



PEDESTRIAN WIND ENVIRONMENT STATEMENT THE WHARF SITE, WENTWORTH POINT

W382-54F03(REV0)- WS REPORT

5 FEBRUARY 2014

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DOCUMENT CONTROL

Date	Revision History	Non-Issued Revision	Issued Revision	Prepared By (initials)	Instructed By (initials)	Reviewed & Authorised by (initials)
05/02/2014	Initial.	-	0	AB	TR	AB/TR

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EXECUTIVE SUMMARY

This report is in relation to the proposed development known as Wharf Site, Wentworth Point, and is located at 1 Burroway Road, Sydney Olympic Park. This report presents an opinion on the likely impact of the proposed design on the local wind environment to the critical outdoor areas within and around the subject development. The effect of wind activity is examined for the three predominant wind directions for the Sydney region; north-easterly, southerly and westerly winds. The analysis of the wind effects relating to the proposal was carried out in the context of the local wind climate, building morphology and land topography. The conclusions of this report are drawn from our extensive experience in this field and are based on an examination of the architectural drawings which have been prepared by the project architect Rice Daubney, received during January and February 2014. No wind tunnel tests have been undertaken for the subject development, and hence this report addresses only the general wind effects and any localised effects that are identifiable by visual inspection. Any recommendations in this report are made only in-principle and are based on our extensive experience in the study of wind environment effects.

The results of this assessment indicate that the majority of the ground level areas within and around the site will benefit from the inclusion of the many proposed trees, which line the pedestrian footpaths around the site, and also along the central pedestrian corridor through the site. However, due to the alignment of the three buildings of the development, funnelling of the southerly winds is expected to occur along the central pedestrian corridor through the site, and on the two large communal terraces of the development on Level 2. Note that the southerly winds are the strongest and most frequent for the Sydney region. Although this potential funnelling effect will be somewhat reduced with the inclusion of other apartment buildings to the south of the site, which will likely provide a shielding effect from the southerly winds, it is recommended to include additional trees to these areas of the development to provide adequate wind conditions. Note that, for trees to be effective in wind mitigation, they should be selected from a densely foliating and evergreen species. Furthermore, the ground level trees should be capable of growing to a minimum height of 6m with a 5m wide canopy, and the trees for the Level 2 terraces should be capable of growing to a minimum height of 5m with a 4m wide canopy. If soil depth is an issue for the Level 2 terraces, it is suggested that these trees could be placed within raised planters.

Regarding wind conditions for the various private balconies and terraces of the development, it is expected that adequate wind conditions will be experienced for the majority of these areas. However, some of the private balconies and/or terraces of Building A protrude further from the main building façade than others, and hence are more exposed to the prevailing winds. Hence it is recommended to include the following:

- For the north-western corner balconies of Building A, on Levels 2 to 5, it is recommended to include some full-height sunshade louvred screens on the western

aspect. These screens could be on rails and able to be moved along the edge of the balcony slab by the occupants of those apartments, and can be used to provide some protection to the balcony area on days when there is a strong wind coming from the west.

- For the balconies on the northern aspect of Building A, on Levels 2 to 5, it is recommended to have a solid screen (at least 2m high) on the western side of those balconies to provide protection to the balcony area on days when there is a strong wind coming from the west.
- For the larger balcony at south-western aspect of Building A, on Levels 2 to 9, it is recommended to have solid screens (at least 2m high) on either side.

In addition to the above recommendations, it is recommended that all private balconies and terraces of the development have solid balustrades (ie: glass, concrete, etc).

Hence, with the inclusion of the additional trees to the central pedestrian corridor through the site and on the Level 2 communal terraces, and with the incorporation of the abovementioned treatments for the private balconies and terraces, it is expected that adequate wind conditions will be achieved for all trafficable outdoor areas within and around the subject development. Furthermore, it is not expected that the proposed development will have any adverse impact onto wind conditions experienced within the local area.

