HONEYSUCKLE CITY CAMPUS MASTERPLAN, UNIVERSITY OF NEWCASTLE

PEDESTRIAN WIND ENVIRONMENT STATEMENT

WF132-01F02(REV1)- WS REPORT

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DOCUMENT CONTROL

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EXECUTIVE SUMMARY

This report is in relation to the University of Newcastle Honeysuckle City Campus Masterplan located in Newcastle, and presents an opinion on the likely wind conditions affecting the various trafficable outdoor areas within and around the subject development. The effect of wind activity is examined for the predominant wind directions for the Newcastle region. The analysis of the wind effects relating to the subject site has been 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 concept masterplan drawings set prepared by Cox Architecture, received November 6, 2019. 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 some parts of the subject development will benefit from shielding by neighbouring buildings and the development itself from some of the prevailing wind directions. Some of the key design elements that have been incorporated into the masterplan which are expected to aid in mitigating adverse wind conditions include:

- The introduction of defined podiums and significant setbacks above Level 1 across all the Lots of the development.
- The orientation of the lots to avoid direct alignment with the strongest of the prevailing wind directions.
- Corner chamfers to reduce the effect of winds accelerating around the corners of the built form.

However, the site is still relatively exposed to the prevailing winds for the region due to the low-rise surrounding structures. Certain regions of the development may be prone to adverse wind effects due to the interaction of the prevailing winds with the built form. These potentially adverse wind effects include the direct impact of the prevailing winds, funnelling winds between the various podia and towers due to the alignment of the buildings with respect to the prevailing winds, the side-streaming and acceleration of winds around the various corners of the development and downwash caused by the prevailing winds impacting the building and redirecting winds downwards.

To address the potential for adverse wind effects impacting the comfort of pedestrians within and around the development, generalised wind mitigation treatments that should be considered are discussed within this report, and are summarised as follows:

- Retention of proposed planting and vegetation throughout the site. Undergrowth such as shrubs or hedges are expected to further improve wind conditions.

- Inclusion of continuous awnings over trafficable areas below towers or podia of a significant height which are exposed to the prevailing winds.
- Inclusion of localised screening where longer duration activities are expected such as cafés, shopfronts and main entryways.
- Inclusion of operable screening to be utilised by the various retail tenancy owners for usability of outdoor spaces and patron comfort.
- Inclusion of wind screens or planting within through-site links, and near the corners of buildings.

A landscaping strategy is undergoing development for the site. Note that for tree planting/landscaping to be effective as a wind mitigation device, the species should be of a densely foliating variety to ensure its effectiveness in wind mitigation. Evergreen trees should be considered for areas affected by the prevailing winds during winter. Trees should also be planted in clusters with interlocking canopies to more effectively absorb incident winds.

With the inclusion of these considerations in the detailed design of the development, wind conditions within outdoor trafficable areas of the development are expected to be suitable for their intended uses.

At this early design stage, wind tunnel testing is not necessary to be undertaken, as the recommendations and advice given at this stage are general in nature and is intended to guide the ongoing development of the design. It is important that wind tunnel testing is undertaken at a later, more detailed design stage to provide a quantitative assessment of the wind conditions to align with the intended uses of the spaces, when treatment strategies will undergo further refinement.

1 INTRODUCTION

An opinion on the likely impact of the proposed design on the local wind environment affecting pedestrians within the critical outdoor areas within and around the subject development is presented in this report. The analysis of wind effects relating to the proposed development was carried out in the context of the predominant wind directions for the region, building morphology of the development and nearby buildings, and local land topography. The conclusions of this report are drawn from our extensive experience in the field of wind engineering and studies of wind environment effects.

No wind tunnel testing was undertaken for this assessment. Hence this report addresses only the general wind effects and any localised effects that are identifiable by visual inspection, and any recommendations in this report are made only in-principle.

2 DESCRIPTION OF THE DEVELOPMENT AND SURROUNDINGS

The University of Newcastle Honeysuckle City Campus Masterplan site is bounded by Honeysuckle Drive to the north, Worth Place to the west, Civic Lane to the south, and adjacent developments to the east.

Further from the site is Hunter River to the north, existing mid-rise buildings approximately 5-9 storeys tall to the north, east and west of the site, and low to mid-rise buildings to the south.

The development precinct will be primarily comprised of academic buildings and student accommodation up to 9 storeys in height, with ground floor activation, and plaza areas.

