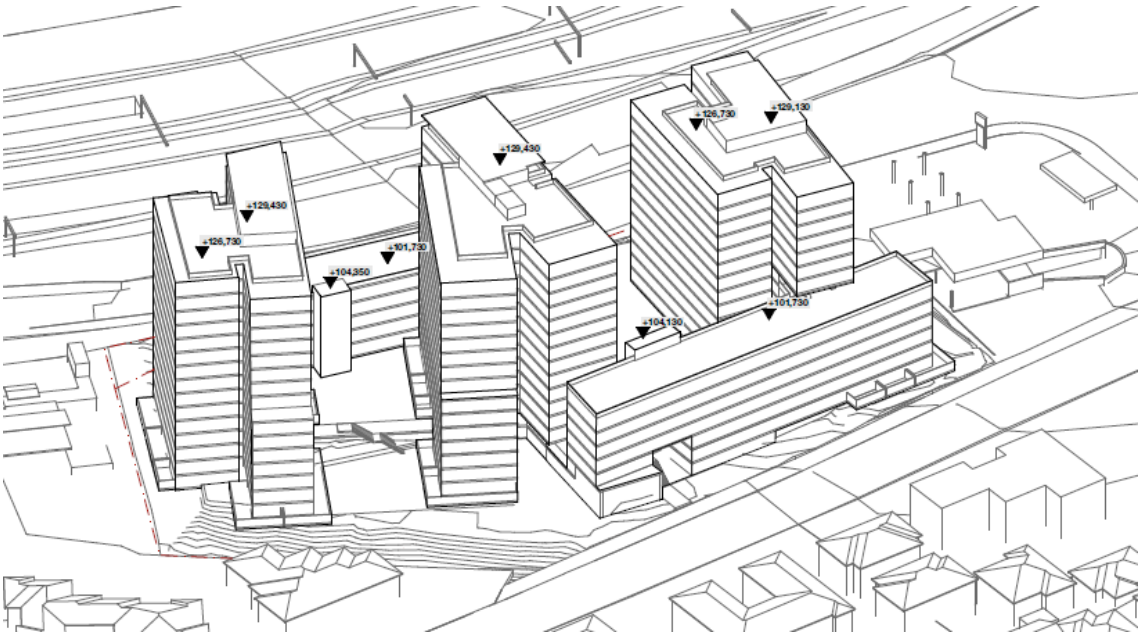

PEDESTRIAN WIND ENVIRONMENT STATEMENT

240-244 BEECROFT ROAD, EPPING

WE165-01F02(REV0)- WS REPORT

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Prepared for:

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DOCUMENT CONTROL

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June 5, 2018	Initial.	0	HK	SWR	BU
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EXECUTIVE SUMMARY

This report is in relation to the proposed development located at 240-244 Beecroft Road, Epping and presents an opinion on the likely impact of the proposed design on the local wind environment to the critical outdoor areas within and around the subject development. The effect of wind activity is examined for the three predominant wind directions for the Sydney region; namely the north-easterly, southerly and westerly winds. The analysis of the wind effects relating to the proposed development 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 received May, 2018. No wind tunnel tests have been undertaken for the subject development, and hence 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 this assessment indicate that the outdoor trafficable areas of the development site benefits from the shielding provided by subject and neighbouring buildings and use of effective wind mitigation strategies in the design such as dense landscaping and building orientation. However, there are a number of the outdoor trafficable areas are potentially exposed to a variety of adverse wind effects due to the interaction of the prevailing winds with the built form. These effects include exposure to direct wind effects due to the lack of shielding from up-stream obstructions to the prevailing winds, accelerating flows around the corners of the building, funnelling wind effects between buildings and downwash wind effects off the building facade.

It is expected that the inclusion of the following treatment strategies will be effective in mitigating the adverse wind effects within the various outdoor trafficable areas of the site detailed in this report (note that these treatment recommendations are general in nature and will be developed further during the detailed design stage).

- Inclusion of strategically located densely foliating evergreen landscaping on the ground floor and elevated outdoor spaces.
- Inclusion of screens at the corners of building forms
- Inclusion of baffle screens in the through site links
- Inclusion of awnings over the ground level footpaths, wrapping around corners
- Recessed balconies with impermeable balustrades
- Inclusion of full-height end screens for the corner balconies

- Inclusion of perimeter screening for the outdoor open spaces on the podia and rooftop
- Canopies over the rooftop outdoor open spaces

With the inclusion of the abovementioned recommendations in the final design, it is expected that wind conditions for the various trafficable outdoor areas within and around the development will be acceptable for their intended uses. Wind tunnel testing can be performed to quantitatively assess the wind effects and determine the size and extent of the treatments to ensure pedestrian comfort and safety at a more detailed design stage.

