104-116 REGENT STREET, REDFERN

Environmental Wind Tunnel Test

Prepared for:

The Trust Company (Australia) Limited ATF WH Redfern Trust
c/- Antoniades Architects Pty Ltd
19a Boundary Street
DARLINGHURST NSW 2010

SLR Ref: 610.30265-R01
Version No: -v1.0
December 2021

PREPARED BY

SLR Consulting Australia Pty Ltd
ABN 29 001 584 612
Tenancy 202 Submarine School, Sub Base Platypus, 120 High Street
North Sydney NSW 2060 Australia

T: +61 2 9427 8100
E: sydney@slrconsulting.com www.slrconsulting.com

BASIS OF REPORT

This report has been prepared by SLR Consulting Australia Pty Ltd with all reasonable skill, care and diligence, and taking account of the timescale and resources allocated to it by agreement with The Trust Company (Australia) Limited ATF WH Redfern Trust (the Client). Information reported herein is based on the interpretation of data collected, which has been accepted in good faith as being accurate and valid.

This report is for the exclusive use of the Client. No warranties or guarantees are expressed or should be inferred by any third parties. This report may not be relied upon by other parties without written consent from SLR

SLR disclaims any responsibility to the Client and others in respect of any matters outside the agreed scope of the work.

DOCUMENT CONTROL

Reference	Date	Prepared	Checked	Authorised
610.30265-R01-v1.0	13 December 2021	Nikhil Pardeshi	Dr Peter Georgiou	Dr Neihad Al-Khalidy
610.30265-R01-v0.2	17 July 2021	Nikhil Pardeshi	Dr Peter Georgiou	Dr Neihad Al-Khalidy

EXECUTIVE SUMMARY

SLR Consulting Australia Pty Ltd (SLR) has been engaged by The Trust Company (Australia) Limited ATF WH Redfern Trust, to undertake a quantitative wind assessment of a proposed development at 104-116 Regent Street, Redfern, via an Environmental Wind Tunnel Study.

The assessment has been carried out via a Discrete Sensor Environmental Wind Tunnel Study whereby wind tunnel measurements were made to investigate wind conditions throughout and around the proposed development (simulated via a 1:400 scale model) at areas to be used by visitors and occupants of the development itself.

The assessment of the proposed development also included testing of the Redfern Centre Urban Design Principles "Compliant" design conforming to standard CoS set-back and building podium/height requirements.

There is no mention in the project SEARs (SSD-12618001) of compliance with RWUDP. There is reference in the Project SEARs: Section 1 - "Statutory and Strategic Context" to consideration of wind effects in Sub-Clause 8 – "Environmental Amenity" as follows:

> **8. Environmental amenity**
>
> The EIS must:
>
> - demonstrate how the proposal achieves a high level of environmental amenity within the proposal and on surrounding buildings, assessing impacts associated with view loss, ventilation, pedestrian movement, access to landscape and outdoor spaces, visual privacy, lighting, reflectivity and wind

With regard to Regent Street, SLR notes that Regent Street is a highly trafficked thoroughfare.

The proposed development is bounded by Regent Street to the east, Margaret Street to the south, and similar height built and future developments to the west and to the north.

The proposed development consists of Level 1 (Ground) with building entrances, gym, common areas, retail and bicycle parking spaces; Level 2 mainly with indoor and outdoor communal areas/terraces and some student units; Level 4 mainly with student units and some outdoor area; Levels 3, 5-15, and 17-18 with student units; Level 16 with student units and outdoor area; and non-trafficable Roof Level.

Buildings surrounding the site are generally low and mid-rise, comprising a mix of commercial, retail and residential buildings (several of similar height to the proposed development). Gibbons Street Reserve lies to the west with Redfern train station to the north-northwest. There are a number of planned and approved future developments of similar height located immediately to the north and west of the proposed development, running between Gibbons Street and Regent Street. Sydney's CBD area lies further to the north.

EXECUTIVE SUMMARY

Redfern Wind Climate

The study has developed a site-specific statistical wind climate model based on long-term wind records obtained from nearby Bureau of Meteorology stations at Sydney Kingsford Smith Airport and Bankstown Airport.

For Redfern, SLR has determined that local winds have characteristics very close to Sydney (KS) Airport compared to Bankstown Airport, given Redfern's proximity to Sydney (KS) Airport and similar distance inland from the coastline.

Key prevailing wind directions of interest are the northeast, southeast and south for summer and mainly west quadrant winds for winter.

Wind Acceptability Criteria

The present study has adopted the so-called "Melbourne" criteria for assessment, currently referenced by many Australian Local Government Development Control Plans in relation to wind impact.

Previous Assessment

An initial assessment of the proposed development was carried out by SLR in July 2021. Mitigation recommendations were made to ensure a comfortable and safe wind environment within and surrounding the development.

Since the time of the initial assessment, the initial proposed preferred design has been changed. Therefore, SLR has been engaged to carry out retesting of the proposed development incorporating the latest design changes to assess its impact on the wind conditions throughout and around the proposed development.

Built Environment Scenarios Assessed

The proximity models used in the present testing simulate the following three built environment "scenarios":

- "Baseline": Existing built environment
- "Future-P": "Baseline" + future proposed development (Preferred Design) with proposed trees
- "Future-C": as per "Future-P" but with City of Sydney "Compliant" Design

All of the above scenarios include the approved future developments lying to the immediate north and west of the site.

"Baseline" (Existing) Wind Environment

The "Baseline" scenario testing showed that with the existing built environment, a number of pedestrian areas in surrounding thoroughfares were found to lie above the adopted 16 m/s walking comfort criterion, but all the locations lie below the 23 m/s safety criterion.

"Future" Wind Environment – Surrounding Pedestrian Footpath Areas

From the results of the various "future" scenarios, the wind conditions of potential concern in relation to the proposed development revealed by the wind tunnel study are:

EXECUTIVE SUMMARY

- Selected footpath areas along Margaret Street and along the western frontage of the development
- The new Proposed Laneway to the west of the site
- The outdoor open areas of Level 2 and Level 16 – Locations 21 to 24.

To address the above, the following recommendations were made

- All "proposed" and/or "replacement" trees are evergreen and of similar foliage as the existing trees.
- The proposed vertical façade screening along the perimeter of the development (from level 2 slab up to level 4 slab) should be retained – refer **Figure 18**.
- It is recommended that the proposed awning along the eastern façade to be continuous. Note that the awnings can be connected in a stepped manner if required to account for the change in ground elevations – refer **Figure 19.**
- It is recommended to include landscaping such as planter boxes in front of the primary entrance along Regent Street, with plants that are capable to grow up to a height of 2m, measured from the ground. Note that this mitigation treatment is only required if the existing tree along Regent Street is to be removed – refer **Figure 20.**
- The proposed tree planting on the Level 2 communal area should be retained – refer **Figure 18**.
- The proposed tree planting on the Level 4 outdoor area should be retained – refer **Figure 18**.
- The proposed tree planting on the Level 16 communal area should be retained – refer **Figure 18**.
- Horizontal protection (eg pergola, shade-cloth, canopies, operable louvered pergola, etc) to be added to protect podium areas intended to be used for longer duration activities such as sitting/outdoor dining.

A final round of wind tunnel testing was carried out substituting the "Preferred" Design of the proposed development for the City of Sydney "Compliant" Design, 0° to 360°, all sensor locations – with the same additional ground level treatments as the "Future-P" scenario.

- This testing has been termed the … "Future-C" built scenario

"Future-P" Scenario Testing

The "Future-P" scenario demonstrates that areas requiring consideration of windbreak treatment, and which can be attributed to the impact of the proposed development, can successfully be addressed through a combination of:

- Vertical screening, especially ground level public access areas – including vertical screens, landscaping, etc;
- Awnings, canopies, shade cloths and pergolas (especially for internal development areas likely to be used for extended duration "sitting" type activities).

"Future-P" versus "Future-C" Design

On the basis of the test results at all ground level locaions it has been concluded that

- On average, the "Future-Preferred" Design performs comparably, wind-wise, to the "Future-Compliant" Design; and

EXECUTIVE SUMMARY

- Taking into account the number of predicted wind speed increases and decreases, and their magnitude, the “Future-Preferred” Design overall performs the same as the “Future-Compliant” Design.

Taking into account all of the above, it is believed that the proposed development will comply with the adopted wind acceptability criteria at all pedestrian and public access locations within and around the development.

CONTENTS

CONTENTS

TABLES

FIGURES

PHOTOS

APPENDICES

1 INTRODUCTION

SLR Consulting Australia Pty Ltd (SLR) has been commissioned by Antoniades Architects Pty Ltd, on behalf of Wee Hur (Australia) Pte Ltd, to assess the ground level wind environment around a proposed student village development located at 104-116 Regent Street, Redfern.

The assessment has been carried out via a Discrete Sensor Environmental Wind Tunnel Study whereby wind tunnel measurements were made to investigate wind conditions throughout and around the proposed development (simulated via a 1:400 scale model) at areas to be used by visitors and occupants of the development itself.

The assessment of the proposed development also included testing of the Redfern Centre Urban Design Principles "Compliant" design conforming to standard CoS set-back and building podium/height requirements.

There is no mention in the project SEARs (SSD-12618001) of compliance with RWUDP. There is reference in the Project SEARs: Section 1 - "Statutory and Strategic Context" to consideration of wind effects in Sub-Clause 8 – "Environmental Amenity" as follows:

> **8. Environmental amenity**
>
> The EIS must:
>
> - demonstrate how the proposal achieves a high level of environmental amenity within the proposal and on surrounding buildings, assessing impacts associated with view loss, ventilation, pedestrian movement, access to landscape and outdoor spaces, visual privacy, lighting, reflectivity and wind

1.1 Structure of the Report

The remainder of this report is structured as follows:

Section 2 … describes the proposed development and surrounds

Section 3 … describes Sydney's regional wind climate

Section 4 … presents the wind comfort and safety criteria used in the study

Section 5 … describes the local wind climate characteristics expected at the site

Section 6 … discusses the wind tunnel test methodology used in the study

Section 7 … presents the results of the testing

Section 8 … presents a summary of the results compared to the adopted acceptability criteria

Section 9 … discusses the typical wind mitigation options

Section 10 … discusses the wind mitigation recommendations for the development

Section 11 … discusses the additional testing scenario "Future-C"

2 DESCRIPTION OF THE PROPOSED DEVELOPMENT

2.1 Location of Development Site

The proposed development is bounded by Regent Street to the east, Margaret Street to the south, and similar height future developments to the west and to the north. - refer **Figure 1**.

Figure 1 Satellite Image of the Proposed Development Site

Image Courtesy: Nearmap, May 2021

2.2 Proposed Development Description

The proposal comprises the redevelopment of the site as summarised below:

- Construction of an 18-storey building comprising a total of 9,562m² gross floor area with a mix of land use activities including:
    - Level 1: 72 m² of retail floorspace, 490m² of communal area for the student accommodation, 102 bicycle parking spaces, loading and waste management facilities and ancillary services and facilities.
    - Upper levels: student accommodation providing a total of 411 beds, including ensuite rooms, studios and two-bedroom configurations, with indoor and outdoor communal spaces on Levels 2, 4 and 16 and additional indoor communal areas on Levels 2 and 4.
- Hard and soft landscaping within the outdoor communal terraces on the roof-top of the podium level and Levels 4 and 16.
- Public domain improvements including provision of a landscaped through-site link connecting William Lane to Margaret Street and associated improvements to the Regent Street and Margaret Street frontages, including awnings and footpath upgrades.

Figure 2 Key Architectural Floor Plans of Interest and Representative Elevations

Level 1 (Ground)

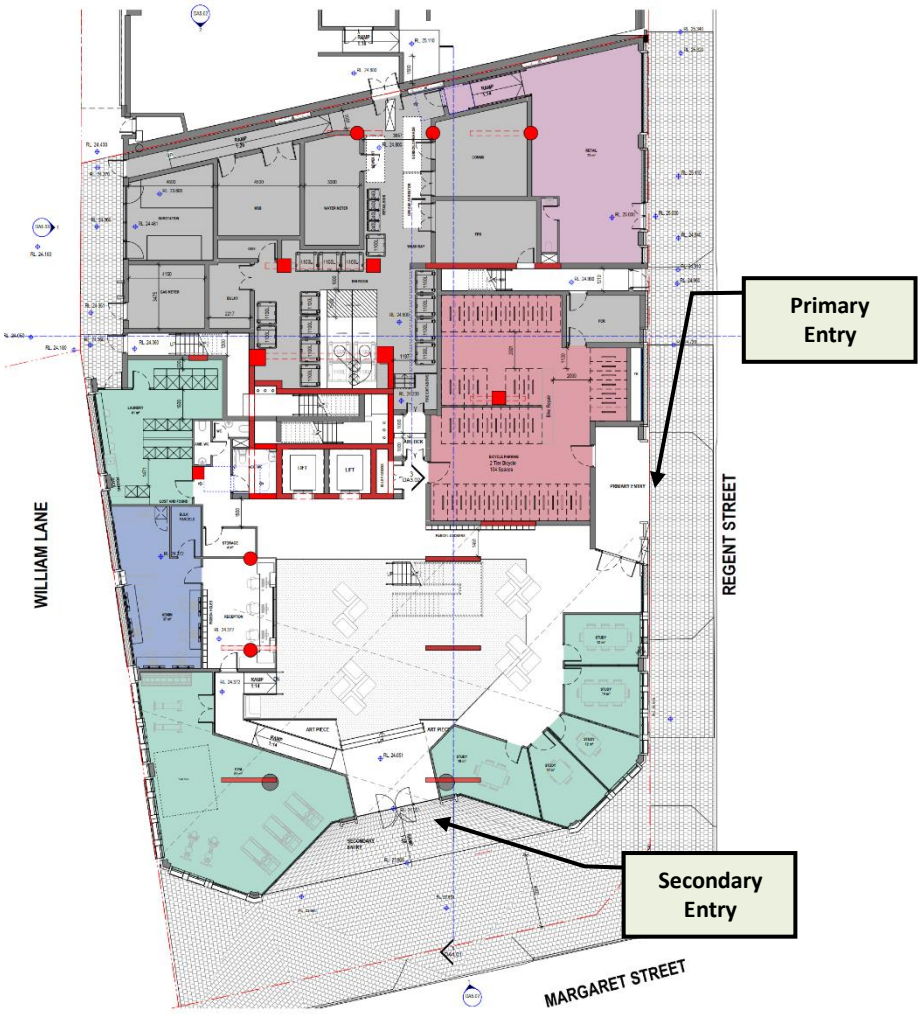
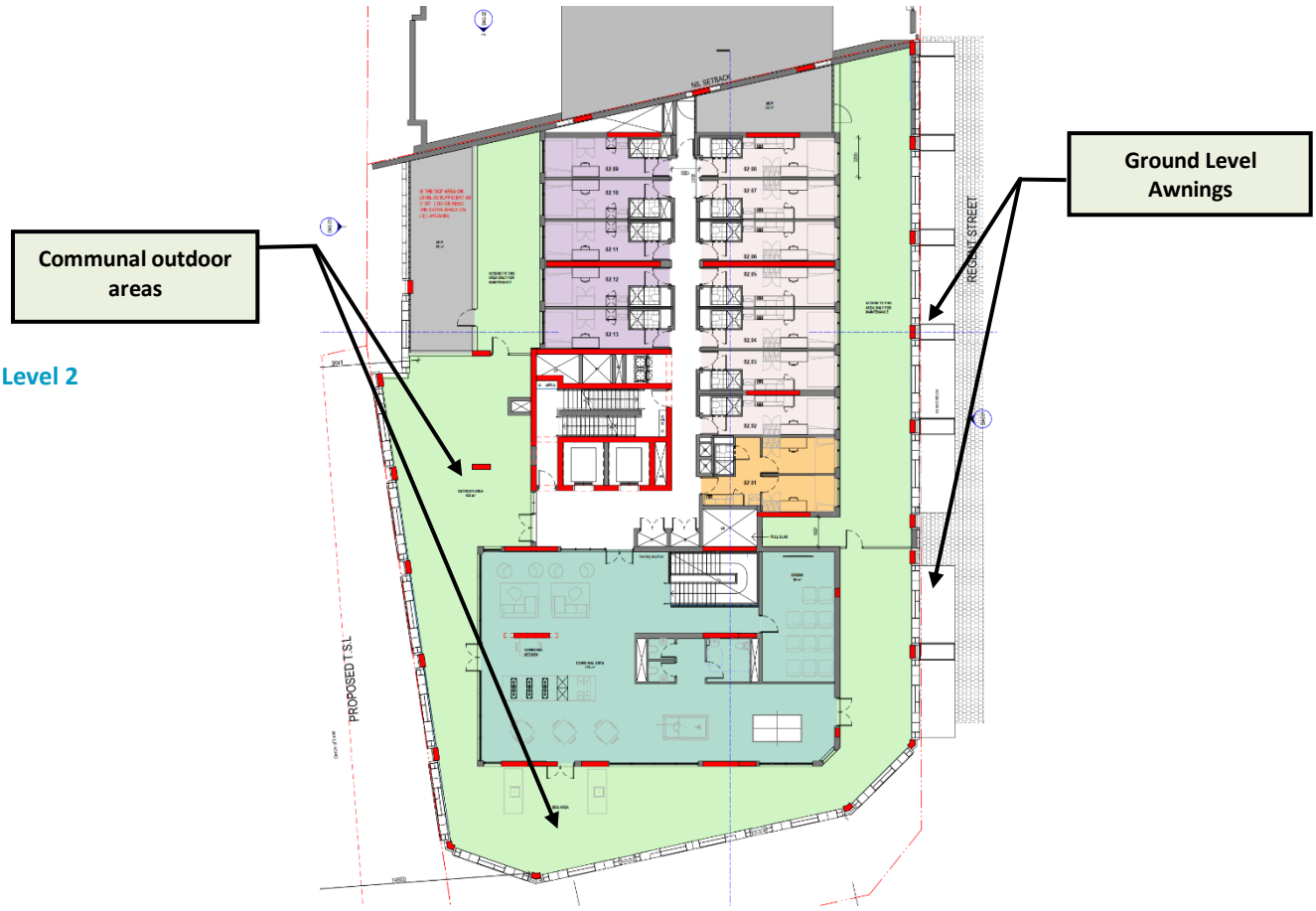
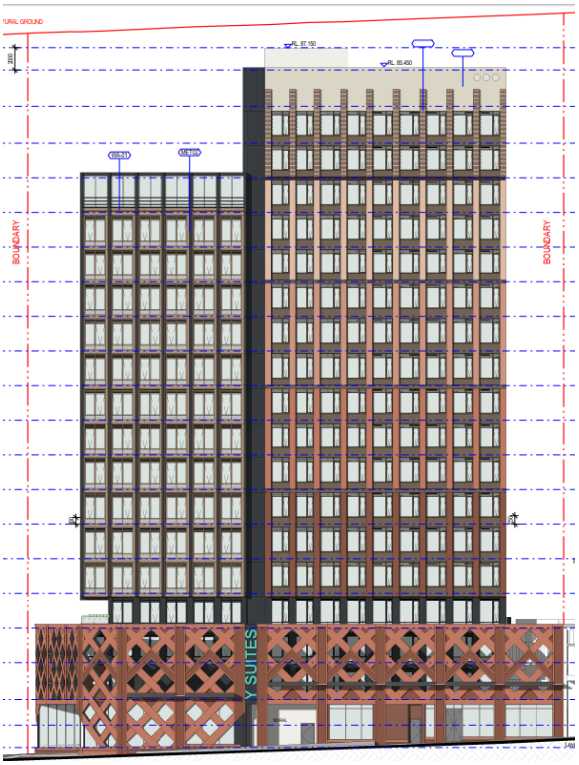


