Wind Effects

in relation to the proposed

Concept Plan for East Darling Harbour, Sydney

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1. Executive Summary

A Concept Plan submission has been prepared for the East Darling Harbour site. This site is bounded by Hickson Rd to the east, Darling Habour to the west, Walsh Bay to the North and the King St Wharf development to the south (refer Figure 2).

This report presents a preliminary assessment of the existing wind environment within the East Darling Harbour precinct, Sydney. Comments regarding the potential impact of the proposed building massing are also presented in this report. No specific recommendations are made in this report as the aim is to highlight potential areas of concern rather than prescibe specific solutions. However some general suggestions have been made to assist in the future design process.

The site is currently subject to strong southerly and westerly wind effects. The changes on the site proposed by the Concept Plan are not expected to result in a worsening of the existing conditions. However, due to the proposed change of use, it is important that the design of any areas for outdoor passive recreational use be subjected to wind tunnel modeling to confirm the effectiveness of any proposed ameliorative measures for wind effects, subject to the following;

- wind tunnel testing methodology must comply with the Australasian Wind Engineering Society AWES-QAM-1-2001.
- Comfort under wind conditions should be assessed based on the applicable criteria for the weekly maximum Gust Equivalent Mean. The criteria by Davenport (1972) are preferred, although the Lawson(1975) criteria may also be used.
- Not-withstanding the above criteria, all public outdoor spaces will also need to satisfy the safety limit of 23m/s annual maximum gust suggested by Melbourne (1978).
- the appropriate criterion should be selected for the type of activity intended for the area in question. For example, all seating areas must comply with the short exposure criterion, whereas outdoor dining areas should aim to comply with the long exposure criterion.

The use of strategic planting and localised screens are effective in providing protection to the outdoor areas designated for passive recreational use. However, the form of the buildings also plays a significant role and the proposal to have a continuous wall along Hickson Rd within each block is encouraged.

The gradual increase in building heights towards the south is helpful in minimising the impact of the north-westerly winds.

The planting of trees along the Hickson Road boundary of the precinct and along the east-west streets within the precinct is important in minimising the impact of the southerly and westerly winds on pedestrians.

2. Introduction

A Draft Concept Plan has been developed for the East Darling Harbour site. The site is bounded by Hickson Rd to the east, Darling Habour to the west, Walsh Bay to the North and the King St Wharf development to the south.

This report presents a preliminary assessment of the existing wind environment within the East Darling Harbour precinct, Sydney. Comments regarding the potential impact of the proposed building massing are also presented in this report. No specific recommendations are made in this report as the aim is to highlight potential areas of concern rather than prescibe specific solutions. However some general suggestions have been made to assist in the future design process.

3. Results and Discussion

The various wind effects are assessed in respect of the local wind climate summarised in Appendix A and the level of exposure of the site. The impact of wind will differ depending on the type of activity intended for the outdoor space (refer to Appendix B).

3.1 Assessment of Existing Conditions

Figure 1 illustrates the main impacts of the 3 winds most prevalent in Sydney.

