

## CENTRAL BARANGAROO

SYDNEY NSW

PEDESTRIAN WIND STUDY

RWDI # 2001665

November 15, 2021

### SUBMITTED TO

Infrastructure NSW

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## ACKNOWLEDGMENT OF COUNTRY

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



## EXECUTIVE SUMMARY

RWDI was retained to conduct a pedestrian wind assessment for the proposed Central Barangaroo development located in Sydney, NSW (Image 1). Several configurations were tested in the wind tunnel: the existing configuration; a refined design scheme within the MOD 9 envelope; and with the inclusion of a representative landscaping scheme.

The wind conditions around the proposed development are discussed in detail within the contents of this report and results for the final configurations are summarised as follows:-

- The existing wind conditions in and around the site are expected to be generally appropriate for the intended use throughout the year. Conditions are expected to be generally calmer to the east of the site. Relatively windier conditions are likely to prevail along the foot of Crown Sydney Hotel Resort (CSHR) and One Sydney Harbour (OSH), which are significantly taller than other surrounding buildings; and along the waterfront areas due to the exposure to the prevailing winds.
- With the inclusion of the proposed Central Barangaroo MOD 9 massing envelope, the wind microclimate conditions within and around the site would remain largely consistent with the existing configuration. The landscaping features around the Proposed Development were found to reduce the wind speeds, resulting in calmer wind conditions.
- The inclusion of the proposed Central Barangaroo MOD 9 massing envelope also reduces the number of locations where the safety criterion is exceeded. Inclusion of the representative landscaping scheme further reduced these locations.
- It is anticipated that further improvement in wind conditions can be achieved through refinement of the landscaping scheme in due course as the design of Central Barangaroo progresses.



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# 1 INTRODUCTION

RWDI was retained to assess and consult on the pedestrian wind conditions on and around the proposed Central Barangaroo development in Sydney, Australia. The site location is shown in **Image 1**.

The purpose of the study is to assess the wind environment around the Proposed Development in terms of pedestrian comfort and safety. This quantitative assessment was based on wind speed measurements on a scale model of the Proposed Development and its surroundings in a boundary-layer wind tunnel. The assessment focused on critical pedestrian areas at ground level including the sidewalks along adjacent and nearby streets as well as elevated areas of the Proposed Development.

This report summarises the methodology of the wind tunnel studies for pedestrian wind conditions, describes the RWDI pedestrian wind comfort and safety criteria, presents the local wind conditions and their effects on pedestrians and provides tested wind control measures, where necessary.



**Image 1: Site plan – Aerial view of Site and surroundings (courtesy of Infrastructure NSW, June 2021)**

## 1.1 Introduction to Central Barangaroo

Central Barangaroo is located between the Barangaroo Reserve, Barangaroo South and the nearby historic suburbs of Miller Point and Walsh Bay and adjacent to Barangaroo Station.

As Barangaroo's keystone project, Central Barangaroo will complete the sweep of city and foreshore experiences along the western waterfront of Sydney's CBD to become the vibrant civic and community heart of Barangaroo.

Central Barangaroo is proposed as a dynamic mixed-use foreshore precinct that draws together and integrates high quality foreshore public spaces with city living, next generation workspace, community and cultural uses, and a bustling shopping and dining precinct, all easily connected to Sydney's new metro network.

Barangaroo Station will significantly improve access for visitors, residents, workers and shoppers alike and transform how people arrive in Sydney CBD and on the harbour foreshore. Central Barangaroo will connect seamlessly to the new metro station and create the new place to arrive in and experience the city.

Central Barangaroo comprises the remaining development Blocks 5, 6 and 7 of the approved Barangaroo Concept Plan and the Central Barangaroo Harbour Park connecting to the harbour foreshore.

The Central Barangaroo Urban Design Report builds upon the key objectives and core principles of the SOM Master Plan Framework to ensure the proposed built form creates an appropriately scaled visual transition between the natural setting and scale of Barangaroo Reserve and Nawi Cove, to the bustling, high rise central business district scale of Barangaroo South.

The recently completed Wulugul Walk now extends along the entire Barangaroo waterfront as a vital section of the 14km Woolloomooloo to Glebe foreshore walk. Central Barangaroo's Harbour Park will create a major western harbour public open space that seamlessly integrates with Wulugul Walk, to diversify and enhance the city's waterfront experience. To the south, Central Barangaroo will shape and activate Hickson Park as a city park and to the north, and will help create Nawi Cove as the new place to arrive in the city.

## 1.2 Proposed Modification to Barangaroo Concept Plan for Central Barangaroo (MOD 9)

Modification 9 to the Barangaroo Concept Plan for Central Barangaroo (MP06\_0162 MOD 9) proposes:

1. An increase in total permissible GFA from 602,354 sqm to 708,041 sqm, with the following within Central Barangaroo and Barangaroo Reserve:
  - a. Up to 116,189sqm of above ground GFA within Blocks 5, 6 and 7;
  - b. Up to 28,166sqm of below ground GFA within Blocks 5, 6 and 7;
  - c. A minimum of 2,800sqm of Community uses GFA within Blocks 5, 6 and 7; and
  - d. A minimum of 6,000sqm and up to 18,000sqm of Community uses GFA within the RE1 Zone of Barangaroo Reserve.
2. Modifications of Barangaroo's movement network to redirect and reduce the impact of vehicular traffic and significantly improve pedestrian movement, safety, and amenity, including the removal of vehicular traffic from Block 5 and 6 and the extension of Central Barangaroo's Harbour Park.
3. Modifications to the Central Barangaroo building envelope that allow for greater variation in building heights across Blocks 5, 6 and 7 to enable building form, massing and modulation that is responsive to context and adjusts the development boundary for Block 5.
4. Introduction of Design Guidelines for Central Barangaroo.
5. Consequential amendments to the State Significant Precincts SEPP.
6. Revisions to the Barangaroo Concept Plan Statement of Commitments.

## 1.3 Central Barangaroo - Proposed GFA and maximum building heights

The existing and proposed GFA and maximum building heights for each Barangaroo development block, comprising Barangaroo South, Central Barangaroo and including Barangaroo public domain (RE1), are tabulated below:

Precinct and Block	Total GFA (Max) (sqm)	Residential GFA (Max) (sqm)	Height (m) (Max AHD)	Height above existing ground level (m)
<b>BARANGAROO SOUTH - Existing</b>				
Block 1	1,927	0	RL 25	23
Block 2	197,280	0	RL 180	178
Block 3	129,934	10,515	RL 209	207
Block 4A	92,629	91,816	RL 250	248
Block 4B	21,508	20,637	RL 107	173
Block X	18,908	16,463	RL 41.5	39.5
Block Y	77,500	22,600	RL 275	273
<b>Barangaroo South subtotals</b>	<b>539,686</b>	<b>162,031</b>		
<b>CENTRAL BARANGAROO - Proposed</b>				
Blocks 5, 6 and 7 above ground	116,189	28,000	Block 5 & 6: RL44.5 Block 7: RL73.7	Block 5 & 6: 42.0 Block 7: 71.2
Blocks 5, 6 and 7 (below ground)	28,166	0	n/a	n/a
<b>Blocks 5, 6 and 7 subtotals</b>	<b>144,355</b>	<b>28,000</b>		
<b>COMMUNITY AND ACTIVE USES (RE1)</b>				
Community uses (located in the Cutaway, located below the Barangaroo Reserve RE1 Zone)	18,000		n/a	n/a
Active uses in the RE1 Zone	5,000		RL 25	23.0
Community uses in the RE1 Zone (Central Barangaroo and Barangaroo South)	1,000		RL 25	23.0
<b>Community and active uses subtotals</b>	<b>24,000</b>			
<b>BARANGAROO CONCEPT PLAN TOTAL</b>	<b>708,041</b>			

**NOTE:** The approved Barangaroo Concept Plan defines Community uses and Active uses as follows:

- **Community uses** include child care centres, community facilities, educational establishments, entertainment facilities (other than cinemas and amusement centres) information and education facilities, landside ferry facilities, places of public worship, public administration buildings, public halls, recreations areas, recreation facilities (major, outdoor and indoor) and health services facility;
- **Active uses** include café kiosks, retail kiosks, pavilions, ferry ticket office, public convenience (toilet facilities) and small equipment storage spaces and the like.



## 2 METHODOLOGY

### 2.1 Wind Tunnel Study Model

To access the wind environment around the Proposed Development, a 1:400 scale model of the Proposed Development for various scenarios were tested in the configurations noted below..

- |                             |   |
|-----------------------------|---|
| A - Existing:               | Existing site with existing surroundings (Image 2a),  |
| B - Proposed:               | Refined Design Scheme within MOD 9 Envelope with existing surroundings (Image 2b), and,                     |
| C- Proposed with Landscape: | Refined Design Scheme within MOD 9 Envelope with existing surroundings and proposed landscaping (Image 2c). |

The scale model of the proposed development was constructed using the design information and drawings listed in Section 5 (Applicability of Results). The wind tunnel model included all relevant surrounding buildings and topography within an approximately 480 m radius of the study site. The boundary-layer wind conditions beyond the modeled area were also simulated in RWDI's wind tunnel through the use of an upwind fetch with roughness elements and flow-conditioning spires. The wind tunnel model was instrumented with 122 wind speed sensors to measure mean and gust wind speeds at a full-scale height of approximately 2 m. The placement of wind measurement locations was based on our experience and understanding of the pedestrian usage for this site. These measurements were recorded for 36 equally incremented wind directions.

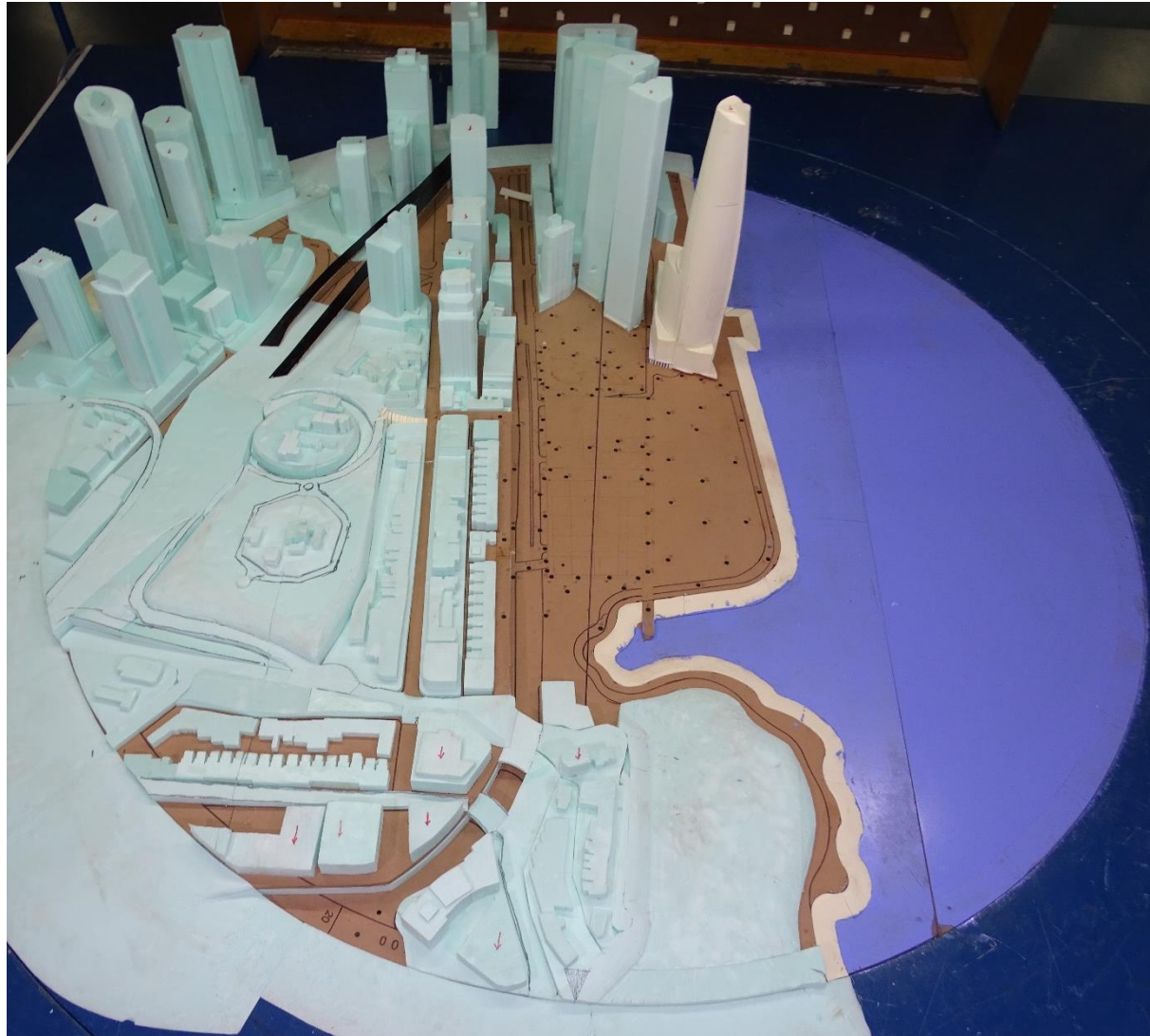


Image 2a: Wind tunnel study model – Existing

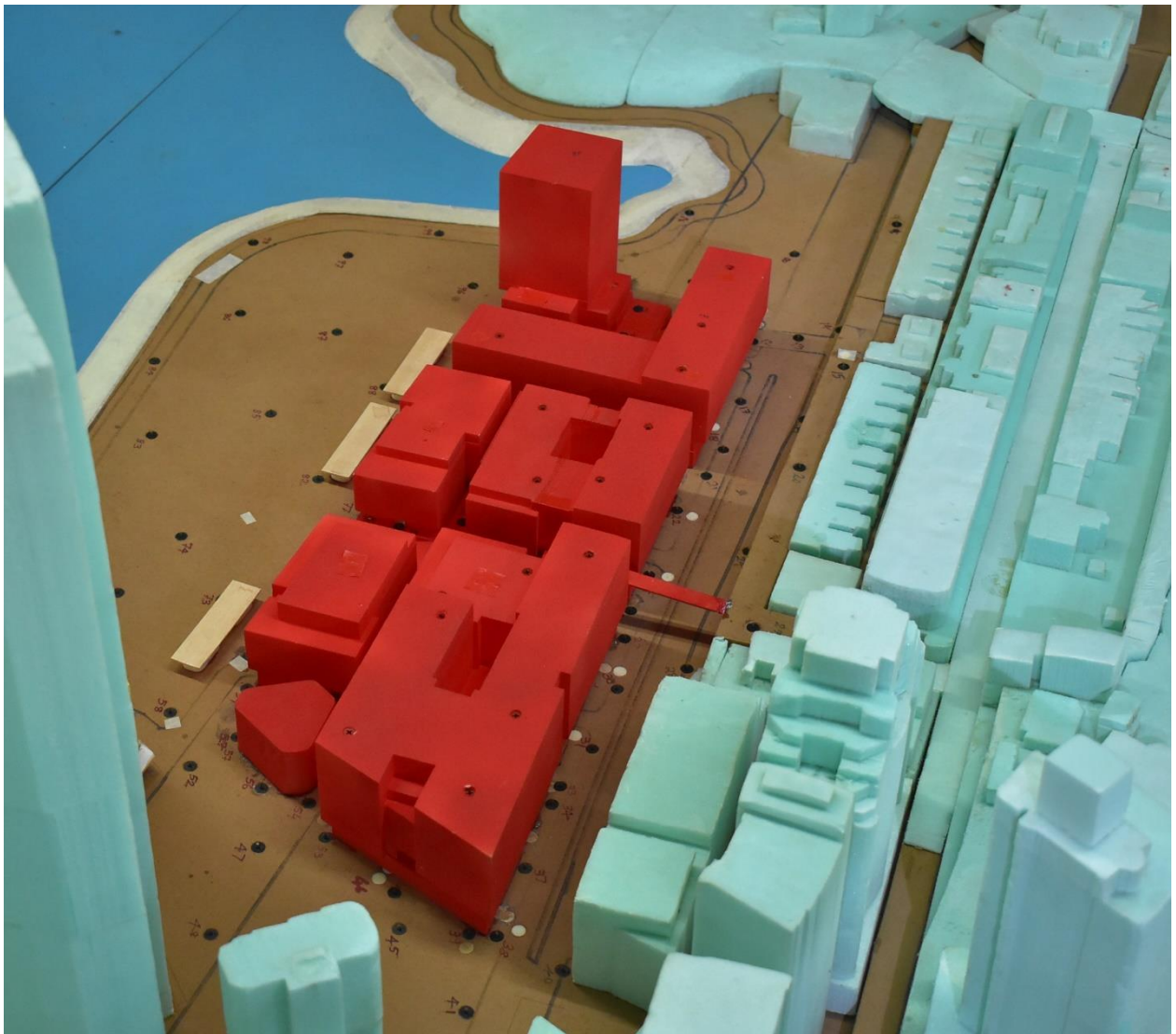
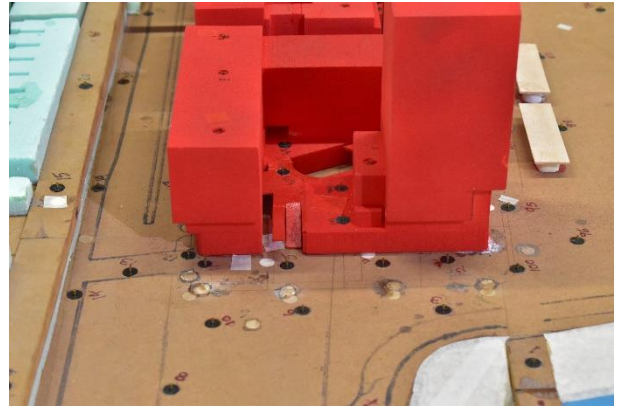
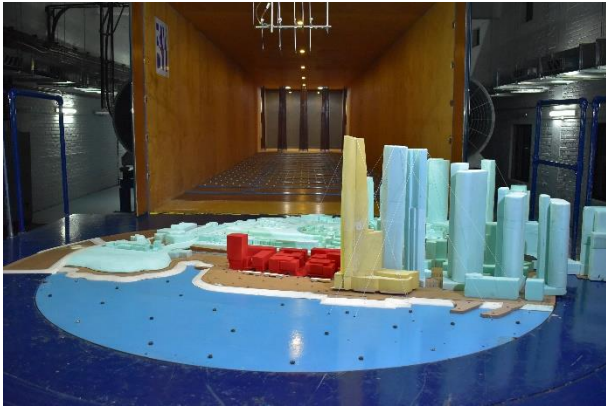


