

Attachment A16

Pedestrian Wind Assessment



WIND ENGINEERING
CONSULTANTS

PEDESTRIAN WIND ASSESSMENT
CPP PROJECT 20234
16 DECEMBER 2025

133 Castlereagh Street

Sydney, NSW

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Executive Summary

This report for Planning Proposal provides results and discussion around wind equivalence for the proposed Stockland Piccadilly Complex redevelopment at 133 Castlereagh Street, Sydney, NSW. Measurements of winds likely to be experienced by pedestrians were combined with wind statistics and compared with wind comfort and safety criteria.

The wind tunnel testing was performed in a natural boundary layer wind tunnel of CPP. A model of the project was fabricated to a 1:400 length scale and centred on a turntable in the wind tunnel. Replicas of existing and approved surrounding buildings within a 570 m radius were constructed and placed on the turntable. Approach boundary layers representative of the environment surrounding the proposed development was established in the test section of the wind tunnel.

Measurements of winds likely to be experienced by pedestrians were made with a hot-film anemometer at up to 18 locations in four configurations for 18 wind directions each, Table 1. These points were tested around the development site focusing on pedestrian access routes, entries, and outdoor recreation areas. The measurements were combined with site specific wind statistics to produce results of wind speed versus the percentage of time that wind speed is exceeded for each location.

The results of the wind assessment can be summarised as follows:

GROUND LEVEL:

The wind environment around the development was typically found to be suitable for Pedestrian Standing style activities from a comfort perspective with reference to the City of Sydney comfort criteria. All areas surrounding the site satisfied the City of Sydney safety criteria. The average 5% of the time exceedance comfort wind speed for the Proposed Designs (Configurations B, C and D) is slightly better than the City of Sydney Compliant Design (Configuration A). This indicates that the proposed scheme meets the wind equivalence criteria described in Schedule 12, Section 12.2.4.a, Procedure B of the Sydney DCP 2012.

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1. Introduction

GENERAL INFORMATION

This report (CPP20234_133 Castlereagh Street_REP_PW_R04.pdf) accompanies a planning proposal seeking to amend the Sydney Local Environmental Plan 2012 (the LEP) relevant to the land known as 'Stockland Piccadilly Complex' located at 133-145 Castlereagh Street, Sydney (the site) and legally described as Lot 10 in DP828419.

The planning proposal seeks to prescribe site specific LEP provisions, including amending the floor space ratio development standard, as well as concurrently preparing a site specific Development Control Plan (DCP) to guide the future development. The DCP will establish building envelopes for the site, as well as other key assessment criteria including the establishment of a through-site link and parking and vehicular access.

The intended outcome of the proposed amendments to the LEP and DCP is to facilitate the redevelopment of the site for either an all commercial development or a mixed-use development, together with an activated ground plane, basement car parking and associated facilities. The proposal will retain the structure of the majority of the existing commercial tower as well as the basement structure. The proposal facilitates additional commercial floor space capacity in Central Sydney while also delivering improved public domain outcomes. Such outcomes will include a rectified Solar Access Plane breach to Hyde Park, a northerly aligned direct through-site link between Pitt and Castlereagh Street and enhanced pedestrian amenity and activation at the ground plane.

Pedestrian wind studies are conducted to investigate comfort and safety in and around proposed developments. This assessment can inform designers about the suitability of outdoor areas for their intended uses. Where necessary, design modifications can be made, or intervention measures added to mitigate areas with the potential for excessive wind speeds.

This report contains information regarding the local wind climate, wind tunnel testing and analysis procedures, a discussion of the test results, and recommendations to improve wind conditions in areas where any adverse wind conditions may be identified. The test parameters and configurations are summarised in Table 1.

All data collection was performed in accordance with the guidelines of the Australasian Wind Engineering Society (2019), and the American Society of Civil Engineers (1999, 2021). While analytical methods such as Computational Fluid Dynamics (CFD) have some utility in the field of pedestrian wind comfort, they are not yet capable of reliably and accurately predicting gust wind speeds for assessment of wind conditions from a safety perspective.

Table 1: Wind Tunnel Test Parameters

SUMMARY OF TEST PARAMETERS	
GENERAL INFORMATION	
Model Scale	1:400
Surrounding Model Radius (full scale)	570 m
Approach Terrain Category	Intermediate environment approach (22.5° – 202.5° clock-wise) Built-up environment approach (225° – 0° clock-wise)
ENVIRONMENTAL WINDS STUDY	
Number of test locations	18
Reference height (full scale)	200 m
TEST CONFIGURATION(S)	
Configuration A: Baseline	City of Sydney compliant design of 133 Castlereagh Elizabeth Street tower, with existing surrounds and any/all approved, or under construction, developments within the modelled test radius as shown in Figure 1a(T), c(T).
Configuration B: Proposed (PP2024)	Proposed mixed-use design (previously proposed 2024), with existing surrounds and any/all approved, or under construction, developments within the modelled test radius as shown in Figure 1a(B), c(B).
Configuration C: Proposed (mixed-use)	Proposed mixed-use design, with existing surrounds and any/all approved, or under construction, developments within the modelled test radius as shown in Figure 1b(T), d(T).
Configuration D: Proposed (all office)	Proposed all office design, with existing surrounds and any/all approved, or under construction, developments within the modelled test radius as shown in Figure 1b(B), d(B).

2. Methodology

WIND TUNNEL MODEL

The wind conditions around the project site were evaluated through wind tunnel testing of a 1:400 scale model of the development and surrounding area. This scale allowed for an adequate portion of surrounding developments and terrain to be included within an approximately 570 m radius of the site and all the relevant building details to be modelled accurately. The boundary-layer wind conditions beyond the modelled area were appropriately simulated in one of CPP's wind tunnels (see Appendix A). The models were mounted on the turntable, located near the downstream end of the wind tunnel test section, allowing rotation of the modelled area for examination of wind speeds from any approach wind direction.

Photographs of the test and surrounds models in all configurations installed in the wind tunnel are presented in Figure 1.

MEASUREMENT POINTS

For this study, wind speed measurements were recorded at 18 locations to evaluate pedestrian wind comfort and safety in and around the project site. The selected test locations are shown in Figure 4 to Figure 11.

Wind speed measurements were made at the model scale equivalent of 1.5 to 2.1 m above the surface for 16 wind directions at 22.5° intervals. Locations were chosen to determine the degree of pedestrian wind comfort and safety at building corners where relatively severe conditions are frequently found, near building entrances and passageways, and at outdoor recreation areas.

The hot-film signal was sampled for a period corresponding to one hour in full scale. All wind speed data were digitally filtered to obtain the half or three second running mean wind speed at each point; this is the basis for the various acceptability criteria. These local wind speeds, U , were normalised by the tunnel reference mean wind speed, U_{ref} . Mean and turbulence statistics were measured and used to calculate the normalised effective peak gust using:

$$\frac{U_{pk}}{U_{ref}} = \frac{U + g_f \cdot U_{rms}}{U_{ref}}$$

Where the peak factor (g_f) is: $g_f = 3$ for a 3 s gust and $g_f = 3.6$ for a 0.5 s gust.

The mean and gust equivalent mean wind speeds relative to the free stream wind tunnel reference speed at a full-scale elevation of 200 m are plotted in polar form in Appendix B. The graphs show the directional magnitude of wind speed ratio. The polar plots aid in visualisation of the effects of the nearby structures or topography, the relative significance of various wind azimuths, and whether the mean or gust wind speed is of greater importance.

The measured local wind speeds were combined with wind climate data described in the following section to allow assessment of the pedestrian wind environment.

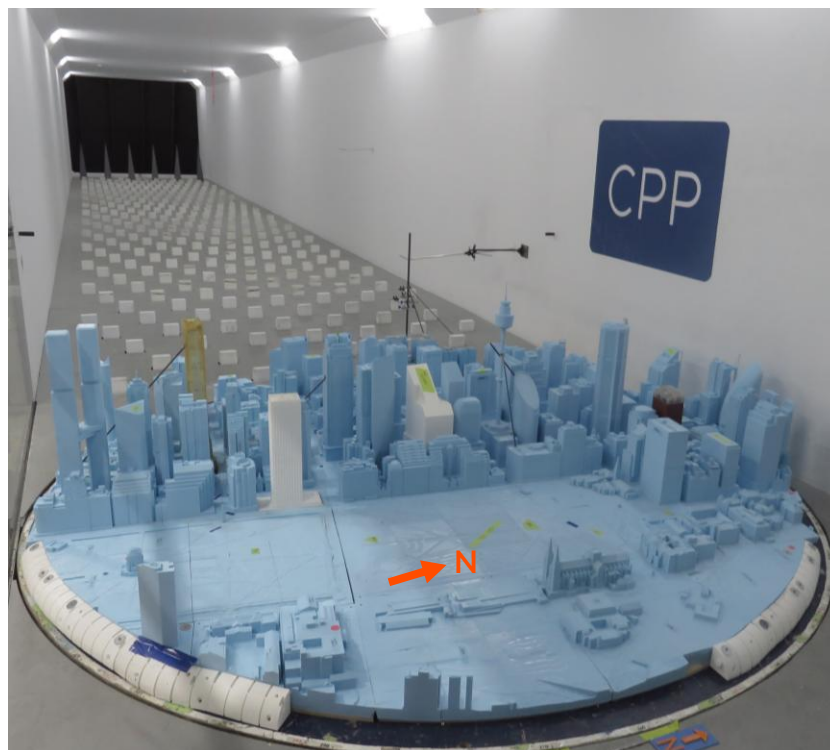
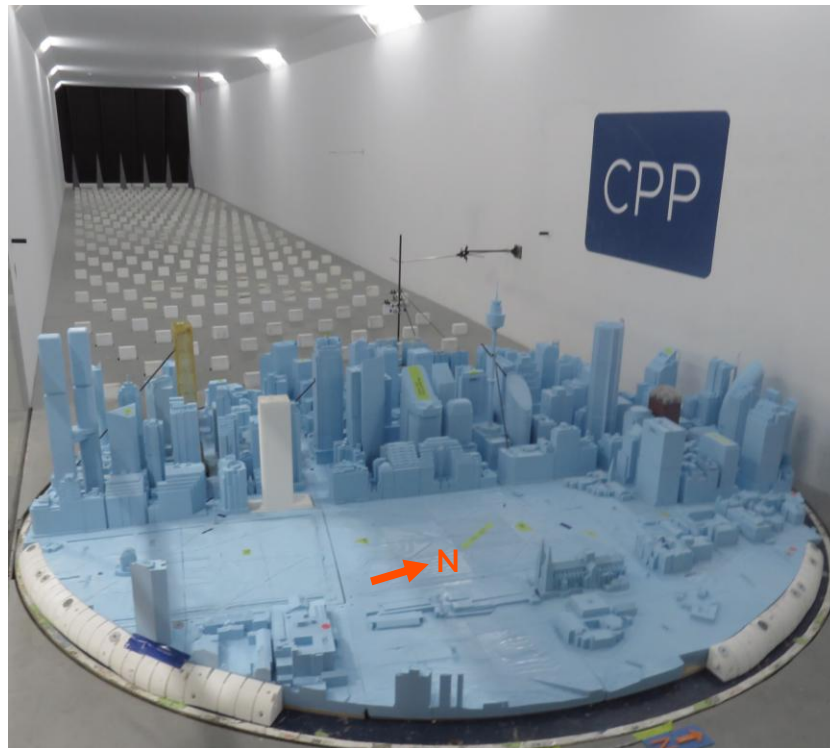


Figure 1a: Photographs of Wind Tunnel Test and Surrounds Model – Configuration A (top) and Configuration B (bottom).

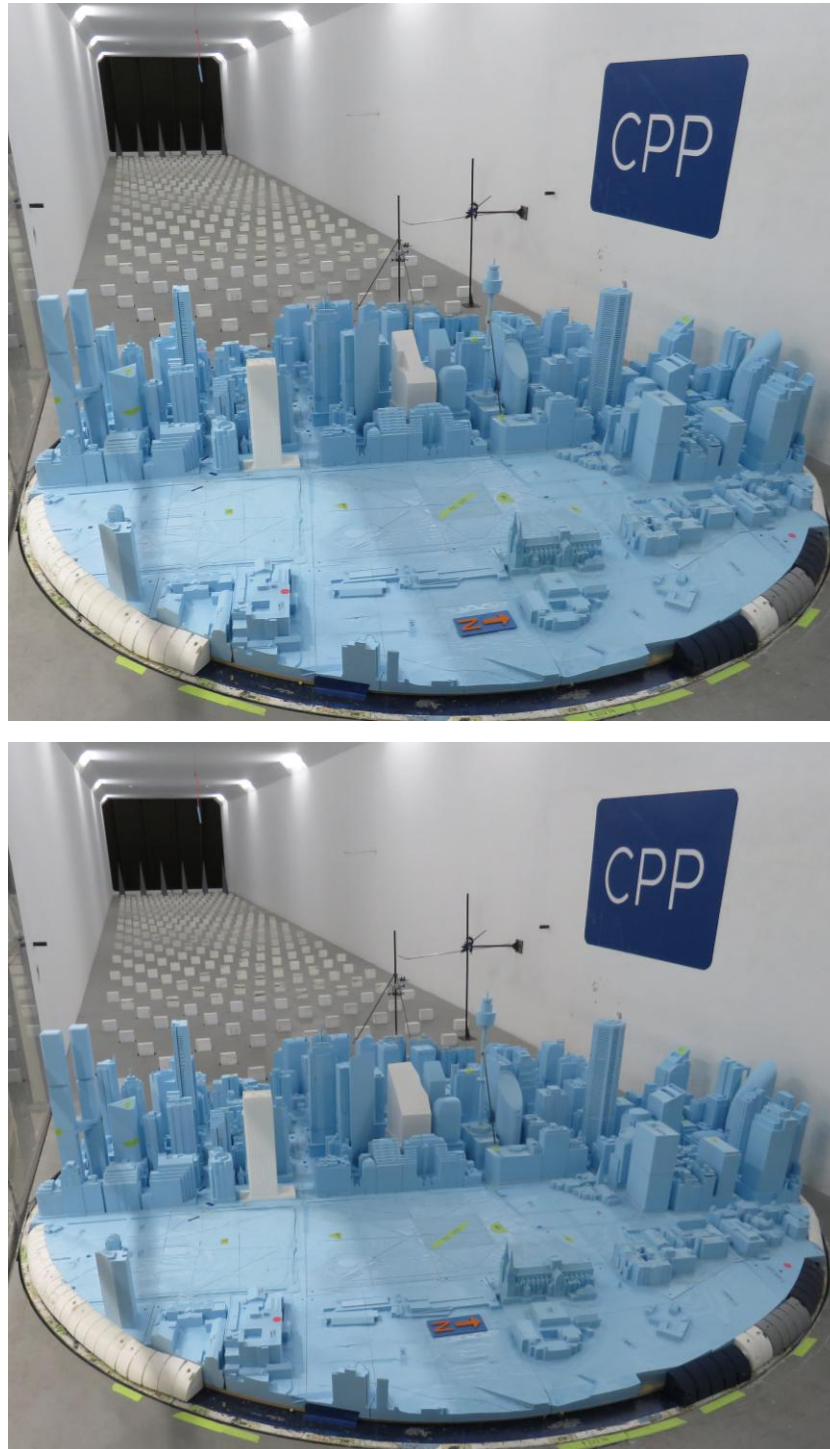


Figure 1b: Photographs of Wind Tunnel Test Model – Close up – Configuration C (top) and Configuration D (bottom).