1 DESCRIPTION OF THE DEVELOPMENT AND SURROUNDINGS

The proposed development site is located in the Epping Town Centre and is bounded by Beecroft Road to the east running along the railway line, Ray Road and low-rise buildings to the the west, and low-rise buildings immediately to the north and south.

Further form the site to the north-east are 15-22 storey high apartment towers, mid-rise apartment towers and low rise residential buildings to the south. Proposed towers up to 45 storeys are proposed to the south of the subject development. To the west lies low to mid rise residential buildings approximately 5-6 storeys tall. Epping Station lies further to the south-east, and Boronia Park to the south-west. Beyond the immediate surrounds lies low to mid rise residential buildings.

An aerial image of the site and the local surroundings is shown in Figure 1.

The subject development consists of three main towers up to 15 storeys tall, with a podium being shared between the northern pair of towers on the east side, and a podium shared between the southern two towers to the west side. The site slopes upwards to the west and east of the site and upwards to the north and south of the site.

The critical outdoor trafficable areas associated with the proposed development, which are the focus of this assessment with regards to wind effects, are detailed as follows:

- The ground level pedestrian footpaths around the site
- The ground level communal outdoor areas within the site
- The various private balconies and terraces
- The elevated communal terraces and open spaces on the podia
- The rooftop communal open spaces

Figure 1: Aerial Image of the Site Location

2 WIND CLIMATE OF THE SYDNEY REGION

The Bankstown region is governed by three principal wind directions, and these can potentially affect the subject development. These winds prevail from the north-east, south to south-east and west. These wind directions were determined from an analysis undertaken by Windtech Consultants of recorded directional wind speeds obtained at the meteorological station located at Bankstown Airport by the Bureau of Meteorology. The data has been collected from this station from 1993 to 2016 and corrected so that it represents winds over standard open terrain at a height of 10m above ground level. Figure 2 shows a summary of this analysis in the form of, a directional plot of the annual and 5% exceedance mean winds for the Bankstown region is also determined. The frequency of occurrence of these winds is also shown in Figure 2.

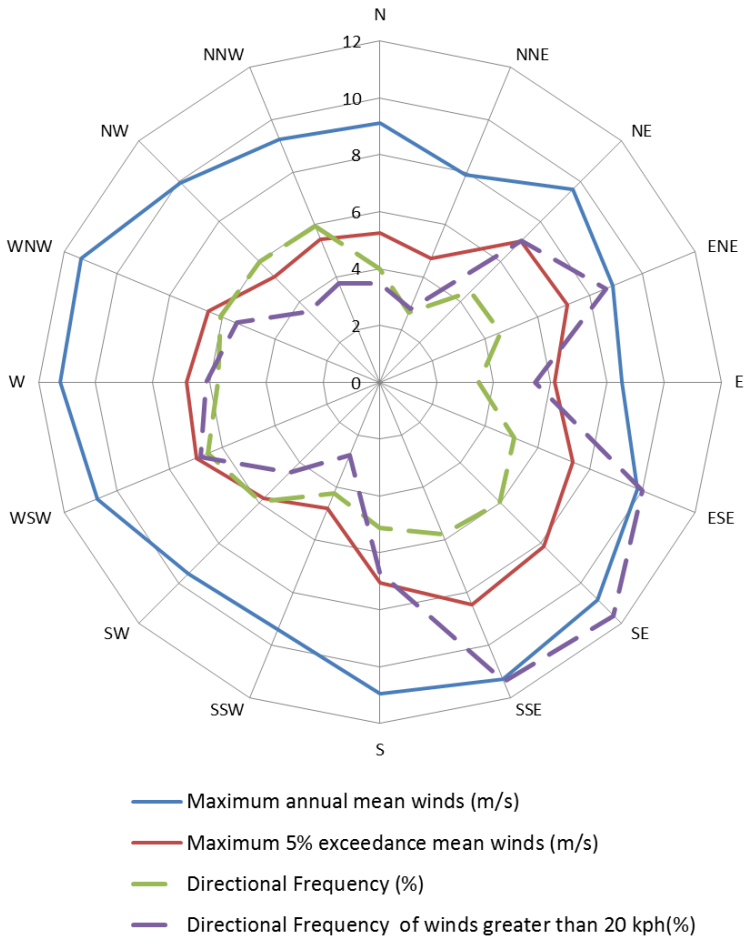

Figure 2: Annual and Weekly Recurrence Mean Wind Speeds, and Frequencies of Occurrence, for the Bankstown Region (Observations from Bankstown Airport from 1993 to 2016, corrected to open terrain at 10m)

3 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. Various other researchers, such as Davenport, Lawson, Melbourne, Penwarden, etc, have published criteria for pedestrian comfort for pedestrians in outdoor spaces for various types of activities. Some Councils and Local Government Authorities have adopted elements of some of these into their planning control requirements in Australia.

