CPP WIND ENGINEERING CONSULTANTS

QUALITATIVE WIND ASSESSMENT
CPP PROJECT 18496
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Portside Build to Rent

Hamilton, Brisbane

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Executive Summary

A qualitative assessment of the Portside Build to Rent development to be built in Hamilton, Brisbane was conducted to provide an initial assessment of the surrounding pedestrian wind environment. The assessment was based on the local wind climate, CPP's experience in the region and on comparable projects, and the characteristics of the proposed development.

The wind environment around the development is likely to be generally suitable for Pedestrian Standing to Walking style activities from a comfort perspective with reference to the Lawson criteria. No major adverse impacts to pedestrian comfort or amenity are foreseen as a result of the proposed development. Areas intended for long term stationary activity such as seating and dining may require treatment to ensure they are suitable for their intended use. All areas in the public domain in the vicinity of the subject site are expected to satisfy the relevant wind safety criterion.

Stronger wind conditions are expected to occur on the podium and rooftop terraces during higher winds. The proposed booth style seating, pavilions, pergolas and heavy landscaping features will help to create calmer areas suitable for their intended use.

The proposed residential balconies, at the tower corners, may occasionally experience strong wind conditions, though conditions would be similar to comparable developments in Brisbane. The proposed balconies situated away from the tower corners are well located and sized from a wind comfort perspective.

This report is a high-level qualitative assessment based on basic features of the local wind climate and proposed built environment. Wind tunnel testing would be suggested should quantification of conditions be required and/or for development of specific mitigation measures.

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1. Introduction

GENERAL INFORMATION

The assessment of the wind environment around developments can ensure adverse impacts are minimized and inform designers about the suitability of outdoor areas for their intended uses. Where necessary, design modifications can be made, or intervention measures added to mitigate areas with the potential for excessive wind speeds.

The proposed development is located in Hamilton, approximately 5 kilometres to the north-east of the Brisbane CBD. The surrounding terrain is comprised primarily of low-rise suburban development, with some larger commercial towers, Figure 1

The proposed development is comprised of two prismatic towers with compound planform shapes set back over a podium, reaching a maximum height of about 80 m above ground level, Figure 2. As it is slightly larger than most of the surrounding structures, the addition of the proposed development is expected to have some impact on the local wind conditions, and the extents are broadly discussed in this report.

Figure 1: Aerial view of proposed development site (Google Earth, 2023)

Figure 2: Level 5 – Podium Rooftop Floor plan and south Elevation of proposed development

2. Wind Climate

The proposed development lies approximately 6 km to the south-west of the Brisbane Airport Bureau of Meteorology anemometer, which provides the best source of historical wind data for the project. 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 from 2000 – 2022 have been used in this analysis.

The wind rose for Brisbane Airport is shown in Figure 3. The arms of the wind roses point in the direction from where the wind is blowing from, the width and color of the arm represent the wind speed, and the length of the arm indicates the percent of the time that the wind blows for that combination of speed and direction.

The distribution and frequency of winds on an annual basis were analyzed to assess the project with regards to wind comfort and safety. As can be seen from the wind rose in Figure 3, winds from the south-west to west and north-east directions are predominant, with secondary winds occurring from the south-east quadrant. This wind assessment is structured around these prevailing wind directions.