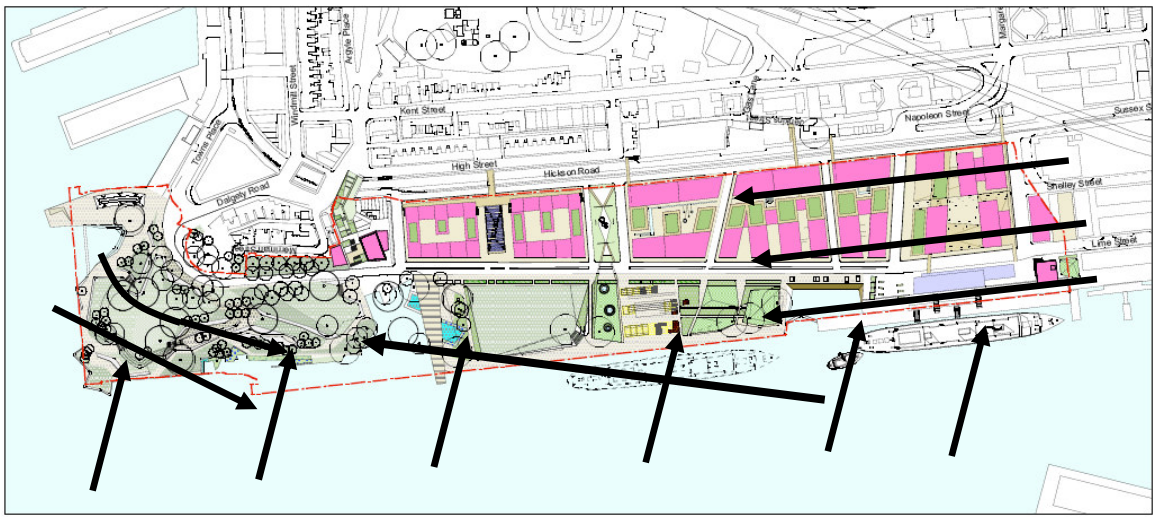

Figure 1: Main Impacts of the 3 principal winds for Sydney

3.1.1 North-Easterly Winds

North Easterly winds are generally not as strong or frequent as the other prevailing winds. Furthermore, as they occur during the summer months they are likely to have a positive environmental effect.

However, it is important to ensure that the proposed building morphology will not result in accelerated flows at the ground level to the point where the North-Easterly winds will tend to cause discomfort. The present conditions at the area north and west of Merriman St are expected to be consistently windy due to its exposure to these winds. The effect of the North-Easterly winds on the remainder of the site is not expected to be significant due to the effect of the substantial escarpment along the eastern side of Hickson Rd and the shielding provided by the row of tall buildings adjacent to the southern half of the precinct.

3.1.2 Southerly Winds

The southerly winds currently have a significant impact on the local wind environment. The Western Distributor is expected to direct strong southerly winds onto the southern part of the site.

At present, Southerly to South-Westerly winds are expected to result in strong wind conditions along the foreshore area.

3.1.3 Westerly Winds

The West to North-Westerly winds will have the greatest impact on the site due to the exposure of the site to these winds (refer to Figure 1). This is compounded by the fact that these tend to be the dominant winds during the cold winter months, when people are more sensitive to the wind.

The East Darling Harbour precinct is not alone with regards to the exposure to the westerly winds. Other areas, experiencing a similar problem are the Observatory Park, the top of the Hickson Rd cliff-face, particularly where there are no tall buildings behind to stagnate the westerly winds such as along High St and Gas Lane, and along certain areas of Darling Harbour and King Street Wharf.

Wind conditions within Clyne Reserve are expected to be tolerable due to the effect of the existing planting. However, conditions are expected to be particularly windy in areas immediately north or west of that area.

Figure 2: Existing Aerial View of the local precinct.

3.2 Assessment of Future Conditions (based on the draft Concept Plan)

It is proposed to create a large public recreational area along the western (waterfront) portion of the site.

It is proposed to gradually increase the heights of the buildings towards the south of the site. Buildings will increase in height from low-rise at the northern part of the site to maximum heights of approximately 40-levels at the southern end of the site. It is proposed to gradually vary the development mix from predominanty residential at the northern end to predominantly commercial at the southern end. Ground level areas on the southern half of the precinct will involve retail activities.

East-West streets will be aligned with the existing streets, east of the site.

3.2.1 North-Easterly Winds

North Easterly winds are generally not critical. However, care should be taken with regard to the potential use and protection of those using the northern end of the precinct, particularly the northern half of Headland Park. The escarpment that otherwise protects the site from the north-easterly winds is likely to funnel the north-easterly winds into this northern area. This effect can be ameliorated by means of strategic planting as suggested by the the indicative landscape plans subject to future detailed design. Any areas within this part of the Headland Park that involve seating or other stationary activities will require substantial protection - techniques such as earth mounds or strategic planting could be considered.

3.2.2 Southerly Winds

Any proposal to have tall buildings at the southern end of the site with minimal or no podium setbacks is likely to result in substantial side-streaming and funnelling of the southerly winds onto Hickson Rd. A primary method of amelioration in this scenario would be signifacant street tree planting along the eastern boundary of the site, particuarly the section of Sussex St between Napoeon and Margaret Sts. The selected species will need to be of a large density foliating type, with wide canopies. The use of strategic planting of trees is considered the most effective in this particular situation. However, alternative measures may be adopted provided that it can demonstrated, using wind tunnel modelling techniques, that they are as effective.

Downwash effects are likely on Margaret St and care should be taken in the future designs to account for this. If no podium setback is to be provided from the southern aspects of the towers then alternative techniques chould be investigated such as one or two permeable floors near the base of the towers.

Alternative measures can involve an aerodynamic form of the towers themselves to facilitiate the horizontal movement of the wind and to minimise downwash.

South to south-westerly winds are likely to have an adverse impact on the wind environment west of Globe St, including Globe St itself. As mentioned in the case of the north-easterly winds, localised protection is the most effective means of protecting areas intended for seating or other stationary activities. The method of treating these direct ground-level wind effects will depend on the design and use of the area and should be determined at subsequent design stages.

