Wind Impact Statement

CPP

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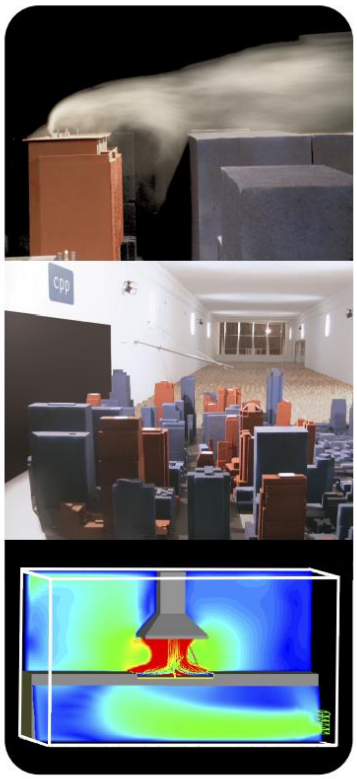
WIND ENGINEERING AND AIR QUALITY CONSULTANTS

FINAL REPORT



Wind Assessment for:

COCKLE BAY WHARF REDEVELOPMENT

Sydney, Australia

Prepared for:

DPT Operator and DPPT Operator

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Introduction

This report supports a State Significant Development Application (SSDA) submitted to the Minister for Planning and Infrastructure pursuant to Part 4 of the Environmental Planning and Assessment Act 1979 (EP&A Act).

DPT Operator Pty Ltd and DPPT Operator Pty Ltd (the Proponent) is seeking to secure approval to establish concept proposal details for the redevelopment of the Cockle Bay Wharf Building and surrounding area (Cockle Bay Wharf). The concept proposal will include:

- up to 12,000m2 of publicly accessible open space,
- new retail outlets, including new food and beverage destinations,
- new cultural and entertainment destinations, and
- a new commercial office tower.

The project supports the realisation of the NSW State Government's vision for an expanded 'cultural ribbon' spanning from Barangaroo, around to Darling Harbour and Pyrmont. The project importantly will add further renewed diversity in tourism and entertainment facilities to reinforce Sydney's CBD being Australia's pre-eminent tourist destination.

Background

The Proponent controls the lease of the site, and also of the adjacent Darling Park site. The Darling Park site is a successful premium grade office precinct located on the west of the Sydney CBD, the associated Crescent Garden, located to the west of the three existing Darling Park towers, is a key area of open space in this part of the city.

The Proponent has recognised a number key issues with the existing layout of the Darling Park and Cockle Bay precinct, these being:

- the existing Cockle Bay Wharf building is not well integrated with the city, the Western Distributor freeway currently acts as a barrier to separate this area from the CBD,
- despite being publicly accessible, the existing Darling Park Crescent Garden is not well utilised, and
- the existing Cockle Bay Wharf building is outdated and is not in keeping with the future of Darling Harbour area as a vibrant entertainment and tourist destination.

The Cockle Bay precinct is at risk of being left behind and undermining the significant investment being made in Darling Harbour that will see it return to the world stage as a destination for events and entertainment.

Accordingly, the Proponent is taking a carefully considered and staged approach to the complete revitalisation of the site and its surrounds. The envisaged development, which will be facilitated by the proposed building envelopes will:

- reconnect the city with the Darling Harbour waterfront and the Darling Park Crescent Garden,
- provide new access routes between the city and the ICC Sydney / Darling Harbour Live precinct,
- support the Sydney economy by providing a new premium commercial building, and
- refresh and renew an existing entertainment and tourist destination.

Site Description

The Site is located within Darling Harbour. Darling Harbour is a 60 hectare waterfront precinct on the south-western edge of the Sydney Central Business District that provides a mix of functions including recreational, tourist, entertainment and business.

The Site is located to the immediate south of Pyrmont Bridge, within the Sydney CBD on the eastern side of the Darling Harbour precinct. The Site is located within the City of Sydney local government area (LGA). A locational context area plan and location plan are provided Figure 1.

