Pedestrian Wind Environment Statement

for the proposed development at

12-40 Bonar Street, Arncliffe

October 7, 2009

Report Reference No. W930-04F02(rev0)- WS Report

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Document Control

Revision Number	Date	Revision History	Prepared By (initials)	Initial Review By (initials)	Reviewed & Authorised By (initials)
0	02/09/2009	Initial	TH	-	AB

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1.0 Introduction

This report presents an opinion on the local pedestrian wind environment effects for the latest design scheme of the proposed development of 12-40 Bonar Street, Arncliffe, and also with reference to the wind tunnel study results for the previous April 2009 design scheme of the site. Results of the previous wind tunnel study for this development site are presented in the earlier pedestrian wind environment report (reference number W930-02F02(rev0), dated April 14, 2009).

The proposed development consists of four main residential buildings surrounding a central communal outdoor area. The building heights range from six to seven stories above ground. The latest design scheme for the site is similar to the previous scheme, and the previous wind tunnel study results are still valid for most of the development.

The analysis of the wind effects relating to the proposal was carried out in the context of the local wind climate, building morphology, land topography and the wind comfort criteria as required by Section 5 of the Rockdale City Council Development Control Plan No. 62 for Wolli Creek, summarised as follows:

- Wind conditions for all pedestrian accessible ground level areas within and around the proposed development should satisfy the following;
    - **Comfortable Walking Criteria of 16m/s for annual maximum gust wind speeds** in walkways, pedestrian transit areas, streets where pedestrians do not generally stop, sit, stand, window shop and the like.
    - **Short Exposure Criteria of 13m/s for annual maximum gust wind speeds** where pedestrians are involved in stationary short-exposure activities such as window shopping, standing or sitting (including areas such as bus stops, public open space and private open space).
    - **Long Exposure Criteria of 10m/s for annual maximum gust wind speeds** in areas for stationary long-exposure activity, such as outdoor dining.

  However, it is also considered acceptable if the measured wind speed exceeds the above criteria if it is better than the existing conditions (however note that the wind conditions must satisfy the safety criterion of 23m/s for the annual maximum peak wind speeds at all locations).
- Wind conditions for private balconies and terraces of the proposed development should satisfy the safety limit of 23m/s for the annual maximum peak wind speeds.

The conclusions of this report are drawn from our extensive experience in this field and are based on an examination of the architectural drawings prepared by Meriton Apartments, dated November, 2008, and the wind tunnel study results of the previous design scheme. Any recommendations in this report are made only in-principle and are based on our extensive experience in the study of wind environment effects.

2.0 Local Wind Climate

This report is assessed on the regional wind climate data for Sydney, recorded by the Bureau of Meteorology from Sydney Airport between 1939 and 2008, as shown in Figure 1. Table 1 presents a summary of the principal time of occurrence of the predominant wind directions affecting the proposed development. A full set of wind roses for the Sydney region, obtained from Sydney Airport (1939 to 2000) at 9am and 3pm for each month throughout the year, are attached in the Appendix of this report.

Table 1: Principal Time of Occurrence of Winds – Sydney Region

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	

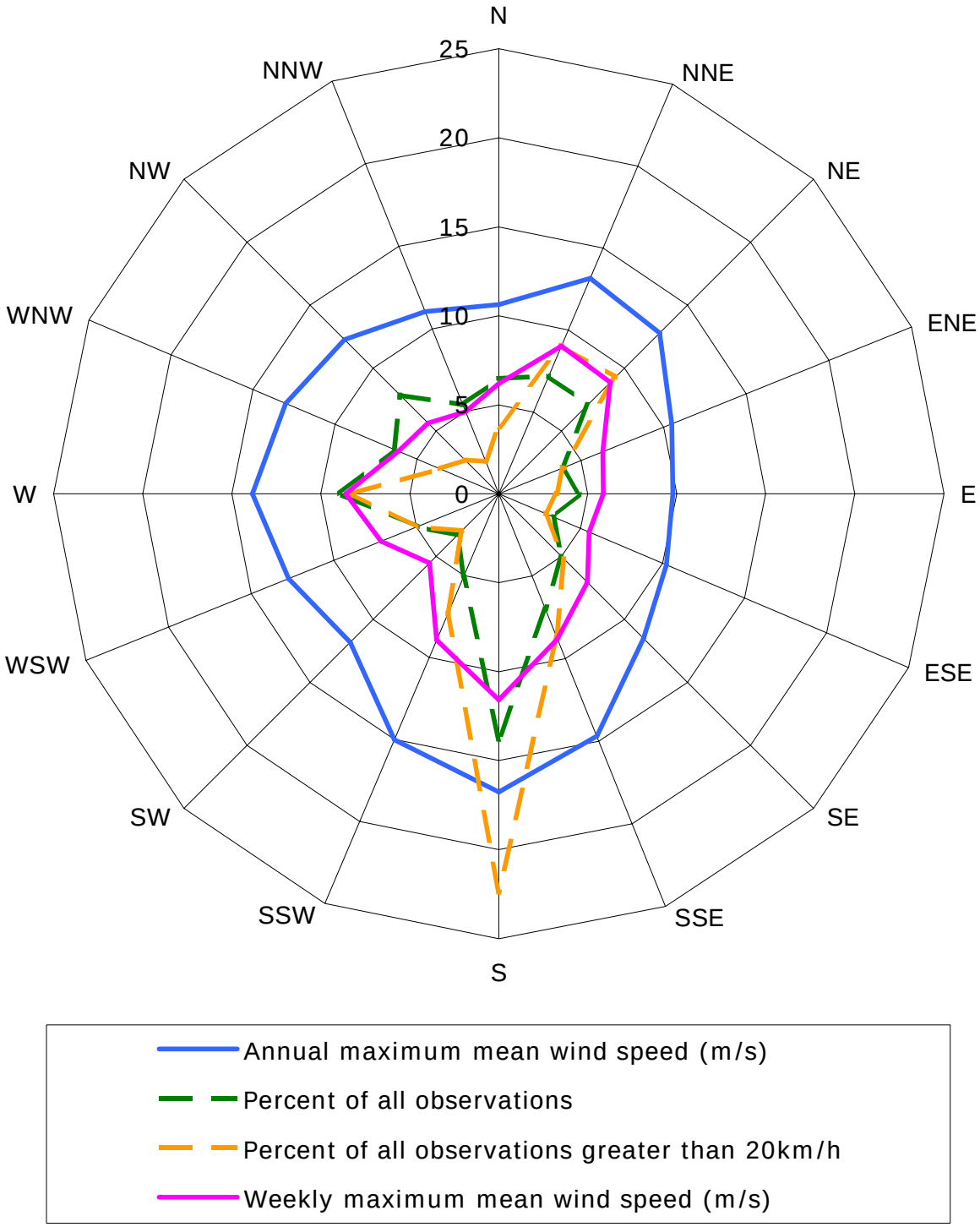


Figure 1: Reference Wind Speeds and Frequencies for Sydney (based on 10 minute mean observations at Kingsford Smith Airport, from 1939 to 2008, corrected for 10m height in open terrain)

3.0 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.