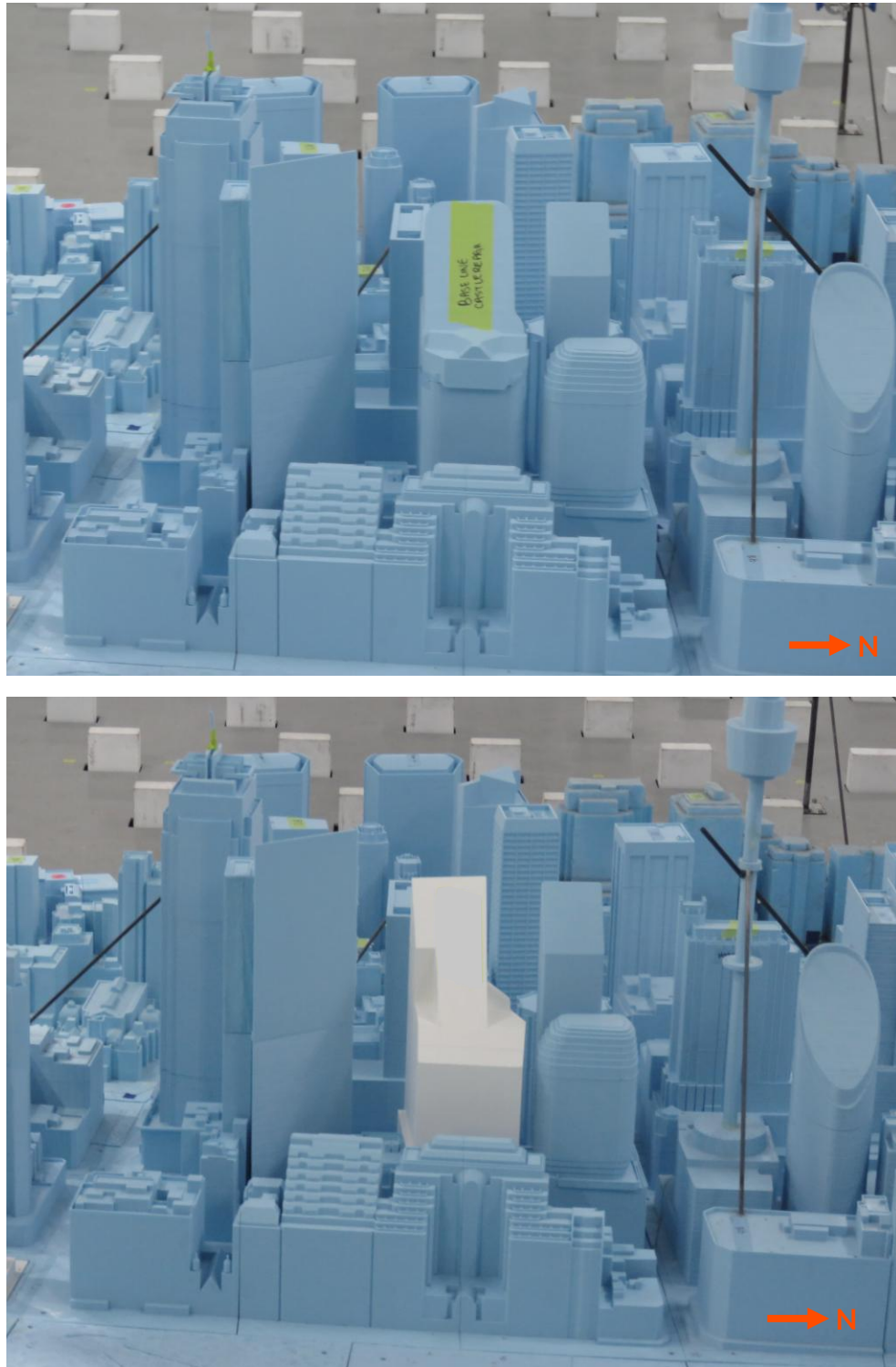


Figure 1c: Photographs of Wind Tunnel Test Model – Close up – Configuration A (top) and Configuration B (bottom).

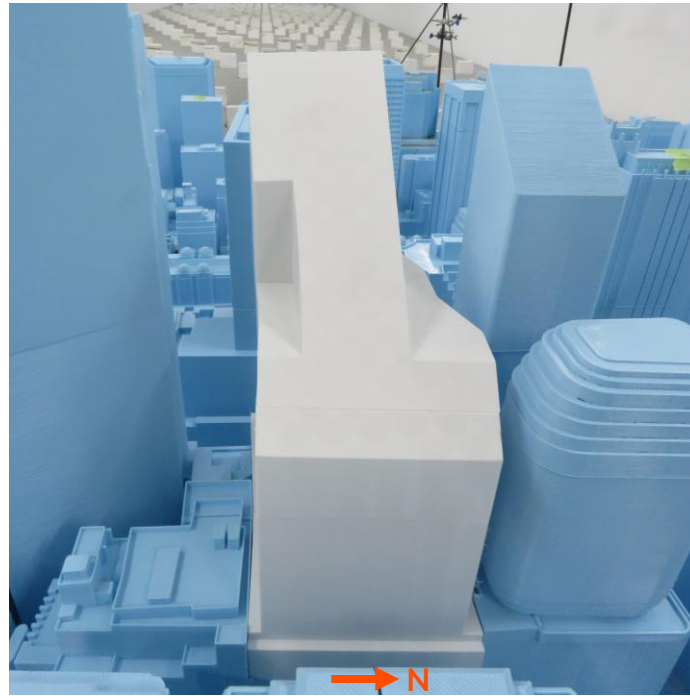


Figure 1d: Photographs of Wind Tunnel Test Model – Close up – Configuration C (top) and Configuration D (bottom).

WIND CLIMATE

The measured wind speed data were normalized to an approach reference mean wind speed and then combined with a climatological model (wind frequency and direction) derived from data measured at a standard height of 10 m at Sydney International Airport. The project site is located approximately 10 km to the north of the airport anemometer, which provides the best source of historical wind data for the project.

These data are portrayed in the wind rose in Figure 2. The arms of the wind roses point in the direction from where the wind is blowing from, the width and colour of the arm represent the wind speed, and the length of the arm indicates the percent of the time that the wind blows for that combination of speed and direction. These data were then adjusted to the site location using an analytical method to account for the exposure of the project site for each direction.

The distribution and frequency of winds during daylight hours (6 am to 10 pm) on an annual basis were analysed to assess the project with regards to wind comfort and safety. As can be seen from Figure 2, prevailing winds come from the north-east, south, and west quadrants. The locations tested around the development site may be susceptible to winds from these directions, depending on the relative position of the location tested to the geometry of the proposed development and surrounds.

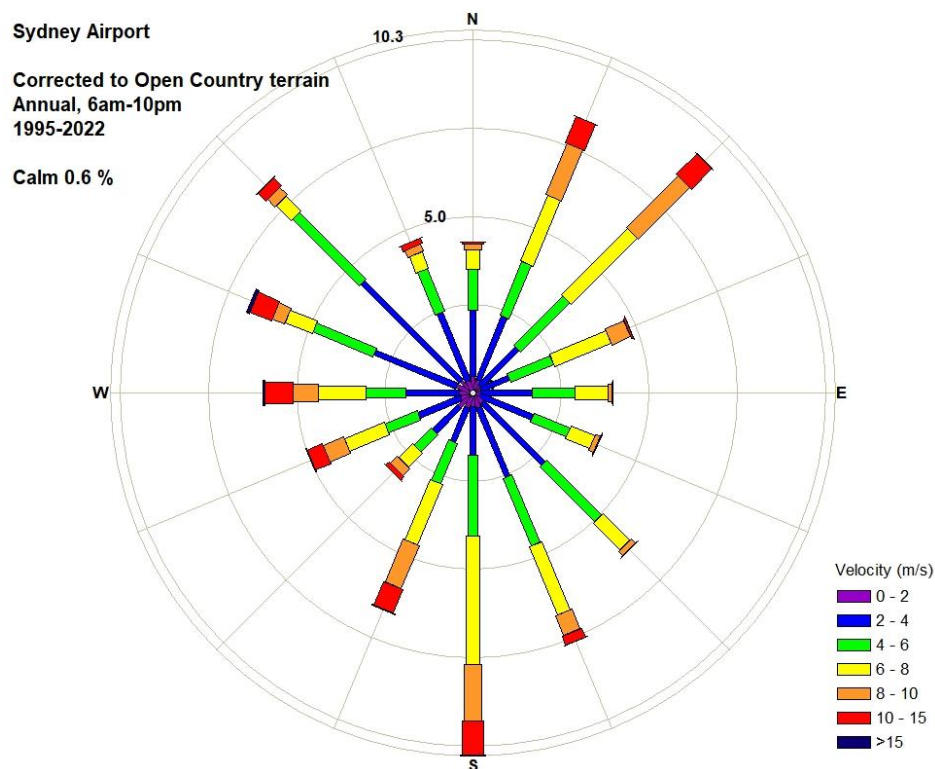


Figure 2: Probability of Wind Speeds by Direction – Sydney International Airport (1995 – 2022, Daylight Hours (6 am-10 pm))

WIND ASSESSMENT CRITERIA

To enable a quantitative assessment of the wind environment, the wind tunnel data and climatological model are combined to calculate wind speeds for comparison with pedestrian wind comfort and safety criteria at each test point.

The wind comfort and safety criteria used in this assessment were taken from section 5.1.9 of the City of Sydney DCP 2012. For pedestrian comfort, the categories are specified in Table 2 and represent the greater of the hourly mean or 3 s gust equivalent mean wind speed occurring for 5% of the time, i.e. no more than 292 hours per annum between 6 am and 10 pm.

For pedestrian safety the annual maximum 0.5 s gust wind speed occurring in an hour between 6 am and 10 pm is outlined in Table 3 and should be less than 24 m/s. This represents a 0.0171% probability of occurrence.

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

Table 2: Wind Comfort and Safety criteria (after Lawson, 1990)

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

* $U_{Equiv} = \text{Max} (U_{Mean}, U_{Gust} / 1.85)$. U_{Gust} is the peak 3 s gust wind speed in an hour.

** For regular outdoor dining, and in semi-enclosed spaces, it has been the experience of CPP that the comfort rating of Sitting may be windier than desired and a comfort criterion of 2 m/s or less may be more applicable.

Table 3: City of Sydney Safety Criteria

COMFORT RATING	U_{MAX}^*	DESCRIPTION
 Pass	< 24 m/s	Meets wind safety criterion.
 Fail	> 24 m/s	Excessing wind speeds that can adversely affect a pedestrian's balance and footing. Wind mitigation is often required.

* U_{Max} speeds are based on an annual exceedance of the maximum 0.5 s gust wind speed in an hour over daylight hours (6 am to 10 pm), 0.0171% (1 / year).

3. Results

A summary of the assessed comfort and safety ratings for each test location is given in Table 4, with test locations shown in Figure 3. The results of the study are graphically presented in Figure 4 to Figure 11 in which measurement locations are displayed on a site plan and colour coded to denote the predicted wind comfort and safety ratings. The number (XX.Y) combines the location identifier (XX) and the test configuration (.Y): XX.1 baseline, XX.2 Proposed (PP2024), XX.3 Proposed (mixed-use), and XX.4 Proposed (all office). The central colour indicates the comfort rating for the location, and the colour of the outer ring indicates whether the location passes or exceeds the safety criterion.

From the cumulative wind speed distributions for each location, the percentage of time each of the Lawson comfort rating wind speeds are exceeded are presented in tabular form under the polar plots in Appendix B. These plots include directional criterion lines for the Lawson comfort levels to provide additional information regarding directional sensitivity at each location.

In general, wind conditions comfortable for Sitting and Standing are considered appropriate for areas such as entrances where pedestrians are likely to gather for longer durations, while wind conditions comfortable for Casual Walking and Business Walking are more appropriate for sidewalks where pedestrians are actively in transit. Locations rated as Uncomfortable are generally less suitable for most pedestrian activities and wind control solutions are often sought. Whether mitigation is needed at a location depends upon the intended use of the location. Although conditions may be classified as acceptable, there may be certain wind directions that cause regular strong events.

Satisfaction of the safety rating is required for areas accessible to the general public. Mitigation measures are generally required to address any locations deemed to fail the safety assessment.

Table 4: Summary of wind comfort and safety assessment results

Description / Location		Wind Tunnel Results							
		Comfort rating, 5% exceedance wind speed (m/s)				City of Sydney Safety rating, 0.0171% exceedance 0.5s gust wind speed (m/s)			
		Configuration				Configuration			
		Baseline XX.1	Proposed (PP2024) XX.2	Proposed (mixed-use) XX.3	Proposed (all office) XX.4	Baseline XX.1	Proposed (PP2024) XX.2	Proposed (mixed-use) XX.3	Proposed (all office) XX.4
Remote	1	5.7	5.5	4.7	4.6	20.0	19.2	17.6	17.4
	2	7.6	7.2	7.0	7.0	23.9	23.6	23.5	23.4
Ground	3	5.7	5.2	5.3	5.4	21.6	21.4	20.8	22.0
	4	3.7	3.6	3.8	4.0	15.6	15.4	15.8	17.0
	5	4.6	4.3	4.9	4.7	17.0	17.8	20.6	19.2
	6	4.7	4.1	4.1	4.2	15.6	16.0	15.6	16.2
	7	4.4	4.9	4.7	4.8	17.8	23.0	20.8	21.2
	8	5.0	4.9	4.8	4.8	21.6	21.6	20.2	20.0
	9	5.2	5.3	4.7	4.7	23.8	23.7	21.0	21.4
	10	5.5	5.7	5.5	5.8	23.4	23.8	20.2	20.8
	11	6.0	5.7	5.8	5.4	22.0	22.0	21.8	22.4
	12	4.6	4.7	4.3	4.3	17.4	16.8	17.0	17.4
	13	4.4	4.7	4.8	4.6	16.0	17.0	18.2	17.8
	14	3.9	4.3	4.7	4.8	15.4	15.6	17.4	17.6
	15	4.6	4.7	4.8	4.6	17.2	17.4	17.4	17.2
	16	5.0	4.7	4.4	4.4	20.0	18.4	16.8	17.0
	17	3.7	4.2	4.2	4.2	13.8	16.4	15.6	15.4
	18	4.9	4.8	5.2	5.2	19.6	21.8	20.2	20.6
Ave. Loc. 3-18		4.743	4.740	4.739	4.741				

LEGEND	
Comfort Criteria	Safety Criteria
 Outdoor Dining	 Passes safety criteria
 Pedestrian Sitting	 Fails safety criteria
 Pedestrian Standing	
 Pedestrian Walking	
 Uncomfortable	



Figure 3: Test point Locations for all configurations

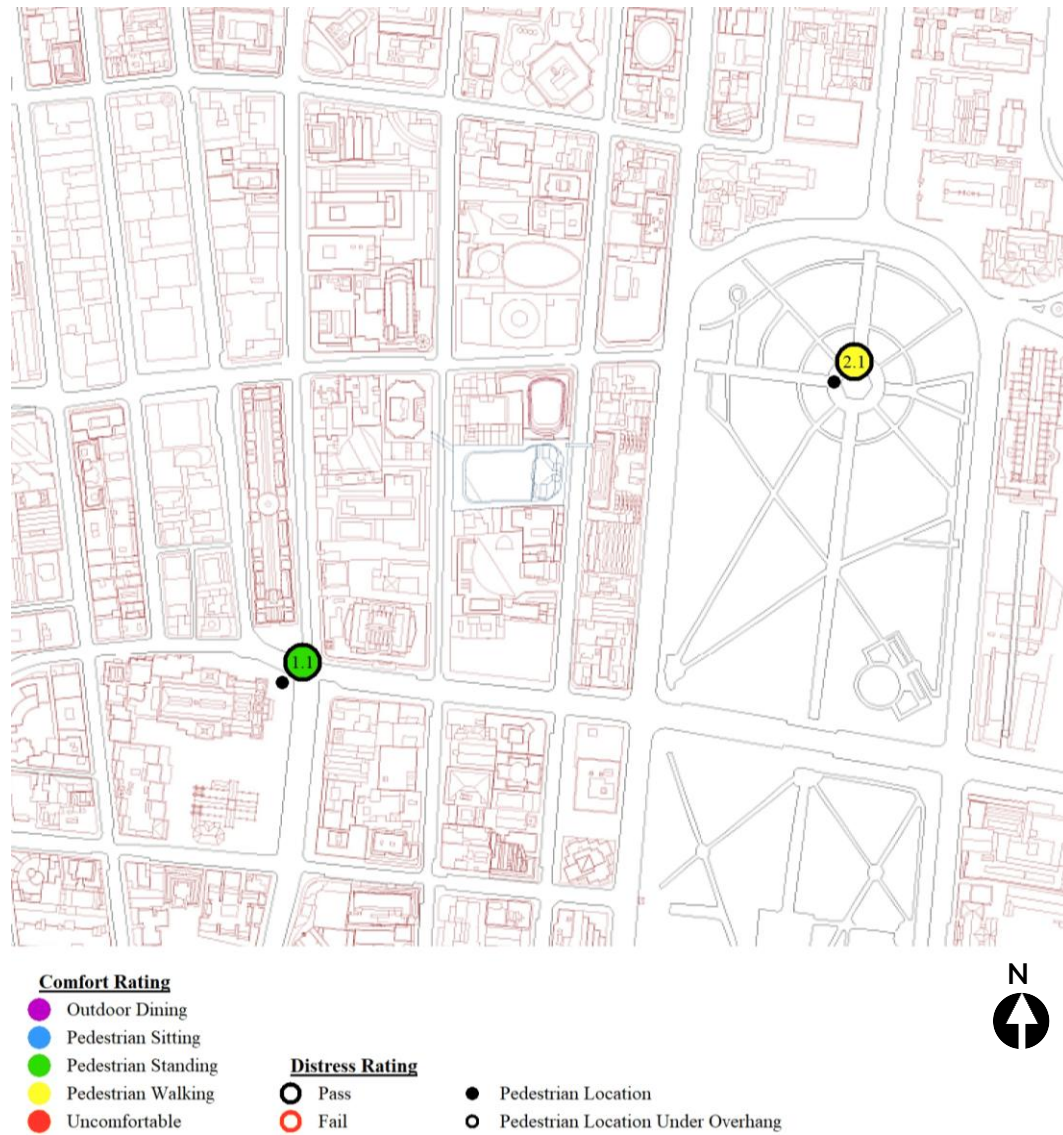


Figure 4: Pedestrian wind speed measurement locations with comfort/safety ratings. Surrounds – Configuration A: Baseline

