613 – 627 PACIFIC HIGHWAY, CHATSWOOD

SYDNEY, NSW

PEDESTRIAN WIND ASSESSMENT

PROJECT # 2103069

MARCH 31, 2021

SUBMITTED TO

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1. INTRODUCTION

RWDI was retained to assess the potential pedestrian wind conditions around the proposed development at 613 – 627 Pacific Highway in Chatswood (Image 1). This qualitative assessment is based on the following:

- A review of the regional long-term meteorological data from Sydney International Airport for the period 1998 - 2019
- Planning proposal received by RWDI on 25th March 2021;
- Wind-tunnel studies undertaken by RWDI for similar projects in Sydney;
- Our engineering judgment, experience and expert knowledge of wind flows around buildings[1-3]; and,
- Use of software developed by RWDI (Windestimator[2]) for estimating the potential wind conditions around generalized building forms.

This qualitative approach provides a screening-level estimation of potential wind conditions. Conceptual wind control measures to improve wind comfort are recommended where necessary.

Note that other wind issues, such as those related to cladding and structural wind loads, snow drifting and loading, air quality, door operability, etc., are not considered in the scope of this assessment.

Image 1: Aerial View of the Existing Site and Surroundings (Credit: Google Maps)

1. C.J. Williams, H. Wu, W.F. Waechter and H.A. Baker (1999), "Experience with Remedial Solutions to Control Pedestrian Wind Problems", 10th International Conference on Wind Engineering, Copenhagen, Denmark.
2. H. Wu, C.J. Williams, H.A. Baker and W.F. Waechter (2004), "Knowledge-based Desk-Top Analysis of Pedestrian Wind Conditions", ASCE Structure Congress 2004, Nashville, Tennessee.
3. H. Wu and F. Kriksic (2012). "Designing for Pedestrian Comfort in Response to Local Climate", Journal of Wind Engineering and Industrial Aerodynamics, vol.104-106, pp.397-407.

2. SITE & BUILDING INFORMATION

The proposed development is bounded by Pacific Highway to the west, Gordon Avenue to the north, and Nelson street to the south. The existing site comprises a four-storey office building which would be demolished as part of the development. The proposed development will consist of a 90 m tall residential building with retail and commercial space at podium levels and a rooftop garden at Level 2. The concept massing is shown in Image 3 below.

The surrounding area comprises mainly low-rise buildings. Pedestrian areas of interest in this assessment include entrances (with entrances to retail shops located along Pacific Highway and Nelson street), footpaths and walkways around the building, plus the terrace on the Level 2 (rooftop garden) which it is assumed will be utilized for amenity purposes.

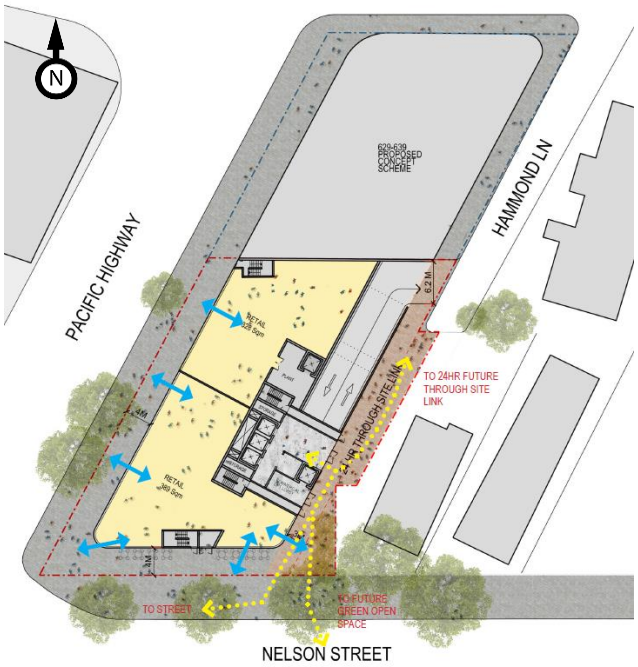


Image 2: Site Plan – Ground Level

Image 3: 3d View of the Proposed Concept Massing

3. METEOROLOGICAL DATA

Meteorological data recorded at Sydney International Airport for the period from 1998 to 2019 were used as a reference for wind conditions in the study area. The distributions of wind frequency and directionality for the summer (November through April) and winter (May through October) seasons are shown in Image 4. Winds from the northeast, south-southeast directions are predominant in the summer season whereas the west and northwest directions are predominant in the winter season are predominant in the summer season.

