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WIND ENGINEERING AND AIR QUALITY CONSULTANTS

FINAL REPORT

Wind Impact Assessment for:
AMP CIRCULAR QUAY PRECINCT DEVELOPMENT
Sydney, NSW, Australia
CPP Project: 6582
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INTRODUCTION

Synopsis

Cermak Peterka Petersen Pty. Ltd. has been engaged by AMP Capital to provide an opinion based assessment of the impact of the proposed AMP Circular Quay precinct development on the local pedestrian level wind environment. This report is for the purpose of lodging a planning justification report for a LEP and DCP amendment.

AMP Circular Quay precinct development is located across 4 site locations in the blocks bounded by Alfred, Phillip, Bridge, and Loftus Streets at the north edge of Sydney CBD, Figure 1. The site is surrounded by a large number of medium to high rise buildings in the immediate vicinity, and to the south and west, with open water and parkland of the Sydney Botanical Gardens to the north and east, Figure 1 and Figure 5. The site slopes downward from the south-east to north-west.

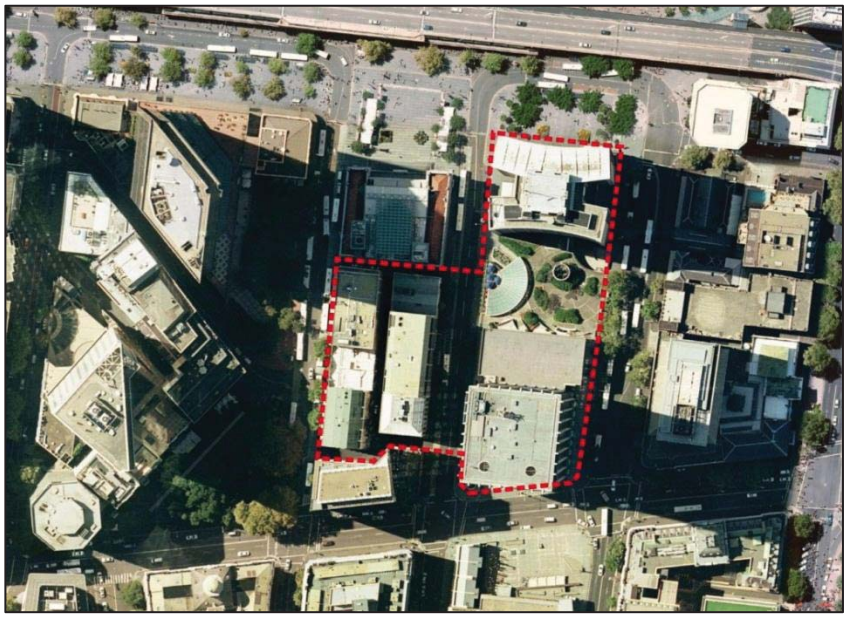


Figure 1: Location of the AMP Circular Quay precinct development

Sydney Wind Climate

The proposed development lies approximately 11.5 km to the north of the Bureau of Meteorology anemometer located at Sydney Airport. The wind rose for the airport is shown in Figure 2 and is considered to be representative of prevailing winds at the site. It is evident that the prevailing winds from coastal Sydney come from the north-east, south, and west. Winds from the north-east tend to be summer sea breezes and bring welcome relief on summer days. Winds from the south occur throughout the year and tend to be cold and associated with frontal systems that can last for several days. Winds from the west tend to be the strongest of the year and are associated with large weather patterns and thunderstorm activity. These winds occur throughout the year and can be cold or warm depending on the inland conditions.

The Bureau of Meteorology anemometer located on Observatory although near the city is poorly positioned on the top of a hill, shielded by trees and nearby buildings, which locally amend the local wind speed and direction, and only has readings every 3 hours. This results in an unreliable data set for statistically analysing the approach wind conditions.

