



PEDESTRIAN WIND ENVIRONMENT STATEMENT  
161 SUSSEX STREET REDEVELOPMENT, SYDNEY

WB327-02F01(REV0)- WS REPORT  
20 FEBRUARY 2013

Prepared for:

GL Investment Management Pty Ltd

Suite 2.02B, 350 George Street  
Sydney, NSW 2000

Attention: Ms Jenny Watt

## DOCUMENT CONTROL

Date	Revision History	Non-Issued Revision	Issued Revision	Prepared By (initials)	Instructed By (initials)	Reviewed & Authorised by (initials)
20/02/2013	Updated from the previous report (report reference WB327-01F03(rev4), dated 30/05/2012) due to the latest architectural design.	-	0	AB	TR	TR

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## EXECUTIVE SUMMARY

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This report is in relation to the proposed 161 Sussex Street redevelopment, Sydney, and presents an opinion on the likely impact of the proposed design on the wind environment in the critical outdoor areas within and around the subject redevelopment. The redevelopment is located within the Darling Harbour precinct and has been identified as a State Significant Development. The effect of wind activity is examined for the three predominant wind directions for the Sydney region; north-easterly, southerly and westerly winds. The analysis of the wind effects relating to the proposal was carried out in the context of the local wind climate, building morphology and land topography.

The conclusions of this report are drawn from our extensive experience in this field and are based on an examination of the architectural drawings which have been prepared by the project architect Cox Richardson, received on February 15, 2013. No wind tunnel tests have been undertaken for the subject redevelopment. As such, this report addresses only the general wind effects and any localised effects that are identifiable by visual inspection. Any recommendations in this report are made only in-principle and are based on our extensive experience in the study of wind environment effects around buildings.

This assessment has been undertaken with consideration of the Director General's Environmental Assessment Requirements, Schedule 2, Key Issue 5 Ecologically Sustainable Development (ESD).

The proposed redevelopment includes the addition of a tower which extends from the southern aspect of the existing hotel building, and an extension of the podium component of the hotel which is to extend over the Western Distributor roadway. Some parts of the eastern aspect façade of the existing podium will also be redeveloped, and will include the addition of some glass awnings. This report investigates the expected wind impact as a result of the proposed redevelopment.

The results of this study indicate that the trafficable areas within and around redevelopment site are quite well shielded from the prevailing winds. There are only very few areas accessible to pedestrians in the immediate vicinity of the subject redevelopment, and any changes to the wind conditions for those areas is expected to be negligible with the inclusion of the proposed redevelopment. There may be increased wind velocities at higher altitudes within the immediate vicinity around the tower (ie: above Market Street due to the effect of the westerly winds) due to the "canyon" effect of the wind travelling between the various towers of the city, however this is typical of any tower in a dense urban environment and it should be noted that, within the immediate vicinity of this particular redevelopment, no adverse effects will be observed since there are no trafficable areas on any of the nearby towers at that height. Hence wind conditions within the accessible surrounding areas are expected to remain suitable for pedestrian activity.

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# 1 WIND CLIMATE OF THE SYDNEY REGION