Strong winds of a mean speed greater than 30 km/h measured at the airport (at an anemometer height of 10 m) occur more often in the summer (17.7%) than in winter (13%). During both seasons, strong winds from the southerly directions are predominant. Winds from these directions could potentially be the source of uncomfortable wind conditions, depending on the site exposure or development design. The analysis methods have accounted for this and all winds directions.

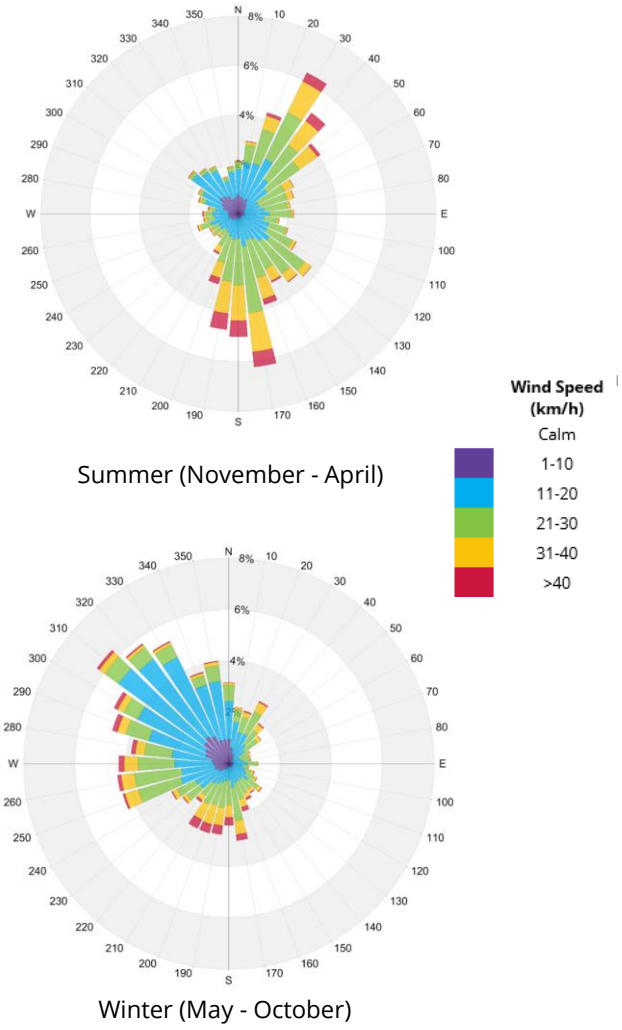


Image 4: Directional Distribution of Winds Approaching Sydney International Airport (1998-2019)

4. PEDESTRIAN WIND CRITERIA

Consideration for the wind comfort conditions for the development have been based on the RWDI pedestrian wind criteria. These criteria have been developed by RWDI through research and consulting practice since 1974. They have also been widely accepted by municipal authorities and by the building design and city planning community.

4.1 Pedestrian Safety

Pedestrian safety is associated with excessive gust wind speeds that can adversely affect a pedestrian's balance and footing. If strong winds that can affect a person's balance (**83 km/h per AWES**) occur more than 0.1% of the time or 9 hours per year, the wind conditions are considered severe.

4.2 Pedestrian Comfort

Wind comfort levels are categorized by typical pedestrian activities:

- **Sitting (≤ 10 km/h)**: Calm or light breezes desired for outdoor seating areas where one can read a paper without having it blown away.
- **Standing (≤ 14 km/h)**: Gentle breezes suitable for main building entrances and bus stops.
- **Strolling (≤ 17 km/h)**: Moderate winds that would be appropriate for window shopping and strolling along a downtown street, plaza or park.
- **Walking (≤ 20 km/h)**: Relatively high speeds that can be tolerated if one's objective is to walk, run or cycle without lingering.
- **Uncomfortable**: None of the comfort categories are met.