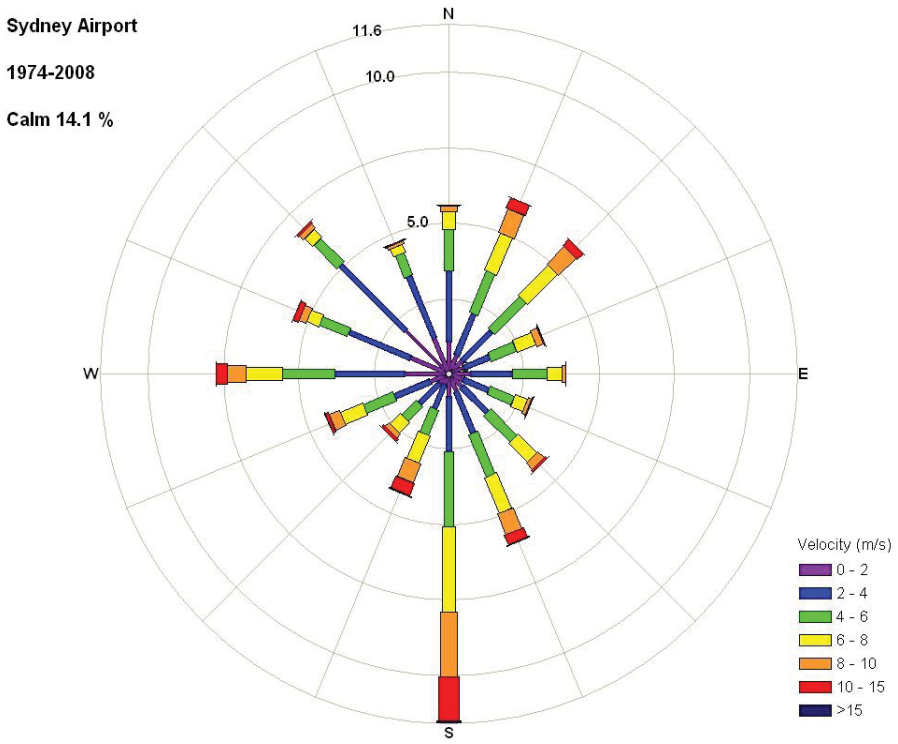


Figure 2: Wind rose for Sydney Airport

Environmental Wind Speed Criteria

It is generally accepted that wind speed and the rate of change of wind velocity are the primary parameters that should be used in the assessment of how wind affects pedestrians. Local wind effects can be assessed with respect to a number of environmental wind speed criteria established by various researchers. Despite the apparent differences in numerical values and assumptions made in their development, it has been found that when these are compared on a probabilistic basis, there is remarkably good agreement.

The wind assessment criteria in the draft City of Sydney Council development control plan 2010 (DCP) are assumed to be based on the work of Melbourne (1978) and relate to a once per annum gust wind speed. The City of Sydney Council criteria have generally become more stringent compared with the 2004 DCP, with active streets requiring a wind environment suitable for outdoor café style activities. These criteria yield no direct information on the mean wind climate, or the percent of year that serviceability winds occur, which are of most use to town planners and architects. The wind assessment criteria used herein are those of Lawson (1990), which are described in Table 1 for both pedestrian comfort and distress. The relevant Lawson criterion is similar to the Melbourne criterion. The benefits of these criteria over many in the field are that they use both a mean and gust equivalent mean (GEM) wind speed to assess the suitability of specific locations. The criteria based on the mean wind speeds define when the steady component of the wind causes discomfort, whereas the GEM wind speeds define when the wind gusts cause discomfort.

Sydney is relatively windy, with an average wind speed at 10 m reference height of approximately 4 m/s (8 kt, 14 kph), and five percent of the time the mean wind speed is in excess of 9.5 m/s (18 kt, 34 kph). Converting the five percent of the time wind speed to typical pedestrian level at the site would result in about 6.0 m/s (12 kt, 22 kph). Comparing this with the comfort criteria of Table 1 indicates that the locale would be acceptable for pedestrian walking; hence any

recreational outdoor activity requires significant shielding from prevailing wind directions. The 5% of the time mean wind speed of 6.0 m/s (12 kt, 22 kph) would produce a corresponding peak gust wind speed in excess of 11 m/s. This 5% of the time is evidently in excess of the once per annum active frontage requirement of the draft City of Sydney 2010 DCP.

Table 1: Pedestrian comfort criteria for various activities

Comfort (maximum wind speed exceeded 5% of the time)	
<2 m/s	Outdoor dining
2 - 4 m/s	Pedestrian sitting (considered to be of long duration)
4 - 6 m/s	Pedestrian standing (or sitting for a short time or exposure)
6 - 8 m/s	Pedestrian walking
8 - 10 m/s	Business walking (objective walking from A to B or for cycling)
> 10 m/s	Uncomfortable
Distress (maximum wind speed exceeded 0.022% of the time, twice per annum)	
<15 m/s	General access area
15 - 20 m/s	Acceptable only where able bodied people would be expected; no frail people or cyclists expected
>20 m/s	Unacceptable

The wind speed is either a mean wind speed or a gust equivalent mean (GEM) wind speed. The GEM wind speed is equal to the 3 s gust wind speed divided by 1.85.