The following table, developed by Penwarden (1975), is a modified version of the Beaufort Scale, and describes the effects of various wind intensities on people. Note that the applicability column related to 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 (after Penwarden, 1975)

Type of Winds	Beaufort Number	Gust Speed (m/s)	Effects	Applicability
Calm, light air	1	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	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	Generally acceptable for walking & stationary, short exposure activities such as window shopping, standing or sitting in plazas.
Fresh breeze	5	8.0 - 10.7	Force of wind felt on body	Acceptable as a main pedestrian thoroughfare
Strong breeze	6	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	7	13.9 - 17.1	Inconvenience felt when walking.	
Gale	8	17.2 -20.7	Generally impedes progress, Great difficulty with balance.	Unacceptable as a public accessway.
Strong gale	9	20.8 - 24.4	People blown over by gusts.	Completely unacceptable.

4.0 Description and Location of the Proposed Development

The site is located at 12-40 Bonar St, Arncliffe. Figure 2 shows an aerial image of the site location. The site is bounded by is bounded by Bonar Street to the east, Hirst Street to the south, Loftus Street to the west and the Arncliffe West Public School to the north. The local land topography generally rises to the north and west of the site.

The proposed development consists of four main residential buildings surrounding a central communal outdoor area. The building heights range from six to seven stories above ground.

This report assesses the likely wind conditions to the various outdoor areas of the site accessible by pedestrians. The architectural drawings indicate three main outdoor accessible areas of the site, described as follows:

- The ground level pedestrian footpaths along Bonar, Loftus, and Hirst Streets, and along the northern boundary between the proposed development and Arncliffe West Public School.
- The ground level internal courtyard and associated pedestrian access areas within the apartment complex of the proposed development
- Private balcony and terrace areas from Levels 1 to 7 of the various residential buildings.

Figure 2: Aerial Image of the Proposed Development Site

5.0 Wind Conditions for the Proposed Development

The interaction between the wind and the building morphology in the area was considered based on the regional wind climate data for Sydney. Important features taken into account include the distances between building forms, their overall heights and bulk, as well as the local landform. The report also references the results presented in the previous pedestrian wind environment study report for the site, which was based on a wind tunnel study of the previous design scheme for the site (reference number W930-02F02 (rev0), dated April 14, 2009). The latest design scheme for the site is similar to the previous scheme, and the previous wind tunnel study results are still valid for most of the development.

5.1 Ground Level Pedestrian Footpaths around the Site

Wind conditions for the various pedestrian footpaths around the development site will be unaffected by the latest design changes to the proposal. The results of the previous pedestrian wind environment study report indicated that wind conditions along these pedestrian footpaths would exceed the relevant criteria, and a strategic layout of densely foliating vegetation was recommended to mitigate the adverse wind effects. This included several densely foliating trees capable of growing to a height of 5m with a 4m wide canopy, and densely foliating shrubs capable of growing to a height of 1.2m. These are shown in the following marked-up figures (Figures 3a to 3d).

Note that for vegetation to be effective in mitigating adverse westerly winds for the Sydney region, which predominantly occur during the winter months of the year, they should be of an evergreen species.

These ameliorative treatments are still recommended for the latest design scheme of the proposed development. With these treatments applied it is expected that wind conditions for all of the pedestrian footpaths around the proposed development site will be acceptable for their intended uses and satisfy the wind speed criteria described in Section 5 of the Rockdale City Council Development Control Plan No. 62 for Wolli Creek.

5.2 Ground Level Internal Courtyard and Associated Pedestrian Access Areas Within the Proposed Development

The results from the previous pedestrian wind environment study report indicate that the central internal courtyard areas adjacent to the swimming pool were exposed to adverse southerly winds from a combination of funnelling and a down-wash effect over Buildings B and C. The results also indicated that the pedestrian thoroughfare between Buildings A and B was exposed to strong westerly winds due to the funnelling between the buildings, and similarly the pedestrian thoroughfare between Buildings C and D experienced a strong funnelling effect for easterly winds. To mitigate these adverse effects, a strategic layout of densely foliating vegetation was devised and tested in the wind tunnel. The results of the study indicated that the vegetation would be

effective in providing suitable wind conditions to all outdoor areas within the central communal area of the site.

For the latest design scheme, the removal of the south-western section of Building D is expected to allow a more direct path for the strong southerly winds to flow over Building C and across the northern landscaped area of the internal courtyard, and to then funnel between Buildings A and D. Wind conditions to the other areas of the site are not expected to be affected by the latest design scheme change.

To provide suitable wind conditions to all outdoor areas within the central and northern courtyard areas of the development site, a similar treatment plan has been recommended. This is shown in Figure 3e, and includes several densely foliating trees capable of growing to a height of 5m, with a 4m wide canopy across the middle of the central area. These additional trees are expected to assist with breaking-up the strong southerly winds across the middle of the courtyard area.

With the addition of the treatments shown in Figure 3e of this report, it is expected that wind conditions for all outdoor areas within the internal courtyard of the proposed development site will be acceptable for their intended uses and satisfy the wind speed criteria described in Section 5 of the Rockdale City Council Development Control Plan No. 62 for Wolli Creek.

5.3 Private Balconies and Terraces

The results from the previous pedestrian wind environment study of the proposed development site indicated that wind conditions for most of the various private balcony and terrace areas would be acceptable. This is mainly due to the effective use of blade walls and building setbacks in the architectural design.

The south-eastern corner private balconies and terraces of Building C were subjected to adverse direct southerly winds. It was recommended that 1.2m high impermeable balustrades be implemented along the perimeter of those private balcony and terrace areas to mitigate the adverse wind effects.

The latest design changes for the proposed development are not expected to have any significant impact on the previously presented wind conditions for the various private balconies and terraces of the proposed development. Hence it is still recommended that 1.2m high impermeable balustrades are used on the perimeter of the south-eastern corner private balconies and terraces of Building C to mitigate the adverse wind effects. This is shown in Figures 3f to 3h of this report.

It is now proposed to have several new private terraces on the mid-section of Level 6 of Building D. These terraces are expected to be exposed to strong easterly and westerly winds being funnelled through the gap. To mitigate this potentially adverse effect, it is recommended that full-height impermeable privacy screens are used between the various terraces and 1.2m high impermeable balustrades on the terrace edges. These treatments are shown in Figure 3i. With the implementation of these treatments it is expected that wind conditions

to the new Level 6 terraces of Building D will be acceptable for their intended uses and satisfy the wind speed criteria described in Section 5 of the Rockdale City Council Development Control Plan No. 62 for Wolli Creek.