Image 2b: Wind tunnel study model – Proposed

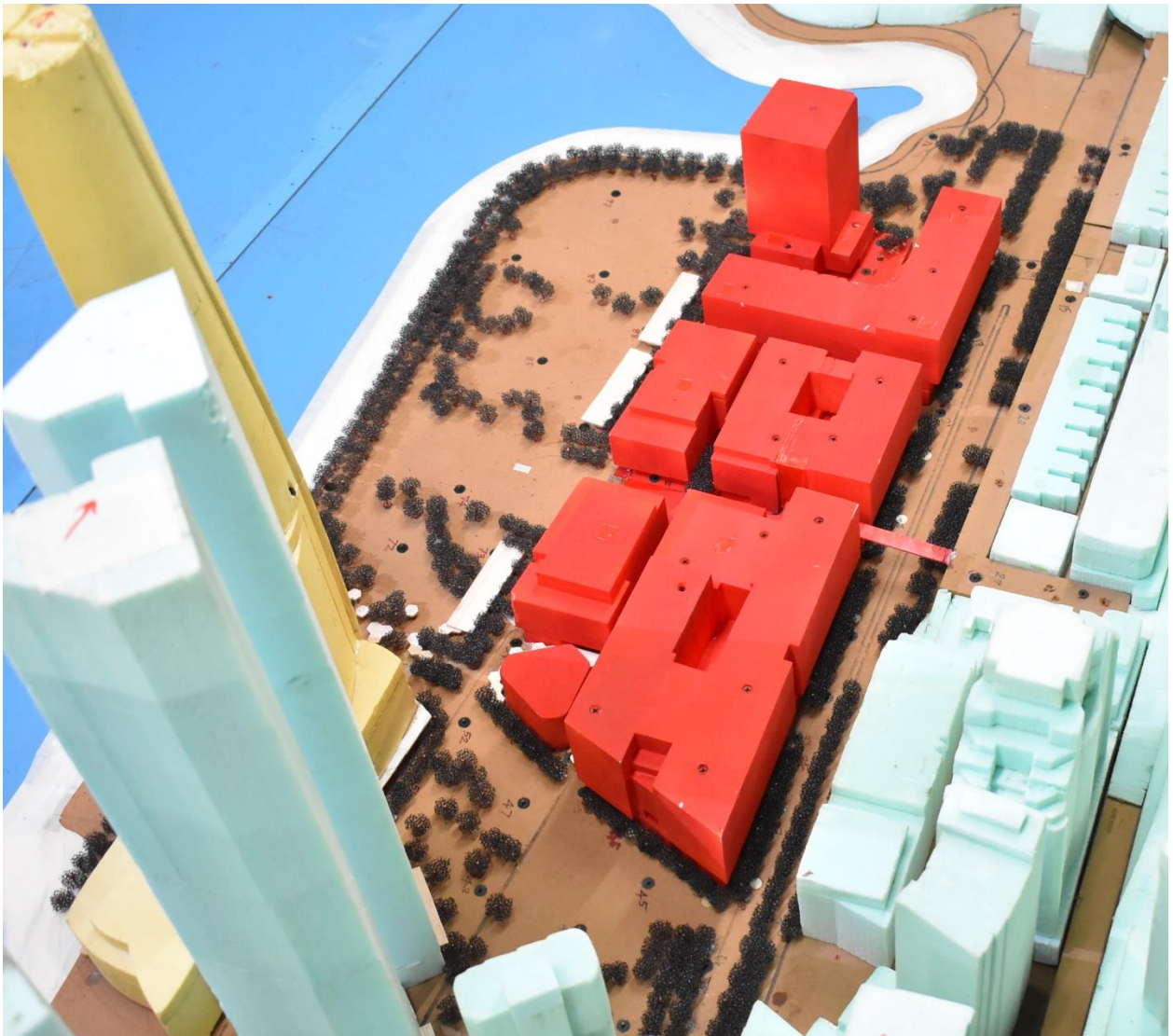


Image 2c: Wind tunnel study model – Proposed with Landscaping

## 2.2 Meteorological Data

Wind statistics recorded at Sydney Airport between 1985 and 2013, inclusive, were analysed for the Summer (November through April) and Winter (May through October) seasons. Image 3 graphically depicts the directional distributions of wind frequencies and speeds for the two seasons.

Winds from the north-northeast, northeast, south-southeast and south are predominant during the summer, while winter winds tend to originate from the west-southwest through northwest and the southerly directions, as indicated by the wind roses shown in Image 3. Strong winds of a mean speed greater than 30 km/h measured at the airport (at an anemometer height of 10 m) occur more often in the summer (14.1%) than in the winter (10.0%).

Wind statistics from Sydney Airport were combined with the wind tunnel data in order to predict the frequency of occurrence of full-scale wind speeds. The full-scale wind predictions were then compared with the RWDI criteria for pedestrian comfort and safety.

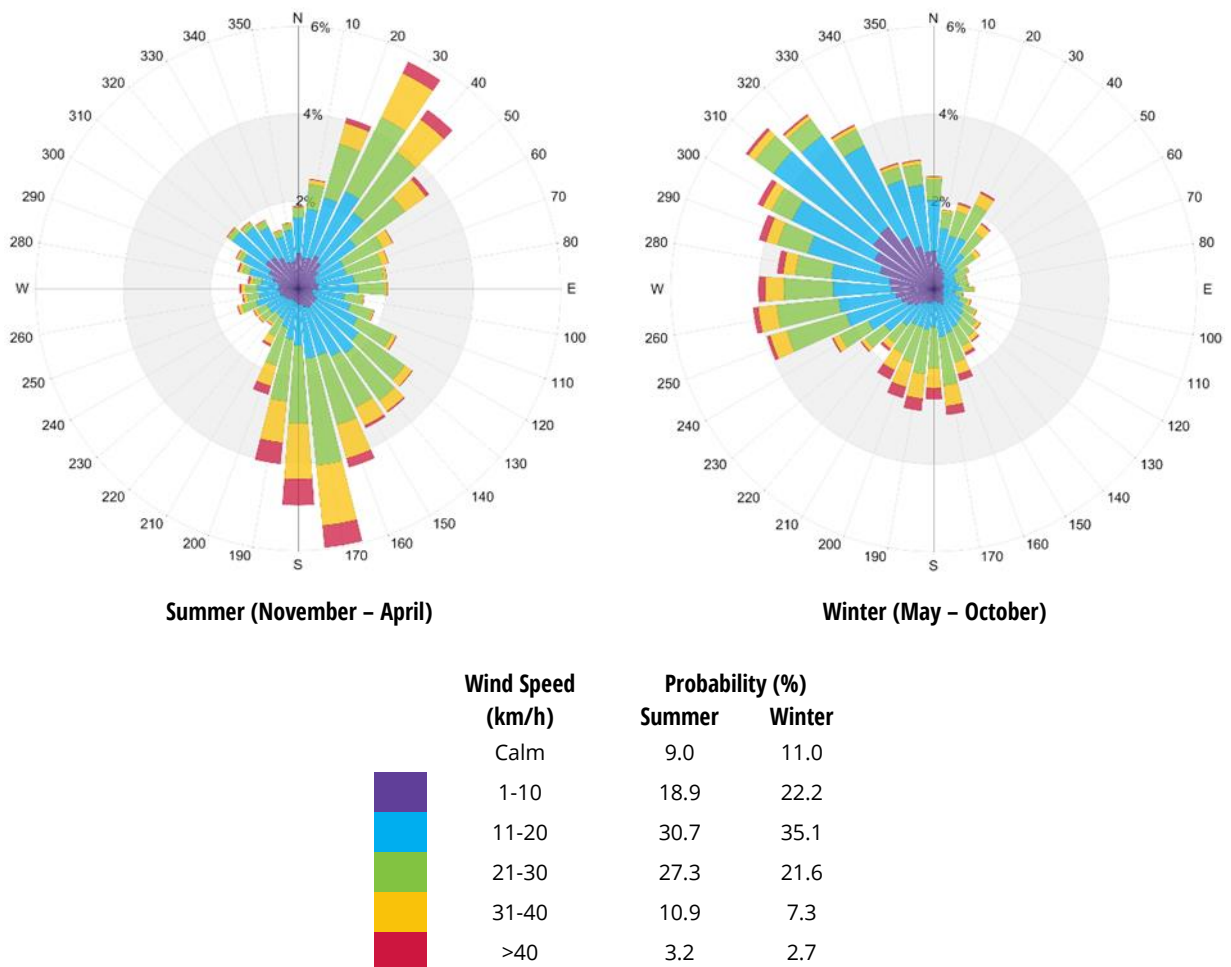


Image 3: Directional Distribution of Winds Approaching Sydney International Airport From 1985 to 2013

## 2.3 RWDI Pedestrian Wind Criteria

The RWDI pedestrian wind criteria, which have been developed by RWDI through research and consulting practice since 1974, are used in the current study. These criteria have been widely accepted by municipal authorities as well as by the building design and city planning community. Regional differences in wind climate and thermal conditions as well as variations in age, health, clothing, etc. can affect a person's perception of the wind climate. Therefore, comparisons of wind speeds for the existing and proposed building configurations are the most objective way in assessing local pedestrian wind conditions. In general, the combined effect of mean and gust speeds on pedestrian comfort can be quantified by a Gust Equivalent Mean (GEM).

Comfort Category	GEM Speed (km/h)	Description
Sitting	$\leq 10$	Calm or light breezes desired for outdoor restaurants and seating areas where one can read a paper without having it blown away
Standing	$\leq 14$	Gentle breezes suitable for main building entrances, bus stops, and other places where pedestrians may linger
Strolling	$\leq 17$	Moderate winds that would be appropriate for window shopping and strolling along a downtown street, plaza or park
Walking	$\leq 20$	Relatively high speeds that can be tolerated if one's objective is to walk, run or cycle without lingering
Uncomfortable	$> 20$	Strong winds of this magnitude are considered a nuisance for all pedestrian activities, and wind mitigation is typically recommended

**Notes:**

- (1) GEM speed = max (mean speed, gust speed/1.85); and,
- (2) GEM speeds listed above are based on a seasonal exceedance of 20% of the time between 6:00 and 23:00. Nightly hours between 0:00 and 5:00 are excluded from the wind analysis for comfort since limited usage of outdoor spaces is anticipated.

Safety Criterion	Gust Speed (km/h)	Description
Exceeded	$> 90$	Excessive gust speeds that can adversely affect a pedestrian's balance and footing. Wind mitigation is typically required.

**Notes:**

- (1) Based on an annual exceedance of 9 hours or 0.1% of the time for 24 hours a day; and,
- (2) Only gust speeds need to be considered in the wind safety criterion. These are usually rare events, but deserve special attention in city planning and building design due to their potential safety impact on pedestrians.

A few additional comments are provided below to further explain the wind criteria and their applications.

- Both mean and gust speeds can affect pedestrian comfort and their combined effect is typically quantified by a Gust Equivalent Mean (GEM) speed, with a gust factor of 1.85.
- Instead of standard four seasons, two periods of summer (November to April) and winter (May to October) are adopted in the wind analysis, because in a moderate climate such as that found in Sydney, there are distinct differences in pedestrian outdoor behaviours between these two time periods.

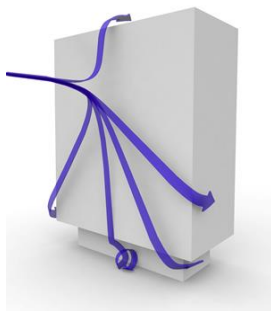


- Nightly hours between midnight and 6 AM are excluded from the wind analysis for comfort since limited usage of outdoor spaces is anticipated, while wind safety analysis is conducted for a 24-hour period.
- A 20% exceedance is used in these criteria to determine the comfort category, which suggests that wind speeds would be comfortable for the corresponding activity at least 80% of the time or four out of five days.
- Only gust wind speeds need to be considered in the wind safety criterion. These are usually rare events, but deserve special attention in city planning and building design due to their potential safety impact on pedestrians.
- These criteria for wind forces represent average wind tolerance. They are somewhat subjective and regional differences in wind climate and thermal conditions as well as variations in age, health, clothing, etc. can also affect people's perception of the wind climate. Comparisons of wind speeds for different building configurations are the most objective way in assessing local pedestrian wind conditions.

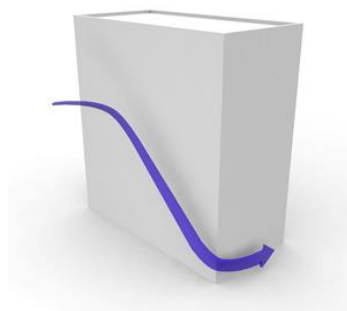
## 3 PREDICTED WIND CONDITIONS

In our review of anticipated wind conditions, reference is made to the following generalised wind flows:

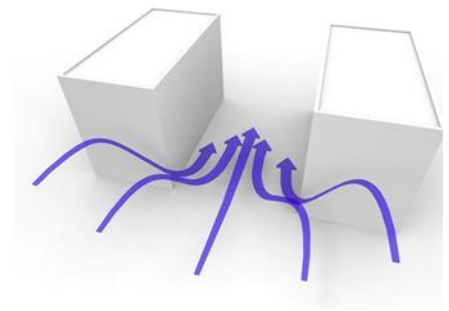
- Tall buildings tend to intercept the stronger winds at higher elevations and redirect them to the ground level (Image 4.1). Such a Downwashing Flow is often the main cause for wind accelerations around large buildings at the pedestrian level.
- When winds approach at an oblique angle to a tall façade and are deflected down, a localised increase in the wind activity or Corner Acceleration can be expected around the exposed building corner at pedestrian level (Image 4.2).
- When two buildings are situated side by side, wind flow tends to accelerate through the space between the buildings due to Channelling Effect caused by the narrow gap (Image 4.3).



4.1) Downwashing flow



4.2) Corner acceleration



4.3) Channelling effect

**Image 4: General wind patterns**

The predicted wind comfort and safety conditions pertaining to the tested configurations assessed are graphically depicted on a site plan in the attached **Figures 1a to 3c** (located in the Figures Section of this report). These conditions and the associated wind speeds are presented in the attached **Table 1**, (located in the Tables Section of this report).

The following is a detailed discussion of the suitability of the predicted wind comfort conditions for the anticipated pedestrian use of each area of interest. It is noted that only the massing of the Proposed Development has been assessed and therefore the exact locations of entrances and amenity terraces are not known at this stage; however, the wind conditions observed will provide guidance on suitable locations for these throughout the precinct.

### 3.1 Existing

The discussion of the wind microclimate for the Existing Configuration is based on the results shown in **Figures 1a and 2a** for the summer and winter seasons, respectively. **Figure 3a** shows any locations which have wind speeds exceeding the safety criterion throughout the year.



### 3.1.1 Pedestrian Wind Comfort

The existing wind conditions in and around the site are expected to currently be generally appropriate for the intended use throughout the year. Conditions are expected to be relatively calmer to the east of the site, suitable for sitting and standing use during both seasons. Relatively windier conditions, suitable for strolling and walking use, are likely to prevail in the areas near Wulugal Walk and Barton Plaza, adjacent to Crown Sydney Hotel Resort (CSHR) due to the exposure to the prevailing winds from the waterfront and within Hickson Park, adjacent to One Sydney Harbour (OSH), due to the interaction with the significantly taller built form of these two developments.

Uncomfortable wind conditions are also predicted at a localised area to the south-west of the site, near the Urban Theatre and Wulugal Walk at northwest corner of CSHR, at measurement locations 69, 70 and 71 during the summer (**Figure 1a**) and at measurement locations 69 and 70 during the winter season (**Figure 2a**). Wind conditions are slightly windier during the summer season due to the seasonally stronger winds.

### 3.1.2 Pedestrian Wind Safety

Wind speeds at six measurement locations 43 and 51 in Hickson Park and 69, 70, 72 and 74 in the Urban Theatre and Wulugal Walk at the northern aspect of CSHR, are expected to exceed the safety threshold in the existing configuration as shown in **Figure 3a**.

## 3.2 Proposed

The discussion of the wind microclimate for the proposed configuration (Refined Design Scheme within the MOD 9 Envelope) is based on the results shown in **Figures 1b and 2b** for the summer and winter seasons, respectively. **Figure 3b** shows any locations which have wind speeds exceeding the safety criterion throughout the year. Mitigation measures are discussed in Section 4.

### 3.2.1 Pedestrian Wind Comfort

With the Proposed Development built out, the wind microclimate conditions within and around the site would remain largely consistent (within the range, suitable for sitting through to strolling use at the majority of the locations with some walking/uncomfortable conditions) with the existing configuration. However, windier conditions are predicted at localised areas at the southwest corner of the Proposed Development near Barangaroo Avenue. This is due to the interaction of CSHR and OSH with the Proposed Development built form.

#### Footpaths

Wind conditions comfortable for walking or strolling use are appropriate for footpaths. Sitting or Standing wind conditions are expected immediately around the Proposed Development. There are some locations where walking wind conditions were observed at the south, west, and northern sides of the Proposed Development; however, these wind conditions are acceptable for the intended pedestrian use.

Uncomfortable wind conditions are expected along the Barton Street and Wulugal Walk near the corner of CSHR represented by measurement locations 68, 69, 70 throughout the year. These windy conditions are

primarily due to the wind accelerating around the corners of CSHR which is largely consistent with the existing configuration.

### Entrances

Wind conditions suitable for standing use or calmer are desired at building entrances. The exact location of entrances into the Proposed Development is not known at this stage of the design. However, from the wind microclimate assessment, it could be inferred that wind speeds in most areas along the building perimeter are expected to be comfortable for sitting or standing use which is appropriate for locating entrances. We recommend avoiding entrances close to locations where strolling or walking conditions are predicted.

### Public Parklands

It is generally desirable for wind conditions in areas intended for passive activities to be comfortable for sitting or standing use. The public areas at ground level include Harbour Park to the west of the Proposed Development and Hickson Park to the south. The wind conditions in Harbour Park to the west are predicted to be comfortable for standing use close to the Proposed Development and strolling and walking use closer to the waterfront, throughout the year. This is largely in line with the existing conditions given its an exposed area on the waterfront. Hickson Park would have a mix of strolling and walking wind conditions throughout the year. Conditions suitable for strolling or walking are considered too windy for the intended use of longer duration stay activities.