General Wind Flow Mechanisms

When the wind hits a large isolated building, the wind is accelerated down and around the windward corners, Figure 3; this flow mechanism is called downwash and causes the windiest conditions at ground level on the windward and sides of the building. In Figure 3 smoke is being released into the wind flow to allow the wind speed, turbulence, and direction to be visualised. The image on the left shows smoke being released across the windward face, and the image on the right shows smoke being released into the flow at about third height in the centre of the face.

Techniques to mitigate the effects of downwash winds on pedestrians include the provision of horizontal elements, the most effective being a podium to divert the flow away from pavements and building entrances. Awnings along street frontages perform a similar function and the larger the horizontal element the more effective it will be in diverting the flow.

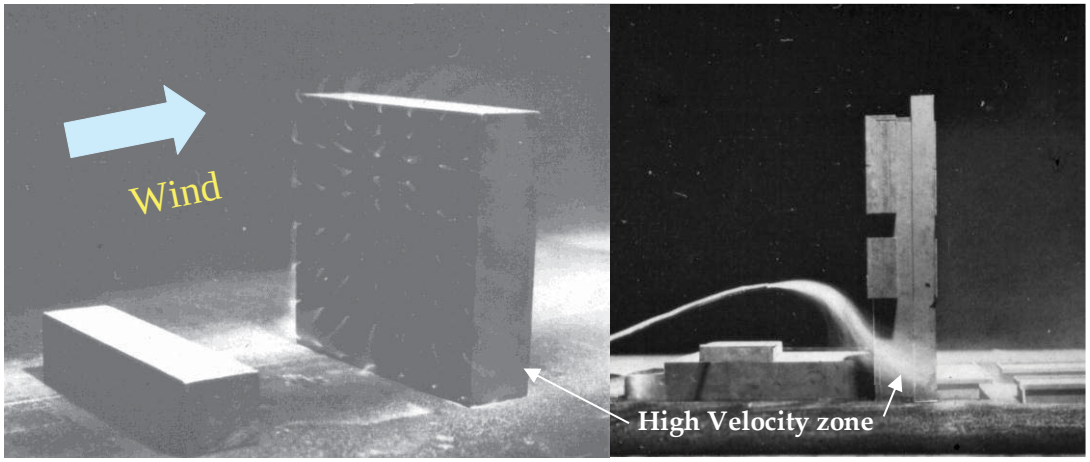


Figure 3: Flow visualisation around a tall building

Channelling occurs when the wind is accelerated between two buildings or along straight streets with buildings on either side.

ENVIRONMENTAL WIND ASSESSMENT

AMP Circular Quay precinct development is spread over four sites: 50 Bridge Street, 2-10 Loftus Street, 16-20 Loftus Street, and 9-17 Young Street, Figure 4. From a wind perspective, the important changes to 50 Bridge Street include the tower extension to the north with undercroft area below, the removal of the low-rise annex podium building, with two new low-rise podium buildings to the north of the extension. The proposed 2-10 Loftus Street building is of similar plan form, but is considerably lower than the existing building. The proposed building at 16-20 Loftus Street is of similar height and massing to the existing building,. The proposed building at 9-17 Young Street is of similar height and massing to the existing building, but is lower to the north.

There will be heavy pedestrian traffic along all main streets surrounding the development. The podium roof to the north of 50 Bridge Street will be developed into a pedestrian thoroughfare and café precinct.

