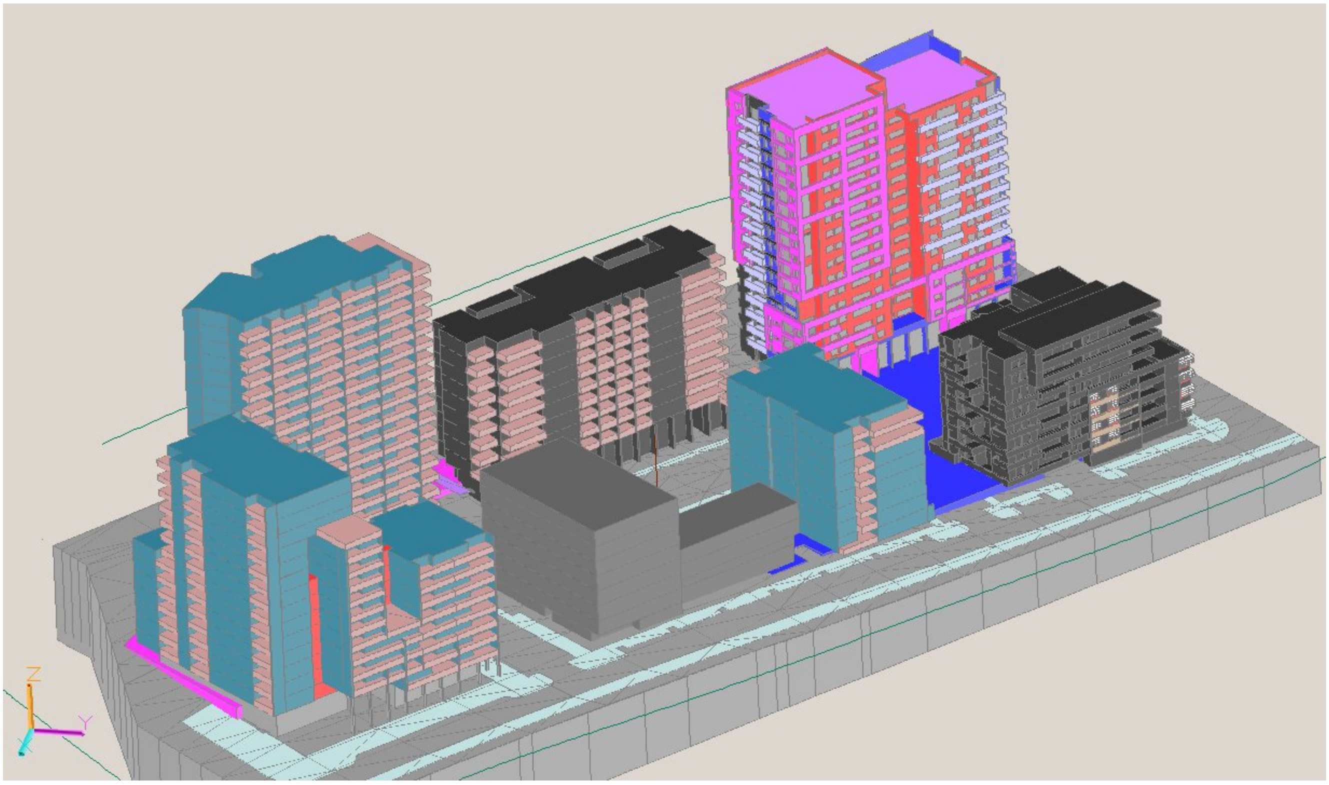
Allen Jack + Cottier

Macquarie Village

Wind Effects Statement



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Macquarie Village

Wind Effects Statement

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EXECUTIVE SUMMARY

Vipac Engineers & Scientists Ltd (VIPAC) has been commissioned by Allen Jack + Cottier to prepare a wind assessment report of the proposed Macquarie Village, 110-114 Herring road, Macquarie Park, NSW. This appraisal is based on Vipac's experience as a wind-engineering consultancy.

Drawings of the proposed Development were supplied by Allen Jack + Cottier as listed in Appendix C.

The findings of this study can be summarised as follows:

- The proposed Development is not expected to generate wind condition in excess of the recommended criteria on the ground level with:
  - Plantation on the Epping Road, Herring Road and northeastern boundaries;
  - Balconies on the south facades; and
  - Balconies or equivalent surface roughness features to the facade between Building Y and M as well as between Building M and D.
- VIPAC predicts the proposed development is likely to generate wind conditions in excess of the recommended criteria at the upper level balconies for Building W, D and L.
- Measures that may be employed to control wind on balconies includes:
  - Increasing balustrade height;
  - Installation of planter boxes;
  - Installation of dividing screens etc.

We recommend the effectiveness of the above wind control mechanisms should be validated by a suitably qualified wind engineer and finalised during the detail design and prior to issue of a construction certificate.

The assessments provided in this report have been made based on experience of similar situations in Sydney and around the world. As with any desktop assessment a margin of error may occur when compared to a full wind tunnel assessment.

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1 INTRODUCTION

Vipac Engineers & Scientists Ltd (VIPAC) has been commissioned by Allen Jack + Cottier to prepare a wind assessment report for the proposed Macquarie Village Development at 110-114 Herring road, Macquarie Park, NSW.

The application being submitted to the Department of Planning is for consent for a Concept Plan and Stage 1 Project Application. Whilst the Concept Plan covers the whole site, the Stage 1 Project Application only seeks detailed consent for the following buildings:

- Hunter;
- Woodward;
- Cutler; and
- Young.

The details of the remaining buildings will be constructed under Stage 2. Stage 2 of the project will involve a further application that is to be submitted to Ryde City Council.

The NSW Department of Planning Director General require a wind assessment as part of the overall Environmental Assessment requirements.

This report considers both the concept plan and Stage 1 application and details the opinion of VIPAC as an experienced wind engineering consultancy regarding the wind effects in:

- Ground level public areas;
- Access-ways in and adjacent to the development
- Apartment balconies.

No wind tunnel testing has been carried out for this Development. VIPAC has carried out wind tunnel studies on a large number of developments of similar shape and having similar exposure to that of the proposed Development. These serve as some valid references for the prediction of wind effects. Empirical data for typical buildings in boundary layer flows has also been used to estimate the likely ground level wind conditions adjacent to the proposed Development [2, 3].

Drawings of the proposed Development were supplied to VIPAC by Allen Jack + Cottier. A list of the drawings used in this desktop study is provided in Appendix C.

2 ANALYSIS APPROACH

In assessing whether a proposed development is likely to generate adverse wind conditions in adjacent ground level areas, VIPAC has considered the following points:

- Site characteristics, including the geometry and orientation of the proposed development;
- The regional wind climate;

- The interaction of predicted flows with adjacent developments;
- The exposure of the proposed development to wind;
- Comparison of generated wind speeds against the accepted assessment criteria as determined by the intended use of the public areas.

