16.42m RL; the top of Lower Level 1 glazing is at 22.0m RL and the top of the Entry Level glazing is at 25.4m RL. The Vertical bearing angles have been calculated based on these heights.

	Vertical Bearing Angle		Horizontal Bearing Angle (0° at North)	
	Lower Bound	Upper Bound	Lower Bound	Upper Bound
Façade Aspect 55 (65m) North-eastern glazed wall of Level 2 Multi-Purpose Hall	8.5°	14.1°	230°	258°
Façade Aspect 35 (115m) Northern wall of Entry Level of Entry Pavilion	10.8°	12.5°	230°	251°
Façade Aspect 125 (115m) Eastern wall of Entry Level of Entry Pavilion	10.8°	12.5°	225°	230°
Façade Aspect 100 (95m) Eastern wall of Level 1 of café	9.8°	13°	212°	222°



View image above, reflected sun image and view angle – blue lines (below)

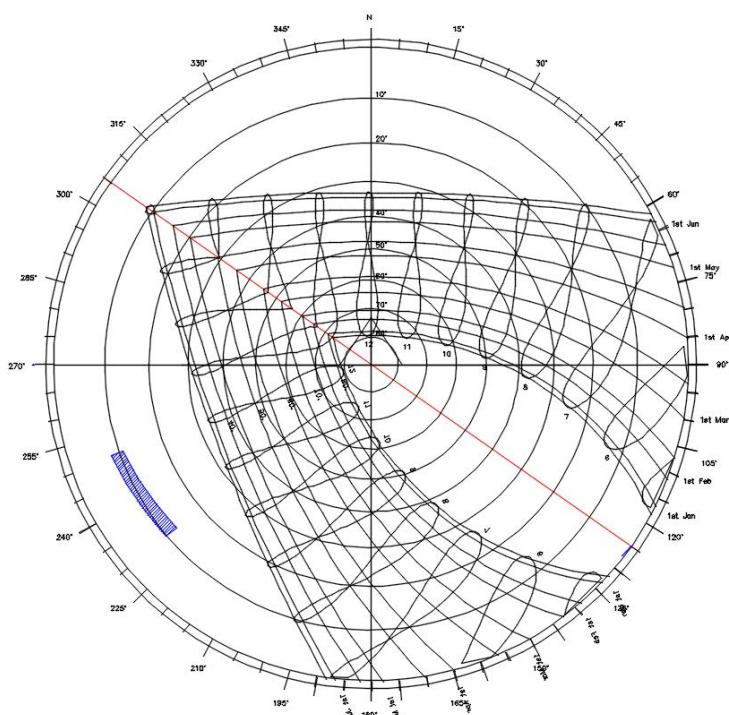
### 3.3.1 Point 3 - Façade Aspect 55 - North-eastern glazed wall of Level 2 Multi-Purpose Hall



There is the potential for disability glare for between 07:00am and 08:30 am between May and July. A Glare protector has been overlaid onto the driver position in the next image. It can be shown that glare is not an issue if the reflectivity of materials used is less than 15%

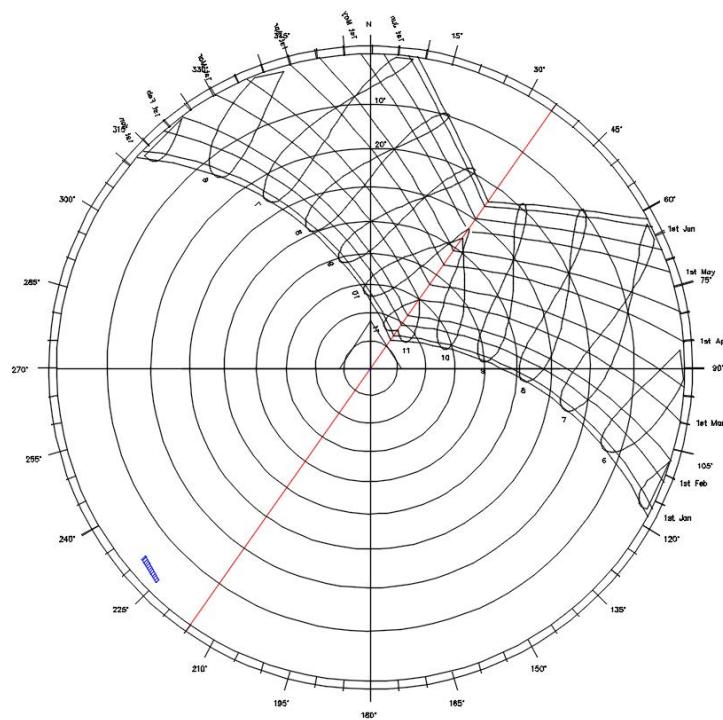


### 3.3.2 Point 3 - Façade Aspect 35 - Northern wall of Entry Level of Entry Pavilion



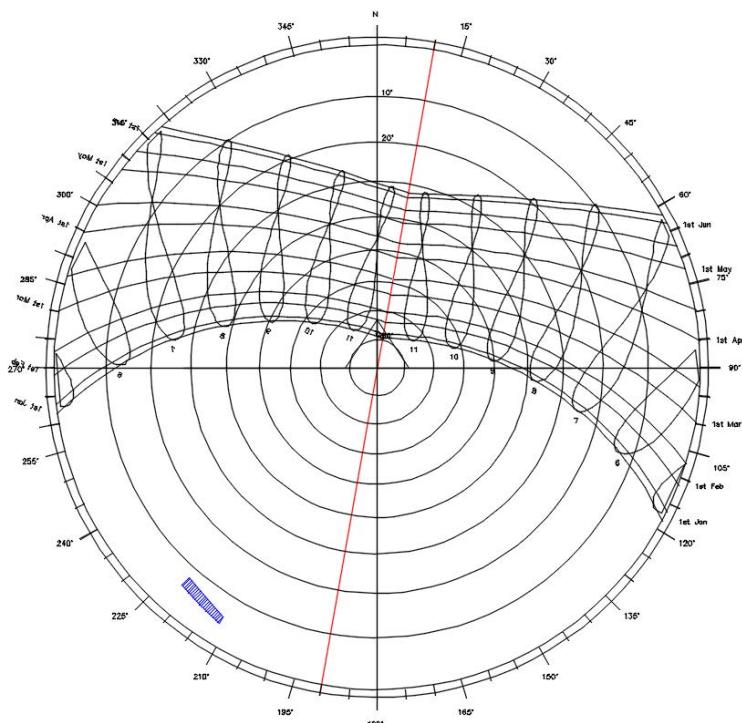
There is no risk of rogue reflections from this façade to this viewpoint.

**3.3.3 Point 3 -Façade Aspect 125 - Eastern wall of Entry Level of Entry Pavilion**



There is no risk of rogue reflections from this façade to this viewpoint.

**3.3.4 Point 3 - Façade Aspect 100 - Eastern wall of Level 1 of café**



There is no risk of rogue reflections from this façade to this viewpoint.