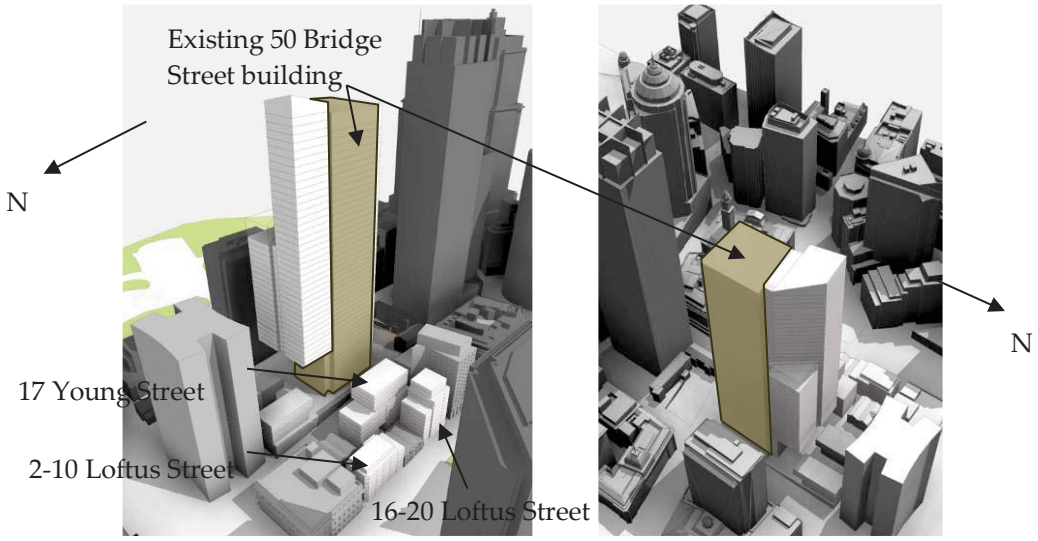


Figure 4: Massing perspective images of the proposed geometric changes

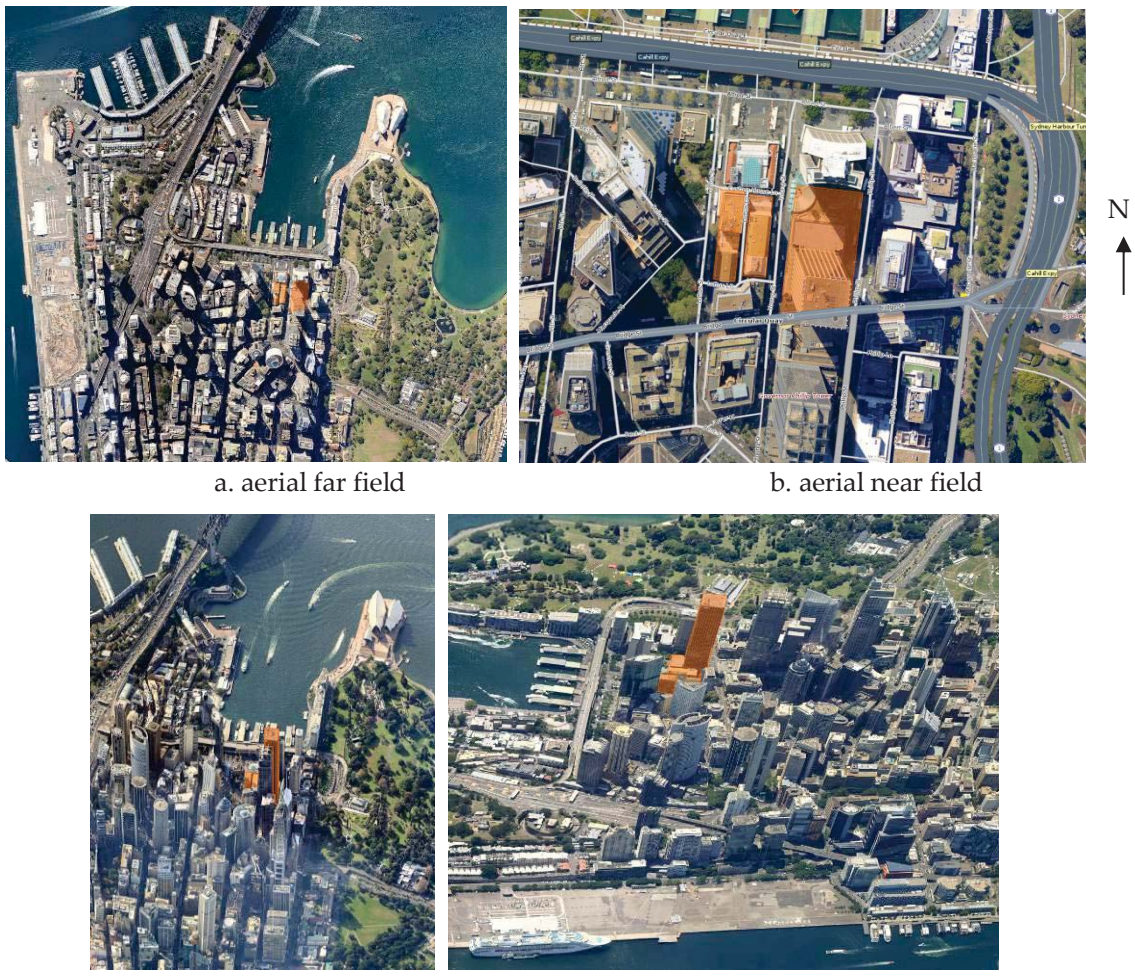
The proposed buildings on the Young and Loftus Street sites are similar or smaller in massing and hence the ground-level wind conditions around these buildings are expected to remain similar or marginally improve for all wind directions. The orientation of the Young and Loftus precinct laneways are excellent from a wind perspective as they do not align with the prevailing wind directions. This configuration reduces wind being channelled along the laneways providing a calmer environment.