### Elevated Level

Wind conditions on the elevated levels are predicted to be acceptable (sitting or standing wind conditions) at the majority of the locations. However, there are some locations at the west side of the elevated level where windier than desired conditions (measurement locations 105, 106) are predicted throughout the year.

## 3.2.2 Pedestrian Wind Safety

With the addition of the Proposed Development, the safety exceedances identified in the Existing configuration at measurement locations 43 and 51 in Hickson Park and 69, 72 and 74 near the Urban Theatre area for the existing configuration would be mitigated. However, wind speeds at measurements location 70 on Wulugul Walk (pre-existing), and two new measurement locations 68 (Barton Street walkway) and 90 near proposed built form, are expected to exceed the safety threshold.

## 3.3 Proposed with Landscaping

To demonstrate the potential of the Proposed Development and surrounding areas to achieve appropriate levels of wind comfort and safety throughout the precinct, testing was performed for the refined design scheme within the MOD 9 envelope with the inclusion of a representative landscaping scheme as shown in Image 4.

The discussion of the wind microclimate for the proposed with landscaping configuration is based on the results shown in **Figures 1c and 2c** for the summer and winter seasons, respectively. **Figure 3c** shows any locations which have wind speeds exceeding the safety criterion throughout the year. These are presented in the Figures section of the report.



Image 4: Landscaping Plan

### 3.3.1 Pedestrian Wind Comfort and Safety

Reduced wind speeds are expected across the site, resulting in calm wind conditions throughout the year at most locations with the addition of landscaping features (these include trees of 5 to 6 m high, canopies and trellis of 3 m high as shown in wind tunnel photos in Image 2c and landscape plan in Image 4).

In summary:

- The majority of the strolling wind conditions expected at the southern side of the Proposed Development, on Barton Street and Hickson Park, would become either suitable for sitting or standing use, with a few locations of strolling wind conditions at localised areas. These locations in Hickson Park are a noted improvement over the existing conditions which were generally strolling or walking conditions.
- The notably windy conditions on the Barton Street Walkway and Wulugul Walk, close to CSHR are improved considerably.
- The majority of locations along Barangaroo Avenue are suitable for sitting and standing throughout the year.
- Wind conditions on the elevated levels including on the Barangaroo Steps linking to High Street are predicted to be calm throughout the year and suitable for passive occupant use.
- Wind conditions in Hickson Park are found to be comparable or improved when compared to the existing configuration.
- The majority of the safety exceedances expected at the proposed configuration are mitigated with the addition of the landscaping features.

In conclusion, the representative landscaping scheme is shown to improve wind conditions throughout the precinct. It is recommended that this strategy be refined in due course once the Proposed Development progresses to the detailed design stage and the built form of the development has been refined. This is to ensure that this is design cohesively with the any minor changes to the wind flow patterns experienced.

The consideration for both vertical and horizontal elements to enhance the wind conditions for the area is important so that they are responsive to the wind flow conditions experienced. The site is exposed to the direct prevailing winds over the waterfront (vertical elements most suitable), while also the localised downwashed winds from the proposed development built form as well as CSHR and OSH (horizontal elements most suitable). Developing and selecting the right mitigation strategy in accordance with the associated flow pattern is important to achieve the most beneficial outcome.



## 4 CONCLUSION

Wind tunnel testing has been undertaken for the proposed Central Barangaroo precinct with consideration for the built form design of the development and well as potential landscaping proposed as part of the masterplan for the area. It has been found that the majority of the precinct with the inclusion of the proposed development will generally be similar to the existing conditions. Consideration has been made for the proposed landscape masterplan at this stage which was found to satisfy the wind comfort criteria for the precinct, including within Harbour Park and Hickson Park areas. The landscape design is expected to be further refined as the Central Barangaroo design scheme is further refined. Consideration should be made for the effect of tree maturity once the species have been selected.



## 5 APPLICABILITY OF RESULTS

The drawings and information listed below were received from Central Barangaroo Developer and were used to construct the scale model of the proposed Central Barangaroo. The wind conditions presented in this report pertain to the proposed as detailed in the architectural design drawings listed in the table below. Should there be any design changes that deviate from this list of drawings, the wind condition predictions presented may change. Therefore, if changes in the design are made, it is recommended that RWDI be contacted and requested to review their potential effects on wind conditions.

File Name	File Type	Date Received (dd/mm/yyyy)
200811_3D-RefinedDesign&Envelope.dwg	CAD	11/08/2020
201106_Masterplan_A1@1-500.pdf	PDF	06/11/2020

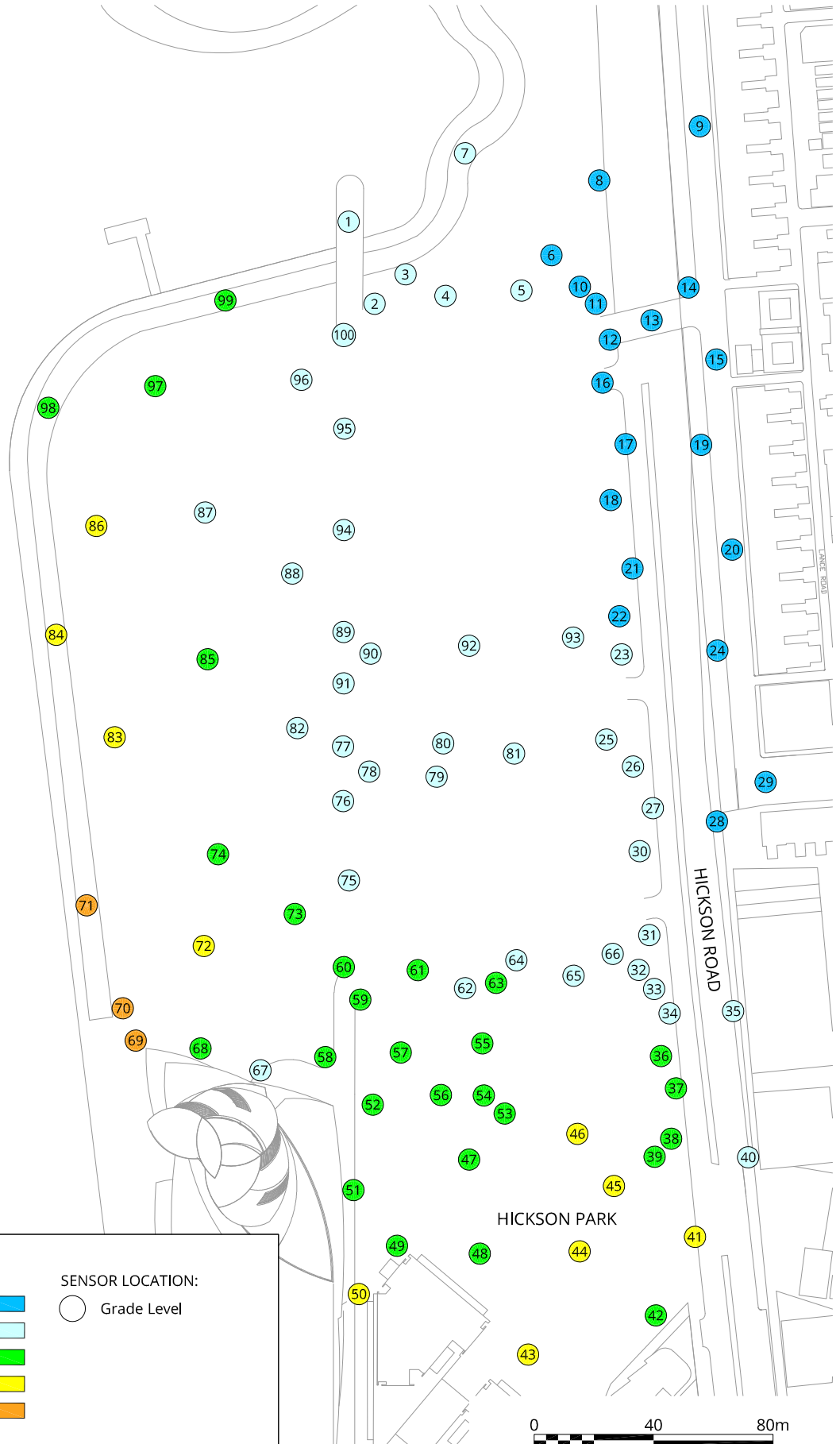
## 6 REFERENCES

1. ASCE Task Committee on Outdoor Human Comfort (2004). *Outdoor Human Comfort and Its Assessment*, 68 pages, American Society of Civil Engineers, Reston, Virginia, USA.
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# FIGURES





**LEGEND:**

COMFORT CATEGORIES:

- Sitting —————
- Standing —————
- Strolling —————
- Walking —————
- Uncomfortable —————

SENSOR LOCATION:

- Grade Level

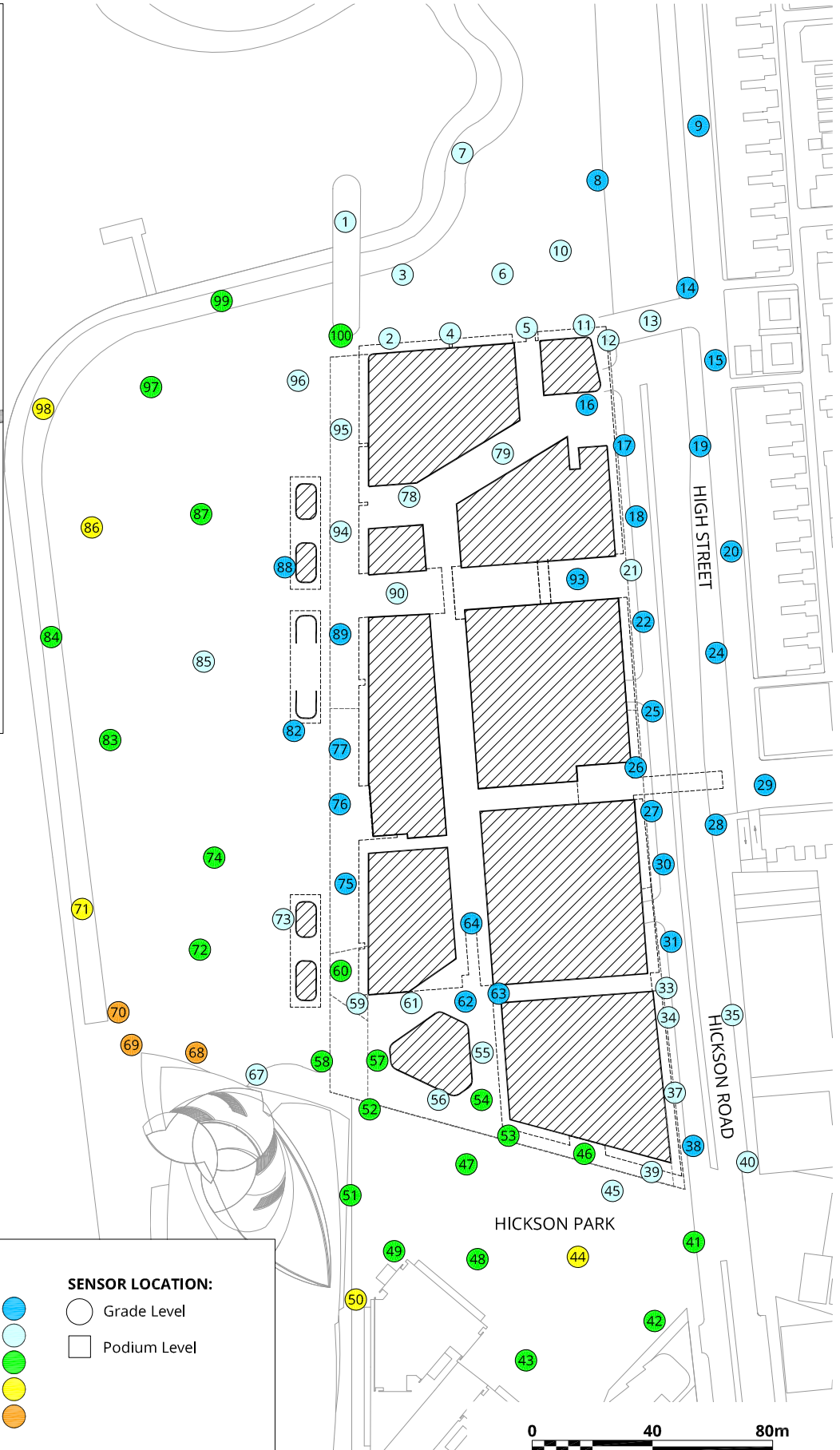
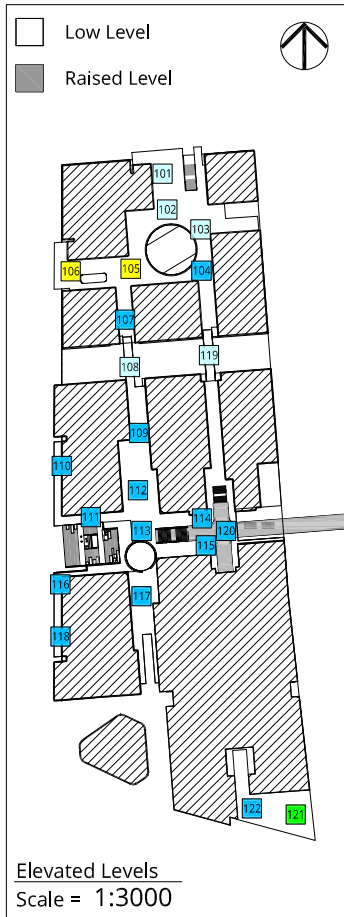
**Pedestrian Wind Comfort Conditions**  
 Existing  
 Summer (November to April, 6:00 to 23:00)  
 Central Barangaroo - Sydney, Australia



Project #1803974

Drawn by: AFR	Figure: 1A
Approx. Scale: 1:2000	
Date Revised: Aug. 2, 2018	





**LEGEND:**

**COMFORT CATEGORIES:**


- Sitting ———— ● (blue)
- Standing ———— ● (light blue)
- Strolling ———— ● (green)
- Walking ———— ● (yellow)
- Uncomfortable ———— ● (orange)

**SENSOR LOCATION:**

- Grade Level
- Podium Level

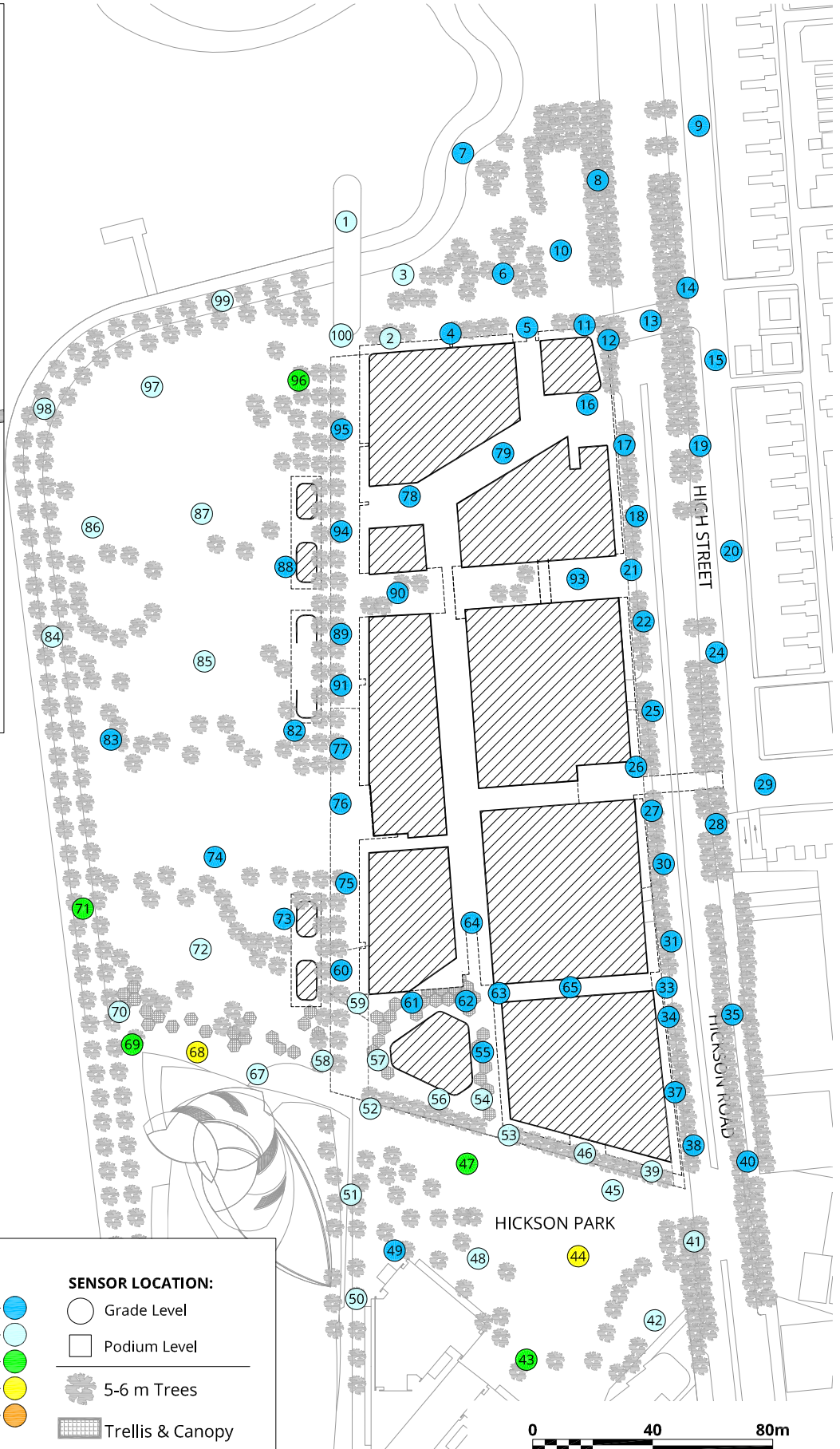
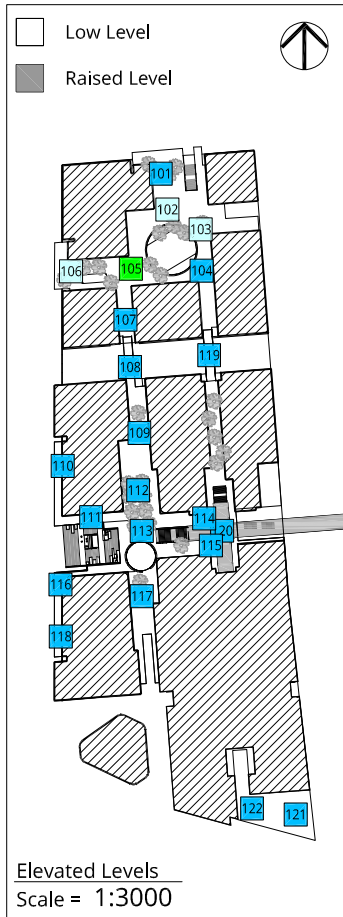
**Pedestrian Wind Comfort Conditions**  
 Proposed  
 Summer (November to April, 6:00 to 23:00)