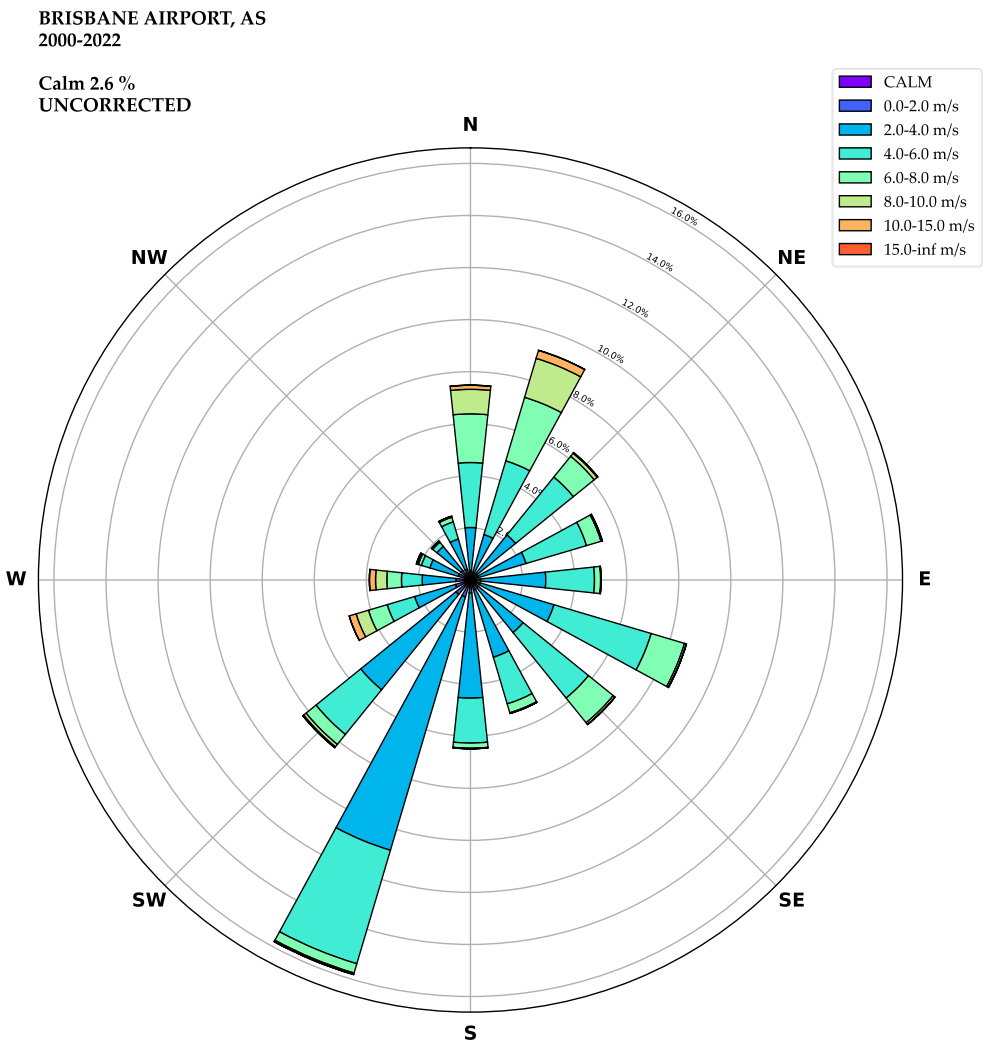

Figure 3: Probability of Wind Speeds by Direction Brisbane Airport –(2000 – 2022, All Hours)

3. Wind Assessment Criteria

A number of researchers have suggested quantitative methods for assessing wind comfort and safety based on estimated wind speeds and local climate statistics. These criteria provide a means of evaluating the wind amenity of location based on the frequency of threshold wind speeds, noting that pedestrians will tolerate higher wind speeds for a shorter time period than lower speeds. The comfort criteria also allow planners to assess the usability, with respect to the wind environment, of different locations for various purposes.

The Northshore Hamilton PDA Development Scheme (2022) requires consideration of the prevailing winds for the site area but does not specify a method of assessing wind comfort or safety for this site. CPP uses a modified form of the widely-accepted pedestrian-level wind criteria developed by Lawson (1990). Lawson's criteria are divided into separate categories of comfort and distress (safety).

Lawson's criteria are based on wind speeds exceeded 5% of the time, and are described as categories for comfort ranging from 'Pedestrian Sitting' to 'Business Walking', allowing planners to judge the usability of locations for various intended purposes. The criteria also include a distress rating, for safety assessment, which is based on occasional (once or twice per year) wind speeds, to identify locations where wind speeds may be hazardous to pedestrians.

The categories and criteria are specified in Table 1. In general, wind conditions comfortable for Sitting and Standing are considered appropriate for areas such as entrances where pedestrians are likely to gather for longer durations, while wind conditions comfortable for Casual Walking and Business Walking are more appropriate for sidewalks where pedestrians are actively in transit. Locations rated as Uncomfortable are generally less suitable for most pedestrian activities and wind control solutions are often sought. Whether mitigation is needed at a location depends upon the intended pedestrian use of the location.

Satisfaction of the safety rating is generally required for areas accessible to the general public. A rating of 'Able-Bodied' may be acceptable for areas with managed access or where pedestrians are unlikely to be present under adverse conditions.

Pedestrians' perception of wind can often be subjective and vary depending on regional difference in wind climate and thermal conditions, as well as by individual. Calibration to the local wind environment should be taken into account when evaluating predicted wind comfort conditions. Note that the ratings of 'Uncomfortable' and 'Safety' are the words of the published wind criteria and applicability may vary by project and location.

Table 1: Wind Comfort and Safety criteria (after Lawson, 1990)

COMFORT RATING	U_{EQUIV}*	DESCRIPTION
Dining**	< 2 m/s	Calm / light breezes suitable for outdoor restaurant uses, seating areas, and other amenities based on CPP experience.
Sitting	2-4 m/s	Calm or light breezes suitable for long duration seating areas, and other amenities.
Standing	4-6 m/s	Gentle breezes suitable for sitting for shorter periods, main entrances and bus stops where pedestrians may linger.
Pedestrian Walking	6-8 m/s	Moderate winds appropriate for window shopping and strolling along a downtown street, or park.
Business Walking	8-10 m/s	Relatively high speeds that can be tolerated if one's objective is to walk, run, or cycle.
Uncomfortable	> 10 m/s	Strong winds unacceptable for all pedestrian activities; wind mitigation is typically required.