North-east Winds

Winds from the north-east are relatively unimpeded on reaching the site. The geometry of the extension to 50 Bridge Street with the setback at mid-height is such that it will minimise the amount of downwash reaching ground level by diverting the flow around the tower. The local topography will accelerate wind flow up Phillip Street and under the reverse podium. Wind conditions in the east-west link over the podium roof are expected to be slightly windy for outdoor dining, but would be ameliorated with local screening. The areas in the north-south link between the two smaller buildings joining the towers are expected to be more suitable for pedestrian sitting activities. Wind conditions around the site are expected to be similar to existing conditions and suitable for use as a main public accessway.

South Winds

Due to the location of the site relative to the orientation of the street grid in the north of the city, particularly around Bent and Bligh Streets, winds from the south, Figure 5c, will tend to be lifted above pedestrian level. The dominant larger buildings downstream of the irregular street pattern will direct a component of the flow along the streets. The drop in topography to the north of Bent Street helps to develop calmer conditions along Phillip, Young, and Loftus Streets. The changes to 50 Bridge Street are to the north of the development in the lee of the building and therefore will not influence environmental wind conditions for winds from this direction including the area under the reverse podium. Wind conditions around the site are expected to be similar to existing conditions and suitable for use as a main public accessway.



a. aerial far field b. aerial near field

c. view from south d. view from west

Figure 5 Location of the proposed development site (Nearmap, 2011, 2012)

West Winds

Winds from the west, Figure 5d, are channelled along Bridge Street by the street orientation, topography, and high-rise buildings to the west. The proposed extension to the north of the existing 50 Bridge Street tower is not expected to significantly change the wind conditions along Bridge Street. The extension is expected to induce higher wind speeds over the podium rooftop area due to downwash from the tower being accelerated through the reverse podium. This flow will have a large vertical component and the horizontal solid element proposed to extend between the towers will ameliorate the wind conditions at ground level. The roof between the

two smaller buildings to the north of the podium can be more open. The main east-west link is not expected to be suitable for outdoor café areas and these types of activities would be better located in the north-south passageway and along the Young and Phillip Street frontages of the podium.

The laneway between the tower on Alfred Street and the small podium buildings is expected to be windy for all prevailing wind directions due to the proximity of the large tower, but considered acceptable for use as a main thoroughfare. The escalator between Loftus Street and the podium roof is exposed to all prevailing wind-driven rain directions. The tower will divert rain towards the escalator, which will need protection from the elements.

CONCLUSIONS

Cermak Peterka Petersen Pty. Ltd. has provided an opinion based assessment of the impact of the proposed AMP Circular Quay precinct development on the local wind environment. Due to the location and orientation of the proposed changes to the precinct, the proposed development is not expected to significantly change the existing wind environment around the site. The pedestrian level wind conditions around the site are expected to remain suitable for use as a public accessway with public locations around the building expected to meet the Lawson and Draft 2010 DCP 16 m/s walking criteria. The City of Sydney wind requirement for the active frontage along Loftus Street is acknowledged, but would be difficult to achieve in this part of the city yet would remain similar to existing conditions.

To maximise the potential for the podium roof to be used as an outdoor dining area care should be taken over the detailed design of the reverse podium and lower roof covering the space. It is recommended to conduct wind-tunnel testing to quantify the wind conditions in these areas and generally around the site during detailed design.

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City of Sydney (2010), Draft Development Control Plan 2010, Part 2 General Provisions.

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