The Darling Harbour precinct is undergoing significant redevelopment as part of the SICEEP, Darling Square, and IMAX renewal projects. The urban, built form and public transport / pedestrian context for Harbourside will fundamentally change as these developments are progressively completed.

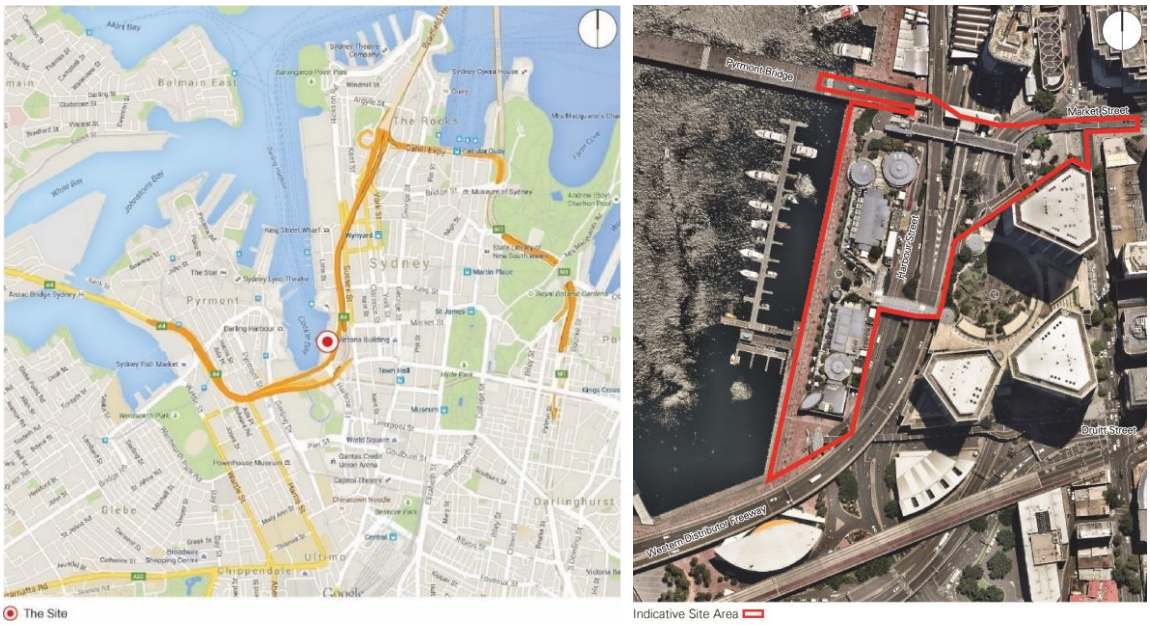

Figure 1: Location context area plan (L), indicative site area (R)

Overview of Proposed Development

The proposal relates to a staged development application and seeks to establish concept proposal details for the renewal and re-imagining of Cockle Bay Wharf.

The concept proposal establishes the vision and planning and development framework which will be the basis for the consent authority to assess future detailed development proposals.

The Cockle Bay Wharf site is to be developed for a mix Retail, Cultural and Commercial (Office) uses, including retail and restaurants, commercial offices, and open space.

The Concept Proposal seeks approval for the following key components and development parameters:

- demolition of existing site improvements, including the existing Cockle Bay Wharf, pedestrian bridge links across the Western Distributor, and obsolete monorail infrastructure;
- building envelopes;
- land uses across the site;
- a maximum total Gross Floor Area (GFA) across the Cockle Bay Wharf of 85,000 m² for commercial development and 25,000 m² for retail, including food and beverage, development;
- car parking rates to be utilised in subsequent detailed (Stage 2) Development Applications);

- urban Design and Public Realm Guidelines to guide future development and the public domain; and
- strategies for utilities and services provision, drainage and flooding, and ecological sustainable development.