2.1 SITE DESCRIPTION

The proposed development site is located at the corner of Epping Road and Herring Road in North Ryde. The development is located in the middle of existing low-rise buildings typically not above 2 storeys. The development comprises 7 medium rise residential towers of various heights (see Figure 1) with orientations as shown on the site layout, Figure 2.

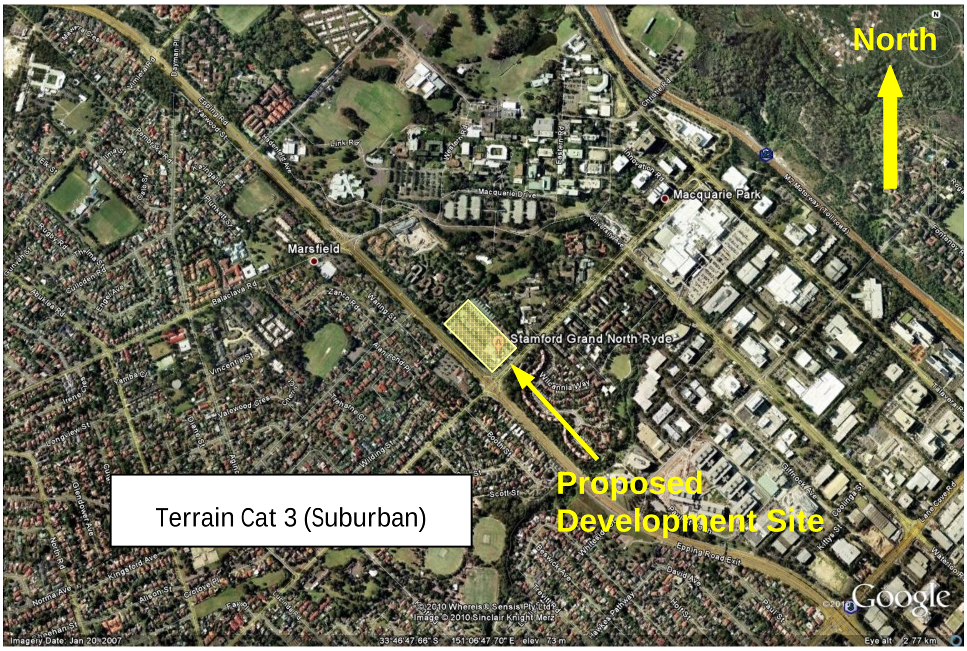


Figure 1: Site location and surrounding terrain

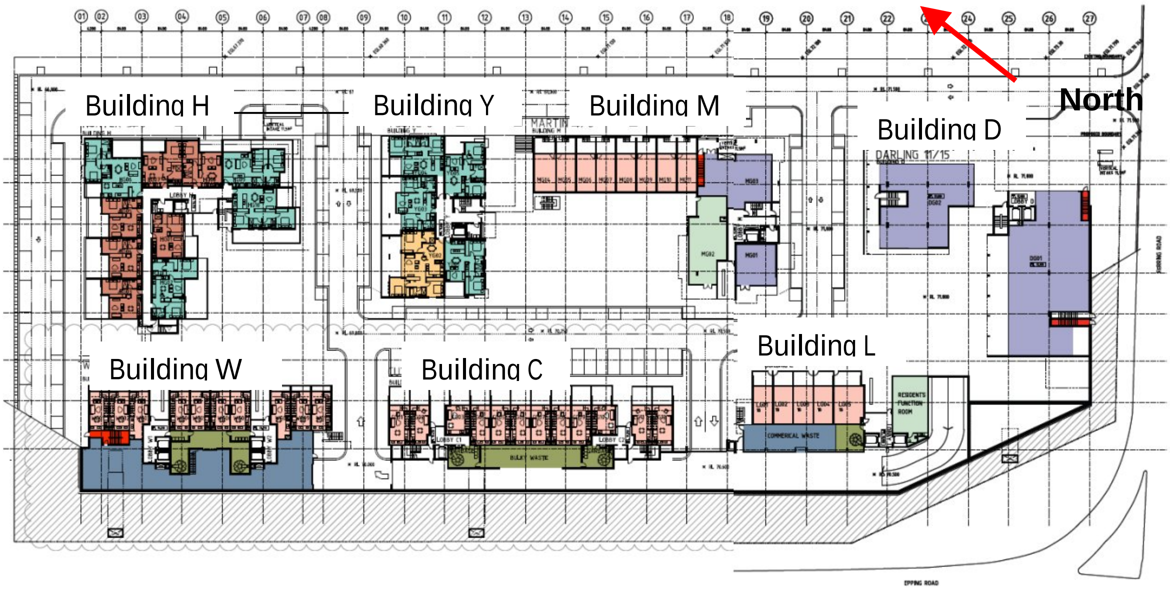


Figure 2: Proposed Site Layout

3 Dimensional views of the site are also shown in Figure 3 and Figure 4.

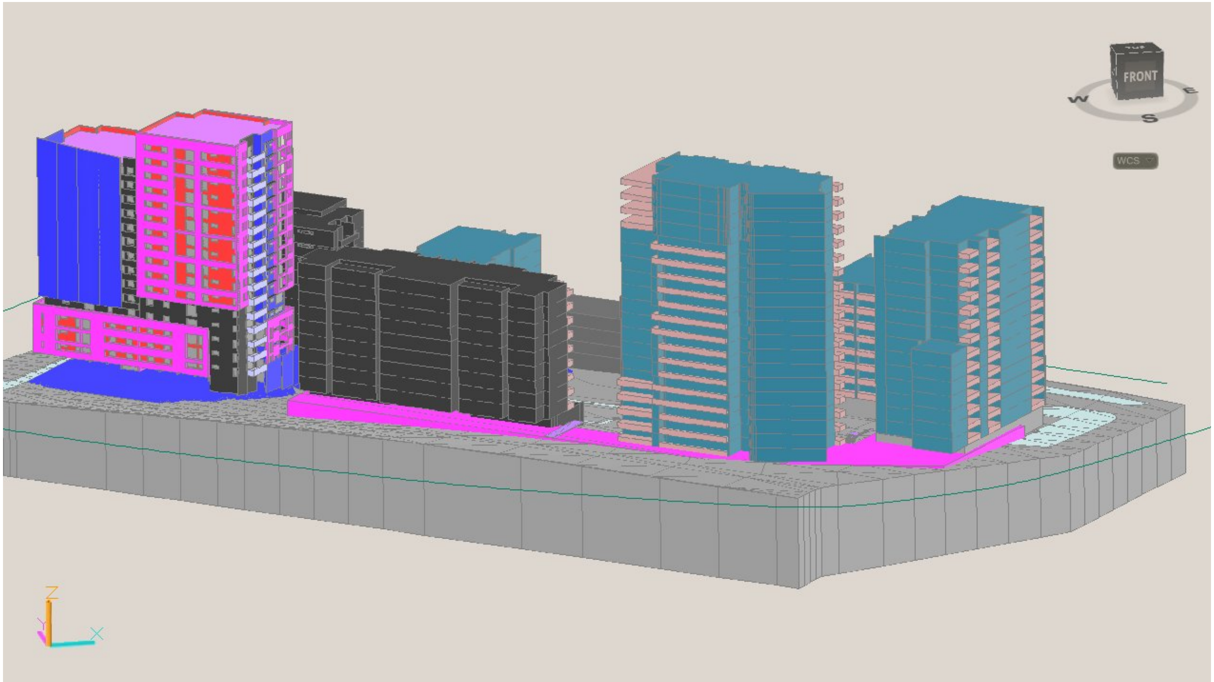


Figure 3: The proposed Development (Southwest view)

