Wind Environment Statement

for the proposed development known as

Darling Walk, Darling Harbour

April 2, 2008

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1.0 Introduction

This report is prepared in relation to the proposed development known as Darling Walk, Darling Harbour. This report presents an opinion on the likely impact of proposed design on the wind environment within and around the site.

The effect of wind activity within and around the site of the proposal is examined for the three predominant wind directions for Sydney, i.e. north-east, south and west. 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 prepared by Francis-Jones Morehen Thorp Architects, dated January 2008. No wind tunnel tests have been undertaken for the subject development. 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.

2.0 Local Wind Climate

Three principal wind directions potentially affect the development. These winds prevail from the north-east, south and west, Table 1 is a summary of the principal time of occurrence of these winds. This summary is based on data obtained by the Bureau of Meteorology from Sydney Airport, between 1939 and 1992. Table 1 presents a summary of the principal time of occurrence of these winds.

Table 1: Principal Time of Occurrence of Winds – Sydney Region

Month	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	

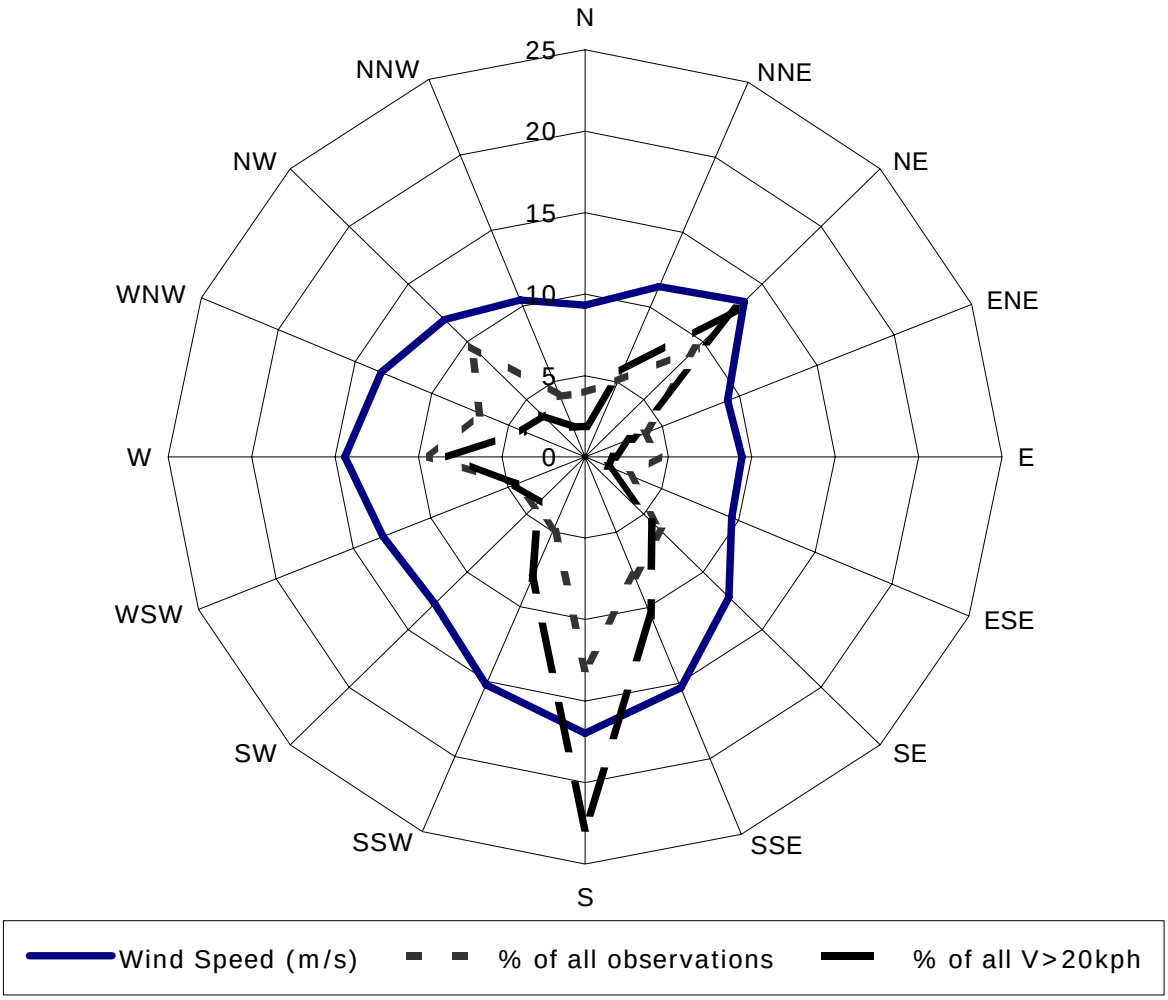


Figure 1: Basic Mean Wind Speed Data for Sydney, 1932-1992 (in metres per second, based on 3 hourly mean wind speeds, at 10m height at Kingsford Smith Airport)

