CERMAK
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WIND ENGINEERING AND AIR QUALITY CONSULTANTS

FINAL REPORT

Wind Assessment for:

118 MOUNT STREET

North Sydney, Australia

Prepared for:

Zurich Insurance

c/- White and Partners

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Introduction

Cermak Peterka Petersen Pty. Ltd. has been engaged by White and Partners to provide an opinion based assessment of the impact of the proposed development at 118 Mount Street, Sydney, on the pedestrian level local wind environment in and around the proposed development site.

The proposed development is located on the eastern edge of the North Sydney CBD, Figure 1. The site is bounded by Mount and Little Walker streets to the south and west, and Arthur street and the adjacent Bradfield Highway to the east. Approximately 600 m to the south and south east are Lavender and Neutral Bays. The proposed development is surrounded by high-rise buildings, with a relatively unimpeded approach from the east. There is a steep embankment that runs along the edge of the freeway, which will accelerate winds from the north-east. Winds from the south are accelerated up the rise from Lavender Bay and associated topography.

Figure 1: Site location and 600m radius (Google Earth, 2016)

Sydney Wind Climate

To enable a qualitative assessment of the wind environment, the wind frequency and direction information measured by the Bureau of Meteorology at a standard height of 10 m at Sydney Airport from 1995 to 2015 have been used in this analysis, Figure 2. The anemometer is located about 11 km to the south of the site and is considered representative of the wind conditions at the site. It is noted from Figure 2 that strong prevailing winds are organised into three main groups which centre at about

north-east, south, and west. This wind assessment is focused on these prevailing strong wind directions.

Strong summer winds occur mainly from the south quadrant and the north-east. Winds from the south are associated with large synoptic frontal systems and generally provide the strongest gusts during summer. Moderate intensity winds from the north-east tend to bring cooling relief on hot summer afternoons typically lasting from noon to dusk. These are small-scale temperature driven effects; the larger the temperature differential between land and sea, the stronger the breeze.

Winter and early spring winds typically occur from the south and west quadrants. West quadrant winds provide the strongest winds affecting the area throughout the year and are large scale synoptic events that can be hot or cold depending on inland conditions.

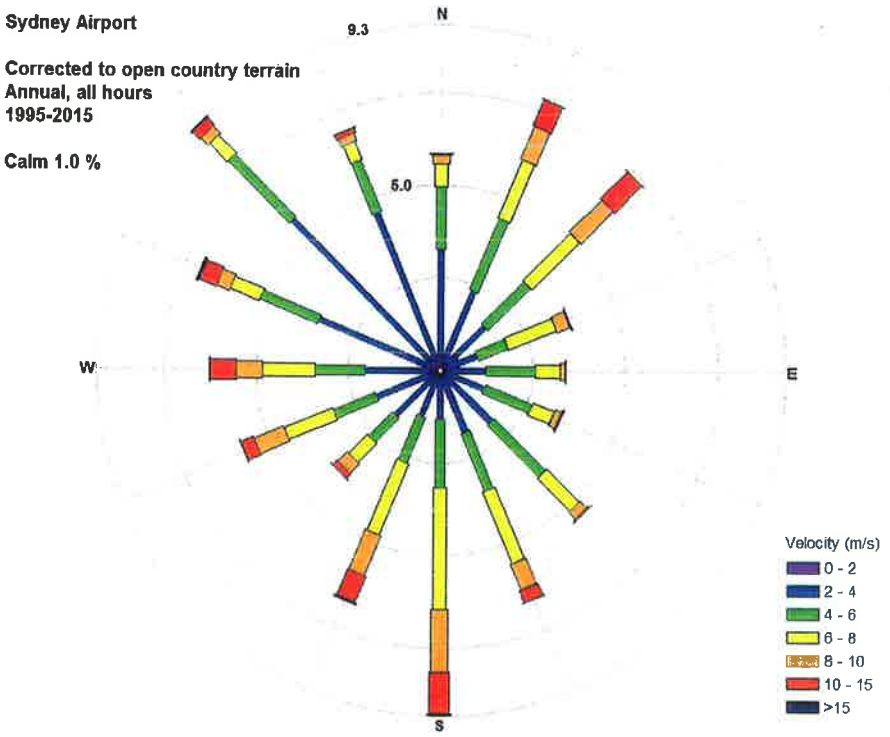

Figure 2: Wind rose showing probability of time of wind direction and speed for Sydney Airport

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. Downwash will occur on buildings of all heights, but the vertical component is dictated by the height to width ratio 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.