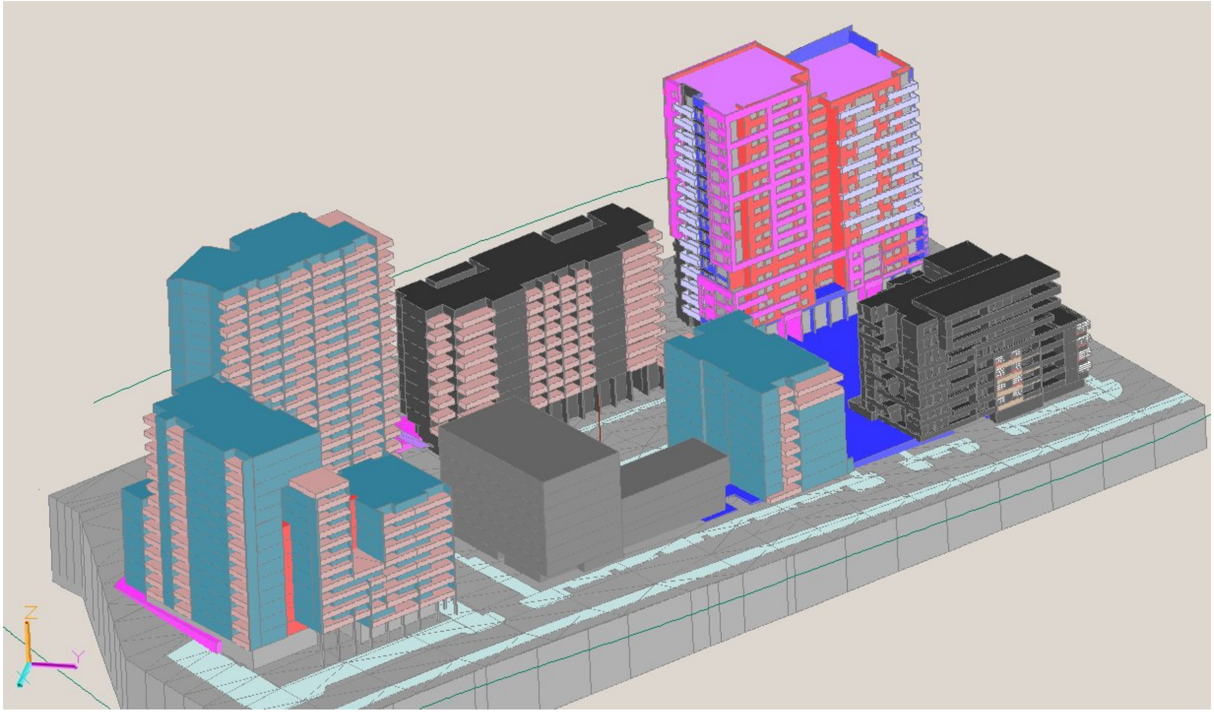


Figure 4: The proposed Development (Northeast view)

The heights of the building from ground level are as follows:

- Building H 25.7m
- Building W 62.2m
- Building Y 25.7m
- Building M 26.2m
- Building C 35.9m
- Building D 48.8m
- Building L 69.6m

2.2 REGIONAL WIND CLIMATE

Wind speeds have been recorded at Sydney Airports for over 30 years. This data has been analysed and a composite directional probability distribution of wind speeds have been determined, and calculations made that allow the prediction of the wind environment that exists above the earths boundary layer. This level is described as the Gradient height. The directional distribution of hourly mean wind speed at the gradient height, with a probability of occurring once per year (i.e. 1 year return period) is shown in Figure 5.

The distribution indicates that the strongest winds above Sydney are from the Northwest, Northeast and Southwest directions. This is factored into the assessment. The wind data at this free stream height can be considered to be common to all Sydney sites and is used as a reference to assess ground level wind conditions at this site.

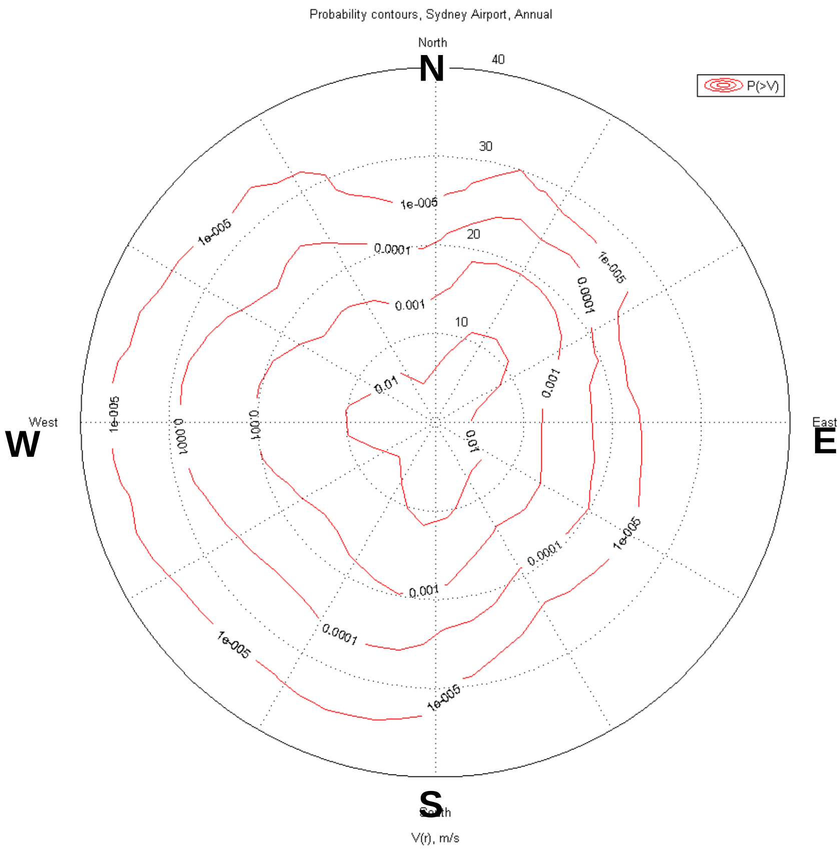


Figure 5: Directional Distribution of Annual Return Period Mean Hourly Wind Velocities (m/s) at Gradient Height for Sydney.