*U_{Equiv} = Max (U_{Mean}, U_{Gust} / 1.85).
*U_{Equiv} speeds are based on an annual exceedance of 5% (~8 hours / week) assessed over all hours.
** For regular outdoor dining, and in semi-enclosed spaces, it has been the experience of CPP that the comfort rating of Sitting may be windier than desired and a comfort criterion of 4 m/s or less may be more applicable.

SAFETY RATING	U_{EQUIV}*	DESCRIPTION
Pass	< 15 m/s	Meets wind safety criterion.
Able-Bodied	15-20 m/s	Acceptable where only able-bodied people would be expected; not acceptable for frail persons or cyclists
Fail	>20 m/s	Excessive wind speeds that can adversely affect a pedestrian's balance and footing. Wind mitigation is often required.

* U_{Equiv} = Max (U_{Mean}, U_{Gust} / 1.85).
*U_{Equiv} speeds are based on an annual exceedance of 0.022% (~2 / year or 1 / season) assessed over all hours.

3. Assessment

SITE DESCRIPTION

The proposed development site is surrounded by medium-rise buildings of comparable height in the north, south and west directions. A region of parkland lies to the north-west and on the eastern side, the site is bordered by low-rise buildings and the Brisbane River. Topography surrounding the site is relatively flat from a wind perspective and unlikely to significantly affect the wind climate at the site. Winds in such surrounds tend to experience less channelling than areas with many tall structures, with local effects instead being dictated by exposed buildings and their relation to prevailing strong wind directions. Several wind flow mechanisms such as downwash and channelling flow are described in Appendix A and the effectiveness of some common wind mitigation measures are described in Appendix B.

The subject site is located on a block bounded by MacArthur Avenue to the north and Wharf Street to the east. The proposed development consists of two prismatic towers with a curved compound rectangular planform, over a shared podium structure with ground-floor retail tenancies and pedestrian communal spaces. A ground floor plan is shown in Figure 4.