Central Barangaroo - Sydney, NSW

True North  
  
 Project #2001665

Drawn by: AFR	Figure: 1B
Approx. Scale: 1:2000	
Date Revised: Aug. 27, 2020	





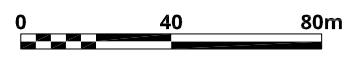
**LEGEND:**

**COMFORT CATEGORIES:**

- Sitting ———— ● (Blue)
- Standing ———— ● (Light Blue)
- Strolling ———— ● (Green)
- Walking ———— ● (Yellow)
- Uncomfortable ———— ● (Orange)

**SENSOR LOCATION:**

- Grade Level
- Podium Level
- 5-6 m Trees
- ▒ Trellis & Canopy



**Pedestrian Wind Comfort Conditions**  
 Proposed With Landscape  
 Summer (November to April, 6:00 to 23:00)

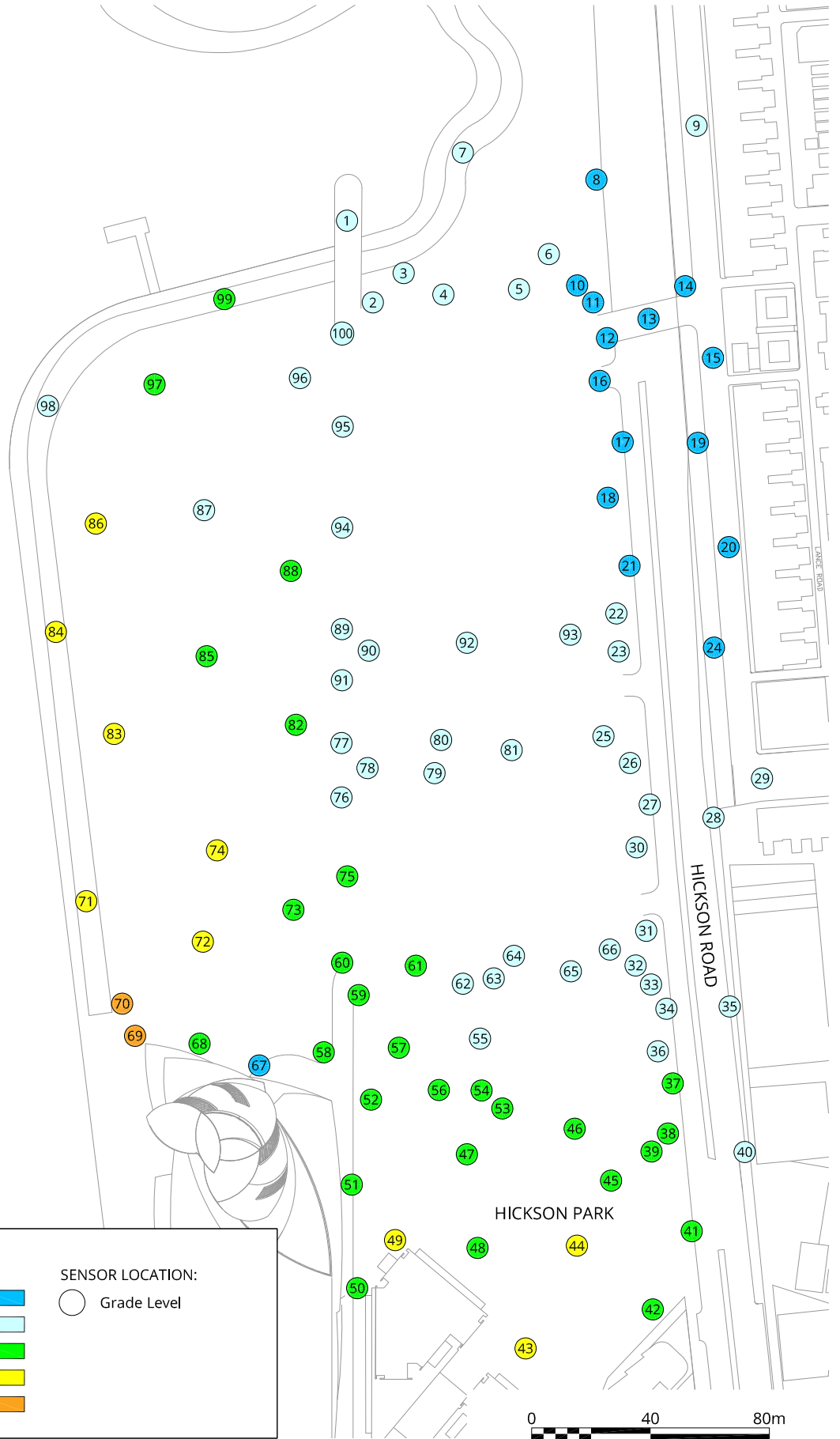
Central Barangaroo - Sydney, NSW



Project #2001665

Drawn by: AFR	Figure: 1C
Approx. Scale: 1:2000	
Date Revised: Dec. 08, 2020	





**LEGEND:**

COMFORT CATEGORIES:

- Sitting —————
- Standing —————
- Strolling —————
- Walking —————
- Uncomfortable —————

SENSOR LOCATION:

- Grade Level

**Pedestrian Wind Comfort Conditions**  
 Existing  
 Winter (May to October, 6:00 to 23:00)

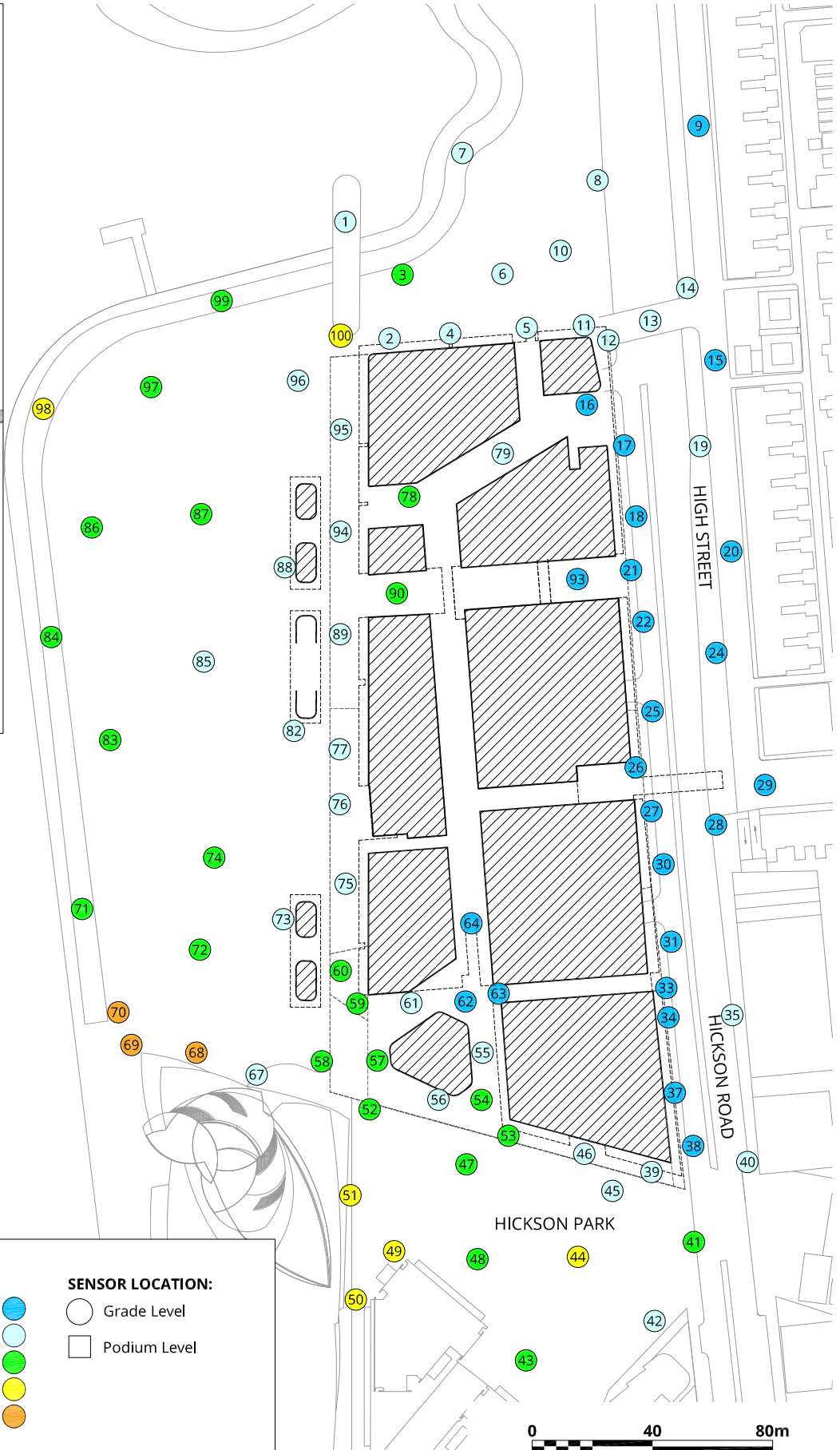
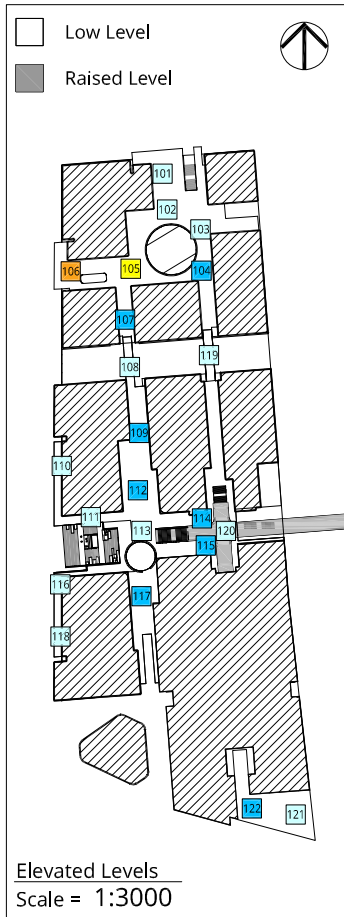
Central Barangaroo - Sydney, Australia



Project #1803974

Drawn by: AFR	Figure: 2A
Approx. Scale: 1:2000	
Date Revised: Aug. 2, 2018	





**LEGEND:**

**COMFORT CATEGORIES:**


- Sitting ———— ● (light blue)
- Standing ———— ● (medium blue)
- Strolling ———— ● (green)
- Walking ———— ● (yellow)
- Uncomfortable ———— ● (orange)

**SENSOR LOCATION:**

- Grade Level
- Podium Level

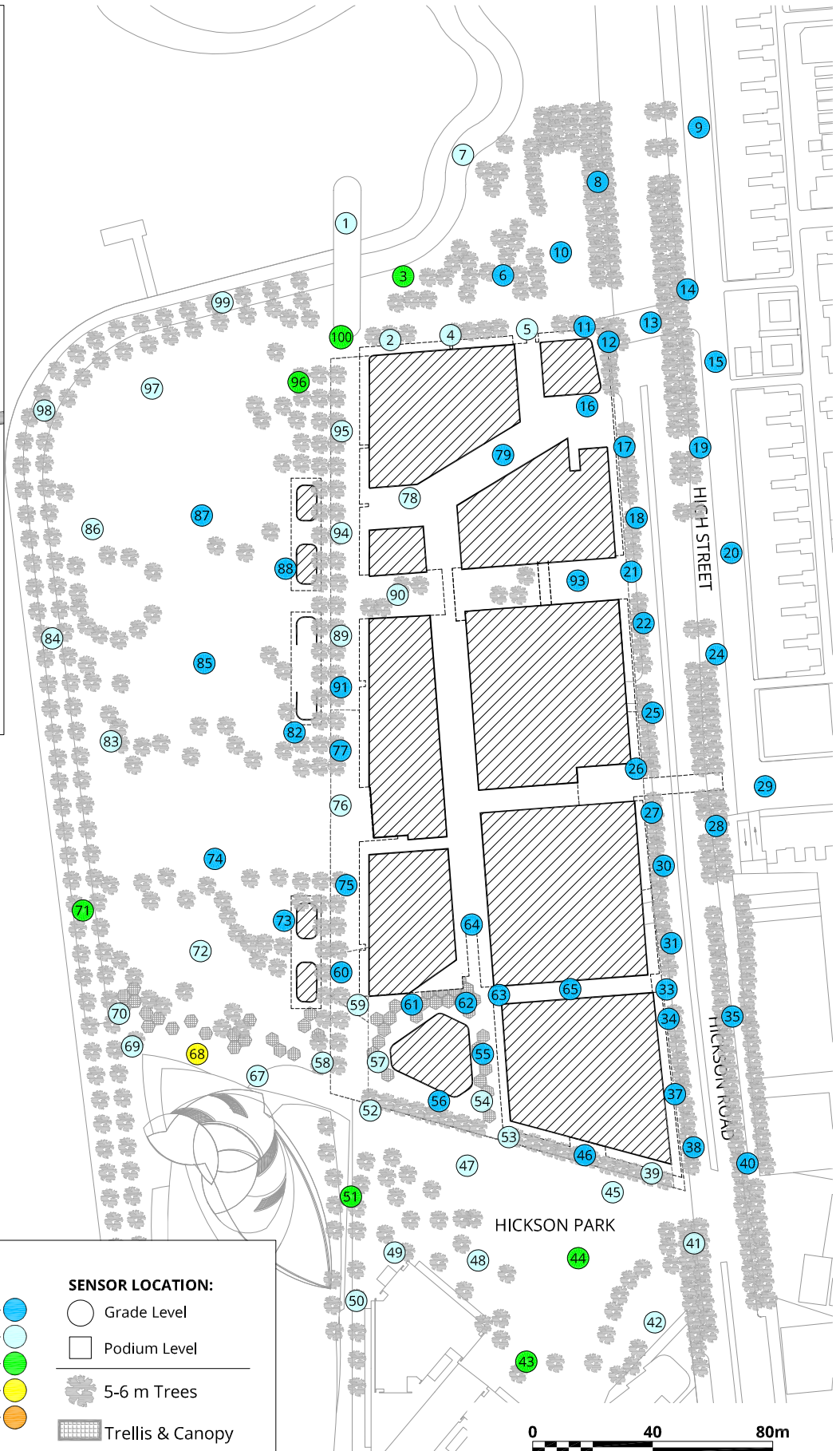
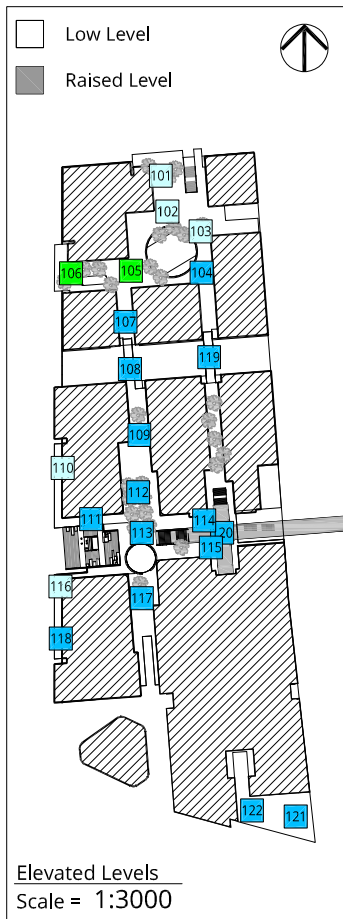
**Pedestrian Wind Comfort Conditions**  
 Proposed  
 Winter (May to October, 6:00 to 23:00)

Central Barangaroo - Sydney, NSW

True North  
  
 Project #2001665

Drawn by: AFR	Figure: 2B
Approx. Scale: 1:2000	
Date Revised: Aug. 27, 2020	





**LEGEND:**

**COMFORT CATEGORIES:**

- Sitting ———— ● (Blue)
- Standing ———— ● (Light Blue)
- Strolling ———— ● (Green)
- Walking ———— ● (Yellow)
- Uncomfortable ———— ● (Orange)