Wind conditions are considered suitable for sitting, standing, strolling or walking if the associated wind speeds are expected for at least four out of five days (80% of the time). Wind control measures are typically required at locations where winds are rated as uncomfortable or they exceed the wind safety criterion.

These criteria for wind forces represent average wind tolerance. They are sometimes subjective and regional differences in wind climate and thermal conditions as well as variations in age, health, clothing, etc. can also affect people's perception of the wind climate.

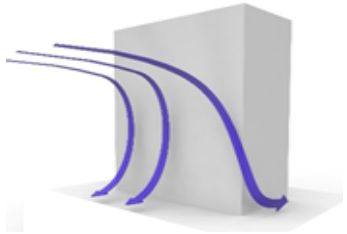
For the current development, wind speeds comfortable for walking or strolling are appropriate for sidewalks and laneways, and lower wind speeds comfortable for standing are required for building entrances where pedestrians may linger. Wind speeds comfortable for sitting are appropriate for outdoor terraces during the summer, when these areas are typically in use.

5. RESULTS AND DISCUSSION

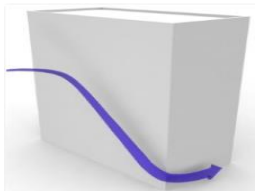
5.1 Background

Predicting wind speeds and occurrence frequencies is complicated. It involves building geometry, orientation, position and height of surrounding buildings, upstream terrain and the local wind climate. Over the years, RWDI has conducted thousands of wind-tunnel model studies regarding pedestrian wind conditions around buildings, yielding a broad knowledge base. This knowledge has been incorporated into RWDI's proprietary software that allows, in many situations, for a qualitative, screening-level numerical estimation of pedestrian wind conditions without wind tunnel testing.

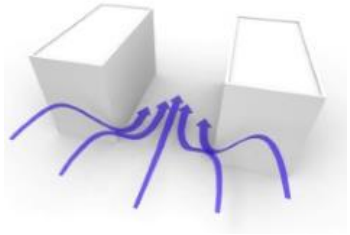
Tall buildings tend to intercept the stronger winds at higher elevations and redirect them to the ground level (Downwashing – **Image 5a**). These winds subsequently move around exposed building corners, causing a localised increase in wind activity due to Corner Acceleration (**Images 5b**). When two buildings are situated side by side, wind flows tend to accelerate through the space between the buildings due to the Channelling Effect (**Images 5c**). If these building / wind combinations occur for prevailing winds, there is a greater potential for increased wind activity and *uncomfortable* conditions. Given the local wind climate and the moderate height of the proposed development, it is our opinion that the wind safety criterion will be met at all areas on and around the building. Detailed discussions on the potential wind comfort conditions at key pedestrian areas are provided in the following sections.



a) Downwashing and Corner Acceleration



b) Corner Acceleration



c) Channeling Effect

Image 5: General wind flow around buildings

5.2 Existing conditions

The existing site is occupied by a four-storey office building and surrounded by suburban neighbouhoods, comprising buildings that are one to three storeys tall in all the directions. As such, there are no significant structures that would deflect ambient winds to ground to cause adverse wind impacts. Additionally, the existing trees located along the Pacific Highway and Nelson street will help to diffuse the higher winds from the west and south directions. Currently, wind conditions on footpaths around the site would be considered comfortable for standing or strolling in the summer and winter. Wind conditions exceeding the safety criterion are not expected.

5.3 Expected Conditions

The proposed development will be taller than its surroundings with a height of approximately 90 m and therefore will be exposed to the prevailing winds from all directions. Commentary is provided in the following sections based on the proposed development alone, consideration is given to the likely impact of future development to the North in Section 7. The narrow nature of the tower form in the north-south direction is expected to minimise downwash from these prevailing directions

5.3.1 Wind Safety

Although the proposed development is taller than the existing buildings in the surrounding area, it is not expected to result in wind speeds which cause an exceedance of the wind safety criterion.