A survey of the local land topography around the site indicates that the terrain is generally flat around the development. An aerial image of the site and the local surroundings is shown in Figure 1. The critical trafficable outdoor areas associated with the proposed development, which are the focus for pedestrian wind effects in this assessment, are detailed as follows:

- The pedestrian footpaths areas around the site.
- The activated ground level areas with and around the site.
- The "Campus Heart" area.
- The "Turntable Plaza" area.
- The podia of the various towers of each lot.

Figure 1: Aerial Image of the Proposed Development Site

3 REGIONAL WIND

The Newcastle region is governed by three principal wind directions, and these can potentially affect the subject development. These winds prevail from the west-north-west, north-east and south directions. A directional plot of the annual and 5% probability of exceedance winds for the Newcastle region is shown in Figure 2. The frequency of occurrence of these winds is also shown in Figure 2. The seasonal frequency of the prevailing wind directions is shown in Figure 3. The west-north-westerly winds are the most frequent and occur predominantly throughout the winter months, while the north-easterly and southerly winds occur most frequently throughout the summer months. These plots have been produced based on an analysis of recorded wind speed data obtained from Williamtown Airport from 1958 to 2013.

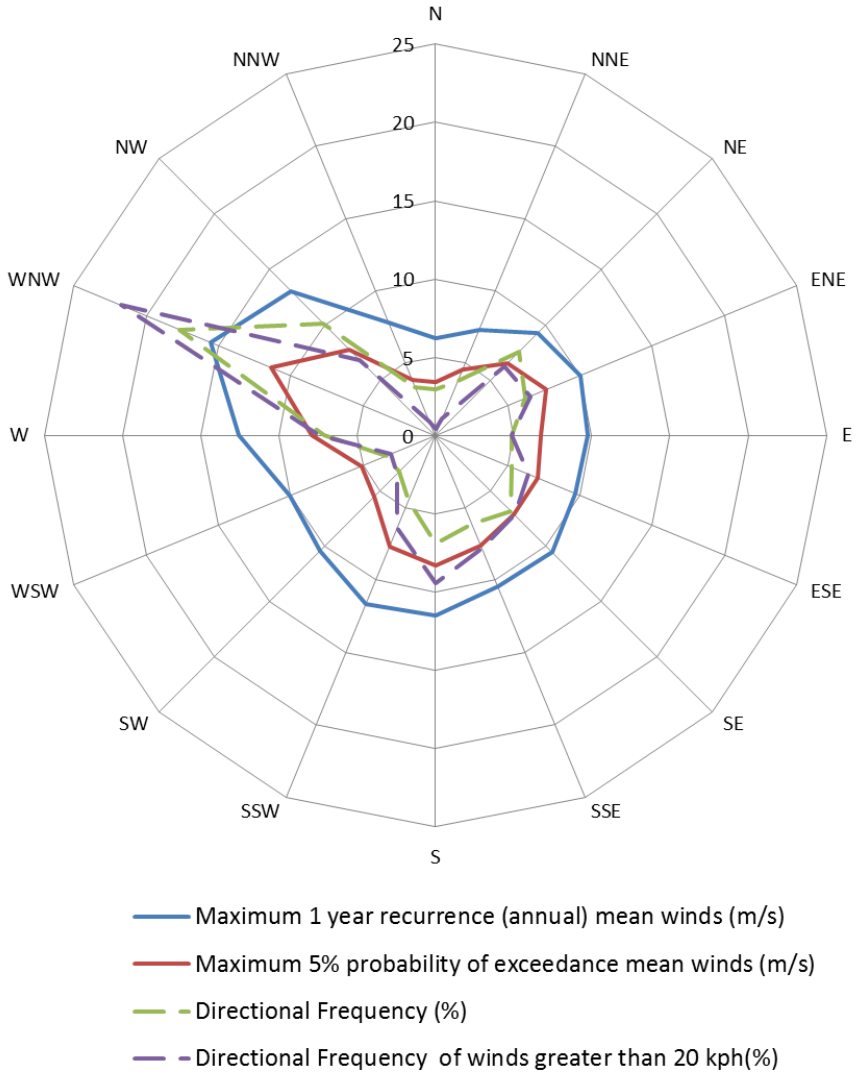

Figure 2: Annual and 5% probability of exceedance Mean Wind Speeds, and Frequencies of Occurrence, for the Newcastle Region (based on 10-minute mean observations from Williamtown Airport from 1958 to 2013, corrected to open terrain at 10m)