**SENSOR LOCATION:**

- Grade Level
- Podium Level
- 5-6 m Trees
- ▒ Trellis & Canopy

**Pedestrian Wind Comfort Conditions**  
 Proposed With Landscape  
 Winter (May to October, 6:00 to 23:00)

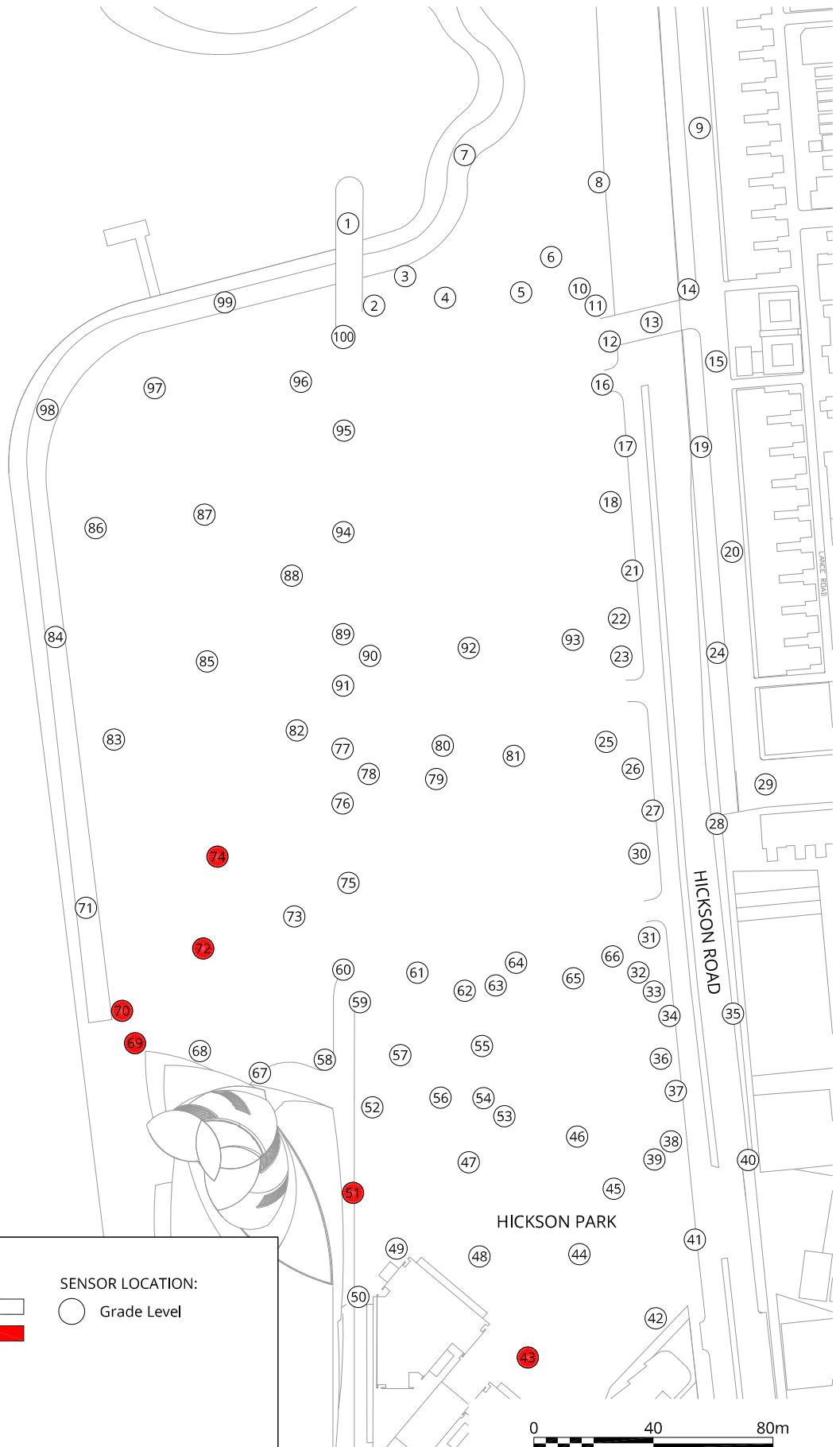
Central Barangaroo - Sydney, NSW



Project #2001665


Drawn by: AFR	Figure: 2C
Approx. Scale: 1:2000	
Date Revised: Dec. 08, 2020	







**LEGEND:**

SAFETY CATEGORIES:

Pass 

Exceeded 

SENSOR LOCATION:

 Grade Level

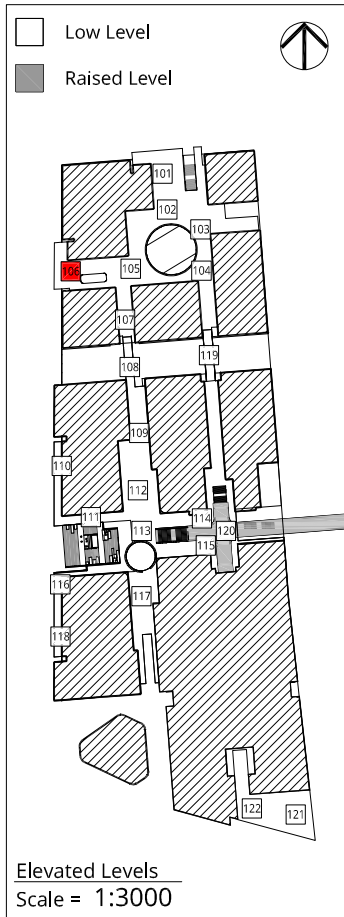
**Pedestrian Wind Safety Conditions**  
 Existing  
 Annual (January to December, 0:00 to 23:00)  
 Central Barangaroo - Sydney, Australia



Project #1803974

Drawn by: AFR	Figure: 3A
Approx. Scale: 1:2000	
Date Revised: Aug. 2, 2018	





**LEGEND:**

**COMFORT CATEGORIES:**

Pass ———— ○

Exceeded ———— ●

**SENSOR LOCATION:**

○ Grade Level

□ Podium Level

**Pedestrian Wind Safety Conditions**  
 Proposed  
 Annual (January to December, 0:00 to 23:00)

Central Barangaroo - Sydney, NSW

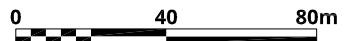
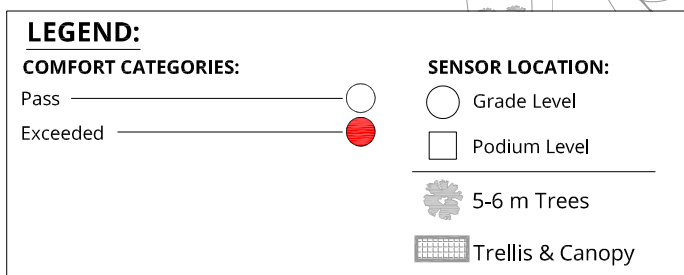
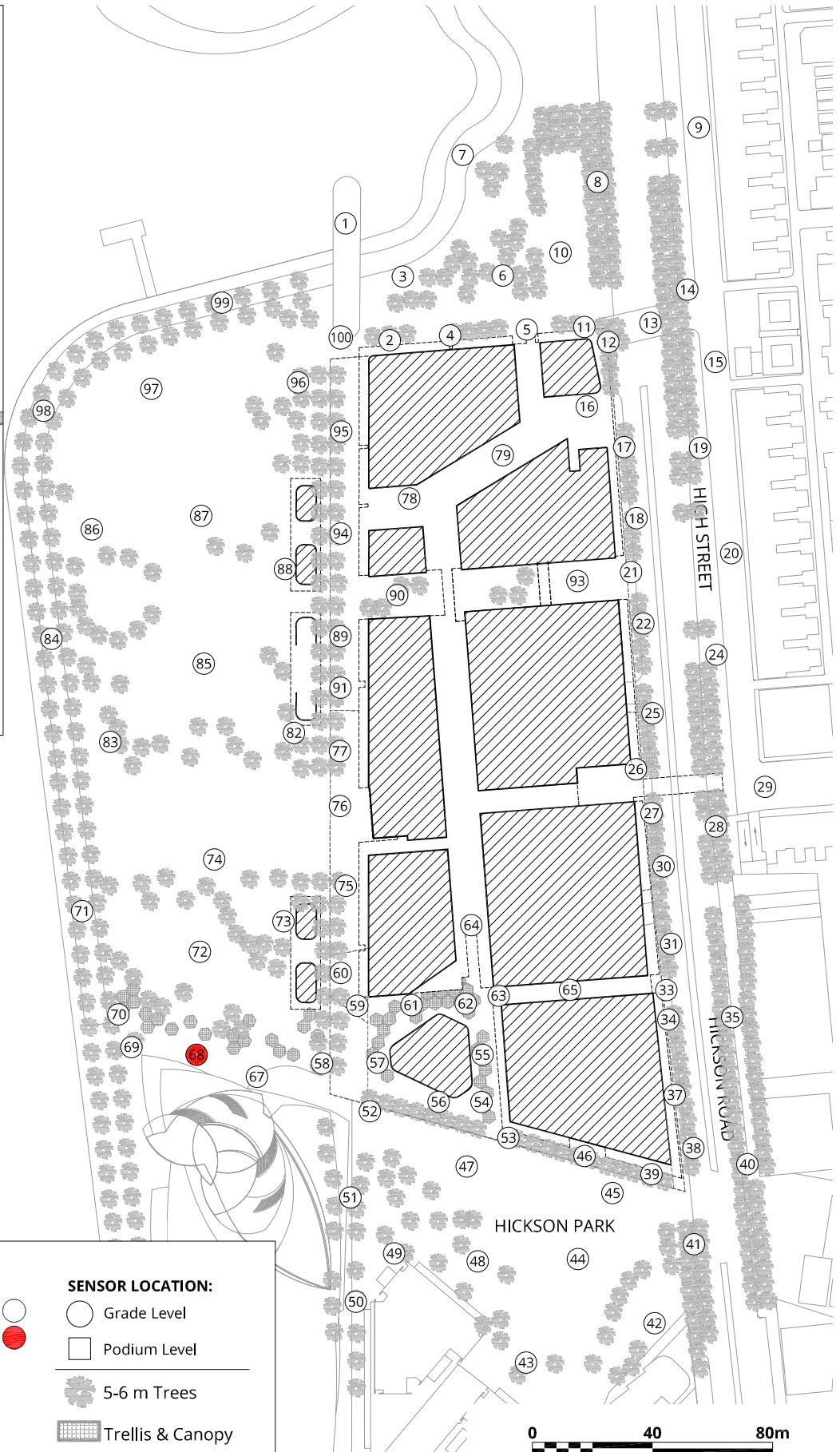
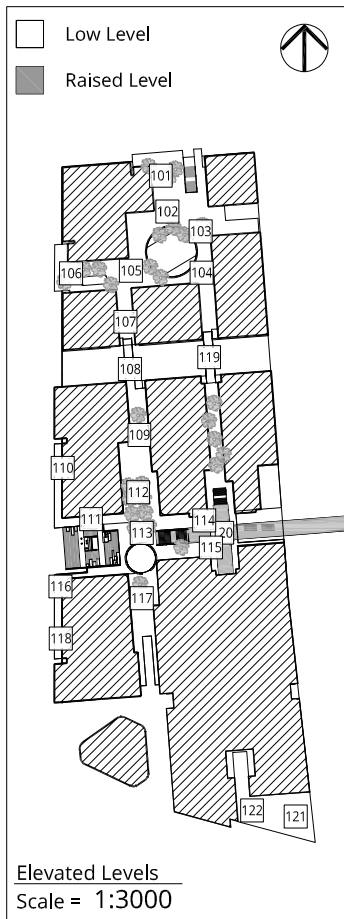


Project #2001665

Drawn by: AFR	Figure: 3B
Approx. Scale: 1:2000	
Date Revised: Aug. 27, 2020	







<p><b>Pedestrian Wind Safety Conditions</b>          Proposed With Landscape          Annual (January to December, 0:00 to 23:00)</p> <p>Central Barangaroo - Sydney, NSW</p>	<p>True North  </p> <p>Project #2001665</p>	<p>Drawn by: AFR</p>	<p>Figure: 3C</p>	
		<p>Approx. Scale: 1:2000</p>	<p>Date Revised: Dec. 08, 2020</p>	

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# TABLES

**Table 1: Pedestrian Wind Comfort and Safety Conditions**

Location	Configuration	Wind Comfort				Wind Safety	
		Summer		Winter		Annual	
		Speed (km/h)	Rating	Speed (km/h)	Rating	Speed (km/h)	Rating
1	Existing	12	Standing	13	Standing	68	Pass
	Proposed	13	Standing	14	Standing	69	Pass
	Proposed + Mitigation	12	Standing	12	Standing	63	Pass
2	Existing	13	Standing	14	Standing	67	Pass
	Proposed	14	Standing	13	Standing	75	Pass
	Proposed + Mitigation	12	Standing	12	Standing	65	Pass
3	Existing	12	Standing	13	Standing	67	Pass
	Proposed	14	Standing	17	Strolling	88	Pass
	Proposed + Mitigation	12	Standing	15	Strolling	81	Pass
4	Existing	12	Standing	13	Standing	65	Pass
	Proposed	12	Standing	13	Standing	69	Pass
	Proposed + Mitigation	10	Sitting	11	Standing	65	Pass
5	Existing	11	Sitting	12	Standing	61	Pass
	Proposed	11	Standing	14	Standing	76	Pass
	Proposed + Mitigation	9	Sitting	11	Standing	73	Pass
6	Existing	10	Sitting	11	Standing	57	Pass
	Proposed	11	Standing	13	Standing	73	Pass
	Proposed + Mitigation	9	Sitting	9	Sitting	44	Pass
7	Existing	11	Standing	13	Standing	64	Pass
	Proposed	11	Standing	14	Standing	73	Pass
	Proposed + Mitigation	10	Sitting	12	Standing	67	Pass
8	Existing	9	Sitting	10	Sitting	51	Pass
	Proposed	9	Sitting	11	Standing	61	Pass
	Proposed + Mitigation	7	Sitting	8	sitting	55	Pass
9	Existing	9	Sitting	11	Standing	60	Pass
	Proposed	9	Sitting	10	Sitting	49	Pass
	Proposed + Mitigation	8	Sitting	9	Sitting	50	Pass
10	Existing	10	Sitting	10	Sitting	54	Pass
	Proposed	11	Standing	11	Standing	65	Pass
	Proposed + Mitigation	9	Sitting	9	Sitting	43	Pass
11	Existing	10	Sitting	10	Sitting	53	Pass
	Proposed	12	Standing	12	Standing	64	Pass
	Proposed + Mitigation	9	Sitting	9	Sitting	50	Pass
12	Existing	9	Sitting	10	Sitting	51	Pass
	Proposed	12	Standing	12	Standing	67	Pass
	Proposed + Mitigation	10	Sitting	10	Sitting	57	Pass
13	Existing	8	Sitting	9	Sitting	50	Pass
	Proposed	11	Standing	12	Standing	57	Pass
	Proposed + Mitigation	9	Sitting	9	Sitting	48	Pass
14	Existing	7	Sitting	9	Sitting	55	Pass
	Proposed	9	Sitting	11	Standing	70	Pass
	Proposed + Mitigation	7	Sitting	8	Sitting	51	Pass

**Table 1: Pedestrian Wind Comfort and Safety Conditions**

Location	Configuration	Wind Comfort				Wind Safety	
		Summer		Winter		Annual	
		Speed (km/h)	Rating	Speed (km/h)	Rating	Speed (km/h)	Rating
15	Existing	8	Sitting	10	Sitting	61	Pass
	Proposed	8	Sitting	9	Sitting	51	Pass
	Proposed + Mitigation	8	Sitting	10	Sitting	56	Pass
16	Existing	10	Sitting	10	Sitting	53	Pass
	Proposed	10	Sitting	9	Sitting	46	Pass
	Proposed + Mitigation	8	Sitting	7	Sitting	39	Pass
17	Existing	9	Sitting	10	Sitting	49	Pass
	Proposed	9	Sitting	8	Sitting	42	Pass
	Proposed + Mitigation	8	Sitting	7	Sitting	37	Pass
18	Existing	10	Sitting	10	Sitting	52	Pass
	Proposed	10	Sitting	8	Sitting	42	Pass
	Proposed + Mitigation	8	Sitting	6	Sitting	33	Pass
19	Existing	7	Sitting	9	Sitting	56	Pass
	Proposed	9	Sitting	12	Standing	76	Pass
	Proposed + Mitigation	7	Sitting	7	Sitting	42	Pass
20	Existing	8	Sitting	10	Sitting	60	Pass
	Proposed	8	Sitting	8	Sitting	41	Pass
	Proposed + Mitigation	8	Sitting	8	Sitting	38	Pass
21	Existing	10	Sitting	10	Sitting	51	Pass
	Proposed	11	Standing	10	Sitting	47	Pass
	Proposed + Mitigation	8	Sitting	7	Sitting	39	Pass
22	Existing	10	Sitting	11	Standing	54	Pass
	Proposed	10	Sitting	7	Sitting	42	Pass
	Proposed + Mitigation	7	Sitting	5	Sitting	33	Pass
23	Existing	11	Standing	11	Standing	57	Pass
	Proposed	-	-	-	-	-	-
	Proposed + Mitigation	4	Sitting	4	Sitting	20	Pass
24	Existing	7	Sitting	9	Sitting	53	Pass
	Proposed	9	Sitting	9	Sitting	41	Pass
	Proposed + Mitigation	6	Sitting	5	Sitting	27	Pass
25	Existing	11	Standing	11	Standing	57	Pass
	Proposed	10	Sitting	7	Sitting	43	Pass
	Proposed + Mitigation	7	Sitting	5	Sitting	33	Pass
26	Existing	12	Standing	11	Standing	55	Pass
	Proposed	9	Sitting	7	Sitting	42	Pass
	Proposed + Mitigation	7	Sitting	5	Sitting	29	Pass
27	Existing	12	Standing	11	Standing	54	Pass
	Proposed	10	Sitting	8	Sitting	42	Pass
	Proposed + Mitigation	7	Sitting	6	Sitting	35	Pass
28	Existing	10	Sitting	12	Standing	69	Pass
	Proposed	9	Sitting	8	Sitting	37	Pass

**Table 1: Pedestrian Wind Comfort and Safety Conditions**

Location	Configuration	Wind Comfort				Wind Safety	
		Summer		Winter		Annual	
		Speed (km/h)	Rating	Speed (km/h)	Rating	Speed (km/h)	Rating
	Proposed + Mitigation	6	Sitting	6	Sitting	31	Pass
29	Existing	10	Sitting	11	Standing	72	Pass
	Proposed	8	Sitting	9	Sitting	44	Pass
	Proposed + Mitigation	9	Sitting	8	Sitting	40	Pass
30	Existing	11	Standing	11	Standing	56	Pass
	Proposed	9	Sitting	7	Sitting	38	Pass
	Proposed + Mitigation	6	Sitting	5	Sitting	29	Pass
31	Existing	13	Standing	12	Standing	58	Pass
	Proposed	10	Sitting	9	Sitting	39	Pass
	Proposed + Mitigation	7	Sitting	6	Sitting	30	Pass
32	Existing	14	Standing	13	Standing	62	Pass
	Proposed	-	-	-	-	-	-
	Proposed + Mitigation	5	Sitting	5	Sitting	30	Pass
33	Existing	14	Standing	13	Standing	63	Pass
	Proposed	11	Standing	9	Sitting	44	Pass
	Proposed + Mitigation	9	Sitting	7	Sitting	36	Pass
34	Existing	14	Standing	14	Standing	63	Pass
	Proposed	11	Standing	8	Sitting	41	Pass
	Proposed + Mitigation	7	Sitting	5	Sitting	38	Pass
35	Existing	14	Standing	14	Standing	68	Pass
	Proposed	12	Standing	11	Standing	59	Pass
	Proposed + Mitigation	6	Sitting	5	Sitting	31	Pass
36	Existing	15	Strolling	14	Standing	67	Pass
	Proposed	-	-	-	-	-	-
	Proposed + Mitigation	6	Sitting	6	Sitting	27	Pass
37	Existing	15	Strolling	15	Strolling	71	Pass
	Proposed	12	Standing	9	Sitting	47	Pass
	Proposed + Mitigation	7	Sitting	6	Sitting	30	Pass
38	Existing	16	Strolling	16	Strolling	74	Pass
	Proposed	10	Sitting	10	Sitting	58	Pass
	Proposed + Mitigation	7	Sitting	8	Sitting	45	Pass
39	Existing	16	Strolling	16	Strolling	73	Pass
	Proposed	14	Standing	12	Standing	66	Pass
	Proposed + Mitigation	11	Standing	11	Standing	55	Pass
40	Existing	13	Standing	14	Standing	65	Pass
	Proposed	12	Standing	11	Standing	55	Pass
	Proposed + Mitigation	7	Sitting	7	Sitting	35	Pass
41	Existing	18	Walking	16	Strolling	75	Pass
	Proposed	16	Strolling	15	Strolling	66	Pass
	Proposed + Mitigation	13	Standing	11	Standing	57	Pass
42	Existing	16	Strolling	15	Strolling	69	Pass