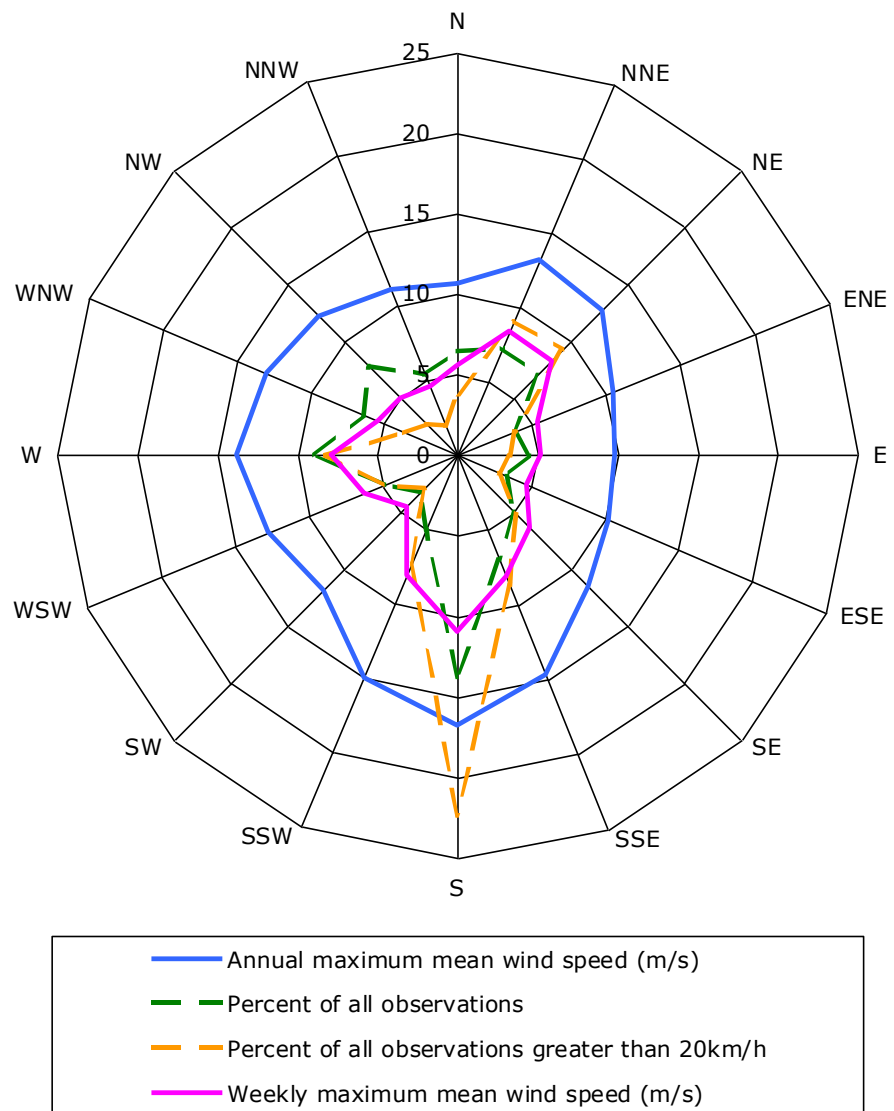
The Sydney region is governed by three principle wind directions, and these can potentially affect the subject redevelopment. These winds prevail from the north-east, south and west. A summary of the principal time of occurrence of these winds throughout the year is presented in Table 1 below. This summary is based on an analysis of wind rose data obtained by the Bureau of Meteorology from Kingsford Smith Airport between 1939 and 2000. The wind roses are attached in the appendix of this report.

**Table 1: Principle Time of Occurrence of Winds for Sydney**

Month(s)	Prevailing Wind Direction		
	North-Easterly	Southerly	Westerly
January	X	X	
February	X	X	
March	X	X	
April		X	X
May			X
June			X
July			X
August			X
September		X	X
October	X	X	
November	X	X	
December	X	X	

A directional plot of the annual and weekly recurrence winds for the Sydney region is shown in Figure 1 below. The frequency of occurrence of these winds is also shown in Figure 1. This plot has been produced based on an analysis of recorded wind speed data obtained from Sydney Airport from 1939 to 2008.

As shown in Figure 1 of this report, the southerly winds are by far the most frequent wind for the Sydney region, and are also the strongest. The westerly winds occur most frequently during the winter season for the Sydney region, and although they are typically not as strong as the southerly winds, they are usually a cold wind since they occur during the winter and hence can be a cause for discomfort for outdoor areas. North-easterly winds occur most frequently during the warmer months of the year for the Sydney region, and hence are usually welcomed within outdoor areas. North-easterly winds are also typically not as strong as the southerly or westerly winds.



**Figure 1: Annual and Weekly Recurrence Mean Wind Speeds, and Frequencies of Occurrence, for the Sydney Region (based on 10 minute mean observations from Kingsford Smith Airport from 1939 to 2008, corrected to open terrain at 10m)**

## 2 WIND EFFECTS ON PEOPLE

The acceptability of wind in any area is dependent upon its use. For example, people walking or window-shopping will tolerate higher wind speeds than those seated at an outdoor restaurant.

The following table, developed by Penwarden (1975), describes the effects of various wind intensities on people. Note that the applicability column relates to the indicated wind conditions occurring frequently (exceeded approximately once per week on average). Higher ranges of wind speeds can be tolerated for rarer events.