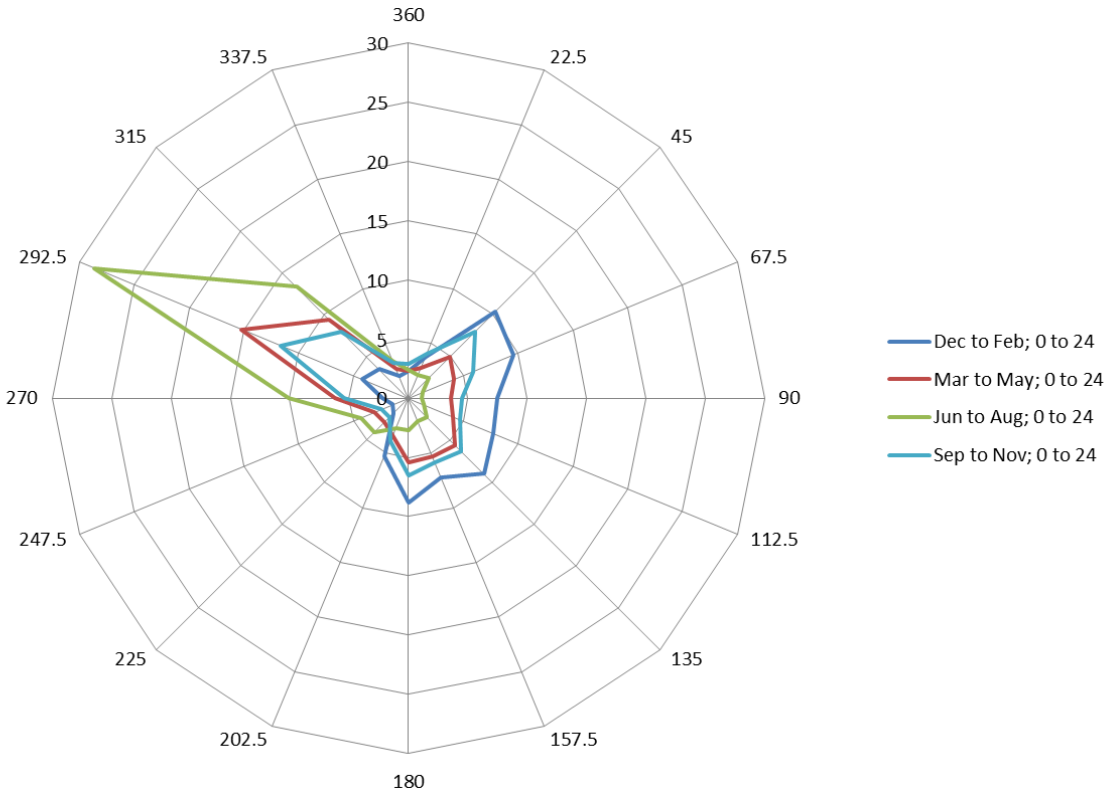

Figure 3: Seasonal Mean Wind Speeds for the Newcastle Region (based on 10 minute mean observations from Williamtown Airport from 1958 to 2013, corrected to open terrain at 10m)

4 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 A.G. Davenport, T.V. Lawson, W.H. Melbourne, and A.D. Penwarden, 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.

For example, A.D. Penwarden (1973) developed a modified version of the Beaufort scale which describes the effects of various wind intensities on people. Table 1 presents the modified Beaufort scale. Note that the effects listed in this table refers to wind conditions occurring frequently over the averaging time (a probability of occurrence exceeding 5%). Higher ranges of wind speeds can be tolerated for rarer events.

Table 1: Summary of Wind Effects on People (A.D. Penwarden, 1973)

Type of Winds	Beaufort Number	Mean Wind Speed (m/s)	Effects
Calm	0	Less than 0.3	Negligible.
Calm, light air	1	0.3 – 1.6	No noticeable wind.
Light breeze	2	1.6 – 3.4	Wind felt on face.
Gentle breeze	3	3.4 – 5.5	Hair is disturbed, clothing flaps, newspapers difficult to read.
Moderate breeze	4	5.5 – 8.0	Raises dust, dry soil and loose paper, hair disarranged.
Fresh breeze	5	8.0 – 10.8	Force of wind felt on body, danger of stumbling
Strong breeze	6	10.8 – 13.9	Umbrellas used with difficulty, hair blown straight, difficult to walk steadily, wind noise on ears unpleasant.
Near gale	7	13.9 – 17.2	Inconvenience felt when walking.
Gale	8	17.2 – 20.8	Generally impedes progress, difficulty balancing in gusts.
Strong gale	9	Greater than 20.8	People blown over.