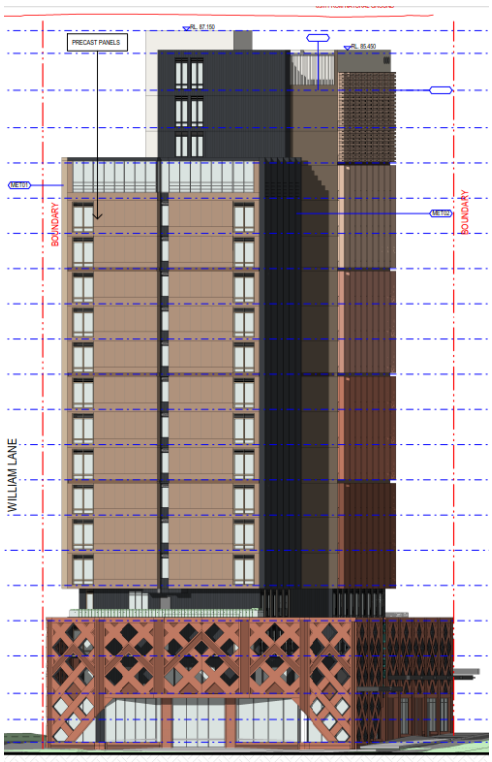
Fig.2 (cont'd)



East (Regent Street) Elevation

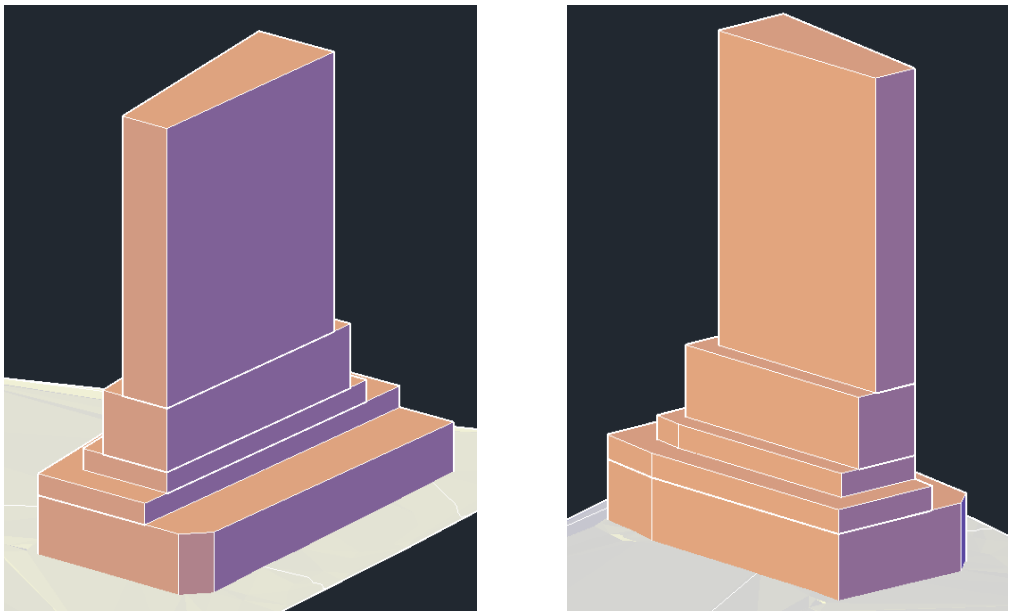


South (Margaret Street) Elevation



The assessment of the proposed development also included testing of the Redfern Centre Urban Design Principles "Compliant" design conforming to standard CoS set-back and building podium/height requirements. This is shown in **Figure 3**.

Figure 3 Redfern Centre Urban Design Principles "Compliant" Design



2.3 The Surrounding Built Environment

In terms of surrounding buildings:

- Buildings surrounding site are generally low and mid-rise, comprising a mix of commercial, retail and residential buildings (several of similar height to the proposed development).
- Gibbons Street Reserve lies to the west with Redfern train station to the north-northwest.
- There are a number of planned and approved future developments of similar height located immediately to the north and west of the proposed development, running between Gibbons Street and Regent Street.
- Sydney's CBD area lies further to the north.

The terrain is undulating in the surrounding built environment, with no particularly significant topographical variations (ie hills, escarpments, etc) influencing local wind speeds.

These aspects are shown in representative views in **Photo 1**.

Photo 1 Representative Project Surrounds (Views towards Site, East and West of Site)

3 SYDNEY'S REGIONAL WIND CLIMATE

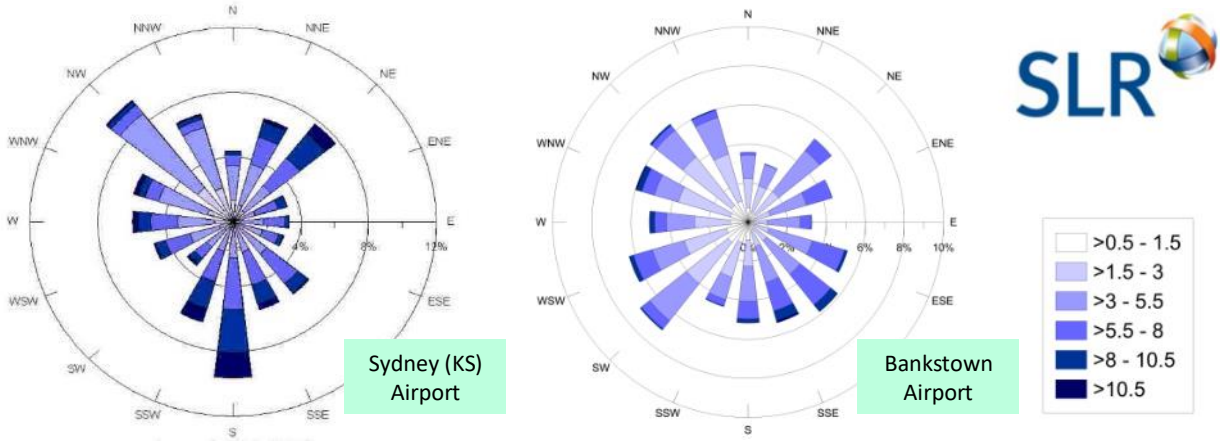
The data of interest in this study are the mean hourly wind speeds and largest gusts experienced throughout the year (especially higher, less frequent winds), how these winds vary with azimuth, and the seasonal break-up of winds into the primary Sydney Region wind seasons.

3.1 Seasonal Variations

Key characteristics of Sydney's Regional Wind Climate are illustrated in two representative wind roses shown in **Figure 4**, taken from Bureau of Meteorology (BoM) data recorded during the period 1999-2017 at Sydney (Kingsford Smith) Airport and Bankstown Airport. The associated seasonal wind roses (refer **Appendix A**) show that Sydney is affected by two primary wind seasons with short (1-2 month) transition periods in between:

- Summer winds occur mainly from the northeast, southeast and south. While northeast winds are the more common prevailing wind direction (occurring typically as offshore land-sea breezes), southeast and southerly winds generally provide the strongest gusts during summer. Northeast sea breeze winds and stronger southerly winds associated with "Southerly Busters" and "East Coast Lows" typically have a significantly greater impact along the coastline. Inland, these systems lose strength and have altered wind direction characteristics.
- Winter/Early Spring winds occur mainly from west quadrants and to a lesser extent from the south. West quadrant winds provide the strongest winds during winter and in fact for the whole year, particularly at locations away from the coast.

Figure 4 Annual Wind Roses for Sydney (KS) Airport and Bankstown Airport (BoM Data)



3.2 Wind Exposure at the Site – the "Local" Wind Environment

Close to the ground, the "regional" wind patterns described above are affected by the local terrain, topography and built environment, all of which influence the "local" wind environment.

- As noted in **Section 1.3**, the site is currently surrounded by a mix of low to mid-rise retail, commercial and residential buildings, with a number of these of similar height to the proposed development. The site will therefore receive moderate wind shielding depending upon oncoming wind direction at lower levels with upper levels exposed to higher winds from most wind directions.

4 WIND ACCEPTABILITY CRITERIA

The choice of suitable criteria for evaluating the acceptability of particular ground level conditions has been the subject of international research over recent decades.

4.1 The "Melbourne" Wind Criteria

One of the acceptability criteria developed from this research, and currently referenced by many Australian Local Government Development Control Plans, are the so-called "Melbourne" criteria, summarised in **Table 1**.

Table 1 Melbourne-Derived Wind Acceptability Criteria

Type of Criteria	Gust Wind Speed Occurring Once Per Year	Activity Concerned
Safety	24 m/s	Knockdown in Isolated Areas
	23 m/s	Knockdown in Public Access Areas
Comfort	16 m/s	Comfortable Walking
	13 m/s	Standing, Waiting, Window Shopping
	10 m/s	Dining in Outdoor Restaurant

The following objectives relate to the above wind impact criteria:

- The general objective for pedestrian areas is for annual 3-second gust wind speeds to remain at or below the 16 m/s "walking comfort" criterion. Whilst this magnitude may appear somewhat arbitrary, its value represents a level of wind intensity above which the majority of the population would find unacceptable for comfortable walking on a regular basis.
- In many urban locations, either because of exposure to open coastal conditions or because of street "channelling" effects, etc, the 16 m/s criterion may already be currently exceeded. In such instances a new development should ideally not exacerbate existing adverse wind conditions and, wherever feasible and reasonable, ameliorate such conditions.
- The recommended criteria for spaces designed for activities such as seating, outdoor dining, etc, are lower (ie more stringent) than for "walking comfort".

The **Table 1** criteria, especially for Comfort-type criteria, should not be viewed as *"hard"* numbers as the limiting values were generally derived from subjective assessments of wind acceptability. Such assessments have been found to vary with the height, strength, age, etc, of the pedestrian concerned.

A further factor for consideration is the extent of windy conditions, and some relaxation of the above criteria may be acceptable for small areas under investigation provided the general site satisfies the relevant criteria.

Finally, it is noted that the wind speed criteria in Table 1 are based on the maximum wind gust occurring (on average) once per year. Winds occurring more frequently, eg monthly winds, weekly winds, etc, would be of lesser magnitude. So, for example, a location with a maximum annual gust of 10 m/s would experience winds throughout the year of a much lower and hence generally mild nature, conducive to stationary activities (seating, dining, etc).

Mitigation Using Landscaping

The Australasian Wind Engineering Society (AWES) *Guidelines for Pedestrian Wind Effects Criteria* provides advice related to the use of landscaping (trees, shrubs, etc) for mitigation of adverse wind conditions. In particular, the AWES Guideline notes the following:

- Trees planted in locations where the 23 m/s safety criterion is exceeded are likely to experience wind speeds every 5 years or so which will be sufficient to destroy or severely damage many trees.
- Moreover, landscaping planted in high wind locations rarely matures to its normal full height assumed for wind mitigation and trees placed in high wind areas have the potential to shed limbs during windstorms, thereby causing a public danger and a public nuisance.
- Finally, trees located on public footpaths become the responsibility of the local municipality. Their maintenance, replacement following damage, loss of limbs, etc, can become burdensome financially (assuming the Municipality is even aware of such damage) and cannot be guaranteed.

Accordingly, the AWES Guideline does not recommend the use of landscaping when seeking to mitigate wind conditions that equal or exceed the public safety 23 m/s criterion.

5 DESIGN WIND SPEEDS

5.1 Methodology

SLR has carried out a detailed study of Sydney Basin wind speeds using continuous records of wind speed and direction measured at the Bureau of Meteorology's (BoM) Sydney weather stations. The objective of this study was to develop statistical wind information for locations not situated in close proximity (ie within say approximately a kilometre) of BoM weather stations.

The study is described in detail in …

- SLR Technical Note: *"9300-TN-CW&E-v2.0 Sydney Region Design Winds"*, March 2018.