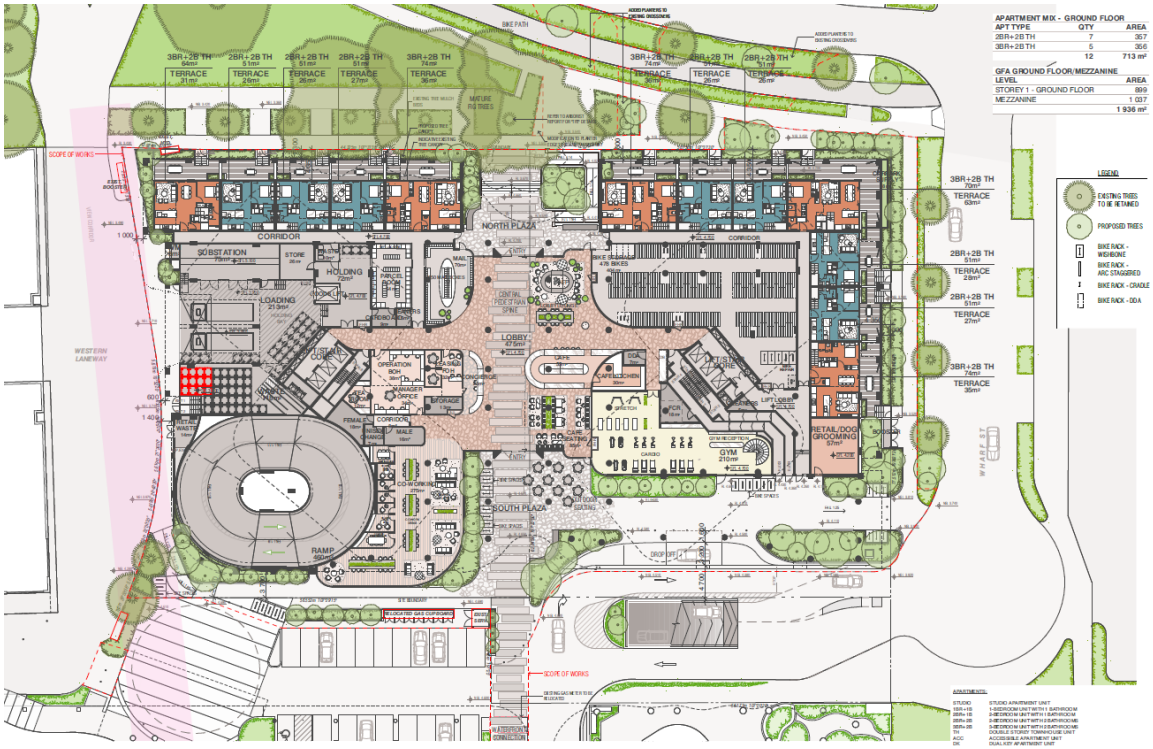

Figure 4: Ground floor plan of proposed development

WINDS FROM THE NORTH-EAST

Winds from the north-east quadrant will approach the site over Moreton Bay and the industrial area of Brisbane Airport and Eagle Farm. Winds from this quadrant are relatively unimpeded approaching the development due to the absence of tall buildings or obstacles. Pedestrian areas along the eastern and northern boundaries of the development may be affected by stronger breezes as the proposed development massing directs wind flow along Macarthur Avenue and Wharf Street. The proposed landscaping at the site boundary will provide a beneficial effect on local wind conditions and is recommended to be retained.

As the towers are taller than the upwind surrounds, some incoming winds from the north-east are likely to be directed toward the ground in the form of downwash. The setback of the tower from the podium edge, as well as the large trees on the norther side of the development will reduce the impact of such flows on ground level by redirecting them horizontally, however windier conditions may arise on the podium rooftop level.

Relatively high wind speeds would be expected on the podium roof near to the windward corners of the towers during winds from the north-east. The tower setback from the podium edge may concentrate the impact of downwash from the towers onto the podium roof. The podium roof is to be activated for pedestrian use, therefore amelioration measures that incorporate horizontal elements are recommended, particularly near entries at the tower bases or proposed seating areas. Such measures are proposed in the form of awnings, pavilion areas and landscaping features. This will help to create areas of calm and increase wind amenity on the podium level and will be necessary for the success of this area.

Due to the orientation and massing of the two towers, winds from the north-east may be channelled through the gap on the podium roof creating windier conditions between the two towers. The proposed residence lounge, connecting the two towers on the podium rooftop, will aid in shielding the podium area between the two towers by keeping more of the channelled flow above pedestrian level.

During winds from the north-east, conditions at the North and South Plaza main pedestrian entries, as well as public domain locations on the southern and western sides of the development, are expected to remain reasonably calm. The location of the North Plaza behind inset corners of the podium will help to protect the area from stronger north-easterly winds. The proposed landscaping at the North Plaza will also contribute to increasing the wind amenity at this location. Locations on the southern and western sides of the site are largely shielded from north-easterly winds by the massing of the podium.

Overall, for winds from this quadrant, conditions at most public domain locations around the site are expected to remain similar to the existing wind conditions and satisfy the Lawson safety/distress criterion.

WINDS FROM THE SOUTH-WEST

Winds from the south-west quadrant will approach the site over a large region of low-rise suburban development, and from some directions sections of the Brisbane River. The neighbouring Gallery House and Portside Wharf developments to the south and west respectively, are of similar height to the proposed development and will provide a degree of shielding at podium and ground levels.

Most of the outdoor areas on the southern and western boundaries of the site are reasonably well protected from winds from this quadrant by the neighbouring developments. However, some areas on the southern side of the site are somewhat exposed to winds channelling between the neighbouring buildings to the south and the proposed development when winds come from a more westerly direction. The proposed location of the south plaza, behind an inset corner of the podium, will create a calmer environment and keep these potential stronger breezes away from high-use pedestrian areas. The walkway area east of the south plaza may be more susceptible to channelled wind flow from the west, though is expected to remain suitable for general pedestrian access. The proposed landscaping in this area will have a beneficial effect on local wind conditions and is recommended to be retained.

Similarly, winds from the south to south-west may be channelled between the Gallery House and Rivello buildings, directing stronger breezes off the river toward the subject site. Parts of the south plaza area may experience adverse wind conditions for winds from this direction. The proposed landscaping at the boundary of the southern plaza will help to shield the proposed outdoor seating area from southerly winds. Additional mitigation in the form of vertical screening elements may be required for the proposed outdoor seating areas within the southern plaza to ensure the wind environment is acceptable for intended use under these conditions.

The proposed development is slightly taller than the neighbouring building to the west. Areas on the southern side of the podium rooftop may therefore be susceptible to downwash during winds from this directional quadrant. The proposed awnings at the base of the two towers, as well as the booth style seating and pergolas at the south-east barbecue/dining area will create areas of calm suitable for their intended use. The retention of the proposed landscaping at the base of the west tower as well as on the south and west perimeters of the podium is recommended to increase wind amenity on the podium level.