1 DESCRIPTION OF THE PROPOSED DEVELOPMENT AND SURROUNDS

The subject development site is located at 1 Burroway Road, Sydney Olympic Park, and is adjacent to the Sydney Olympic Park Ferry Wharf. The site is located on a peninsula known as Wentworth Point, with the water bodies of the Parramatta River located to the north, and Homebush Bay located to the south-east. The site is bounded by Burroway Road to the south-west, an extension of Hill Road to the north-west, and new roads will be located along the northern and south-eastern site boundaries. Running through the centre of the site is an open pedestrian corridor for access from the Ferry Wharf to Burroway Road. Currently surrounding the site are low-rise warehouse buildings, although the entire precinct is undergoing extensive redevelopment and in the future the area will include many other residential apartment buildings to the south and east of the subject site (ie: to the east of Hill Road). These future buildings will likely be a similar height to the subject development (ie: approximately 9 storeys above ground). The land topography is somewhat flat in the immediate vicinity of the site, although it does slightly fall away to the Parramatta River to the north. An aerial image of the site location is presented in Figure 1.

The proposal is for a mixed-use development, which consists of 3 residential apartment buildings atop retail areas and a grocery store on the ground level. The overall height of the three buildings is 9 storeys above ground level, with an additional 3 storeys of basement car parking also proposed for the development.

On the ground level, the site features a pedestrian corridor running through the middle to allow for access from the Ferry Wharf to Burroway Road. The grocery store component of the development is located on the western side of the pedestrian corridor. Other smaller retail shops are also proposed lining each side of the pedestrian corridor. A childcare centre is proposed at the north-eastern corner of the site. Many trees are proposed along the pedestrian footpaths around the site, as well as several trees along the central corridor through the site.

The remaining levels of the development feature residential apartments within three main buildings, named Buildings A, B and C (with Building A located on the western side of the site, and Building C on the eastern side). The three buildings are aligned somewhat in a north/south orientation, and private balconies and/or terraces are proposed for each of the residential apartments. The balconies and/or terraces are located on the northern, eastern and western aspects of the three buildings. Two large communal terraces are also proposed between the buildings on Level 2, on the rooftop of the shops below. Some trees are proposed for the communal terrace between Buildings A and B. A typical plan of the proposed development is presented in Figure 2.

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:

- Pedestrian footpaths all around the development site.

- The central pedestrian corridor through the site.
- The outdoor area associated with the proposed childcare centre at the north-eastern corner of the site.
- The two large communal terraces on Level 2 of the development.
- The various private balconies and terraces of the three buildings of the development.