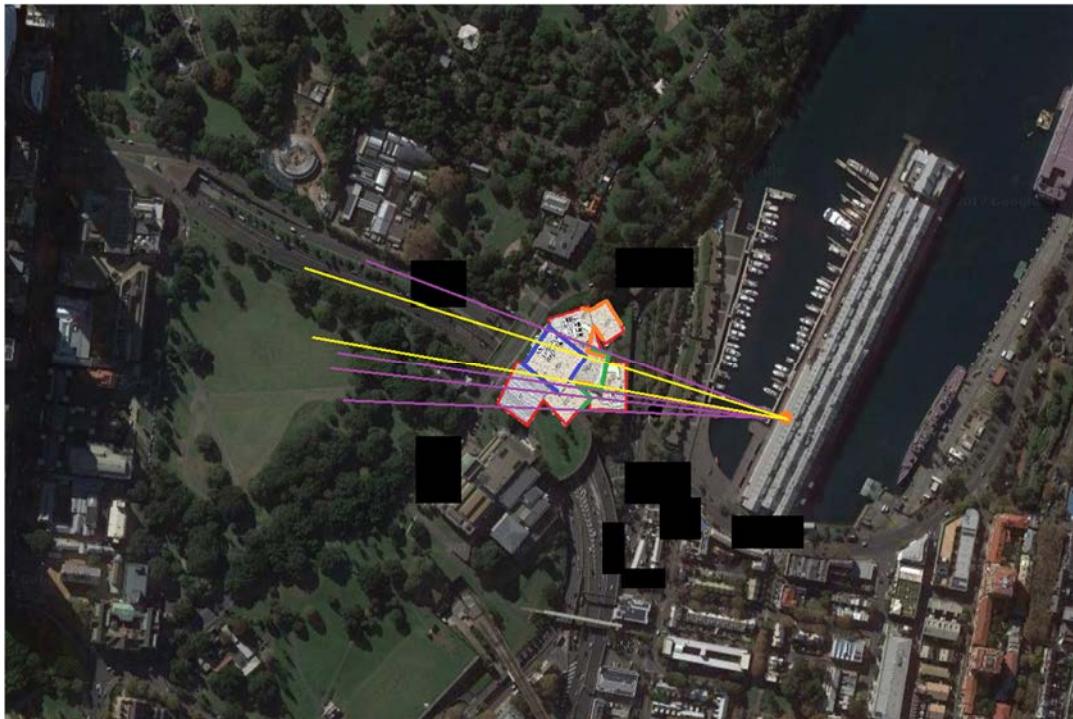
## 4. Impact on Finger Wharf

### 4.1 Point 4 - OTTO restaurant on Woolloomooloo Finger Wharf (street level – on wharf)

The image below identifies the glazed façades visible from the viewpoint in question.

There are four facades visible from this viewpoint:

- o Northern wall of Entry Level of Entry Pavilion
- o Eastern wall of Entry Level of Entry Pavilion
- o Eastern wall of Level 1 of café
- o Eastern wall of Level 1 of shop



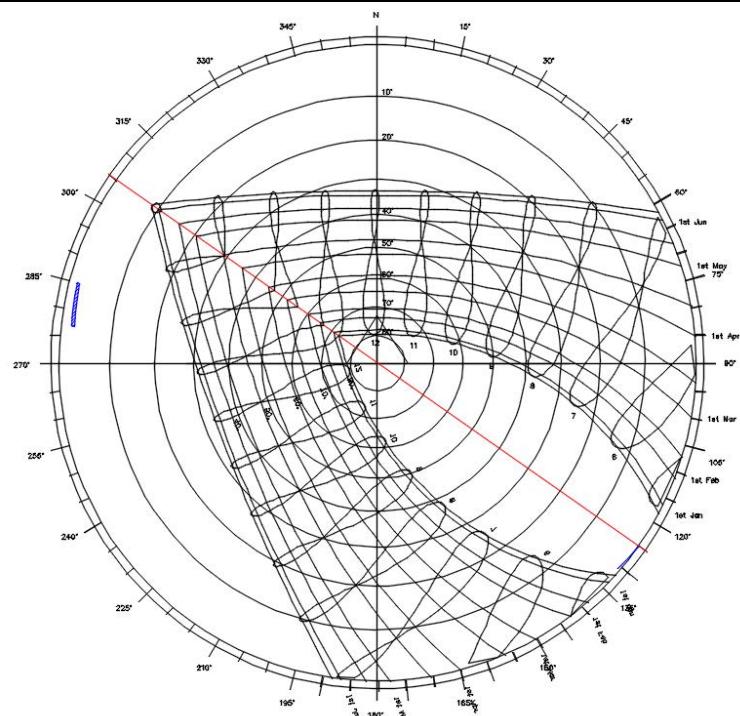
The level of seating at OTTO is approximately 5m RL to the Art Gallery. The bottom of the Lower Level 2 glazing is at 9.7m RL, the top of the Lower Level 2 glazing is at 16.42m RL; the top of Lower Level 1 glazing is at 22.0m RL and the top of the Entry Level glazing is at 25.4m RL. The Vertical bearing angles have been calculated based on these heights.

	Vertical Bearing Angle		Horizontal Bearing Angle (0° at North)	
	Lower Bound	Upper Bound	Lower Bound	Upper Bound
Façade Aspect 35 (210m) Northern wall of Entry Level of Entry Pavilion	4.6°	5.6°	282°	285°
Façade Aspect 125 (210m) Eastern wall of Entry Level of Entry Pavilion	4.6°	5.6°	279°	282°
Façade Aspect 100 (190m) Eastern wall of Level 1 of café	3.4°	5.1°	278°	285°
Façade Aspect 145 (190m) Eastern wall of Level 1 of shop	3.4°	5.1°	272°	275°



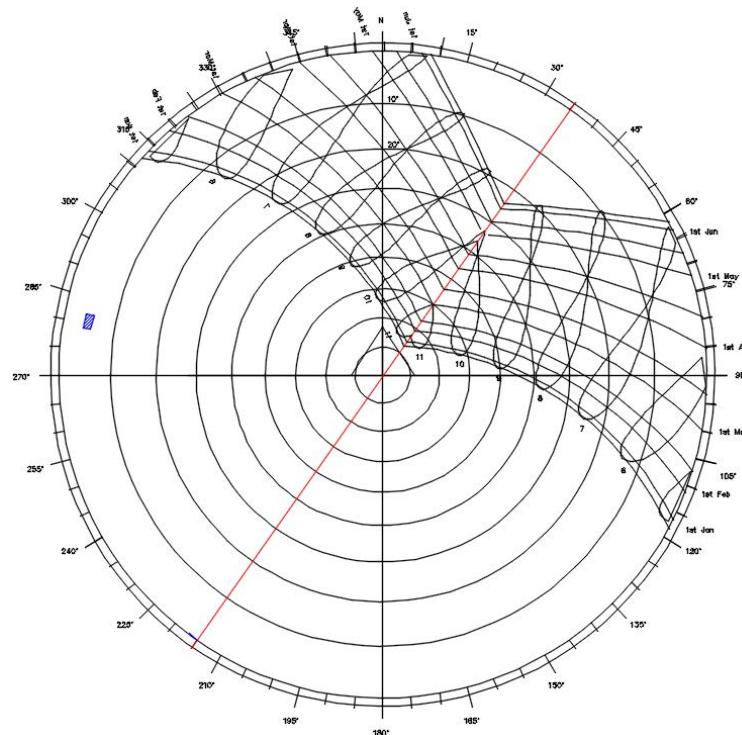
View image above, reflected sun image and view angle – blue lines (below)

#### 4.1.1 Point 4 -Façade Aspect 35 - Northern wall of Entry Level of Entry Pavilion



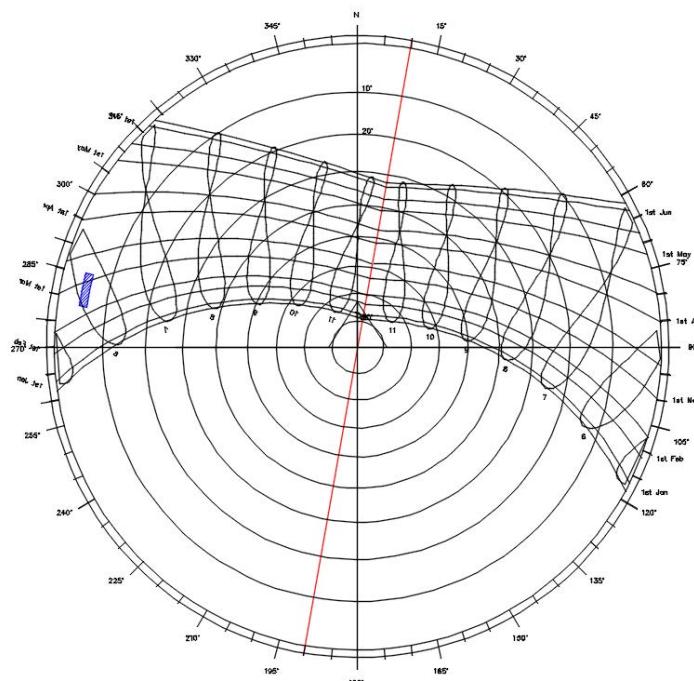
There is no risk of rogue reflections from this façade to this viewpoint.