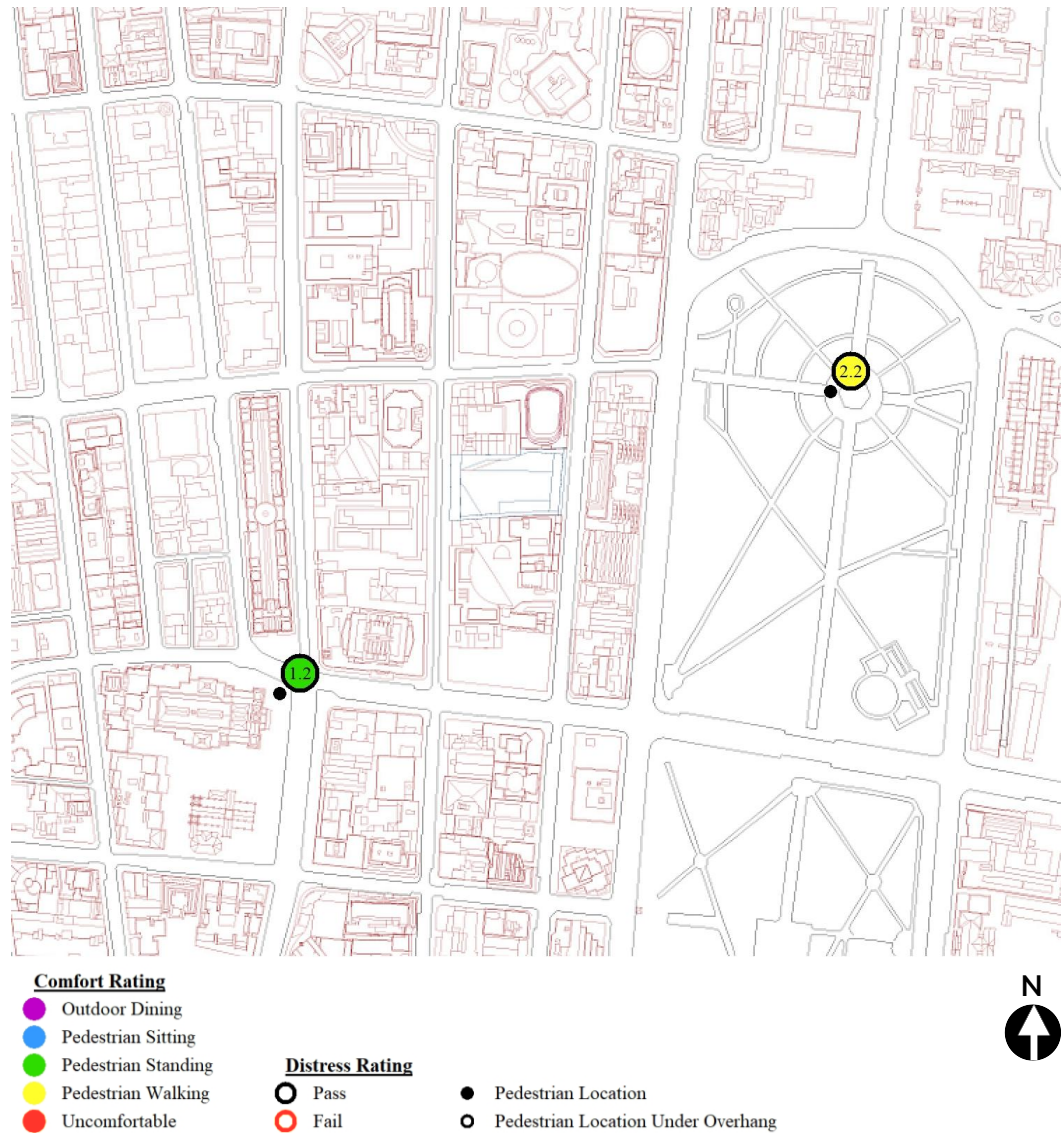


Figure 5: Pedestrian wind speed measurement locations with comfort/safety ratings. Surrounds – Configuration B: Proposed – PP2024

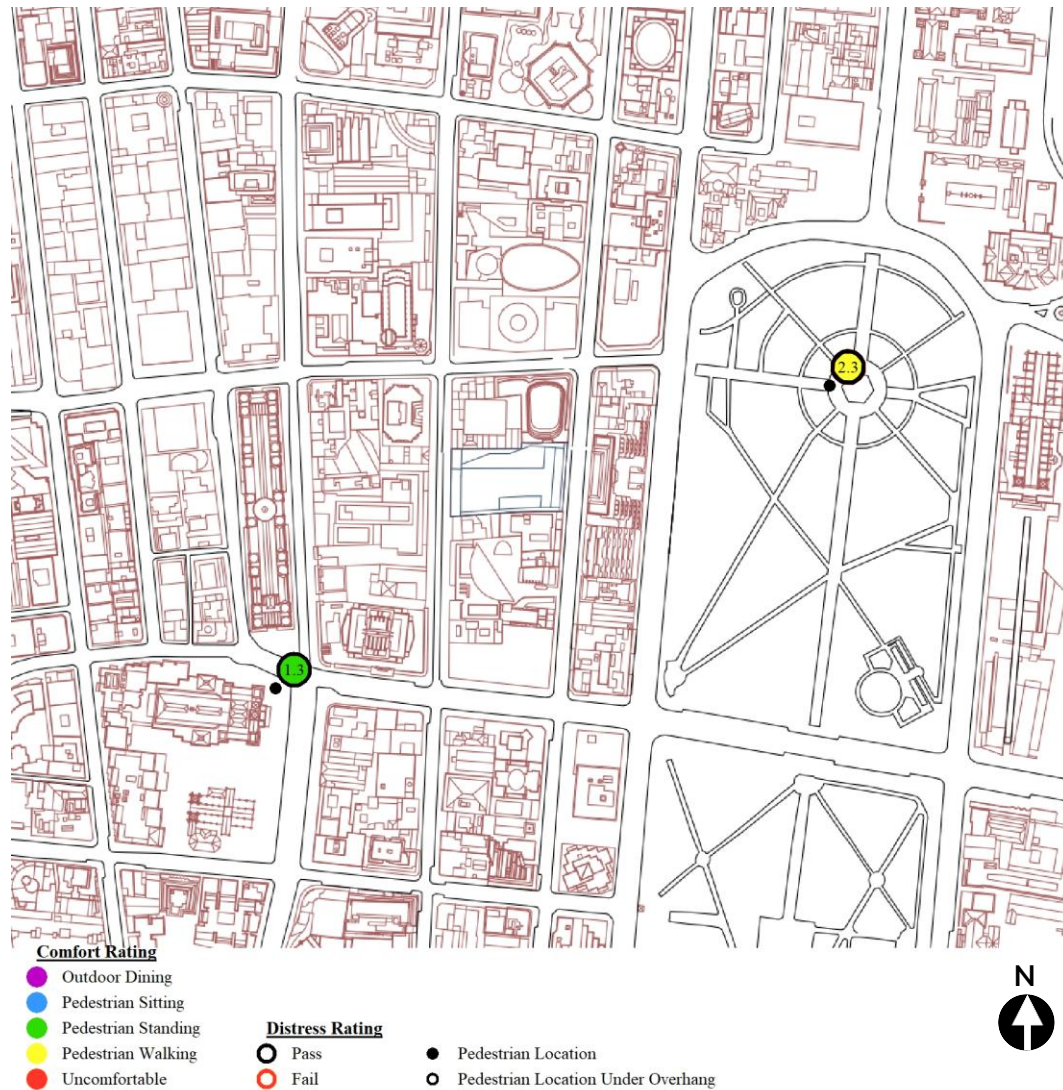


Figure 6: Pedestrian wind speed measurement locations with comfort/safety ratings. Surrounds – Configuration C: Proposed mixed-use

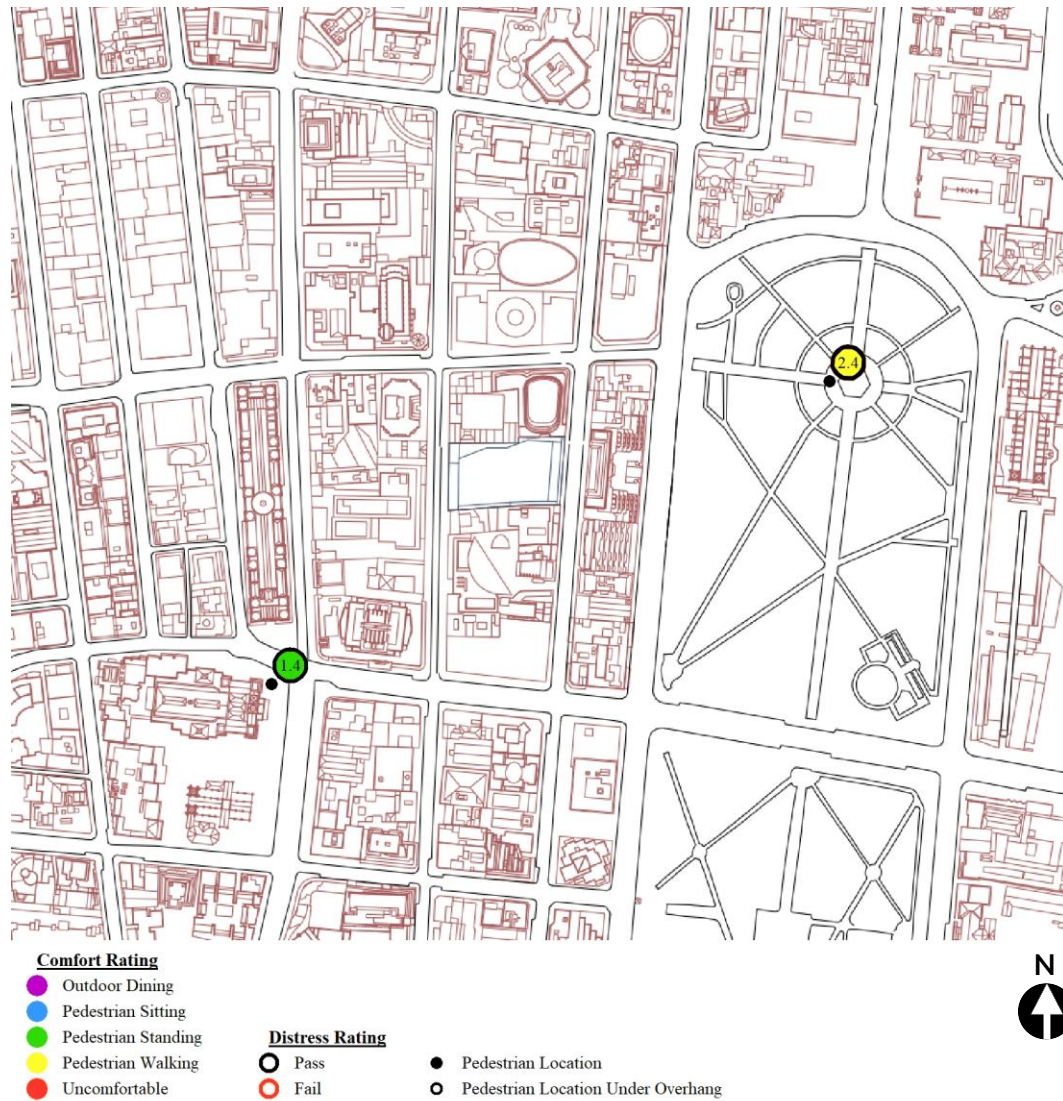


Figure 7: Pedestrian wind speed measurement locations with comfort/safety ratings. Surrounds – Configuration D: Proposed all office

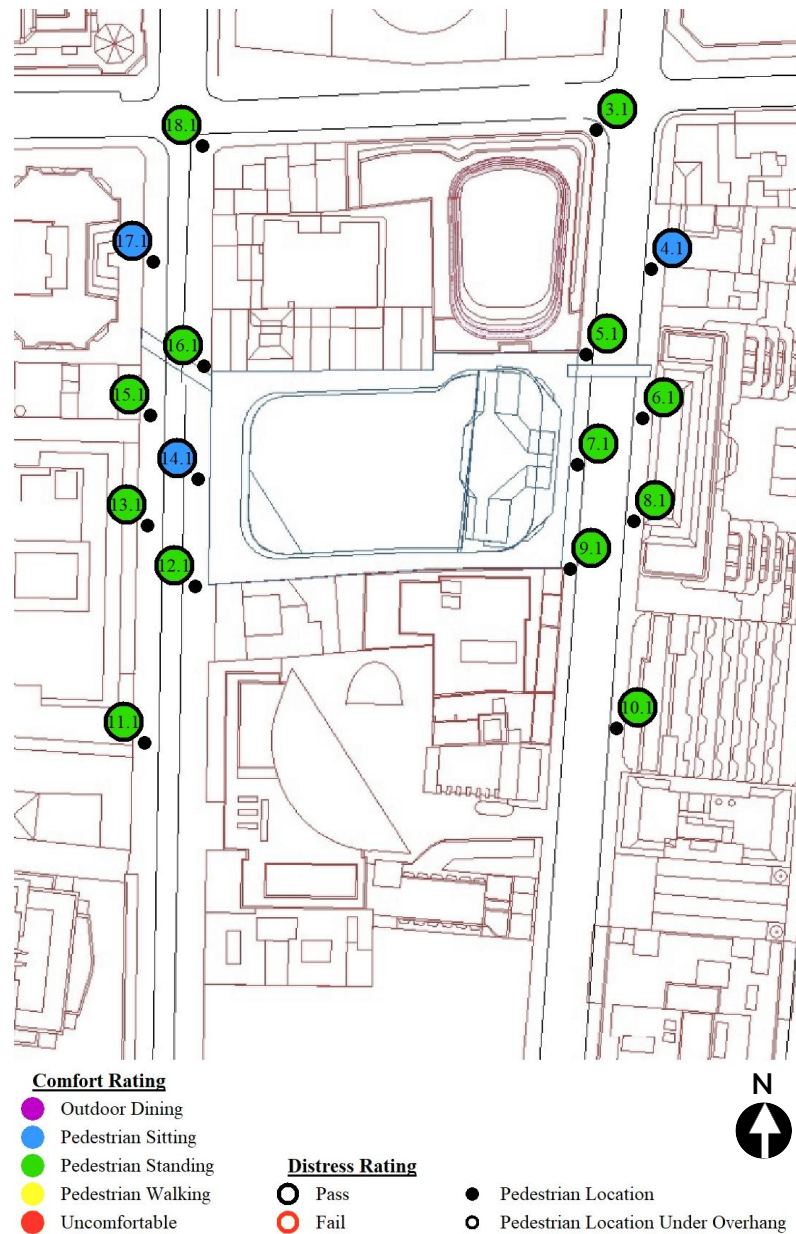


Figure 8: Pedestrian wind speed measurement locations with comfort/safety ratings. Ground – Configuration A: Baseline

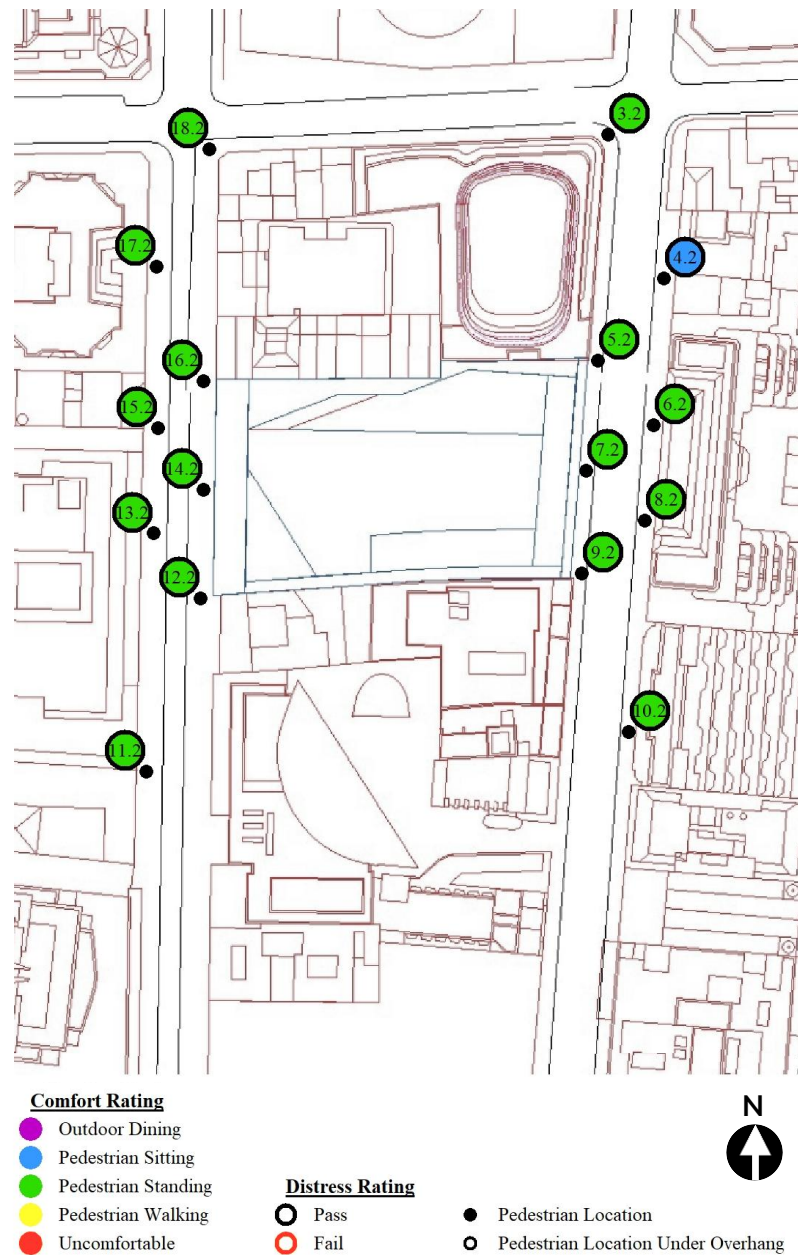


Figure 9: Pedestrian wind speed measurement locations with comfort/safety ratings. Ground – Configuration B: Proposed – PP2024