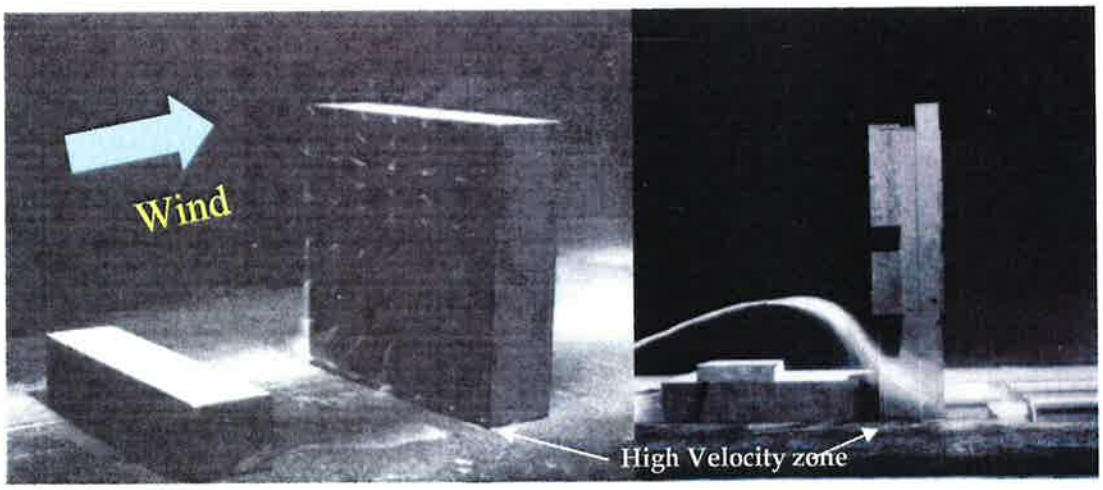

Figure 3: Flow visualisation around a tall building

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 deeper the horizontal element generally the more effective it will be in diverting the flow.

Channelling occurs when the wind is accelerated between two buildings or along straight streets with buildings on either side. For long buildings relative to their height the flow around the corners will generally be horizontal.

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. Over the years, a number of researchers have added to the knowledge of wind effects on pedestrians by suggesting criteria for comfort and safety. Because pedestrians will tolerate higher wind speeds for a smaller period of time than for lower wind speeds, these criteria provide a means of evaluating the overall acceptability of a pedestrian location. A location can further be evaluated for its intended use, such as for an outdoor café or footpath.

The current North Sydney (2013) DCP requires a minimisation of wind impact, and specifies wind speed should not exceed 13 m/s for footpaths and outdoor spaces. The criterion does not specify whether this is a mean or gust wind speed nor the frequency of occurrence throughout the year. It is expected that this is derived from the work of Melbourne (1978), which specifies that this is a

maximum 3 s gust wind speed in an hour, occurring for 0.1% of the year from each direction. There are few locations in Sydney that would meet this criterion without some shielding to improve the wind conditions. This wind speed would be classified as suitable for pedestrian standing activities such as window shopping and is a comfort rather than a safety criterion.

From Figure 2, the 0.1% mean wind speed measured at 10 m above ground for all directions is about 16.5 m/s. Converting this to a mean and gust wind event at pedestrian level in a built-up environment in accordance with Standards Australia (2011) would result in mean and gust wind speeds of 10.5 and 20.5 m/s respectively, which is evidently greater than the 13 m/s in the DCP.