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.

5 ANALYSIS AND DISCUSSION

The expected wind conditions are discussed in the following sub-sections of this report for the various outdoor areas within and around the subject development, for each of the prevailing wind directions for the region. The interaction between the wind and the building morphology in the area was considered, and important features taken into account include the distances between the building forms, their overall heights and bulk, as well as the landform. Note that only the potentially critical wind effects are discussed in this report.

5.1 Site Location

The site is located on the southern side of Hunter River, and so is particularly exposed from the north-easterly direction. However, there are several taller nearby buildings immediately to the north and north-east of the site that offers some protection from the north-easterly prevailing winds which would otherwise impact the site directly.

Other low and medium rise buildings lie to the east, south and west of the site are expected offer some protection from the southerly and west-north-westerly prevailing winds.

5.2 West-North-Westerly Sector Winds

The west-north-westerly prevailing winds occur predominantly during the winter months for the Newcastle region. These winds are particularly undesirable due to the negative impact upon the human perception of comfort as a result of the cooler winds. They are also the strongest and most frequent for the region.

The podium setback for lots A2, B and C are expected to aid in mitigating the downwash from impacting the ground level significantly. The alignment of the chamfered corner of Lot A1 also promotes the formation of a wind stagnation region where lower wind speeds are expected.

However, adverse wind conditions are expected near the exposed corners of the buildings, particularly for the north-eastern corner of Lots A1, A2 and C, and south-western corner of Lots A1 and B. The corner acceleration. Direct impact and side streaming winds are also expected for the Worth Place aspect. Funnelling is also expected to occur between Lots A1 and B, as well as between the northern lots along Honeysuckle Drive. The expected north-north-westerly wind flow and hot spots are shown in Figure 4.

Corner treatments such as screening to trip the wind as it accelerates around the corners of the built form on the Honeysuckle Drive frontage is recommended. Additional localised screening, planting or operable screens are recommended to be implemented for any area that would require. Further measures such as chamfering the building form may be required to reduce the strength of the winds accelerating around the corner. An awning over the pedestrian trafficable areas to the west of Lot B and wrapping around to Civic Lane can be implemented to reduce the impact of downwashed winds combining with the ground level side streaming winds.

Relocation of areas where longer duration stay is expected away from the hot spots as shown in Figure 4 can also be considered.

Additional significant densely foliating evergreen landscaping within the Campus Heart and Turntable Plaza is recommended to provide additional shielding to wind sensitive areas due to the funnelling of the prevailing winds. In addition, further planting is recommended between Lots A1/A2 and Lot B to further mitigate the effect of the funnelling between the built forms.

The podium between Lot A1 and A2 are expected to experience funnelling effects. Perimeter screening can be used to deflect these winds. Further landscaping between the buildings is expected to aid in reducing the funnelling impact. The podium of Lots B and C are expected to also be affected by the west-north-westerly prevailing winds. Perimeter screening and/or landscaping within these spaces can be implemented to aid in achieving conditions suitable for the uses of these various outdoor trafficable areas.