**Table 1: Pedestrian Wind Comfort and Safety Conditions**

Location	Configuration	Wind Comfort				Wind Safety	
		Summer		Winter		Annual	
		Speed (km/h)	Rating	Speed (km/h)	Rating	Speed (km/h)	Rating
	Proposed	16	Strolling	14	Standing	67	Pass
	Proposed + Mitigation	12	Standing	11	Standing	56	Pass
43	Existing	18	Walking	20	Walking	92	Exceeded
	Proposed	16	Strolling	16	Strolling	68	Pass
	Proposed + Mitigation	15	Strolling	16	Strolling	70	Pass
44	Existing	19	Walking	20	Walking	86	Pass
	Proposed	19	Walking	18	Strolling	80	Pass
	Proposed + Mitigation	18	Walking	16	Strolling	76	Pass
45	Existing	18	Walking	17	Strolling	80	Pass
	Proposed	14	Standing	14	Standing	61	Pass
	Proposed + Mitigation	13	Standing	12	Standing	60	Pass
46	Existing	18	Walking	16	Strolling	76	Pass
	Proposed	15	Strolling	14	Standing	73	Pass
	Proposed + Mitigation	11	Standing	10	Sitting	48	Pass
47	Existing	17	Strolling	15	Strolling	73	Pass
	Proposed	17	Strolling	15	Strolling	69	Pass
	Proposed + Mitigation	15	Strolling	14	Standing	66	Pass
48	Existing	16	Strolling	15	Strolling	69	Pass
	Proposed	16	Strolling	15	Strolling	65	Pass
	Proposed + Mitigation	14	Standing	13	Standing	60	Pass
49	Existing	16	Strolling	18	Walking	87	Pass
	Proposed	15	Strolling	18	Walking	81	Pass
	Proposed + Mitigation	10	Sitting	11	Standing	57	Pass
50	Existing	18	Walking	16	Strolling	67	Pass
	Proposed	19	Walking	19	Walking	73	Pass
	Proposed + Mitigation	14	Standing	13	Standing	59	Pass
51	Existing	15	Strolling	17	Strolling	93	Exceeded
	Proposed	15	Strolling	18	Walking	81	Pass
	Proposed + Mitigation	14	Standing	16	Strolling	70	Pass
52	Existing	16	Strolling	17	Strolling	77	Pass
	Proposed	16	Strolling	17	Strolling	71	Pass
	Proposed + Mitigation	13	Standing	13	Standing	57	Pass
53	Existing	16	Strolling	15	Strolling	68	Pass
	Proposed	15	Strolling	16	Strolling	85	Pass
	Proposed + Mitigation	11	Standing	14	Standing	78	Pass
54	Existing	16	Strolling	15	Strolling	67	Pass
	Proposed	16	Strolling	15	Strolling	70	Pass
	Proposed + Mitigation	12	Standing	11	Standing	52	Pass
55	Existing	15	Strolling	14	Standing	66	Pass
	Proposed	13	Standing	12	Standing	59	Pass
	Proposed + Mitigation	7	Sitting	7	Sitting	38	Pass

**Table 1: Pedestrian Wind Comfort and Safety Conditions**

Location	Configuration	Wind Comfort				Wind Safety	
		Summer		Winter		Annual	
		Speed (km/h)	Rating	Speed (km/h)	Rating	Speed (km/h)	Rating
56	Existing	17	Strolling	15	Strolling	71	Pass
	Proposed	14	Standing	14	Standing	64	Pass
	Proposed + Mitigation	12	Standing	10	Sitting	50	Pass
57	Existing	16	Strolling	16	Strolling	70	Pass
	Proposed	17	Strolling	16	Strolling	76	Pass
	Proposed + Mitigation	14	Standing	12	Standing	64	Pass
58	Existing	15	Strolling	15	Strolling	65	Pass
	Proposed	16	Strolling	16	Strolling	72	Pass
	Proposed + Mitigation	13	Standing	12	Standing	59	Pass
59	Existing	16	Strolling	15	Strolling	72	Pass
	Proposed	14	Standing	15	Strolling	75	Pass
	Proposed + Mitigation	13	Standing	12	Standing	66	Pass
60	Existing	16	Strolling	15	Strolling	72	Pass
	Proposed	15	Strolling	15	Strolling	74	Pass
	Proposed + Mitigation	9	Sitting	10	Sitting	57	Pass
61	Existing	16	Strolling	17	Strolling	86	Pass
	Proposed	13	Standing	13	Standing	59	Pass
	Proposed + Mitigation	9	Sitting	9	Sitting	49	Pass
62	Existing	14	Standing	14	Standing	66	Pass
	Proposed	9	Sitting	10	Sitting	59	Pass
	Proposed + Mitigation	8	Sitting	9	Sitting	49	Pass
63	Existing	15	Strolling	14	Standing	65	Pass
	Proposed	9	Sitting	8	Sitting	47	Pass
	Proposed + Mitigation	7	Sitting	7	Sitting	45	Pass
64	Existing	13	Standing	14	Standing	64	Pass
	Proposed	9	Sitting	9	Sitting	52	Pass
	Proposed + Mitigation	8	Sitting	8	Sitting	42	Pass
65	Existing	14	Standing	14	Standing	64	Pass
	Proposed	-	-	-	-	-	-
	Proposed + Mitigation	6	Sitting	5	Sitting	23	Pass
66	Existing	13	Standing	13	Standing	61	Pass
	Proposed	-	-	-	-	-	-
	Proposed + Mitigation	5	Sitting	4	Sitting	18	Pass
67	Existing	11	Standing	10	Sitting	53	Pass
	Proposed	13	Standing	13	Standing	67	Pass
	Proposed + Mitigation	11	Standing	12	Standing	60	Pass
68	Existing	17	Strolling	17	Strolling	84	Pass
	Proposed	21	Uncomfortable	23	Uncomfortable	94	Exceeded
	Proposed + Mitigation	18	Walking	20	Walking	91	Exceeded
69	Existing	26	Uncomfortable	24	Uncomfortable	94	Exceeded
	Proposed	23	Uncomfortable	22	Uncomfortable	86	Pass
	Proposed + Mitigation	15	Strolling	14	Standing	65	Pass

**Table 1: Pedestrian Wind Comfort and Safety Conditions**

Location	Configuration	Wind Comfort				Wind Safety	
		Summer		Winter		Annual	
		Speed (km/h)	Rating	Speed (km/h)	Rating	Speed (km/h)	Rating
70	Existing	24	Uncomfortable	23	Uncomfortable	94	Exceeded
	Proposed	23	Uncomfortable	21	Uncomfortable	91	Pass
	Proposed + Mitigation	14	Standing	13	Standing	60	Pass
71	Existing	21	Uncomfortable	20	Walking	89	Pass
	Proposed	19	Walking	17	Strolling	82	Pass
	Proposed + Mitigation	16	Strolling	16	Strolling	71	Pass
72	Existing	19	Walking	20	Walking	92	Exceeded
	Proposed	17	Strolling	17	Strolling	85	Pass
	Proposed + Mitigation	13	Standing	11	Standing	56	Pass
73	Existing	15	Strolling	16	Strolling	86	Pass
	Proposed	13	Standing	13	Standing	63	Pass
	Proposed + Mitigation	9	Sitting	9	Sitting	54	Pass
74	Existing	16	Strolling	18	Walking	91	Exceeded
	Proposed	16	Strolling	15	Strolling	86	Pass
	Proposed + Mitigation	10	Sitting	9	Sitting	60	Pass
75	Existing	13	Standing	15	Strolling	81	Pass
	Proposed	10	Sitting	11	Standing	54	Pass
	Proposed + Mitigation	7	Sitting	9	Sitting	48	Pass
76	Existing	12	Standing	14	Standing	80	Pass
	Proposed	10	Sitting	12	Standing	67	Pass
	Proposed + Mitigation	9	Sitting	11	Standing	61	Pass
77	Existing	13	Standing	14	Standing	76	Pass
	Proposed	10	Sitting	12	Standing	61	Pass
	Proposed + Mitigation	10	Sitting	10	Sitting	50	Pass
78	Existing	12	Standing	14	Standing	79	Pass
	Proposed	13	Standing	15	Strolling	76	Pass
	Proposed + Mitigation	10	Sitting	12	Standing	63	Pass
79	Existing	12	Standing	13	Standing	78	Pass
	Proposed	11	Standing	12	Standing	68	Pass
	Proposed + Mitigation	8	Sitting	9	Sitting	46	Pass
80	Existing	12	Standing	13	Standing	75	Pass
	Proposed	-	-	-	-	-	-
	Proposed + Mitigation	6	Sitting	5	Sitting	24	Pass
81	Existing	12	Standing	13	Standing	69	Pass
	Proposed	-	-	-	-	-	-
	Proposed + Mitigation	5	Sitting	5	Sitting	23	Pass
82	Existing	13	Standing	15	Strolling	81	Pass
	Proposed	10	Sitting	11	Standing	54	Pass
	Proposed + Mitigation	8	Sitting	8	Sitting	44	Pass
83	Existing	18	Walking	18	Walking	87	Pass
	Proposed	15	Strolling	16	Strolling	80	Pass



**Table 1: Pedestrian Wind Comfort and Safety Conditions**

Location	Configuration	Wind Comfort				Wind Safety	
		Summer		Winter		Annual	
		Speed (km/h)	Rating	Speed (km/h)	Rating	Speed (km/h)	Rating
	Proposed + Mitigation	10	Sitting	11	Standing	60	Pass
84	Existing	19	Walking	18	Walking	84	Pass
	Proposed	17	Strolling	17	Strolling	76	Pass
	Proposed + Mitigation	12	Standing	14	Standing	67	Pass
85	Existing	16	Strolling	16	Strolling	84	Pass
	Proposed	13	Standing	13	Standing	73	Pass
	Proposed + Mitigation	11	Standing	9	Sitting	60	Pass
86	Existing	18	Walking	18	Walking	81	Pass
	Proposed	18	Walking	16	Strolling	78	Pass
	Proposed + Mitigation	13	Standing	11	Standing	56	Pass
87	Existing	13	Standing	13	Standing	66	Pass
	Proposed	16	Strolling	15	Standing	73	Pass
	Proposed + Mitigation	12	Standing	10	Sitting	59	Pass
88	Existing	14	Standing	15	Strolling	79	Pass
	Proposed	10	Sitting	11	Standing	57	Pass
	Proposed + Mitigation	7	Sitting	7	Sitting	46	Pass
89	Existing	12	Standing	14	Standing	72	Pass
	Proposed	9	Sitting	13	Standing	69	Pass
	Proposed + Mitigation	8	Sitting	11	Standing	60	Pass
90	Existing	12	Standing	14	Standing	73	Pass
	Proposed	11	Standing	16	Strolling	91	Exceeded
	Proposed + Mitigation	9	Sitting	12	Standing	73	Pass
91	Existing	12	Standing	13	Standing	65	Pass
	Proposed	-	-	-	-	-	-
	Proposed + Mitigation	4	Sitting	4	Sitting	19	Pass
92	Existing	12	Standing	14	Standing	73	Pass
	Proposed	-	-	-	-	-	-
	Proposed + Mitigation	5	Sitting	5	Sitting	22	Pass
93	Existing	11	Standing	11	Standing	63	Pass
	Proposed	10	Sitting	9	Sitting	43	Pass
	Proposed + Mitigation	9	Sitting	7	Sitting	43	Pass
94	Existing	13	Standing	14	Standing	74	Pass
	Proposed	11	Standing	13	Standing	65	Pass
	Proposed + Mitigation	9	Sitting	11	Standing	60	Pass
95	Existing	13	Standing	14	Standing	70	Pass
	Proposed	13	Standing	14	Standing	61	Pass
	Proposed + Mitigation	8	Sitting	11	Standing	56	Pass
96	Existing	14	Standing	14	Standing	76	Pass
	Proposed	14	Standing	13	Standing	55	Pass
	Proposed + Mitigation	17	Strolling	15	Strolling	67	Pass
97	Existing	16	Strolling	17	Strolling	76	Pass

**Table 1: Pedestrian Wind Comfort and Safety Conditions**

Location	Configuration	Wind Comfort				Wind Safety	
		Summer		Winter		Annual	
		Speed (km/h)	Rating	Speed (km/h)	Rating	Speed (km/h)	Rating
	Proposed	17	Strolling	15	Strolling	73	Pass
	Proposed + Mitigation	13	Standing	11	Standing	58	Pass
98	Existing	15	Strolling	14	Standing	68	Pass
	Proposed	18	Walking	18	Walking	77	Pass
	Proposed + Mitigation	14	Standing	14	Standing	63	Pass
99	Existing	15	Strolling	16	Strolling	74	Pass
	Proposed	16	Strolling	15	Strolling	70	Pass
	Proposed + Mitigation	12	Standing	11	Standing	64	Pass
100	Existing	13	Standing	14	Standing	68	Pass
	Proposed	17	Strolling	18	Walking	80	Pass
	Proposed + Mitigation	13	Standing	15	Strolling	77	Pass
101	Existing	-	-	-	-	-	-
	Proposed	12	Standing	13	Standing	70	Pass
	Proposed + Mitigation	10	Sitting	11	Standing	61	Pass
102	Existing	-	-	-	-	-	-
	Proposed	14	Standing	13	Standing	64	Pass
	Proposed + Mitigation	13	Standing	12	Standing	62	Pass
103	Existing	-	-	-	-	-	-
	Proposed	12	Standing	14	Standing	75	Pass
	Proposed + Mitigation	12	Standing	13	Standing	78	Pass
104	Existing	-	-	-	-	-	-
	Proposed	10	Sitting	10	Sitting	48	Pass
	Proposed + Mitigation	9	Sitting	9	Sitting	47	Pass
105	Existing	-	-	-	-	-	-
	Proposed	18	Walking	18	Walking	80	Pass
	Proposed + Mitigation	16	Strolling	15	Strolling	68	Pass
106	Existing	-	-	-	-	-	-
	Proposed	19	Walking	21	Uncomfortabl	96	Exceeded
	Proposed + Mitigation	14	Standing	17	Strolling	89	Pass
107	Existing	-	-	-	-	-	-
	Proposed	8	Sitting	8	Sitting	35	Pass
	Proposed + Mitigation	9	Sitting	8	Sitting	41	Pass
108	Existing	-	-	-	-	-	-
	Proposed	11	Standing	12	Standing	70	Pass
	Proposed + Mitigation	8	Sitting	10	Sitting	54	Pass
109	Existing	-	-	-	-	-	-
	Proposed	9	Sitting	8	Sitting	42	Pass
	Proposed + Mitigation	8	Sitting	7	Sitting	38	Pass
110	Existing	-	-	-	-	-	-
	Proposed	8	Sitting	12	Standing	64	Pass
	Proposed + Mitigation	7	Sitting	11	Standing	62	Pass

**Table 1: Pedestrian Wind Comfort and Safety Conditions**

Location	Configuration	Wind Comfort				Wind Safety	
		Summer		Winter		Annual	
		Speed (km/h)	Rating	Speed (km/h)	Rating	Speed (km/h)	Rating
111	Existing	10	Sitting	11	Standing	74	Pass
	Proposed	9	Sitting	10	Sitting	65	Pass
	Proposed + Mitigation						
112	Existing	9	Sitting	9	Sitting	41	Pass
	Proposed	7	Sitting	6	Sitting	30	Pass
	Proposed + Mitigation						
113	Existing	10	Sitting	12	Standing	70	Pass
	Proposed	8	Sitting	10	Sitting	64	Pass
	Proposed + Mitigation						
114	Existing	7	Sitting	8	Sitting	52	Pass
	Proposed	6	Sitting	7	Sitting	41	Pass
	Proposed + Mitigation						
115	Existing	7	Sitting	7	Sitting	39	Pass
	Proposed	6	Sitting	7	Sitting	43	Pass
	Proposed + Mitigation						
116	Existing	9	Sitting	13	Standing	76	Pass
	Proposed	7	Sitting	12	Standing	79	Pass
	Proposed + Mitigation						
117	Existing	8	Sitting	9	Sitting	48	Pass
	Proposed	7	Sitting	7	Sitting	44	Pass
	Proposed + Mitigation						
118	Existing	10	Sitting	12	Standing	71	Pass
	Proposed	7	Sitting	10	Sitting	64	Pass
	Proposed + Mitigation						
119	Existing	11	Standing	11	Standing	53	Pass
	Proposed	10	Sitting	10	Sitting	50	Pass
	Proposed + Mitigation						
120	Existing	10	Sitting	11	Standing	63	Pass
	Proposed	9	Sitting	10	Sitting	52	Pass
	Proposed + Mitigation						
121	Existing	15	Strolling	13	Standing	72	Pass
	Proposed	10	Sitting	10	Sitting	67	Pass
	Proposed + Mitigation						
122	Existing	9	Sitting	9	Sitting	63	Pass
	Proposed	7	Sitting	8	Sitting	61	Pass
	Proposed + Mitigation						
Season	Months	Hours	Comfort Speed (km/h)		Safety Speed (km/h)		
Summer	May - October	6:00 - 23:00 for comfort	(20% Seasonal Exceedance)		(0.1% Annual Exceedance)		
Winter	November - April	6:00 - 23:00 for comfort	≤ 10	Sitting	≤ 90 Pass		
Annual	January - December	0:00 - 23:00 for safety	11 - 14	Standing	> 90 Exceeded		
Configurations							
Existing	Existing site and surrounds						
Proposed	Proposed Development with existing surrounds						
Mitigation	Proposed Development with landscaping and existing surrounds						

The background features a large, light grey curved shape on the right side, and a blue curved shape on the left side, separated by a white curved line.