**Table 2: Summary of Wind Effects on People (after Penwarden, 1975)**

Type of Winds	Gust Speed (m/s)	Effects	Applicability
Calm, light air	0 - 1.5	Calm, no noticeable wind.	Generally acceptable for Stationary, long exposure activities such as in outdoor restaurants, landscaped gardens and open air theatres.
Light breeze	1.6 - 3.3	Wind felt on face.	
Gentle breeze	3.4 - 5.4	Hair is disturbed, Clothing flaps.	
Moderate breeze	5.5 - 7.9	Raises dust, dry soil and loose paper. Hair disarranged.	Generally acceptable for walking & stationary, short exposure activities such as window shopping, standing or sitting in plazas.
Fresh breeze	8.0 - 10.7	Force of wind felt on body.	Acceptable as a main pedestrian thoroughfare
Strong breeze	10.8 - 13.8	Umbrellas used with difficulty, Hair blown straight, Difficult to walk steadily, Wind noise on ears unpleasant.	Acceptable for areas where there is little pedestrian activity or for fast walking.
Near gale	13.9 - 17.1	Inconvenience felt when walking.	Unacceptable as a public accessway.
Gale	17.2 - 20.7	Generally impedes progress, Great difficulty with balance.	
Strong gale	20.8 - 24.4	People blown over by gusts.	

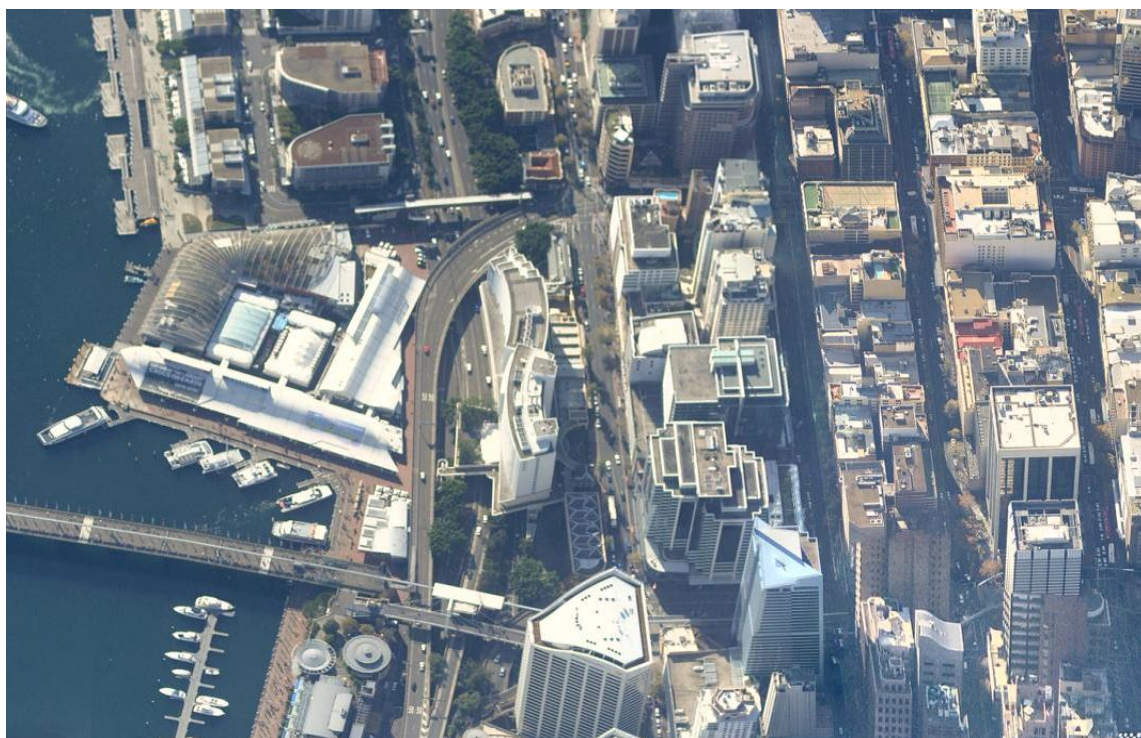
### 3 DESCRIPTION OF THE PROPOSED REDEVELOPMENT AND SURROUNDS

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The proposed redevelopment includes the addition of a tower which extends from the southern aspect of the existing hotel building, and an extension of the podium component of the hotel which is to extend over the Western Distributor roadway. Some parts of the eastern aspect façade of the existing podium will also be redeveloped, and will include the addition of some glass awnings.