A more detailed and comprehensive description of the proposal is contained in the Environmental Impact Statement (EIS) prepared by JBA.

Planning Approvals Strategy

The Site is located within the Darling Harbour precinct, which is identified as a State Significant Site in Schedule 2 of State Environmental Planning Policy (State and Regional Development) 2011. As the proposed development will have a capital investment exceeding $10 million, it is declared to be State Significant Development (SSD) for the purposes of the Environmental Planning and Assessment Act 1979 (EP&A Act), with the Minister for Planning the consent authority for the project.

This State Significant Development Application (DA) is a staged development application made under section 83B of the EP&A Act. It seeks approval for the concept proposal for the entire site and its surrounds.

More specifically this staged DA includes establishing land uses, gross floor area, building envelopes, public domain concept, pedestrian and vehicle access and circulation arrangements and associated car parking provision.

Detailed development application/s (Stage 2 DAs) will accordingly follow seeking approval for the detailed design and construction of all or specific aspects of the proposal in accordance with the approved staged development application.

The Department of Planning and Environment provided the Secretary's Environmental Assessment Requirements (SEARs) to the applicant for the preparation of an Environmental Impact Statement for the proposed development on 23 June 2016. This report has been prepared having regard to the SEARs as relevant.

Introduction

Cermak Peterka Petersen Pty. Ltd. has been engaged by DPT Operator and DPPT Operator to provide an opinion based assessment of the impact of the proposed Cockle Bay Wharf redevelopment, Sydney, on the pedestrian level local wind environment in and around the proposed development.

The site is located to the west of Sydney CBD in Darling Harbour and is surrounded by medium- to high-rise buildings, Figure 2.

Figure 2: Site location for the proposed Cockle Bay Wharf redevelopment

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 3. It is noted from Figure 3 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 greater 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.

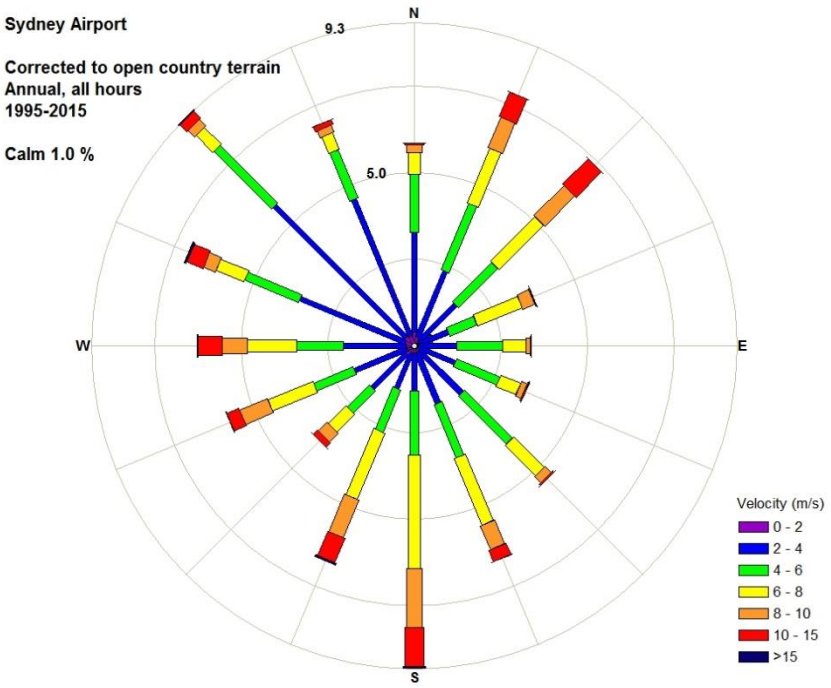

Figure 3: Wind rose of direction and speed for Sydney Airport

Wind Flow Mechanisms

When the wind hits a large isolated building, the wind is accelerated down and around the windward corners, Figure 4; this flow mechanism is called downwash and causes the windiest conditions at ground level on the windward and sides of the building. In Figure 4 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 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.