Figure 10: Pedestrian wind speed measurement locations with comfort/safety ratings. Ground – Configuration C: Proposed mixed-use

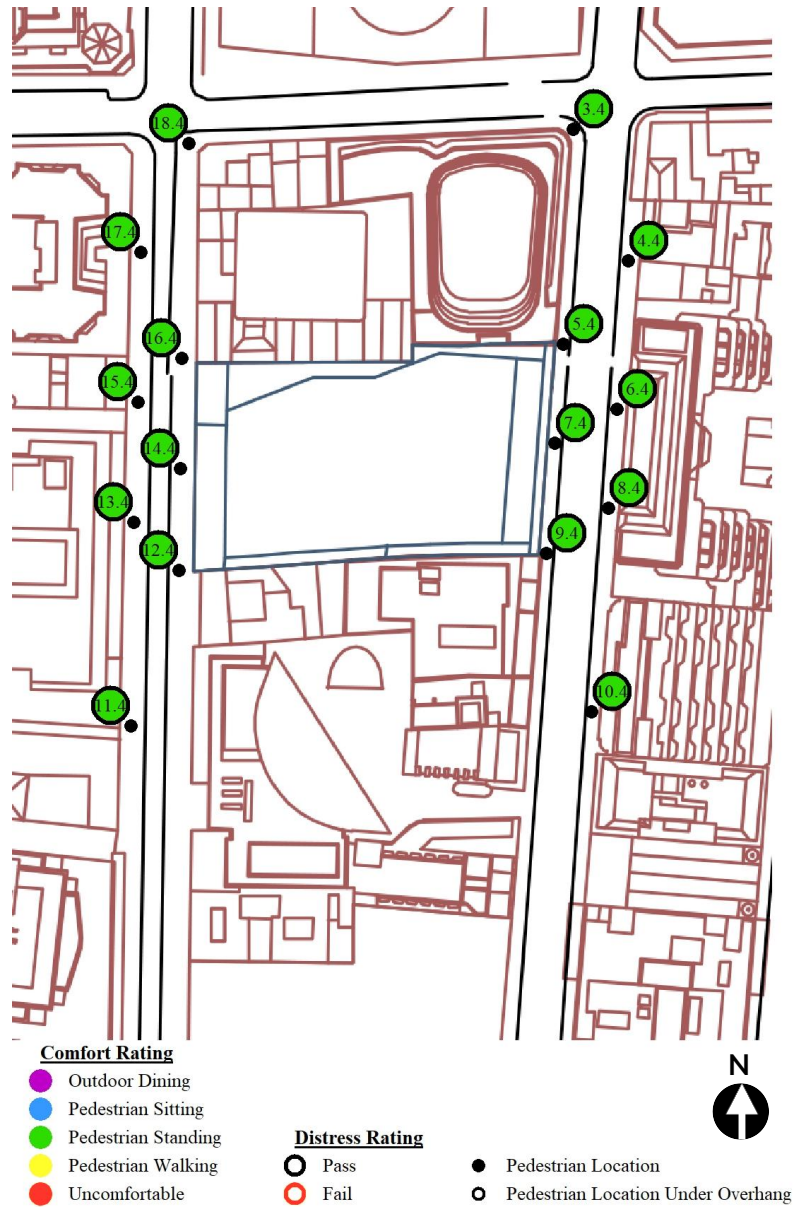


Figure 11: Pedestrian wind speed measurement locations with comfort/safety ratings. Ground – Configuration D: Proposed all office

4. Discussion

GENERAL CONDITIONS

In the street-level areas remote from the site (Figure 4 to Figure 7) wind comfort conditions fall into the Pedestrian Standing or Pedestrian Walking Lawson comfort categories..

Pedestrian level winds tend to be governed by exposure to the prevailing winds from the north-east, south, or west. In general, slightly stronger local winds are found near street block corners, or in more open areas such as parks, while calmer areas may be available where the nearby buildings provide shielding from these prevailing wind directions.

Location 1 is rated Pedestrian Standing and Location 2 is rated Pedestrian Walking in all configurations, Table 4. Note all testing was conducted without trees or landscaping to provide a conservative result for pedestrian safety. The comfort wind conditions at Locations 2, near the Archibald Fountain in Hyde Park, would receive considerable shielding from the surrounding dense treescape and would be expected to be calmer than the comfort classification reported herein.

The proposed site has little measurable impact on the wind conditions at these remote locations.

Both locations satisfy the City of Sydney safety criteria.

GROUND LEVEL

The comfort and safety ratings at ground level closer to the site are shown in Figure 8 to Figure 11 for Configurations A to D respectively, with easier results comparison in Table 4. In general, conditions at tested areas around the site fall into the Pedestrian Standing comfort category and all locations pass the City of Sydney safety criteria.

The comfort conditions at Locations 3 to 10, to the east of the site along Castlereagh Street, are generally rated Pedestrian Standing. The exception is Location 4, which is rated as Pedestrian Sitting in configurations A, B, and C. In Configuration D, Location 4 is marginally above the threshold for the Sitting category and rated Pedestrian Standing. The strongest winds in this area are caused by incident winds from the west quadrant.

Wind comfort conditions at Locations 11 to 18 on Pitt Street are generally governed by exposure to winds from the south-west quadrant. For the Baseline scenario (Configuration A), all locations are rated Pedestrian Standing except for Locations 14.1 and 17.1, which are slightly calmer and rated Pedestrian Sitting. For the proposed designs (Configurations B, C, and D), all locations are rated Pedestrian Standing.

These results indicate wind conditions on the ground level are acceptable for general pedestrian access/thoroughfare in all areas from a wind comfort perspective. The average 5% of the time exceedance comfort wind speed for the baseline design (Configuration A) and the proposed designs (Configuration B, C and D) is shown in Table 4. The proposed designs (Configuration B, C and D) are marginally calmer than the baseline design (Configuration A).

APPLICABILITY

Testing was performed without existing and proposed trees and other plantings to provide a worst-case assessment. Heavy landscape planting typically reduces wind speeds by less than 10% and in general should not be relied upon to mitigate strong winds due to variation in size and foliage and difficulty in accurate modelling. Further, trees or other plantings may pose a safety risk if damaged during high winds.

The results presented within this report are based on the 3D Revit models received by CPP on the 3 October 2024 (baseline design – Configuration A), 4 November 2024 (proposed design – Configuration B), and 27 June 2025 (proposed designs – Configurations C and D). If significant changes to the design of the development have occurred beyond these dates or new information regarding the status of surrounding buildings becomes available, it is recommended that CPP be contacted to evaluate the impact of any changes.

5. Conclusion

CPP has conducted a wind tunnel study to quantify the pedestrian-level wind environment for the proposed 133 Castlereagh Street development. Pedestrian-accessible areas around the site are typically assessed as suitable for Pedestrian Standing under the City of Sydney comfort criteria, with all tested locations satisfying the City of Sydney safety criteria. These conditions are suitable for the intended use of public domain spaces. Wind conditions for Configurations B, C and D were marginally better than Configuration A. This indicates that the proposed schemes meet the wind equivalence criteria described in Schedule 12, Section 12.2.4.a, Procedure B of the Sydney DCP 2012.

References

American Society of Civil Engineers (1999), Wind tunnel studies of buildings and structures, ASCE Manuals and reports on engineering practice No.67.

American Society of Civil Engineers (2021), *Wind Tunnel Testing for Buildings and Other Structures* (ASCE 49-21).

Australasian Wind Engineering Society (2019), Wind Engineering Studies of Buildings (AWES-QAM-1-2019).

City of Sydney (2024), Sydney Development Control Plan 2012.

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

Standards Australia (2021), *Australian/New Zealand Standard, Structural Design Actions, Part 2: Wind Actions* (AS/NZS1170.2:2021).

Appendix A – Wind Tunnel Test Facilities

The wind tunnel testing was performed at the CPP wind engineering laboratory in Sydney, Australia. Specifications for the wind tunnel used for this project are given in Figure A1.

The mean velocity profile approaching the modelled area for each direction has the form:

$$\frac{U}{U_{ref}} = \left(\frac{z}{z_{ref}} \right)^n$$

in which U is the mean velocity at height z , U_{ref} is a reference wind speed at reference height z_{ref} , and n is a constant which depends on the characteristics of the upstream roughness for each direction.

The profiles of longitudinal turbulence intensity in the flow approaching the modelled area are also modelled. The turbulence intensities are appropriate for the approach mean velocity profiles selected.

CPP SYDNEY WIND TUNNELS	
DIMENSIONS	
Test section length	21 m (69 ft)
Test section width	3 m (10 ft)
Ceiling height	2.4 m (8 ft)
DRIVE SPECIFICATIONS	
Total power	110 kW
Type of drive	Single Axle motor/12 blade axial fan
Speed Control	Variable frequency drive
FLOW CHARACTERISTICS	
Mean Velocity	0 to 20 m/s (0 to 66 ft/s)
Boundary-layer thickness*	1.2 m (4 ft) (nominal)
Turbulence	About 2% at entrance to test section
Longitudinal pressure gradient	Zero by blockage tolerant roof

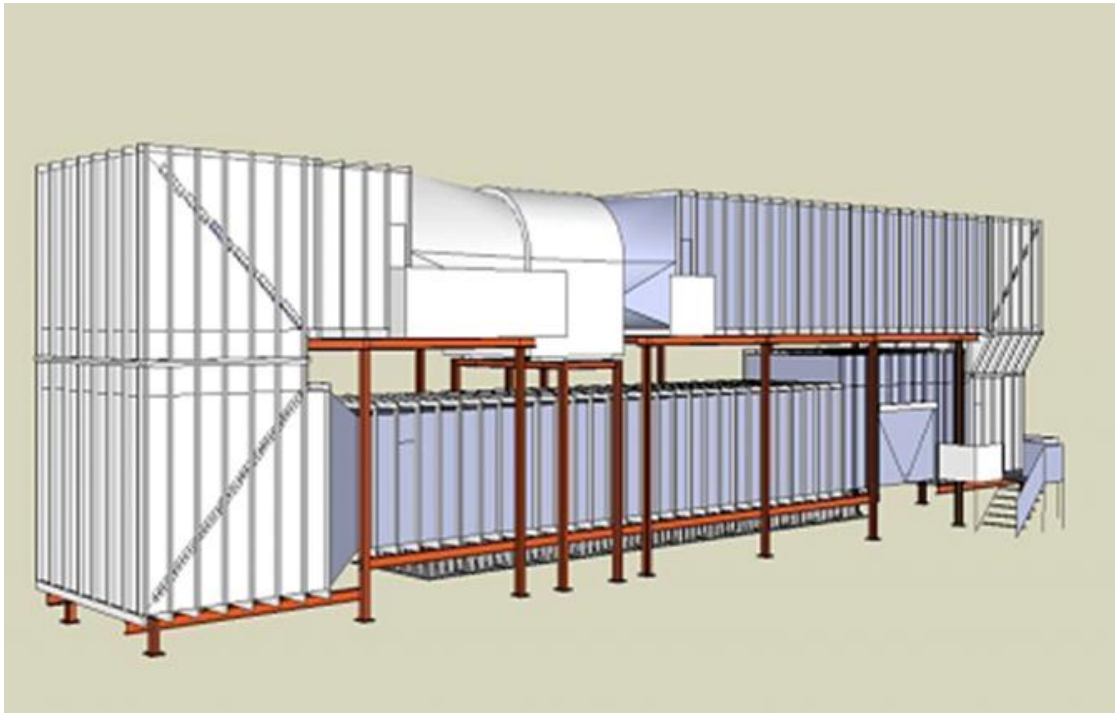
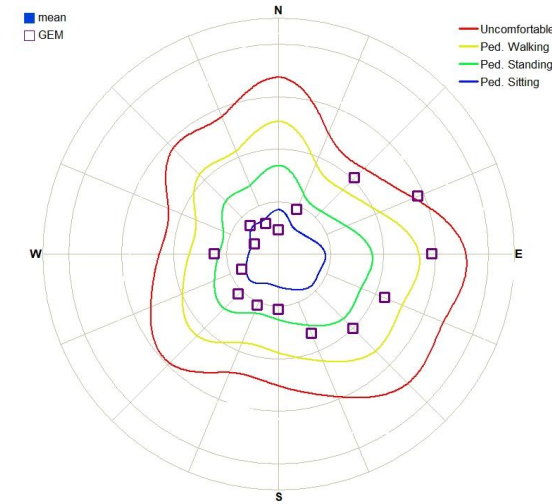


Figure A1: CPP Wind Tunnel - Sydney, Australia

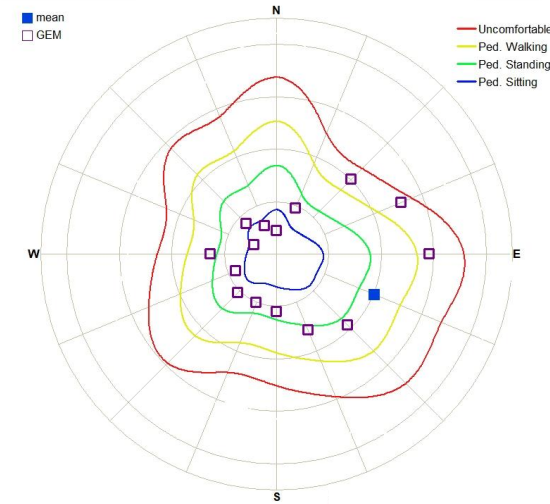
Appendix B - Directional wind results

LOCATION 1.1



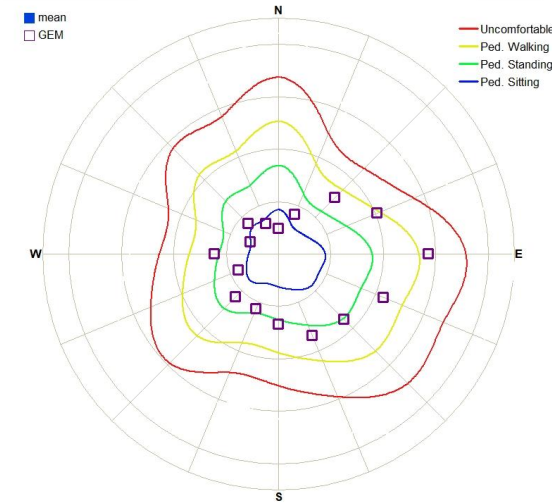
% of time in excess of wind speed V			
V (m/s)	MEAN	GEM	COMBINED
2	27.77	45.28	45.28
4	10.01	14.08	14.08
6	1.74	4.00	4.00
8	0.09	0.63	0.63
10	0.01	0.04	0.04

LOCATION 1.2



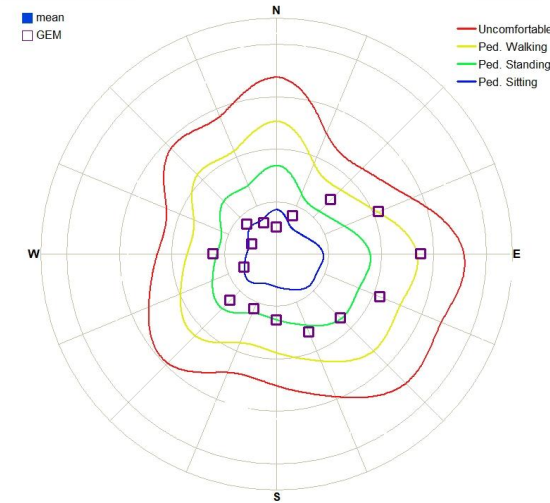
% of time in excess of wind speed V			
V (m/s)	MEAN	GEM	COMBINED
2	27.12	45.15	45.15
4	9.11	13.05	13.05
6	1.06	3.07	3.07
8	0.05	0.32	0.32
10	0.00	0.02	0.02