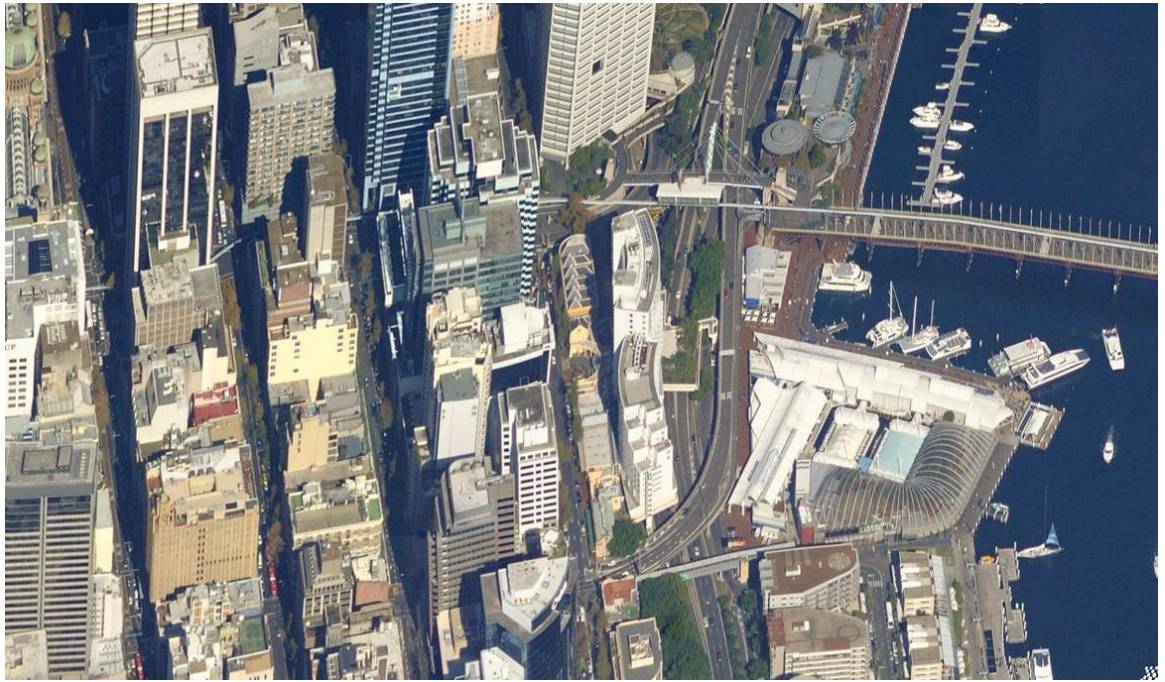
The podium extension over the Western Distributor extends from the existing terrace slab which covers part of the Western Distributor, and will include function and meeting rooms. A metal roof is proposed for the podium extension, and it will feature a series of small pitched roofs aligned perpendicular to the overall orientation of the site. The proposed new tower will be approximately 30m taller than the main bulk of the existing southern wing of the existing hotel building. The façade of the tower and the podium extension over the Western Distributor are to be mostly covered by small vertical louvres, positioned perpendicular or slightly angled to the face of the redevelopment.

The topography varies across the site since the landform falls away towards Darling Harbour. The Sussex Street ground level is approximately one storey higher than the Western Distributor ground level. To the east of the site, the landform continues to rise until George Street, where it generally levels off. An aerial perspective of the existing site area is shown in Figures 2a and 2b, and a marked-up site plan of the redevelopment is shown in Figure 3.