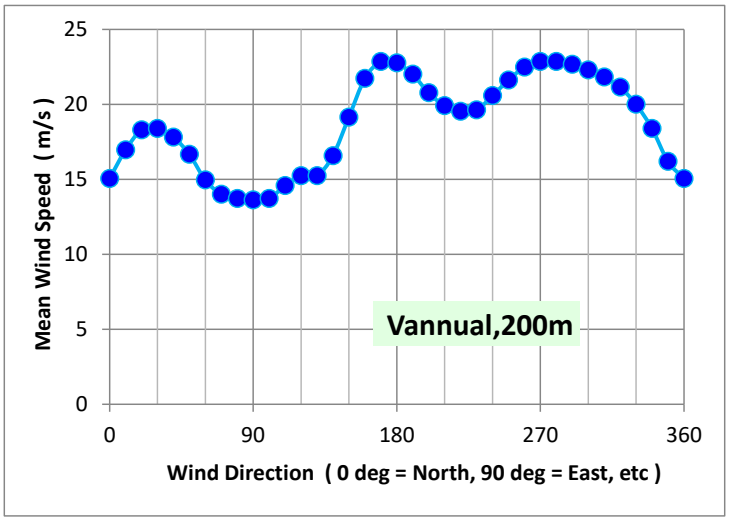
Wind records given particular emphasis were from weather stations with a "clean" surrounding exposure, eg stations such as Sydney (Kingsford Smith) Airport and Bankstown Airport, ie locations relatively free of immediately surrounding obstacles such as buildings, vegetation, trees, etc, which would otherwise distort the winds seen by the weather station anemometer.

For Redfern, SLR has determined that local winds have characteristics very close to Sydney (KS) Airport compared to Bankstown Airport, given Redfern's proximity to Sydney (KS) Airport and similar distance inland from the coastline. Key prevailing wind directions of interest are the northeast, southeast and south for summer and mainly west quadrant winds for winter.

5.2 Reference Height Wind Speeds

In the wind tunnel testing, the reference dynamic pressure used to record all wind speed data was measured at an equivalent (full-scale) height of 200 m above ground level (500 mm in the wind tunnel). Accordingly, conversion from wind tunnel speeds to full-scale speeds requires the determination of reference height design mean wind speeds for the site. These are shown in **Figure 5** and have been based on the adopted Liverpool wind model as described above. The winds shown in **Figure 5** have a once-per-year exceedance probability.

Figure 5 Reference Height (200 m) Annual Recurrence Mean Wind Speed at Project Site



6 WIND TUNNEL TEST METHODOLOGY

6.1 Simulation of Natural Wind

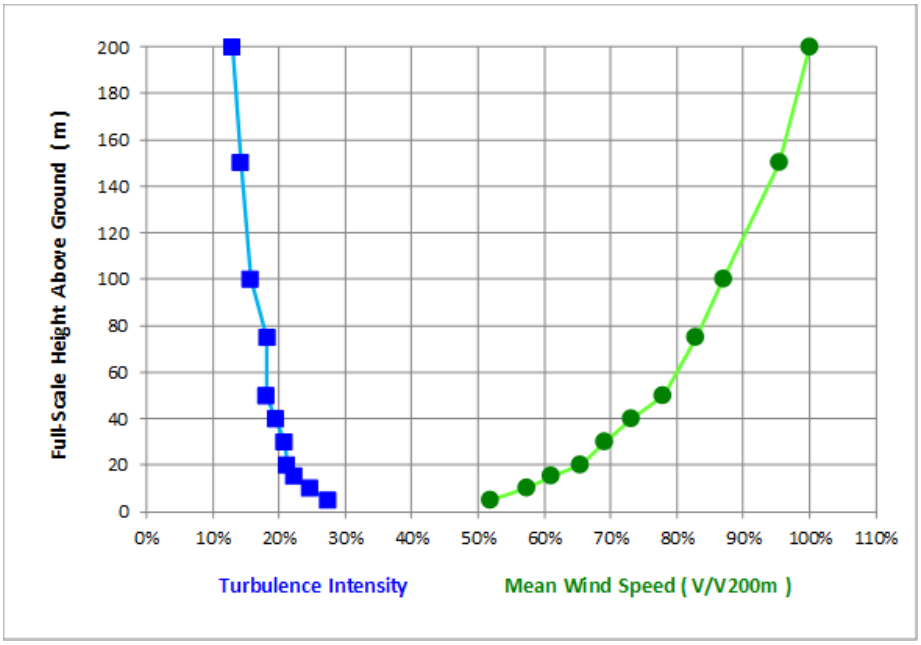
Similarity requirements between the wind tunnel model and prototype (ie full-scale) need to be fulfilled so that similitude in the flow conditions is satisfied. Usually all requirements cannot be satisfied and compromises need to be made. In this type of wind tunnel test it is possible to waive strict adherence to the full range of similarity parameters.

The wind tunnel test has been carried out using a geometric length scale of 1:400 for all dimensions (standard wind tunnel test scaling) and by scaling the boundary layer approach wind in the wind tunnel to the same scale as in the atmosphere.

The approach wind was modelled by matching terrain category conditions for all wind directions. In the wind tunnel, this is achieved by an almost 20-metre fetch of appropriate roughness elements.

The upstream profile conditions simulated in the present study is Terrain Category 3 associated with medium density suburban surroundings. The variation of mean wind speed (green curve) and turbulence intensity (blue curve) is shown in **Figure 6**.

Figure 6 Wind Tunnel Test Profiles for Mean Wind and Turbulence Intensity



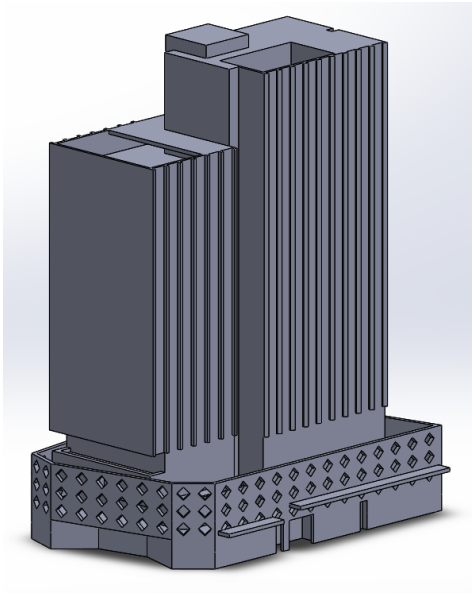
6.2 Development Models and Proximity Model

Development Models: November 2021 Latest Design & "Compliant" Design

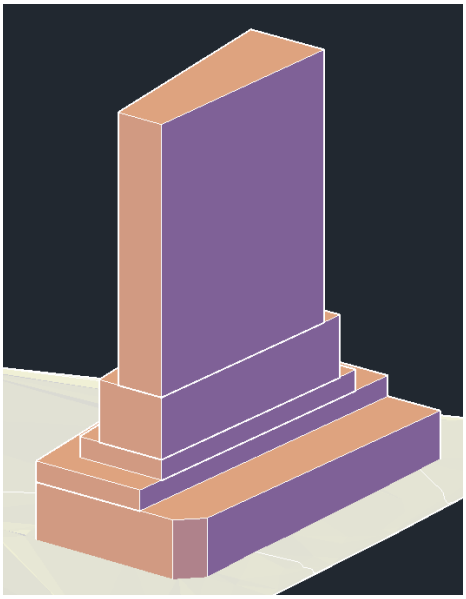
Two 1:400 scale models of the proposed development were built for the testing – refer **Figure 7** - for the latest (November 2021) proposed "Preferred" design and Redfern Centre Urban Design Principles "Compliant" design.

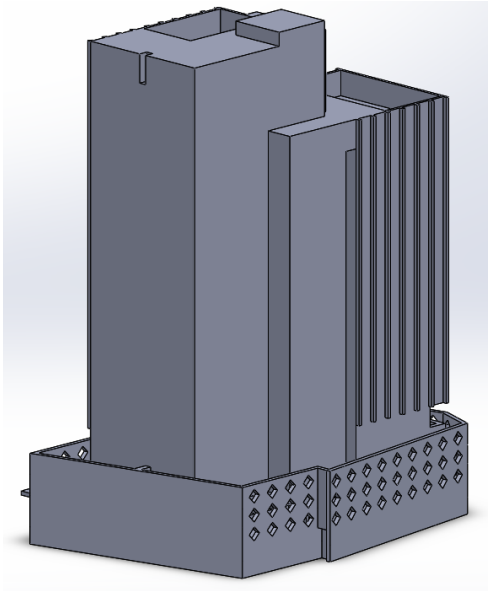
Figure 7 1:400 Scale Model of the Proposed Development

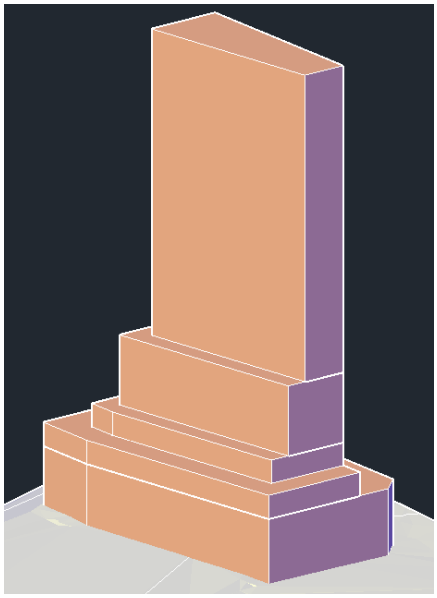
November 2021 Proposed development "Preferred" Design



November 2021 Redfern Centre Urban Design Principles "Compliant" Design







Proximity Model

To take into account the influence of the immediate surrounding physical environment, all neighbouring buildings and local topography within a diameter of almost 900 m around the site were included in the purpose-built 1:400 scale "proximity model" used for the test as shown in **Figure 8**.

The proximity models used in the present testing simulate the following three built environment "scenarios":

- "Baseline": Existing built environment
- "Future-P": "Baseline" + future proposed development (Preferred Design) with proposed trees
- "Future-C": as per "Future-P" but with City of Sydney "Compliant" Design

All of the above scenarios include the approved future developments lying to the immediate north and west of the site – refer **Figure 8**.

Figure 8 Proximity Models Used in the Wind Tunnel Testing

"Baseline" Scenario (Existing)

View from South

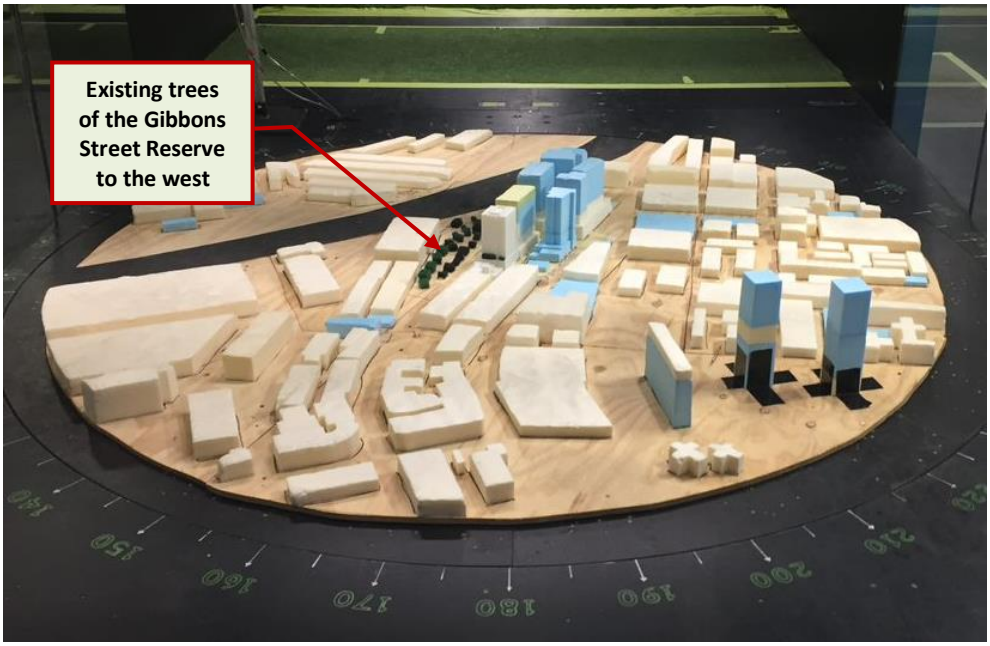
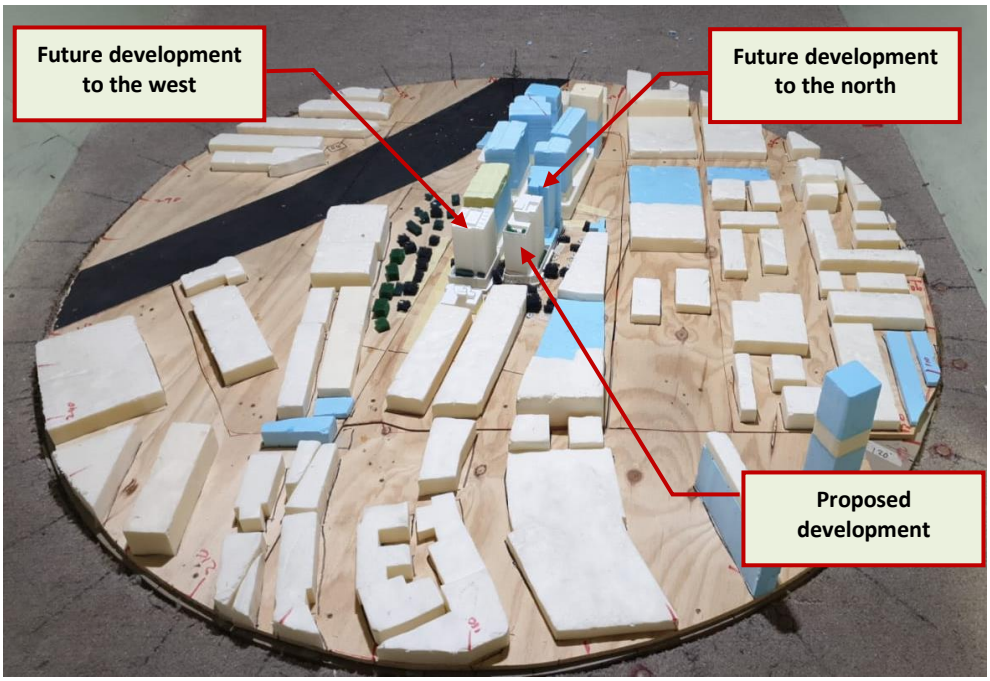


Fig.8 (cont'd)

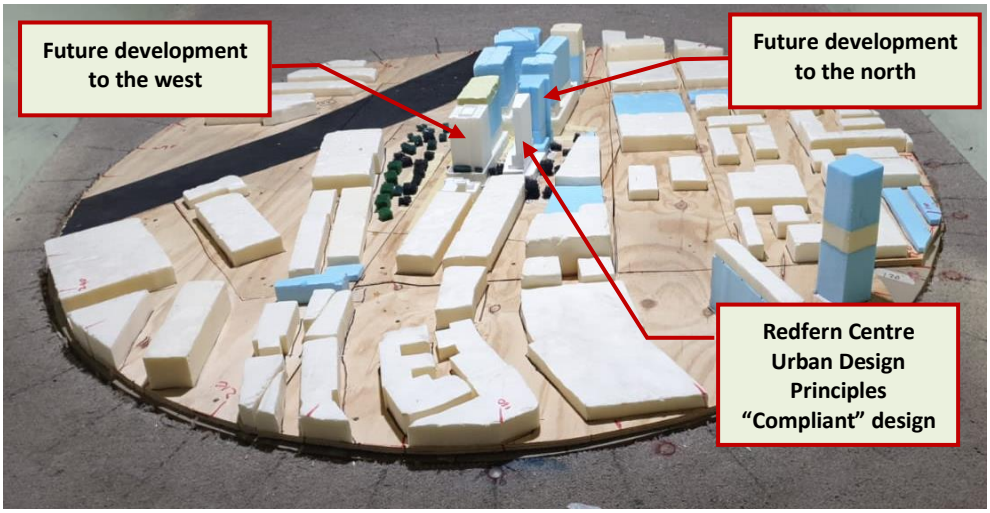
"Future-P" Scenario (with Proposed development)

View from South



"Future-C" Scenario (Redfern Centre Urban Design Principles "Compliant" design)

View from South



6.3 Data Processing

Wind speed measurements were taken at 10° intervals:
the 0° wind direction is from the north, with east at 90°, south at 180°, etc.