LOCATION 1.3



% of time in excess of wind speed V			
V (m/s)	MEAN	GEM	COMBINED
2	25.92	45.86	45.86
4	3.17	10.42	10.42
6	0.11	0.81	0.81
8	0.01	0.05	0.05
10	0.00	0.01	0.01

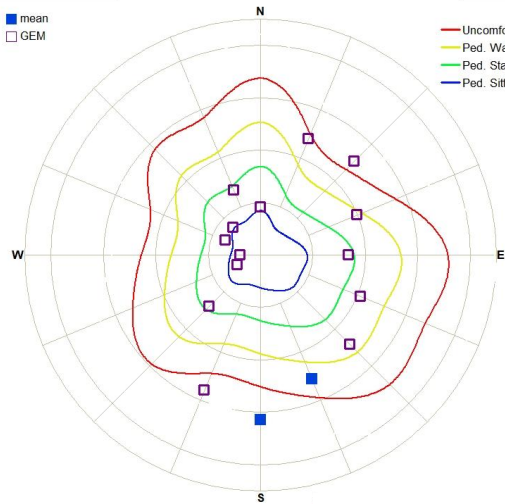
LOCATION 1.4



% of time in excess of wind speed V			
V (m/s)	MEAN	GEM	COMBINED
2	24.79	44.06	44.06
4	2.84	9.46	9.46
6	0.08	0.73	0.73
8	0.01	0.04	0.04
10	0.00	0.01	0.01

LOCATION 2.1

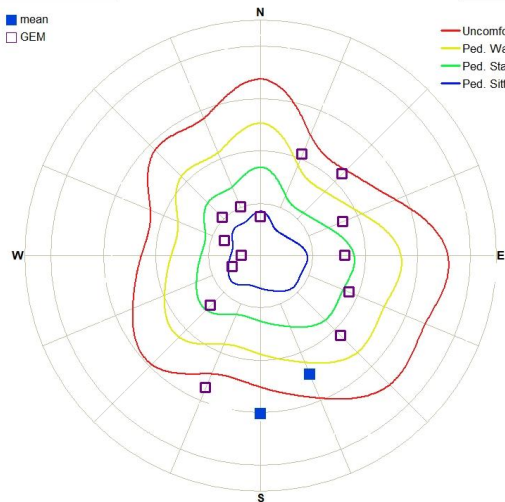
■ mean
□ GEM



% of time in excess of wind speed V			
V (m/s)	MEAN	GEM	COMBINED
2	49.64	57.00	57.24
4	27.22	31.26	32.09
6	10.27	12.14	13.69
8	2.57	2.99	3.76
10	0.63	0.57	0.91

LOCATION 2.3

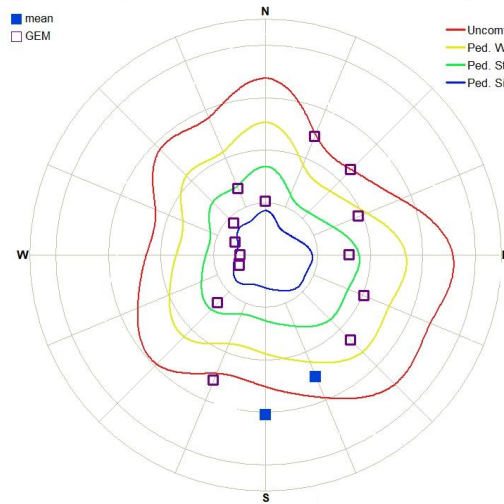
■ mean
□ GEM



% of time in excess of wind speed V			
V (m/s)	MEAN	GEM	COMBINED
2	46.50	54.59	55.03
4	23.47	26.78	28.21
6	7.66	8.54	10.38
8	2.02	1.69	2.55
10	0.46	0.25	0.56

LOCATION 2.2

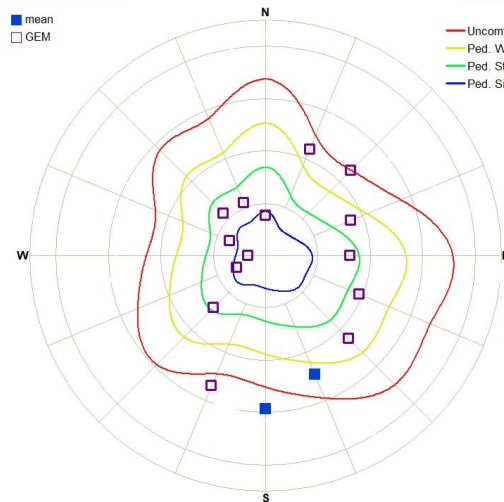
■ mean
□ GEM



% of time in excess of wind speed V			
V (m/s)	MEAN	GEM	COMBINED
2	49.22	56.59	56.87
4	26.41	29.61	30.59
6	8.88	10.30	11.79
8	2.19	2.15	2.90
10	0.50	0.31	0.61

LOCATION 2.4

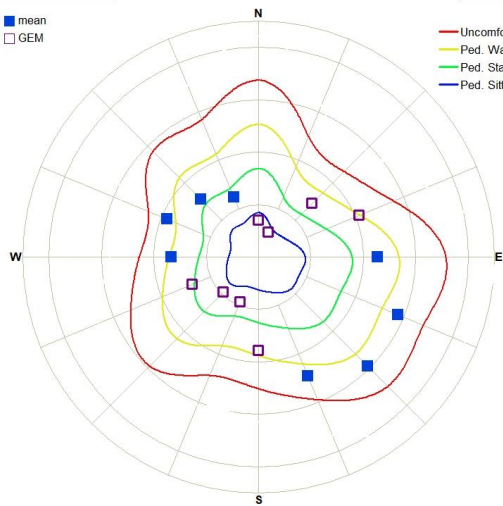
■ mean
□ GEM



% of time in excess of wind speed V			
V (m/s)	MEAN	GEM	COMBINED
2	47.36	55.89	56.13
4	23.64	27.82	29.01
6	7.50	9.13	10.59
8	1.85	1.79	2.49
10	0.38	0.26	0.49

LOCATION 3.1

■ mean
□ GEM

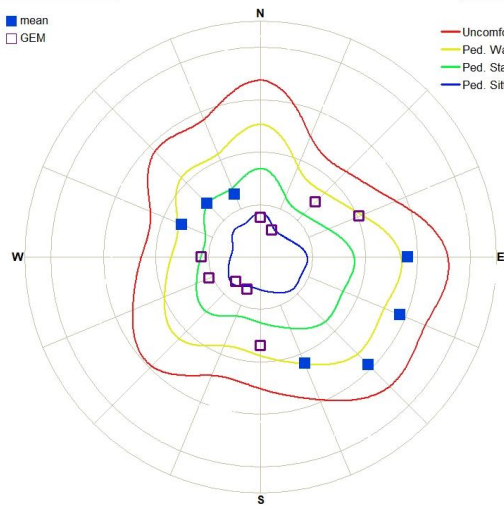


% of time in excess of wind speed V			
V (m/s)	MEAN	GEM	COMBINED
2	51.87	54.16	57.43
4	16.27	16.15	19.95
6	2.94	1.64	3.29
8	0.42	0.12	0.43
10	0.05	0.01	0.05

LOCATION 3.2

LOCATION 3.2

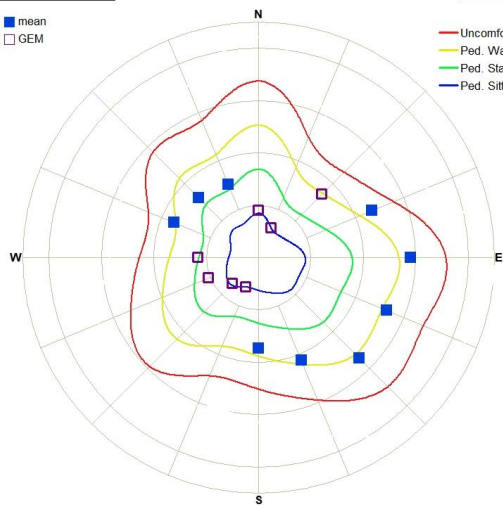
■ mean
□ GEM



% of time in excess of wind speed V			
V (m/s)	MEAN	GEM	COMBINED
2	47.87	48.65	51.61
4	15.08	14.40	17.76
6	2.22	1.28	2.50
8	0.23	0.08	0.24
10	0.03	0.01	0.03

LOCATION 3.3

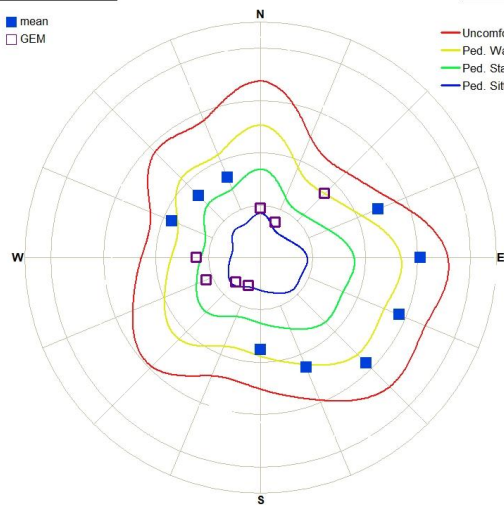
■ mean
□ GEM



% of time in excess of wind speed V			
V (m/s)	MEAN	GEM	COMBINED
2	51.01	49.76	54.30
4	18.00	15.93	19.76
6	2.83	1.77	3.10
8	0.25	0.10	0.26
10	0.03	0.01	0.03

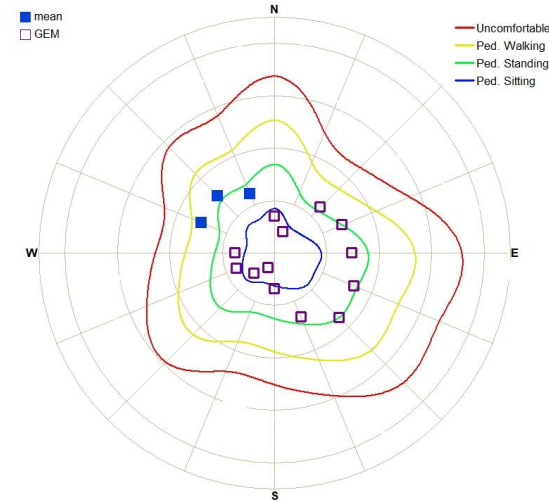
LOCATION 3.4

■ mean
□ GEM



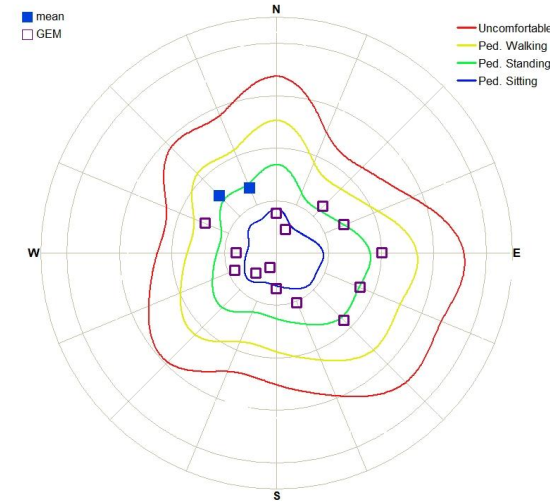
% of time in excess of wind speed V			
V (m/s)	MEAN	GEM	COMBINED
2	53.23	52.34	57.03
4	20.25	17.45	21.69
6	3.95	2.19	4.21
8	0.40	0.13	0.41
10	0.05	0.01	0.05

LOCATION 4.1



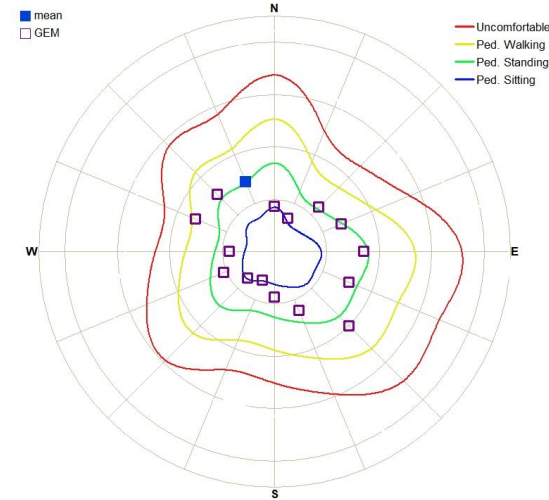
% of time in excess of wind speed V			
V (m/s)	MEAN	GEM	COMBINED
2	18.63	30.73	31.53
4	1.63	3.14	3.28
6	0.27	0.26	0.30
8	0.01	0.01	0.01
10	0.00	0.00	0.00

LOCATION 4.2



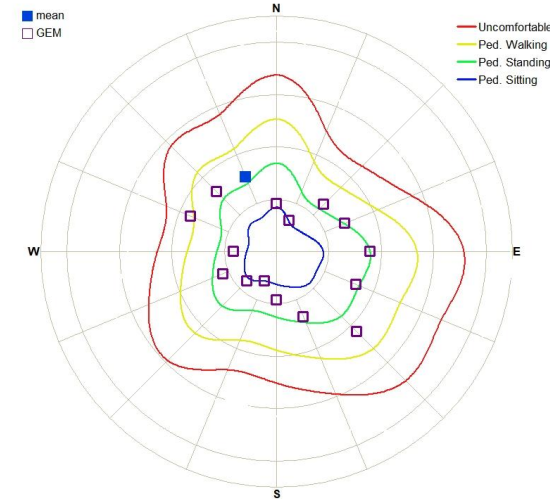
% of time in excess of wind speed V			
V (m/s)	MEAN	GEM	COMBINED
2	21.01	30.83	31.70
4	1.67	3.64	3.80
6	0.16	0.28	0.30
8	0.01	0.01	0.01
10	0.00	0.00	0.00

LOCATION 4.3



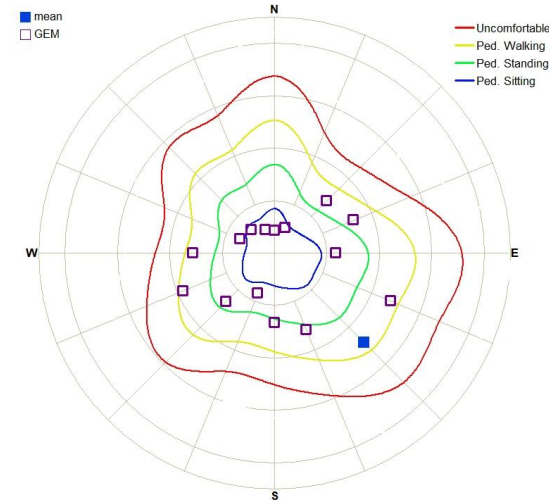
% of time in excess of wind speed V			
V (m/s)	MEAN	GEM	COMBINED
2	20.26	37.06	37.41
4	1.17	3.78	3.89
6	0.06	0.41	0.41
8	0.00	0.03	0.03
10	0.00	0.00	0.00

LOCATION 4.4



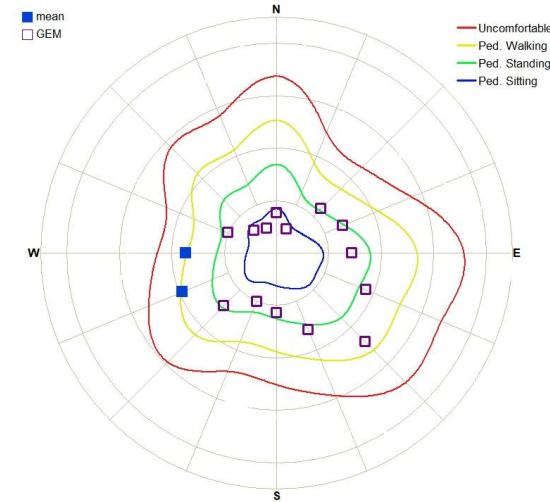
% of time in excess of wind speed V			
V (m/s)	MEAN	GEM	COMBINED
2	24.99	40.52	40.89
4	2.09	5.18	5.38
6	0.16	0.64	0.66
8	0.01	0.08	0.09
10	0.00	0.00	0.00

LOCATION 5.1



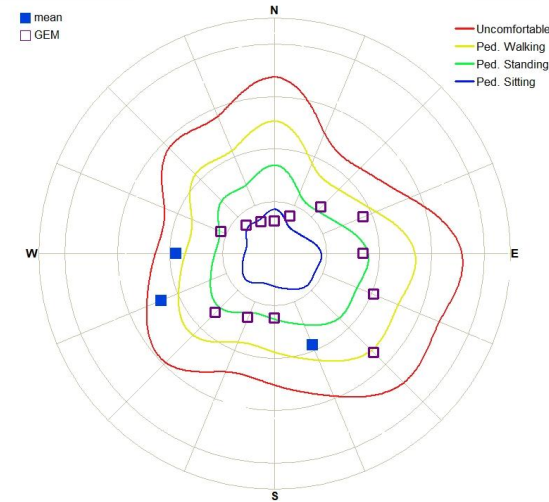
% of time in excess of wind speed V			
V (m/s)	MEAN	GEM	COMBINED
2	30.52	43.34	43.76
4	4.03	8.98	9.60
6	0.29	0.65	0.75
8	0.02	0.04	0.05
10	0.00	0.00	0.01