**Figure 2a: Aerial Perspective of the Existing Site  
(view from the south, facing north)**



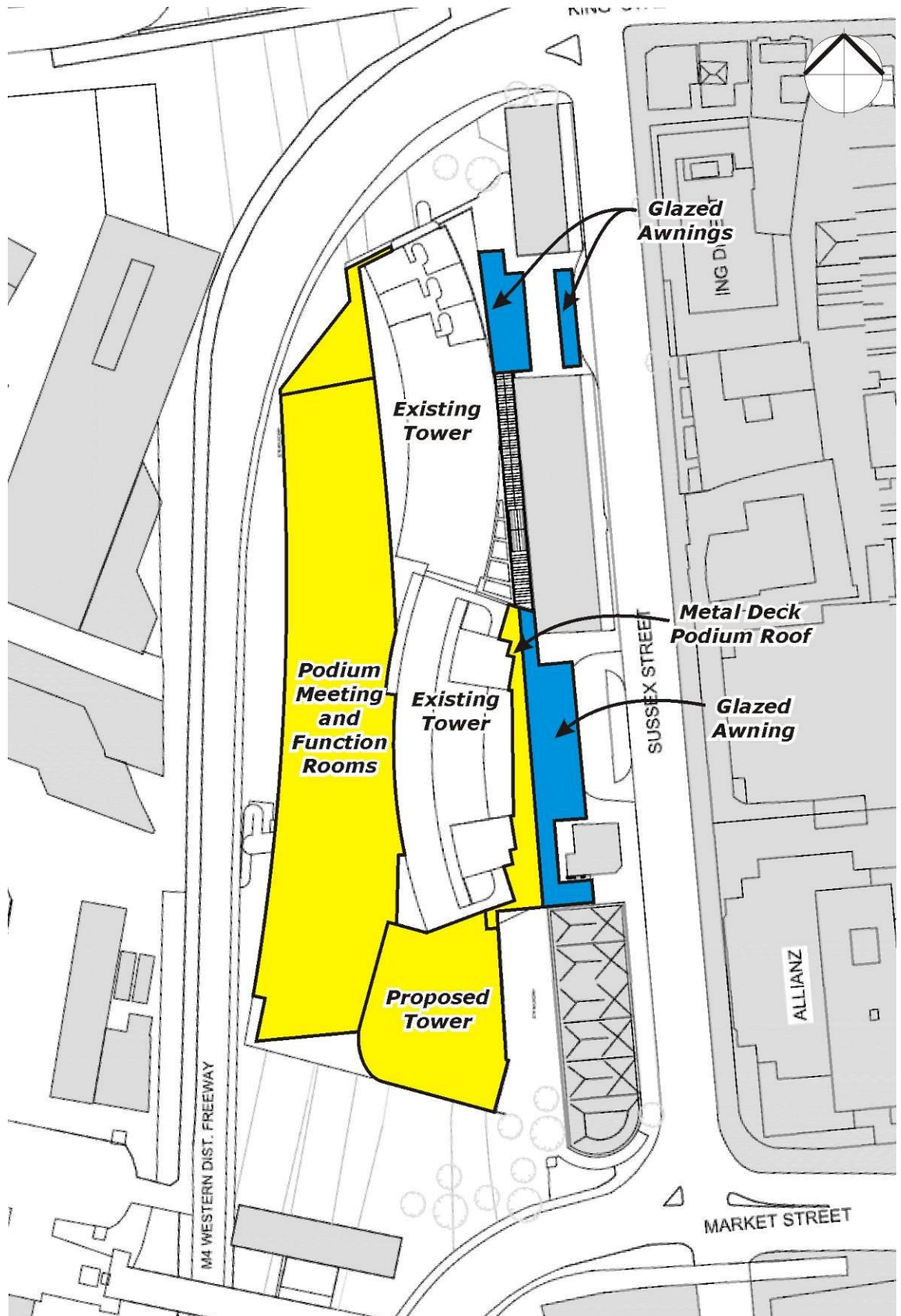


**Figure 2b: Aerial Perspective of the Existing Site  
(view from the north, facing south)**

The outdoor areas trafficable by pedestrians within and around the redevelopment site are rather limited, since the Western Distributor is not accessible by pedestrians, and there are no outdoor terraces or balcony areas associated with the redevelopment. Furthermore, the existing open-air pedestrian bridge from Sussex Street over the Western Distributor will be enclosed as part of the podium extension of the redevelopment, and although it will continue to be a pedestrian thoroughfare through the site, it will not be exposed to the prevailing winds.

The trafficable outdoor areas within and around the redevelopment, which are the focus for the assessment of pedestrian wind conditions for this study, are summarised as follows:

- The northern ground level entrance into the hotel from Sussex Street.
- The southern ground level entrance into the hotel from Sussex Street, and porte cochere area.
- Pedestrian footpaths around the perimeter of the site, along Market Street, Sussex Street and King Street.
- Pedestrian stairway on the western aspect of the podium extension.
- The terrace area located atop the podium extension.



**Figure 3: Site Plan**

## 4 RESULTS AND DISCUSSION

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The expected wind conditions for the various outdoor areas within and around the subject redevelopment are discussed in this section of the report with respect to each of the three predominant wind directions for the Sydney region. The interaction between the prevailing wind and the building morphology in the area was considered, and important features taken into account include the distances between the proposed building form, their overall heights and bulk, as well as the landform. Note that only the potentially critical wind effects are discussed in this report.