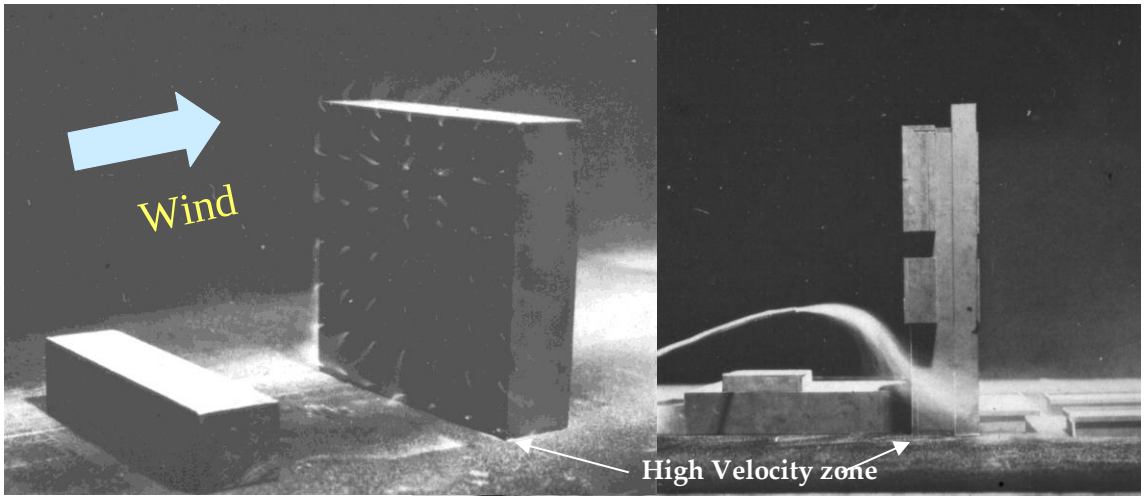

Figure 4: Flow visualisation around a tall building

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 City of Sydney (2012) DCP specifies wind effects not to exceed 16 m/s, as the area around the site is not classified as an 'active frontage'. With reference to the wind rose in Figure 3, there are few locations in Sydney that would meet this criterion without some level of shielding from surrounding buildings, or local treatments. From discussions with Council this is a once per annum gust wind speed similar to the wind criteria in City of Sydney 2004 DCP, but is meant to be interpreted as a comfort level criterion and is not intended to be used as a distress requirement. The once per annum gust wind speed criterion used in the City of Sydney (2012) DCP is based on the work of Melbourne (1978), and the 16 m/s level is classified as generally acceptable for use as a main public accessway. This criterion gives the once per annum wind speed, and uses this as an estimator of the general conditions at a site, which may be more relevant. To combat this limitation, as well as the once per annum maximum gust wind speed, this 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.

From ongoing findings using the criteria and clients who have issues with strong wind, a more stringent criterion is required for outdoor dining style activities and a value of 2 m/s for 5% of the time is recommended for such intended use. As the 5% of the time wind speed recorded at the airport is about 9 m/s, and even with the benefits of shielding from the city compared with the airport, any location in the city requires significant shielding to meet such a criterion.

Assessment using the Lawson criteria provides a similar classification as using the once per annum gust, which is the basis of the City of Sydney (2011) DCP, however also provides information regarding the serviceability wind climate.

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.