3.0 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), is a modified version of the Beaufort Scale, and describes the effects of various wind intensities on people. Note that the applicability column related to 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	Beaufort Number	Gust Speed (m/s)	Effects	Applicability
Calm, light air	1	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	2	1.6 - 3.3	Wind felt on face	
Gentle breeze	3	3.4 - 5.4	Hair is disturbed, Clothing flaps	
Moderate breeze	4	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	5	8.0 - 10.7	Force of wind felt on body	Acceptable as a main pedestrian thoroughfare
Strong breeze	6	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	7	13.9 - 17.1	Inconvenience felt when walking.	
Gale	8	17.2 -20.7	Generally impedes progress, Great difficulty with balance.	Unacceptable as a public accessway.
Strong gale	9	20.8 - 24.4	People blown over by gusts.	Completely unacceptable.

4.0 Description of the Proposal

The development consists of a north and south building (named Building 1 and Building 2 respectively, see Figure 2 below), both with a height of approximately 40m above ground level. It is proposed that the ground levels of both buildings will consist of retail areas, and the levels above to be used as office space. Atop each building it is proposed to have plant rooms and trafficable roof garden areas.

The critical zones of interest with regards to wind effects include the following trafficable areas:

- Outdoor ground level areas within and around the site.
- Roof gardens on Building 1 and Building 2.