The outdoor trafficable areas within and around the subject redevelopment are shielded from the prevailing north-easterly and southerly winds by the many other nearby buildings of the Sydney CBD. The pedestrian footpaths at the King Street and Market Street ends of Sussex Street are somewhat exposed to the prevailing south-westerly to westerly winds. However, this is an existing condition and the proposed redevelopment is expected to have a negligible impact onto those areas with regards to pedestrian wind amenity, while possibly transferring the sidestream effect slightly south at the Market Street end. The pedestrian footpath along Sussex Street is also currently affected by a canyon effect generated by the southerly winds due to the alignment of Sussex Street with respect to the southerly winds. The proposed redevelopment is expected to have a negligible effect on the wind conditions along the Sussex Street pedestrian footpaths. Furthermore, the redevelopment is set-back from Sussex Street, and the pedestrian entrances from Sussex Street into the redevelopment are shielded from all prevailing winds.

Wind conditions at the commercial foyer entrance is expected to benefit from shielding from the downstream buildings, as well as the existing and proposed densely foliating tree planting.

The wind conditions under the podium section of the redevelopment along Slip Street are expected to be similar to the existing due to the locations of the openings to this area and shielding provided by the redevelopment and surrounding buildings.

There may be increased wind velocities at higher altitudes within the immediate vicinity around the tower (ie: above Market Street due to the effect of the westerly winds) due to the "canyon" effect of the wind travelling between the various towers of the city, however this is typical of any tower in a dense urban environment and it should be noted that, within the immediate vicinity of this particular redevelopment, no adverse effects will be observed since there are no trafficable areas on any of the nearby towers at that height.

Hence the proposed redevelopment is expected to a negligible impact onto the wind conditions for the local surrounding area, and wind conditions are expected to remain suitable for pedestrian activity.

## 5 CONCLUSION

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An analysis of the wind environment impact with respect to the three principal wind directions for the Sydney region has been undertaken for the proposed 161 Sussex Street redevelopment. The conclusions of this report are drawn from our extensive experience in this field and are based on an examination of the architectural drawings by Cox Richardson, received on February 15, 2013. No wind tunnel tests have been undertaken for the subject redevelopment. As such, this report addresses only the general wind effects and any localised effects that are identifiable by visual inspection. Any recommendations in this report are made only in-principle and are based on our extensive experience in the study of wind environment effects.

This assessment has been undertaken with consideration of the Director General's Environmental Assessment Requirements, Schedule 2, Key Issue 5 Ecologically Sustainable Development (ESD).

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The results of this study indicate that the trafficable areas within and around redevelopment site are quite well shielded from the prevailing winds. There are only very few areas accessible to pedestrians in the immediate vicinity of the subject redevelopment, and any changes to the wind conditions for those areas is expected to be negligible with the inclusion of the proposed redevelopment.

Wind conditions on the proposed terrace area located atop the podium extension are expected to be suitable for the intended use of the area due to the effective placement of the planter box and solid balustrade along the front edge of that area.

There may be increased wind velocities at higher altitudes within the immediate vicinity around the tower (ie: above Market Street due to the effect of the westerly winds) due to the "canyon" effect of the wind travelling between the various towers of the city, however this is typical of any tower in a dense urban environment and it should be noted that, within the immediate vicinity of this particular redevelopment, no adverse effects will be observed since there are no trafficable areas on any of the nearby towers at that height.