Table 1: Pedestrian comfort criteria for various activities

Environmental Wind Assessment

The development site is situated on the east side of Darling Harbour, adjacent to Pyrmont Bridge and the Darling Park development, Figure 2. The proposed Cockle Bay Wharf redevelopment comprises a retail podium up to 6 storeys with rooftop recreational areas, and a single commercial tower rising to a potential maximum height of about 245 m above ground level. The envelope building form is presented in Figure 5 to Figure 8, however the final building would be expected to be about 70-80% of the envelope volume and therefore likely to have less of an impact on the local wind environment. The proposed development is surrounded by medium to high-rise buildings, which will provide some shielding for certain wind directions. Topography surrounding the site is relatively flat rising gently to the east. The wind conditions in this part of town on the western edge of the city are known to be erratic and relatively windy. The sunken courtyard at Darling Park is flanked by the three towers and is relatively calm due to the tower orientation.

The plan form and orientation of the building is still under development and the final shape will influence the local wind conditions. There are several potential techniques to reduce the intensity of the impact of the building on the ground level such as rounding or chamfering the corners of the tower, including a tower setback, altering the floor plate with height to form a taper or twist, and

changing the orientation of the tower. These would be addressed during detailed design. In the context of the surrounds, for a development of this size the general flow pattern around the site will be similar, with the final form impacting the local wind conditions, which can be amended during detailed design.

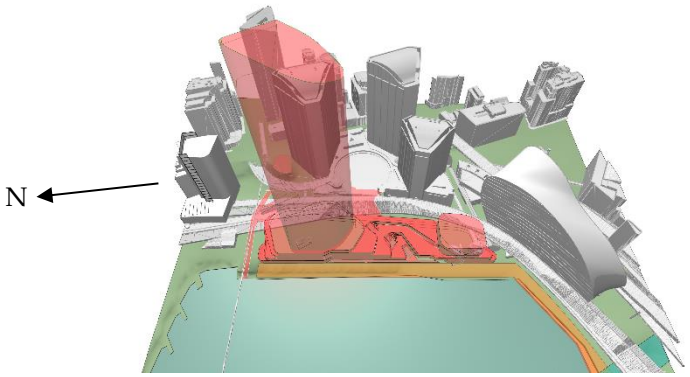

Figure 5: Perspective of the proposed envelope Cockle Bay Wharf redevelopment from the west

Winds from the north-east

Winds from the north-east will be shielded by the general massing of the city. On reaching the site, winds from the north-east would impinge on the north-east corner of the tower at an oblique angle, encouraging the flow to pass around the tower horizontally thereby reducing the quantity of downwash, Figure 6. Compared with a square face in the same orientation, an elliptical design would be considered a reasonably good design to minimise downwash. If the façade were to become more square and faced to the north-east, the amount of downwash would increase, causing windier conditions at ground level.

Flow would accelerate around the north-west and south-east corners of the tower, with any downwash discharging over the podium roof and Darling Harbour. Wind conditions on the podium roof close to the tower are expected to be relatively windy, decreasing in magnitude to the south.