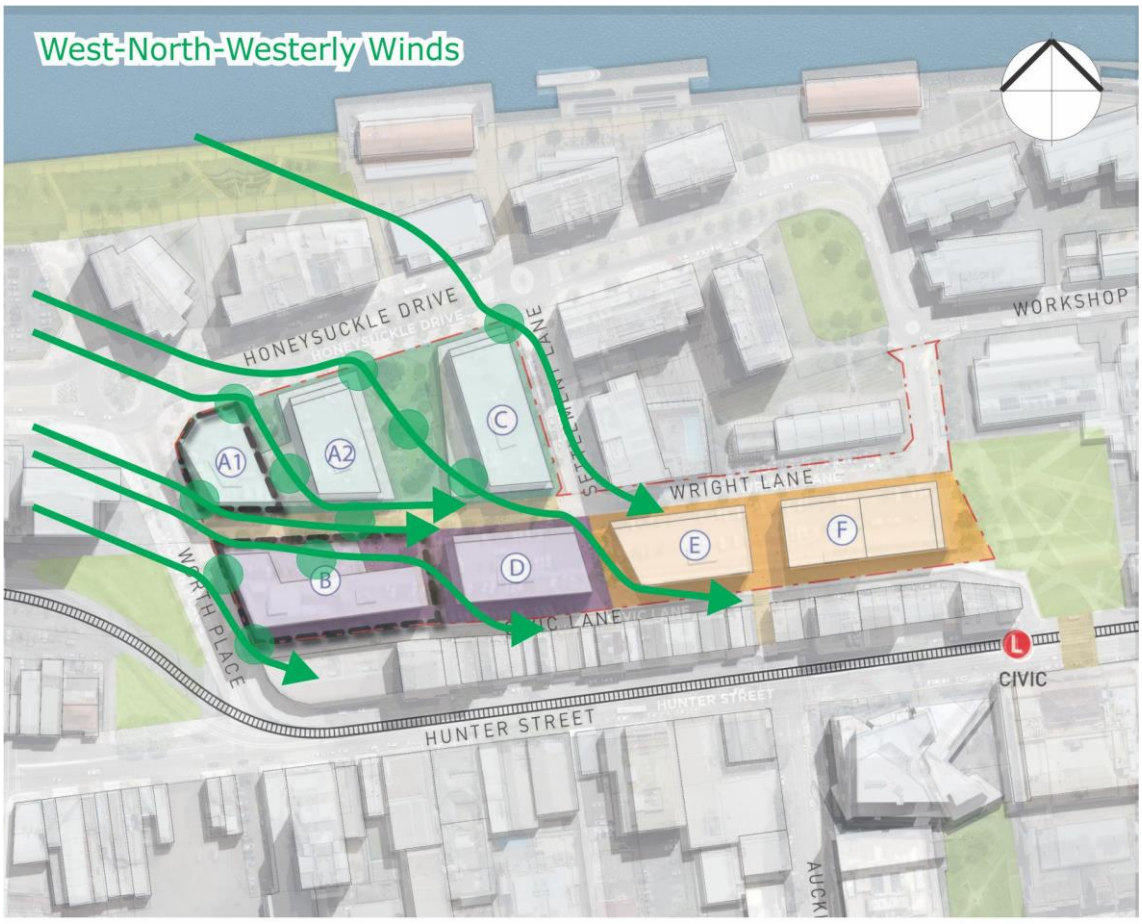

Figure 4: West-North-Westerly Wind Flow and Hotspots

It is recommended that wind tunnel testing be undertaken at a more detailed design stage in order to quantitatively asses the wind conditions within and around the site and each of the lots, to ensure suitable pedestrian wind conditions are satisfied throughout the development.

It is expected that with the implementation of treatment measures, the requirements of which are to be optimised at a more detailed design stage, the development can meet pedestrian wind comfort and safety requirements appropriate for the use of the space.

5.3 North-Easterly Sector Winds

The north-easterly winds prevail throughout the summer months (and the spring and autumn to a lesser extent) and is expected to impact site by flowing over the shorter neighbouring buildings, as well as sidestreaming along Honeysuckle Drive. The taller buildings to the north and north-east of the site are expected to reduce the strength of the prevailing wind.

The presence of significant tower setbacks from the podium and alignment of the building façades with respect to the north-easterly prevailing wind, is expected to reduce the severity of winds downwashing on the pedestrians below for the Honeysuckle Drive footpaths. These design features are recommended to be retained as the design develops. The development itself provides shielding for the Worth Place and Civic Lane pedestrian footpaths from this prevailing wind direction.

There critical areas within the site that are expected to experience strong wind conditions are shown in Figure 5. Of particular note are the corners of the various affected lots, which are expected to accelerate these prevailing winds around the building corner. Furthermore, due to the orientation of the building forms, the prevailing winds are expected to funnel through between Lots A2 and C and impact the Campus Heart outdoor communal space, and the Turntable Plaza. Wright Lane and the area between Lots E and F may also experience adverse winds due to the north-easterly winds funnelling between the tower forms.

