

# Sky View Impact Assessment for Barangaroo Concept Plan (06\_0162) Modification 9 - RtS

Prepared by AECOM on behalf of Infrastructure NSW



## Sky View Impact Assessment for Barangaroo Concept Plan (06\_0162) Modification 9 - RtS

Prepared on behalf of: Infrastructure NSW

Prepared by

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Modification 9 - RtS

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Date 31-Oct-2023

Prepared by Belinda Dods

Reviewed by Frank Ciancio

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ABN: 39612713916

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## Executive Summary

This report was prepared to address submissions made in response to the Modification 9 exhibited Concept Plan MP06\_0162 MOD 9 (MOD 9), and to reassess the amended Response to Submission concept (MOD9 - RtS).

AECOM previously provided a Sky View Assessment for the MOD 9 – exhibited concept design which was publicly exhibited during July and August 2022. In response to the public submissions the proposed concept design for Central Barangaroo has been amended. This report is an updated assessment of the sky view impacts for the MOD9- RtS.

This report will assess the proposed MOD 9 - RtS Central Barangaroo development to satisfy the concerns raised by Sydney Observatory, the Powerhouse Museum, City of Sydney and the Sydney Observatory specific requirement in the Modification 6 (MOD 6) Director General's Requirements (DGR's), as well as to support the MOD 9 DGR's.

The following elements have been assessed:

- clear view requirements azimuth 210° to 225°;
- clear view requirements azimuth 236° to 303°;
- other astronomical elements; and
- lighting impacts.

Due to the proposed development envelopes sitting below the horizon, there are no reduction in sky view due to the Central Barangaroo MOD 9 -RtS development.

A formal study has not been prepared to assess the impact of cumulative light spill impact, however, due to the relatively low building envelope heights in Central Barangaroo and the highly illuminated environment it will sit within, there is expected to be limited additional light spill.

## 1.0 Introduction

This report was originally prepared in September 2011 to assess the Concept Plan (MP06\_0162 MOD 9) to address a section of the MOD 8 DGR's specific to Sydney Observatory, concerns raised by Sydney Observatory about the impacts of the Barangaroo Development on sky view, and to support the MOD 9 DGR's.

Subsequent to the public exhibition of the MOD 9 Proposed Concept Plan during July and August 2022, the design has been amended in response to submissions. The amended design is the MOD 9 Response to Submissions scheme (MOD 9 – RtS). An overview of the new design and a summary of the changes is provided in Section 3.1.

This current report will assess the amended MOD 9 – RtS design. Technical astronomical information within this report is summarised from the Sky View Impact Assessment by George Georgevitis (UNSW Unisearch), refer Appendix A. The astronomical technical information provided in the above-mentioned report has been simplified here to explain the effects of the proposed Central Barangaroo MOD 9 building envelope on the ability of Sydney Observatory to see the night sky.

Additionally, responses to the recent submissions are also addressed within this report.

This report is a supplement to the modification to Concept Plan (MP06\_0162) submitted to the Minister for Planning and Infrastructure pursuant to Section 75W of Part 3A of the Environmental Planning and Assessment Act 1979 (EP&A Act).

NB: all RL heights are measured against the Australian Height Datum.

## 2.0 Site Location

### **Barangaroo**

Barangaroo is located to the west of the Sydney central business district. The site sits along the edge of the Sydney Harbour, north of the King Street Wharf Precinct. The Harbour sits to the west and north of the site. Central Barangaroo lies adjacent to Millers Point.

Previously a disused container terminal, Barangaroo is in the process of being transformed into a waterfront precinct which will include - in addition to the completed International Towers Sydney and Barangaroo Reserve - further commercial and residential buildings; active frontages including restaurants, cafes and retail; a hotel and casino, all set within public open space.

Barangaroo consists of three separate sections; Barangaroo Reserve is the northern section, Barangaroo South is the south section, and Central Barangaroo is the area between. This concept plan amendment known as MOD 9 relates to Central Barangaroo. Refer Figure 1 for the Barangaroo site context.

### **Sydney Observatory**

The Sydney Observatory is a museum and education centre set on top of Observatory Hill overlooking Sydney Harbour. It is a historic landmark for Sydney, recognised as an item of 'state significance' by the New South Wales Government. Built in 1858, the Observatory has a history of timekeeping, meteorology, navigation and astronomy.

The Observatory is now part of the Museum of Applied Arts and Sciences. It acts as a museum and astronomy education centre, providing public telescope viewing. The Observatory is no longer used for professional astronomical viewing.

Located at 1003 Upper Fort Street, Millers Point, the Observatory sits on top of Observatory Hill. The Bradfield Highway runs along its eastern edge, Fort Street Public School is to the south, and Millers Point Heritage Conservation area to the north and west. It sits to the east of the proposed Central Barangaroo development site.



The Sydney Observatory is on high ground, which affords views out to Sydney Harbour to the north and west. The Sydney Observatory north dome sits at approximately 54m RL AHD (Australian Height Datum), with the Barangaroo ground level RL at 3.5m. Subsequent sections detail the heights of the proposed building envelopes in the MOD 9 - RtS development and their effect on the view from the Sydney Observatory.