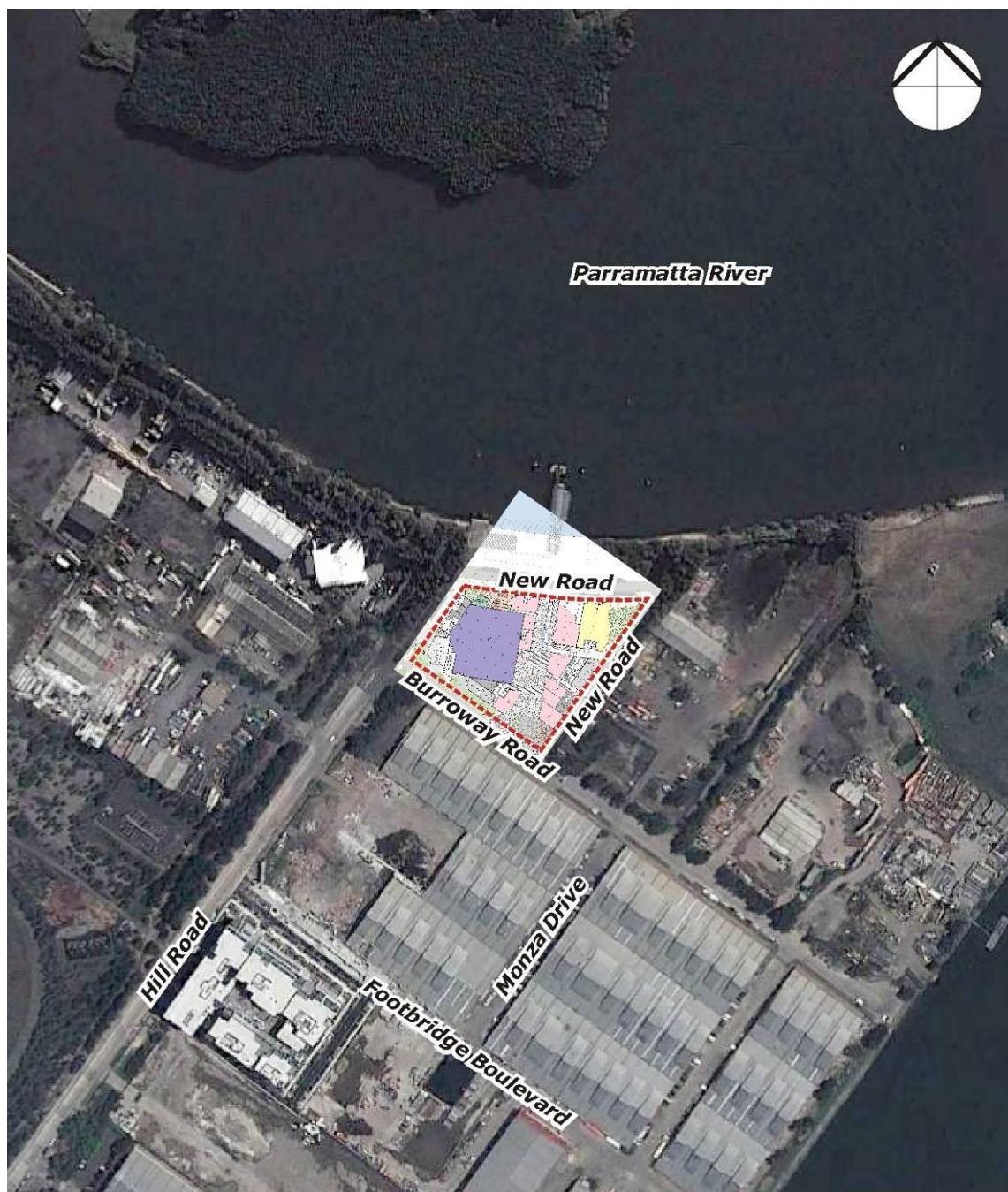


Figure 1: Aerial Image of the Site Location



Figure 2: Typical Plan of the Development (Level 4 shown)

2 WIND CLIMATE OF THE SYDNEY REGION

The Sydney region is governed by three principle wind directions, and these can potentially affect the subject development. These winds prevail from the north-east, south and west. A summary of the principal time of occurrence of these winds throughout the year is presented in Table 1 below. This summary is based on a detailed analysis undertaken by Windtech Consultants of recorded directional wind speeds obtained at the meteorological station located at Kingsford Smith Airport by the Bureau of Meteorology (recorded from 1939 to 2008). From this analysis, a directional plot of the annual and weekly recurrence winds for the Sydney region is also determined, as shown in Figure 3. The frequency of occurrence of these winds is also shown in Figure 3.

As shown in Figure 3, the southerly winds are by far the most frequent wind for the Sydney region, and are also the strongest. The westerly winds occur most frequently during the winter season for the Sydney region, and although they are typically not as strong as the southerly winds, they are usually a cold wind since they occur during the winter and hence can be a cause for discomfort for outdoor areas. North-easterly winds occur most frequently during the warmer months of the year for the Sydney region, and hence are usually welcomed within outdoor areas since they are typically not as strong as the southerly or westerly winds.