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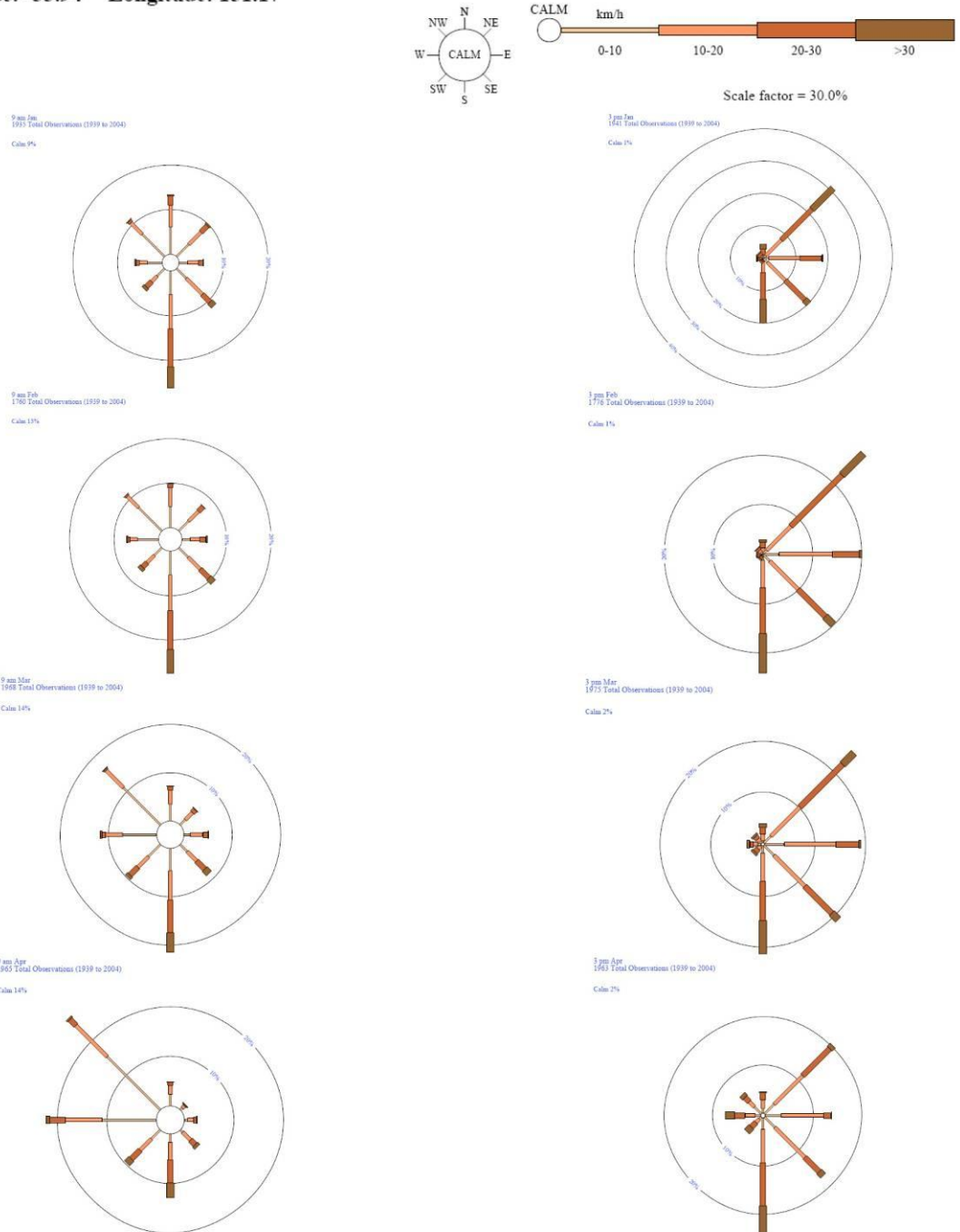


## APPENDIX A - WIND ROSES FOR THE SYDNEY REGION

### WIND FREQUENCY ANALYSIS (in km/h)

SYDNEY AIRPORT AMO STATION NUMBER 066037

Latitude: -33.94 ° Longitude: 151.17 °



Wind directions are divided into eight compass directions. Calm has no direction.

An asterisk (\*) indicates that calm is less than 1%.

An observed wind speed which falls precisely on the boundary between two divisions (eg 10km/h) will be included in the lower range (eg 1-10 km/h). Only quality controlled data have been used.



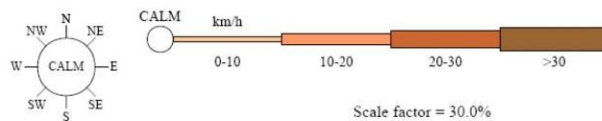
Australian Government  
Bureau of Meteorology

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# WIND FREQUENCY ANALYSIS (in km/h)

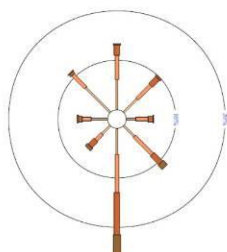
SYDNEY AIRPORT AMO STATION NUMBER 066037

Latitude: -33.94 ° Longitude: 151.17 °



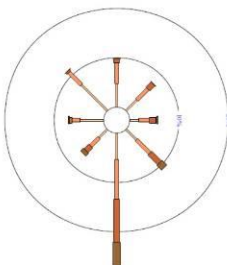
9 am Jan  
1925 Total Observations (1939 to 2004)

Calm 3%



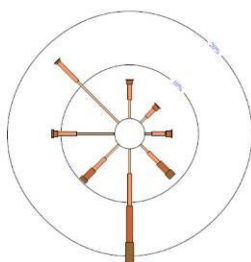
9 am Feb  
1780 Total Observations (1939 to 2004)