# APPENDIX A

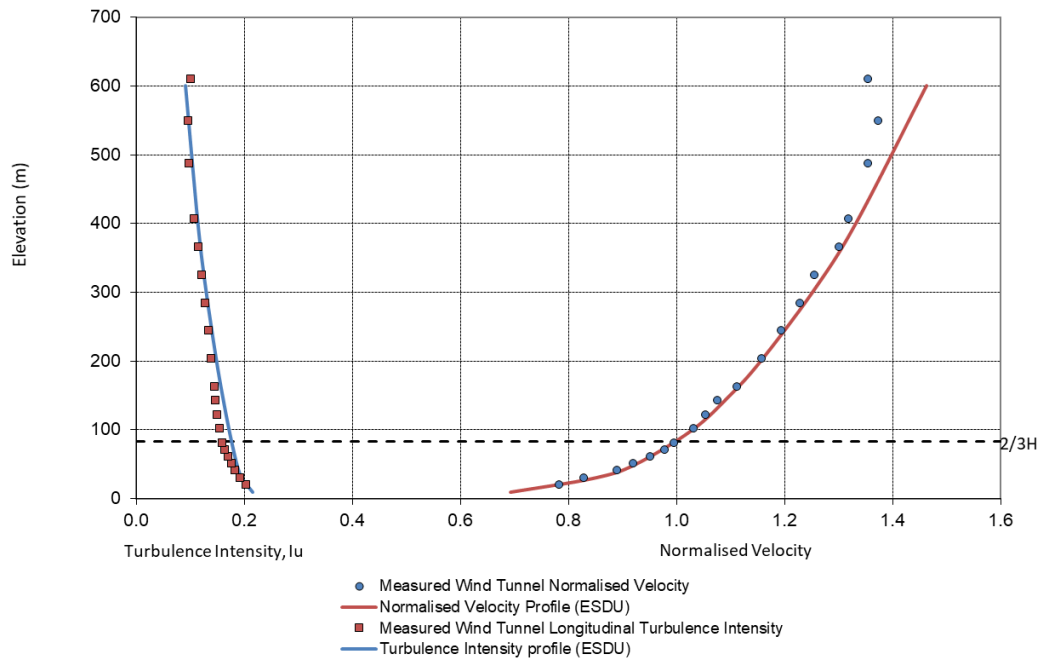
## APPENDIX A - VELOCITY AND TURBULENCE INTENSITY PROFILES USED FOR TESTING

The wind speeds near the surface of the earth slow down due to the associated roughness of the earth's surface. This effect is observed up to the gradient height which is defined as the height where the roughness has a minimal effect on the wind speed (600m for this study). Within this range the prevailing wind forms what is known as a planetary boundary layer.

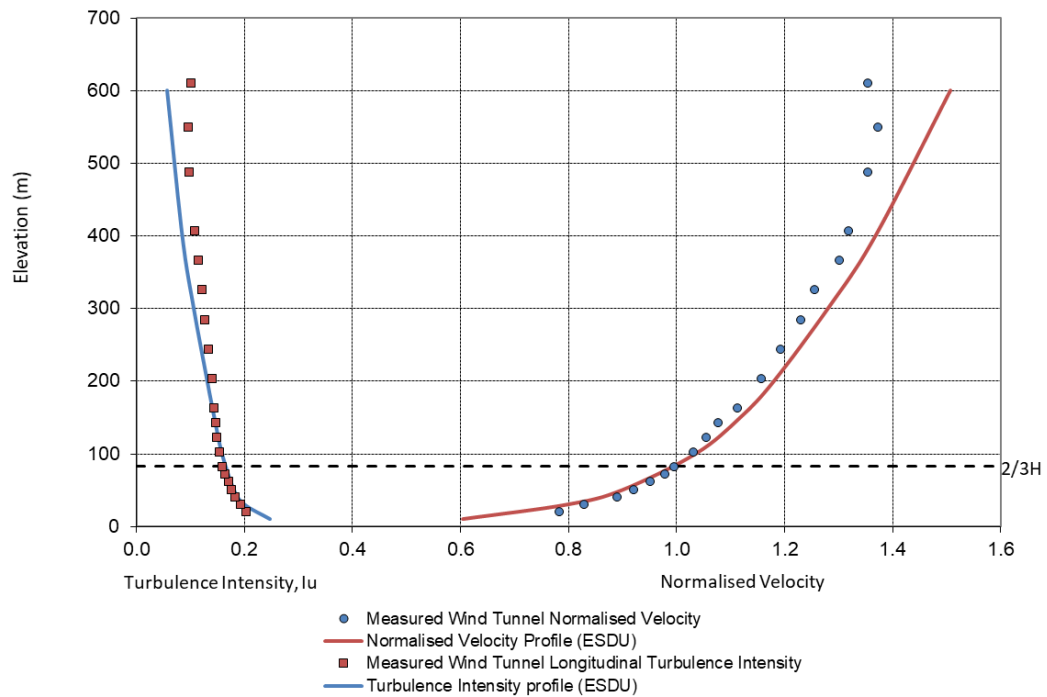
It should be noted that this boundary layer profile does not change instantly due to a change in terrain, and it can take several kilometers to reach a state of equilibrium. Therefore, it is necessary to understand the effect of these upwind terrain changes to model an accurate wind profile in wind tunnel tests. For this study, this has been undertaken based on the provisions of the ESDU for wind engineering applications using a fetch length of approximately 30km from the site. The resulting normalised wind velocity and longitudinal turbulence intensity profiles are presented in this section for the various sectors. The corresponding terrain categories from the Australian standard for wind action are summarised below:

- Terrain Category 1 (TC1 - Open Water) – 70°
- Between Terrain Category 2 and 3 (TC2.5 – Open Suburban) – 10° to 60°, 80° to 100°, 180°, 190°, 250° to 270° and 300° to 360°
- Terrain Category 3 (TC3 - Suburban) – 110° to 170°, 200° to 240°, 280° and 290°