**4.1.2 Point 4 - Façade Aspect 125 - Eastern wall of Entry Level of Entry Pavilion**



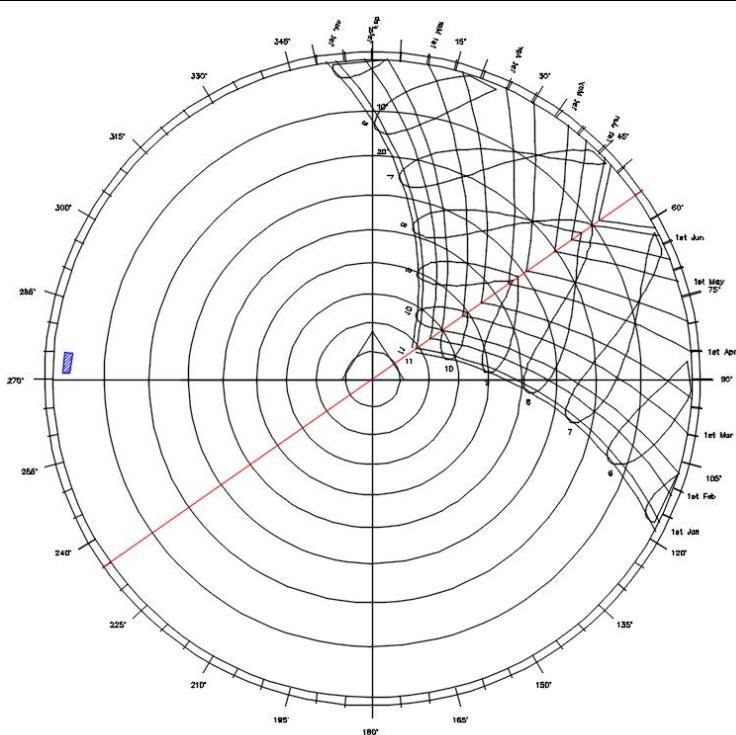
There is no risk of rogue reflections from this façade to this viewpoint.

**4.1.3 Point 4 - Façade Aspect 100 - Eastern wall of Level 1 of café**



Glare will reach this viewpoint for approximately 10 minutes each day, between 545am and 6am in February and November.

4.1.4 Point 4 - Façade Aspect 145 - Eastern wall of Level 1 of shop



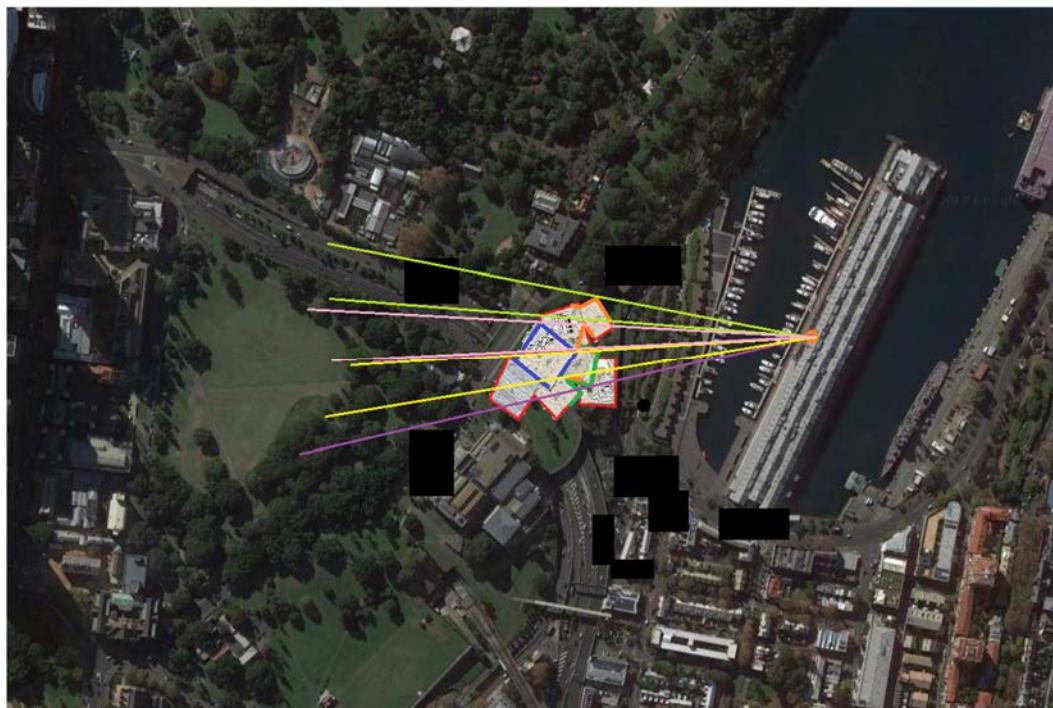
There is no risk of rogue reflections from this façade to this viewpoint.

#### 4.2 Point 5 - Finger Wharf apartment 108

The image below identifies the glazed façades visible from the viewpoint in question.

There are 5 glazed facades visible from this viewpoint:

- o North-eastern glazed wall of Level 2 Multi-Purpose Hall
- o Northern wall of Entry Level of Entry Pavilion
- o Eastern wall of Entry Level of Entry Pavilion
- o Eastern wall of Level 1 of café
- o Northern wall of Level 1 of café



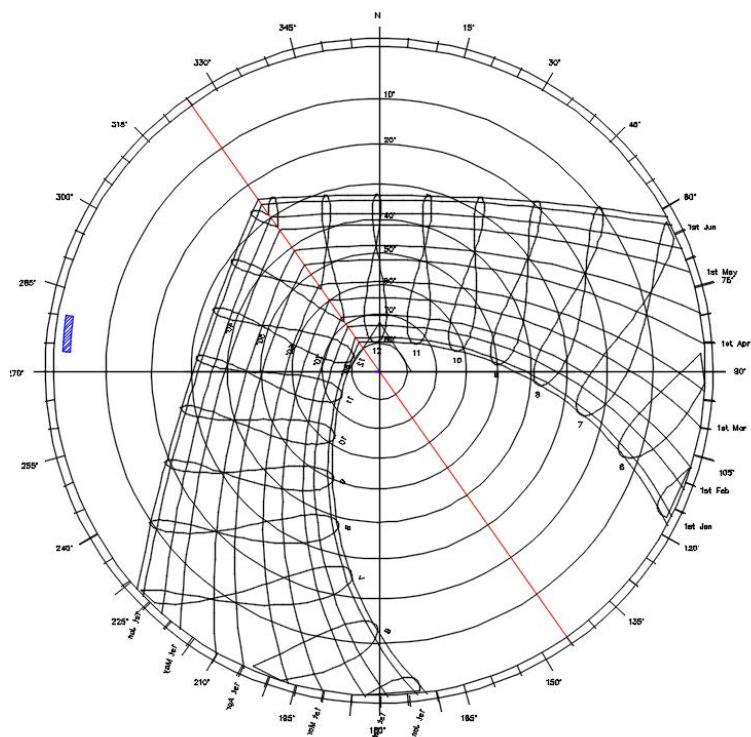
The bottom of the Level 1 apartment on the wharf is approximately 4.5m RL to the Art Gallery and the top of the Level 1 apartment on the wharf is approximately 11m RL to the Art Gallery (worst case is used). The bottom of the Lower Level 2 glazing is at 9.7m RL, the top of the Lower Level 2 glazing is at 16.42m RL; the top of Lower Level 1 glazing is at 22.0m RL and the top of the Entry Level glazing is at 25.4m RL. The Vertical bearing angles have been calculated based on these heights.