Winds from the south-west may be accelerated through the gap in between the two towers, creating windier conditions on the podium roof between the two towers. As previously noted, the proposed Lounge link connecting the two towers on the podium roof will aid in keeping more of the channelled flow above pedestrian level and reduce the impact on the podium area. Conditions at locations on the north side of the podium, including the pool area, are therefore expected to remain reasonably calm for south-westerly winds.

During winds from the south-west, conditions for ground level public domain locations on the northern and eastern sides of the development are expected to remain relatively calm. Overall, for winds from this quadrant, conditions at most public domain locations around the site are expected to remain similar to the existing wind conditions and satisfy the Lawson safety/distress criterion.

WINDS FROM THE SOUTH-EAST

Winds from the south-east quadrant in Brisbane are generally not as strong compared to those originating from the north-east or south-west, but they occur with similar frequency. These south-east winds will approach the site over a large region of low-rise buildings. Winds from this quadrant are relatively unimpeded approaching the development, approaching over a stretch of the Brisbane River. The existing developments to the south of the site are approximately the same height as the proposed towers, and will therefore offer a degree of shielding from south easterly winds at podium and ground levels. Additionally, the west tower of the development is somewhat shielded from winds from the south-east by the east tower.

Most of the outdoor areas on the southern boundary of the site are reasonably well protected from south-easterly winds. However, incoming winds may be directed and accelerated around the north-east and south-east corners of the building. The eastern boundary of the site may also be susceptible to stronger breezes developing along Wharf Street. The indicated allowance for tower setbacks on the proposed development will limit the potential for localised high wind areas caused by downwashing flow. The proposed landscaping at the eastern site boundary will slightly reduce the impact of strong breezes. Additional wind mitigation is not likely required for normal pedestrian access, but may be recommended if long-term stationary activity such as outdoor dining is intended for any areas along these street frontages.

Conditions on the podium rooftop are expected to be relatively calm for winds coming from the south-east for most areas, though higher wind speeds may occur near the near windward corners of the towers due to the impact of downwashing flows from the tower facades and local acceleration around the tower forms. The proposed awnings and pergolas will improve wind conditions for south-easterly winds. The addition of a high balustrade at the podium perimeter may be necessary for areas that are indented for long term stationary activity, such as dining. The main podium area and pool deck will experience some shielding from the east tower of the proposed development, allowing calmer conditions.

During winds from the south-east, conditions for public domain locations on the northern and western sides of the development are expected to remain relatively calm. Overall, for winds from this quadrant, conditions at most public domain locations around the site are expected to remain similar to the existing wind conditions and satisfy the Lawson safety/distress criterion.

SUMMARY – PUBLIC DOMAIN

The addition of the proposed development may cause wind speeds in some areas to increase, while creating calmer conditions in others. On average and for the majority of locations in the vicinity, the pedestrian level wind environment is expected to remain similar to the existing. From a pedestrian comfort perspective, the wind environment around the proposed development site is likely to be classified as acceptable for Pedestrian Standing or Walking under Lawson. These pedestrian comfort levels would be suitable for public accessways, and for stationary short-term exposure activities. The proposed landscaping features will provide a benefit to the local wind conditions. Localised amelioration measures would be suggested if calmer areas are desired for particular locations. The necessity of such measures will depend on the required level of wind amenity and the intended use of specific areas as noted in the preceding sections. All locations in the public domain would be expected to satisfy the safety/distress criterion.

WIND CONDITIONS WITHIN THE DEVELOPMENT

GROUND LEVEL

Strong ground level winds may develop through the Central Pedestrian Spine arcade if the proposed external doors are allowed to be open for extended periods or are removed from the design. The arcade effectively connects a positive pressure region on the windward side with a negative pressure region on the lee side; regular breezes may arise in the arcade volume as a result. If the external doors are left open under normal operating conditions, the wind environment within the arcade is likely to remain acceptable for pedestrian access and thoroughfare; however, may become undesirably windy on high wind days. The proposed operable doors could be used to manage conditions in the arcade and are recommended to be retained if this space is to be used for seated dining or similar.

PODIUM TERRACE

As with most outdoor areas at height and in proximity to taller buildings, the podium terrace is relatively exposed from a wind perspective and may experience higher winds, particularly near to the tower bases and in the space between the two towers. The proposed awnings around the tower bases, particularly near entries or proposed seating areas, will reduce the impact of downwash generated off the tower facades and create protected areas with reasonable conditions for residents. The booth style seating, pavilion and pergola areas, in conjunction with the landscaping features in the proposed layout will reduce the impact of strong winds and create calm areas.