Wind tunnel modelling should be undertaken at future design stages for the components of the precinct located south of Agar Street. This is to obtain a reliable prediction of the likely wind environment effects and to test any recommended treatment options.

3.2.3 Westerly Winds

The westerly to north-westerly winds will have the greatest impact on the wind environment within the open spaces on the western edge of the site west of Globe Street. In addition, the wind conditions on Globe Street and adjacent streets that are oriented east-west will be substantially affected by these direct ground level winds. Funnelling effects are also likely to occur at the southern portion of the site, particularly along Healy, Bull, Napoleon and Margaret Streets. It is noted that with the exception of Margaret St, substantial planting is indicated along these east-west streets. The indicated planting will assist in maintaining acceptable wind conditions along those streets, however depending on the programming of the open space elements, techniques such as earth mounds or physical structures could be considered.

In the case of Margaret St, it is intended to maintain this street as a view corridor to Darling Harbour. This will require careful design of wind mitigation device(s) for Margaret St, in conjunction with the design of the southernmost components of the East Darling Harbour Precint.

Areas along the public reserve, west of Globe Street intended for seating or other passive recreational activities will require localised protection. The method of treating these direct ground-level wind effects can be determined at the future approval stages as such treatments will depend on the design and use of the area. It is recommended that wind tunnel modelling be undertaken at future design stages to obtain a reliable prediction of the likely wind environment effects and to test any recommended treatment options.

The proposal to have a continuous spans of buildings along the eastern boundary of the site (Hickson Road) is likely to be effective in substantially reducing the impact of the westerly winds by means of stagnation, resulting in a potentially favourable environment suitable for retail.

4. Conclusion

A general overview of the key wind environment issues has been presented in this report. It is recommended that at the future design stages wind tunnel modelling and verification of proposed treatments be carried out due to the significant exposure of the site to the southerly and westerly winds.

Any development proposal for the southern portion of the site, where the taller building components are proposed (south of Agar Street) should be subjected to a wind tunnel study, carried out in accordance with the procedures outlined in the Australasian Wind Engineering Society Quality Assurance Manual, AWES-QAM-1-2001. The criteria to be applied for areas involving pedestrian and seating activity should be based on the weekly maximum Gust Equivalent Mean. It is preferrable that such criteria be based on those recommended by Davenport (1972). Melbourne's (1978) safety limit of 23m/s for the annual maximum gust should be satisfied for all outdoor areas.

References

Australasian Wind Engineering Society, AWES-QAM-1-2001, "Wind Engineering Studies of Buildings".

Davenport, A.G., 1972, "An approach to human comfort criteria for environmental conditions", Colloquium on Building Climatology, Stockholm.

Lawson, T.V., 1973, "The wind environment of buildings: a logical approach to the establishment of criteria", Bristol University, Department of Aeronautical Engineering.

Lawson, T.V., 1975, "The determination of the wind environment of a building complex before construction", Bristol University, Department of Aeronautical Engineering.

Melbourne, W.H., 1978, "Criteria for Environmental Wind Conditions", Journal of Wind Engineering and Industrial Aerodynamics, vol.3, pp.241-249.

Appendix A: Sydney Wind Climate

The three principal wind directions affecting this development prevail from the North-East, South and West. Table A1 is a summary of the principal time of occurrence of these winds.

Table A1: Principal Time of Occurrence of Winds for the Sydney Region

Month	Wind Direction		
	North-East	South	West
January	X	X	
February	X	X	
March	X	X	
April		X	X
May			X
June			X
July			X
August			X
September		X	X
October	X	X	
November	X	X	
December	X	X	