LOCATION 5.2



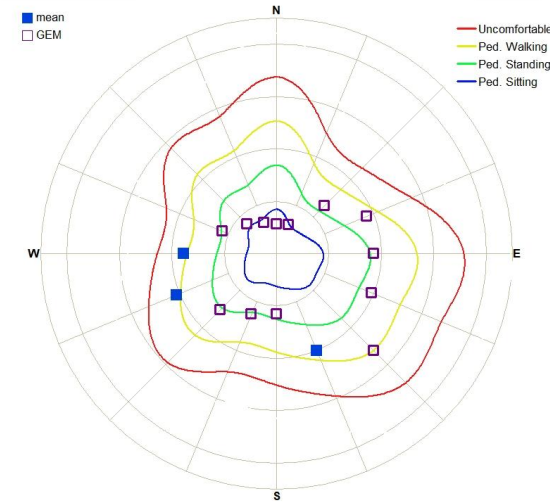
% of time in excess of wind speed V			
V (m/s)	MEAN	GEM	COMBINED
2	30.14	43.59	43.64
4	5.27	6.92	7.01
6	0.72	0.72	0.76
8	0.05	0.05	0.06
10	0.01	0.01	0.01

LOCATION 5.3



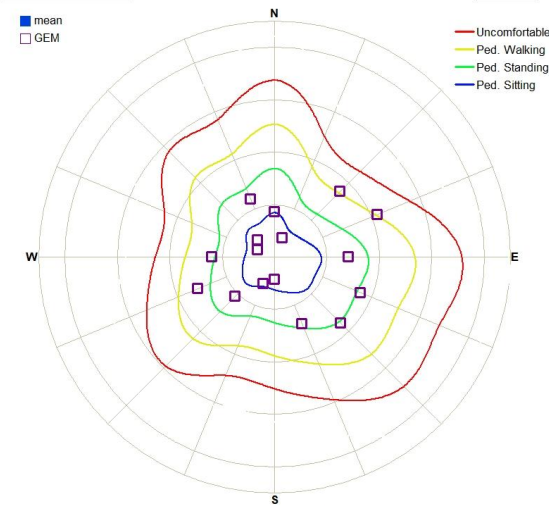
% of time in excess of wind speed V			
V (m/s)	MEAN	GEM	COMBINED
2	34.39	51.27	51.54
4	8.42	12.10	12.56
6	1.66	1.61	1.79
8	0.21	0.16	0.22
10	0.02	0.02	0.02

LOCATION 5.4



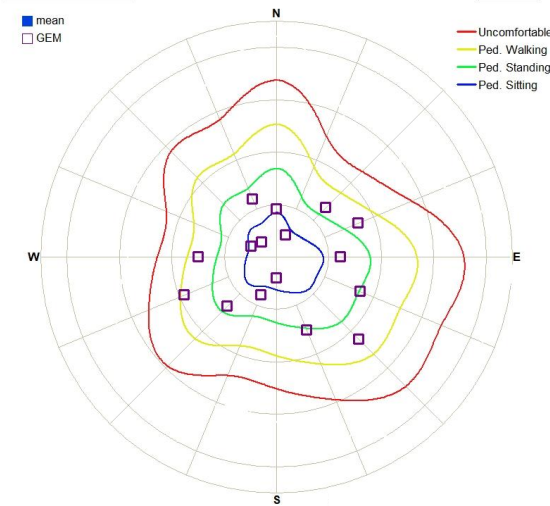
% of time in excess of wind speed V			
V (m/s)	MEAN	GEM	COMBINED
2	34.78	48.90	49.35
4	7.91	11.18	11.84
6	1.26	1.11	1.41
8	0.12	0.08	0.12
10	0.01	0.01	0.01

LOCATION 6.1



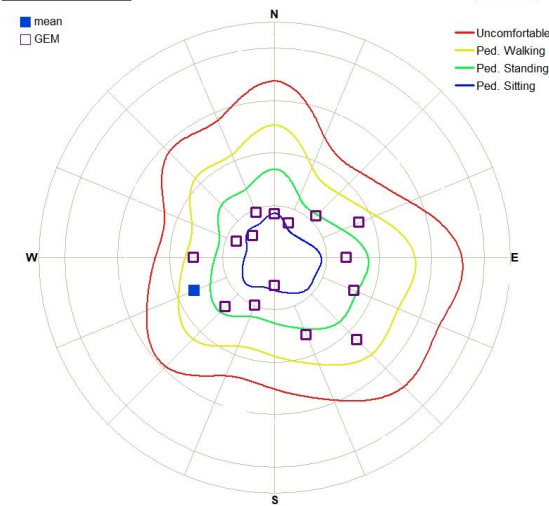
% of time in excess of wind speed V			
V (m/s)	MEAN	GEM	COMBINED
2	23.99	32.68	32.68
4	3.60	8.79	8.79
6	0.10	0.97	0.97
8	0.00	0.04	0.04
10	0.00	0.00	0.00

LOCATION 6.2



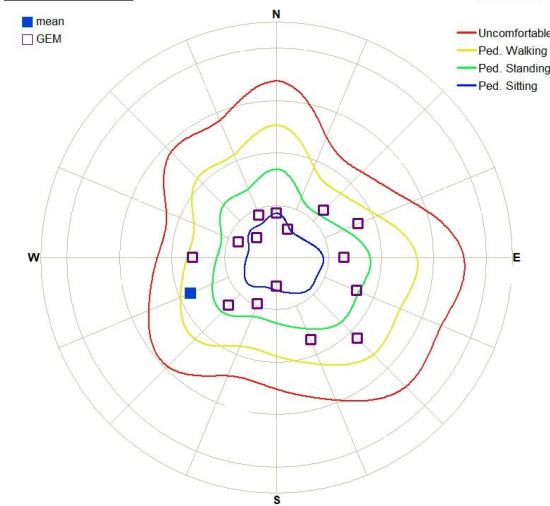
% of time in excess of wind speed V			
V (m/s)	MEAN	GEM	COMBINED
2	24.75	35.24	35.24
4	2.71	7.02	7.02
6	0.17	0.45	0.45
8	0.01	0.03	0.03
10	0.00	0.00	0.00

LOCATION 6.3



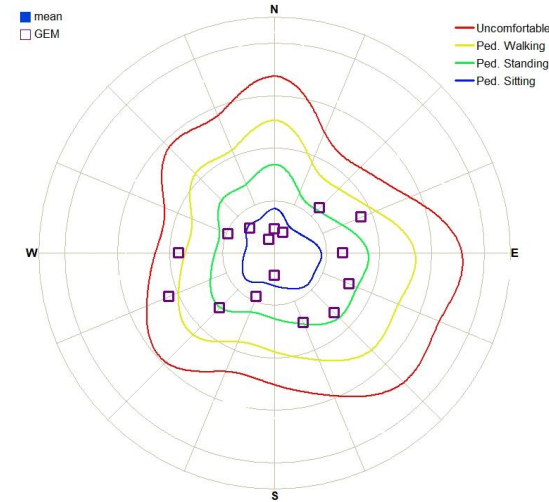
% of time in excess of wind speed V			
V (m/s)	MEAN	GEM	COMBINED
2	23.57	37.84	37.87
4	3.37	5.70	5.79
6	0.21	0.33	0.34
8	0.01	0.02	0.02
10	0.00	0.00	0.00

LOCATION 6.4



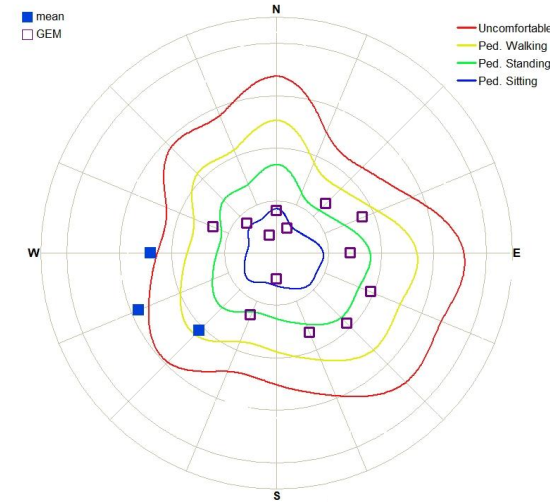
% of time in excess of wind speed V			
V (m/s)	MEAN	GEM	COMBINED
2	25.51	37.23	37.30
4	3.81	6.63	6.82
6	0.29	0.42	0.46
8	0.02	0.02	0.02
10	0.00	0.00	0.00

LOCATION 7.1



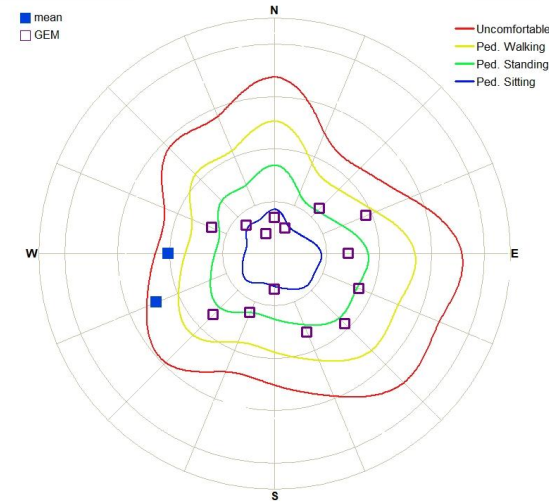
% of time in excess of wind speed V			
V (m/s)	MEAN	GEM	COMBINED
2	21.24	34.67	34.67
4	3.58	6.89	6.89
6	0.72	1.00	1.00
8	0.06	0.11	0.11
10	0.01	0.01	0.01

LOCATION 7.2



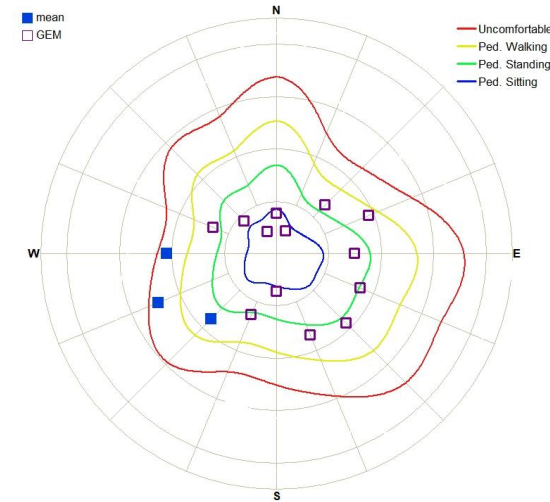
% of time in excess of wind speed V			
V (m/s)	MEAN	GEM	COMBINED
2	31.86	42.53	43.13
4	7.68	11.19	12.32
6	2.78	1.93	2.99
8	0.87	0.34	0.88
10	0.16	0.04	0.16

LOCATION 7.3



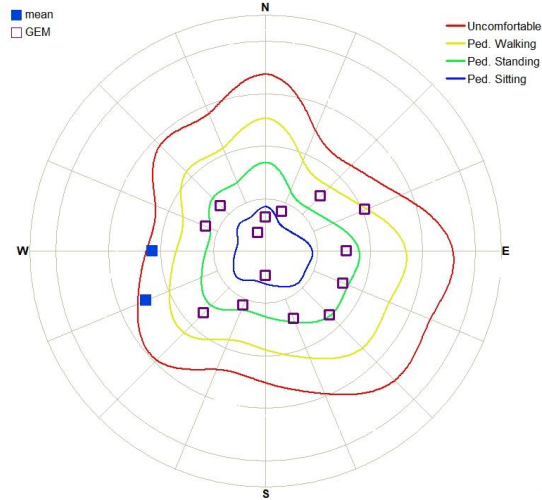
% of time in excess of wind speed V			
V (m/s)	MEAN	GEM	COMBINED
2	28.58	41.10	41.66
4	6.28	8.98	10.04
6	1.51	1.10	1.68
8	0.26	0.10	0.27
10	0.02	0.01	0.02

LOCATION 7.4



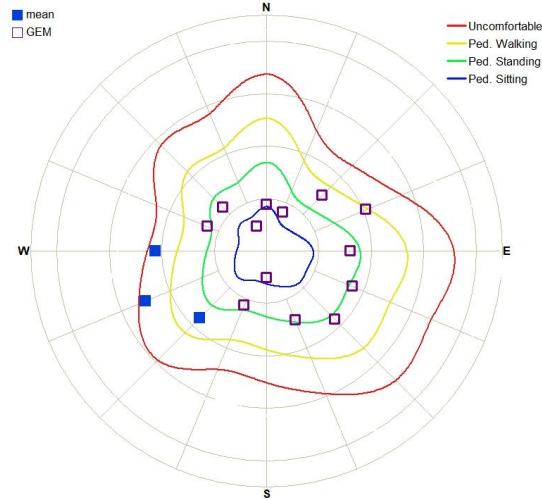
% of time in excess of wind speed V			
V (m/s)	MEAN	GEM	COMBINED
2	30.87	42.54	43.11
4	6.70	9.98	11.08
6	1.66	1.24	1.86
8	0.31	0.12	0.31
10	0.03	0.01	0.03

LOCATION 8.1



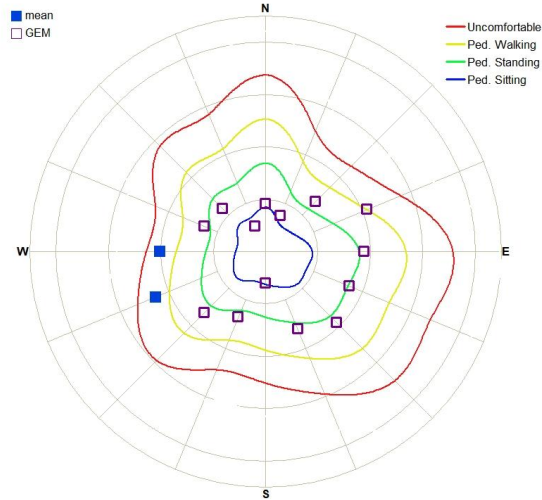
% of time in excess of wind speed V			
V (m/s)	MEAN	GEM	COMBINED
2	31.51	42.56	43.10
4	6.89	10.68	11.73
6	1.75	1.48	2.12
8	0.37	0.14	0.38
10	0.04	0.01	0.04

LOCATION 8.2



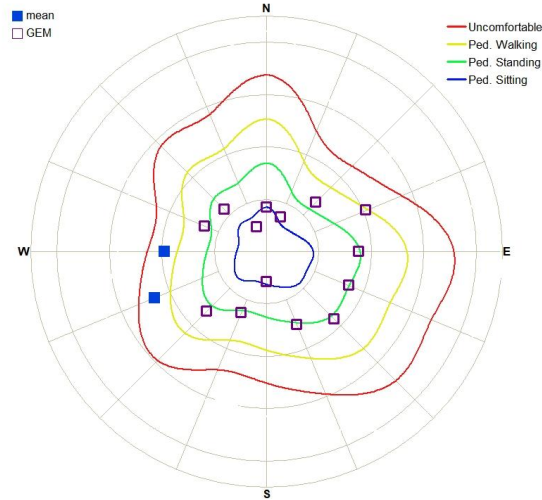
% of time in excess of wind speed V			
V (m/s)	MEAN	GEM	COMBINED
2	33.32	43.50	44.24
4	6.91	11.00	12.37
6	1.78	1.38	2.19
8	0.36	0.11	0.37
10	0.04	0.01	0.04

LOCATION 8.3



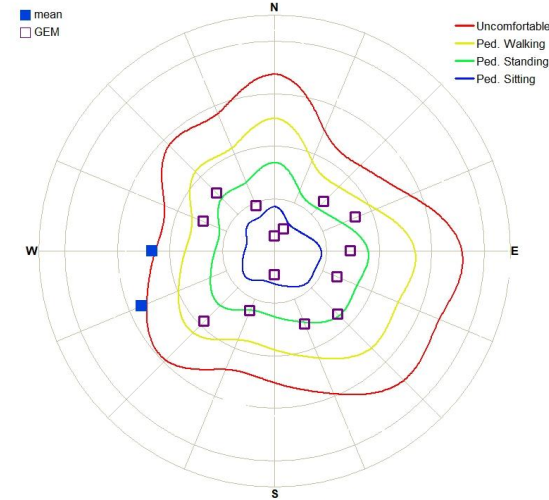
% of time in excess of wind speed V			
V (m/s)	MEAN	GEM	COMBINED
2	34.06	44.56	43.13
4	6.55	10.54	11.66
6	1.39	1.13	1.76
8	0.19	0.08	0.21
10	0.02	0.01	0.02