The wind speeds at the locations of interest are measured
in the wind tunnel using Irwin sensors.

Wind speeds in the wind tunnel were measured at a height
corresponding to approximately chest height (1.5 m) in full scale.

The sampling time for each measurement is 60 seconds.

Wind speed measurements are recorded as dimensionless ratios
of the mean and gust ground level velocity to a mean reference wind speed
at a (full-scale) height of 200 m above ground level.

The reader is referred to the publication referenced below for a full description of this technique and validation of Irwin sensor data using hot-wire anemometry.

- LTR-LA-242 *"A Simple Omni-Directional Sensor for Wind Tunnel Studies of Pedestrian Level Winds"* (Irwin, National Aeronautical Establishment, Ottawa, Canada, May 1980)

The wind tunnel output data is then processed using the directional wind speed information derived from the Redfern wind climate model to yield ground level wind speeds as a function of annual return period and directional mean reference wind speed – refer **Figure 5**.

The ground level wind speeds thus incorporate both the building and terrain/topographical aspects of the location as well as the directional probability of wind speed for the site.

The results have been computed on an annual exceedance basis, to compare to the adopted wind acceptability criteria, using the local Project-Site statistical wind data – refer **Figure 5**.

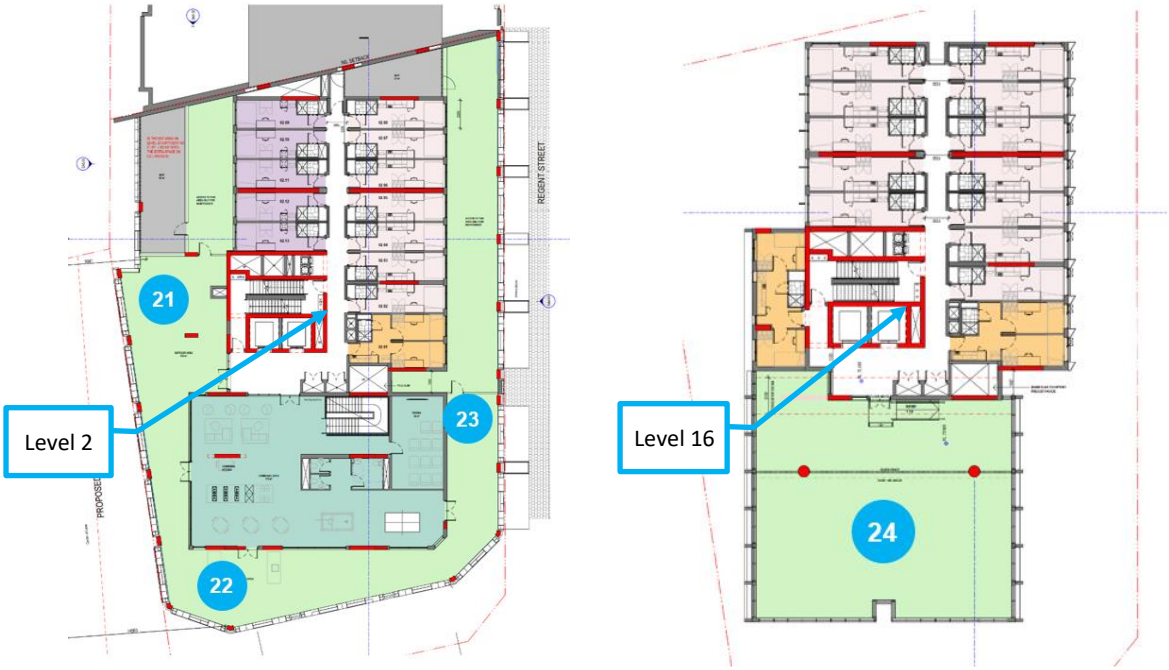
6.4 Test Method – Sensor Locations

In the wind tunnel testing, Irwin wind sensors were positioned at the locations shown in **Figure 9**.

These locations were chosen as potentially susceptible to adverse wind conditions, eg near building corners, or represent locations of interest throughout the development, eg near primary building entrances and along footpaths.

- The 20 Ground level sensors are shown in Yellow – these were measured for all scenarios;
- The 4 sensors located on Level 2 and Level 16 shown in blue were only measured for the "Future-P" scenario.

Figure 9 Wind Tunnel Test Sensor Locations



6.5 Sample Test Result

An example of the test results and interpretation of these results is shown in **Figure 10**, illustrating the peak annual mean and gust wind speeds at:

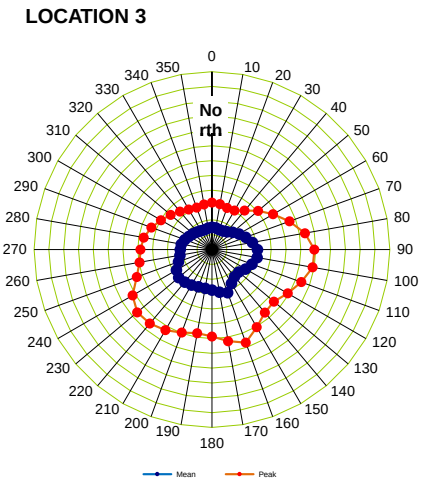
Sensor: **Location 3**
Location: William Lane, along western façade of proposed development

The polar diagram shows the output of the wind tunnel test results in terms of the ratio of mean wind speed and gust wind speed to reference height mean wind speed (Ht=200m):

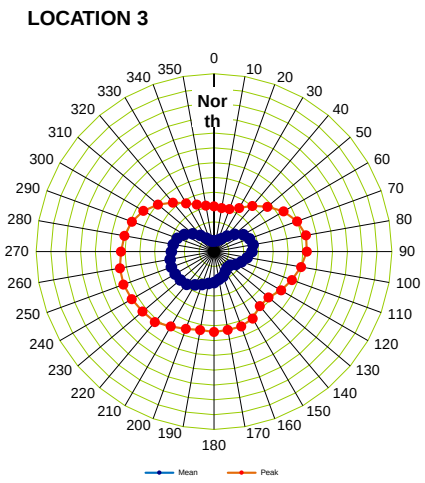
Mean wind speed: "navy blue" data points
Gust wind speed: "red" data points.

Figure 10 Sample Polar Plot Test Result – Location 3 – All Scenarios

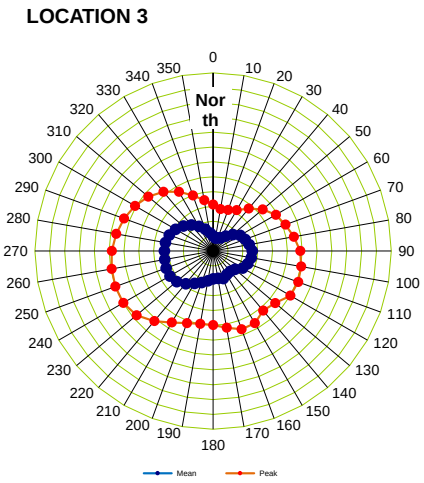
"Baseline" Scenario



"Future-P" Scenario



"Future-C" Scenario



For the **"Baseline"** scenario …

- Winds at Location 3 are strongest from the east and south-southeast, where winds from these directions can impact directly due to minimal shielding provided by the existing low height buildings at site.

For the **"Future-P"** scenario …

- With the addition of the proposed development ("Preferred" Design), winds at Location 3 decrease from the easterly direction due to the shielding provided by the proposed development itself.
- Increase in winds can be seen from the northwest to southwest wind directions as a result of slight downwash as well as increased funnelling effect where the winds side-stream along the western aspect of the development and channel along the William Lane.

For the **"Future-C"** scenario …

- At Location 3, wind responses for the Redfern Centre Urban Design Principles "Compliant" design are similar to the proposed design for almost all wind directions.
- Increase in winds can be seen from the northwest to southwest wind directions as a result of slight downwash as well as increased funnelling effect where the winds side-stream along the western aspect of the development and channel along the William Lane.

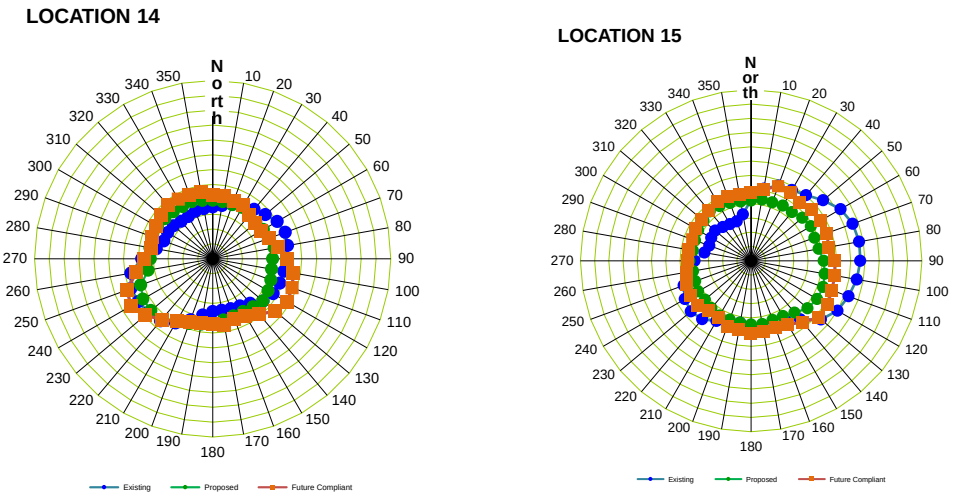
7 TEST RESULTS

Appendices B, C, and D shows the relevant wind tunnel test result polar plots respectively for all locations for the "Baseline" (existing built environment), "Future-P" (with the addition of the future proposed development (Preferred Design) with proposed trees), and "Future-C" (with the "Compliant" design and proposed mitigation) scenarios.

7.1 Sensor Locations: Along Regent Street – (representative locations Fig.11)

- Winds along Regent Street are generally stronger from northeast and southwest. Winds approaching from these wind directions are expected to channel along Regent Street and side-stream along the building facades.
- In the case of "Future-P" and "Future-C" scenarios, with the addition of the development as well as the proposed/existing trees along Regent Street, winds along Regent Street generally slightly decrease from most wind directions due to the significant shielding provided by the proposed development itself as well as the proposed/existing trees.
- The easterly winds tend to be slightly slower at locations along the eastern side footpath of Regent Street as compared to western side footpath, reflecting sheltering from the existing buildings located along eastern side of Regent Street.
- Wind responses along Regent Street for the "Compliant" design are similar to the proposed design for most of the wind directions. In some instances, winds approaching from easterly quadrant are slightly stronger in case of "Compliant" development. Winds approaching from this direction are expected to downwash off the eastern façade of the "Compliant" development. Unlike proposed development, there is no ground level awning in place for the "Compliant" design to deflect the wind to mitigate this downwash effect.

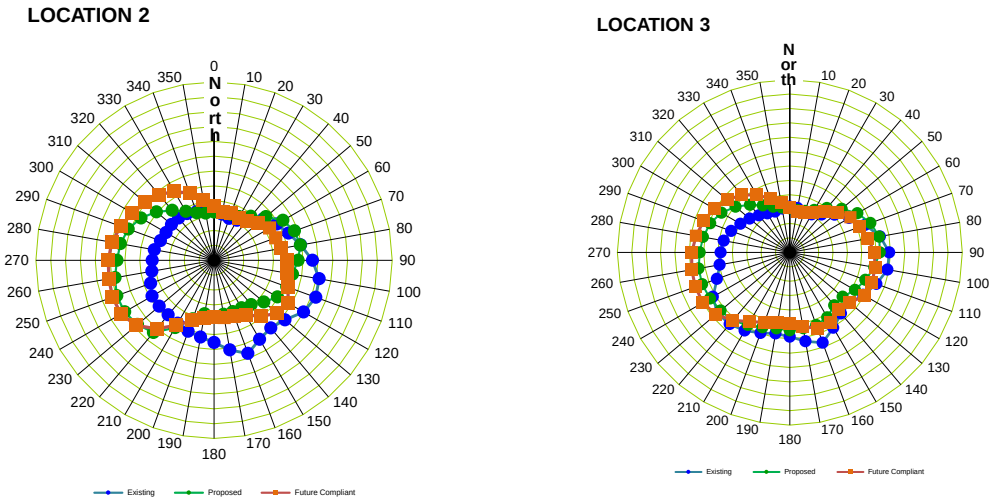
Figure 11 Peak Annual Gusts V/Vref: "Baseline" vs "Future" Scenarios Representative Location



7.2 Sensor Locations: Along William Lane and to the west of the site- (representative locations Fig.12)

- Winds along William Lane are generally high from the east and west-northwest. Easterly winds are expected to channel between the proposed development and the neighbouring development immediately to the north; whereas the winds approaching from west-northwest are expected to funnel through the two future developments located to the west and to the north-west. Winds approaching from the north are expected to be shielded by the adjacent buildings.
- With the addition of the proposed development, winds typically increase from the west to northwest. Winds approaching from these directions are expected to funnel between the neighbouring buildings located to the west and northwest before downwashing off the proposed development's western façade.
- Winds for the two future scenarios ("Future-P" and "Future-C") are similar for most of these locations, with slight variation in winds for west to north-westerly winds.

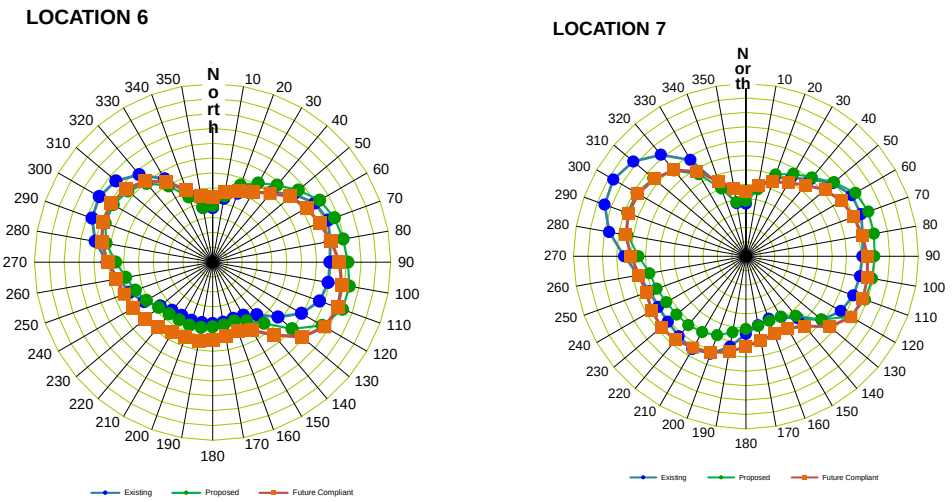
Figure 12 Peak Annual Gusts V/Vref: "Baseline" vs "Future" Scenarios Representative Locations



7.3 Sensor Locations: Along Margaret Street - (representative locations Fig.13)

- Winds along Margaret Street are typically highest for the west-northwest and eastern quadrant wind directions, channelled between the proposed and neighbouring buildings, along Margaret Street. Easterly quadrant winds are expected to accelerate around the building corners along Regent Street and funnel along Margaret Street. Winds approaching from west-northwest are expected to accelerate around the building corners along Gibbons Street and funnelling along Margaret Lane.
- With the addition of the proposed development, winds remain the same from the majority of wind directions and increase slightly from the east to southeast, reflecting the funnelling and corner accelerating effect of the winds approaching from these directions.
- Winds for the two future scenarios ("Future-P" and "Future-C") remain the same, with the exception of Locations 6 and 7 with slight increase in wind speeds for the winds approaching typically from the south to southwest quadrant, in case of "Future-C" scenario.