The following table is an example, which was developed by Penwarden in 1975, and describes the effects of various wind intensities on people. Note that the applicability column relates to the indicated wind conditions occurring frequently (exceeded approximately once per week on average). Higher ranges of wind speeds can be tolerated for rarer events.

Table 1: Summary of Wind Effects on People (Penwarden, 1975)

Type of Winds	Mean Wind Speed (m/s)	Effects	Applicability
Calm, light air	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	1.6 - 3.3	Wind felt on face.	
Gentle breeze	3.4 - 5.4	Hair is disturbed, Clothing flaps.	
Moderate breeze	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	8.0 - 10.7	Force of wind felt on body.	Acceptable as a main pedestrian thoroughfare
Strong breeze	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	13.9 - 17.1	Inconvenience felt when walking.	
Gale	17.2 - 20.7	Generally impedes progress, Great difficulty with balance.	Unacceptable as a public accessway.
Strong gale	20.8 - 24.4	People blown over by gusts.	Completely unacceptable.

It should be noted that wind speeds can only be accurately quantified with a wind tunnel study. This assessment addresses only the general wind effects and any localised effects that are identifiable by visual inspection and the acceptability of the conditions for outdoor areas are determined based on their intended use (rather than referencing specific wind speeds). Any recommendations in this report are made only in-principle and are based on our extensive experience in the study of wind environment effects.

4 RESULTS AND DISCUSSION

The expected wind conditions are discussed in the following sub-sections of this report for the various critical trafficable outdoor areas within and around the subject development for each of the three predominant wind directions for the Sydney region. The interaction between the wind and the building morphology in the area is considered and important features taken into account including the distances between the surrounding buildings and the proposed building form, their overall heights and bulk, as well as the surrounding landform. Note that only the potentially critical wind effects are discussed in this report, and the extent of the treatments recommended below will need to be verified through wind tunnel testing.

It should be noted that where trees have been recommended, they need to be densely foliating evergreen trees with interlocking canopies where possible in order to be effective in wind mitigation throughout the year.

4.1 Ground Level Pedestrian Footpaths

The pedestrian footpath along Beecroft Road benefits from shielding from the westerly winds by the development's building form. However, these are exposed to the prevailing north-easterly and south-easterly winds, which directly impact the site, and stream along the eastern façade. Wind accelerating around the north-eastern and south-eastern corners are expected to impact pedestrian comfort at these locations, while downwash caused by these winds are expected to impact the pedestrian footpaths directly below and adjacent to the proposed development.

The pedestrian footpaths along Ray Road is mostly shielded from the south-easterly winds and north-easterly winds by the development itself. However, the south-western corner can be potentially affected by the south-westerly winds accelerating around the corner. In addition, the westerly winds are expected to cause winds to downwash off the façade and affect pedestrian comfort along the western façade. Winds accelerating around the south-westerly corner is also expected to be caused by the westerly prevailing wind.

The wind conditions around the site are expected to be stronger than existing conditions, due to the fact that the existing site has no significant massing, and it is expected that any built form within this area is likely to cause increased wind speeds. Further from the site, wind speeds may increase further downstream of the towers. However, the conditions are expected to be similar to the existing conditions at these areas.

The proposed plans incorporate several measures that are expected to ameliorate the adverse wind effects. There is a setback from the property boundary which allows for a horizontal shielding element in the form of an awning along the façade and corners of the buildings, where the wind conditions are expected to strongest. A continuous awning or dense planting achieving the same effect is recommended along the eastern and western façades to mitigate the downwash effects. Significant deep soil planting near the south-eastern corner has been proposed, which is expected to ameliorate conditions in this area. Further screening may be

required in the form of porous or impermeable wind screens as the recommended landscaping becomes less effective in stronger winds, necessitating the use of wind screens to achieve the desired outcome. Planting along the Beecroft Road and Ray Road façades are expected to mitigate some of the sidestreaming winds. The landscaping in the areas that are affected by the westerly prevailing winds should be of an evergreen species to ensure its effectiveness throughout the year.