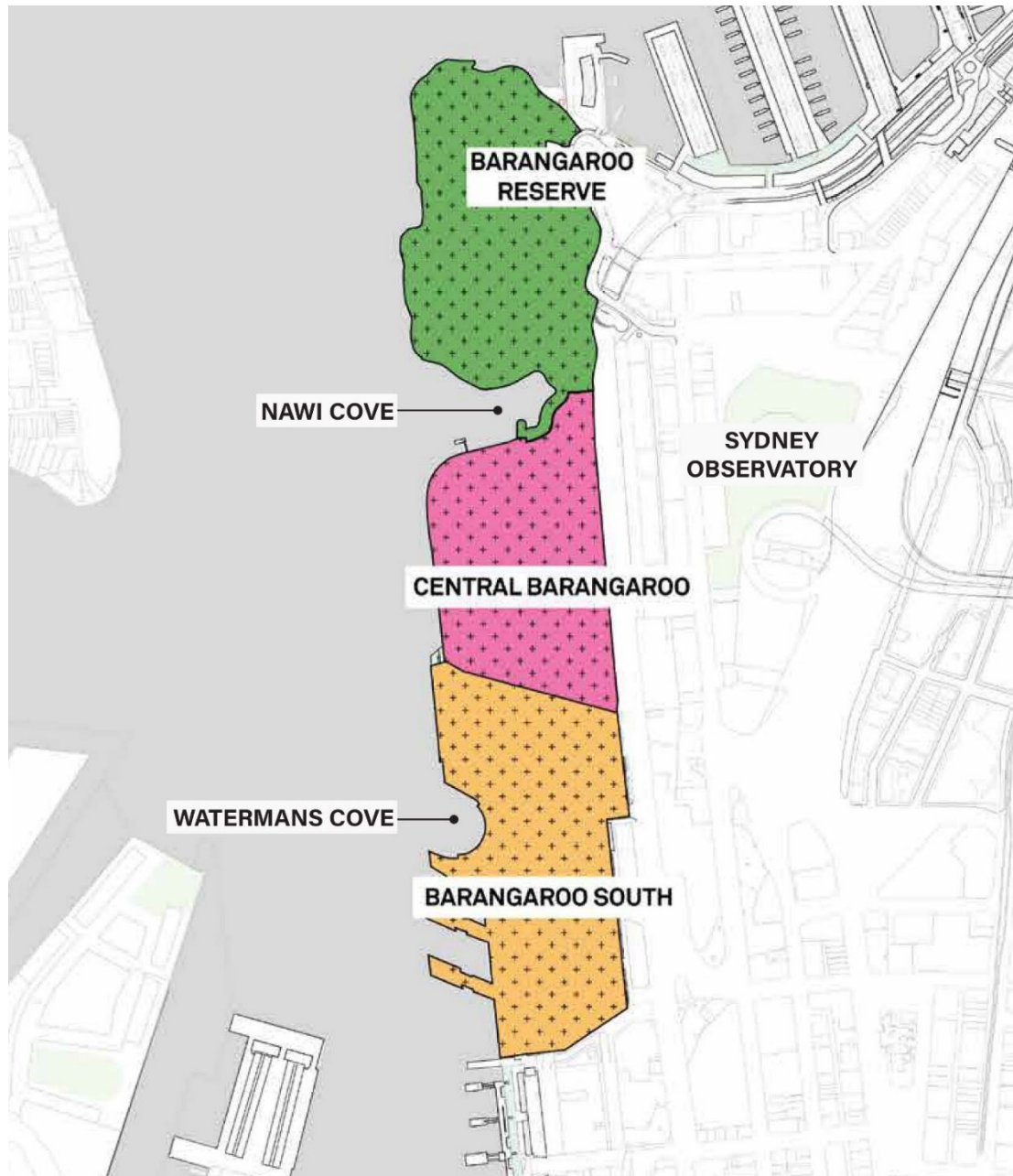


Figure 1. Barangaroo site context. Sydney Observatory sits to the east of the northern edge of Central Barangaroo.  
Source: amended by AECOM from figure prepared by Hassell, November 2020.

### 3.0 Background

#### 3.1 Overview of Proposed Modification MOD 9 - RtS

The proposed MOD 9 - RtS to the Concept Plan (MP06\_0162) includes:

- increase in GFA;
- redistribution of GFA and land uses across development blocks;
- modification to block and building envelopes; and
- redistribution of public domain areas.

Pertinent to this report is the form, height and location of the building envelopes. The highest building envelope in MOD 9 -RtS is in the south eastern corner (42.45m). Refer Figure 2 and Figure 3.

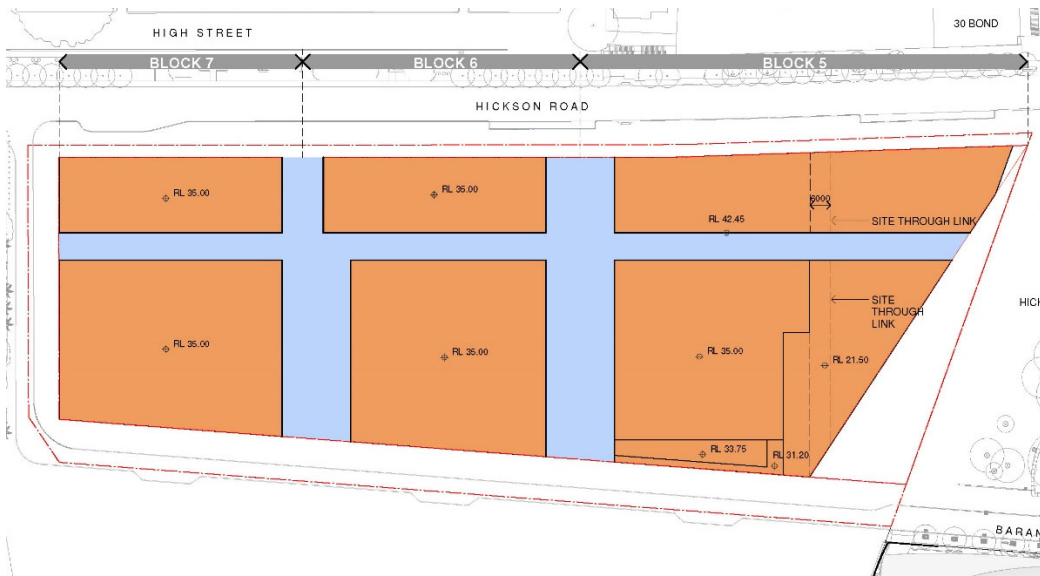


Figure 2 – MOD 9 – RtS Central Barangaroo building envelope plan view. Source: SJB, 2023.