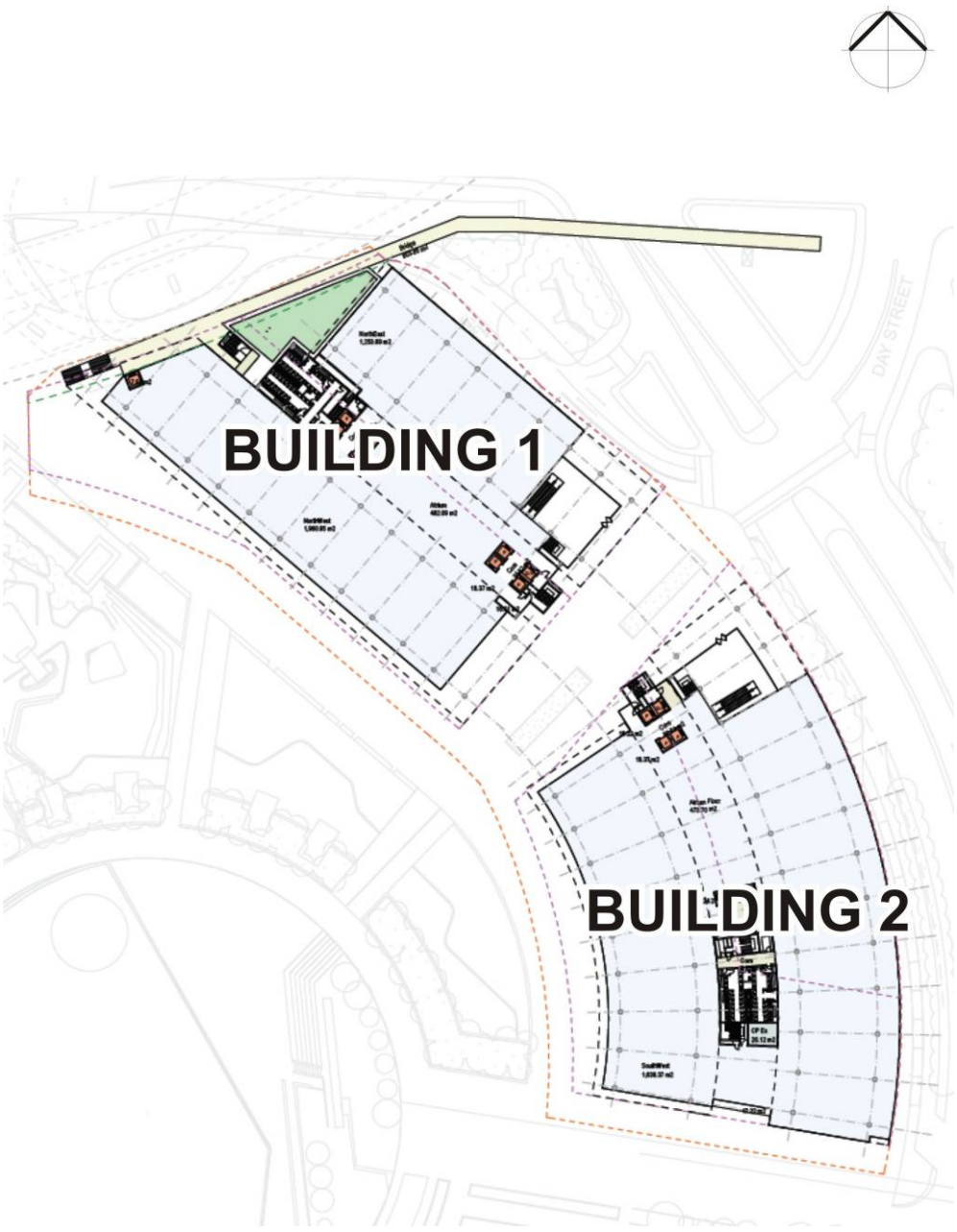


Figure 2: Site Plan

Figure 3: Aerial Photograph of the Proposed Development Site

5.0 Site Analysis

The proposed development site is located in Darling Harbour. The site is bounded by a number of raised road bridges of approximately 17m in height (the Western Distributor) to the north of the site. To the north-east through to the south-east of the development are neighbouring buildings of comparable height to the proposed development. Immediately south of the site is the Chinese Gardens, which is densely foliated to a height of approximately 4m. Further south resides several buildings of comparable height to the proposed development. West of the proposed development is Tumbalong Park which is lightly foliated. Further west resides the Sydney Exhibition Centre which is approximately 12m in height. The local land topography around the site are relatively flat.

For each of the three predominant wind directions, the interaction between the wind and the building morphology in the area was considered. Important features taken into account include the distances between the proposed building forms, their overall heights and bulk as well as the landform. Only the potentially critical wind effects are discussed in this report.

5.1 North-Easterly Winds

The south-eastern entrance to Building 1 and north-western entrance to Building 2 are both well shielded upstream by the adjacent buildings to the north and east immediately across the Western Distributor. Hence, it is expected that the wind conditions as a result of north-easterly winds at these locations will be acceptable for their intended use. Similarly, the walkway running along the edge of the development on the CBD side is also well shielded trough its length by the adjacent buildings to the north and east immediately across the Western Distributor. The proposed trees along this side of the development are expected to further enhance wind conditions to these areas.

All other outdoor areas within and around the proposed development are well shielded by the development. Hence, it is expected that the wind conditions as a result of north-easterly winds on the ground level areas within and around the site will be acceptable for their intended uses.

Both building roof gardens are shielded by the curved roofs on top of each building. It is expected that the north-easterly winds will not reach the roof gardens on either building due to the steep decline in the roof design. Hence, it is expected that wind conditions as a result of the north-easterly winds on both building roof gardens will be acceptable for their intended use. It is also expected that with the inclusion of vegetation to these roof garden areas that wind conditions will be further enhanced.

It is not expected that the proposed development will have any adverse effects to the wind conditions to the local surrounding streets and pedestrian footpaths and thoroughfares.

5.2 Southerly Winds

The pedestrian ground level areas around the southern end of the site are effectively shielded from southerly winds by the densely foliated Chinese Gardens. The remaining ground level areas within and around the site are effectively shielded from southerly winds by the stagnation/shielding effect provided by the proposed development. The proposed and existing trees around the development site will also provide a mitigating effect against strong southerly winds. Hence, it is expected that the wind conditions as a result of southerly winds on the ground level areas within and around the site will be acceptable for their intended uses.

The roof gardens for both buildings will be somewhat exposed to the southerly winds. However, the proposed vegetation on these roof garden areas is expected to mitigate any adverse wind effects. The use of an impermeable balustrade around these roof gardens is expected to further enhance wind conditions to these areas.

It is not expected that the proposed development will have any adverse effects to the wind conditions to the local surrounding streets and pedestrian footpaths and thoroughfares.