2.3 FLOW INTERACTIONS WITH ADJACENT DEVELOPMENTS

Figure 1, Figure 3 and Figure 4 show the proposed development and immediately surrounding buildings. It is noted that the proposed buildings are higher than the immediately surrounding buildings. Thus the proposed buildings will become a wind catcher, especially for the north side of buildings L and W.

However, the proposed buildings have balconies, which tends to break a smooth flow and reduce the high wind speed at ground level.

2.4 SITE EXPOSURE

There are low-rise developments surrounding the site in all directions. As the proposed development will be above the existing buildings it will be directly exposed to wind from all directions.

Therefore, considering the immediate surroundings and upstream terrain, the site of the proposed Development is assumed to be terrain Category 3 (Suburban) from all directions (see Figure 1).

2.5 ASSESSMENT CRITERIA

With some consensus of international opinion, pedestrian wind comfort is rated according to the suitability of certain activities at a site in relation to the expected annual peak 3-second gust velocity at that location for each wind direction. Each of the major areas around the site are characterised by the annual maximum gust wind speeds. Most patrons would consider a site generally unacceptable for its intended use if it were probable that during one annual wind event, a peak 3-second gust occurs which exceeds the established comfort threshold velocity. If that threshold is exceeded once per year then it is also likely that during moderate winds, noticeably unpleasant wind conditions would result, and the windiness of the location would be voted as unacceptable.

In a similar manner, a set of hourly mean velocity criteria with a 1% probability of occurrence are also applicable to ground level areas in and adjacent to the proposed Development. An area should be within both the relevant mean and gust limits in order to satisfy the particular human comfort and safety criteria in question.

The threshold *gust velocity* criteria and threshold *mean velocity* criteria are listed in Table 1.

Where VIPAC predicts that a location would not meet its appropriate comfort criterion, the use of wind control devices, landscaping and/or local building geometry modifications to achieve the desired comfort rating may be recommended. For complex flow scenarios or where predicted flow conditions are well in excess of the recommended criteria, VIPAC recommends scale model wind tunnel testing to determine the type and scope of the wind control measures required to achieve acceptable wind conditions.

Table 1: Recommended Wind Comfort and Safety

Annual Maximum Mean	Annual Maximum Gust	Result on Perceived Pedestrian Comfort
>15m/s	>23m/s	Unsafe (frail pedestrians knocked over)
<10m/s	<16m/s	Acceptable for Walking (steady steps for most pedestrians)
<7m/s	<13m/s	Acceptable for Standing (window shopping, vehicle drop off, queuing)
<5m/s	<10m/s	Acceptable for Sitting (outdoor cafés, pool areas, gardens)

With regard to the above and the intended use of the various external areas we recommend the following criteria as detailed in Table 2. Figure 6 through to Figure 12 show the plan view of ground level areas with the criteria overlaid.

Table 2: Recommended application of criteria

Site Location	Recommended Criteria
Public Footpaths	Acceptable for Walking
Building Entrances	Acceptable for Standing
	Acceptable for Standing
Building Balconies	Acceptable for Safety - (See the discussion in section 2.5.1 below)

2.5.1 Note on Apartment Balconies

VIPAC recommnds as a minimum the apartment balcony areas meet the criterion for safety since:

- these areas are not public spaces,
- the use of these areas is optional,
- many similar developments in Sydney and other Australian capital cities experience wind conditions on balconies and elevated deck areas in the vicinity of the criterion for safety.

However, VIPAC wish to clearly state that meeting the safety criterion on balconies will be no guarantee that occupants will find wind conditions in these areas acceptable. It is VIPAC's experience that balconies should be close to the criterion for sitting comfort in order that the majority of reasonable people consider such areas acceptable for their intended use from a wind point-of-view. Wind conditions over this criterion will tend to result in a perceived reduction in amenity of the area. This perception may be due to:

- the cooling effect of the wind on the human body,
- the removal of lightweight items such as towels, newspapers, lightweight furniture (eg. plastic banana lounges),
- difficulty hearing others speak

Wind conditions meeting the criterion for safety may still result in the following adverse effects whilst the balcony area is unoccupied:

- the removal of lightweight items (eg. furniture) prior to storms,
- the removal of planter boxes during storms.

Figure 6: Schematic plan view of the proposed Building H with the recommended wind criteria overlaid on adjacent ground level areas.

(yellow)	Recommended Acceptable for Walking
(green)	Recommended Acceptable for Standing

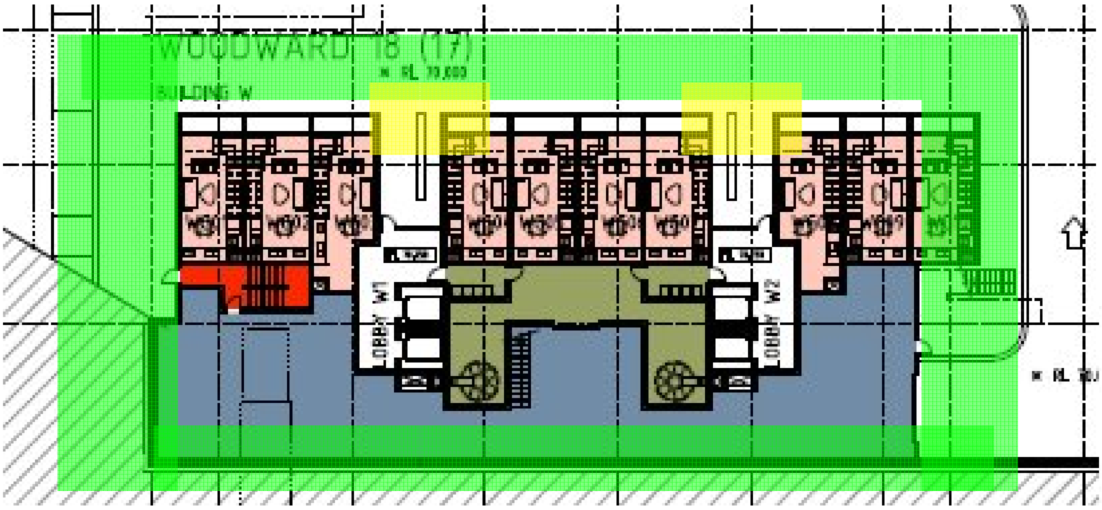


Figure 7: Schematic plan view of the proposed Building W with the recommended wind criteria overlaid on adjacent ground level areas.