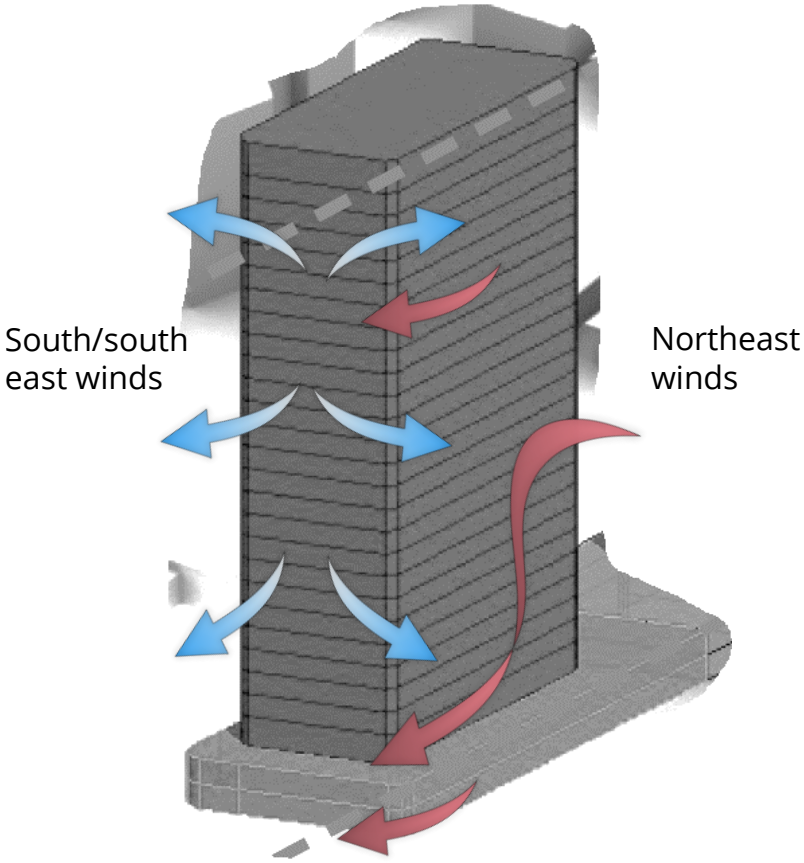


Image 6: General wind flow around the building

5.4.2 Wind Comfort on Footpaths and at Entrances

Wind conditions along the perimeter at ground-level are predicted to be mostly comfortable for strolling which is suitable for footpaths. Some key design elements include the narrow aspect to the prevailing southerly winds and inclusion of a setback of the tower form massing at Level 3. The retention of trees along the Pacific Highway and at the southern entrance to the through-site link are also positive aspects.

- Articulation of the tower form, especially along the eastern and western aspects will be beneficial in minimising downwash from the north-easterly and westerly winds.
- Wind speeds appropriate for standing are preferred for entrance locations which are predicted along Nelson Street (Location A) based on exposure to winds and the retention of existing trees.
- The inclusion of awnings on the western aspect wrapping around the southwest corner would help achieve comfortable conditions at entrances along the Pacific Highway (Location B).
- The podium provides some protection from downwashing winds to the through-site link (Location C). Consideration for elements such as awnings or trellis features as well as landscaping (e.g., trees plus 1.5 m high shrubs in planters) will also help to achieve sitting conditions suitable for outdoor dinking or cafes in the area.

Sample images of recommended measures which can be considered as the design develops are shown in Image 9.