LOCATION 8.4



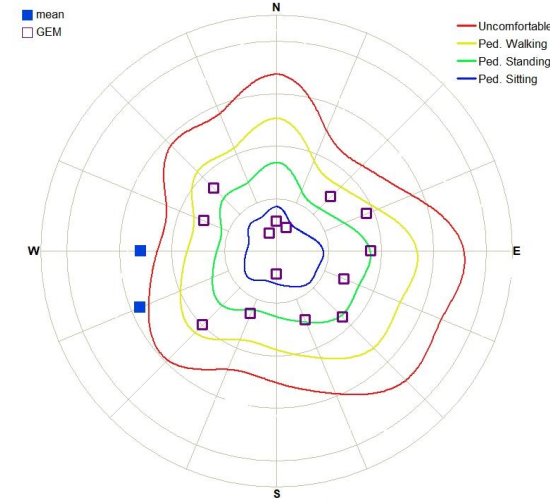
% of time in excess of wind speed V			
V (m/s)	MEAN	GEM	COMBINED
2	31.68	42.84	43.35
4	5.93	9.72	10.69
6	1.29	1.06	1.57
8	0.17	0.08	0.18
10	0.02	0.01	0.02

LOCATION 9.1



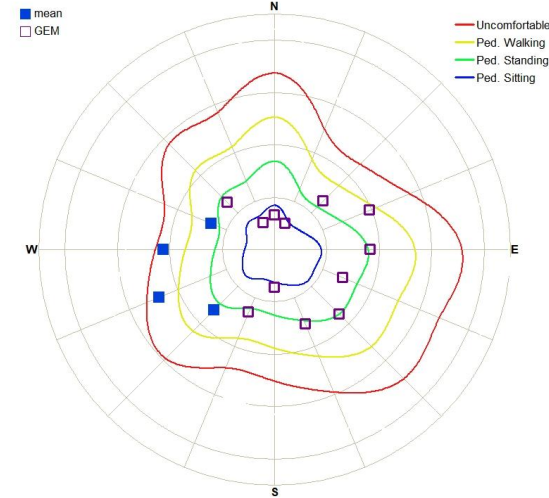
% of time in excess of wind speed V			
V (m/s)	MEAN	GEM	COMBINED
2	30.72	43.60	43.99
4	7.26	10.56	11.34
6	2.45	2.05	2.77
8	0.72	0.37	0.73
10	0.12	0.04	0.12

LOCATION 9.2



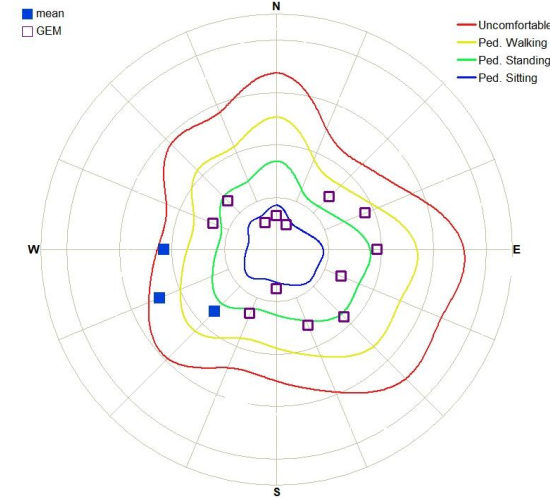
% of time in excess of wind speed V			
V (m/s)	MEAN	GEM	COMBINED
2	34.50	45.54	46.16
4	8.69	12.75	13.92
6	3.09	2.36	3.48
8	1.06	0.43	1.09
10	0.22	0.05	0.22

LOCATION 9.3



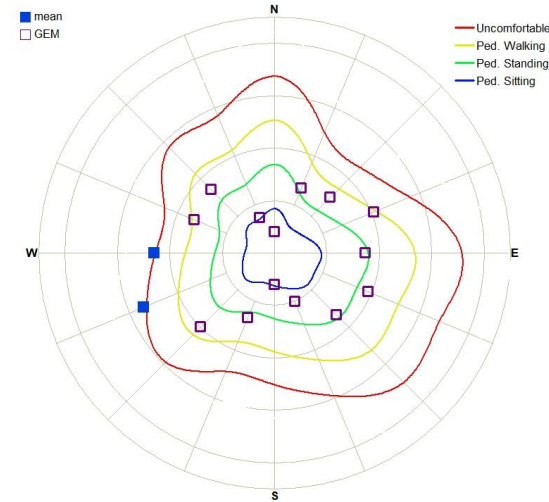
% of time in excess of wind speed V			
V (m/s)	MEAN	GEM	COMBINED
2	34.47	42.60	43.28
4	7.57	9.66	10.89
6	1.66	1.16	1.85
8	0.30	0.10	0.30
10	0.03	0.01	0.03

LOCATION 9.4

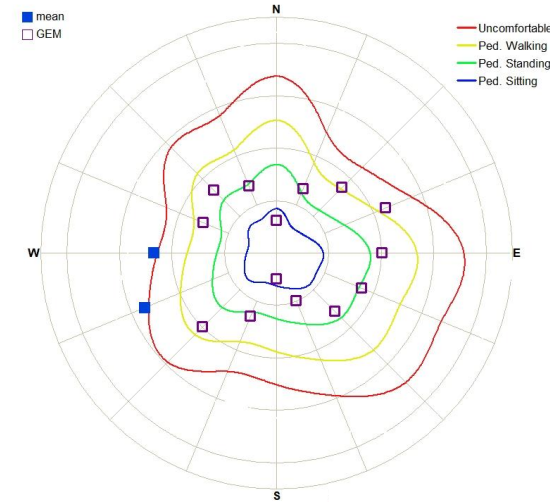


% of time in excess of wind speed V			
V (m/s)	MEAN	GEM	COMBINED
2	36.25	43.89	44.42
4	7.92	10.61	11.63
6	1.72	1.31	1.92
8	0.34	0.13	0.34
10	0.04	0.01	0.04

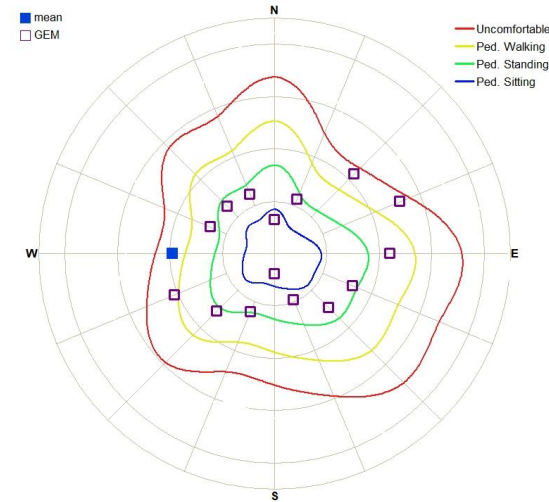
LOCATION 10.1



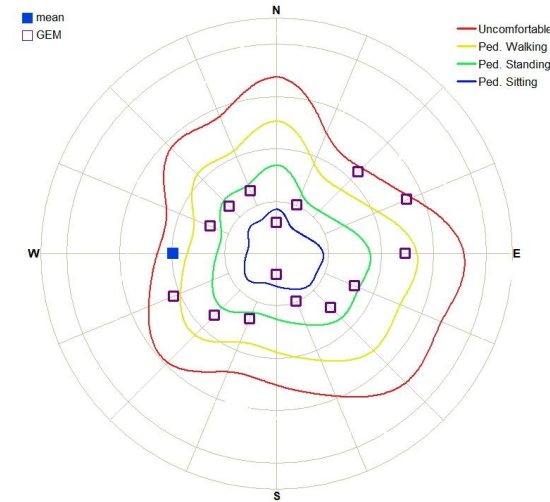
LOCATION 10.2



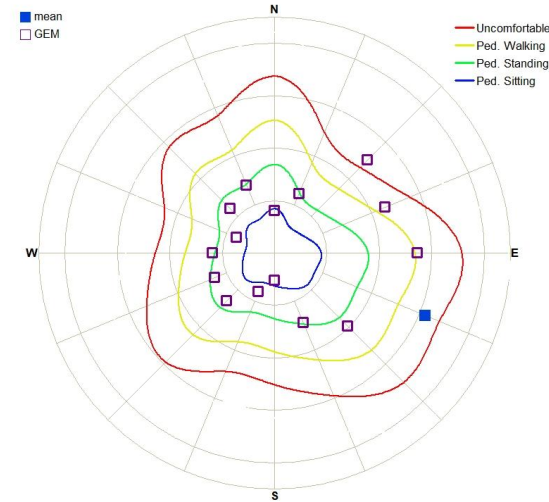
LOCATION 10.3



LOCATION 10.4

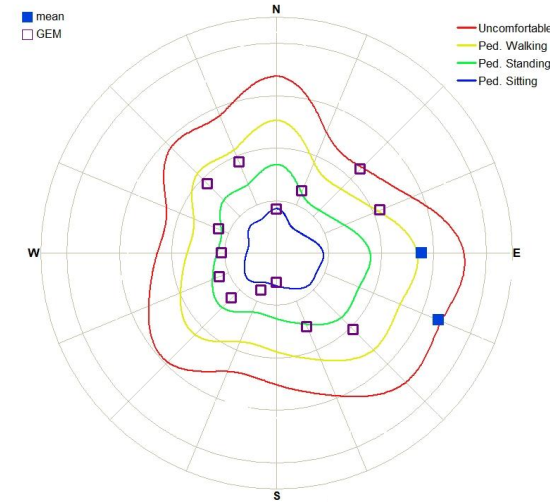


LOCATION 11.1



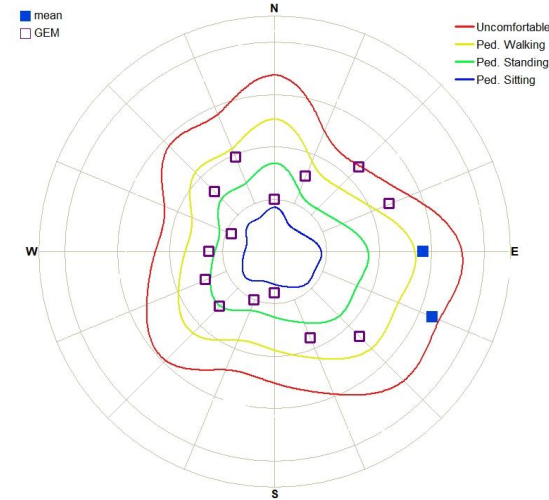
% of time in excess of wind speed V			
V (m/s)	MEAN	GEM	COMBINED
2	31.61	45.73	45.77
4	7.64	15.55	15.62
6	1.12	4.98	5.15
8	0.13	1.00	1.04
10	0.02	0.18	0.19

LOCATION 11.2



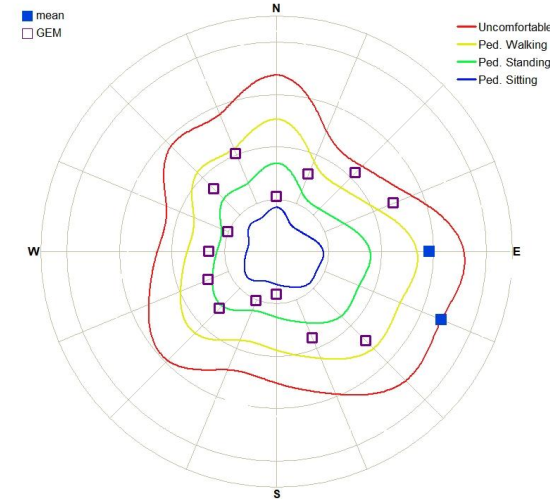
% of time in excess of wind speed V			
V (m/s)	MEAN	GEM	COMBINED
2	35.29	50.59	50.72
4	6.82	16.15	16.37
6	1.26	4.16	4.32
8	0.20	0.59	0.66
10	0.04	0.07	0.09

LOCATION 11.3



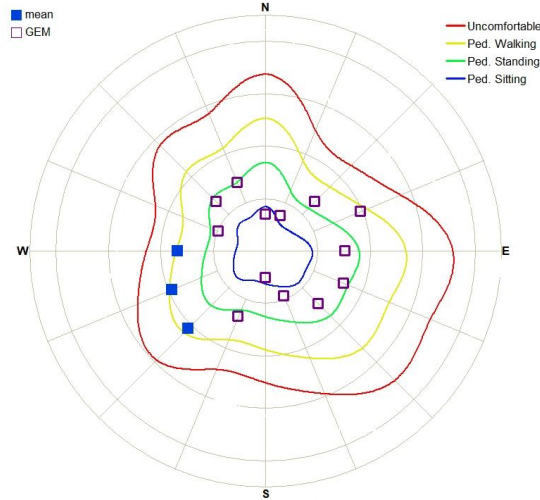
% of time in excess of wind speed V			
V (m/s)	MEAN	GEM	COMBINED
2	44.55	56.20	56.43
4	9.80	19.00	19.58
6	1.40	4.38	5.01
8	0.19	0.57	0.68
10	0.04	0.06	0.08

LOCATION 11.4



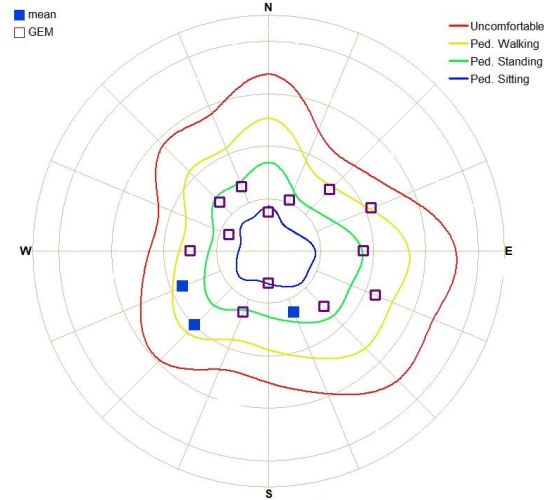
% of time in excess of wind speed V			
V (m/s)	MEAN	GEM	COMBINED
2	45.77	57.79	58.03
4	9.76	19.64	20.27
6	1.64	3.97	4.76
8	0.26	0.46	0.61
10	0.05	0.04	0.07

LOCATION 12.1



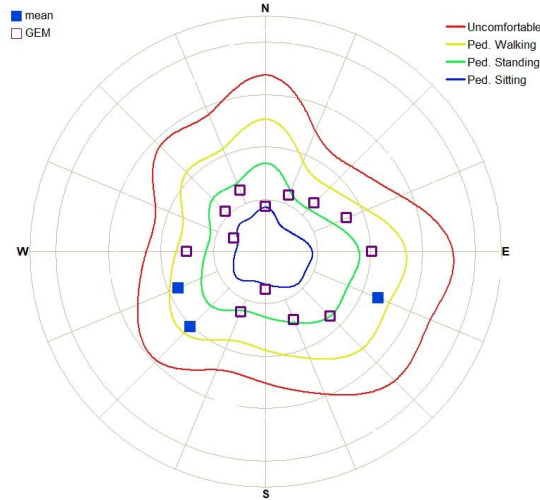
% of time in excess of wind speed V			
V (m/s)	MEAN	GEM	COMBINED
2	24.19	38.64	35.04
4	4.16	7.93	8.61
6	0.64	0.61	0.85
8	0.04	0.03	0.05
10	0.01	0.00	0.01

LOCATION 12.2



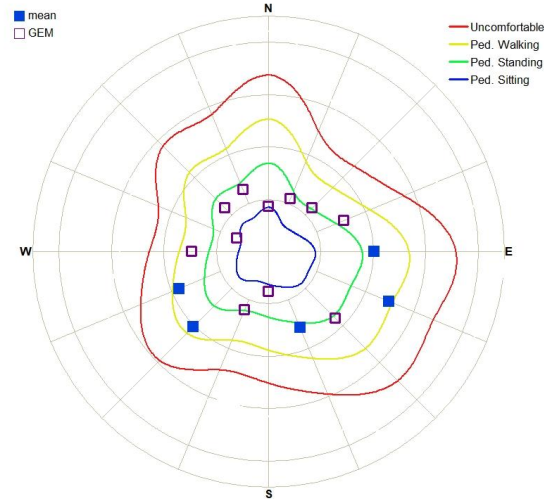
% of time in excess of wind speed V			
V (m/s)	MEAN	GEM	COMBINED
2	34.54	45.28	45.82
4	4.47	10.39	11.00
6	0.36	0.94	1.05
8	0.03	0.04	0.05
10	0.00	0.00	0.00