It has been noted that there are several areas intended for ground level activation. It is recommended that screening measures such as full-height blade walls, localised porous/impermeable screening elements, operator controlled portable screening, planter boxes or other forms of landscaping be implemented for the hot spots as highlighted in Figure 5. Relocation of wind sensitive areas away from these hot spots may also be appropriate, depending on the proposed use of the space. For the Campus Heart and Turntable Plazas, as well as other areas affected by funnelling winds, further landscaping may be required within these spaces to reduce the strength of the wind as it passes through this space.

The outdoor trafficable areas on the various podia for the lots may be adversely affected. Perimeter screening or localised screening elements near the corners of the tower form are expected to be able to mitigate the adverse wind effects.

Figure 5: North-Easterly Wind Flow and Hotspots

It is recommended that wind tunnel testing be undertaken at a more detailed design stage in order to quantitatively asses the wind conditions within and around the site and each of the lots, to ensure suitable pedestrian wind conditions are satisfied throughout the development.

It is expected that with the implementation of treatment measures, the requirements of which are to be optimised at a more detailed design stage, the development can meet pedestrian wind comfort and safety requirements appropriate for the use of the space.

5.4 Southerly Sector Winds

The southerly prevailing winds occur during the summer months (and the spring and autumn to a lesser extent), and flow over a range of low to mid-rise buildings, which is expected to reduce the strength of these winds. The nearby low-rise to the south of the site are expected to provide shielding for the ground level footpaths along Civic Lane. The site itself shields a significant portion of the podium of Lot B2 as well as the Turntable Plaza.

Due to the alignment of the building façade with the prevailing southerly winds, downwash from the towers is expected to increase the strength of the prevailing winds when compared with the existing conditions. Furthermore, the exposed corners of Lot B and Lot F, and through-site links between Lots B and D, Lots D and E and Lots E and F are expected to be adversely affected. While the Civic Lane frontage is for the most part un-activated, there is expected to be a flow-on effect, allowing wind to funnel through the Campus Heart and Settlement Lane. The wind flow paths and associated hot spots are shown in Figure 6.