	Vertical Bearing Angle		Horizontal Bearing Angle (0° at North)	
	Lower Bound	Upper Bound	Lower Bound	Upper Bound
Façade Aspect 55 (215m) North-eastern glazed wall of Level 2 Multi-Purpose Hall	1.4°	3.17°	274°	280°
Façade Aspect 35 (250m) Northern wall of Entry Level of Entry Pavilion	4°	4.8°	266°	273°
Façade Aspect 125 (250m) Eastern wall of Entry Level of Entry Pavilion	4°	4.8°	260°	266°
Façade Aspect 100 (230m) Eastern wall of Level 1 of café	3.0°	4.35°	257°	266°
Façade Aspect 35 (230m) Northern wall of Level 1 of café	3.0°	4.35°	266°	268°



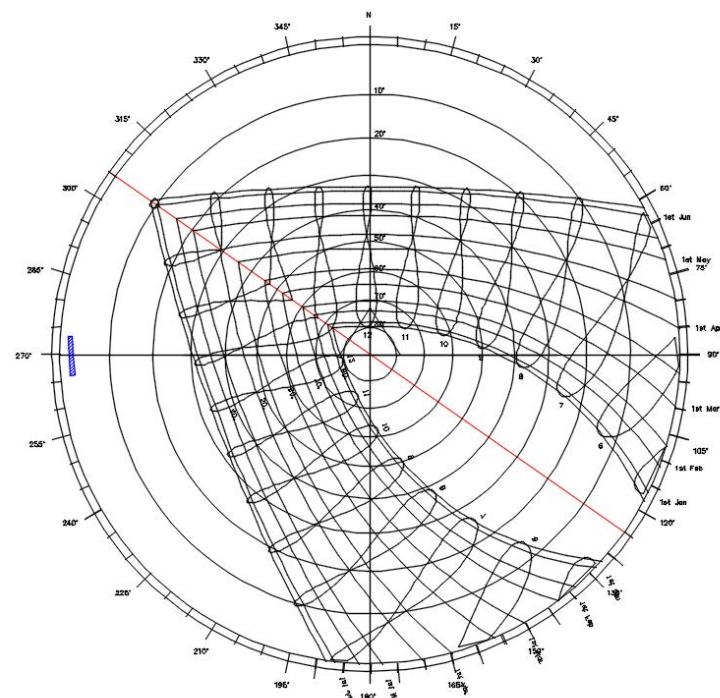
View image above, reflected sun image and view angle – blue lines (below)

#### 4.2.1 Point 5 - Façade Aspect 55 - North-eastern glazed wall of Level 2 Multi-Purpose Hall



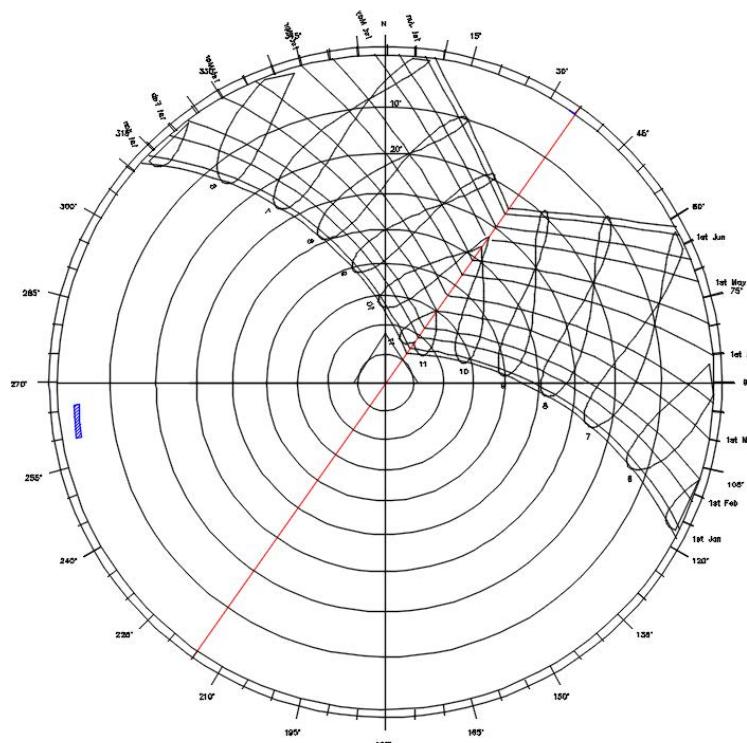
There is no risk of rogue reflections from this façade to this viewpoint.

**4.2.2 Point 5 -Façade Aspect 35 - Northern wall of Entry Level of Entry Pavilion**



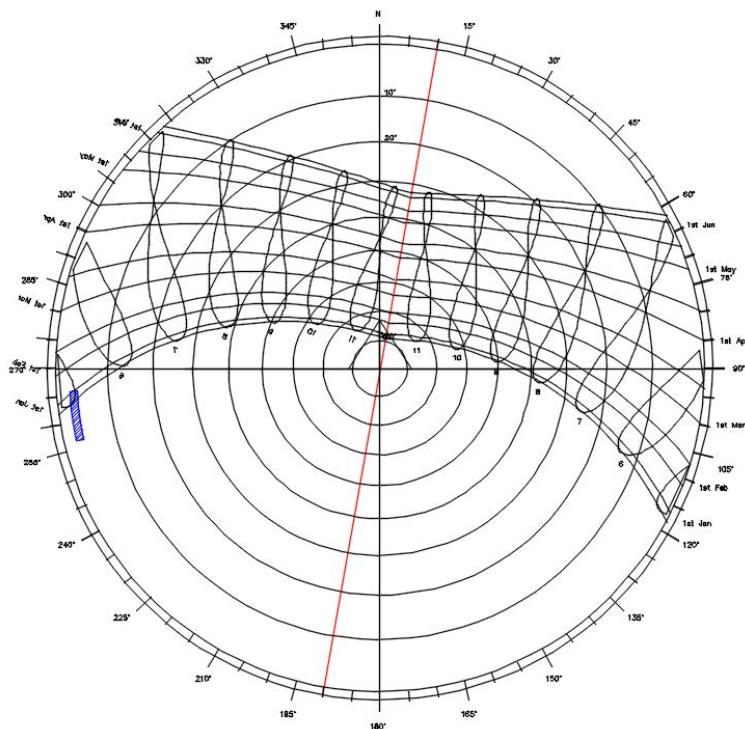
There is no risk of rogue reflections from this façade to this viewpoint.