X ------ Indicates Occurrence

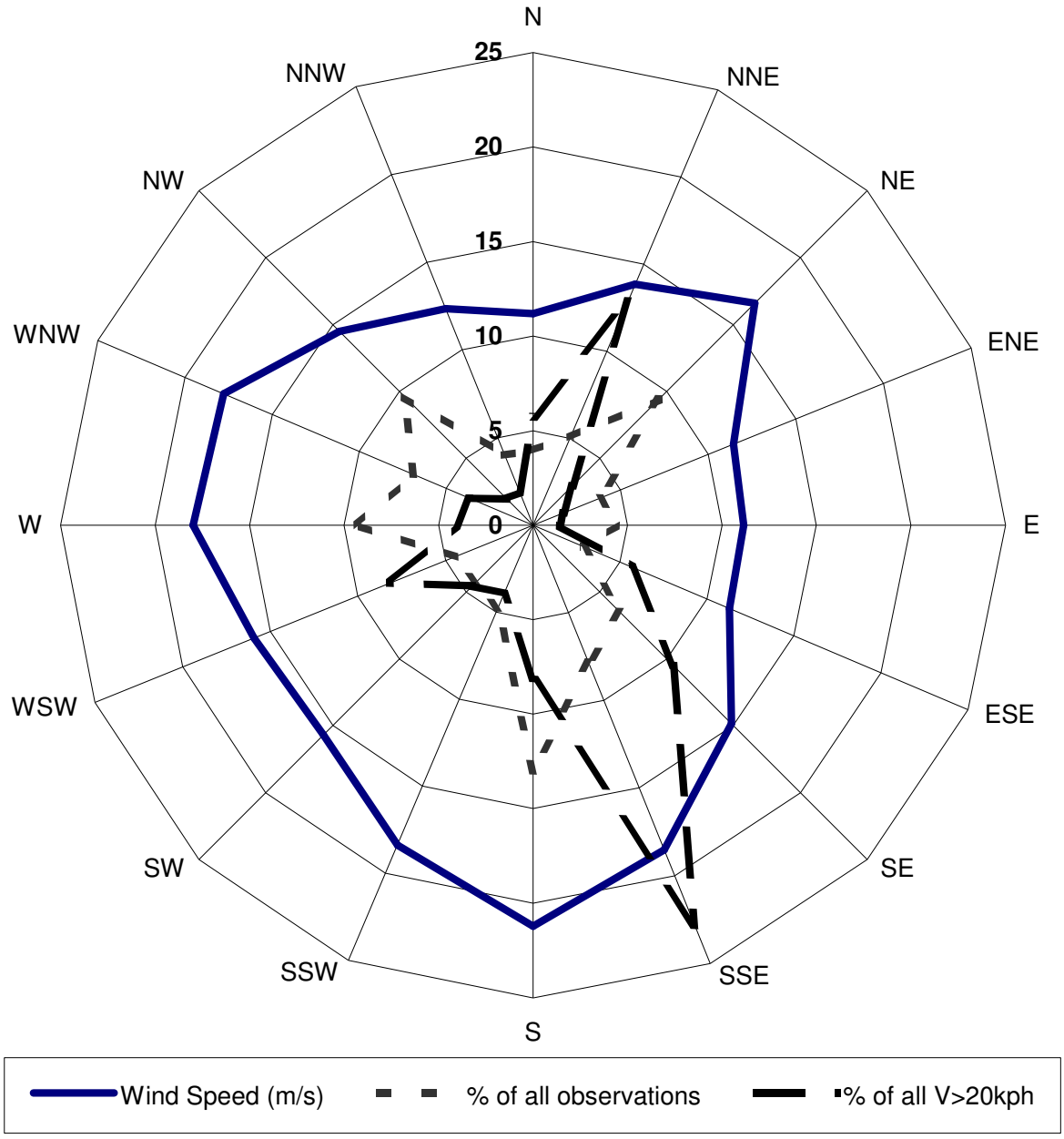

Figure A1: Annual Maximum 10 minute Mean Wind Speeds for Sydney, Corrected for Suburban Terrain at a Reference Height of 200m. (Based on Data Obtained from Sydney Airport Observation Office, from 1939 to 1992)

Appendix B: 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.

Table B1, developed by Penwarden (1975), is a modified version of the Beaufort Scale, and describes the effects of various wind speeds on people. Also note that various criteria relate the acceptability to the frequency of occurrence of certain maximum levels of wind speeds (such as once per week or once per year). Higher ranges of wind speeds can be tolerated for rarer events.

Table B1: Summary of Wind Effects on People (after Penwarden, 1975)

Type of Winds	Beaufort Number	Wind Speed (m/s)	Effects
Calm, light air	1	0 - 1.5	Calm, no noticeable wind
Light breeze	2	1.6 - 3.3	Wind felt on face
Gentle breeze	3	3.4 - 5.4	Hair is disturbed, Clothing flaps
Moderate breeze	4	5.5 - 7.9	Raises dust, dry soil and loose paper - Hair disarranged
Fresh breeze	5	8.0 - 10.7	Force of wind felt on body
Strong breeze	6	10.8 - 13.8	Umbrellas used with difficulty, Hair blown straight, Difficult to walk steadily, Wind noise on ears unpleasant.
Near Gale	7	13.9 - 17.1	Inconvenience felt when walking.
Gale	8	17.2 -20.7	Generally impedes progress, Great difficulty with balance.
Strong gale	9	20.8 - 24.4	People blown over by gusts.