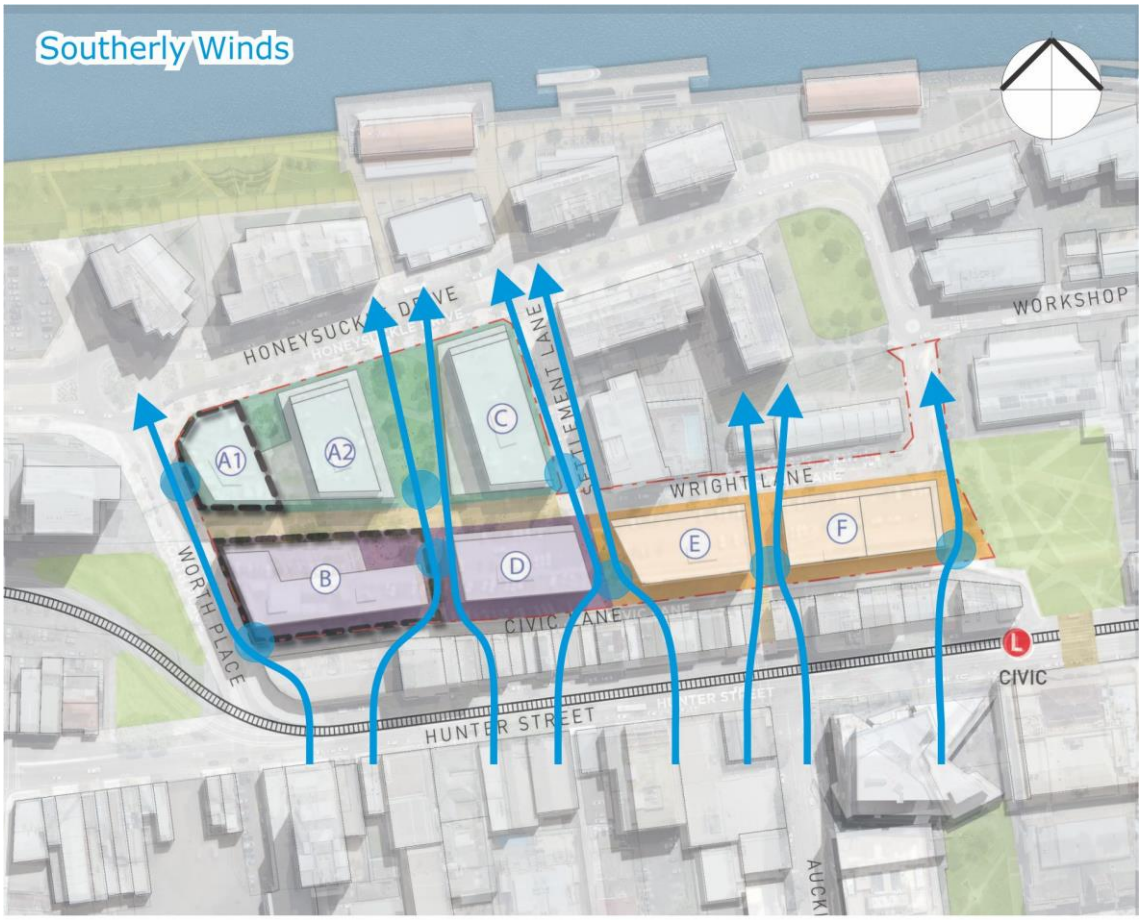

Figure 6: Southerly Wind Flow and Hotspots

Landscaping in the form of densely foliating trees between each of the Lots such as is the case between Lots D and E are expected to aid in reducing the adverse wind conditions expected. Furthermore, the landscaping on the western aspect of Lot B and eastern aspect of Lot F are also expected to aid in reducing the effect of corner acceleration.

To mitigate the adverse downwash effects, an awning along the Civic Lane frontage is recommended, that wrap around the corner to the through-site links, preventing winds from further exacerbating the funnelling between the built forms.

It is recommended that wind tunnel testing be undertaken at a more detailed design stage in order to quantitatively asses the wind conditions within and around the site and each of the lots, to ensure suitable pedestrian wind conditions are satisfied throughout the development.

It is expected that with the implementation of treatment measures, the requirements of which are to be optimised at a more detailed design stage, the development can meet pedestrian wind comfort and safety requirements appropriate for the use of the space.

5.5 General Recommendations

For tree planting/landscaping to be effective as a wind mitigation device, the species should be of a densely foliating variety. The area is affected by a winter wind, it is recommended that an evergreen species be selected to ensure year-round effectiveness. Trees should also be planted in clusters with interlocking canopies to effectively absorb incident winds. In sensitive areas or hotspots where strong winds are expected, mature trees should be used as immature trees have difficulty establishing themselves in strong wind conditions. If immature trees are initially planted, the inclusion of porous screens around these tree plantings, or temporary wind screens is recommended to provide some wind mitigation while the trees develop and also provide some protection as the trees establish. Conditions can be further improved through the use of low-level vegetation such as shrubs/hedges or planter boxes. When utilised below a tree canopy, they provide protection from low level winds, especially for more sensitive areas where longer duration activities are expected. In general, landscaping can help mitigate adverse wind conditions caused by winds directly impacting an area, or side streaming winds by slowing the winds upstream.

In areas where stronger winds are expected, wind screens may be required as trees are generally not effective in particularly strong gusts. These can be in the form of impermeable screens, porous screens, signage, artwork etc. which are strategically located to mitigate winds at a particular location. In areas where longer duration stay is expected, such as café or restaurant seating areas, or communal recreation areas, additional localised screening, tenancy-operated screening deployable during windy conditions, or planting may be required. The location of these areas at the corners of buildings places them in an area where there is a high potential for adverse winds.

Downwash is most likely to occur at the base of tall buildings that present a flat façade to the prevailing winds. The proposed setback in the various towers of the development is expected to assist in breaking up the downwash flows, however to effective in downwash mitigation it is suggested the setback be at least 3m in length. In downwash affected areas, especially at the ground level, awnings and canopies can be used to deflect the winds away from pedestrian accessible areas. Generally, for these to be effective in achieving this, an awning of at least 3m would be required. This combined with tree planting alongside for the winds to be absorbed into would be particularly effective in mitigating this wind effect. Wrap-around awnings at the corners of buildings can also prevent the down washed winds from combining with winds side

streaming around the corners of the development. To reduce the ability of winds to downwash along the tower facades, horizontal and vertical feature elements can also be included.

Through-site links and tower aspects should be oriented to avoid direct alignment with the prevailing winds, incorporate bends, planting or screens in order to mitigate funnelling effects between building and tower massing's. The funnelling between buildings may be severe enough for further mitigation measures such as a baffle screen arrangement. This tends to reduce the severity of winds affecting a particular area by redirecting it around obstacles, and thus reducing the wind speed.