(yellow)	Recommended Acceptable for Walking
(green)	Recommended Acceptable for Standing

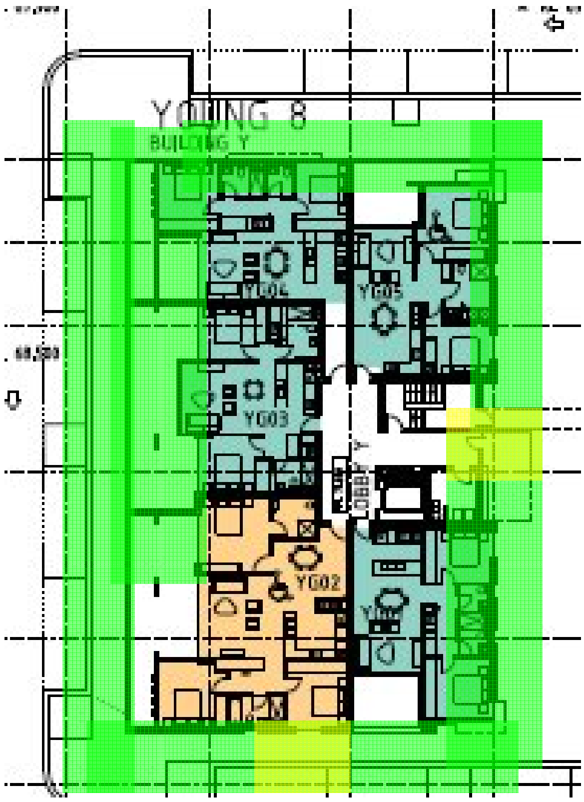


Figure 8: Schematic plan view of the proposed Building Y with the recommended wind criteria overlaid on adjacent ground level areas.

(yellow)	Recommended Acceptable for Walking
(green)	Recommended Acceptable for Standing

Figure 9: Schematic plan view of the proposed Building M with the recommended wind criteria overlaid on adjacent ground level areas.

	Recommended Acceptable for Walking
	Recommended Acceptable for Standing

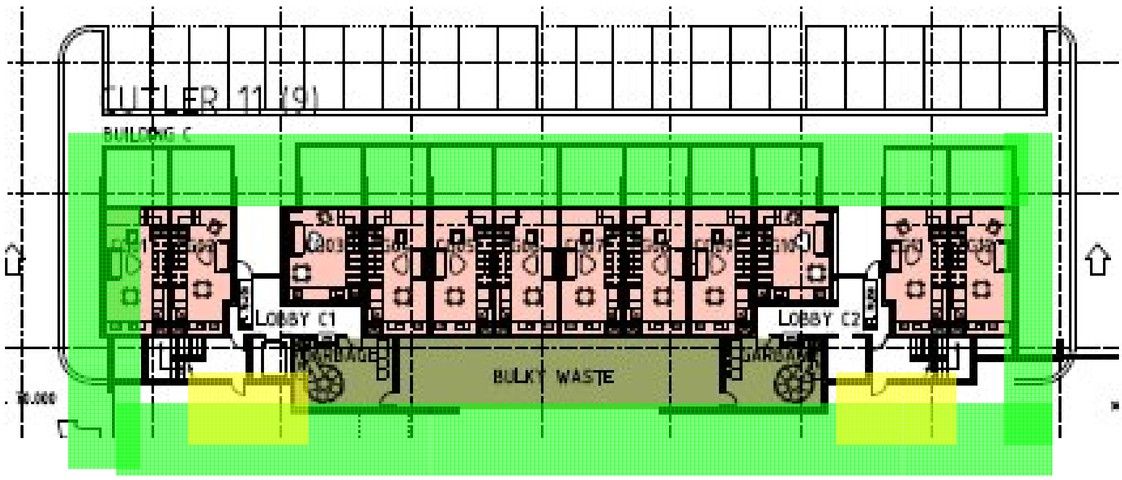


Figure 10: Schematic plan view of the proposed Building C with the recommended wind criteria overlaid on adjacent ground level areas.

	Recommended Acceptable for Walking
	Recommended Acceptable for Standing

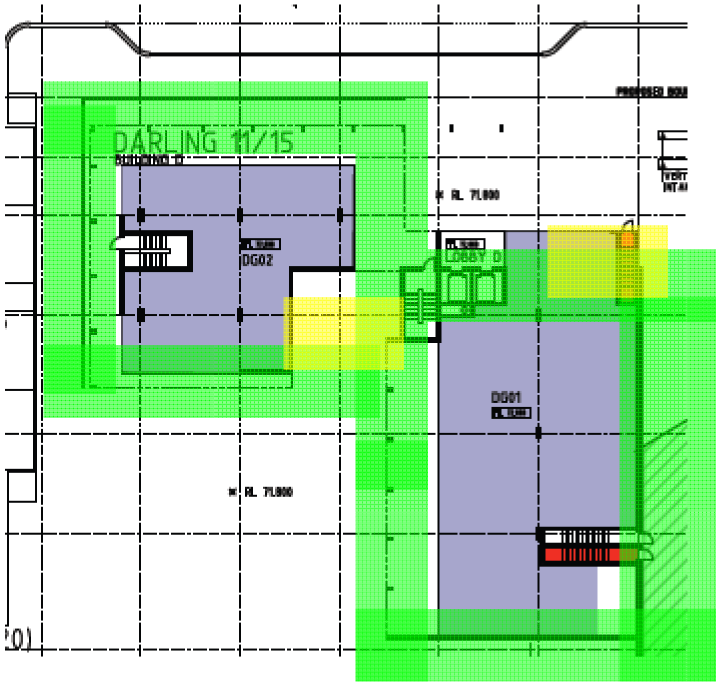


Figure 11: Schematic plan view of the proposed Building D with the recommended wind criteria overlaid on adjacent ground level areas.

	Recommended Acceptable for Walking
	Recommended Acceptable for Standing

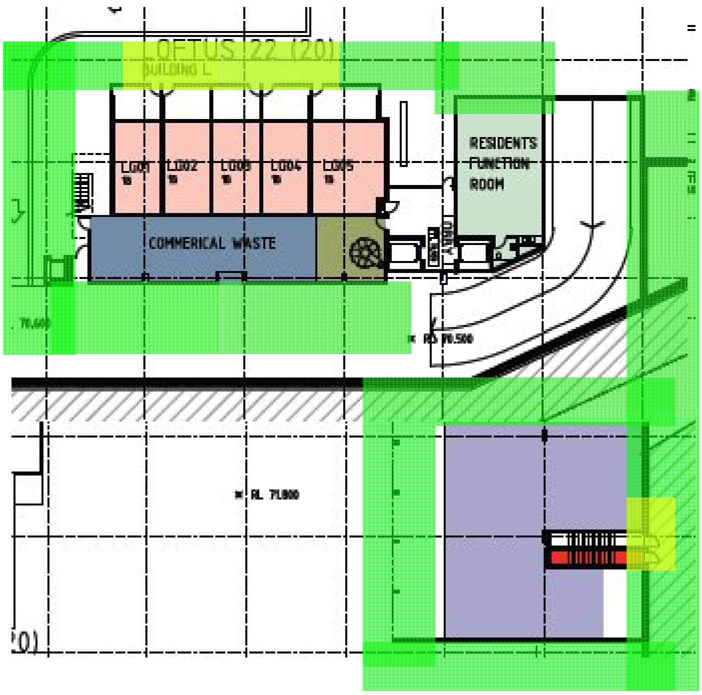


Figure 12: Schematic plan view of the proposed Building L with the recommended wind criteria overlaid on adjacent ground level areas.