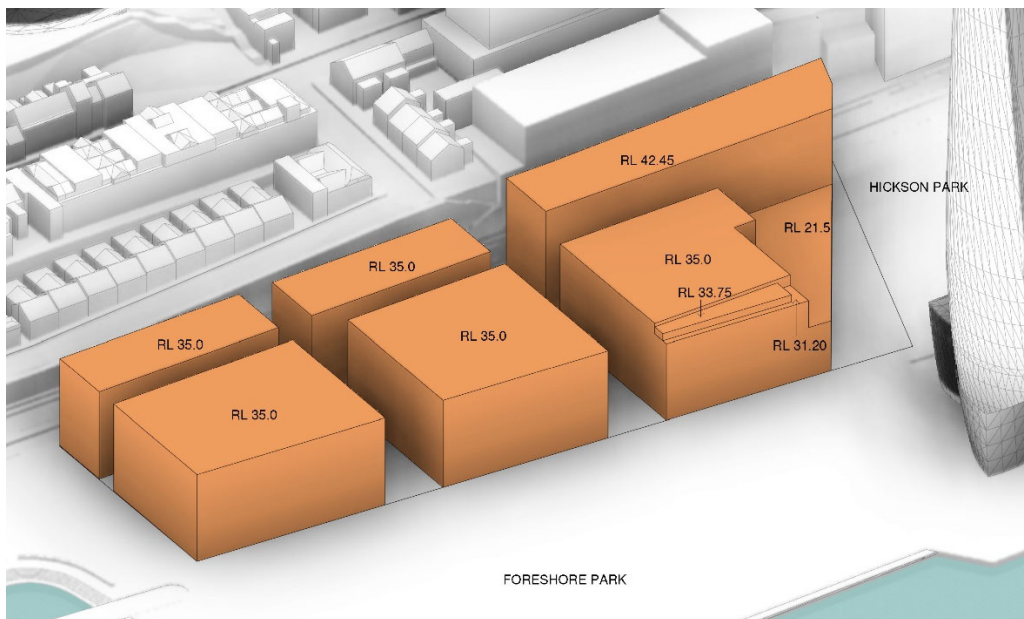


Figure 3. MOD 9 – RtS Central Barangaroo building envelope axonometric view. Source: SJB, 2023.



## 3.2 Amendments from the MOD 9 Exhibited

The changes from the MOD 9 – exhibited building envelope pertinent to the views of the night sky from the Sydney Observatory include:

- Removal of the Block 7 tower (previously RL73)
- Increased separation between the blocks

The previous MOD 9 exhibited design can be seen in Figure 3 below.

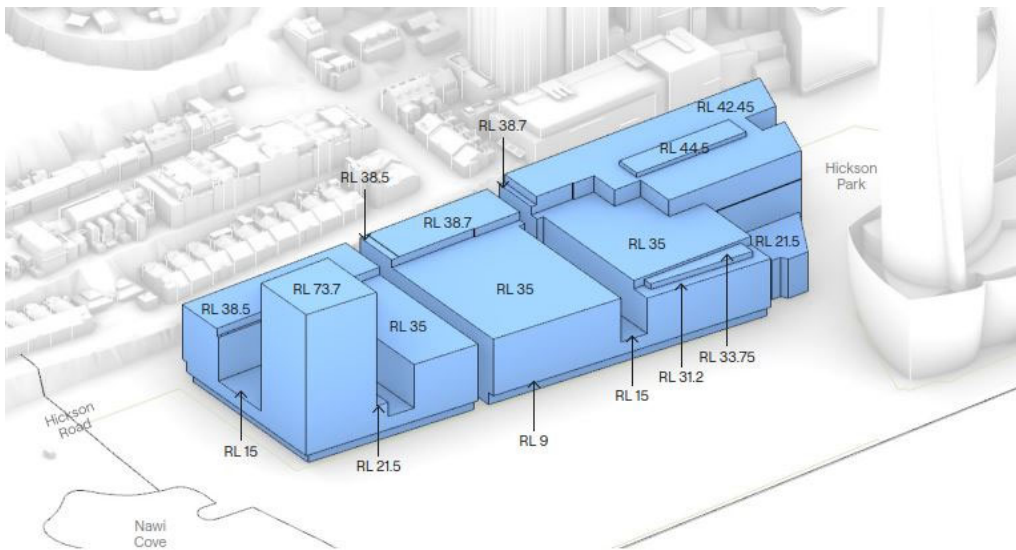


Figure 3. MOD 9 – exhibited Central Barangaroo building envelope axonometric view. Source: SJB,2023.

## 3.3 Considerations in the Sky View Impact Assessment

### 3.3.1 Director General's Requirements

Within the 'Key Issues' of the Director General's Requirements (DGR's) for the Mod 8 Concept Plan (MP06-0162)<sup>3</sup>, there was a requirement to address the potential impact of the development on the Sydney Observatory.

The subsequent DGR's for the MOD 9 development do not include this requirement, however due to the proposed changes to the building envelope, INSW have requested that a review is undertaken to assess MOD 9 -RtS with the relevant Mod 8 DGR's below.

#### 19. Prescribed Airspace for Sydney Airport and Sydney Observatory Impacts

- *Undertake and analysis of potential sky view loss and resultant impacts on the functioning of the Sydney Observatory*

This report also supports requirements under the MOD 9 DGR's<sup>4</sup>, specifically plans & documents item 7, visual catchment:

- *Potential visual catchments and view locations, including contours (areas from which the development is visible) should be identified. This must include, but is not limited to ... Sydney Observatory, ....*

<sup>3</sup> [https://majorprojects.accelo.com/public/8ff3a177308a80d7433648da67e7367c/B\\_Final%20issued%20DGRs.pdf](https://majorprojects.accelo.com/public/8ff3a177308a80d7433648da67e7367c/B_Final%20issued%20DGRs.pdf)

<sup>4</sup> <https://majorprojects.accelo.com/public/3b04f77739e32bfa3ebac04b22547bcc/Final%20Modified%20DGRs%20150414.pdf>

### 3.3.2 Consultation and Submissions

#### **Submissions (2011)**

The Sydney Observatory made a submission to the former Barangaroo Development Authority on the 20th of June 2011 regarding Modification 4 for the Central Barangaroo development proposal<sup>5</sup>.

The Sydney Observatory subsequently provided notes on 'clear view corridors' to Lendlease (the developer at the time) titled *Clear View Required to Western Sky from Sydney Observatory, 2013*<sup>6</sup>, which details the required viewing envelope for the sun, moon, stars and planets - that they would like to retain.

Lendlease met with Sydney Observatory in December 2013 to discuss their concerns in regard to the MOD 4 development (documented in the *Barangaroo South Mod 8 (MP06\_0162 MOD 8) Concept Plan, Sydney Observatory Sky View Impact Assessment, 2014*<sup>7</sup>).