4.2 Ground Level Communal Outdoor Areas

The outdoor communal spaces are divided up into two main areas, the northern communal area, and southern communal area, which are affected by different prevailing wind effects.

The outdoor communal area to the north is shielded from the south-easterly winds, and mostly shielded from the north-easterly winds. There is the potential for the winds to flow over the car park ramp and adversely affect pedestrian comfort in this area. A screen or planting in this gap is recommended to aid in mitigating these wind conditions. This area is exposed to the prevailing westerly winds, however, the proposed planting recommended within this area, along with the orientation of the buildings is expected to aid in ameliorating the wind conditions in this area by slowing the winds and stagnating the flow in this region. Awnings are recommended to mitigate any downwash effects that may be caused by the westerly winds impacting the façade and affecting the pedestrians below.

The southern communal area is shielded from the westerly winds by the development itself. Both the south-easterly and north-easterly winds can cause adverse winds in this area, especially at the corners of the built form where a corner acceleration and downwash can combine near the ground level to cause strong winds. To mitigate these effects, an awning wrapping around the corners of the building form leading into this space is recommended. The planting at the entry and within this space is expected to ameliorate the adverse wind conditions by slowing down the wind. Some funnelling may occur in the through site link between Beecroft Road and Ray Road. It is recommended that the through site link incorporate screening to baffle the flow and ensure that the prevailing winds do not have a direct path through the site. Localised operable screening or planter boxes may be required to ensure that the wind conditions are comfortable for an area's intended purpose.

4.3 Various Private Balconies/Terraces

The wind conditions for the various private balconies are heavily dependent on the location and design. The building itself can shield the balconies from the prevailing winds. For example, the balconies on the middle tower are expected experience some shielding from direct north-easterly and south-easterly winds. However, sidestreaming winds along the façade can still affect the balconies if they protrude from the façade, or if the balconies are directly exposed to the prevailing winds. It is recommended to incorporate screening and/or impermeable balustrades, or to recess the balconies into the building form. Generally, the wind speeds at the corners of the building form are expected to be the highest due to the winds accelerating around the corner of the building. Hence, balconies located in these areas are recommended to

incorporate full-height end screens. This can be in the form of glazing, louvres, etc. (which can be operable) which are expect to mitigate this effect. Larger balconies/terraces may require higher perimeter screening to prevent the flow from reattaching back onto the balcony/terrace.

The use of loose glass-tops, lightweight sheets or covers (including loose BBQ lids) and other lightweight furniture is not recommended on the upper level outdoor terraces and balconies unless it is securely attached to the balcony or terrace floor slab.

4.4 Podia Communal Open Spaces

The elevated communal outdoor areas are located on the podia situated between the towers. The northern communal open space is exposed to the north-easterly, south-easterly and westerly prevailing winds. The wind impacts that are expected to affect this space are north-easterly winds accelerating around the south-eastern corner of the northern tower, south-easterly winds accelerating around the north-eastern corner of the middle tower, and funnelling of the westerly winds between the northern tower and middle tower. Winds impacting the façade can also upwash and cause adverse winds on the middle of the communal open space.

The southern communal open space is similarly less exposed to the prevailing winds. The middle tower is expected to shield this area from the prevailing north-easterly winds significantly, while the southern tower is expected to provide some shielding from the direct south-easterly winds. However, the westerly winds also remain unshielded while the north-easterly and south-easterly winds may cause funnelling between the southern and middle towers as well. The south-western corner of the southern tower is also expected to accelerate the south-easterly winds around this corner.

In both these communal open spaces, landscaping is recommended to reduce the effect of the adverse winds. In order to be effective as a wind mitigation measure, the recommended planting should be densely foliating with interlocking canopies, rather than planted in isolation. Due to its exposure to the prevailing westerly winter winds, the planting should be of an evergreen variety to ensure its effectiveness throughout the year. The perimeter of the terraces should incorporate wind screening to redirect the winds above the trafficable space. For the abovementioned corner accelerations, wind screens connected to the façade are expected to be required to be implemented to mitigate this effect. These screens can be supplemented with additional planting in these areas to further improve conditions.

4.5 Rooftop Communal Open Spaces

The communal open spaces of the various rooftop areas are exposed to all of the prevailing winds due to its height and exposure. Similarly to the mitigation strategies recommended for the podia communal open spaces, perimeter screening and landscaping throughout these areas will benefit the usability of this space. Screening or planting near the corners of the built forms can minimise the corner accelerations, while a canopy (e.g. pergola or trellis) can prevent the adverse winds from reattaching and keep the flow above the trafficable areas.