The work of Melbourne (1978), uses this infrequent wind event as an estimator of the general wind conditions at a site. To combat this limitation, the current study is based upon the criteria of Lawson (1990), which are described in Table 1 for both pedestrian comfort and distress. The limiting criteria are defined for both a mean and gust equivalent mean (GEM) wind speed. 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.

Assessment using the Lawson criteria generally provides a classification of pedestrian walking at a similar wind speed to the North Sydney DCP, however also provides information regarding the serviceability of the wind climate.

Table 1: Pedestrian comfort criteria for various activities

Comfort (maximum of mean or gust equivalent mean (GEM[+]) wind speed exceeded 5% of the time)	
< 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 of mean or GEM wind speed exceeded 0.022% of the time)	
<15 m/s	not to be exceeded more than two times per year (or one time per season) for general access
<20 m/s	not to be exceeded more than two times per year (or one time per season) where only able bodied people would be expected; frail or cyclists would not be expected

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.

Environmental Wind Assessment

The site is surrounded on three sides by primarily medium- to high-rise buildings, with the eastern frontage being exposed due to the presence of the Bradfield Highway, Figure 1. The surrounding street grid pattern is roughly oriented along north-south and east-west directions, which generates channelled flow for incident winds along these axes. There is a moderate topographic gradient rising from Lavender Bay to the south of the site to the north.

Previous wind tunnel testing conducted by CPP in the immediate vicinity of the site has indicated that the majority of areas in the existing configuration are classified as suitable for pedestrian standing or walking under Lawson, and would not pass the North Sydney DCP requirement.

The proposed development consists of a single tower of maximum height 96 m. The building is irregularly shaped, featuring a compound planform with rounded corners, Figure 4. The broad sides of the tower face north and south. The main pedestrian entry is located on the south-western corner of the site. Outdoor terraces are located on the 1st, 3rd, and 23rd floors.

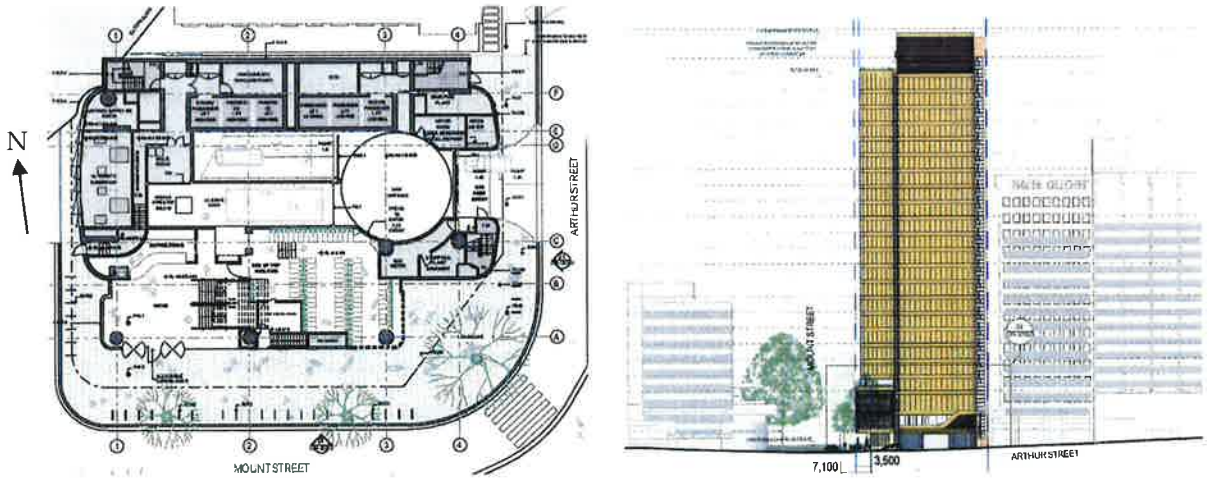

Figure 4: Ground floor plan (L) and east elevation (R) of the proposed development

Winds from the north-east

The site is relatively exposed to incident winds from the north-east. These winds approach over a region of low-rise buildings and the open area of the Bradfield Highway before reaching the larger buildings along Arthur Street. The short embankment ascending from the highway will cause winds from the north-east to accelerate as they reach the site. These winds are then channelled to the south along Arthur Street before expanding along the streets running east-west, producing faster conditions on the south sides. Relatively strong conditions would be expected at the south-east corner of the site, though a calm area will exist close to the building.