Winds may be accelerated between the space between the two towers. As noted in previous sections, the proposed residence lounge connecting the two towers on the podium rooftop, will aid in shielding the podium area between the two towers by keeping more of the channelled flow above pedestrian level. The pavilions and landscaping features, as proposed, will ensure areas of relative calm, suitable for their intended uses. Winds are generally accelerated near to building corners and through undercroft areas. The proposed barbeque/dining areas at the north-east and south-east of the podium terrace may be susceptible to downwash from the tower façade. The proposed pergolas at the barbeque/dining areas will reduce the impact of downwash and wind acceleration at the building corners and help to create a calmer environment in these areas. Further measures such as of vertical screens or high balustrade, raised planter boxes and booth style seating or cabanas may be considered for areas where conditions suited to long term stationary occupation are regularly required.

ROOF TERRACE

In general, rooftop terrace areas may be subject to strong winds due to their elevation and exposure to multiple prevailing wind directions. The incorporation of a high balustrade of at least 1.8m will allow reasonable conditions to be available for most of the time. The proposed perimeter landscaping features, booth style seating and pergolas will help to create calm spaces suitable for their indented use and are recommended to be retained.

Figure 5: Roof Terrace/Plant Floor Plan

BALCONIES

Windier conditions are often found on residential balconies for developments of this type, particularly on exposed corner balconies. Corner balconies open to more than one side can experience strong cross flow for some wind directions. Balconies that are recessed into the façade and situated away from tower corners are generally better protected and experience calmer conditions.

Balconies on tall buildings in Brisbane may experience undesirably strong wind conditions for a significant portion of the time, particularly if they are positioned on tower corners. Most proposed corner balconies are generally well designed, being recessed into the floor plate and representing a small volume compared to the façade. The larger corner balconies in the proposed layout may experience stronger conditions for some wind directions, though an acceptable level of amenity is expected given the tendency of tenants to adapt their use of the space to seasonal and temporal conditions. Other balconies as proposed, situated away from the building corners are generally well designed and located from a wind perspective, representing relatively small volumes and recessed within the floor plate. Conditions are expected to be typical of similar residential balconies in this part of Brisbane.

Figure 6: Typical Tower floor plan, showing balconies.

4. Conclusion

Cermak Peterka Petersen Pty. Ltd. has provided a qualitative assessment of the impact of the proposed Portside Build to Rent project on the local wind environment in and around the development site. Being slightly larger than most surrounding structures, the proposed development will have some effect on the local wind environment, though any changes are not expected to be particularly adverse from the perspective of pedestrian comfort or safety. Wind conditions around the development are expected to be classified as acceptable for Pedestrian Standing or Walking from a Lawson comfort perspective and pass the distress/safety criterion. Local amelioration may be advised for areas intended for long-term stationary or outdoor dining activities.

References

Lawson, T.V. (1990), "The Determination of the Wind Environment of a Building Complex before Construction" Department of Aerospace Engineering, University of Bristol, Report Number TVL 9025.

Economic Development Queensland (2022), *Northshore Hamilton Priority Development Area, Development Scheme Amendment no.1*

Appendix A – Wind Flow Mechanisms

When the wind hits a large isolated building, the wind is accelerated down and around the windward corners, Figure A1 this flow mechanism is called downwash and causes the windiest conditions at ground level on the windward corners and sides of the building. In Figure A1smoke 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 larger the horizontal element, 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 A2 shows the wind at mid and upper levels on a building being accelerated substantially around the corners of the building. When balconies are located on these corners, they are likely to be breezy, and will be used less by the owner due to the regularity of stronger winds. Owners quickly become familiar with when and how to use their balconies. If the corner balconies are deep enough, articulated, or have regular partition privacy fins, then local calmer conditions can exist.