Table 1: Principle Time of Occurrence of Winds for Sydney

Month	Wind Direction		
	North-Easterly	Southerly	Westerly
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	

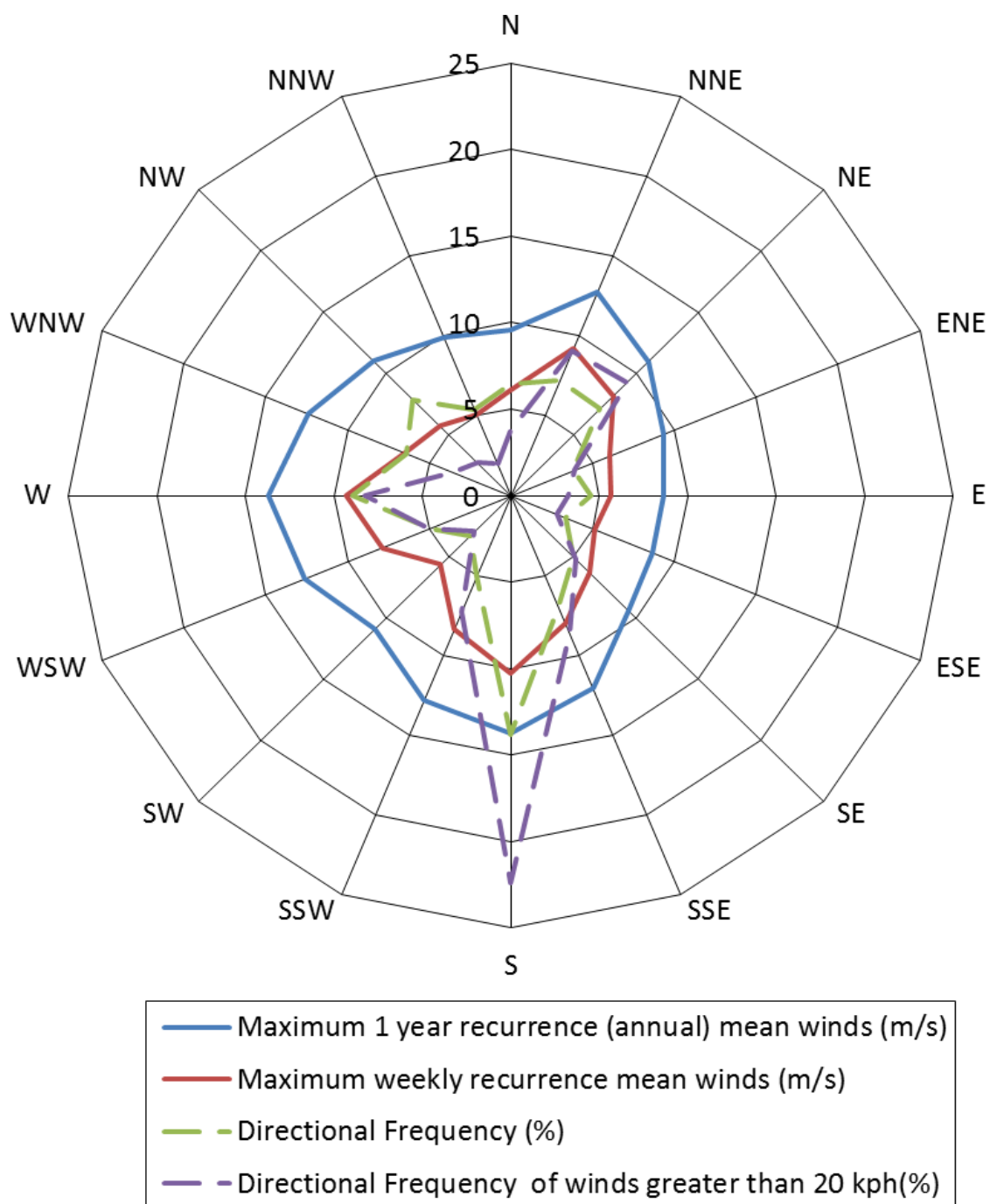


Figure 3: Annual and Weekly Recurrence Mean Wind Speeds, and Frequencies of Occurrence, for the Sydney Region (based on 10-minute mean observations from Kingsford Smith Airport from 1939 to 2008, corrected to open terrain at 10m)

3 WIND EFFECTS ON PEOPLE

The acceptability of wind in any area is dependent upon its use. For example, people walking or window-shopping will tolerate higher wind speeds than those seated at an outdoor restaurant. Various other researchers, such as Davenport, Lawson, Melbourne, Penwarden, etc, have published criteria for pedestrian comfort for pedestrians in outdoor spaces for various types of activities. Some Councils and Local Government Authorities have also adopted elements of some of these into their planning control requirements in Australia.