The higher prevailing winds from the north-east will strike the corner of the tower, resulting in a component of the flow passing around the tower horizontally rather than generating downwash. The existing buildings to the north would provide some shielding by redirecting flow horizontally. Relatively infrequent winds from due east would produce downwash, the primary result being accelerated flows along the Mount Street frontage. In combination with channelling, this action would

adversely impact pedestrian amenity. Overall, it is expected the flow along Mount Street would increase slightly from existing conditions for winds from this direction.

Winds from the south

Winds from the south are channelled between Milsons and McMahons Points and accelerated up the topographical rise to North Sydney. The high-rise buildings channel the flow along the north-south streets and around the outside of the overall massing of the city to the east and west. The site is reasonably well shielded for winds from the south being located on the eastern side of the CBD with several high-rise buildings to the south. The upper broad face of the tower with rounded corners will encourage flow to pass horizontally around the building, but some downwash flow will be generated. This flow is expected to reach ground level, due to the prismatic nature of the tower, thereby slightly increasing the local wind conditions along Little Walker and Arthur Streets.

Winds from the west

The proposed development is relatively shielded from prevailing winds from the west due to the presence of existing and approved buildings of similar height to the west and the drop in ground level from west to east. Winds from the west will be channelled along Mount Street from the upstream buildings, and the proposed development is expected to have a minimal impact on the local wind conditions.

Private Spaces

The outdoor terrace area on the east side of Level 1, Figure 5(L) is recessed from the façade line. At low levels the wind conditions would be expected to be strong at the south-east corner. The east-facing terrace is expected to be windy due primarily to acceleration of winds from the north-east around this corner. It would be recommended to include a full height solid or operable wall on the southern edge of this area that wraps around the south-east corner, Figure 5(L).

The south-facing terrace on Level 3 will likely experience relatively calm conditions, being recessed from the façade line and protected by the compound shape of the tower. Landscape planting beds at its edges will also assist in ameliorating wind conditions.

The rooftop terrace on Level 23, Figure 5(R) is exposed and expected to be windy. The raised mechanical plant area to the north of the terrace and the planting around the perimeter will provide reasonable protection to the terrace.

All of the terrace areas would be expected to be classified as useable for pedestrian standing from a comfort perspective and pass the distress criterion. It would be expected that these areas would meet

the wind speed associated with the upper level of pedestrian sitting for about 60% of the time, which is typical for rooftop terrace areas.