A summary of the concerns and comments from Sydney Observatory are:

#### ***Clear View Requirements to the Western Sky***

Important view corridors were determined in consultation with the Sydney Observatory and Lendlease<sup>8</sup>. They are listed below as an excerpt from *Barangaroo South Mod 8 (MP06\_0162 MOD 8) Concept Plan, Sydney Observatory Sky View Impact Assessment, Lendlease, 2014*: (Note: the 'Azimuth' is the angle measured from North to East in an anticlockwise direction):

#### ***Sun, Moon and Planets:***

*The Sun:*

*Winter solstice - 298° Azimuth, and;  
Summer solstice - 241° Azimuth.*

*The Moon: +/- 5° further North or South of the Sun (i.e. between 236° and 303° Azimuth).*

*The Solar System Planets: Less than 5° from the Sun at Sunset (i.e. between 236° and 303° Azimuth).*

#### ***The Southern Cross and nearby objects (Jewel Box, Alf-Cen, Omega-Cen[NGC5139]):***

*The Southern Cross (Crux), Jewel Box Cluster (Kappa Crucis Cluster [NGC4755]), and Pointers (Alpha-Centauri and Beta-Centauri, also known as Rigil Kentaurus and Hadar respectively): From 225° up to 210° Azimuth.*

*Omega-Centauri (NGC5139) globular duster: Up to 298° Azimuth at 18° altitude.*

#### ***Ring Nebula and Star Albireo:***

*To the North the Ring Nebula (M57, a dead star) and Albireo (Beta Cygni, a multi-coloured twin star): From 303° Azimuth at 15° altitude.*

*In summary, the view corridors can be determined as:*

*Between 210° and 225° Azimuth at 18° altitude, and;*

*Between 236° and 303° Azimuth.*

<sup>5</sup> Appendix 2 of the Barangaroo South Mod 8 (MP06\_0162 MOD 8) Concept Plan, Sydney Observatory Sky View Impact Assessment, 2014 ([https://majorprojects.accelo.com/public/a81207969c5246a2d138b4b22086bb82/Y\\_SkyViewImpact.pdf](https://majorprojects.accelo.com/public/a81207969c5246a2d138b4b22086bb82/Y_SkyViewImpact.pdf))

<sup>6</sup> Appendix 3 of the Barangaroo South Mod 8 (MP06\_0162 MOD 8) Concept Plan, Sydney Observatory Sky View Impact Assessment, 2014 ([https://majorprojects.accelo.com/public/a81207969c5246a2d138b4b22086bb82/Y\\_SkyViewImpact.pdf](https://majorprojects.accelo.com/public/a81207969c5246a2d138b4b22086bb82/Y_SkyViewImpact.pdf))

<sup>7</sup> Barangaroo South Mod 8 (MP06\_0162 MOD 8) Concept Plan, Sydney Observatory Sky View Impact Assessment, 2014 ([https://majorprojects.accelo.com/public/a81207969c5246a2d138b4b22086bb82/Y\\_SkyViewImpact.pdf](https://majorprojects.accelo.com/public/a81207969c5246a2d138b4b22086bb82/Y_SkyViewImpact.pdf))

<sup>8</sup> Appendix 3 of the Barangaroo South Mod 8 (MP06\_0162 MOD 8) Concept Plan, Sydney Observatory Sky View Impact Assessment, 2014 ([https://majorprojects.accelo.com/public/a81207969c5246a2d138b4b22086bb82/Y\\_SkyViewImpact.pdf](https://majorprojects.accelo.com/public/a81207969c5246a2d138b4b22086bb82/Y_SkyViewImpact.pdf))

### **Light Spill**

Concern about poor quality lighting at night from Sydney Observatory is referenced in their 20 June 2011 letter<sup>9</sup>. A number of lighting strategy considerations were requested by Sydney Observatory, a summary of which has been taken from *Barangaroo South Mod 8 (MP06\_0162 MOD 8) Concept Plan, Sydney Observatory Sky View Impact Assessment, Lendlease, 2014*<sup>10</sup>.

*Light direction: No light directed up to the sky or horizontally. Light should be directed downward and spill minimised.*

*Minimising glow and potential uses of the site: Reduce light-reflecting surfaces, and large areas of light emissions producing a glow. Creation of distinct 'night' from 'day approach to not 'flood' the site at night time.*

*Light timers: To reduce lighting at night.*

*Specific lighting recommendations: Use lowest level of lighting as allowed by Australian Standards, light fittings with full cut off with zero UWLR, correlated colour temperature of the light sources should be 2700k (warm white) or less, and minimise unnecessary outdoor lighting.*

### **Exhibition (2022)**

Sky View Assessment for Barangaroo Concept Plan (06\_0162) Modification 9 (AECOM, 2021) which was publicly exhibited during July and August 2022.

### **Submissions (2022)**

The City of Sydney (CoS) and the Powerhouse Museum made submissions raising concern over heights of the proposed MOD 9 – exhibited building envelopes, particularly Block 7 which was in line with the telescopes viewing to the west.

An issue was also raised by both organisations about the assumption in the UNSW report that a viewing angle of less than 10° degrees above the horizon was impractical for viewing the night sky. The submissions advised that astronomical events that occur within 10° (practical lower altitude limit) of the horizon also needed to be considered.

The full submissions are provided in Appendix B.

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<sup>9</sup> Appendix 3 of the Barangaroo South Mod 8 (MP06\_0162 MOD 8) Concept Plan, Sydney Observatory Sky View Impact Assessment, 2014 ([https://majorprojects.accelo.com/public/a81207969c5246a2d138b4b22086bb82/Y\\_SkyViewImpact.pdf](https://majorprojects.accelo.com/public/a81207969c5246a2d138b4b22086bb82/Y_SkyViewImpact.pdf))

<sup>10</sup> ([https://majorprojects.accelo.com/public/a81207969c5246a2d138b4b22086bb82/Y\\_SkyViewImpact.pdf](https://majorprojects.accelo.com/public/a81207969c5246a2d138b4b22086bb82/Y_SkyViewImpact.pdf))

## 4.0 View Analysis

The maximum building envelope heights of the proposed MOD 9 – RtS design are as follows:

- Block 5: RL 42.45
- Block 6: RL 35.00
- Block 7: RL 35.00

The Sydney Observatory north dome observing deck sits at approximately 54m RL AHD. The nominal angle to the horizon from this location is approximately  $-0.1^{\circ}$ <sup>11</sup>. The angle to the tallest Block 5 envelope is  $-2.8^{\circ}$ . As stated in the *Central Barangaroo - Sydney Observatory Updated Sky View Impact Assessment*, UNSW Unisearch, 2023 (refer Appendix 1), given that the rooftops of all the buildings in the proposed development are below the nominal horizon, the proposed buildings will not obstruct any part of the sky view from Sydney Observatory.