Note that it is expected that wind conditions to the remaining private balconies and terraces will be further enhanced with the inclusion of impermeable balustrades and full-height privacy screens, particularly on protruding corner balconies, in a layout similar to that already indicated in the architectural drawings.

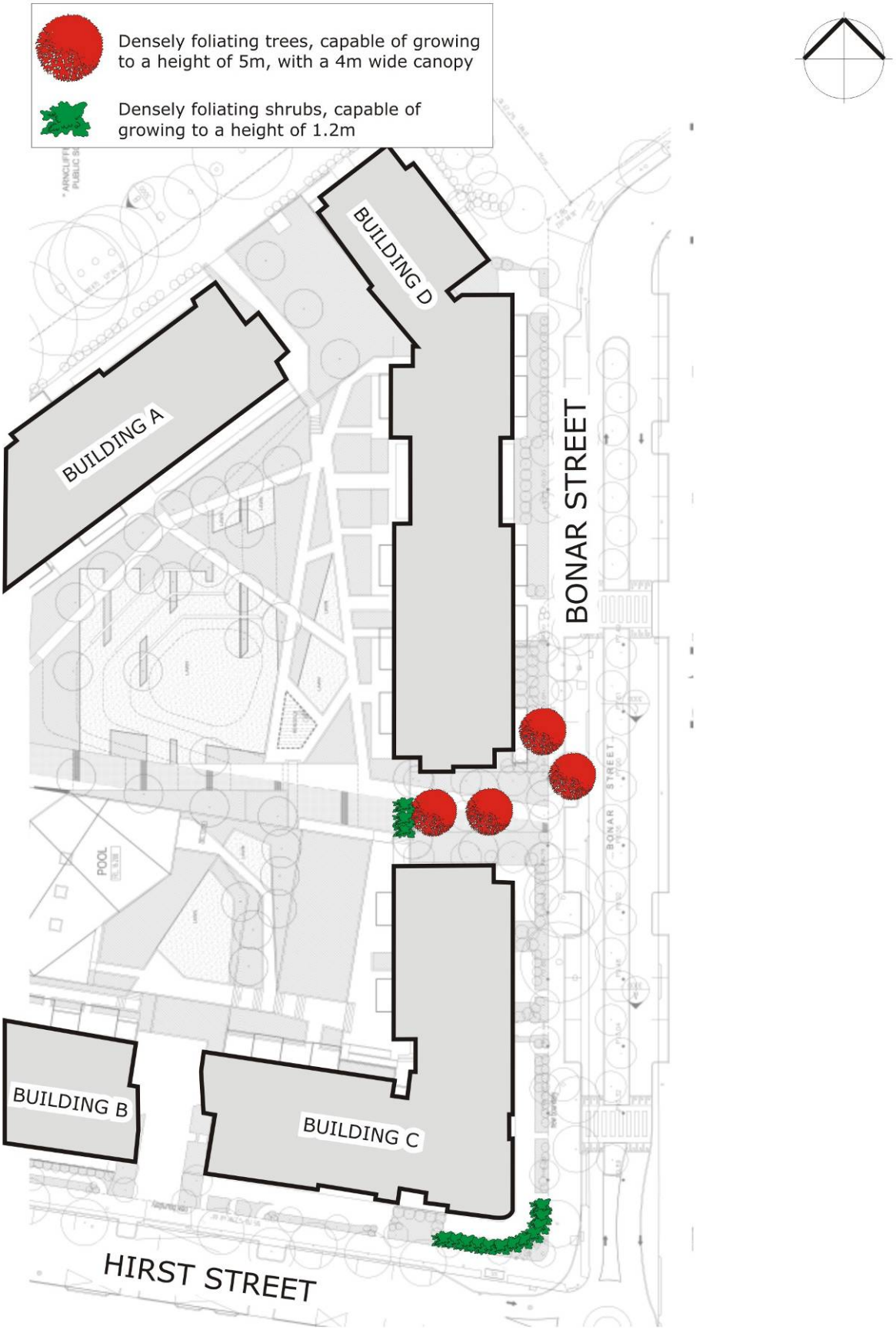


Figure 3a - Recommended and Optional Treatments Along Bonar Street

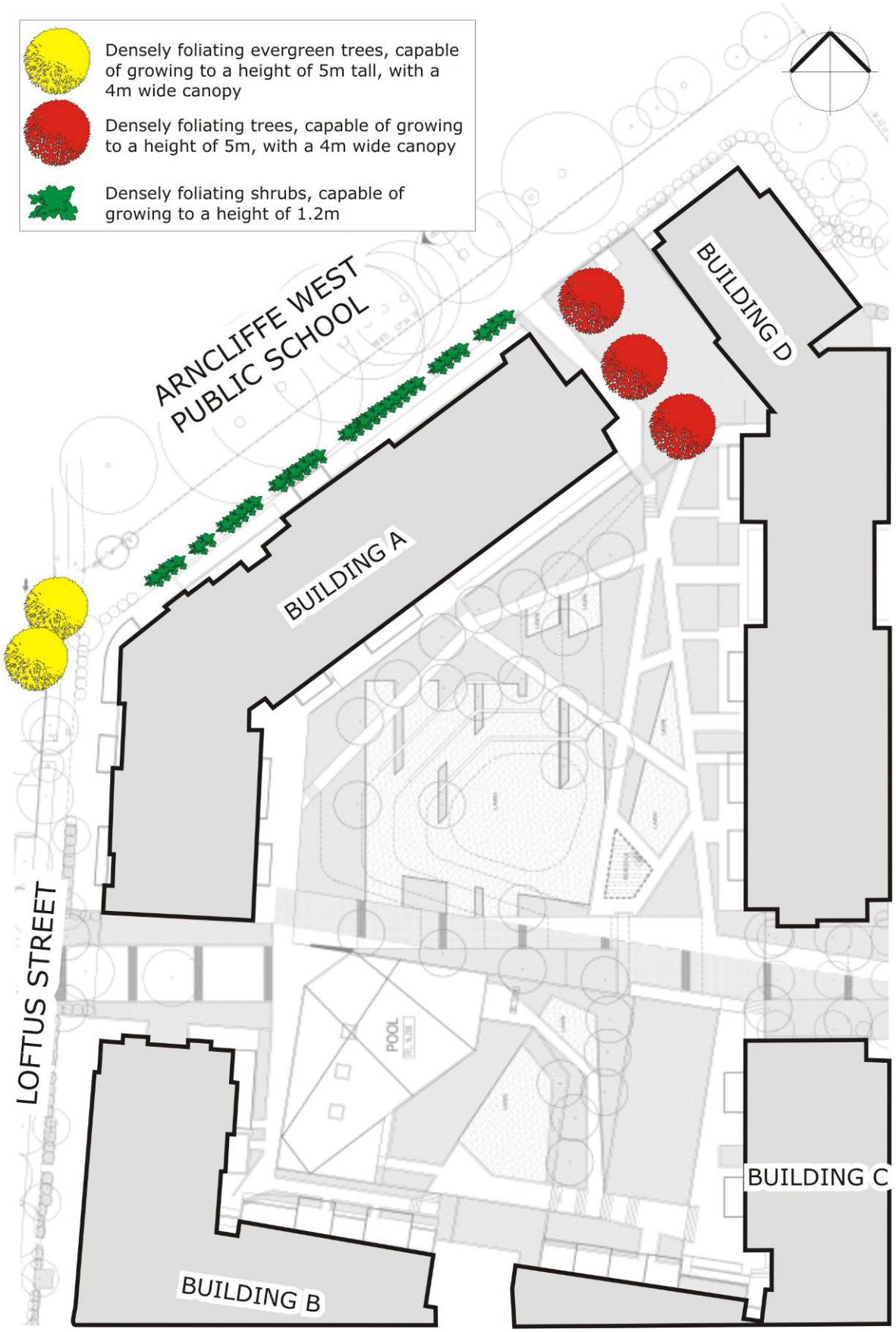


Figure 3b - Recommended Treatments Along the Northern Boundary

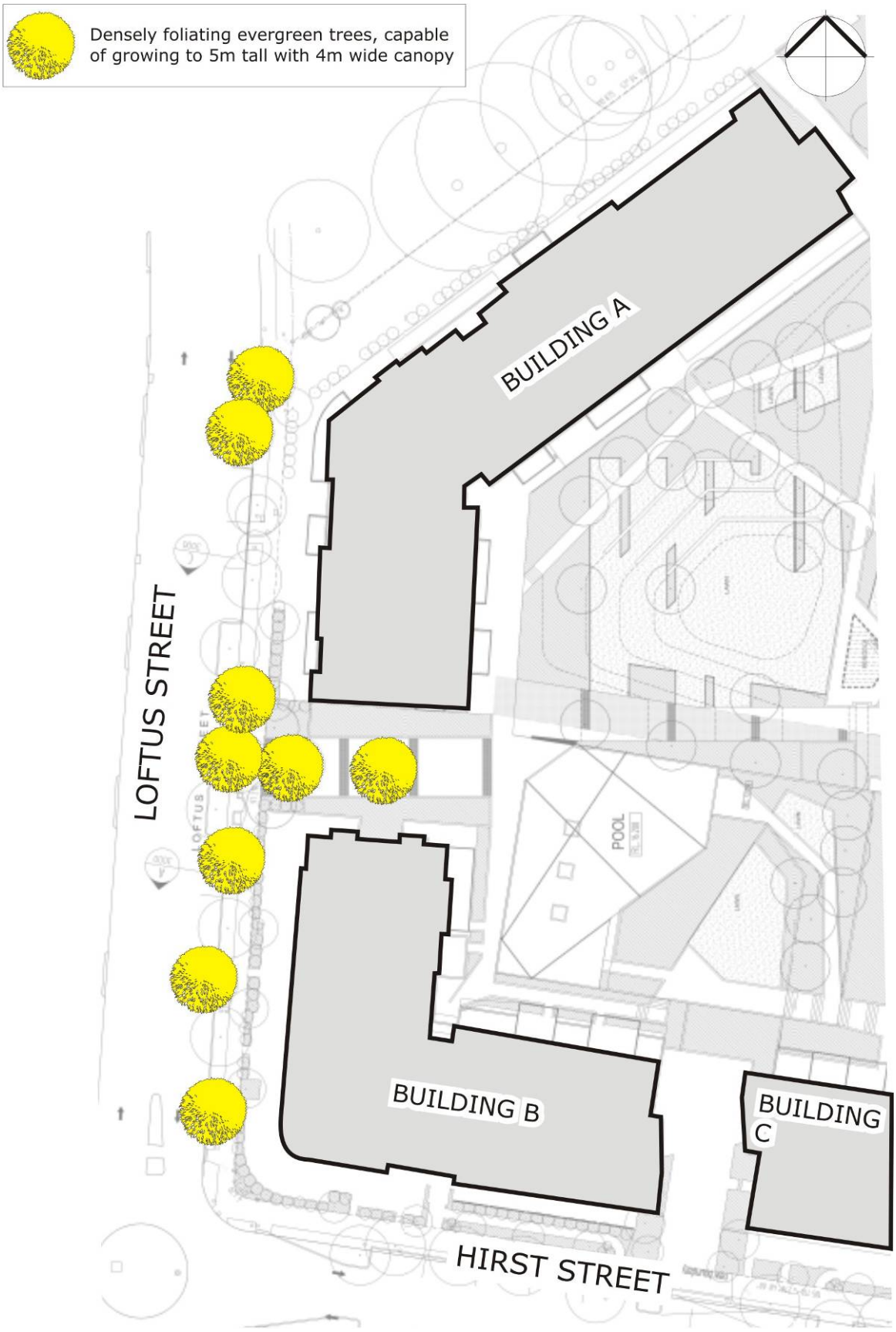


Figure 3c - Recommended Treatments Along Loftus Street

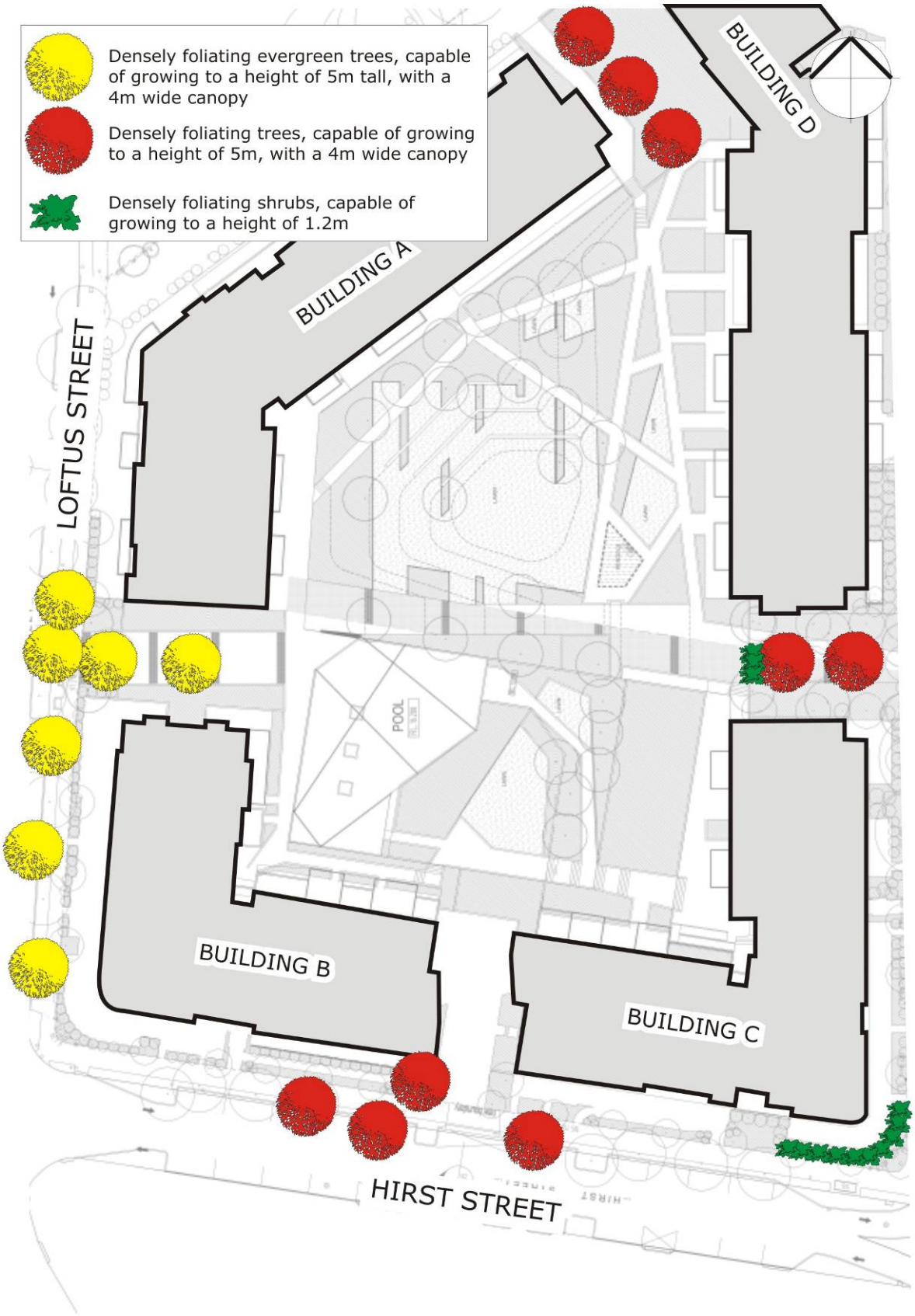


Figure 3d - Recommended Treatments Along Hirst Street

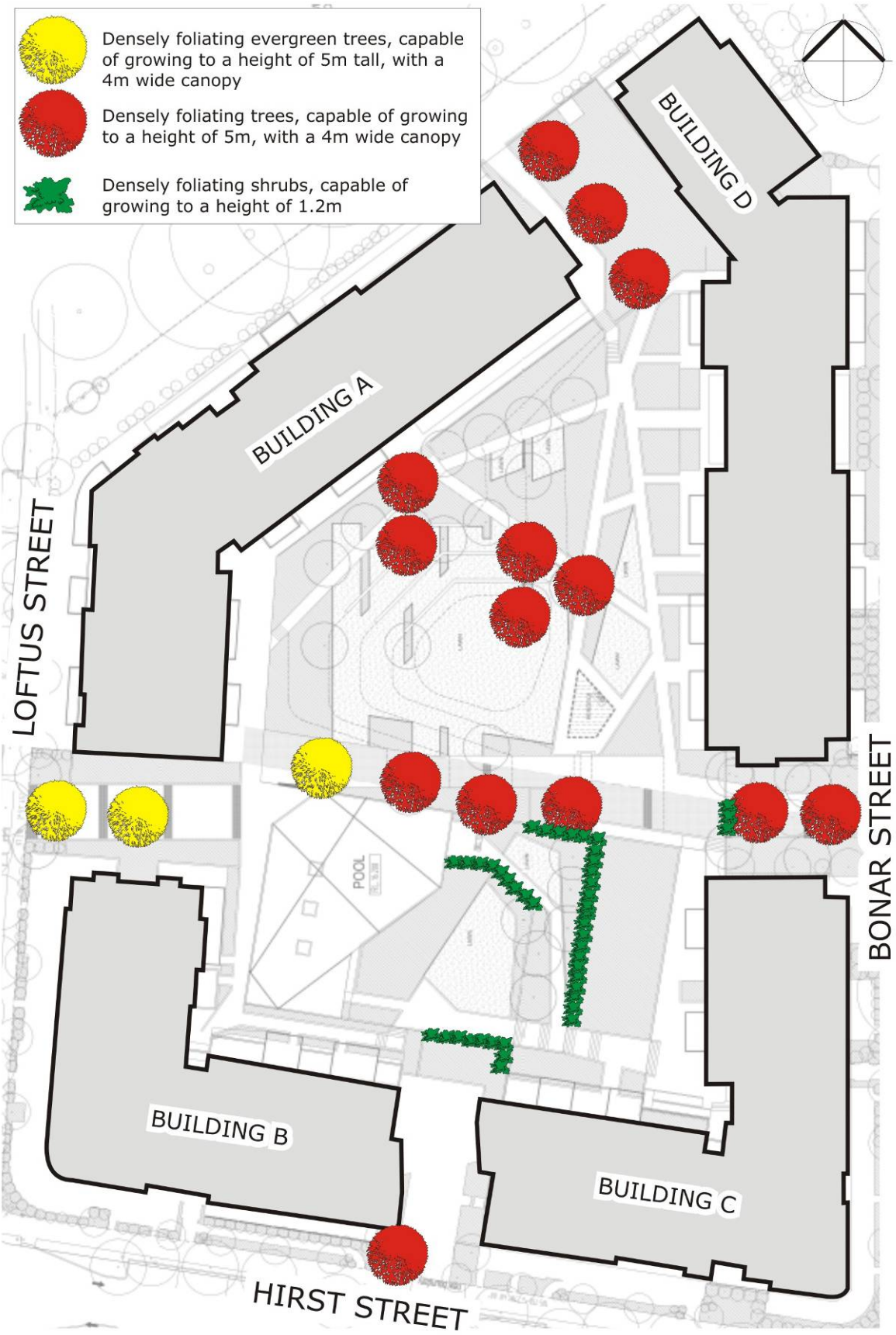


Figure 3e - Recommended Treatments
Internal Courtyard Areas

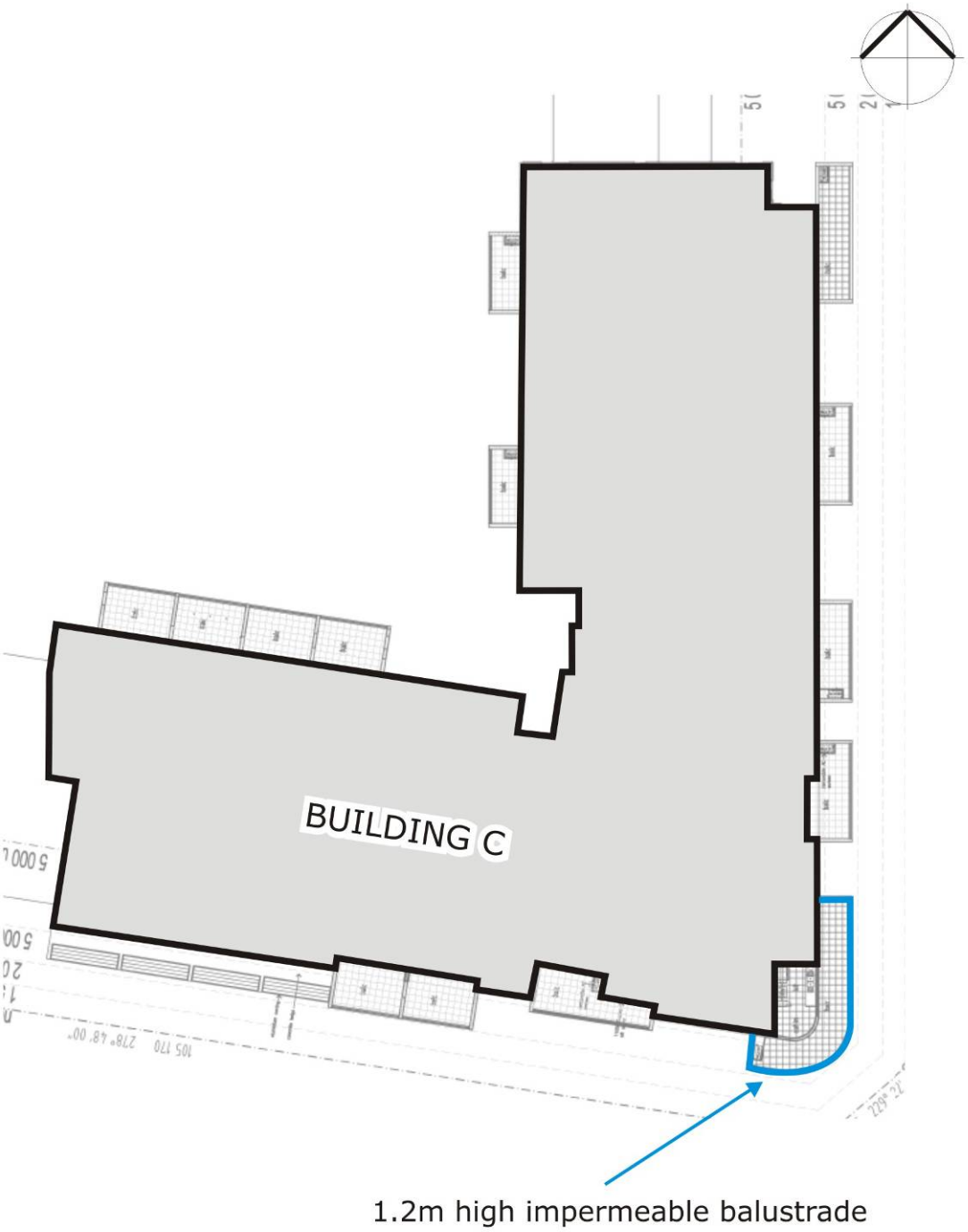


Figure 3f - Recommended Treatments
Lower Level Private Balconies on Building C

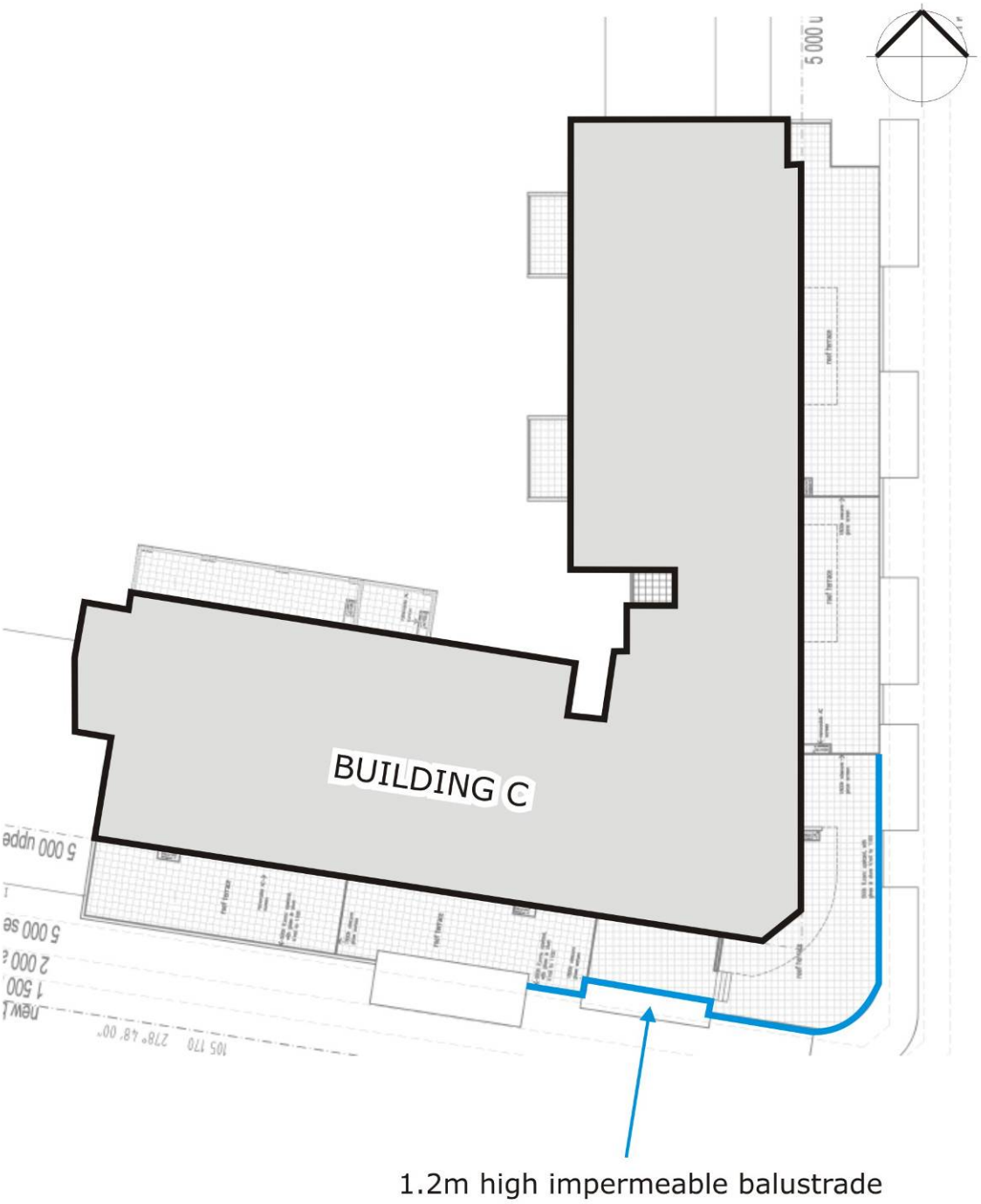


Figure 3g - Recommended Treatments
Level 4 Private Balconies on Building C