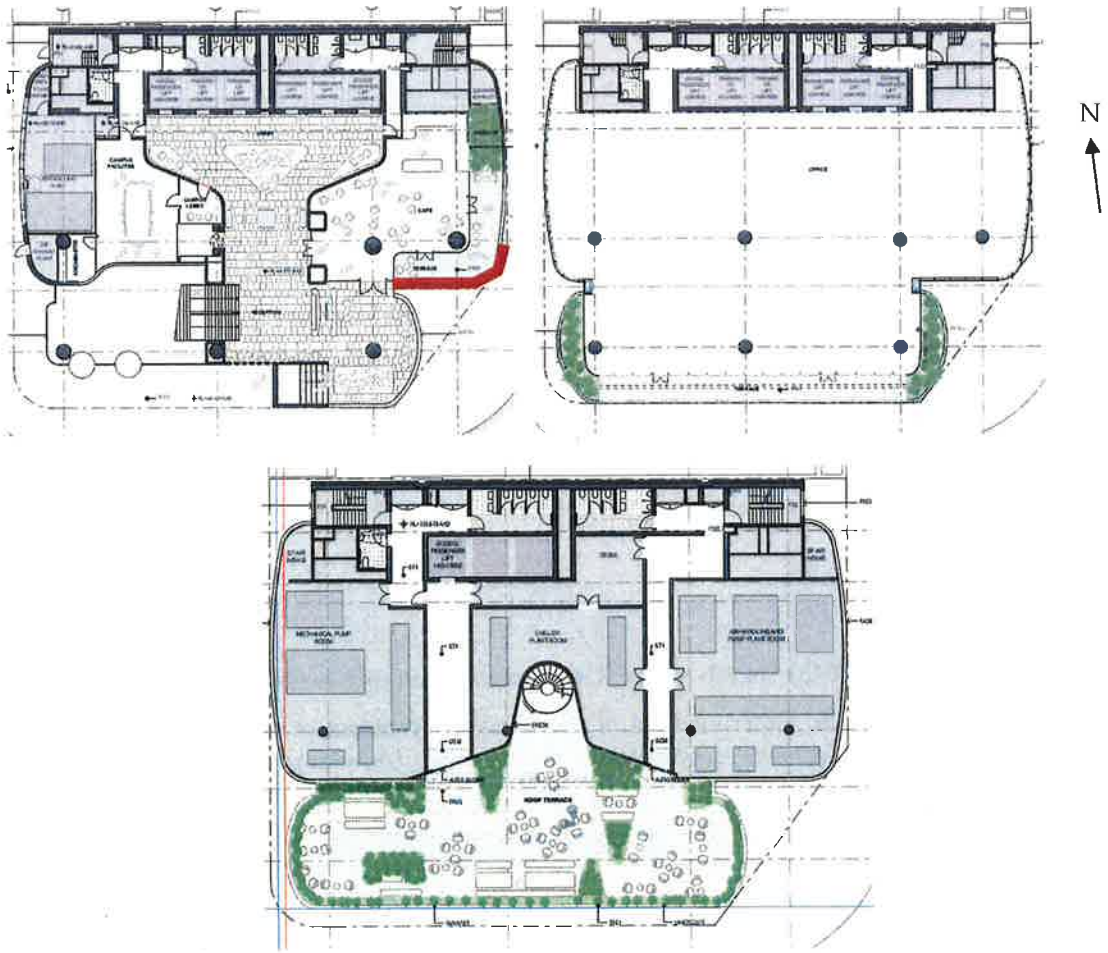

Figure 5: Floor plans for level 1 (TL), Level 3 (TR) and Level 23 (B)

Summary

CPP has previously conducted wind tunnel testing on the pedestrian wind environment within the North Sydney CBD, with results indicating most locations are classified as suitable for pedestrian standing or walking from a comfort perspective, and pass the distress criterion under Lawson. Qualitatively, integrating the expected directional wind conditions around the proposed development with the wind climate, it is considered likely that wind conditions at the majority of locations around the site would remain in these categories.

It is considered unlikely that the existing wind conditions around the site would meet the 13 m/s criterion contained in the North Sydney DCP, and on average the proposed development would not be expected to significantly change the peak gust event. Additional protection to pedestrians from the

effects of downwash may be required; the necessity for such amelioration would be determined through wind-tunnel testing during detailed design.

Conclusions

Cermak Peterka Petersen Pty. Ltd. has provided an opinion based assessment of the impact of the proposed development at 118 Mount Street, North Sydney on the local wind environment.

Wind conditions around the site are expected to be slightly affected by the addition of the proposed tall tower. On average the wind conditions around the site would be expected to be similar to existing conditions with the pedestrian level wind environment for most locations being classified as suitable for pedestrian standing or walking under the Lawson criterion, and that all locations would pass the distress criterion. It is considered that the design would meet the intended use of the space in terms of pedestrian comfort and safety. For such a significant development, wind-tunnel testing would be recommended to quantify the wind advice provided herein, and for the development of specific amelioration measures.

References

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