	Recommended Acceptable for Walking
	Recommended Acceptable for Standing

3 PEDESTRIAN LEVEL WIND EFFECTS ASSESSMENT

The wind structure interactions at the proposed development for wind approaching from various directions are as follows:

3.1 WIND APPROACHING FROM NORTH & NORTHEAST

The Northeast direction is the prevailing wind direction for Sydney. The buildings H, Y, M and D will catch this wind directly. The one year hourly wind speed will reach 12 - 15 m/s at 10m height . The expected wind flow pattern for this wind is shown in Figure 13.

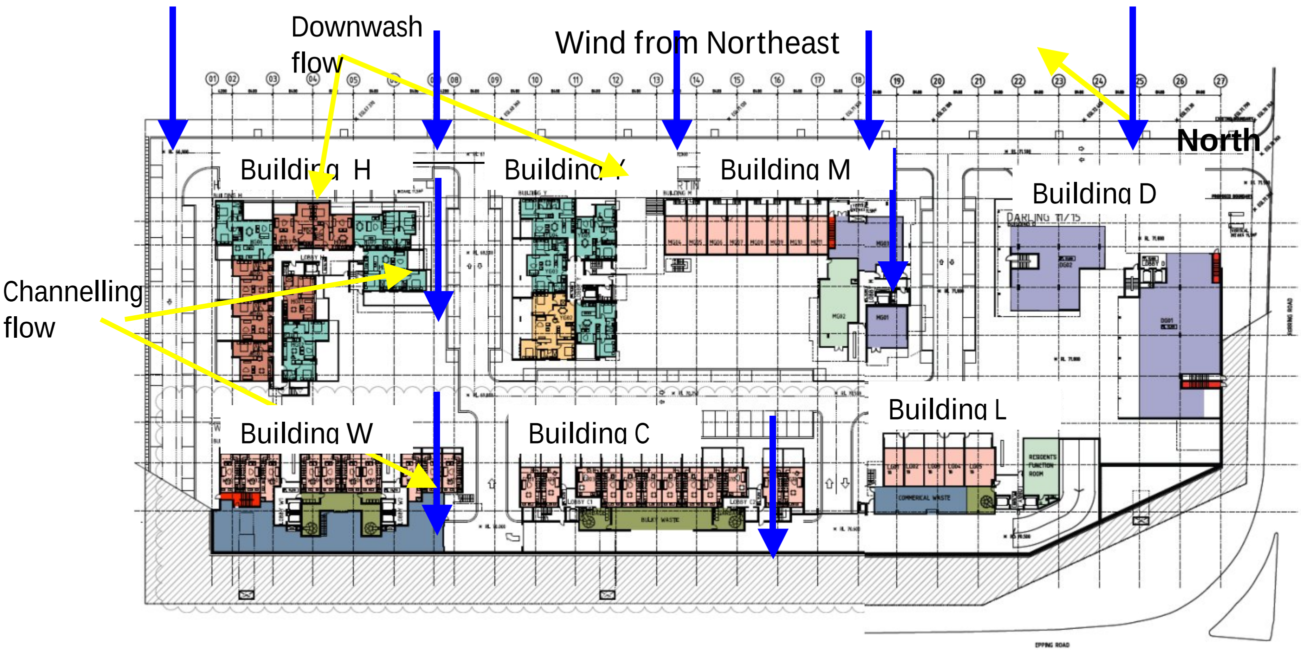


Figure 13: Northeast flow and interaction with the development and expected effect.

The northeast winds flow on the north facades of Buildings H, Y, M and D produce downwash effects on ground level. The wind speeds at the ground level are not expected to be strong due to the balconies on the north facades, which will help break down and dissipate the wind energy before reaching the ground level.

There will be a channelling flow on the footpath between the Building H and Building Y, Building M and Building D. The flow in theses areas without wind mitigation is expected to accelerate. To reduce the channelling flow, the use of plantations on the windward side is expected to reduce the wind speed. However, we recommend the effectiveness of any wind control mechanism would need to be validated during the detail design and prior to issue of a construction certificate.

3.2 WIND APPROACHING FROM SOUTH AND SOUTHWEST

The wind approaching from the Southwest direction for Sydney is also strong. The once a year wind speed (hourly mean) will reach 12 - 15 m/s at 10m height. The wind at the ground level will be accelerated by downwash and channelling flows as shown in Figure 14. The downwash flows are expected on the entire south facing buildings. These flows will be minimized at ground level by the balconies on the south face of the buildings and awnings above building entrances.

The channelling flow created by southwest flow will be between Building W and Building C, Building C and Building L. The channelling flow from these directions may reach the walking criteria without wind controlling mechanisms. Using plantations on the southeast and southwest boundaries of the development is expected to slow down the wind at pedestrian level. The gap between Building C and L as well as between Building L and D are narrow, which potentially amplify the channelling flow. However, we recommend the effectiveness of any wind control mechanism would need to be validated by a suitably qualified wind engineer during the detail design and prior to issue of a construction certificate.

The wind from the south will have an effect on building corners by creating corner accelerations without wind mitigation. However, rough facade surfaces, such as the addition of balconies and plantation on the southeast and southwest boundaries is expected to mitigate these corner accelerations at ground level.