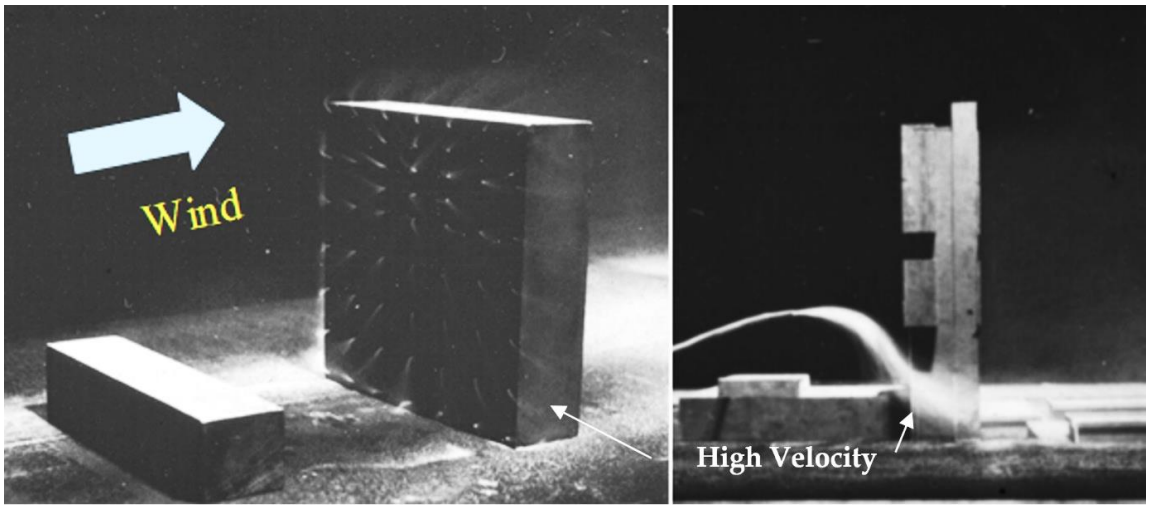

Figure A1: Flow visualisation around a tall building.

Figure A2: Channelling between buildings (L) and visualisation through corner balconies (R).

Appendix B - Wind Impact Planning Guidelines

It is well known that the design of a building will influence the quality of the ambient wind environment at its base. Below are some suggested wind mitigation strategies that should be adopted into precinct planning guidelines and controls (see also Cochran, 2004).

Building form – Canopies

A large canopy may interrupt the flow as it moves down the windward face of the building. This will protect the entrances and sidewalk area by deflecting the downwash at the second storey level, Figure B1. However, this approach may have the effect of transferring the breezy conditions to the other side of the street. Large canopies are a common feature near the main entrances of large office buildings.

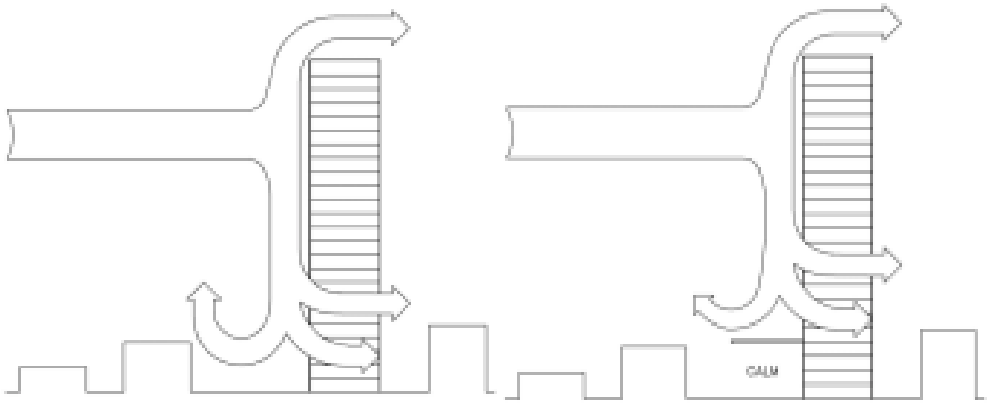

Figure B1: Canopy Windbreak Treatment. (L) Downwash to street level may generate windy conditions for pedestrians. (R) A large canopy is a common solution to this pedestrian-wind problem at street level.

Building form – Podiums

The architect may elect to use an extensive podium for the same purpose, Figure B2, if it complies with the design mandate. This is a common architectural feature for many major projects, but it may be counterproductive if the architect wishes to use the podium roof for long-term pedestrian activities, such as a pool or tennis court.

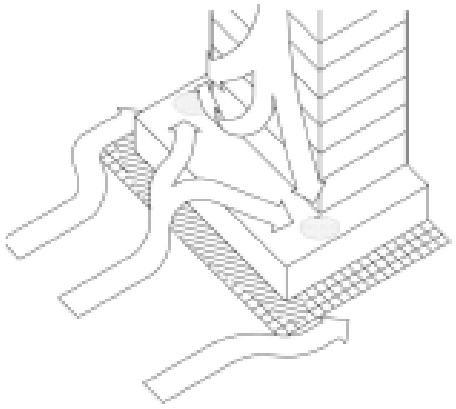

Figure B2:The tower-on-podium massing often results in reasonable conditions at ground level, but the podium may not be useable.

Building form – Arcades

Another massing issue, which may be a cause of strong ground-level winds, is an arcade or thoroughfare opening from one side of the building to the other. This effectively connects a positive pressure region on the windward side with a negative pressure region on the lee side; a strong flow through the opening often results, Figure B3. The uninvitingly windy nature of these open areas is a contributing reason behind the use of arcade airlock entrances (revolving or double sliding doors).