**4.2.3 Point 5 -Façade Aspect 125 - Eastern wall of Entry Level of Entry Pavilion**



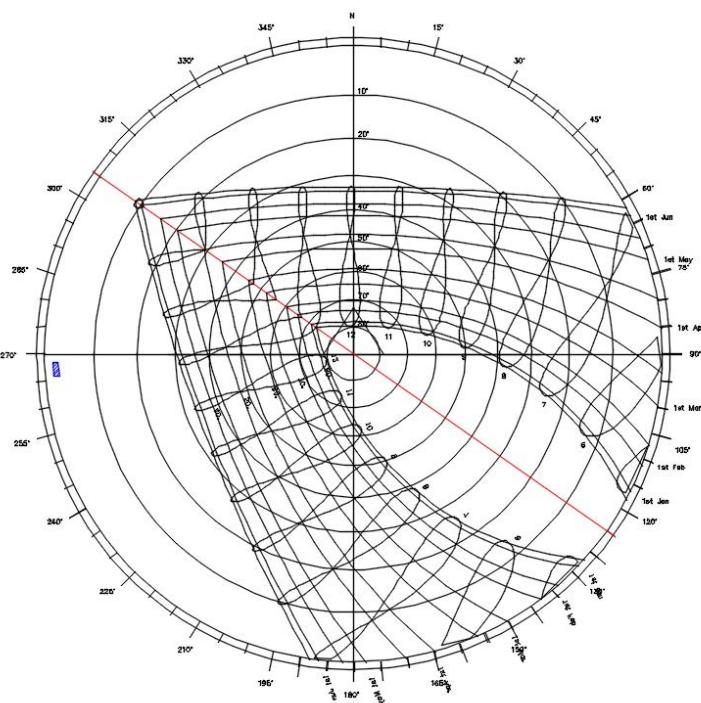
There is no risk of rogue reflections from this façade to this viewpoint.

**4.2.4 Point 5 -Façade Aspect 100 - Eastern wall of Level 1 of café**



There is the potential for glare between 5am and 5:15am from late December to early January.

**4.2.5 Point 5 - Façade Aspect 35 - Northern wall of Level 1 of café**



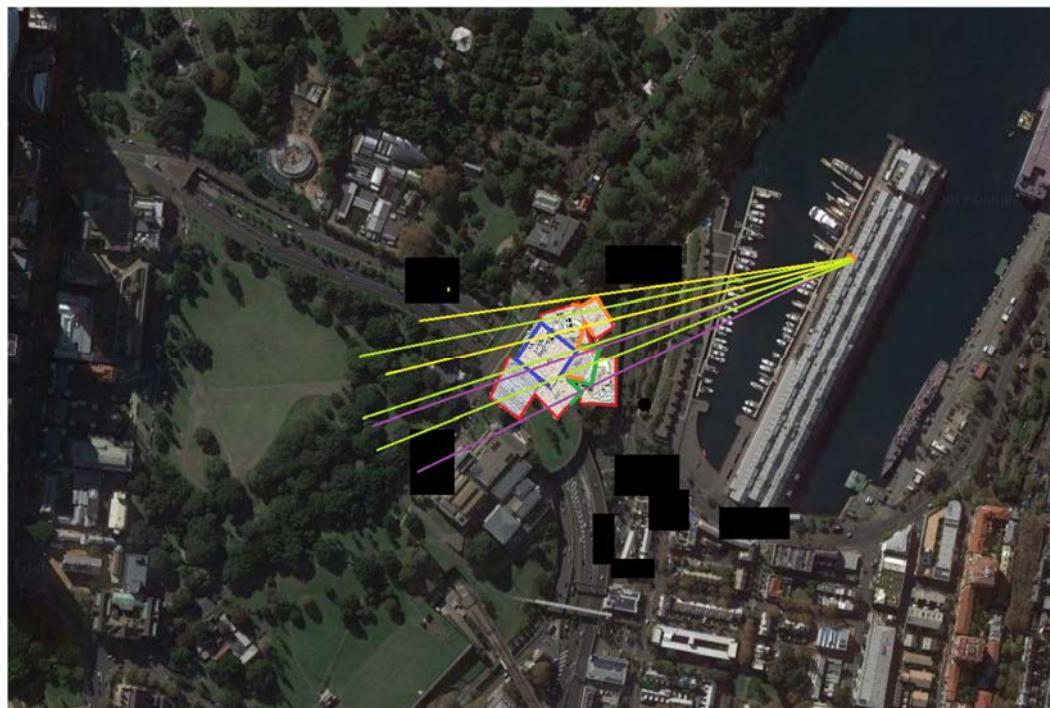
There is no risk of rogue reflections from this façade to this viewpoint.

#### 4.3 Point 6 - Finger Wharf apartment 415

The image below identifies the glazed façades visible from the viewpoint in question.

There are 5 glazed facades visible from this viewpoint;

- o North-eastern glazed wall of Level 2 Multi-Purpose Hall
- o Northern wall of Entry Level of Entry Pavilion
- o Eastern wall of Entry Level of Entry Pavilion
- o Eastern wall of Level 1 of café
- o Northern wall of Level 1 of café



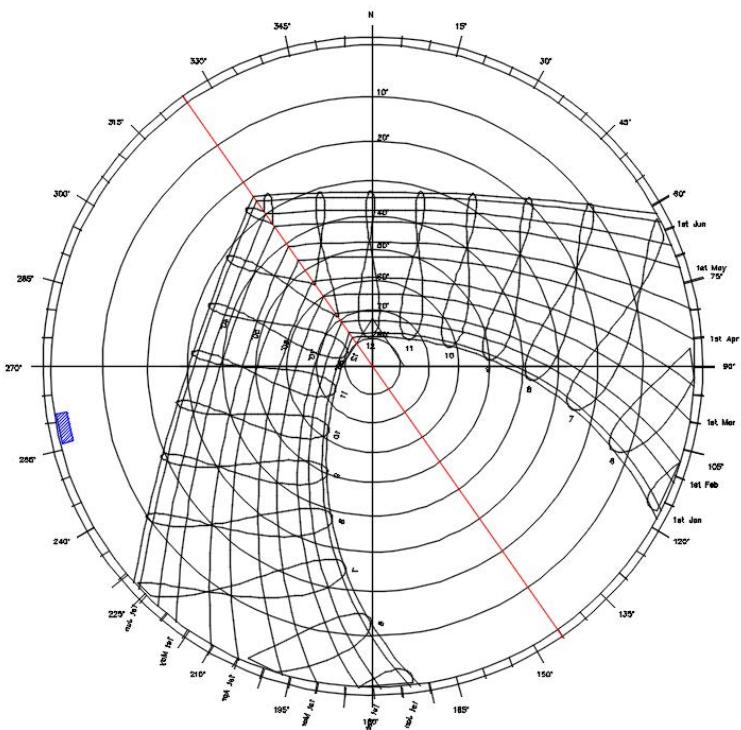
The bottom of the Level 1 apartment on the wharf is approximately 4.5m RL to the Art Gallery and the top of the Level 1 apartment on the wharf is approximately 11m RL to the Art Gallery (worst case is used). The bottom of the Lower Level 2 glazing is at 9.7m RL, the top of the Lower Level 2 glazing is at 16.42m RL; the top of Lower Level 1 glazing is at 22.0m RL and the top of the Entry Level glazing is at 25.4m RL. The Vertical bearing angles have been calculated based on these heights.