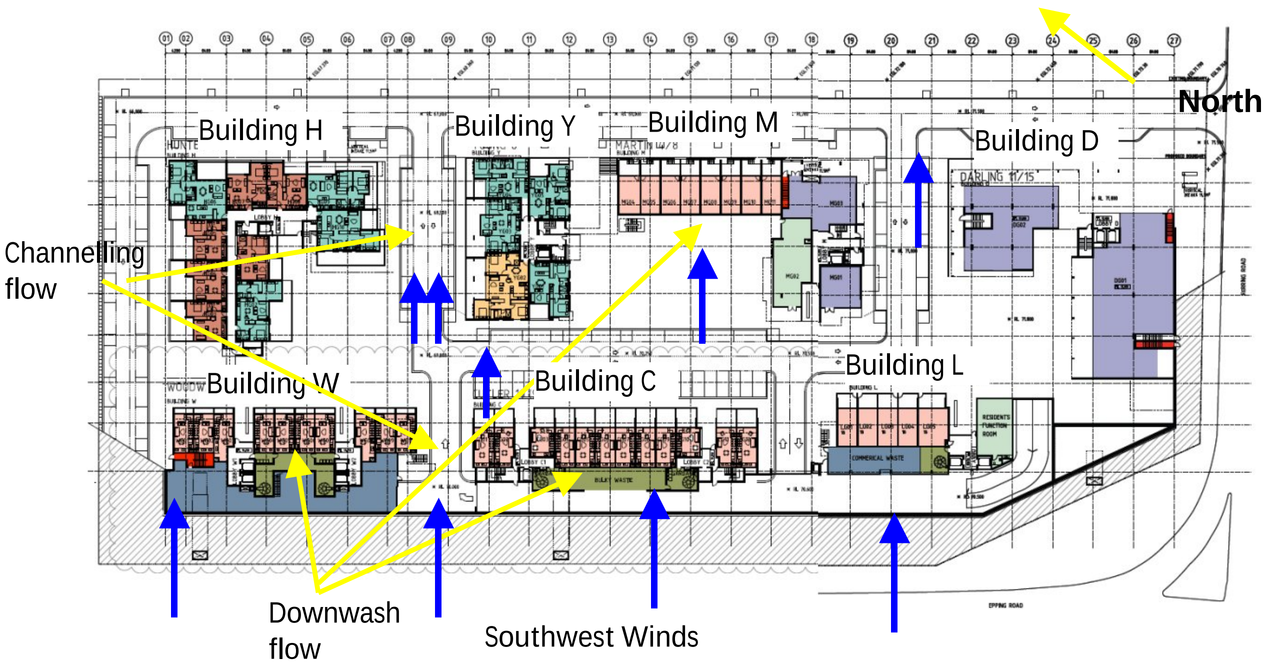


Figure 14: Southwest flow and interaction with the development and expected effect.

3.3 WIND APPROACHING FROM WEST

The wind approaching from the West although of lesser magnitude does so at an angle where the corner acceleration becomes important as shown in Figure 15. The wind speed at these locations can be reduced by using plantations close to the corner to avoid the direct wind flow to the corner of the building at ground level. However, we recommend the effectiveness of any wind control mechanism would need to be validated by a suitably qualified wind engineer during the detail design and prior to issue of a construction certificate.

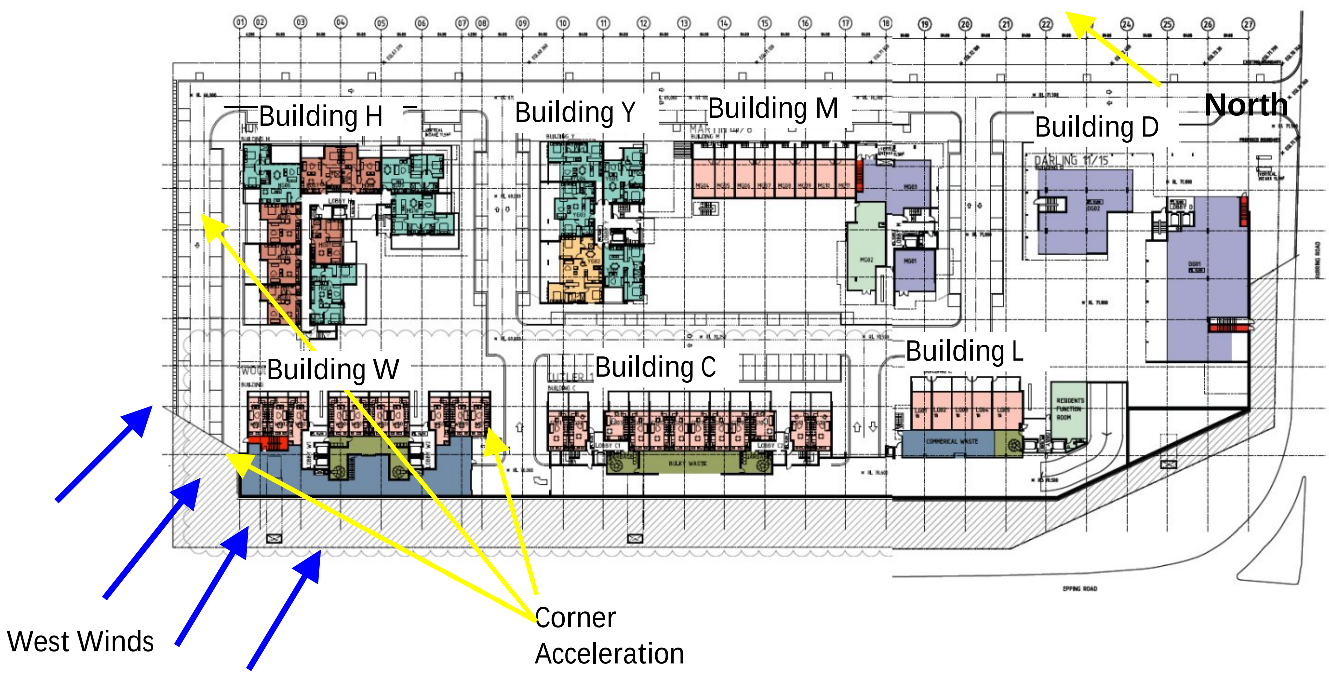


Figure 15: West flow and interaction with the development and expected effect.

3.4 APARTMENT BALCONIES

The apartment balconies for all buildings needs special consideration, particularly Building L, W and D because their size and orientation to the dominant wind directions.

In general, wind conditions will frequently be acceptable for outdoor recreation on the apartment balconies, on high wind days, however, wind conditions could be close to or exceeding the criterion for safety in balconies at elevated levels. Lightweight outdoor lounges, tables and chairs will be at risk of being blown off balcony areas when unattended, particularly during storms.

Measures that that may be employed include, increasing balustrade height, planter boxes, dividing screens etc.

We recommend the above measures and their effectiveness would need to be validated by a suitably qualified wind engineer during the detail design and prior to issue of a construction certificate.

4 RECOMMENDATIONS

4.1 GROUND LEVEL AREAS

VIPAC has carefully considered the nearby ground level public areas at the base of the proposed Development and predicts that the proposed Development is not likely generate wind conditions in excess of the recommended criteria as long as the following measures are put in place:

- Plantation on the Epping Road, Herring Road and northeastern boundary;
- Balconies on the south facades; and
- Balconies or equivalent surface roughness features to the facade between Building Y and M as well as between Building M and D.

However, we recommend the effectiveness of any wind control mechanism would need to be validated by a suitably qualified wind engineer and finalised during the detail design and prior to issue of a construction certificate.