### 4.1 Clear View Requirements Azimuth Corridor 210° to 225°

Figure 4 is a plan showing the extent of the clear view azimuth corridor 210° to 225° and the Barangaroo South building envelope obstructions. This azimuth range crosses Block 5 within the Central Barangaroo building envelope.

There are no building envelopes within Block 5 that will impact on the practical sky view from the Sydney Observatory.

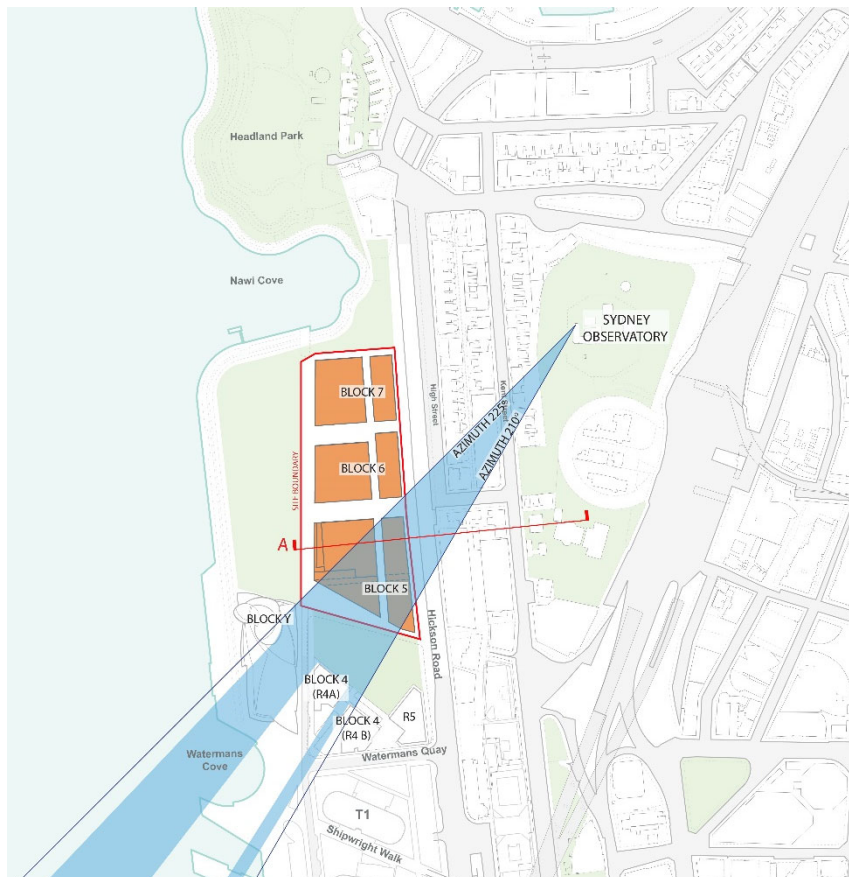


Figure 4. Azimuth clear zone range 210° to 225° in relation to the Barangaroo development. Source: amended by AECOM from figures prepared by Hassell 2021 and SJB 2023.

<sup>11</sup> *Central Barangaroo - Sydney Observatory Updated Sky View Impact Assessment*, UNSW Unisearch, 2023 (refer Appendix 1)

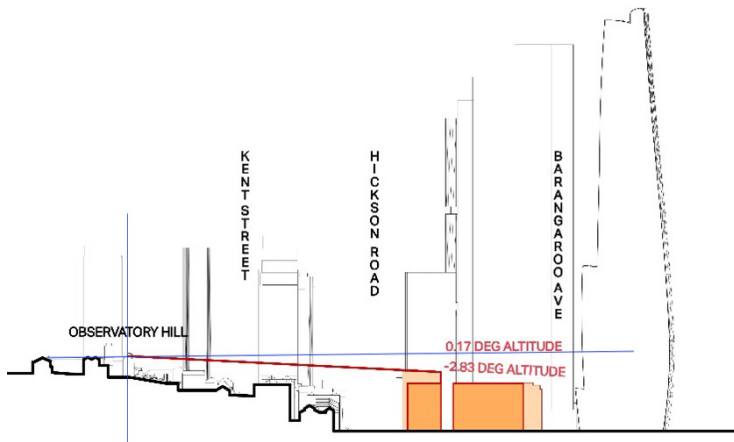


Figure 5. Sectional Elevation A, cut from Sydney Observatory through Block 5 of Mod 9, Central Barangaroo. Source: amended by AECOM from figure prepared by SJB 2023.

### 4.2 Clear View Requirements Azimuth 236° to 303°

Figure 6 is a plan showing the extent of the clear view azimuth range 236° to 303°. This azimuth range crosses Block 7 and a portion of Block 6 within the Central Barangaroo building envelope.

As previously stated, there are no building envelopes high enough within Block 6 and Block 7 to impede views from the Sydney Observatory northern telescope. The levels of building envelope in Blocks 6 and 7 are 35m, which are lower than Sydney Observatory north dome sits level (RL 54m). Therefore, no further assessment is required for this azimuth range.