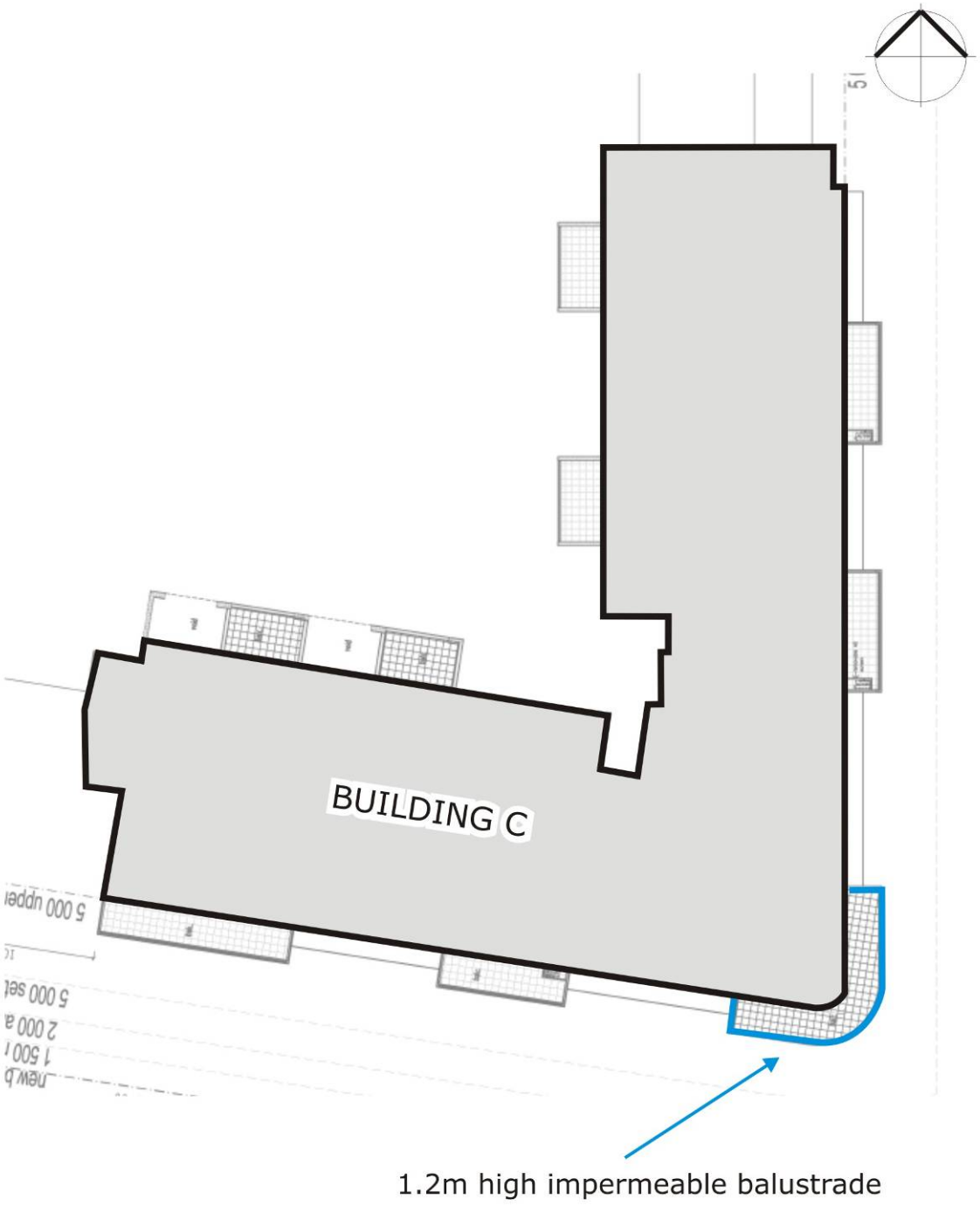


Figure 3h - Recommended Treatments
Upper Level Private Balconies on Building C

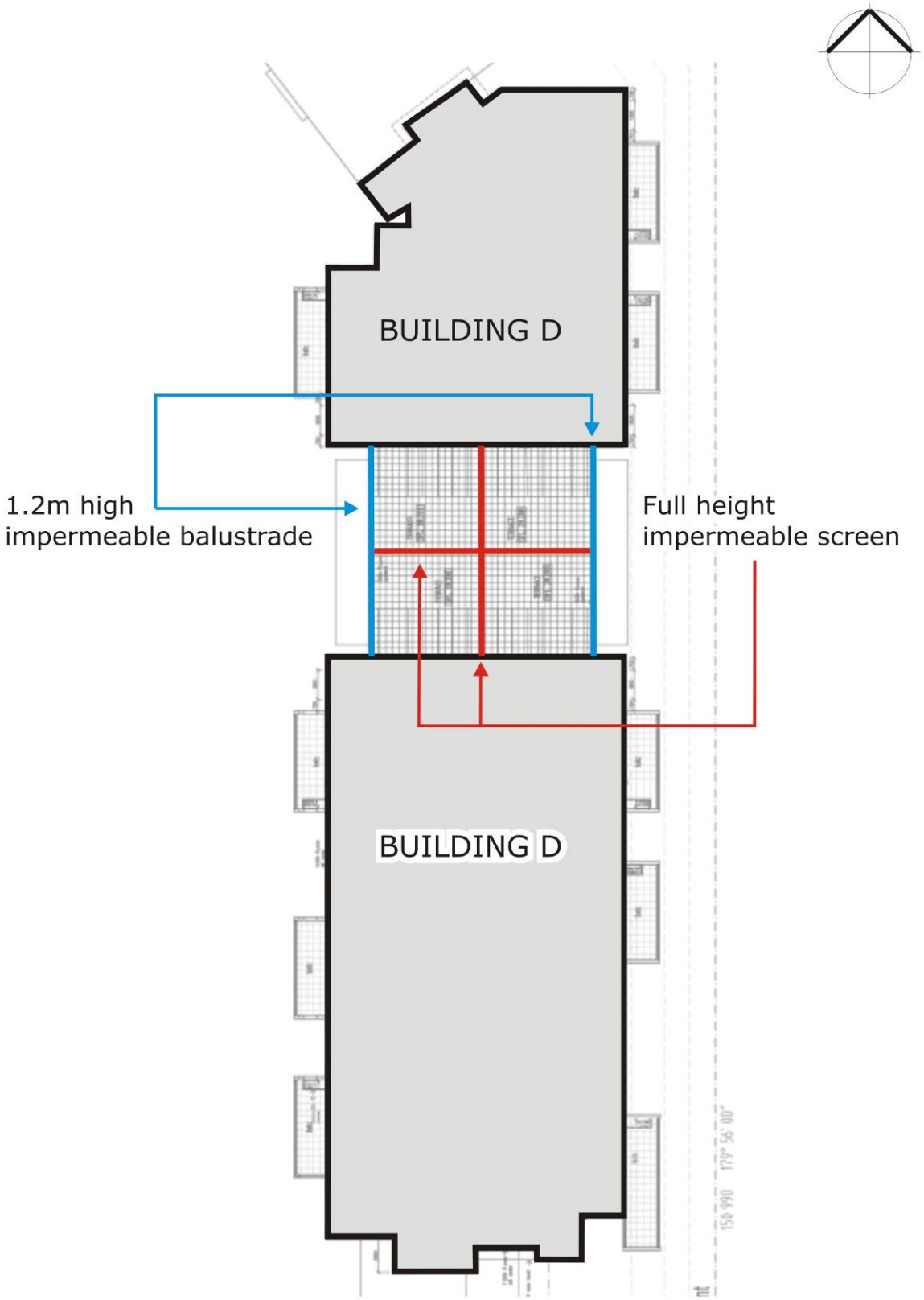


Figure 3i - Recommended Treatments
Level 6 Private Terraces on Building D

6.0 Conclusions

An analysis of the wind environment impact with respect to the latest design scheme for the proposed development of the site located at 12-40 Bonar Street, Arncliffe, was carried out. The conclusions of this report are drawn from our extensive experience in this field and are based on an examination of the architectural drawings prepared by Meriton Apartments, dated November, 2008. A wind tunnel study had previously been undertaken to assess the pedestrian wind environment for the April 2009 design scheme for the subject development site (report reference number W930-02F02(rev0), dated April 14, 2009).

The proposed development consists of four main residential buildings surrounding a central communal outdoor area. The building heights range from six to seven stories above ground. The latest design scheme for the site is similar to the previous scheme, and the previous wind tunnel study results are still valid for most of the development. 