4.2 APARTMENT BALCONIES

Due to risk associated with the displacement of lightweight outdoor lounges, tables and chairs from balconies areas when unattended, particularly during storms we recommend that measures such as, increased balustrade height, planter boxes, dividing screens etc are considered

The effectiveness of these control mechanism would need to be evaluated by a suitably qualified wind engineer and finalised during the detail design and prior to issue of a construction certificate.

5 CONCLUSION

An appraisal of the likely wind conditions adjacent to the proposed Development Macquarie Village, 110-114 Herring road, Macquarie Park has been made.

The findings of this study can be summarised as follows:

- The proposed Development is not expected to generate wind condition in excess of the recommended criteria on the ground level with:
  - Plantation on the Epping Road, Herring Road and northeastern boundaries;
  - Balconies on the south facades; and

- o Balconies or equivalent surface roughness features to the facade between Building Y and M as well as between Building M and D.

The assessments provided in this report have been made based on experience of similar situations in Sydney and around the world. As with any desktop assessment a margin of error may occur when compared to a full wind tunnel assessment.

This Report has been Prepared

For

Allen Jack + Cottier Pty Ltd

By

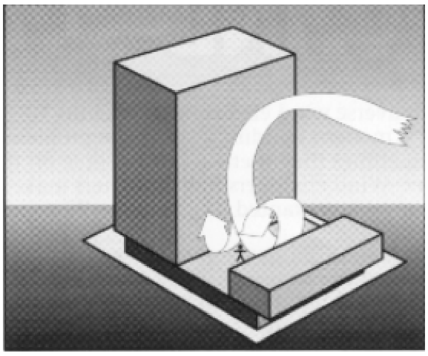
VIPAC ENGINEERS & SCIENTISTS LTD.

APPENDIX A – TERMINOLOGY OF ENVIRONMENTAL WINDS

Atmospheric Boundary Layer

As wind flows over the earth it encounters various roughness elements and terrain such as water, forests, houses and buildings. To varying degrees, these elements reduce the mean wind speed at low elevations and increase air turbulence. The wind above these obstructions travels with unattenuated velocity, driven by atmospheric pressure gradients. The resultant increase in wind speed with height above ground is known as a *wind velocity profile*. When this wind profile encounters a tall building, some of the fast moving wind at upper elevations is diverted down to ground level resulting in local adverse wind effects.

The terminology used to describe the wind flow patterns around the proposed Development is based on the aerodynamic mechanism, direction and nature of the wind flow.



Downwash – refers to a flow of air down the exposed (the upwind) face of a tower. A tall tower can deflect downwards a fast moving wind from higher elevations.

Corner Accelerations – when wind flows around the corner of a building, parcels of air closer to the façade travel longer distances and tend to speed up relative to those parcels in the freely flowing stream.

Flow separation – when wind flowing along a surface meets a discontinuity, like a corner or a step, it may detach from that surface. The resultant energy dissipation produces increased turbulence in the flow. Flow separation at a building corner or at a solid screen can result in gusty conditions.

Flow channelling – the well-known "street canyon" effect occurs when a large volume of air is funnelled through a constricted pathway. To maintain flow continuity the wind must speed up as it passes through the constriction. Examples of this might occur between two towers, in a narrowing street or under a bridge.

Direct Exposure – a location with little upstream shielding for a wind direction of interest. The location will be exposed to the unabated mean wind and gust velocity. Coastal and open water frontage may have such exposure.

APPENDIX B - REFERENCES

[1] *Structural Design Actions, Part 2: Wind Actions*, Australian/New Zealand Standard 1170.2:2002

[2] *Wind Effects on Structures* E. Simiu, R Scanlan, Publisher: Wiley-Interscience

[3] *Architectural Aerodynamics* R. Aynsley, W. Melbourne, B. Vickery, Publisher: Applied Science Publishers

APPENDIX C – DRAWING LIST

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10030_DA2107.1_2.pdf	540.47 KB	10/12/2010 3:48:35 PM
10030_DA2107.1[101210].dwg	428.47 KB	10/12/2010 3:49:27 PM
10030_DA2107.2_2.pdf	361.05 KB	10/12/2010 3:53:09 PM
10030_DA2107.2[101210].dwg	151.22 KB	10/12/2010 3:53:52 PM
10030_DA2108.1_2.pdf	540.36 KB	10/12/2010 3:59:06 PM
10030_DA2108.1[101210].dwg	425.00 KB	10/12/2010 3:59:59 PM
10030_DA2108.2_2.pdf	354.33 KB	10/12/2010 4:01:30 PM
10030_DA2108.2[101210].dwg	142.97 KB	10/12/2010 4:02:01 PM
10030_DA2109.1_2.pdf	427.29 KB	10/12/2010 4:03:33 PM
10030_DA2109.1[101210].dwg	297.72 KB	10/12/2010 4:04:02 PM
10030_DA2109.2_2.pdf	324.04 KB	10/12/2010 4:05:06 PM
10030_DA2109.2[101210].dwg	120.09 KB	10/12/2010 4:05:39 PM
10030_DA2110.1_2.pdf	423.45 KB	10/12/2010 4:07:13 PM
10030_DA2110.1[101210].dwg	295.94 KB	10/12/2010 4:07:52 PM

10030_DA2110.1[101210].dwg	295.94 KB	10/12/2010 4:07:52 PM
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10030_DA2110.2[101210].dwg	110.88 KB	10/12/2010 4:09:48 PM
10030_DA2111.1_2.pdf	420.71 KB	10/12/2010 4:11:02 PM
10030_DA2111.1[101210].dwg	301.91 KB	10/12/2010 4:11:38 PM
10030_DA2111.2_2.pdf	336.49 KB	10/12/2010 4:12:38 PM
10030_DA2111.2[101210].dwg	119.59 KB	10/12/2010 4:13:04 PM
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10030_DA2112.1[101210].dwg	194.34 KB	10/12/2010 4:14:46 PM
10030_DA2112.2_2.pdf	286.73 KB	10/12/2010 4:16:19 PM
10030_DA2112.2[101210].dwg	106.63 KB	10/12/2010 4:16:48 PM
10030_DA2113.1_2.pdf	326.94 KB	10/12/2010 4:18:15 PM
10030_DA2113.1[101210].dwg	186.88 KB	10/12/2010 4:19:06 PM
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10030_DA2113.2[101210].dwg	106.13 KB	10/12/2010 4:20:03 PM
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10030_DA2115.1[101210].dwg	191.56 KB	10/12/2010 4:24:30 PM
10030_DA2115.2_2.pdf	245.48 KB	10/12/2010 4:28:50 PM
10030_DA2115.2[101210].dwg	117.34 KB	10/12/2010 4:29:16 PM
10030_DA2116.1_2.pdf	283.28 KB	10/12/2010 4:30:38 PM
10030_DA2116.1[101210].dwg	184.34 KB	10/12/2010 4:31:01 PM
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10030_DA3101[101210].dwg	68.88 KB	10/12/2010 4:59:56 PM