5.3 Westerly Winds

It is expected that the proposed development will provide an effective stagnation effect to the westerly winds for the pedestrian ground level areas along the western side of the site. The existing trees around the perimeter of Tumbalong Park are also expected to assist in mitigating adverse westerly winds to the site. The remaining ground level areas within and around the site are effectively shielded from westerly winds by the stagnation/shielding effect provided by the proposed development. Hence, it is expected that the wind conditions as a result of westerly winds on the ground level areas within and around the site will be acceptable for their intended uses.

The roof gardens for both buildings will be somewhat exposed to the westerly winds. However, the proposed vegetation on these roof garden areas is expected to mitigate any adverse wind effects. The use of an impermeable balustrade around these roof gardens is expected to further enhance wind conditions to these areas.

Note that for vegetation to be effective in wind mitigation for westerly winds in Sydney, which predominantly occur during the winter months, evergreen varieties should be selected.

It is not expected that the proposed development will have any adverse effects to the wind conditions to the local surrounding streets and pedestrian footpaths and thoroughfares.

6.0 Conclusions

An analysis of the wind environment impact with respect to the principal wind directions for Sydney has been completed for the proposed development known as Darling Walk, Darling Harbour.

The conclusions of this report are drawn from our extensive experience in this field and are based on an examination of the architectural drawings prepared by Francis-Jones Morehen Thorp Architects, dated January, 2008. No wind tunnel tests have been undertaken for the subject development. 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.

The results of the study indicate that the proposed development is not expected to be exposed to any strong adverse wind effects. The site benefits from the densely foliated Chinese Gardens to the south, the dense CBD environment to the north-east through to the south-east, and by the stagnation/shielding effect provided by the subject development itself. The existing trees around the site, including the trees around the perimeter of Tumbalong Park, will also assist in mitigating adverse wind effects. Additional planting of trees within or around the site are expected to further enhance wind conditions. It is recommended that the roof garden areas on each of the proposed buildings of the subject development have densely foliating vegetation and/or impermeable balustrades to assist in wind mitigation due to the exposure of these areas.

Note that for vegetation to be effective in wind mitigation for westerly winds in Sydney, which predominantly occur during the winter months, evergreen varieties should be selected.

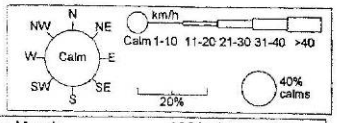
It is not expected that the proposed development will have any adverse effects to the wind conditions to the local surrounding streets and pedestrian footpaths and thoroughfares.

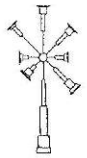
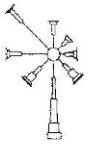
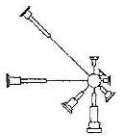
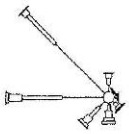
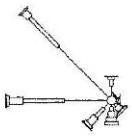
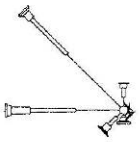
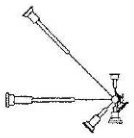
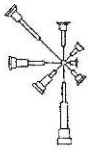
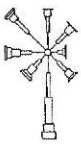
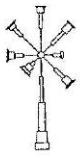
Appendix

Wind Roses for Sydney Airport
1939-2000

Wind Roses using available data between 1939 and 2000 for SYDNEY AIRPORT AMO

Site Number 066037 • Locality: SYDNEY AIRPORT • Opened Jan 1929 • Still Open
Latitude 33°56'28"S • Longitude 151°10'21"E • Elevation 6m



9 am January 1933 observations	9 am February 1755 observations	9 am March 1922 observations
		
9 am April 1834 observations	**9 am May 1866 observations**	**9 am June 1806 observations**
		
9 am July 1873 observations	**9 am August 1876 observations**	**9 am September 1814 observations**
		
9 am October 1901 observations	**9 am November 1835 observations**	**9 am December 1906 observations**
		

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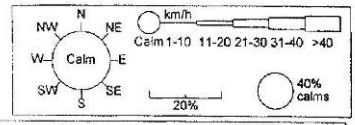

3 pm January 1939 observations	3 pm February 1771 observations	3 pm March 1925 observations
3 pm April 1832 observations	3 pm May 1877 observations	3 pm June 1821 observations
3 pm July 1882 observations	3 pm August 1882 observations	3 pm September 1811 observations
3 pm October 1904 observations	3 pm November 1839 observations	3 pm December 1906 observations