	Vertical Bearing Angle		Horizontal Bearing Angle (0° at North)	
	Lower Bound	Upper Bound	Lower Bound	Upper Bound
Façade Aspect 55 (260m) North-eastern glazed wall of Level 2 Multi-Purpose Hall	1.1°	2.6°	256°	262°
Façade Aspect 35 (310m) Northern wall of Entry Level of Entry Pavilion	3.2°	3.9°	251°	258°
Façade Aspect 125 (310m) Eastern wall of Entry Level of Entry Pavilion	3.2°	3.9°	247°	251°
Façade Aspect 100 (290m) Eastern wall of Level 1 of café	2.4°	3.5°	243°	250°
Façade Aspect 35 (290m) Northern wall of Level 1 of café	2.4°	3.5°	250°	253°



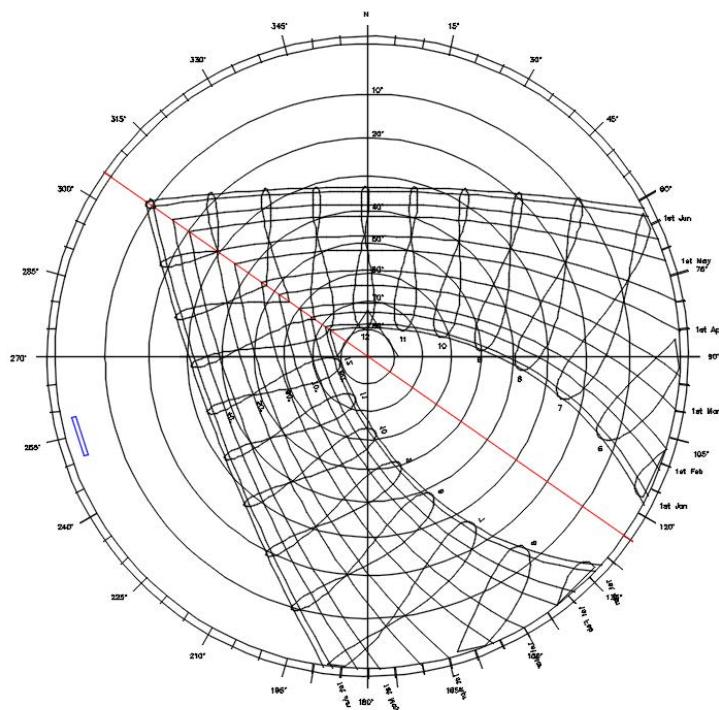
View image above, reflected sun image and view angle – blue lines (below)

#### 4.3.1 Point 6 -Façade Aspect 55 - North-eastern glazed wall of Level 2 Multi-Purpose Hall



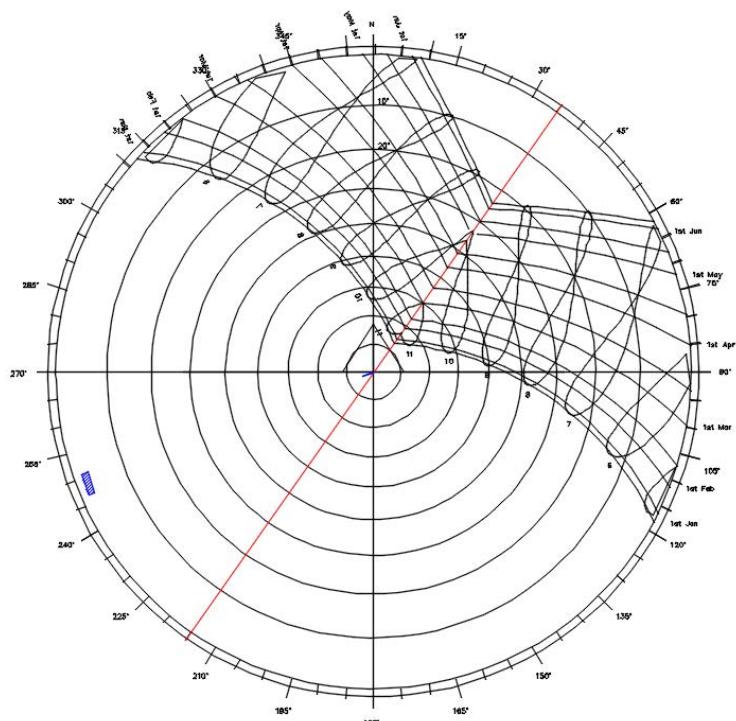
There is no risk of rogue reflections from this façade to this viewpoint.

**4.3.2 Point 6 - Façade Aspect 35 - Northern wall of Entry Level of Entry Pavilion**



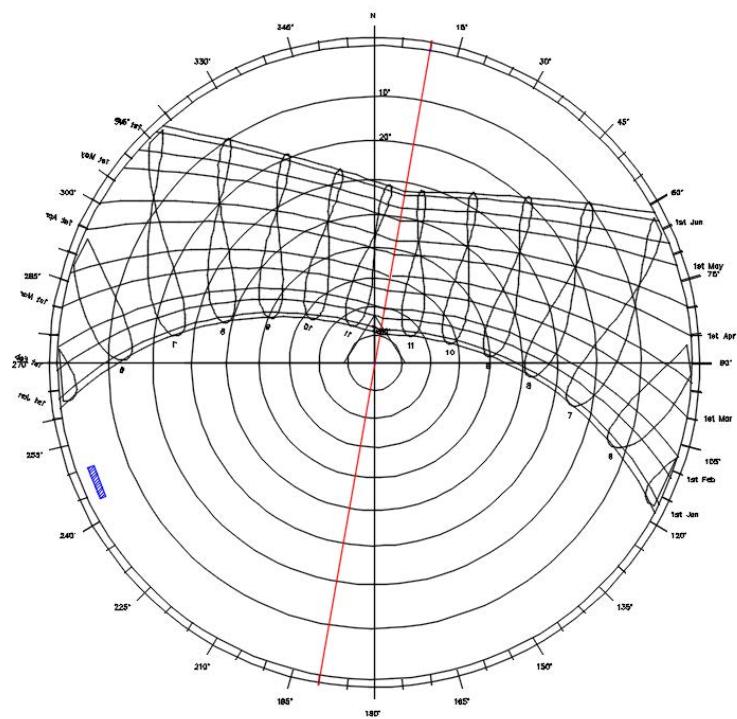
There is no risk of rogue reflections from this façade to this viewpoint.

**4.3.3 Point 6 - Façade Aspect 125 - Eastern wall of Entry Level of Entry Pavilion**



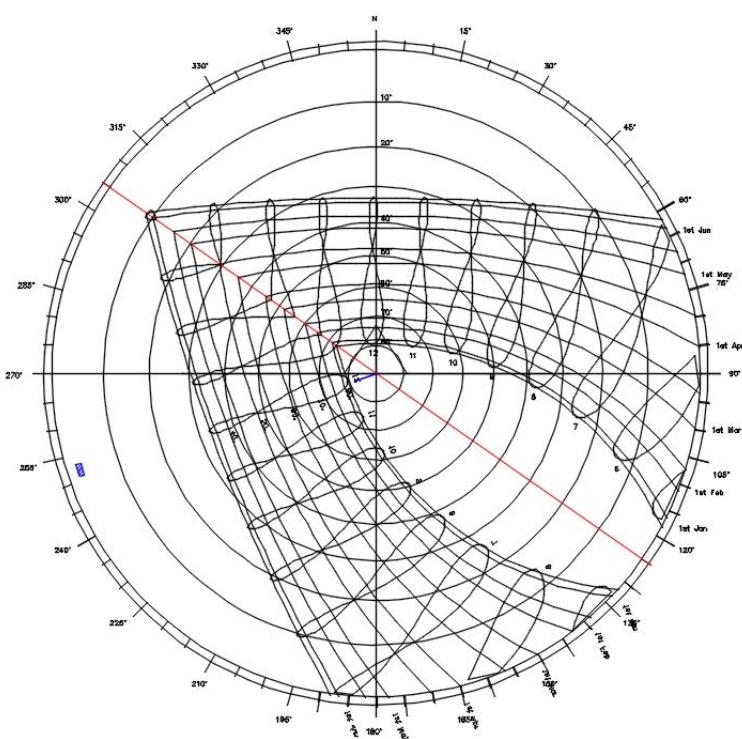
There is no risk of rogue reflections from this façade to this viewpoint.