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 the study indicate that some areas of the proposed development will be exposed to adverse wind effects. Several recommendations have been made in this report to mitigate the adverse wind effects. These are summarised as follows;

- A strategic layout of densely foliating trees, capable of growing to a height of 5m, with a 4m wide canopy, and shrubs capable of growing to a height of 1.2m, for the ground level areas within and around the development site.
- Impermeable balustrades along the perimeter of all private balconies and terraces on the south-east corner of Building C of the proposed development.
- Impermeable balustrades along the perimeter of the mid-section private terraces on Level 6 of Building D of the proposed development.
- Full height impermeable screens separating the mid-section private terraces on Level 6 of Building D of the proposed development.

Note that for vegetation to be effective in mitigating adverse westerly winds for the Sydney region, which predominantly occur during the winter months of the year, they should be of an evergreen species. Furthermore, note that it is expected that wind conditions to the remaining private balconies and terraces will be further enhanced with the inclusion of impermeable balustrades and full-height privacy screens, particularly on protruding corner balconies, in a layout similar to that already indicated in the architectural drawings.

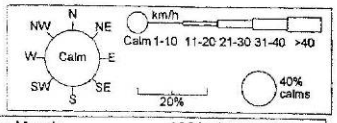
With these treatments included in the final design, it is expected that wind conditions within and around the various outdoor areas of the subject development will be acceptable for their intended uses and satisfy the wind speed criteria described in Section 5 of the Rockdale City Council Development Control Plan No. 62 for Wolli Creek. It is not expected that the proposed development will have an adverse effect on the wind conditions in the local surrounding streets and pedestrian footpaths and thoroughfares.

Appendix

Wind Roses for Sydney Airport
1939-2000