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

Table 2: Summary of Wind Effects on People (Penwarden, 1975)

Type of Winds	Gust Speed (m/s)	Effects	Applicability
Calm, light air	0 - 1.5	Calm, no noticeable wind.	Generally acceptable for Stationary, long exposure activities such as in outdoor restaurants, landscaped gardens and open air theatres.
Light breeze	1.6 - 3.3	Wind felt on face.	
Gentle breeze	3.4 - 5.4	Hair is disturbed, Clothing flaps.	
Moderate breeze	5.5 - 7.9	Raises dust, dry soil and loose paper. Hair disarranged.	Generally acceptable for walking & stationary, short exposure activities such as window shopping, standing or sitting in plazas.
Fresh breeze	8.0 - 10.7	Force of wind felt on body.	Acceptable as a main pedestrian thoroughfare
Strong breeze	10.8 - 13.8	Umbrellas used with difficulty, Hair blown straight, Difficult to walk steadily, Wind noise on ears unpleasant.	Acceptable for areas where there is little pedestrian activity or for fast walking.
Near gale	13.9 - 17.1	Inconvenience felt when walking.	
Gale	17.2 - 20.7	Generally impedes progress, Great difficulty with balance.	Unacceptable as a public accessway.
Strong gale	20.8 - 24.4	People blown over by gusts.	Completely unacceptable.

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

4 RESULTS AND DISCUSSION

The expected wind conditions affecting pedestrians within and around the development site are discussed in the following sub-sections of this report for the various trafficable outdoor areas for each of the three predominant wind directions for the Sydney 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 proposed building form, their overall heights and bulk, as well as the landform. Note that only the potentially critical wind effects are discussed in this report.

4.1 Pedestrian Footpaths around the Site

The pedestrian footpaths around the site will benefit from the effective placement of the proposed trees along the footpaths, as indicated in the architectural drawings. These trees are expected to be effective in mitigating adverse wind effects to pedestrians walking along these footpaths. Hence, to provide adequate conditions for pedestrians walking along the footpaths around the site, the trees proposed along these footpaths are recommended to be retained for the final landscaping plan. It is not expected that the proposed development will create any adverse wind effects to the pedestrian footpaths around the site.

Currently the development site is relatively exposed to the three primary wind directions for the Sydney region due to the lack of significant nearby structures. However, it is noted that in the future many more apartment buildings will be constructed within this precinct, and these other buildings are expected to assist in further improving wind conditions for the pedestrian footpaths around the site due to the shielding effect that they will create.

4.2 Central Pedestrian Corridor through the Site

The central pedestrian corridor running through the site, which allows for access from the Ferry Wharf to Burroway Road, is well shielded from the north-easterly and westerly winds by Buildings C and B respectively. However, there is potential for southerly winds to be funnelled between Buildings B and C and along the central pedestrian corridor. This effect will be somewhat reduced with the inclusion of other apartment buildings to the south of the site, which will likely provide a shielding effect from the southerly winds. Nonetheless, it is recommended that some form of treatment is implemented to mitigate the potentially adverse funnelling of southerly winds for this area. Note that the southerly winds are the strongest and most frequent for the Sydney region. Furthermore, it is noted that many retail stores are lining either side of the central pedestrian corridor through the site, and pedestrians and shop owners/tenants will not tolerate strong winds on a regular basis along this corridor area.