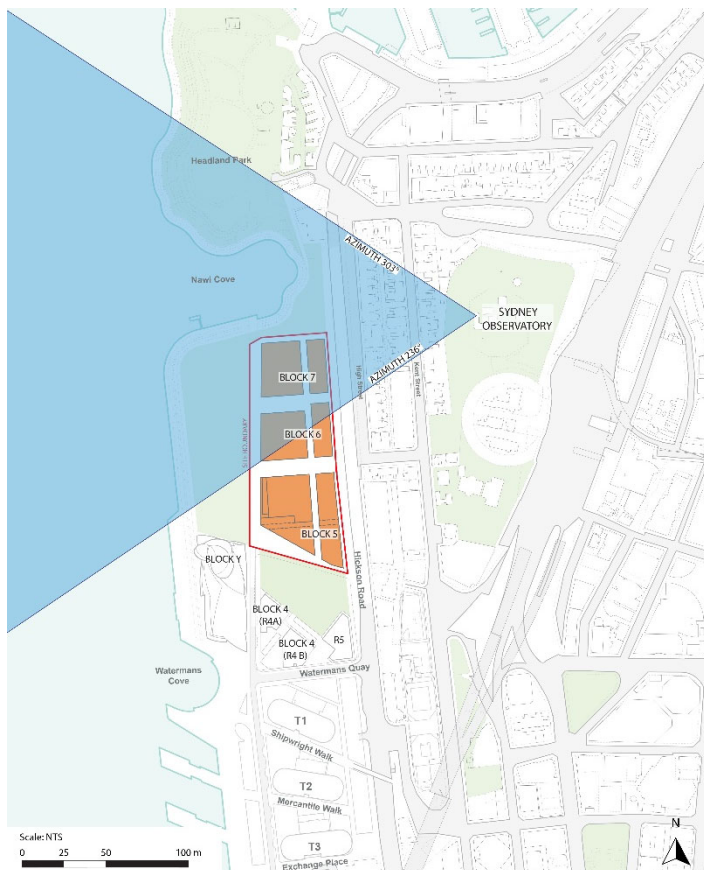


Figure 6. Azimuth clear zone range 236° to 303° in relation to the Barangaroo development. Source: amended by AECOM from figures prepared by Hassell 2021 and SJB 2023



### 4.3 Other Astronomical Elements

It is noted there are other important astronomical events that occur outside of the specified azimuth ranges, including the setting Sun, the Moon, planets, and comets. It is also noted that observations may also be taken by other means and from other locations within the Sydney Observatory.

As the proposed development sits below the horizon as seen from Observatory Hill, there would be no physical obstruction of the night sky by the development. Refer visualisation of the proposed development envelope shown in purple in Figure 7 below.



Figure 7. Proposed MOD 9 – RtS development envelope visualisation. Source: AECOM,2023

### 4.4 Lighting Impact

As noted above, the Sydney Observatory no longer functions as a professional astronomical observatory; it is a museum that provides astronomy education and public sky viewing.

The location of the Sydney Observatory - in the middle of a densely populated city – places limitations on astronomical observations. Light glare, cloud cover, smog, pollution and building envelope all serve as factors that diminish the ability of the Observatory to view the night sky.

There has been no formal assessment on cumulative light spill impacts, however, due to the highly illuminated environment within which the Central Barangaroo MOD 9 -RtS building envelope would sit; it is unlikely that the proposal will contribute significantly to the light spill already affecting the Sydney Observatory.

## 5.0 Conclusion

In completing the Sky View Impact Assessment, the following elements were assessed in response to the Mod 6 DRG requirements and the concerns raised by Sydney Observatory regarding:

- clear view requirements azimuth 210° to 225°;
- clear view requirements azimuth 236° to 303°;
- other astronomical elements; and
- lighting impacts.

Due to the proposed development envelopes sitting below the horizon, there are no physical impacts from the Central Barangaroo MOD 9 -RtS development on the ability of the Sydney Observatory to view the night sky. Light spill is not expected to be significantly increased by the proposal given the high levels of light which currently exist in this highly illuminated urban environment.

In conclusion, this report finds that there will be no additional reduction in sky view as a result of the Central Barangaroo MOD 9 development, and limited additional impact arising from light spill.

## 6.0 Appendices

### 6.1 **Appendix A – Central Barangaroo - Sky View Impact Assessment UNSW Unisearch, 2023**



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Report prepared on behalf of Unisearch Expert Opinion Services  
A business of the University of New South Wales

**CENTRAL BARANGAROO -  
Modification to the Concept Plan (06-0162)  
(MOD 9)  
SYDNEY OBSERVATORY UPDATED  
SKY VIEW IMPACT ASSESSMENT –  
Revision A, May 2023**

for

Infrastructure NSW

by

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Date of Issue: 30 October 2023

Our Reference: UN59699

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## 1. EXECUTIVE SUMMARY

- 1 I previously prepared a report on this subject dated 15 September 2021 (my **First Report**), based on Concept Plan (06-0162) (MOD 9) for Central Barangaroo and information provided by Sydney Observatory.
- 2 The purpose of this report is to assess the impact of the proposed amendments to Concept Plan (06-0162) (MOD 9) for Central Barangaroo on the sky view from Sydney Observatory.
- 3 It has been prepared in direct response to the key issues raised during exhibition of MOD 9 and provides a revised assessment of the sky view impacts associated with the revised proposal.
- 4 In preparing this report, I have reviewed all of the issues raised in the City of Sydney submission, Item 6: *Sydney Observatory – View of Night Sky* and the amended concept plan building envelopes and supporting information prepared by SJB Architects.
- 5 The proposed amended development of Central Barangaroo consists of Blocks 5, 6 and 7, with the indicative reference design illustrating Block 5 as containing four buildings, and Blocks 6 and 7 each containing two buildings.
- 6 The information contained in the amended concept plans prepared by SJB Architects states that the maximum proposed nominal height of these buildings is RL 42.45m for Block 5 and RL 35.0m for Blocks 6 and 7.
- 7 Based on my assessment of this information, I conclude that the height of all of the buildings within the proposed amended development falls below the elevation angle subtended by the nominal horizon, as viewed from Sydney Observatory.



8 Consequently, the proposed amended development will not obstruct any part  
of the sky view, as seen from any part of the observatory.

## 2. TERMS OF ENGAGEMENT

9 I have been engaged by Aqualand (the Central Barangaroo Developer)  
through UNSW Unisearch to provide astronomical advice in relation to this  
matter.

10 My First Report contained my qualifications and informative sections covering  
observational astronomy basics and observing at Sydney Observatory.

11 The reader is referred to these sections of my First Report for background  
information.

12 In all other respects, the impact assessment/analysis in this report  
supersedes my First Report's conclusions.

13 The matter at hand concerns an assessment of the loss of sky view from  
Sydney Observatory as a result of the proposed construction of new buildings  
associated with the Central Barangaroo development.

14 This report has been prepared to support the proposed amended MOD9 to  
Barangaroo Concept Plan for the Central Barangaroo development.

15 It has been prepared to address, in part, the 'Visual Impact Assessment'  
requirements of the MOD 9 DGRs for Central Barangaroo (specifically DGR  
6. Visual Impact Assessment & Plans and Documents requirement 7. Visual  
Impact Assessment – Sydney Observatory).