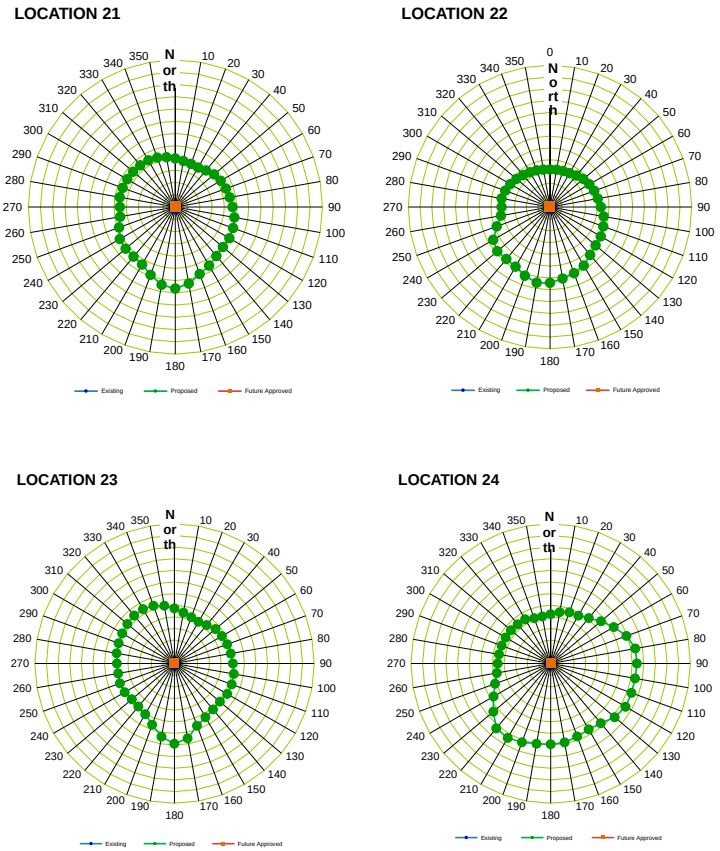
Figure 13 Peak Annual Gusts V/Vref: "Baseline" vs "Future" Scenarios Representative Locations



7.4 "Future-P" Locations – Level 2 and Level 16 Locations - (representative locations Fig.14)

- All of these locations only exist in the "Future-P" scenario (they do not exist in both "Baseline" and "Future-C" scenarios).
- Winds within the open communal area on Level 2 are generally high from the south. Due to the minimal shielding from the south, the southerly winds are expected to downwash off the southern façade as well as accelerate around the corners of the proposed development and side-stream along the facades.
- Winds are stronger from the east through to southwest within the open communal area on Level 16. Due to the open nature of the surrounds to the east through to the southwest, winds are expected to directly impact and adversely affect this area.

Figure 14 Peak Annual Gusts V/Vref: "Future-P" Scenario Representative Locations



8 OVERALL WIND IMPACT

Table 2 gives the peak annual gust wind speeds predicted to occur at the test sensor locations for the "Baseline" and "Future-P" built environment scenarios, relevant to assessment of the Melbourne Criteria.

Table 2 Predicted Peak Annual Gust Wind Speeds at all Locations: "Baseline" & "Future-P"

Sensor No and Location Description (ref Fig.9)		Peak Annual Gust (m/s)	
		BASELINE	FUTURE-P
1	William Lane – northwest of site	16.5	12.5
2	William Lane – northwest of site	14.5	15.0
3	William Lane – northwest corner of the development	14.5	14.5
4	In line with William Lane – west of site	12.0	13.0
5	William Lane – southwest corner of the development	17.0	14.0
6	Margaret Street – southwest of the development site	19.0	17.5
7	Margaret Street – southwest of the development site	22.5	20.0
8	Margaret Street – south of the development site	17.5	14.5
9	Margaret Street – south of the development site	15.0	13.0
10	Regent Street – west footpath, southeast of the development site	12.5	14.5
11	Regent Street – east footpath, east of site	13.5	13.0
12	Regent Street – west footpath, southeast corner of development	12.0	14.0
13	Regent Street – west footpath, along development eastern façade	12.0	12.0
14	Regent Street – east footpath, east of site	12.5	11.0
15	Regent Street – west footpath, along development eastern façade	12.0	10.5
16	Regent Street – east footpath, east of site	15.0	13.0
17	Regent Street – west footpath, northeast corner of the site	13.0	12.0
18	Regent Street – west footpath, northeast of the development site	12.5	14.0
19	Regent Street – east footpath, northeast of site	13.0	14.5
20	New Proposed Lane perpendicular to Gibbons St and William Lane	18.0	15.0
21	Level 2 – outdoor terrace area	*Refer Note 2*	15.0
22	Level 2 – outdoor terrace area		14.5
23	Level 2 – outdoor terrace area		15.5
24	Level 16 – outdoor terrace area		16.0

Note 1: Peak Gust Values rounded off to the nearest 0.5 m/s (the experimental error in results is ±0.5 m/s)

Note 2: Locations 1-20 are Ground Level, locations 21-24 are on Level 2 and Level 4; 21-24 only exist in the "Future-P" scenario

8.1 Wind Impact Relative to Intended Usage

There is no mention in the project SEARs (SSD-12618001) of compliance with RWUDP. There is reference in the Project SEARs: Section 1 - "Statutory and Strategic Context" to consideration of wind effects in Sub-Clause 8 – "Environmental Amenity" as follows:

> **8. Environmental amenity**
>
> The EIS must:
>
> - demonstrate how the proposal achieves a high level of environmental amenity within the proposal and on surrounding buildings, assessing impacts associated with view loss, ventilation, pedestrian movement, access to landscape and outdoor spaces, visual privacy, lighting, reflectivity and wind

Pedestrian Footpath Areas Surrounding the Site (Existing)

Wind category objective: 16 m/s Walking Comfort criterion

Ground level locations surrounding the site (Regent Street, Margaret Street, William Lane) are predicted to experience both modest increases and decreases in wind speed for key prevailing wind directions (northeast, southeast, south and west).

- In terms of the Melbourne Criteria, a number of these locations currently experience peak annual gusts which lie above the 16 m/s walking comfort criterion, but all the locations lie below the 23 m/s safety criterion.

In the "Future-P" scenario:

- There were 4 ground level locations where Future-Preferred Design peak annual gusts were the same as the Baseline.
- There were 10 ground level locations where Future-Preferred Design peak annual gusts improved (ie were lower) compared to the Baseline.
- There were 6 ground level locations where Future-Preferred Design peak annual gusts were higher than the Baseline.
- In the Baseline scneario, there were 5 locations that exceeded the 16 m/sec walking comfort criterion (but with none exceeding 23 m/sec).
- In the Future-Preferred Design scneario, there were only 2 locations that exceeded the 16 m/sec walking comfort criterion (with none exceeding 23 m/sec).

Pedestrian Footpath Areas Surrounding the Site (New)

Wind category objective: 16 m/s Walking Comfort criterion

- In the Future-Preferred Design scneario, the predicted peak annual gust within the new Proposed Laneway was 15 m/sec.

Internal Podium Areas

Wind category objective: 13 m/s Standing-Waiting-Window Shopping criterion
10 m/s Outdoor Dining criterion for seating areas intended for dining

For many wind directions, the Level 2 and Level 16 outdoor areas are relatively sheltered by the adjacent similar height buildings to the immediate north and west, the proposed vertical façade screening along the perimeter of the development (from level 2 slab up to level 4 slab), the proposed full height screening at Level 16, and the proposed development itself. For some other restricted wind directions, the Level 2 communcal area as well as Level 16 terrace area has the potential to experience elevated wind conditions as windflow accelerates past the proposed development's western and southern façades and is directed downwards as downwash and accelerated shear flow.

- All locations (Locations 21-24) satisfy the 16 m/s Walking Comfort criterion
- It is also important to appreciate that, while the Level 2 outdoor areas have the potential to attract elevated winds from building floors above (downwash, etc), these winds are thereby prevented from generating the same impact at ground level locations immediately below. The Podium therefore plays a potentially important role in ameliorating ground level wind conditions in surrounding pedestrian areas.

Impact of the proposed development onto the neighbouring building terrace

The proposed development is expected to have minor impact onto the terrace area located on Level 2 of the neighbouring building located at 90-102 Regent Street, north of the proposed development. Winds aproaching from east-west may funnel between the proposed development and the neighbouring building located to the north; however, these winds are expected to deflect away due to the existing full height screens around this terrace area.

Future-Proposed versus Future-Compliant

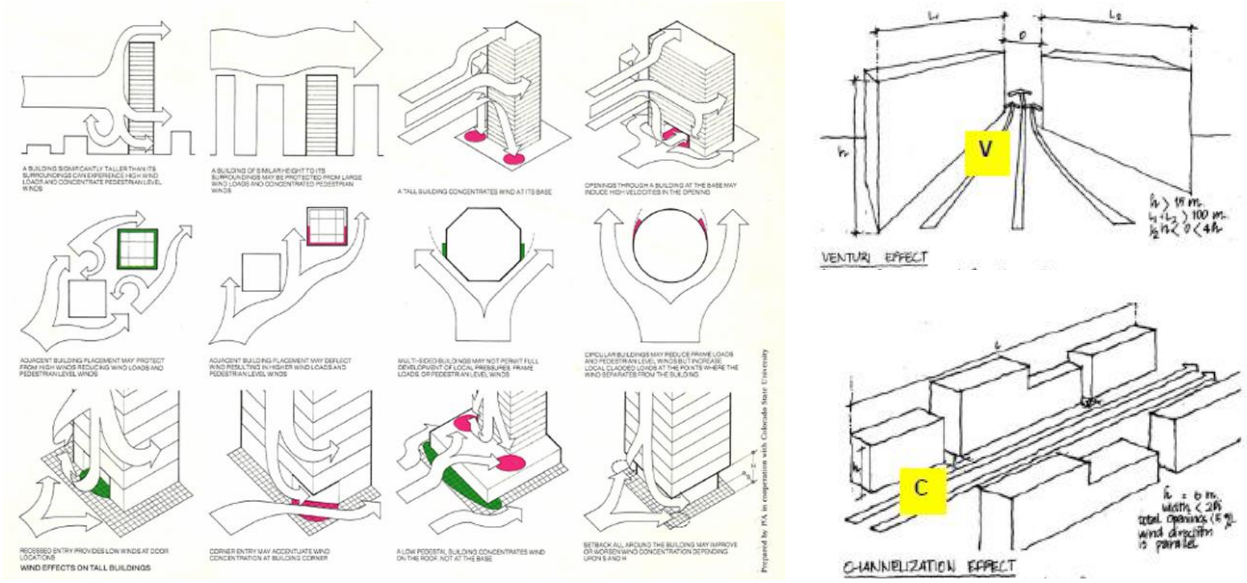
- There were 11 ground level locations where the Future-Compliant Design peak annual gust was the same as the Future-Proposed Design.
- There were 4 ground level locations where the Future-Compliant Design peak annual gust was lower than the Future-Proposed Design (differences typically around 1.0 to 2.0 m/s).
- There were 5 ground level locations where the Future-Compliant Design peak annual gust was higher than the Future-Proposed Design (differences typically around 1 to 2.5m/s).
- Both the Future-Proposed and Future Compliant designs had a simiular number of exceedances of the 16 m/sec walking comfort criterion.
- In most instances, these exceeedances, eg along Margaret Street to the southwest of the site, also existed in the "baseline" test scenario.

On the basis of the above, it is concluded that the "Future-Proposed" Design performs essentially identical, wind-wise, to the "Future-Compliant" Design.

9 WIND MITIGATION OPTIONS

Figure 16 shows some common wind impact flow patterns surrounding a new building development.

Figure 15 Common Built Environment Windflow Patterns



On the basis of the above, wind mitigation options generally fall into two categories:

- Windbreaks designed to mitigate **vertical or oblique** winds; and
- Windbreaks designed to mitigate **horizontal** winds; and

9.1 Windbreaks Suited to Mitigating Vertical/Oblique Winds

Wind mitigation options suited to ameliorating vertical/oblique wind conditions include:

- Horizontal (or near horizontal) Canopies, Awnings and Pergolas which are able to deflect winds approaching from above and redirect the wind away from grounds level areas below.

9.2 Windbreaks Suited to Mitigating Horizontal Winds

Wind mitigation options suited to ameliorating horizontal wind conditions include:

- Landscaping: trees, shrubs, vegetation, etc; and
- Sculptural screening (solid or porous) – which can also be combined with landscaping.

9.3 Horizontal Windbreak Examples

Figure 17 shows typical examples of horizontal windbreak options typically found in urban built environments – they can be soild or porous, purely horizontal or with a slope aimed at deflecting oblique windflow.

Figure 16 Horizontal Windbreak Options






9.4 Vertical Windbreak Examples

Figure 18 shows examples of vertical windbreak options found in urban built environments – they can be soild or porous, involve landscaping (full or partial), timber, glazing, etc, and can provide a wide range of utilitarian functions beyond their wind mitigation capability (eg seating, advertising, etc).

Figure 17 Vertical Windbreak Options

Landscaping

Solid

Multi-Function

Combination

10 MITIGATION TREATMENT RECOMMENDATIONS

Sections 7 and 8 provided guidance as to the areas where the adopted wind acceptability criteria had the potential to be exceeded and an indication as to the likely local optimum wind treatment strategy, eg whether the wind condition of interest is likely to arise from mainly horizontal winds which require vertical windbreaks (refer **Figure 18**) or mainly vertical downwash winds which require horizontal windbreaks (refer **Figure 17**).

The wind conditions of potential concern in relation to the proposed development revealed by the wind tunnel study are:

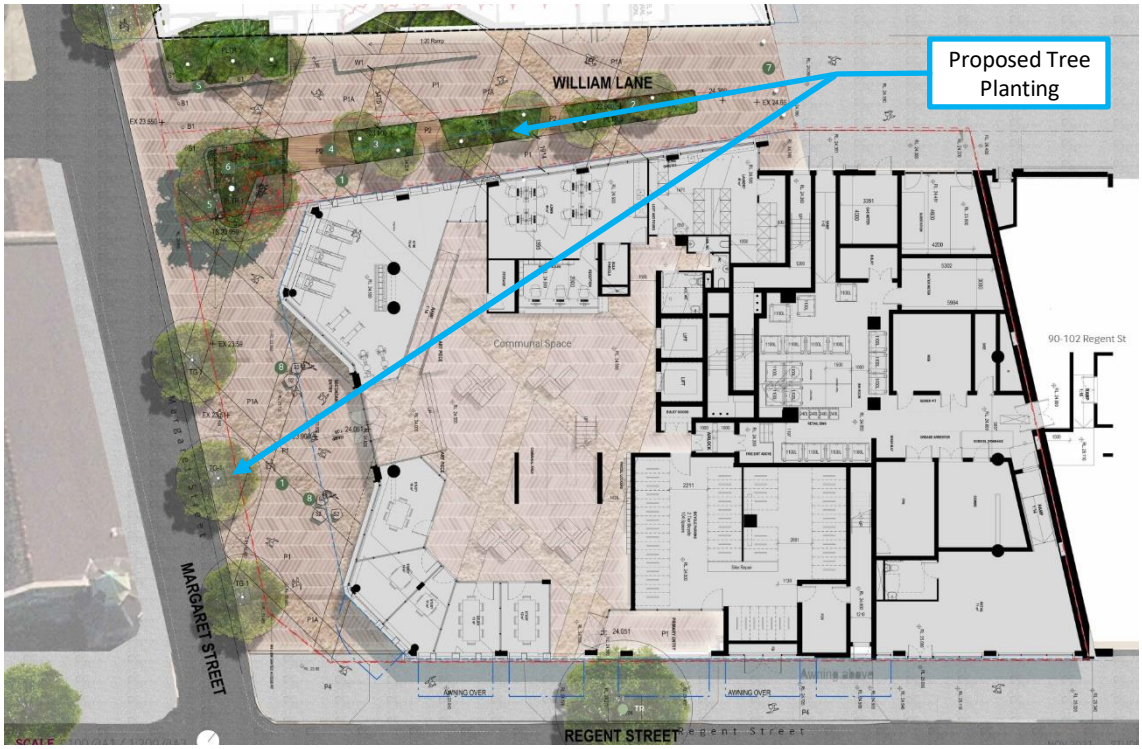
- Selected footpath areas along Margaret Street and along the western frontage of the development
- The outdoor open areas of Level 2 and Level 16 – Locations 21 to 24.