It is noted that several trees are already proposed along the central pedestrian corridor through the site. To provide adequate wind conditions for the intended use of this area, it is recommended to include several more trees, particularly near the narrowest point between Buildings B and C. A suggested layout of trees is presented in Figure 4a for this area. Note that, for trees to be effective in this area, they should be selected from a densely foliating and evergreen species, and be capable of growing to a height of at least 6m with a 5m wide canopy (it is noted in the architectural drawings that the proposed trees already satisfy this size requirement).

Hence, with the inclusion of additional trees for the central pedestrian corridor through the site in a layout similar to the suggested placements indicated in Figure 4a, it is expected that adequate wind conditions will be achieved for this area of the site.

4.3 Outdoor Area associated with the Proposed Childcare Centre

The outdoor area associated with the proposed childcare centre, located at the north-eastern corner of the site on ground level, will benefit from the screen/canopy structure which partially covers this area. This screen/canopy structure will provide some shielding from the prevailing winds that could otherwise have affected this area of the site, and is hence recommended to be retained for the final design of the development. The scattered trees lining the adjacent pedestrian footpaths will also provide some shielding from the prevailing winds. Hence, with the development as proposed, adequate wind conditions are expected to be achieved for the outdoor area associated with the proposed childcare centre at the north-eastern corner of the site.

4.4 Level 2 Communal Terraces

The Level 2 communal terraces of the development are well shielded from the prevailing north-easterly and westerly winds by Buildings A, B and C of the proposed development. However, the alignment of these buildings will also tend to funnel the southerly winds across these terrace areas. This effect will be somewhat reduced with the inclusion of other apartment buildings to the south of the site, which will likely provide a shielding effect from the southerly winds. Nonetheless, it is recommended that some form of treatment is implemented to mitigate the potentially adverse funnelling of southerly winds for this area. Note that the southerly winds are the strongest and most frequent for the Sydney region.

It is noted that several trees are already proposed on the communal terrace between Buildings A and B, although none are proposed for the communal terrace between Buildings B and C. To provide adequate wind conditions for the intended use of these areas, it is recommended to include several more trees. A suggested layout of trees is presented in Figure 4b for these areas. Note that, for trees to be effective in these areas, they should be selected from a

densely foliating and evergreen species, and be capable of growing to a height of at least 5m with a 4m wide canopy (it is noted in the architectural drawings that the proposed trees on the communal terrace between Buildings A and B already satisfy this size requirement). If soil depth is an issue here, it is suggested that these trees could be placed within raised planters.

Hence, with the inclusion of additional trees on these communal terraces in a layout similar to the suggested placements indicated in Figure 4b, it is expected that adequate wind conditions will be achieved for these areas of the site.

4.5 Private Balconies and Terraces

The majority of the private balconies and terraces of the development benefit from being recessed into the overall building footprint, which provides protection from the prevailing winds. The effective use of privacy screens, blade walls, fins, louvre screens, solid balustrades (ie: concrete or glass), and the stepping of the building façade, also all assist in mitigating adverse wind effects, particularly for balconies and terraces located on or near the building corners. However, some of the private balconies and/or terraces of Building A protrude further from the main building façade than others, and hence are more exposed to the prevailing winds. Hence it is recommended to include the following:

- For the north-western corner balconies of Building A, on Levels 2 to 5, it is recommended to include some full-height sunshade louvred screens on the western aspect. These screens could be on rails and able to be moved along the edge of the balcony slab by the occupants of those apartments, and can be used to provide some protection to the balcony area on days when there is a strong wind coming from the west.
- For the balconies on the northern aspect of Building A, on Levels 2 to 5, it is recommended to have a solid screen (at least 2m high) on the western side of those balconies to provide protection to the balcony area on days when there is a strong wind coming from the west.
- For the larger balcony at south-western aspect of Building A, on Levels 2 to 9, it is recommended to have solid screens (at least 2m high) on either side.

The abovementioned treatments are also presented in Figure 4c in the form of a marked-up plan drawing. With the inclusion of these treatments, and solid balustrades (ie: glass, concrete, etc) for all private balconies and terraces of the development, it is expected that adequate wind conditions will be achieved for all private balconies and terraces of the development.