Wind Roses using available data between 1939 and 2000 for SYDNEY AIRPORT AMO

Site Number 066037 • Locality: SYDNEY AIRPORT • Opened Jan 1929 • Still Open
Latitude 33°56'28"S • Longitude 151°10'21"E • Elevation 6m



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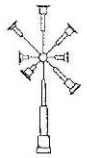
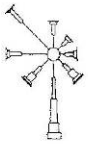
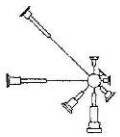
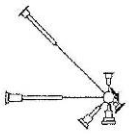
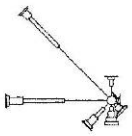
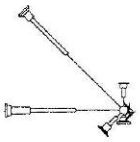
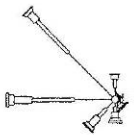
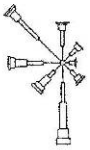
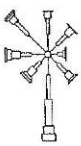
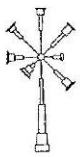
		
9 am April 1834 observations	**9 am May 1866 observations**	**9 am June 1806 observations**
		
9 am July 1873 observations	**9 am August 1876 observations**	**9 am September 1814 observations**
		
9 am October 1901 observations	**9 am November 1835 observations**	**9 am December 1906 observations**
		

Wind Roses using available data between 1939 and 2000 for SYDNEY AIRPORT AMO

Site Number 066037 • Locality: SYDNEY AIRPORT • Opened Jan 1929 • Still Open
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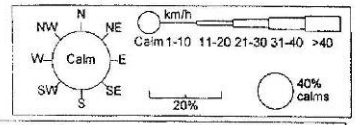

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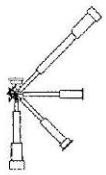

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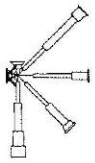
3 pm March 1925 observations



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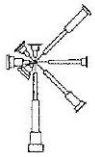

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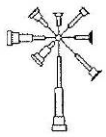

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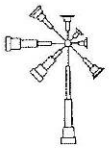

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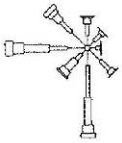

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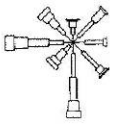
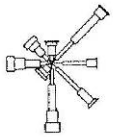
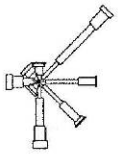


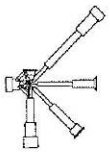
3 pm September 1811 observations



3 pm October 1904 observations



3 pm November 1839 observations



3 pm December 1906 observations