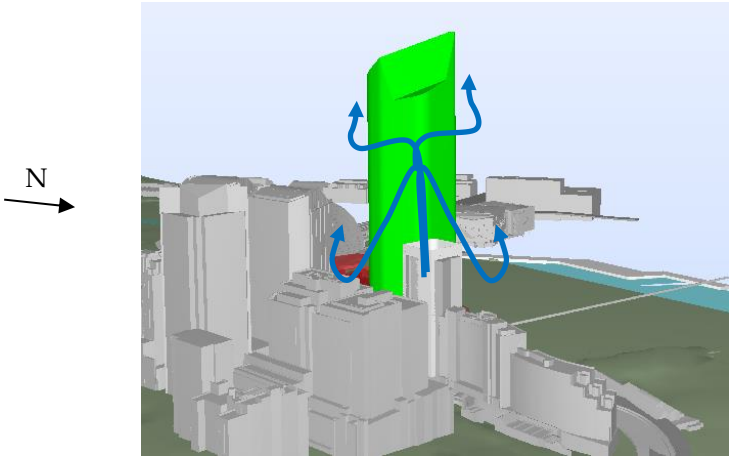

Figure 6: View of the proposed design envelope development from the north-east

Winds from the south

The site is relatively exposed to winds from the south and south-west quadrants, Figure 7(L). The proposed Imax and SICEEP residential towers to the south would offer additional protection to the site. However, near the tower, the proposed and approved redevelopment of the Imax building could increase the amount of downwash. This mechanism would direct high level flow towards ground level, with flow discharging along the waterfront boardwalk and the podium roof, Figure 7(R). The shape of the final design of the tower would determine the flow patterns around the building, with rounder corners, orientation, and tapering being beneficial. The proximity of the tower to Pyrmont Bridge would be expected to ameliorate the impact of the downwash along the boardwalk, however it would also be expected to cause localised slightly stronger wind conditions on the bridge. It is considered that these wind conditions could be suitably addressed during detailed design particularly with the type and placement of the additional proposed access ramp across the site, which could be used as shielding if required. It is expected that the tower would decrease the existing strong flows across the Market and Sussex Street intersection.

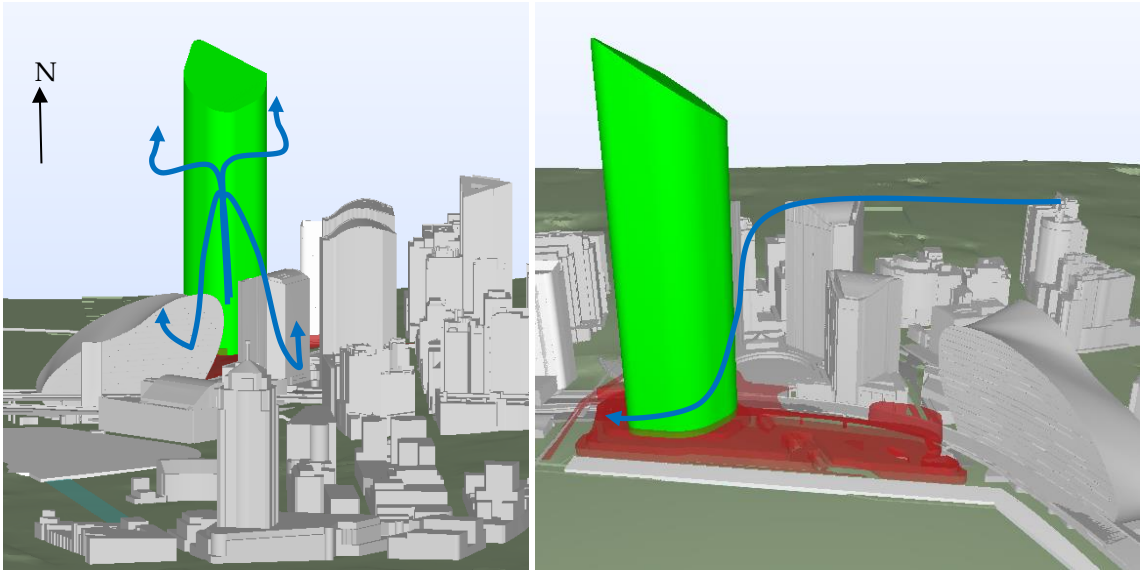

Figure 7: View of the proposed design envelope development from the south (L) and north-west (R)

Winds from the west

The tower is exposed to winds from the west crossing Darling Harbour. Winds from the west will be partially shielded by the neighbouring hotels to the west. The final plan form shape of the building will influence the wind conditions, with rounder buildings producing a lower amount of downwash. The building is expected to channel the flow along Market Street, Figure 8.