Legend



Trees that are already proposed and indicated in the architectural drawings.



Suggested placement of additional trees.

Note: For these trees to be effective in wind mitigation, they should be selected from a densely foliating and evergreen species, and be capable of growing to a height of at least 6m with a 5m wide canopy.

Figure 4a: Suggested Placement of Additional Trees – Central Pedestrian Corridor

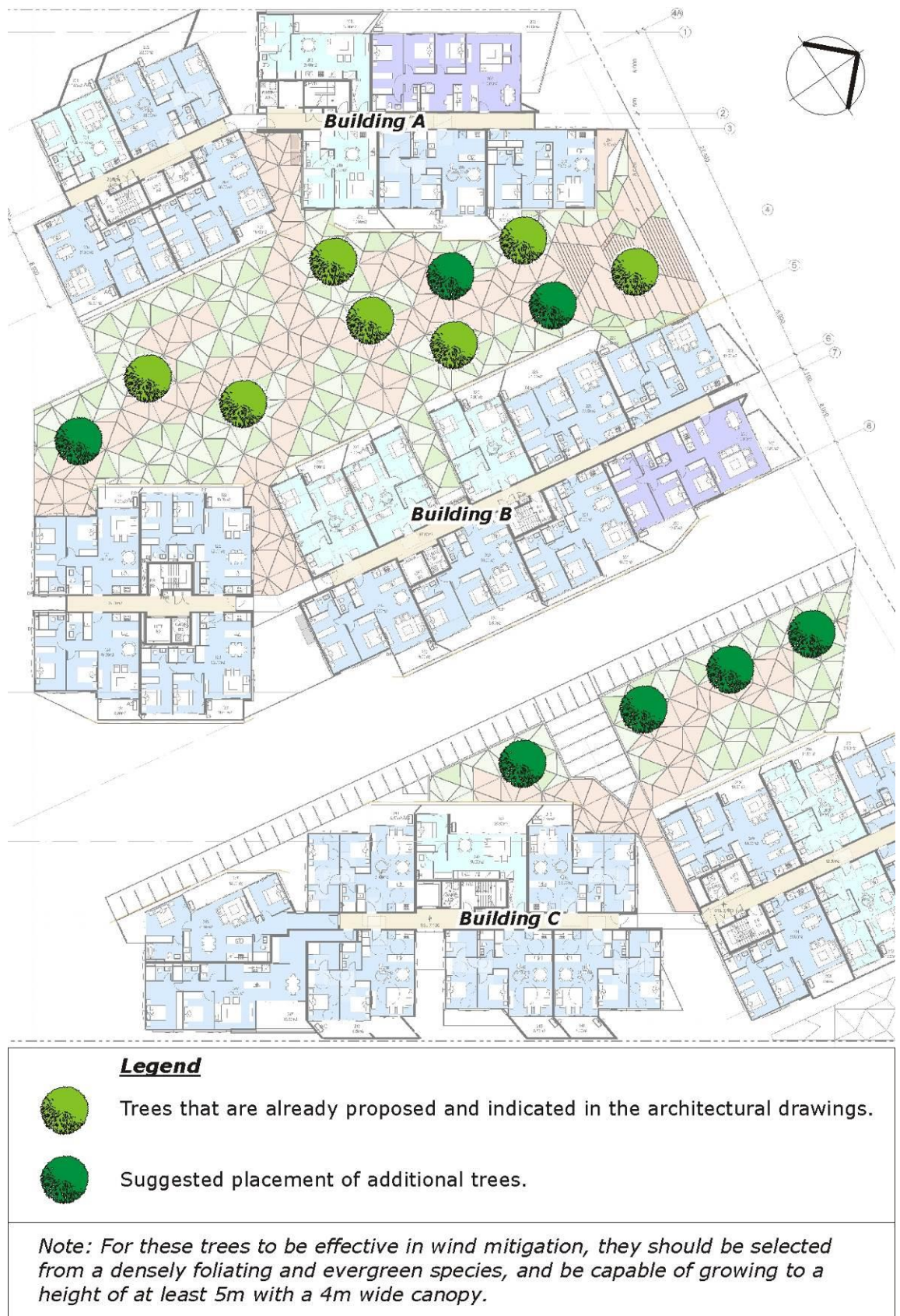


Figure 4b: Suggested Placement of Additional Trees – Level 2 Communal Terraces



Figure 4c: Recommended Treatments for the Private Balconies and Terraces of Building A (Level 4 plan shown)