10.1 Existing and Planned Wind Amelioration

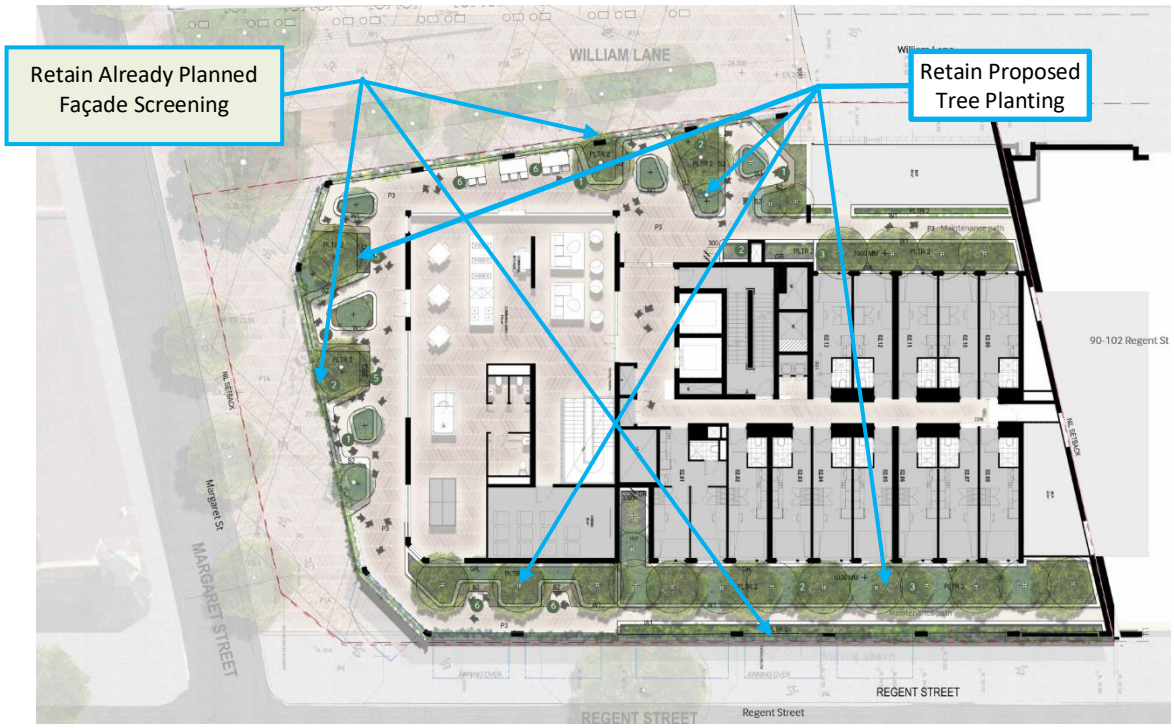
- Vegetation and trees along Regent Street, Margaret Street, and William Lane– refer **Figure 18**;
- Tree planting and landscaping planned for the Level 2 outdoor communal area– refer **Figure 18**;
- Tree planting and landscaping planned for the Level 16 outdoor communal area– refer **Figure 18**.

Figure 18 Project Proposed Landscape Plans Treatments

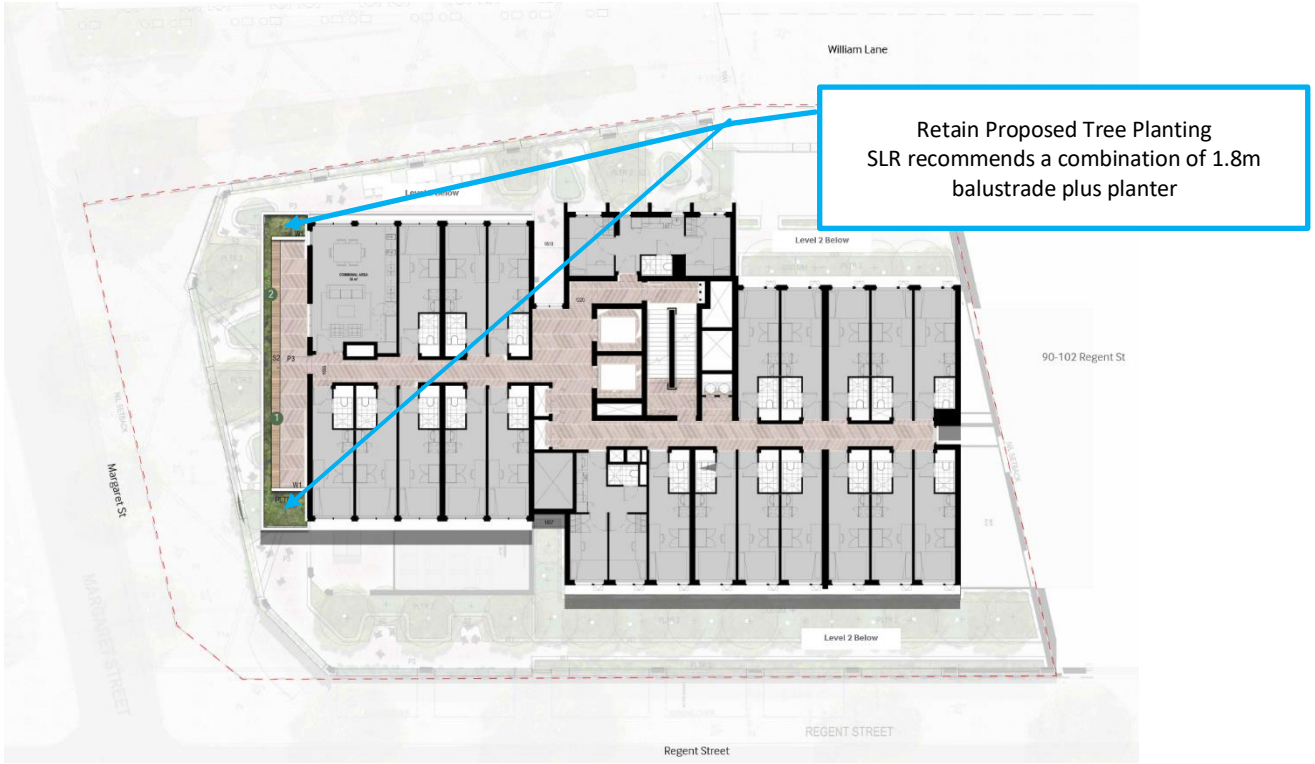
Level 1 (Ground) Landscape Plan



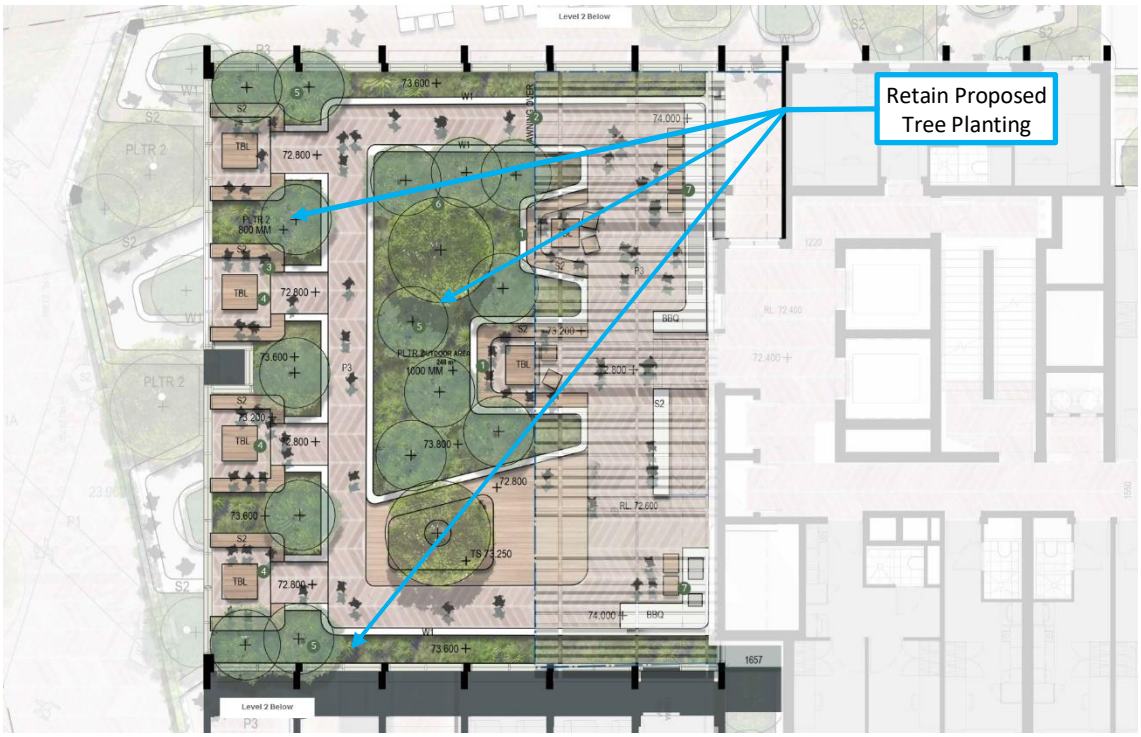
Level 2 Landscape Plan



Level 4 Landscape Plan



Level 16 Landscape Plan



10.2 Additional Wind Mitigation Recommendations

Pedestrian Areas Surrounding the Site

Current plans for the proposed development incorporate an awning along the development's eastern façade - refer **Figure 2**.

The wind tunnel testing showed that potentially high localised winds occur at selected ground level locations along Margaret Street.

We recommend retention of the existing awnings protecting ground level footpaths and all of the trees and landscaping, existing and planned.

- It is recommended that the proposed awning along the eastern façade to be continuous. Note that the awnings can be connected in a stepped manner if required to account for the change in ground elevations – refer **Figure 19.**
- It is recommended to include landscaping such as planter boxes in front of the primary entrance along Regent Street, with plants that are capable to grow up to a height of 2m, measured from the ground. Note that this mitigation treatment is only required if the existing tree along Regent Street is to be removed – refer **Figure 20.**
- It is also recommended that all "proposed" and/or "replacement" trees are evergreen and of similar foliage as the existing trees.

Figure 19 Level 1 (Ground) – Additional treatments

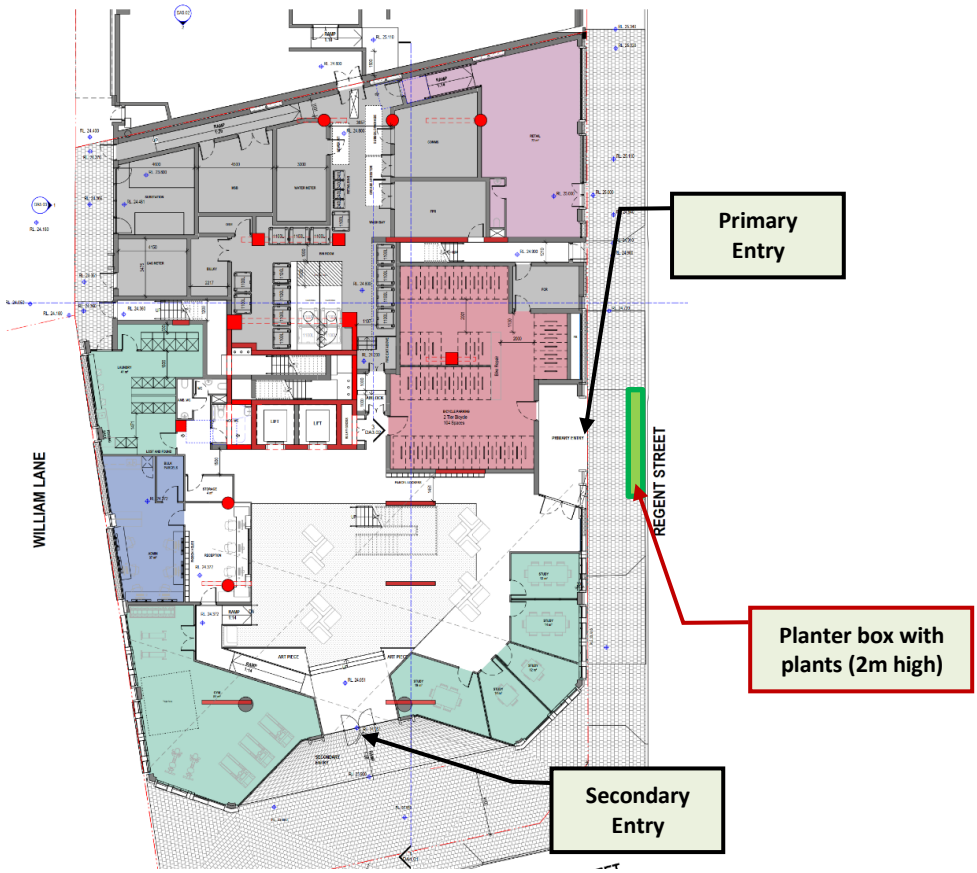


Figure 20 Level 2 – Additional treatments

Level 2, Level 4 and Level 16 outdoor areas

If areas were to be used for seating or for longer duration activities the 10 m/s sitting criterion should be satisfied. As a result, it is recommended to include some type of horizontal windbreak protection elements (eg pergola, shade-cloth, canopies, operable louvered pergola etc) in order to mitigate the strong winds.

The proposed tree planting on these outdoor areas would further mitigate adverse wind conditions in these areas and are expected to meet the 10 m/s sitting and dining comfort criterion along with the abovementioned recommended horizontal windbreak protection elements – refer **Figure 18**.

We recommend:

- Retention of the proposed vertical façade screening along the perimeter of the development (from level 2 slab up to level 4 slab) – refer **Figure 18**.
- Retention of the proposed tree planting on the Level 2 communal area – refer **Figure 18**.
- Retention of the proposed tree planting on the Level 4 outdoor area – refer **Figure 18**.
- Retention of the proposed tree planting on the Level 16 communal area – refer **Figure 18**.

It is recommended that:

- Proposed landscaping around the Level 2 communal areas to be evergreen – refer **Figure 18**.
- Horizontal protection (eg pergola, shade-cloth, canopies, operable louvered pergola, etc) to be added to protect podium areas intended to be used for longer duration activities such as sitting/outdoor dining.

11 ADDITIONAL TESTING – "FUTURE-C" SCENARIO

A final round of wind tunnel testing was carried out substituting the "Preferred" Design of the proposed development for the City of Sydney "Compliant" Design, 0° to 360°, all sensor locations – with the same additional ground level treatments as the "Future-P" scenario.

- This testing has been termed the … "Future-C" built scenario

The dimensionless polar plot ratios of ground level wind speed to reference height wind speed are shown in **Appendix D**.

Peak annual gust wind speeds are shown in **Table 4**, outlining the effectiveness on the Locations surrounding the immediate development site.