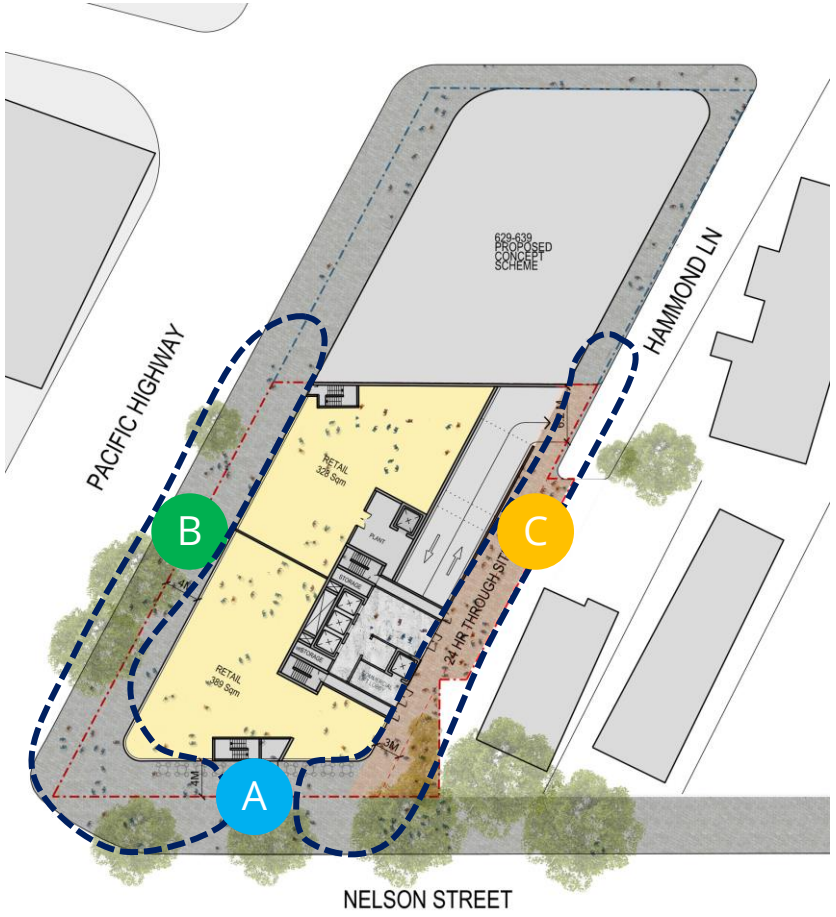


Image 7: Site plan showing key pedestrian areas at grade

5.4.3 Wind Comfort on Terrace at Level 2

The tower massing is likely to deflect westerly and some of the north-easterly winds down to rooftop garden at Level 2. While this is an important feature to enhance ground level conditions, consideration will need to be made to ensure these areas remain useable for occupants of the building. The downwashed winds from the tower form would be channeled along occupant areas and would accelerate around the building corners.

Landscaping features are proposed for the terraces which are positive for reducing wind speeds. Areas on the podium at the corner locations, noted as Location B in Image 8, will experience higher wind speeds, as the wind is directed down and sidestream around the corner of the tower form, as noted in Image 6. Consideration for elements such as awnings or trellis, or landscape features such as porous screens of dense planters will be helpful in breaking up these effects. The approach will need to also respond to the use within the building and on the podium at this level.

Location A will be likely experience the effects of all of the prevailing winds, and hence consideration for how this area may be broken up will be key. Perimeter screening will also be helpful for localised wind protection.

Sample images of recommended design features to be considered as the design develops are shown in Image 10.