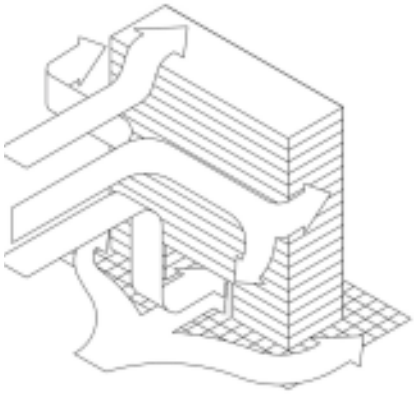

Figure B3: An arcade or open column plaza under a building frequently generates strong pedestrian wind condition.

Building form – Alcove

An entrance alcove behind the building line will generally produce a calmer entrance area at a mid-building location, Figure B4(L). In some cases, a canopy may not be necessary with this scenario, depending on the local geometry and directional wind characteristics. The same undercut design at a building corner is usually quite unsuccessful, Figure B4 (R), due to the accelerated flow mechanism described in Figure B1 and the ambient directional wind statistics. If there is a strong directional wind preference, and the corner door is shielded from those common stronger winds, then the corner entrance may work. However, it is more common for a corner entrance to be adversely impacted by this local building geometry. The result can range from simply unpleasant conditions to a frequent inability to open the doors.

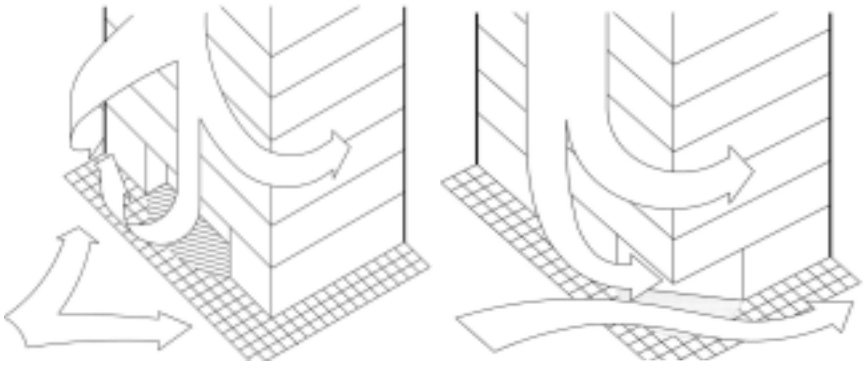

Figure B4: Alcove Windbreak Treatment. (L) A mid-building alcove entrance usually results in an inviting and calm location. (R) Accelerated corner flow from downwash often yields an unpleasant entrance area.

Building form – Façade profile and balconies

The way in which a building's vertical line is broken up may also have an impact. For example, if the floor plans have a decreasing area with increased height the flow down the stepped windward face may be greatly diminished. To a lesser extent the presence of many balconies can have a similar impact on ground level winds, although this is far less certain and more geometry dependent. Apartment designs with many elevated balconies and terrace areas near building ends or corners often attract a windy environment to those locations. Mid-building balconies, on the broad face, are usually a lot calmer, especially if they are recessed. Corner balconies are generally a lot windier and so the owner is likely to be selective about when the balcony is used or endeavours to find a protected portion of the balcony that allows more frequent use, even when the wind is blowing.

Use of canopies, trellises, and high canopy foliage

Downwash Mitigation – As noted earlier, downwash off a tower may be deflected away from ground-level pedestrian areas by large canopies or podium blocks. The downwash then effectively impacts the canopy or podium roof rather than the public areas at the base of the tower, Figure B2. Provided that the podium roof area is not intended for long-term recreational use (e.g. swimming pool or tennis court), this massing method is typically quite successful. However, some large recreational areas may need the wind to be deflected away without blocking the sun (e.g. a pool deck), and so a large canopy is not an option. Downwash deflected over expansive decks like these may often be improved by installing elevated trellis structures or a dense network of trees to create a high, bushy canopy over the long-term recreational areas. Various architecturally acceptable ideas may be explored in the wind tunnel prior to any major financial commitment on the project site.

Horizontally accelerated flows between two tall towers may cause an unpleasant, windy, ground-level pedestrian environment, which could also be locally aggravated by ground topography. Horizontally accelerated flows that create a windy environment are best dealt with by using vertical porous screens or substantial landscaping. Large hedges, bushes or other porous media serve to retard the flow and absorb the energy produced by the wind. A solidity ratio (i.e. proportion of solid area to total area) of about 60-70% has been shown to be most effective in reducing the flow's momentum. These physical changes to the pedestrian areas are most easily evaluated by a model study in a boundary-layer wind tunnel.

References

Cochran L., (2004) Design Features to Change and/or Ameliorate Pedestrian Wind Conditions, Proceedings of the ASCE Structures Congress, Nashville, Tennessee, May 2004.