Discussion of Results – Ground Level (Locations 1-20)

- There were 11 locations where Future-Proposed peak annual gusts were the same as the Future-Compliant.
- There were 5 locations where Future-Proposed peak annual gusts were lower compared to the Futgure-Compliant.
- There were 4 locations where Future-Proposed peak annual gusts were higher than the Future-Compliant.

In relation to locations where predicted peak annual gusts exceed the 16 m/sec walking comfort criterion:

- There are three locations above 16 m/s for both the Future Compliant scenario.
- The wind conditions for the Future Compliant scenario at the worst-overall locations (6 and 7) are similar to the winds at these locations for the Preferred scenario. The wind speeds at location 6 and 7 are expected to be around 17.5 to 18m/s and 19.5 to 20m/s respectively.

Table 3 Predicted Peak Annual Gust Wind Speeds for Locations 1 to 20

Sensor No and Location Description (ref Fig.9)		FUTURE-P	FUTURE-C
1	William Lane – northwest of site	12.5	13.0
2	William Lane – northwest of site	15.0	16.5
3	William Lane – northwest corner of the development	14.5	15.5
4	In line with William Lane – west of site	13.0	13.5
5	William Lane – southwest corner of the development	14.0	13.5
6	Margaret Street – southwest of the development site	17.5	18.0
7	Margaret Street – southwest of the development site	20.0	19.5
8	Margaret Street – south of the development site	14.5	13.0
9	Margaret Street – south of the development site	13.0	11.5
10	Regent Street – west footpath, southeast of the development site	14.5	14.0
11	Regent Street – east footpath, east of site	13.0	13.5
12	Regent Street – west footpath, southeast corner of development	14.0	12.0
13	Regent Street – west footpath, along development eastern façade	12.0	12.0
14	Regent Street – east footpath, east of site	11.0	13.5
15	Regent Street – west footpath, along development eastern façade	10.5	11.5
16	Regent Street – east footpath, east of site	13.0	12.5
17	Regent Street – west footpath, northeast corner of the site	12.0	11.0
18	Regent Street – west footpath, northeast of the development site	14.0	14.5
19	Regent Street – east footpath, northeast of site	14.5	15.0
20	New Proposed Lane perpendicular to Gibbons St and William Lane	15.0	16.0

12 RESULTS SUMMARY

12.1 "Future-P" Scenario Testing

The "Future-P" scenario demonstrates that areas requiring consideration of windbreak treatment and which can be attributed to the impact of the proposed development, can successfully be addressed through a combination of:

- Vertical screening, especially ground level public access areas – including vertical screens, landscaping, etc;
- Awnings, canopies, shade cloths and pergolas (especially for internal development areas likely to be used for extended duration "sitting" type activities).

12.2 "Future-P" versus "Future-C" Design

On the basis of the test results at all ground level locaions it has been concluded that

- On average, the "Future-Preferred" Design performs comparably, wind-wise, to the "Future-Compliant" Design; and
- Taking into account the number of predicted wind speed increases and decreases, and their magnitude, the "Future-Preferred" Design overall performs the same as the "Future-Compliant" Design.

Taking into account all of the above, it is believed that the proposed development
will comply with the adopted wind acceptability criteria
at all pedestrian and public access locations within and around the development.

13 CLOSURE

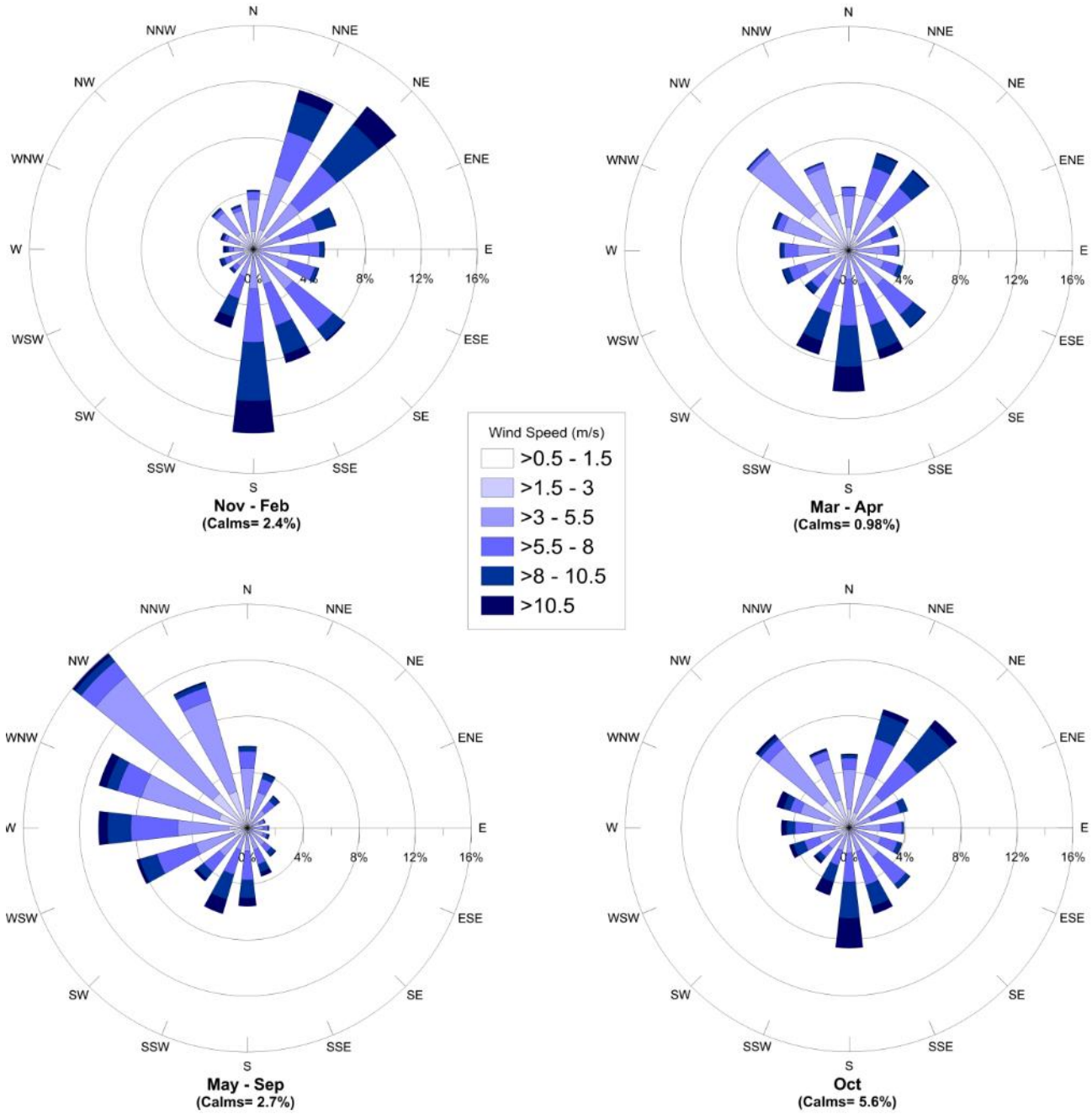
This report has been prepared by SLR Consulting Australia Pty Ltd with all reasonable skill, care and diligence, and taking account of the manpower and resources devoted to it by agreement with the client. Information reported herein is based on the interpretation of data collected and has been accepted in good faith as being accurate and valid.

This report is for the exclusive use of The Trust Company (Australia) Limited ATF WH Redfern Trust. No warranties or guarantees are expressed or should be inferred by any third parties. This report may not be relied upon by other parties without written consent from SLR Consulting.

APPENDIX A

Seasonal Wind Roses for Bureau of Meteorology Met Stations at Sydney (Kingsford Smith) Airport and Bankstown Airport

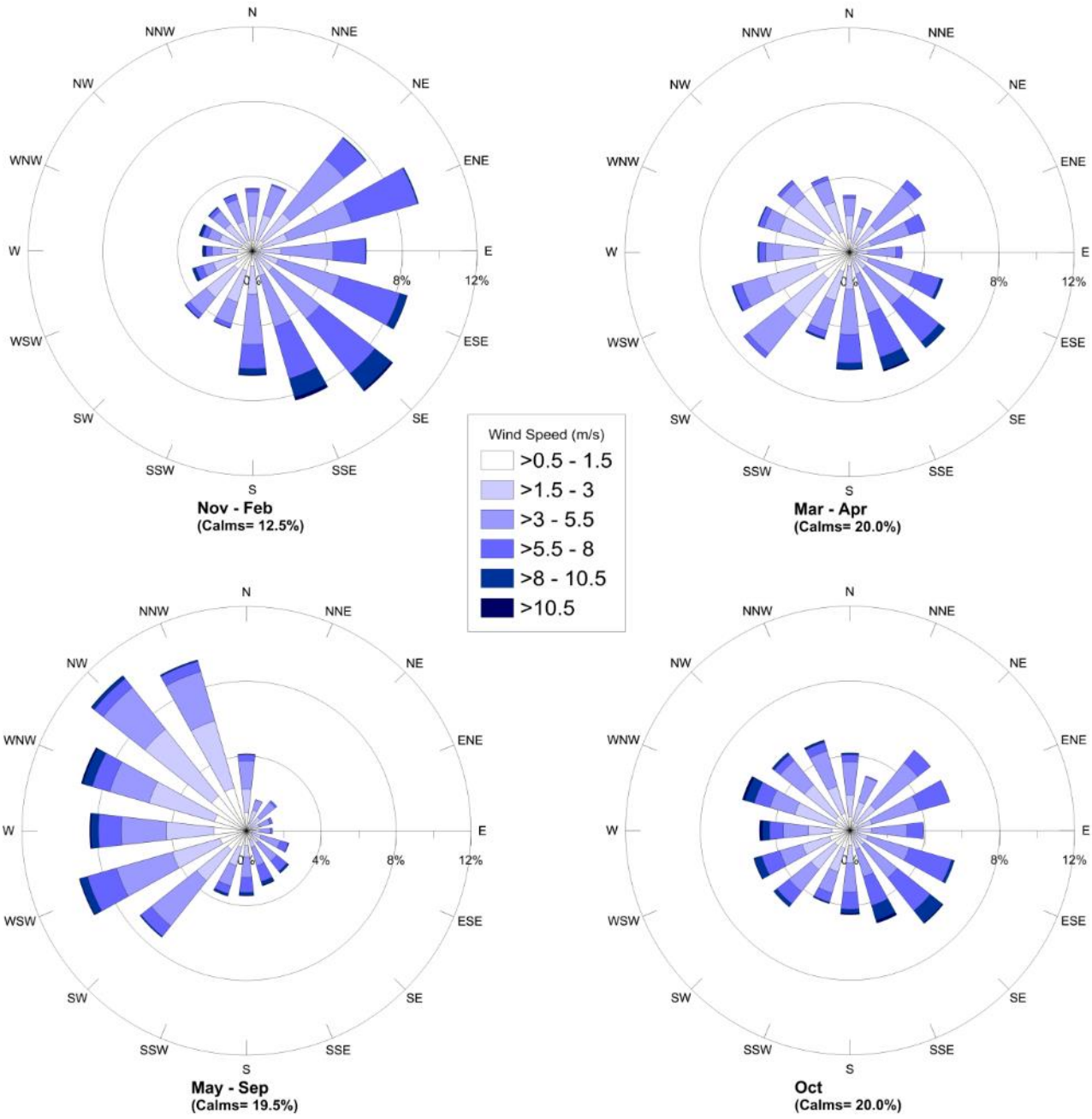
Sydney Airport AWS
(Observations)
1999-2017
600.09300



APPENDIX A

Seasonal Wind Roses for Bureau of Meteorology Met Stations at Sydney (Kingsford Smith) Airport and Bankstown Airport

Bankstown Airport AWS
(Observations)
1999-2017
600.09300

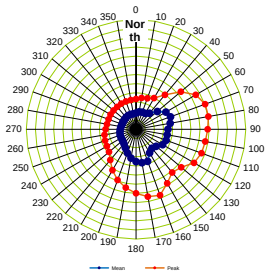


APPENDIX B

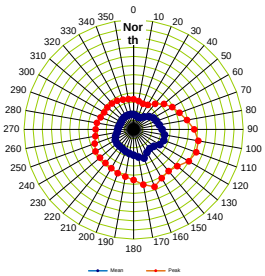
Wind Tunnel Test Results: BASELINE Scenario

Polar Plots: Ratio of Ground Level Wind Speed to Reference Wind Speed

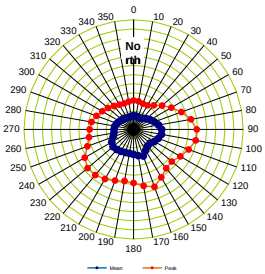
LOCATION 1



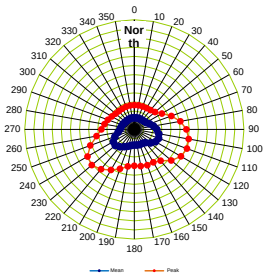
LOCATION 2



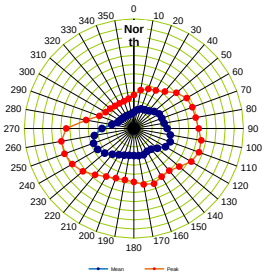
LOCATION 3



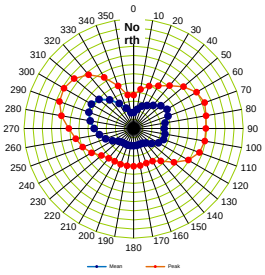
LOCATION 4



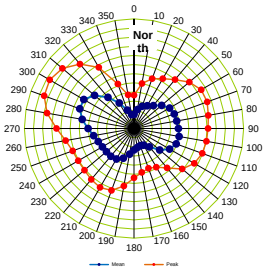
LOCATION 5



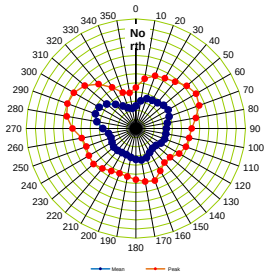
LOCATION 6



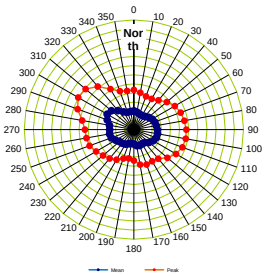
LOCATION 7



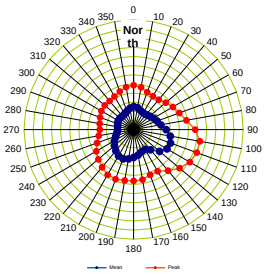
LOCATION 8



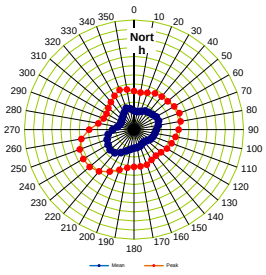
LOCATION 9



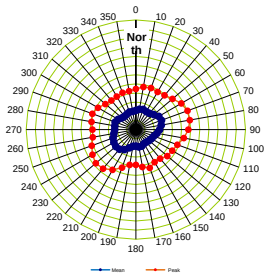
LOCATION 10



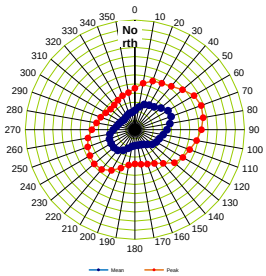
LOCATION 11



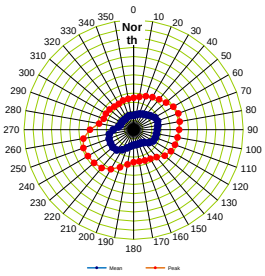
LOCATION 12



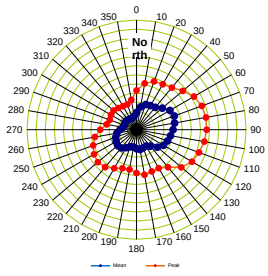
LOCATION 13



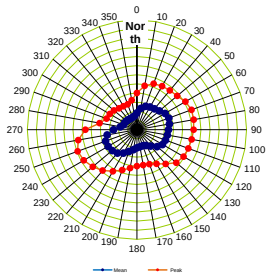
LOCATION 14



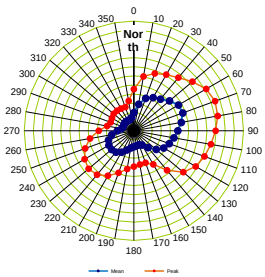
LOCATION 15



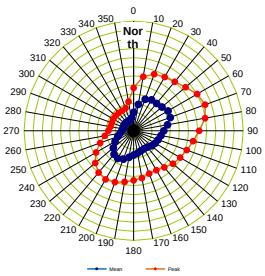
LOCATION 16



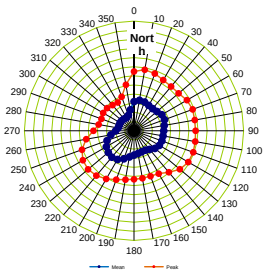
LOCATION 17



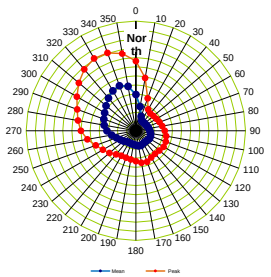
LOCATION 18



LOCATION 19



LOCATION 20

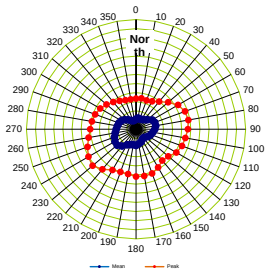


APPENDIX C

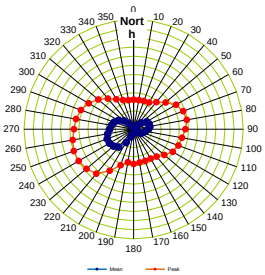
Wind Tunnel Test Results: "FUTURE-P" Scenario