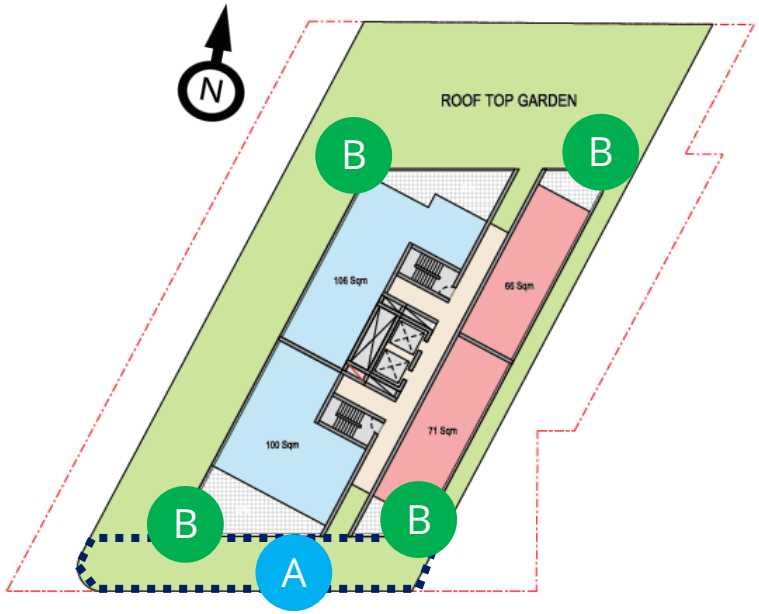


Image 8: Site plan showing key pedestrian areas at Level 2 roof terrace

6. WIND CONTROL MEASURES

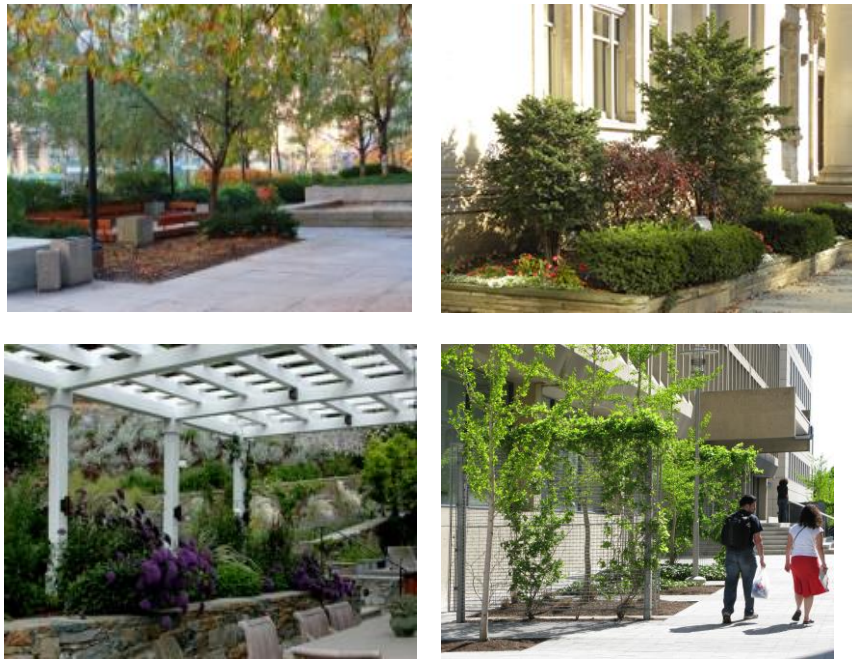


Image 9: Wind Control Measures for Footpaths and Amenity areas

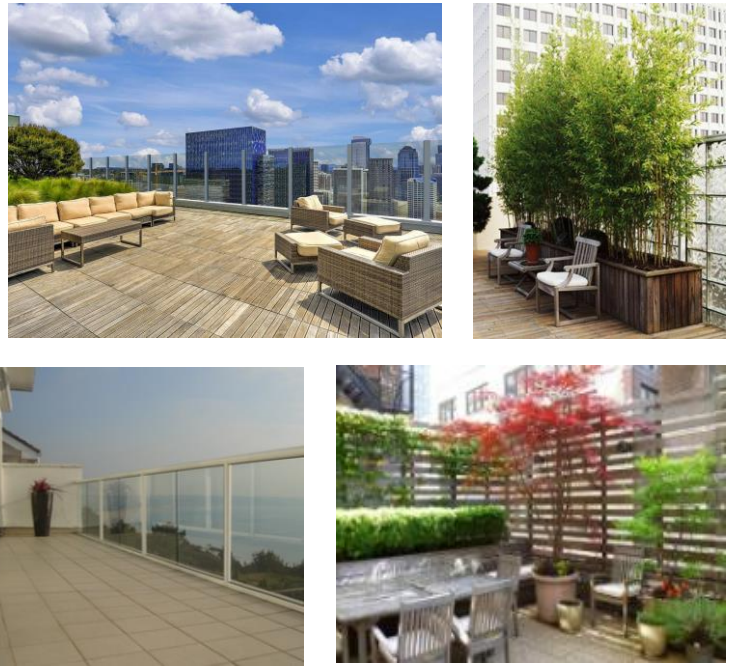


Image 10: Wind Control Measures for Terraces

7. FUTURE BUILDING

7.1 North Tower

The addition of a tower to the north of the Proposed Development in the future will likely impact the rooftop garden at Level 2 due to funnelling. The future development will however need to consider the likely redirection of the westerly winds to the north of the site due to the exposure and tower alignment. Winds from the west and northwest may be squeezed in between the tower area resulting in increased wind speeds on the north side of the terrace. Conditions in this area could be managed through the use of elements such as trellis features will help keep the wind above the podium level, while landscaping elements will further help to filter these wind conditions.