Calm 1%



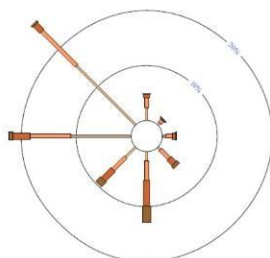
9 am Mar  
1963 Total Observations (1939 to 2004)

Calm 14%



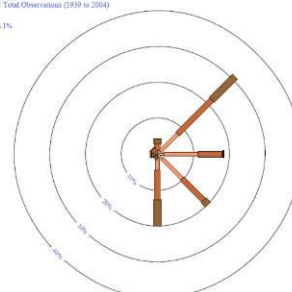
9 am Apr  
1963 Total Observations (1939 to 2004)

Calm 14%



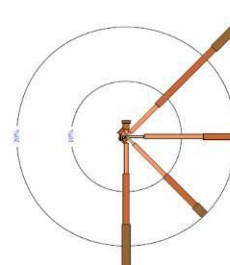
3 pm Jan  
1941 Total Observations (1939 to 2004)

Calm 1%



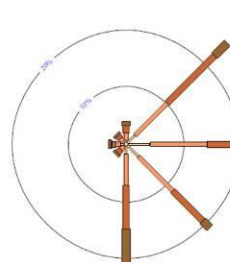
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1776 Total Observations (1939 to 2004)

Calm 1%



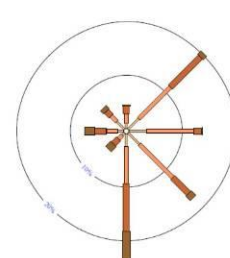
3 pm Mar  
1973 Total Observations (1939 to 2004)

Calm 2%



3 pm Apr  
1963 Total Observations (1939 to 2004)

Calm 2%



Wind directions are divided into eight compass directions. Calm has no direction.

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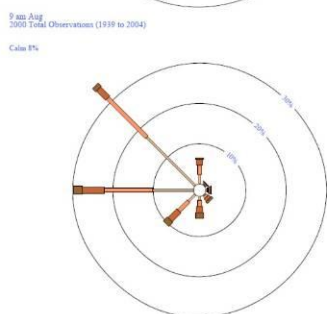
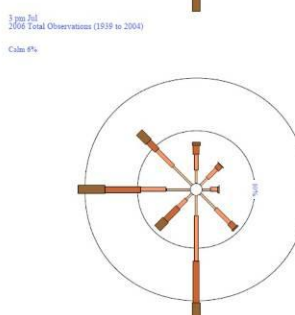
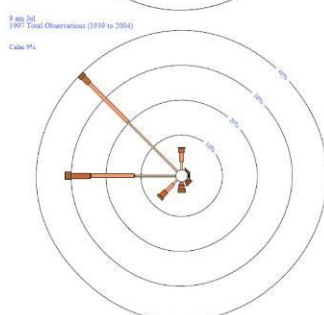
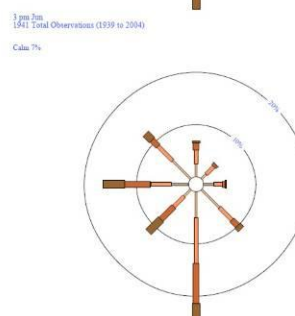
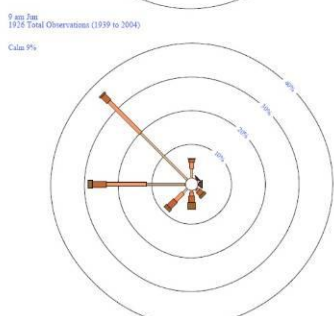
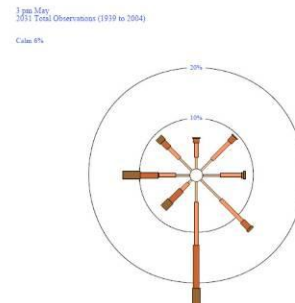
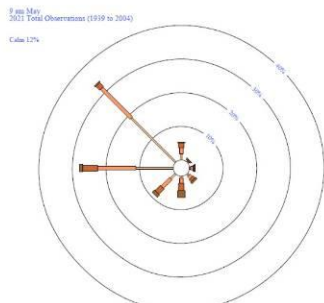
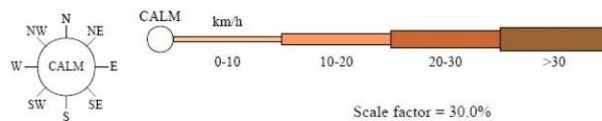
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**SYDNEY AIRPORT AMO STATION NUMBER 066037**  
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