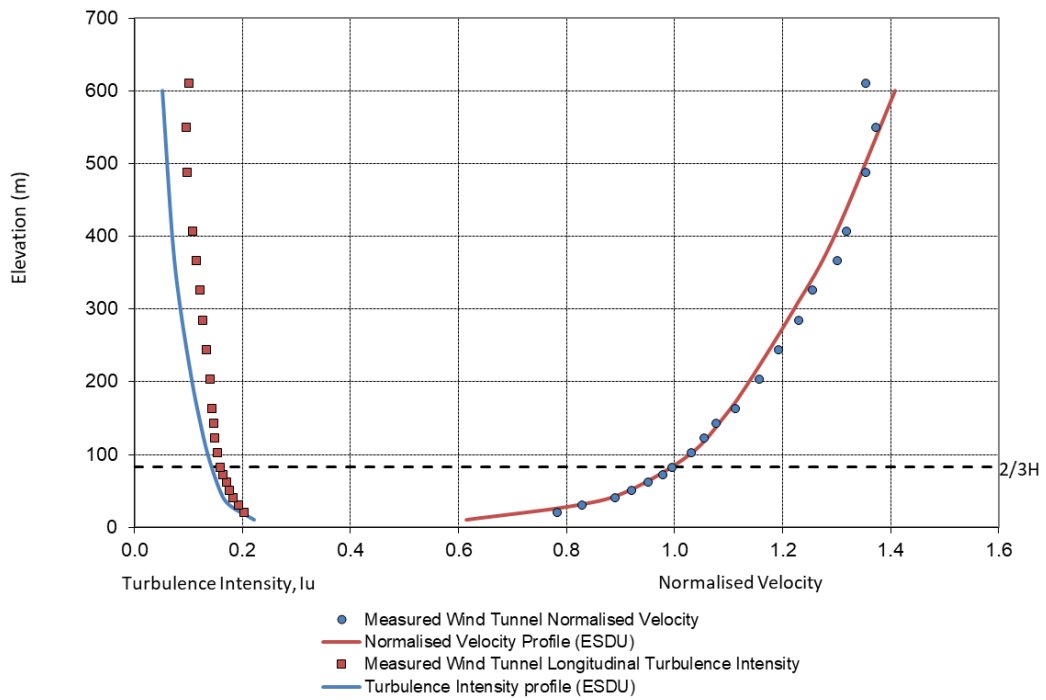
### Profiles for 10° - 30°, 360°



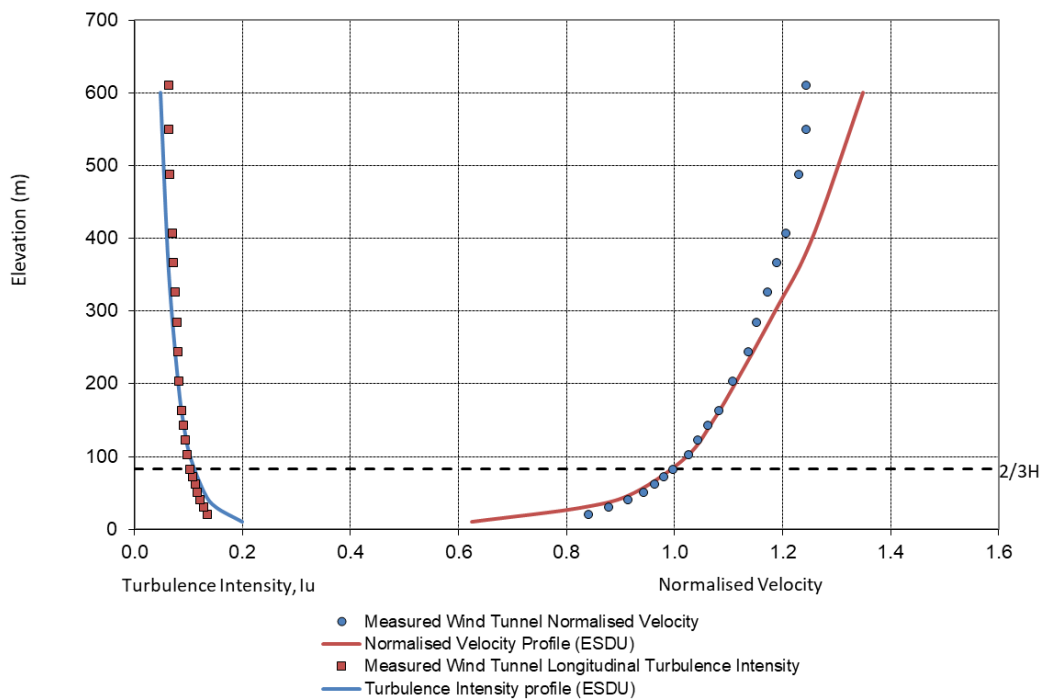
### Profiles for 40° - 50°



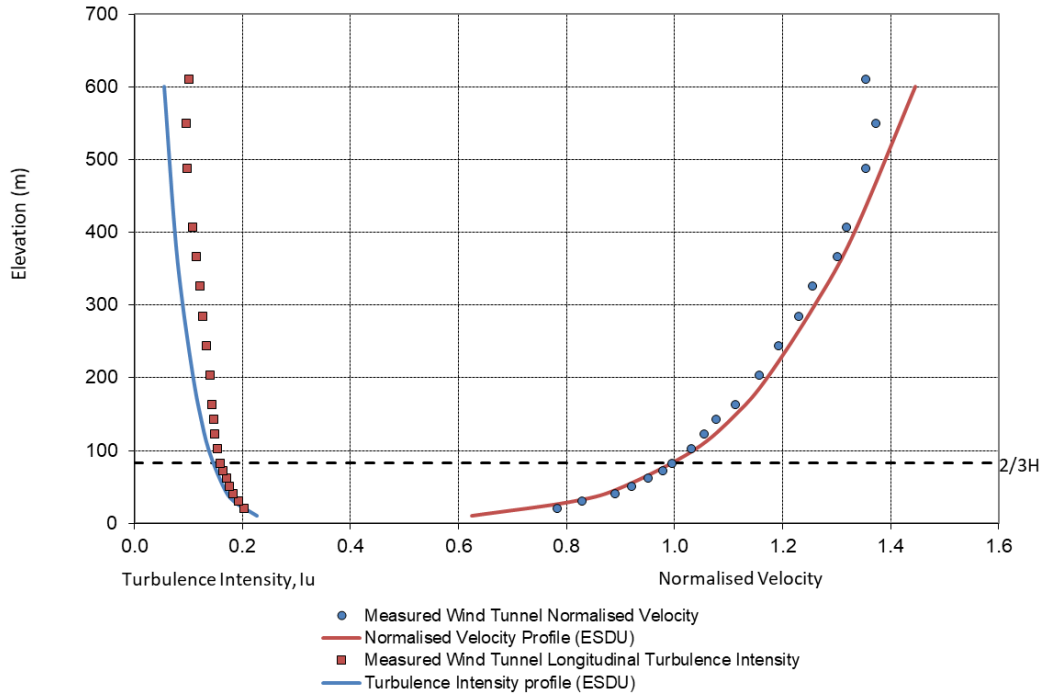
### Profiles for 60°



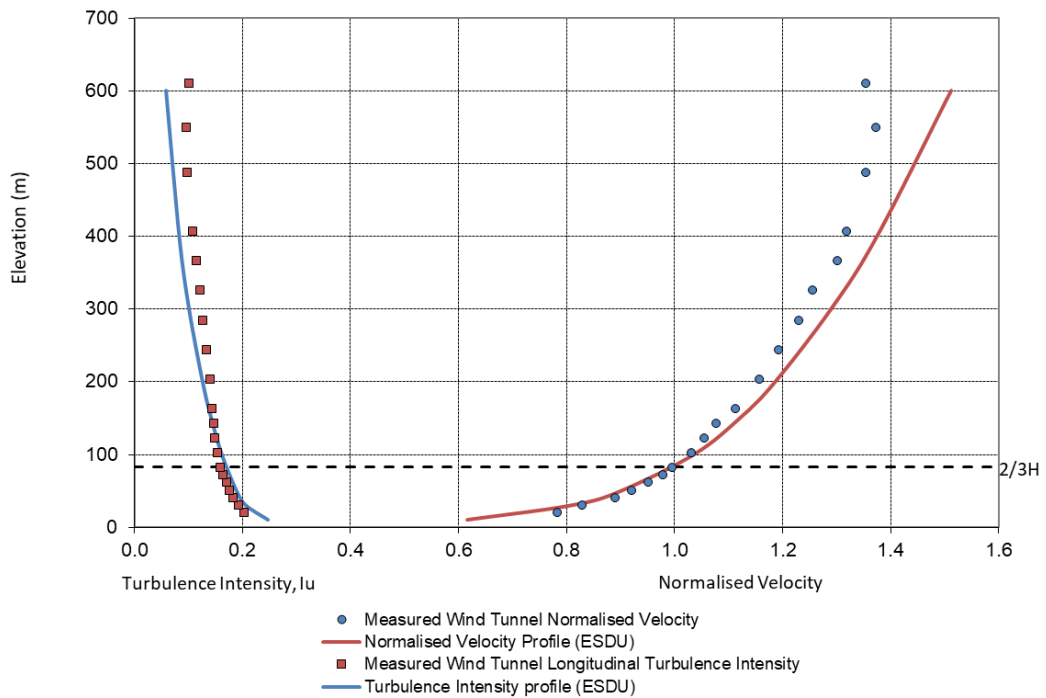
### Profiles for 70°



### Profiles for 80° - 90°

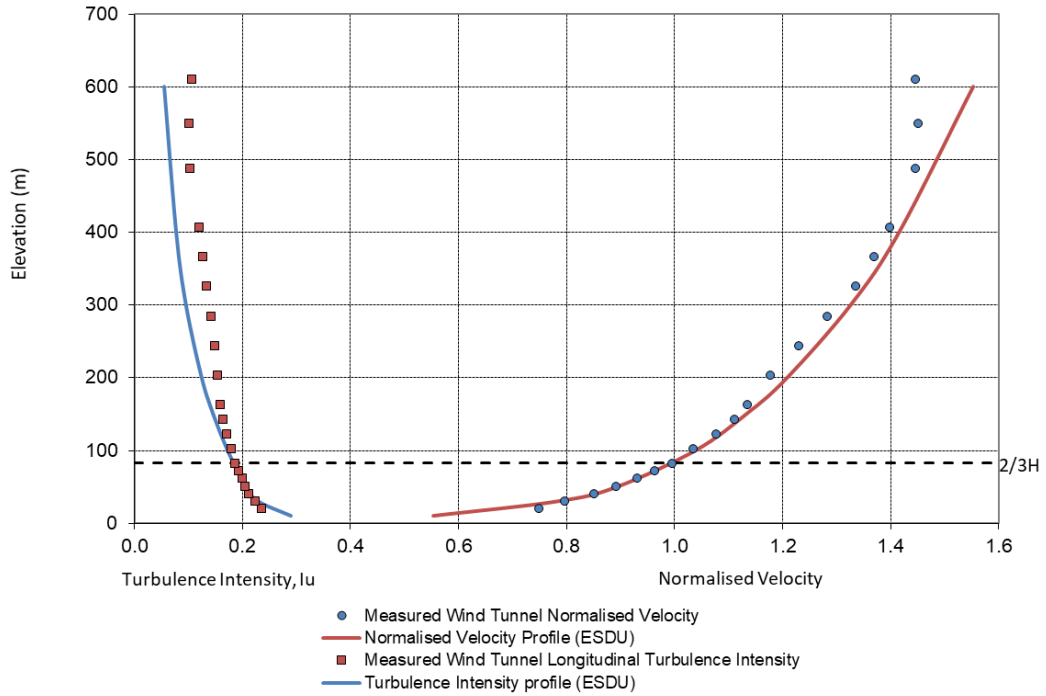


### Profiles for 100°

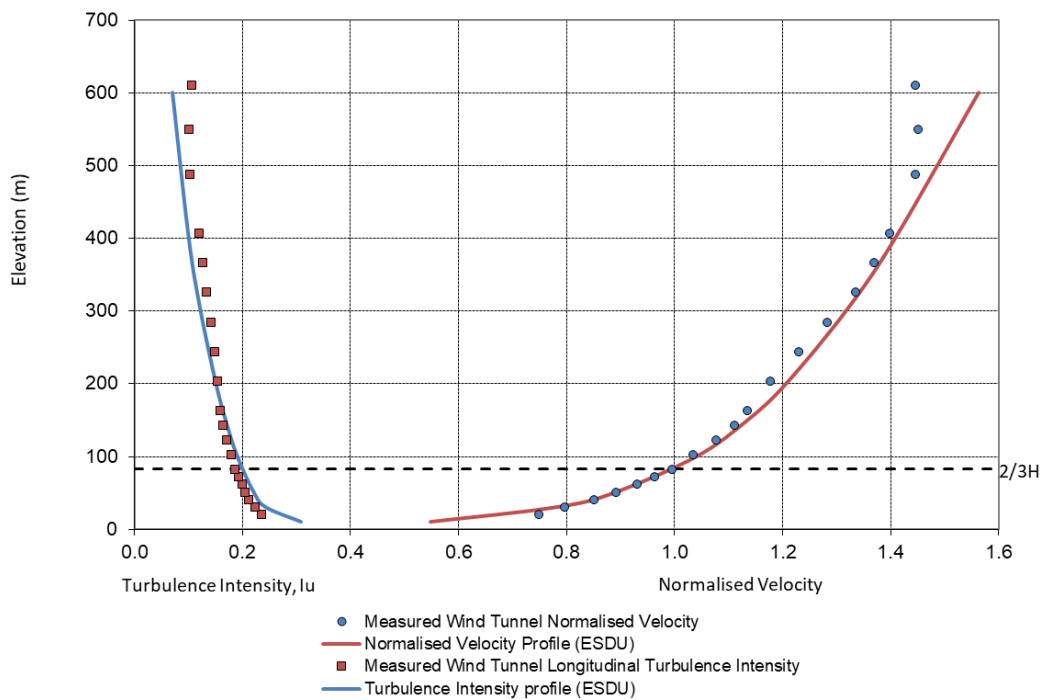




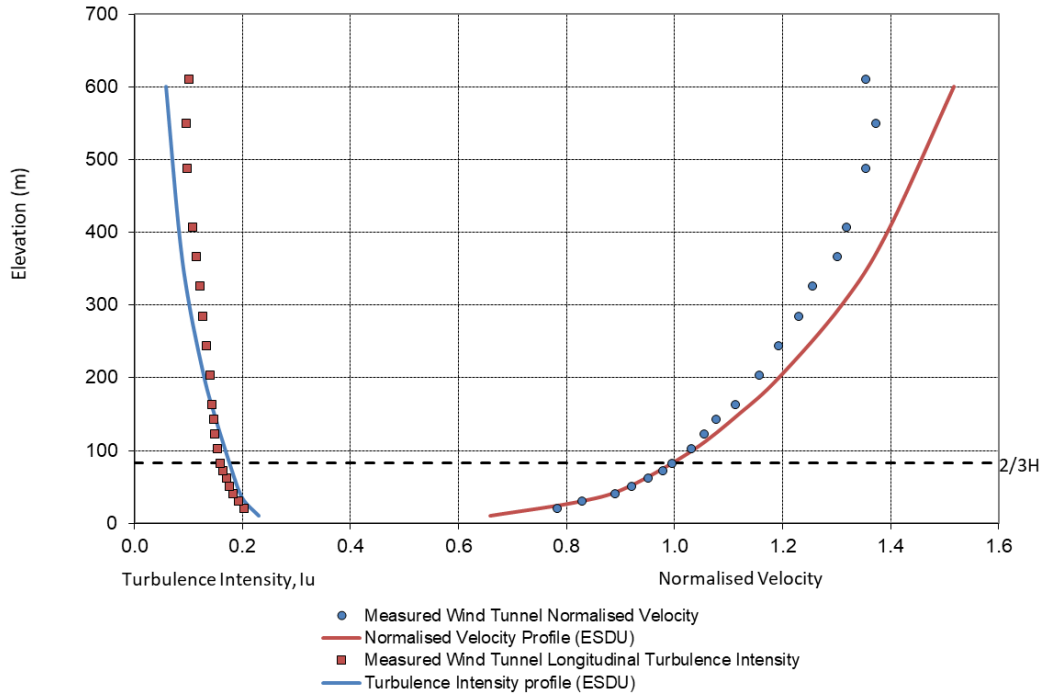
### Profiles for 110° - 140°



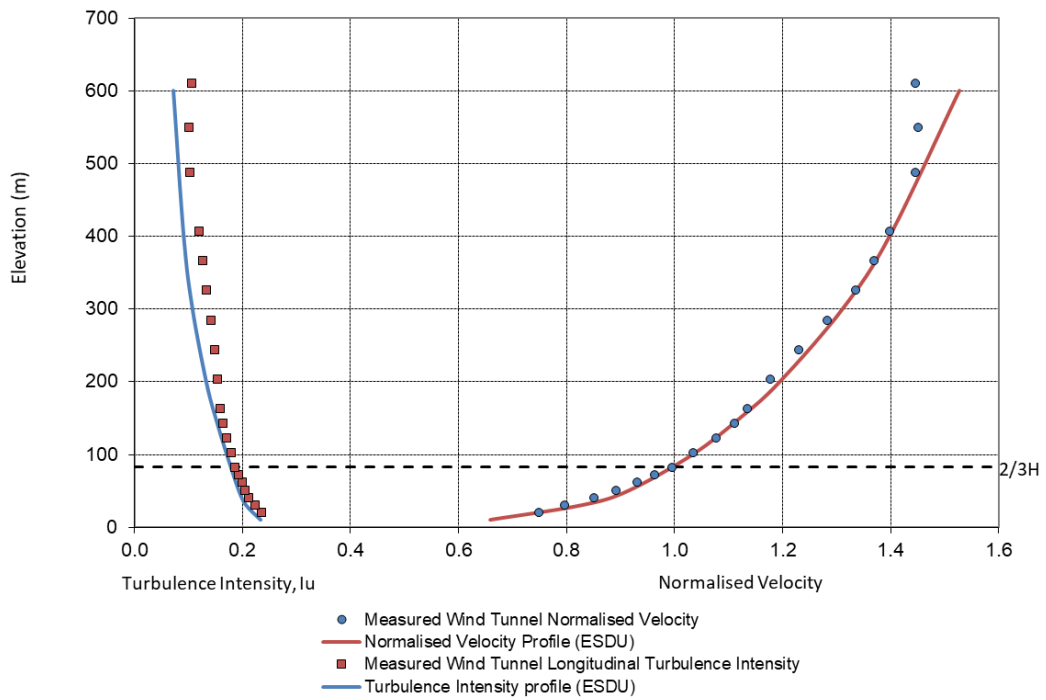
### Profiles for 150° - 170°



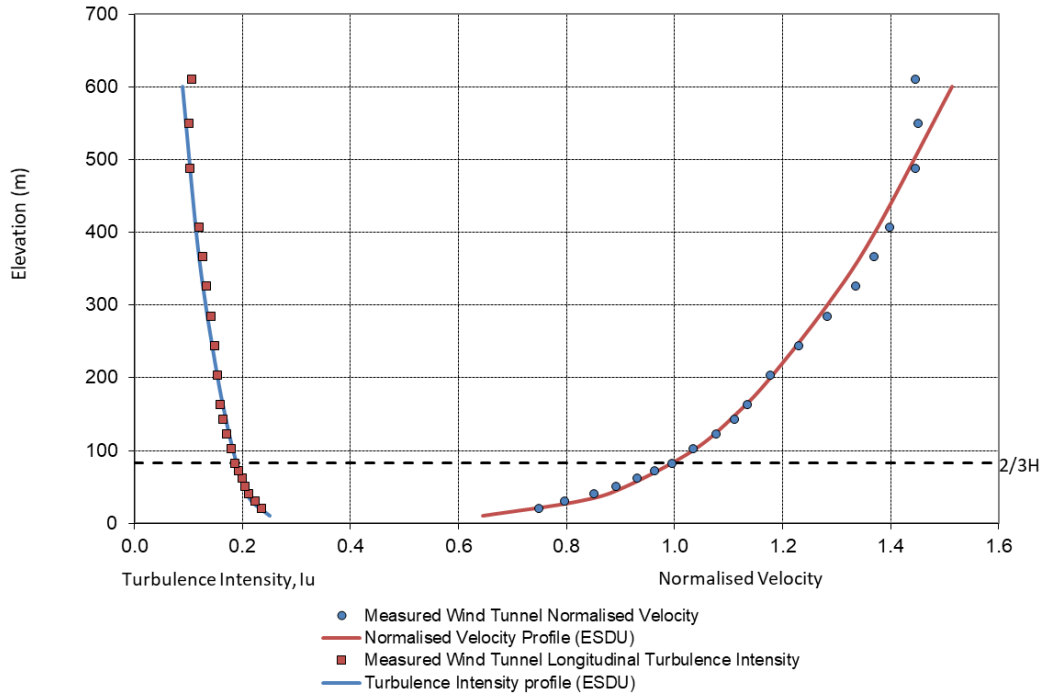
### Profiles for 180° - 190°



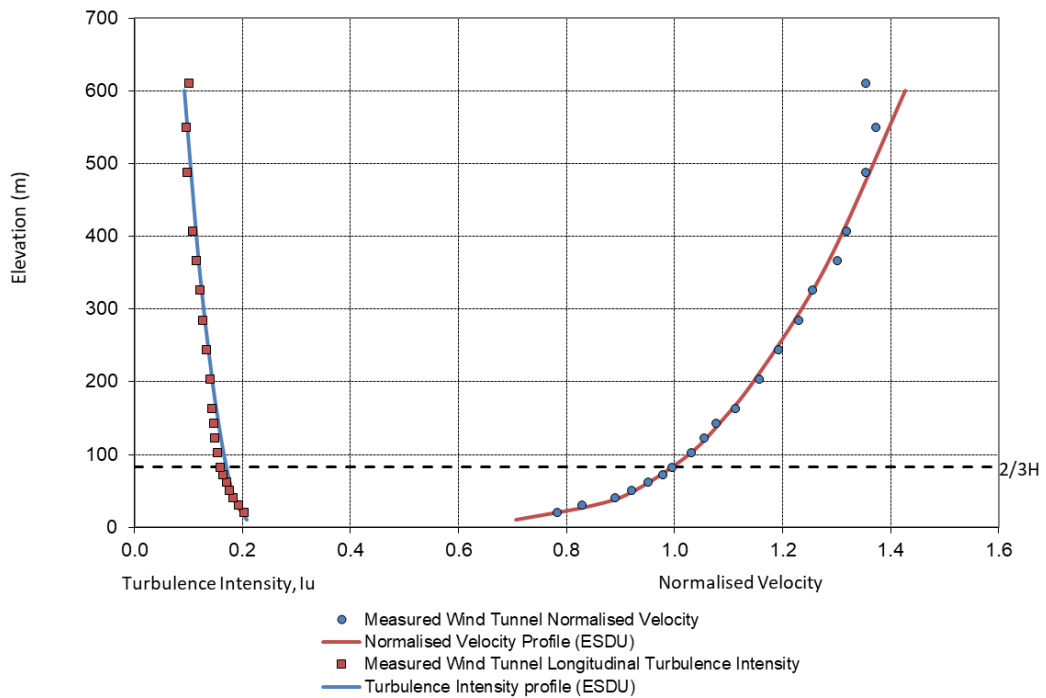
### Profiles for 200°



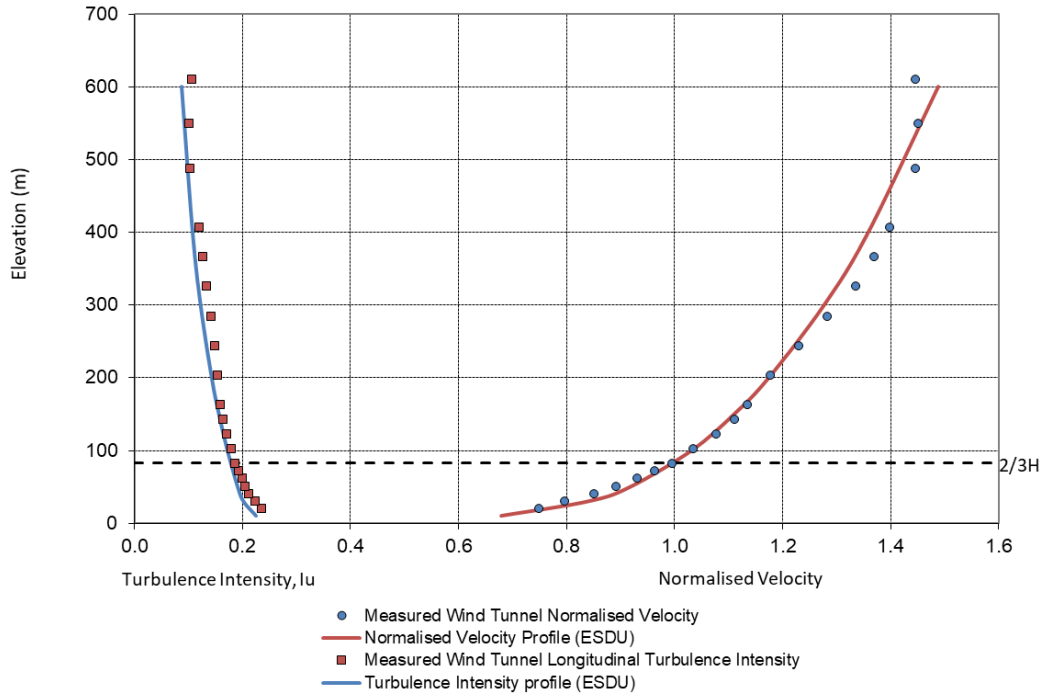
### Profiles for 210° - 240°



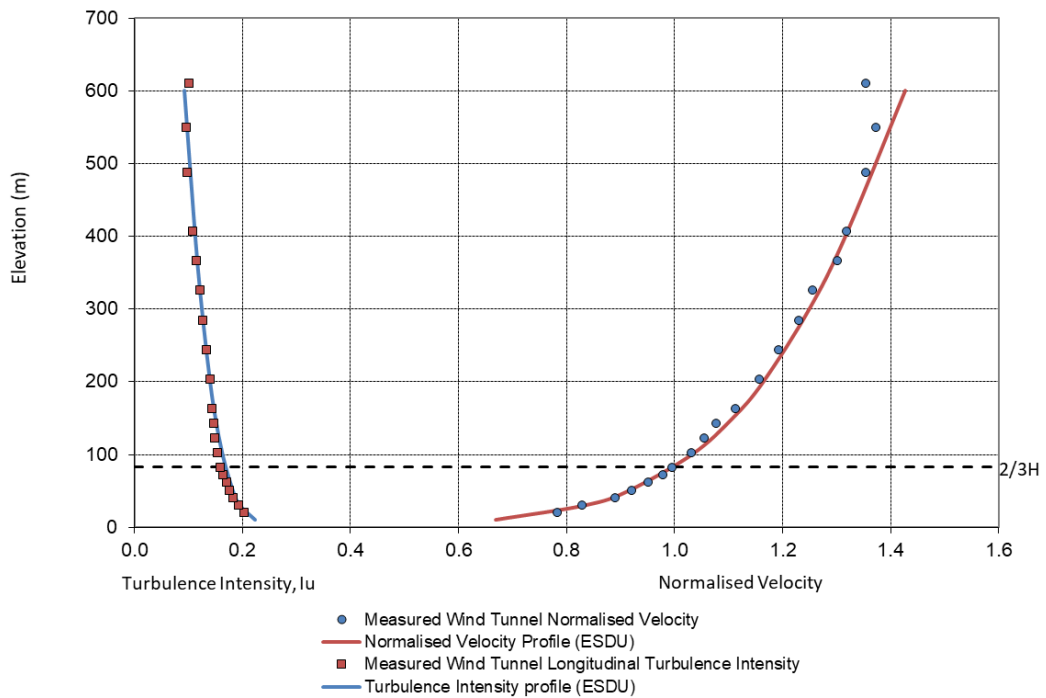
### Profiles for 250° - 270°



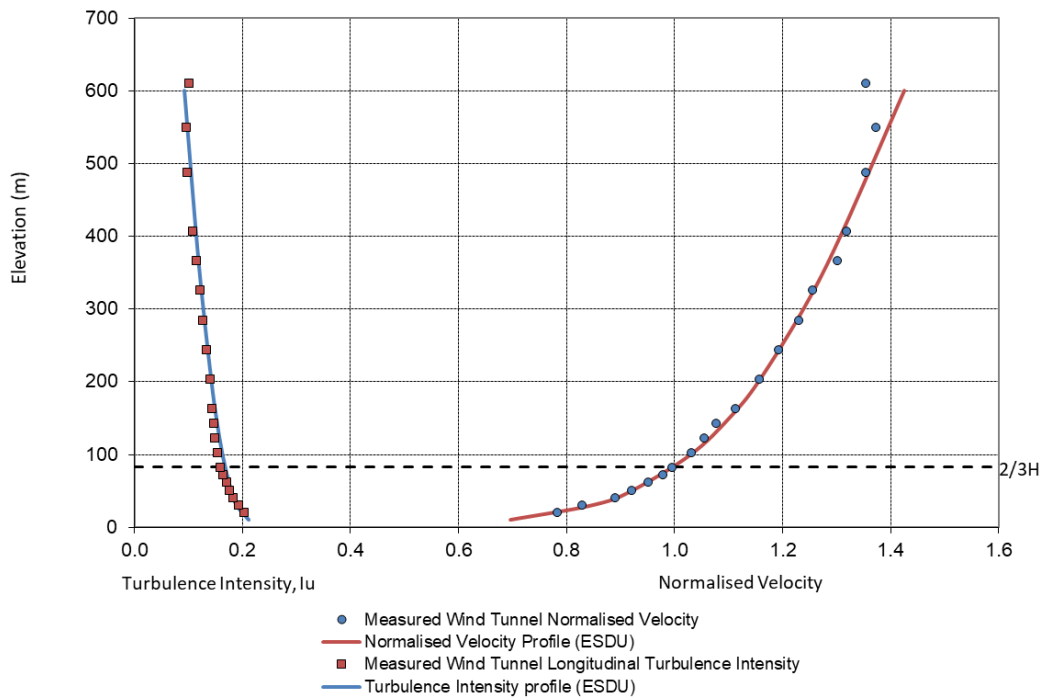
**Profiles for 280° - 290°**



**Profiles for 300° - 310°**



### Profiles for 320°



### Profiles for 330° - 350°