**4.3.4 Point 6 - Façade Aspect 100 - Eastern wall of Level 1 of café**



There is no risk of rogue reflections from this façade to this viewpoint.

**4.3.5 Point 6 - Façade Aspect 35 - Northern wall of Level 1 of café**



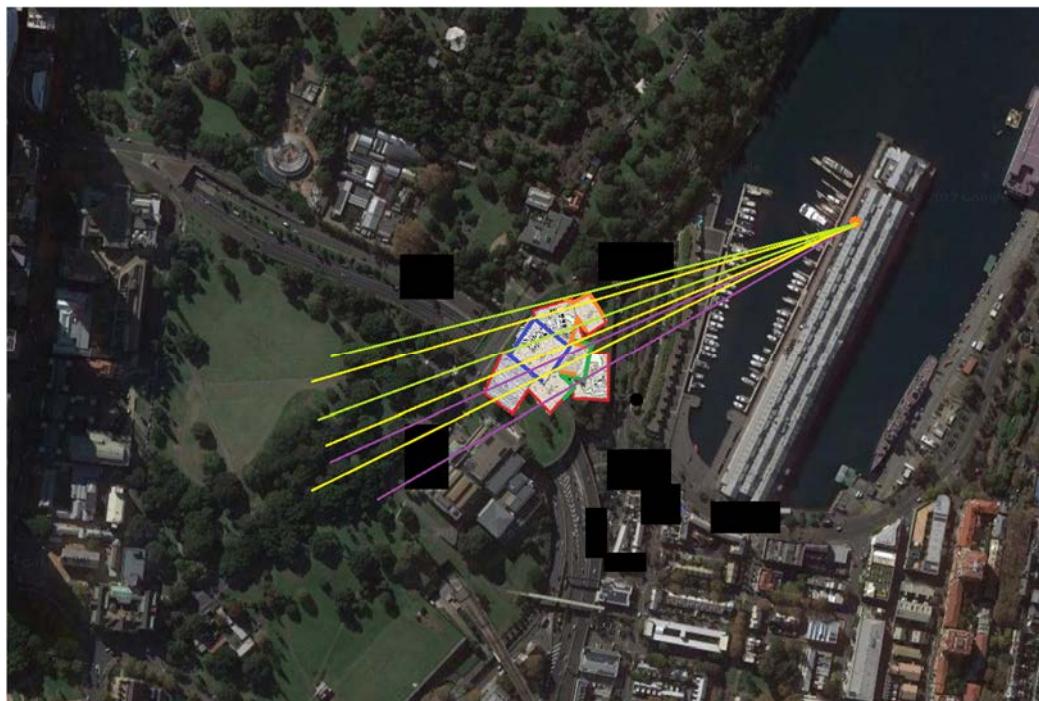
There is no risk of rogue reflections from this façade to this viewpoint.

#### 4.4 Point 7 - Finger Wharf apartment 507

The image below identifies the glazed façades visible from the viewpoint in question.

There are 5 glazed facades visible from this viewpoint;

- o North-eastern glazed wall of Level 2 Multi-Purpose Hall
- o Northern wall of Entry Level of Entry Pavilion
- o Eastern wall of Entry Level of Entry Pavilion
- o Eastern wall of Level 1 of café
- o Northern wall of Level 1 of café



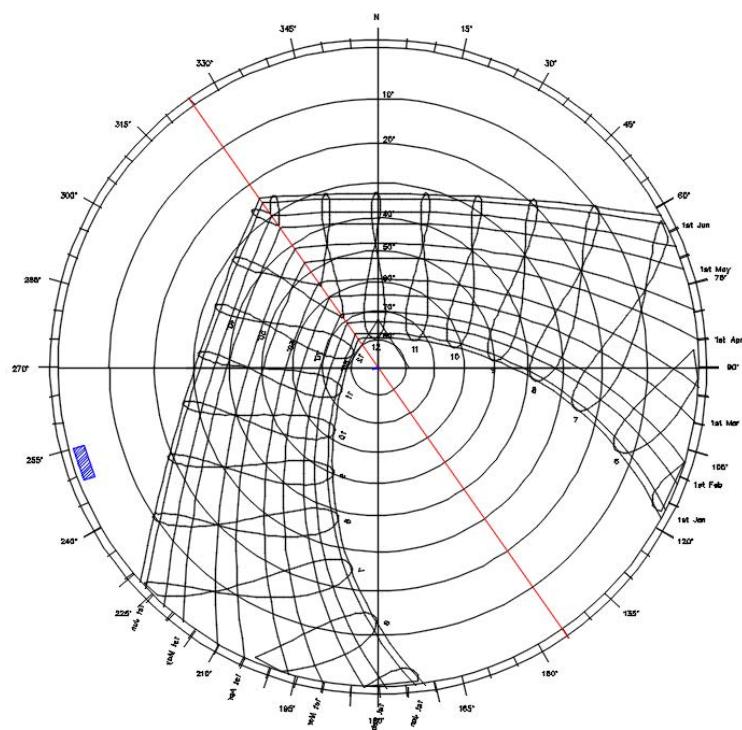
The bottom of the Level 1 apartment on the wharf is approximately 4.5m RL to the Art Gallery and the top of the Level 1 apartment on the wharf is approximately 11m RL to the Art Gallery (worst case is used). The bottom of the Lower Level 2 glazing is at 9.7m RL, the top of the Lower Level 2 glazing is at 16.42m RL; the top of Lower Level 1 glazing is at 22.0m RL and the top of the Entry Level glazing is at 25.4m RL. The Vertical bearing angles have been calculated based on these heights.

	Vertical Bearing Angle		Horizontal Bearing Angle (0° at North)	
	Lower Bound	Upper Bound	Lower Bound	Upper Bound
Façade Aspect 55 (280m) North-eastern glazed wall of Level 2 Multi-Purpose Hall	1.1°	2.4°	249°	255°
Façade Aspect 35 (340m) Northern wall of Entry Level of Entry Pavilion	2.9°	3.5°	246°	253°
Façade Aspect 125 (340m) Eastern wall of Entry Level of Entry Pavilion	2.9°	3.5°	243°	246°
Façade Aspect 100 (320m) Eastern wall of Level 1 of café	2.1°	3.1°	240°	245°
Façade Aspect 35 (320m) Northern wall of Level 1 of café	2.1°	3.1°	245°	248°