16 As part of a broader visual impact assessment, the Sydney Observatory Sky  
View Impact Assessment provides an analysis of the potential sky view loss  
and resultant impacts associated with the building envelopes proposed under

the amended MOD 9 proposal and any consequential impacts on the functioning of the Sydney Observatory astronomical sightlines.

- 17 Finally, I would like to acknowledge the Gadigal people who are the Traditional Custodians of this land and I pay respect to the Elders both past and present of the Eora Nation and extend that respect to all Aboriginal people.

### 3. CENTRAL BARANGAROO DEVELOPMENT – BLOCKS 5, 6 AND 7

- 18 For the matter at hand, Aqualand has provided a set of reference design drawings illustrating the proposed building envelopes for the three Central Barangaroo development blocks of interest (see Fig.1).

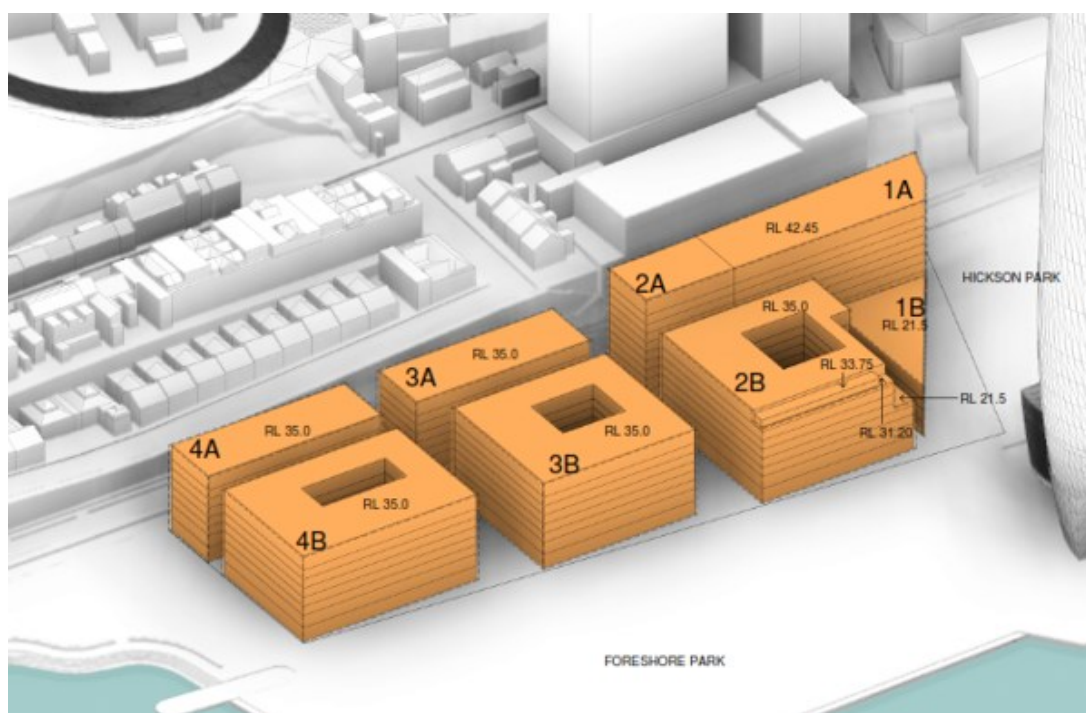


Fig. 1 – The Central Barangaroo development, showing the boundaries and proposed amended MOD 9 envelopes of Block 5 (buildings 1A, 1B, 2A and 2B), Block 6 (buildings 3A and 3B) and Block 7 (buildings 4A and 4B).

19 The RLs of the rooftop for each building in each block are as follows:

**BLOCK 5 (SOUTHERN MOST DEVELOPMENT BLOCK):**

- the RLs for the building rooftops are as follows:
  - Buildings 1A and 2A – 42.45 metres
  - Building 1B – 21.5 metres.
  - Building 2B – 21.5, 31.2, 33.75 and 35.0

**BLOCK 6 (MIDDLE DEVELOPMENT BLOCK):**

- the RL for all building rooftops is 35 metres.

**BLOCK 7 (NORTHERN MOST DEVELOPMENT BLOCK):**

- the RL for all building rooftops is 35 metres.

#### 4. EFFECT OF THE CENTRAL BARANGAROO BUILDINGS ON THE SKY VIEW FROM SYDNEY OBSERVATORY



Photo 1 – Aerial view of Observatory Park as at 2023 (photo courtesy Google Maps).

20 For the following analysis, I have assumed that the trees in the Observatory Hill Park are not present.

21 As sea, the altitude angle of the horizon (located at ~26.5km when viewed from an altitude of 54.0 metres (the altitude of the observing deck between the domes at the observatory – see photo 1) is approximately  $-0.1^\circ$ .

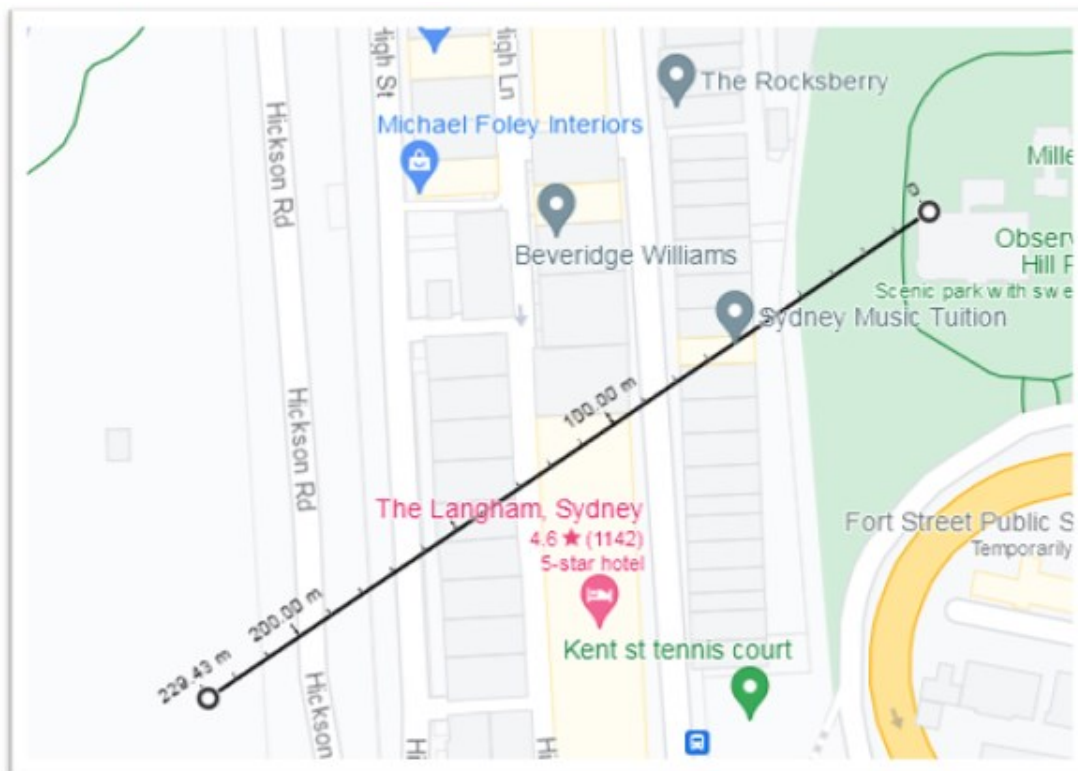
22 However, the actual horizon looking west from the observatory is higher than this due to intervening buildings and landforms (see photo 2).