Depending on the spacing between the towers, consideration for how this may influence wind conditions at any balcony location may be of importance.

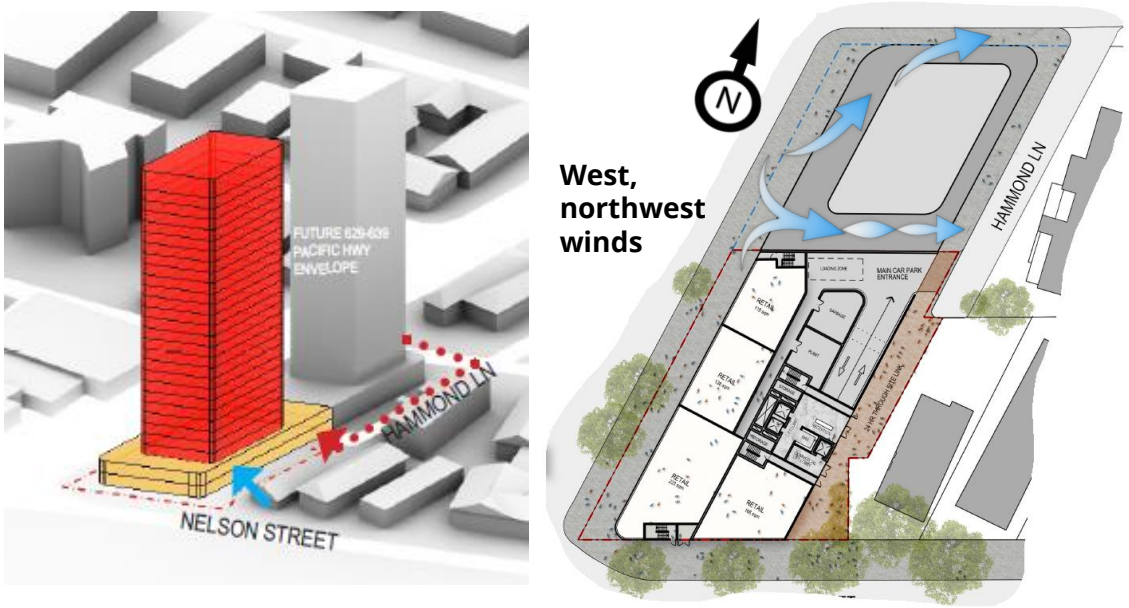


Image 11: Future Building and Wind Flow

Image 12: Sample Mitigation Measures for sitting area

8. SUMMARY

RWDI was retained to provide an assessment of the potential pedestrian wind conditions on and around the proposed development at 613 – 627 Pacific Highway in Chatswood. Our assessment was based on the local wind climate, the current proposed massing design of the proposed development, the existing surrounding buildings, our experience with wind tunnel testing of similar buildings.

Given the location and orientation of the site, and the fact that the proposed building is taller than its nearby neighbours, the form of the development will need to be considered to ensure this does not increase local wind speeds. The safety criterion is not expected to be exceeded, and measures are recommended herein to achieve comfortable wind conditions at ground and on the podium roof terrace with consideration for the impact of the adjacent future development to the north.

9. APPLICABILITY OF ASSESSMENT

The assessment discussed in this report pertain to the proposed development in accordance with the drawings received by RWDI on 25th of March 2021. In the event of any significant changes to the design, construction or operation of the building or addition of surroundings in the future, RWDI could provide an assessment of their impact wind conditions discussed in this report. It is the responsibility of others to contact RWDI to initiate this process.