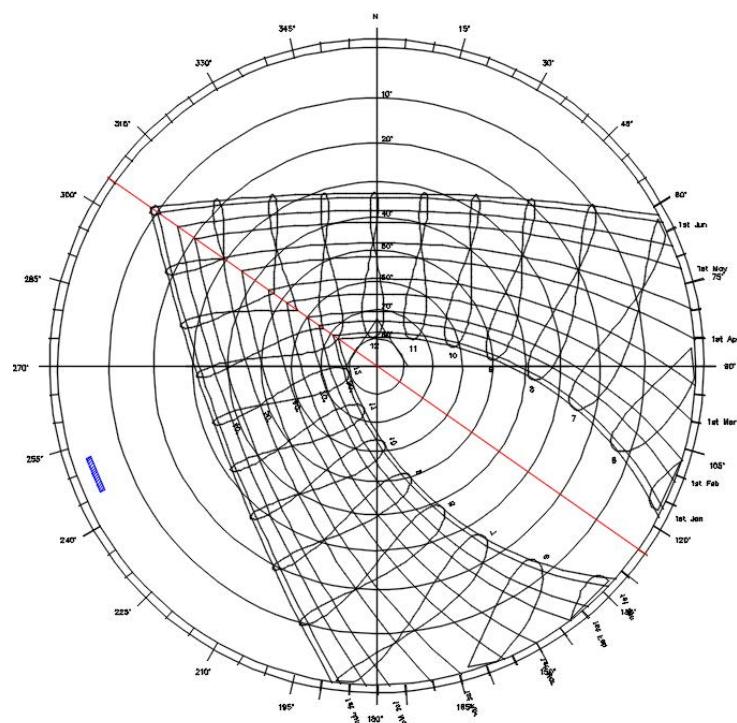
View image above, reflected sun image and view angle – blue lines (below)

#### 4.4.1 Point 7 - Façade Aspect 55 -North-eastern glazed wall of Level 2 Multi-Purpose Hall



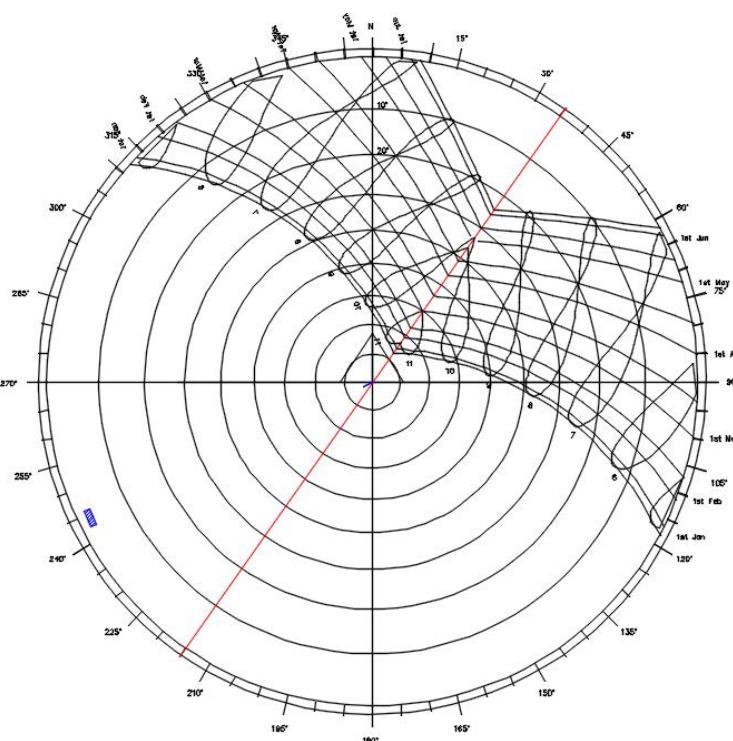
There is no risk of rogue reflections from this façade to this viewpoint.

**4.4.2 Point 7 - Façade Aspect 35 - Northern wall of Entry Level of Entry Pavilion**



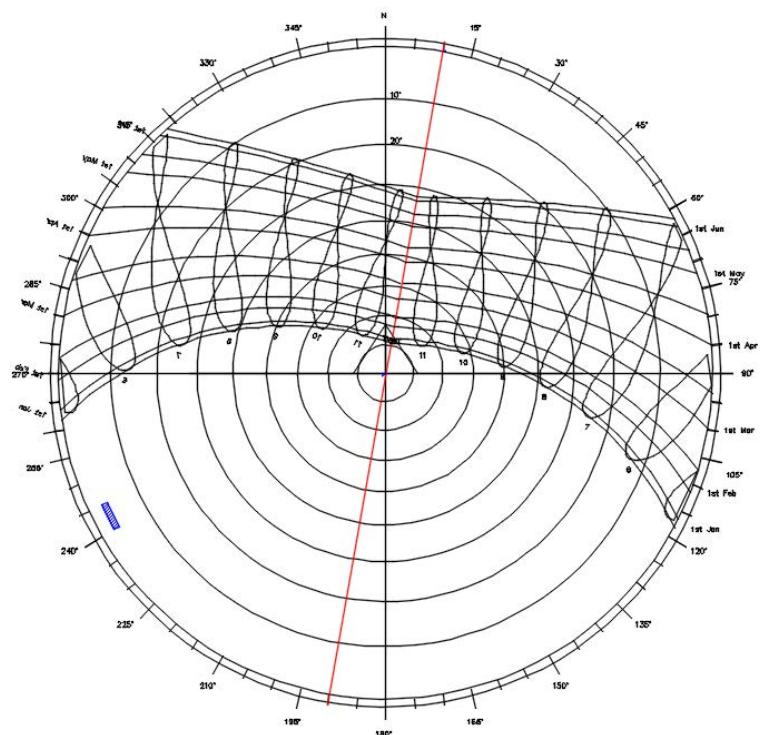
There is no risk of rogue reflections from this façade to this viewpoint.

**4.4.3 Point 7- Façade Aspect 125 - Eastern wall of Entry Level of Entry Pavilion**



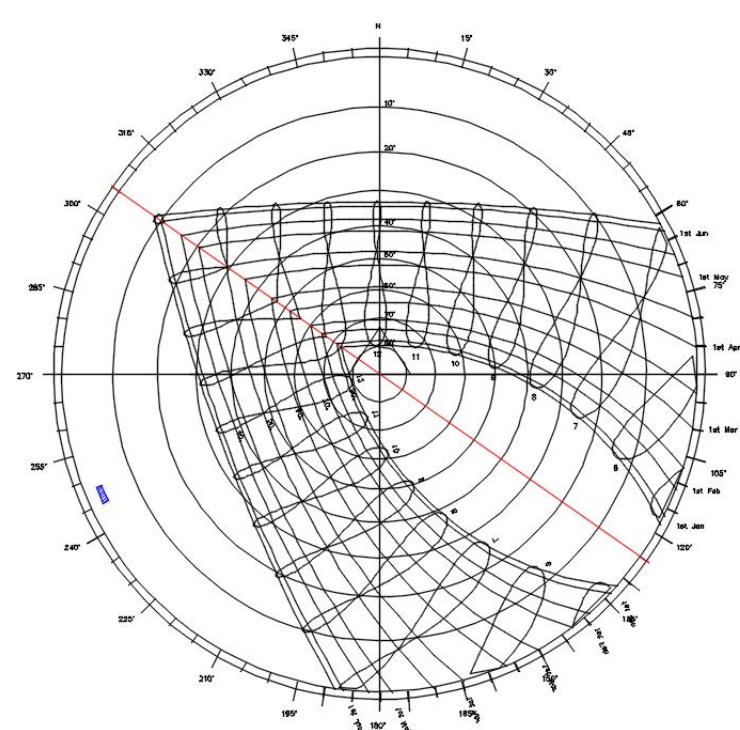
There is no risk of rogue reflections from this façade to this viewpoint.

**4.4.4 Point 7 -Façade Aspect 100 - Eastern wall of Level 1 of café**



There is no risk of rogue reflections from this façade to this viewpoint.

**4.4.5 Point 7- Façade Aspect 35 - Northern wall of Level 1 of café**



There is no risk of rogue reflections from this façade to this viewpoint.

## 5. Conclusion

From the seven points of interest included in study we have studied thirty individual cases for the possibility of sunlight reflecting onto one of those seven locations.

From these studies two cases result in very limited periods of reflected light reaching the study points and one case where it is recommended to modify glazing properties to reduce impact on the garage exit.