**Photo 2 – View from Sydney Observatory looking west towards the north dome (note the height above sea level of the horizon in the background). The observing deck is located just to the left of the north dome and is concealed by the sandstone building in the foreground.**



- 23 The distance from Buildings 1A and 2A to the observatory is approximately 230 metres (see Fig 2).

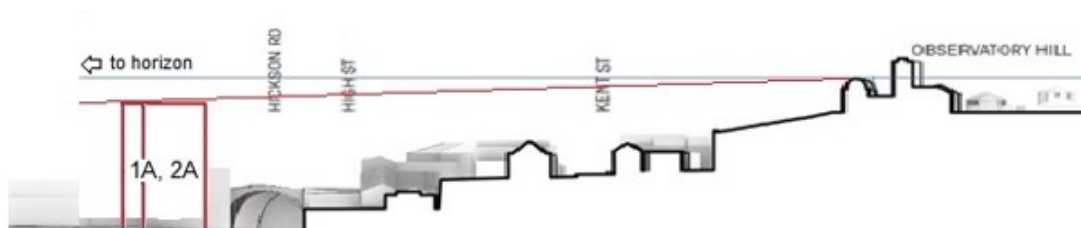


**Fig 2 – Distance from the observatory north dome to the approximate position of Buildings 1A and 2A**

- 24 The difference in height between the observing deck linking the two domes at the observatory and the rooftops of buildings 1A and 2A is:

$$54.0 - 42.45 = 11.55 \text{ metres.}$$

- 25 Using basic trigonometry, I calculate the elevation angle subtended by the roof line of buildings 1A and 2A from the observing deck at the observatory as  $-2.9^\circ$ , which is  $2.8^\circ$  below the nominal horizon (i.e. where sea level would normally be - see Fig 3).



**Fig 3 – The sight line from Sydney Observatory observing deck to the rooftop of Buildings 1A and 2A (red line) subtends an angle of  $-2.8^\circ$  from the line to the nominal horizon (blue line).**

26 Fig 3 clearly demonstrates that the buildings associated with the proposed development do not obstruct the view from the observatory to the nominal horizon.

## 5. CONCLUSIONS

27 Given that the rooftops of all the buildings in the proposed development are well below the nominal horizon, as seen from the observatory's observing deck, the proposed buildings will not obstruct any part of the sky view from Sydney Observatory.

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## 6.2 Appendix B – MP06\_0162 MOD 9 Submissions

ORGANISATION	ISSUE	COMMENT
City of Sydney	View of Night Sky	Central Barangaroo development was intended to be below the line of the rockface/landform and was not to interfere with Sydney Observatory, located near to the east of the site. The proposed building envelopes, particularly the residential tower in the north-western corner of the site (Block 7) will be much higher than originally intended, and the cumulation of all the buildings will significantly add light spill in the direct line of telescopes viewing to the west – where a large number of astronomical events occur throughout the year. Figure 6 of the report titled “Central Barangaroo - Sydney Observatory Sky View Impact Assessment”, dated 7 July 2021, prepared by Unisearch (UNSW) (reference UN59699) shows the viewing angle to the highest building envelope within Block 7 is 8.82°. There are incomplete assumptions regarding viewing the night sky within 10° of the horizon which the sky view impact assessment asserts as the “practical lower altitude limit” for effectively viewing the night sky. This assertion is erroneous as there are important astronomical events that occur within 10° of the horizon, including the setting Sun, Moon, planets such as Mercury and occasionally comets. Planetary transits and eclipses across the Sun as well as planetary and lunar conjunctions are also observed at these lower altitudes. All of these views will be compromised by the proposal and has not been adequately addressed in the sky view impact assessment.
Powerhouse	Height and Massing	The proposed increase in height from RL 35 to RL 73.7 in Block 7 has not been adequately justified in the S75W.
	Planning Processes and Procedural Matters	The S75W fails to provide a cumulative impact assessment that accounts for the R4A / R4B and R5 Towers.
	Heritage Impacts (General & Views)	An incorrect assumption includes that viewing angles of less than 10 degrees above the horizon is not necessary; however, this is incorrect. Other incorrect assumptions relate to the Observatory's operating hours, equipment and how observations are conducted.
	Planning Compliance	An incorrect assumption includes that viewing angles of less than 10 degrees above the horizon is not necessary; however, this is incorrect. Other incorrect assumptions relate to the Observatory's operating hours, equipment and how observations are conducted
	Consultation	The Sky View Impact Assessment has been prepared without consultation with Sydney Observatory. Consultation has been limited to a briefing session on 18 August but this is inadequate. The lack of consultation has led to the inclusion of many incorrect assumptions within the Sky View Assessment.
	View impacts (Observatory)	The proposed height will impact view corridors to and from Sydney Observatory. The VIA designates the level of impact as being high-moderate but yet no mitigation measures specific to Sydney Observatory are proposed, noting that the recommendation to include planting on the rooftop will not protect views of Sydney Observatory.