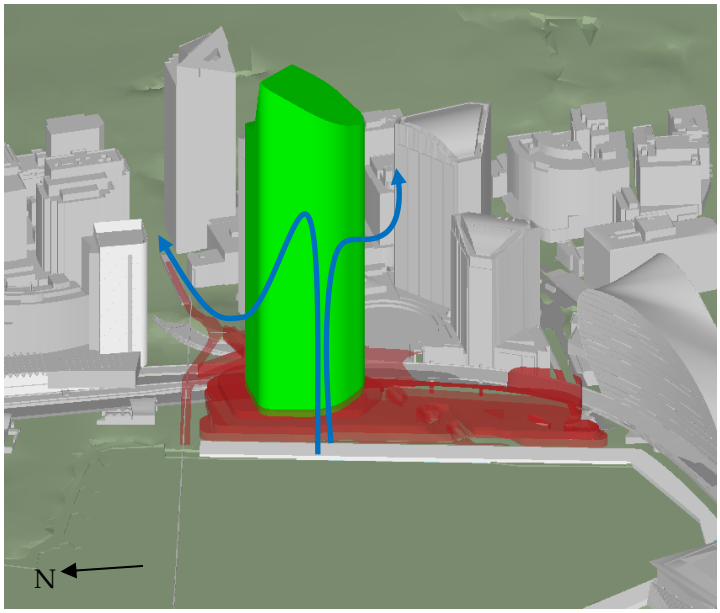

Figure 8: Aerial view of the proposed design envelope from the north-west

Summary

This is currently a relatively windy area and the introduction of major buildings on the fringe of the city would be expected to induce local windier locations close to the building corners, but areas of calm in the lee. Additional amelioration such as planting, landscaping, or porous screen walls could be required to improve the local wind condition for the intended purpose of use.

Qualitatively, integrating the expected directional wind conditions around the site with the wind climate, it is considered that wind conditions at the majority of locations around the site would be classified as suitable for pedestrian standing or walking under the Lawson criterion from a comfort perspective and pass the distress criterion, which would meet the design intent for the space. At the windier locations along the waterfront boardwalk, the wind conditions are likely to be classified as suitable for pedestrian walking. All locations would be expected to meet the distress criterion with the potential exception of areas close to the tower. During detailed design, for areas that have wind conditions exceeding the required intended use of the space, a number of local amelioration strategies can be employed. Through quantification of the wind conditions and an appreciation of the implications to the design, it is considered that a development of this size in this location can be made to work from a wind perspective.

The primary purpose of the podium is to protect pedestrian at ground level and can therefore be expected to be windy. Without localised amelioration to create local calm areas, the majority of the podium roof would be expected to be classified as suitable for pedestrian walking, with locations

close to the tower or edge of the podium classified as suitable for business walking. The stepped nature of the podium terrace is expected to induce calmer areas close to the vertical elements. Any extension of the higher terrace roof edge over the lower terrace would assist in providing calmer areas below.

The size of the development and proximity to the edge of Cockle Bay Wharf is expected to increase the wind conditions along the harbour walkway, but decrease them along Sussex Street. It would be recommended to include an awning or overhang to the west of the tower to improve local wind conditions. The necessity and size of any awning could only be finalised after quantification of the wind conditions following wind-tunnel testing.

Conclusions

Cermak Peterka Petersen Pty. Ltd. has provided an opinion based assessment of the impact of the proposed Cockle Bay Wharf redevelopment, Sydney on the local wind environment. The geometry of the final tower design will have an impact on the wind conditions in and around the site with various measures that can be employed to improve the local wind conditions, such as rounded corners, setbacks, tapering, and façade articulation. These will be addressed during detailed design.

Wind conditions around the site for the proposed envelope development are generally expected to be windier than existing conditions, with windier locations close to the tower that could be managed with local amelioration, landscaping, or restricted access. The majority of locations would be expected to meet the Lawson pedestrian walking criterion and pass the distress criterion with some exceedances close to the tower. With additional localised amelioration, it is considered that the design could meet the intended use of space for pedestrian comfort and safety. Additional amelioration measures may be required for specific locations where local wind speeds may be greater such as close to the corners of the tower, but this would be conducted during detailed design. Wind-tunnel testing would be required to quantify the wind advice provided herein and for specific amelioration.

References

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