5 CONCLUSION

An analysis of the wind environment impact with respect to the three principal wind directions for the Sydney region has been completed for the proposed development known as Wharf Site, Wentworth Point, located at 1 Burroway Road, Sydney Olympic Park. This report presents an opinion on the likely impact of the proposed design on the local wind environment to the critical outdoor areas within and around the subject development. The effect of wind activity is examined for the three predominant wind directions for the Sydney region; north-easterly, southerly and westerly winds. The analysis of the wind effects relating to the proposal was carried out in the context of the local wind climate, building morphology and land topography. The conclusions of this report are drawn from our extensive experience in this field and are based on an examination of the architectural drawings which have been prepared by the project architect Rice Daubney, received during January and February 2014. No wind tunnel tests have been undertaken for the subject development, and hence this report addresses only the general wind effects and any localised effects that are identifiable by visual inspection. Any recommendations in this report are made only in-principle and are based on our extensive experience in the study of wind environment effects.

The results of this assessment indicate that the majority of the ground level areas within and around the site will benefit from the inclusion of the many proposed trees, which line the pedestrian footpaths around the site, and also along the central pedestrian corridor through the site. However, due to the alignment of the three buildings of the development, funnelling of the southerly winds is expected to occur along the central pedestrian corridor through the site, and on the two large communal terraces of the development on Level 2. Note that the southerly winds are the strongest and most frequent for the Sydney region. Although this potential funnelling effect will be somewhat reduced with the inclusion of other apartment buildings to the south of the site, which will likely provide a shielding effect from the southerly winds, it is recommended to include additional trees to these areas of the development to provide adequate wind conditions. Note that, for trees to be effective in wind mitigation, they should be selected from a densely foliating and evergreen species. Furthermore, the ground level trees should be capable of growing to a minimum height of 6m with a 5m wide canopy, and the trees for the Level 2 terraces should be capable of growing to a minimum height of 5m with a 4m wide canopy. If soil depth is an issue for the Level 2 terraces, it is suggested that these trees could be placed within raised planters.

Regarding wind conditions for the various private balconies and terraces of the development, it is expected that adequate wind conditions will be experienced for the majority of these areas. However, some of the private balconies and/or terraces of Building A protrude further from the main building façade than others, and hence are more exposed to the prevailing winds. Hence it is recommended to include the following:

- For the north-western corner balconies of Building A, on Levels 2 to 5, it is recommended to include some full-height sunshade louvred screens on the western aspect. These screens could be on rails and able to be moved along the edge of the balcony slab by the occupants of those apartments, and can be used to provide some protection to the balcony area on days when there is a strong wind coming from the west.
- For the balconies on the northern aspect of Building A, on Levels 2 to 5, it is recommended to have a solid screen (at least 2m high) on the western side of those balconies to provide protection to the balcony area on days when there is a strong wind coming from the west.
- For the larger balcony at south-western aspect of Building A, on Levels 2 to 9, it is recommended to have solid screens (at least 2m high) on either side.

In addition to the above recommendations, it is recommended that all private balconies and terraces of the development have solid balustrades (ie: glass, concrete, etc).

Hence, with the inclusion of the additional trees to the central pedestrian corridor through the site and on the Level 2 communal terraces, and with the incorporation of the abovementioned treatments for the private balconies and terraces, it is expected that adequate wind conditions will be achieved for all trafficable outdoor areas within and around the subject development. Furthermore, it is not expected that the proposed development will have any adverse impact onto wind conditions experienced within the local area.