Polar Plots: Ratio of Ground Level Wind Speed to Reference Wind Speed

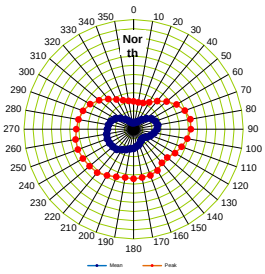
LOCATION 1



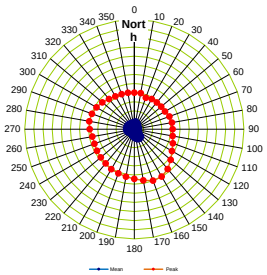
LOCATION 2



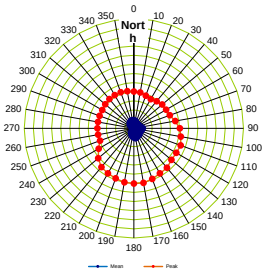
LOCATION 3



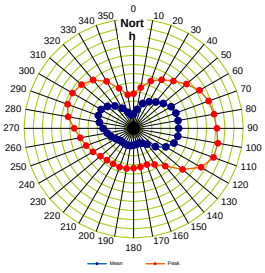
LOCATION 4



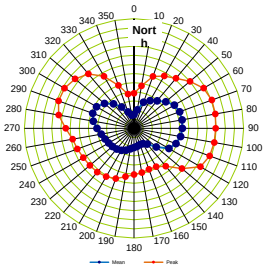
LOCATION 5



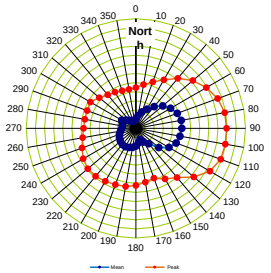
LOCATION 6



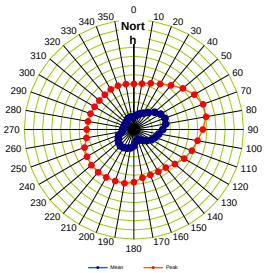
LOCATION 7



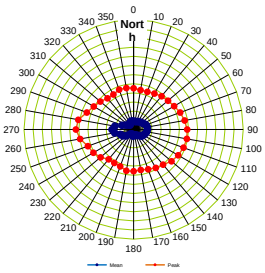
LOCATION 8



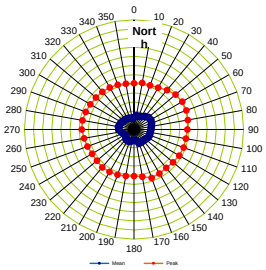
LOCATION 9



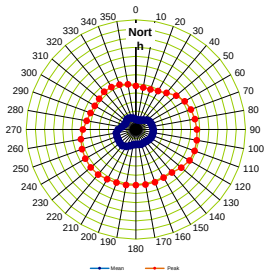
LOCATION 10



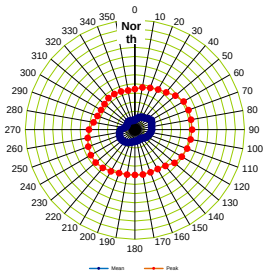
LOCATION 11



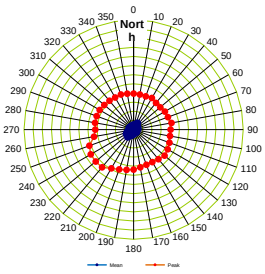
LOCATION 12



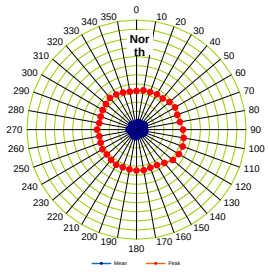
LOCATION 13



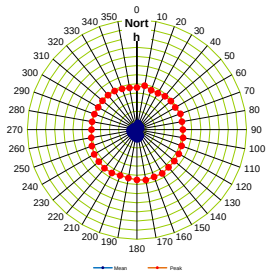
LOCATION 14



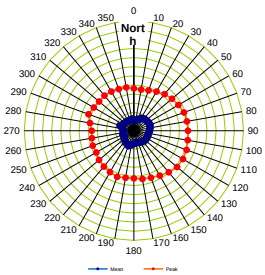
LOCATION 15



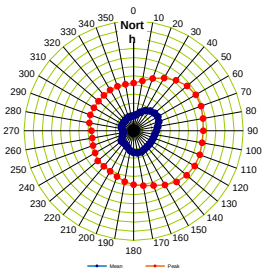
LOCATION 16



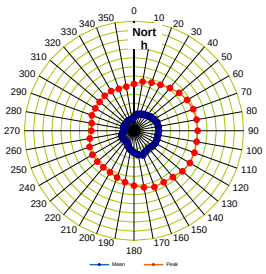
LOCATION 17



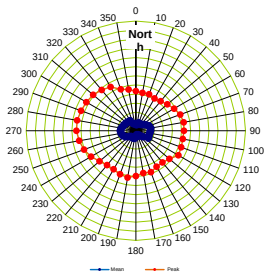
LOCATION 18



LOCATION 19



LOCATION 20

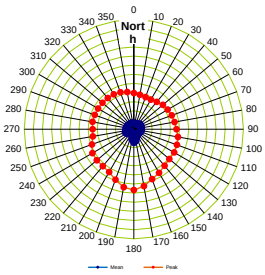


APPENDIX C

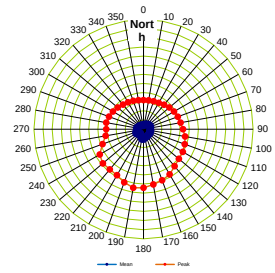
Wind Tunnel Test Results: "FUTURE-P" Scenario

Polar Plots: Ratio of Ground Level Wind Speed to Reference Wind Speed

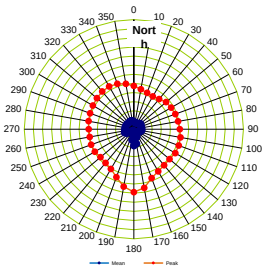
LOCATION 21



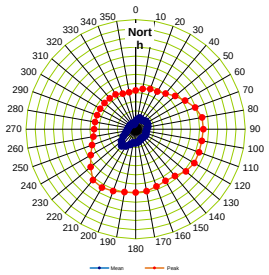
LOCATION 22



LOCATION 23



LOCATION 24

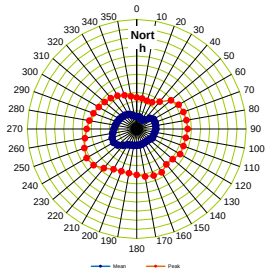


APPENDIX D

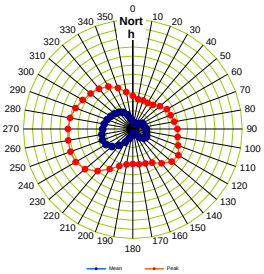
Wind Tunnel Test Results: "FUTURE-C" Scenario

Polar Plots: Ratio of Ground Level Wind Speed to Reference Wind Speed

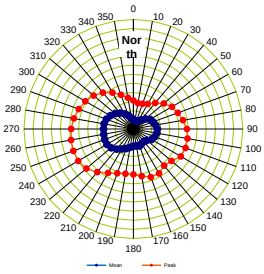
LOCATION 1



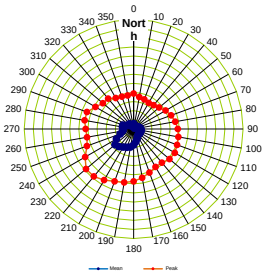
LOCATION 2



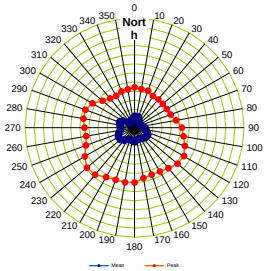
LOCATION 3



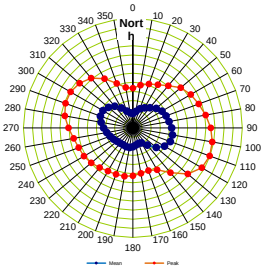
LOCATION 4



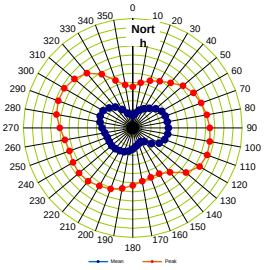
LOCATION 5



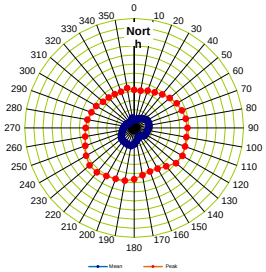
LOCATION 6



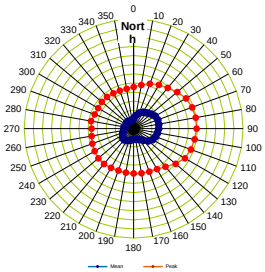
LOCATION 7



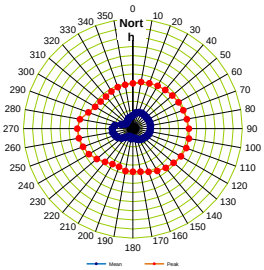
LOCATION 8



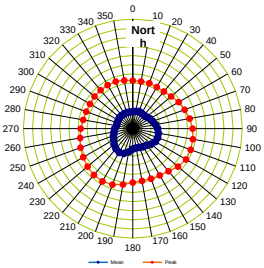
LOCATION 9



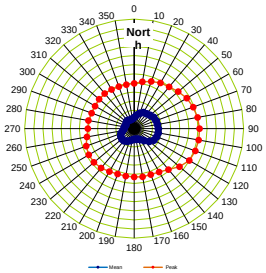
LOCATION 10



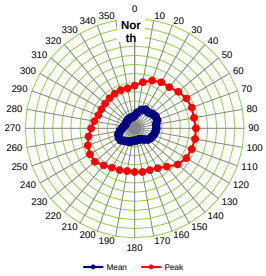
LOCATION 11



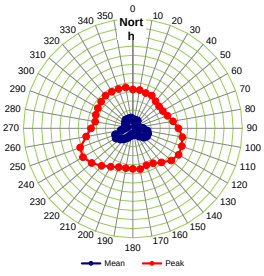
LOCATION 12



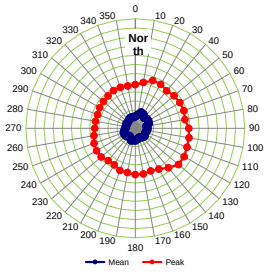
LOCATION 13



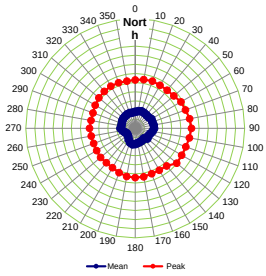
LOCATION 14



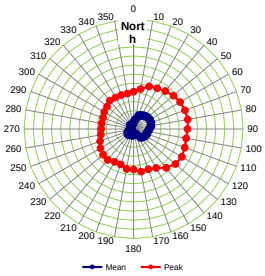
LOCATION 15



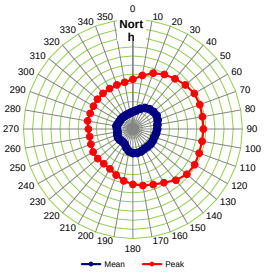
LOCATION 16



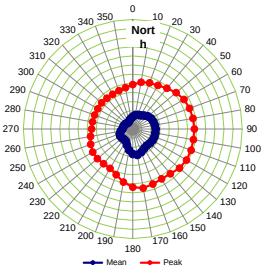
LOCATION 17



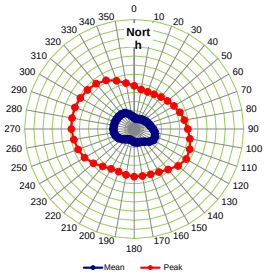
LOCATION 18



LOCATION 19



LOCATION 20



ASIA PACIFIC OFFICES

BRISBANE
Level 2, 15 Astor Terrace
Spring Hill QLD 4000
Australia
T: +61 7 3858 4800
F: +61 7 3858 4801

CANBERRA
GPO 410
Canberra ACT 2600
Australia
T: +61 2 6287 0800
F: +61 2 9427 8200

DARWIN
5 Foelsche Street
Darwin NT 0800
Australia
T: +61 8 8998 0100
F: +61 2 9427 8200

GOLD COAST
Ground Floor, 194 Varsity Parade
Varsity Lakes QLD 4227
Australia
M: +61 438 763 516

MACKAY
21 River Street
Mackay QLD 4740
Australia
T: +61 7 3181 3300

MELBOURNE
Suite 2, 2 Domville Avenue
Hawthorn VIC 3122
Australia
T: +61 3 9249 9400
F: +61 3 9249 9499

NEWCASTLE
10 Kings Road
New Lambton NSW 2305
Australia
T: +61 2 4037 3200
F: +61 2 4037 3201

PERTH
Ground Floor, 503 Murray Street
Perth WA 6000
Australia
T: +61 8 9422 5900
F: +61 8 9422 5901

ROCKHAMPTON
rockhampton@slrconsulting.com
M: +61 407 810 417

SYDNEY
2 Lincoln Street
Lane Cove NSW 2066
Australia
T: +61 2 9427 8100
F: +61 2 9427 8200

TAMWORTH
PO Box 11034
Tamworth NSW 2340
Australia
M: +61 408 474 248
F: +61 2 9427 8200

TOWNSVILLE
Level 1, 514 Sturt Street
Townsville QLD 4810
Australia
T: +61 7 4722 8000
F: +61 7 4722 8001

AUCKLAND
68 Beach Road
Auckland 1010
New Zealand
T: +64 27 441 7849

NELSON
5 Duncan Street
Port Nelson 7010
New Zealand
T: +64 274 898 628

NEW PLYMOUTH
Level 2, 10 Devon Street East
New Plymouth 4310
New Zealand
T: +64 0800 757 695