LOCATION 12.3



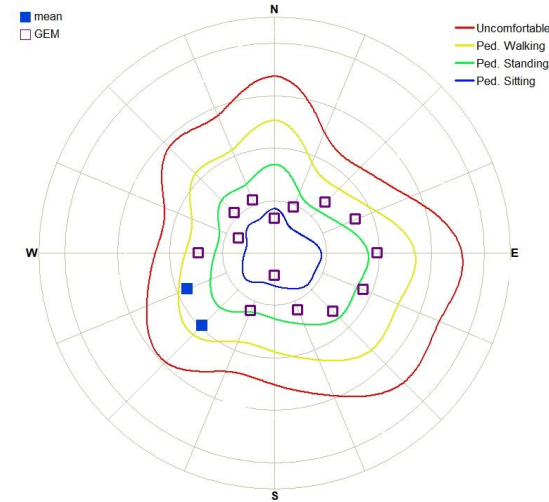
% of time in excess of wind speed V			
V (m/s)	MEAN	GEM	COMBINED
2	35.29	46.30	46.71
4	4.80	7.49	8.27
6	0.45	0.38	0.54
8	0.03	0.02	0.04
10	0.00	0.00	0.00

LOCATION 12.4



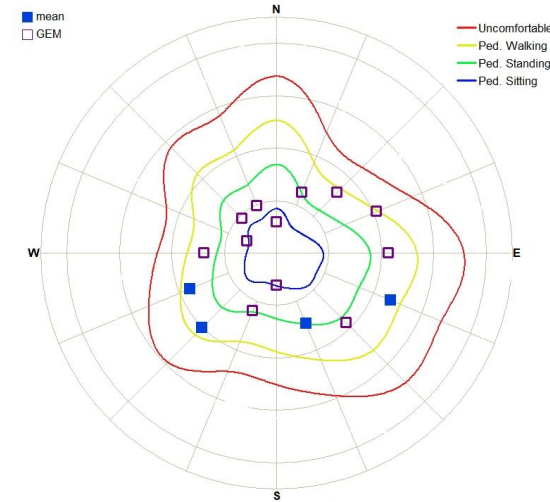
% of time in excess of wind speed V			
V (m/s)	MEAN	GEM	COMBINED
2	33.79	46.34	46.92
4	5.54	6.63	7.61
6	0.54	0.39	0.59
8	0.04	0.03	0.04
10	0.00	0.00	0.01

LOCATION 13.1



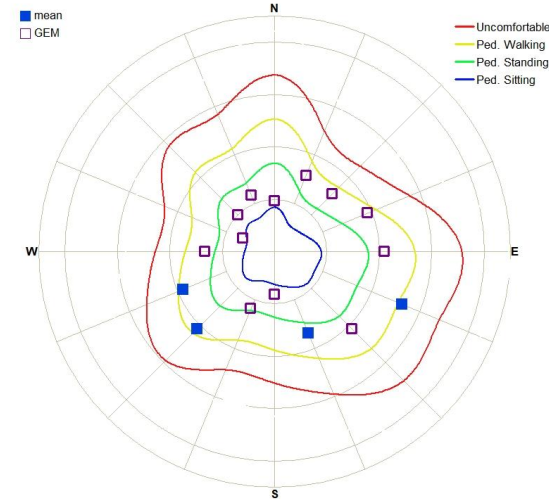
% of time in excess of wind speed V			
V (m/s)	MEAN	GEM	COMBINED
2	29.20	41.18	41.34
4	3.16	6.36	6.67
6	0.28	0.32	0.39
8	0.02	0.02	0.02
10	0.00	0.00	0.00

LOCATION 13.2



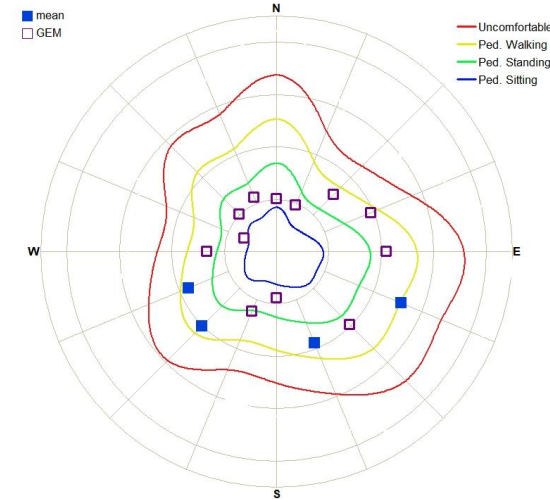
% of time in excess of wind speed V			
V (m/s)	MEAN	GEM	COMBINED
2	36.76	46.28	46.82
4	4.81	11.23	12.02
6	0.39	0.83	0.98
8	0.03	0.04	0.05
10	0.00	0.00	0.00

LOCATION 13.3



% of time in excess of wind speed V			
V (m/s)	MEAN	GEM	COMBINED
2	40.39	50.67	51.32
4	6.15	12.68	13.79
6	0.66	0.81	1.09
8	0.06	0.03	0.07
10	0.01	0.00	0.01

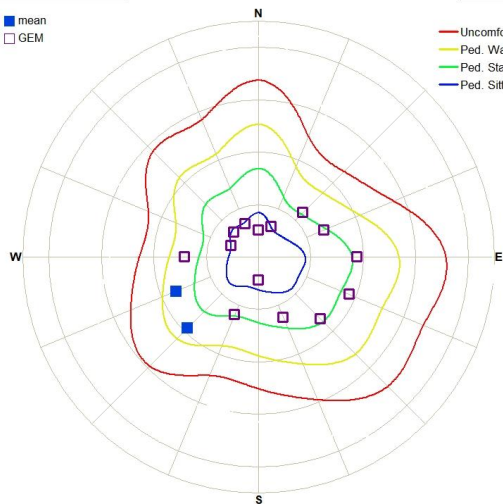
LOCATION 13.4



% of time in excess of wind speed V			
V (m/s)	MEAN	GEM	COMBINED
2	37.34	48.92	49.74
4	5.86	10.63	12.03
6	0.60	0.73	0.99
8	0.05	0.03	0.06
10	0.01	0.00	0.01

LOCATION 14.1

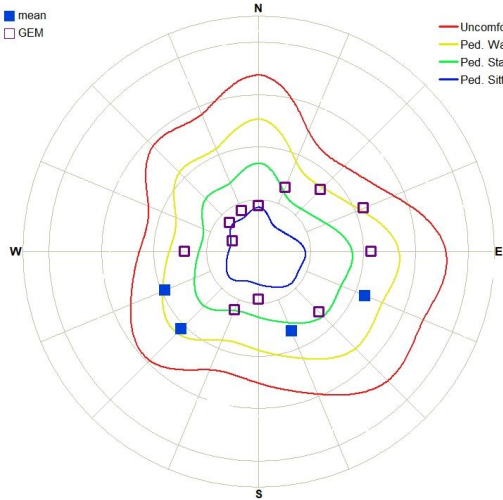
■ mean
□ GEM



% of time in excess of wind speed V			
V (m/s)	MEAN	GEM	COMBINED
2	27.27	35.66	35.81
4	2.91	4.12	4.35
6	0.21	0.22	0.26
8	0.01	0.01	0.01
10	0.00	0.00	0.00

LOCATION 14.3

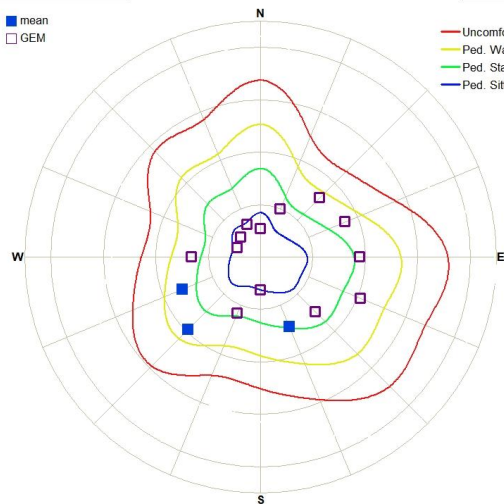
■ mean
□ GEM



% of time in excess of wind speed V			
V (m/s)	MEAN	GEM	COMBINED
2	38.60	47.97	48.83
4	6.00	11.81	12.80
6	0.51	1.07	1.29
8	0.03	0.04	0.06
10	0.00	0.00	0.00

LOCATION 14.2

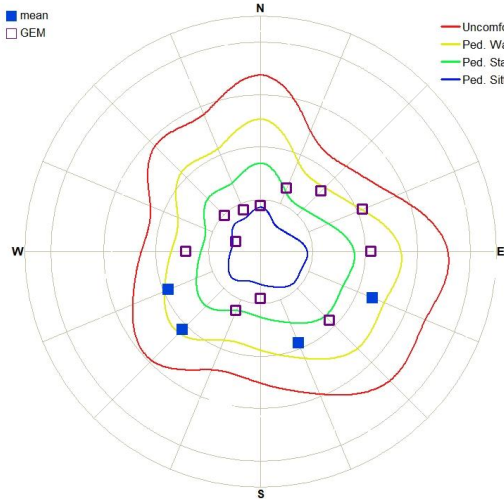
■ mean
□ GEM



% of time in excess of wind speed V			
V (m/s)	MEAN	GEM	COMBINED
2	31.43	40.31	40.96
4	3.17	7.58	8.00
6	0.18	0.46	0.53
8	0.01	0.01	0.02
10	0.00	0.00	0.00

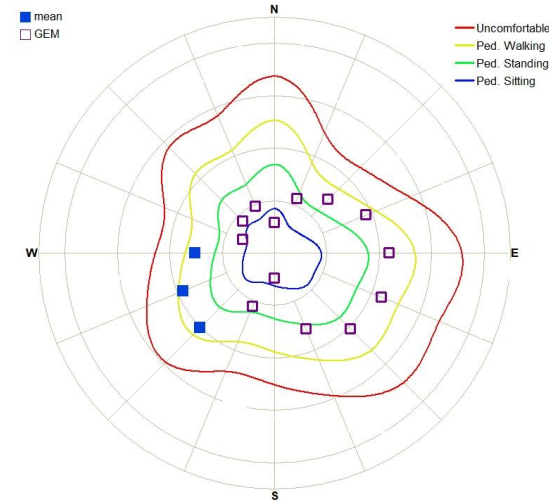
LOCATION 14.4

■ mean
□ GEM



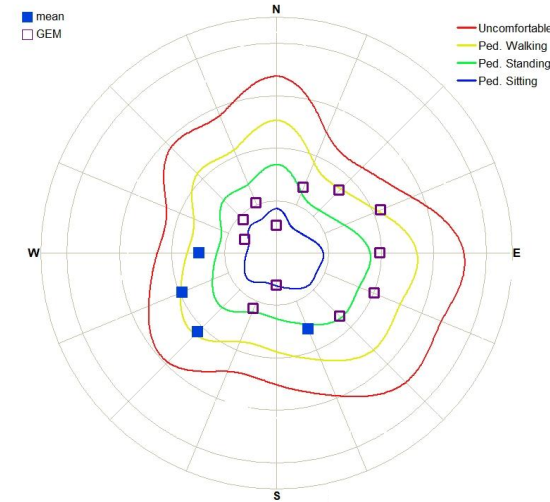
% of time in excess of wind speed V			
V (m/s)	MEAN	GEM	COMBINED
2	40.05	49.55	50.50
4	6.36	12.31	13.71
6	0.60	1.00	1.29
8	0.04	0.04	0.07
10	0.00	0.00	0.01

LOCATION 15.1



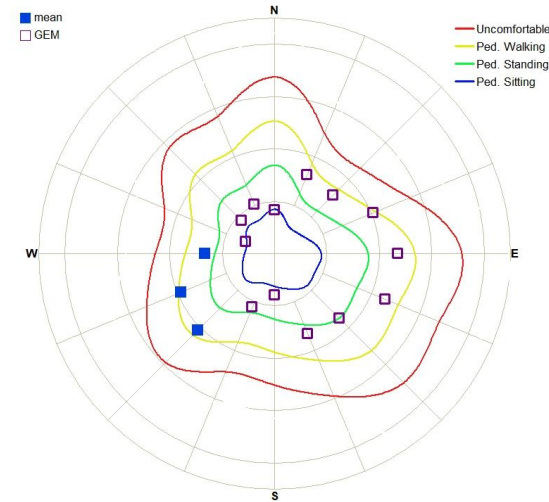
% of time in excess of wind speed V			
V (m/s)	MEAN	GEM	COMBINED
2	35.14	45.40	45.95
4	5.41	9.55	10.49
6	0.51	0.49	0.72
8	0.03	0.03	0.04
10	0.00	0.00	0.00

LOCATION 15.2



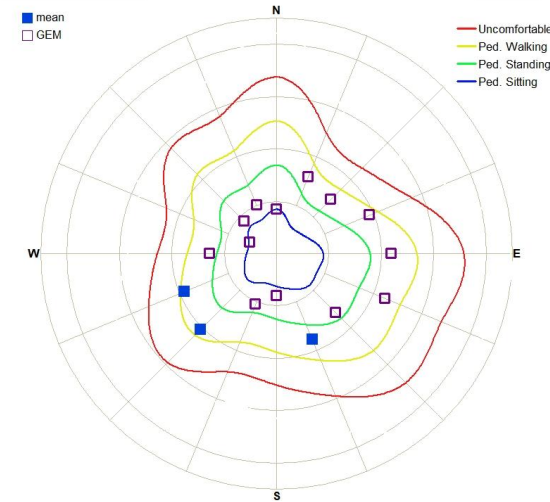
% of time in excess of wind speed V			
V (m/s)	MEAN	GEM	COMBINED
2	35.61	45.39	46.48
4	6.55	11.01	12.29
6	0.54	0.97	1.27
8	0.03	0.04	0.06
10	0.00	0.00	0.00

LOCATION 15.3



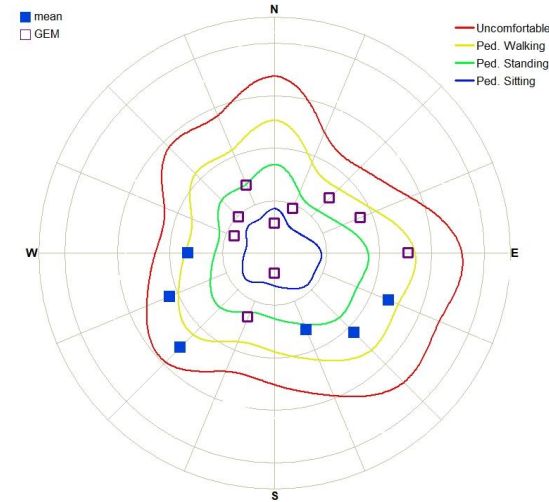
% of time in excess of wind speed V			
V (m/s)	MEAN	GEM	COMBINED
2	35.28	48.54	49.07
4	5.54	12.81	13.71
6	0.46	0.89	1.13
8	0.03	0.04	0.05
10	0.00	0.00	0.01

LOCATION 15.4



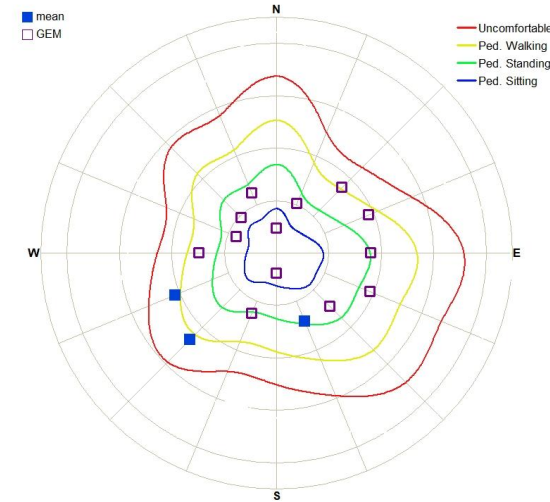
% of time in excess of wind speed V			
V (m/s)	MEAN	GEM	COMBINED
2	34.10	46.79	47.48
4	4.84	10.72	11.72
6	0.44	0.55	0.78
8	0.03	0.02	0.04
10	0.00	0.00	0.00

LOCATION 16.1



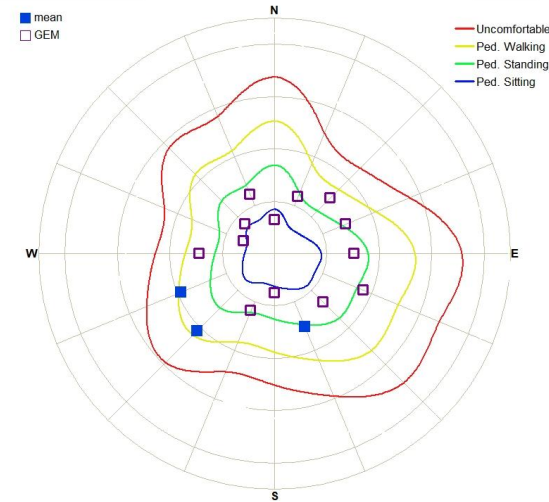
% of time in excess of wind speed V			
V (m/s)	MEAN	GEM	COMBINED
2	38.73	47.54	48.42
4	7.98	12.09	13.42
6	1.27	0.99	1.38
8	0.15	0.06	0.16
10	0.02	0.01	0.02

LOCATION 16.2



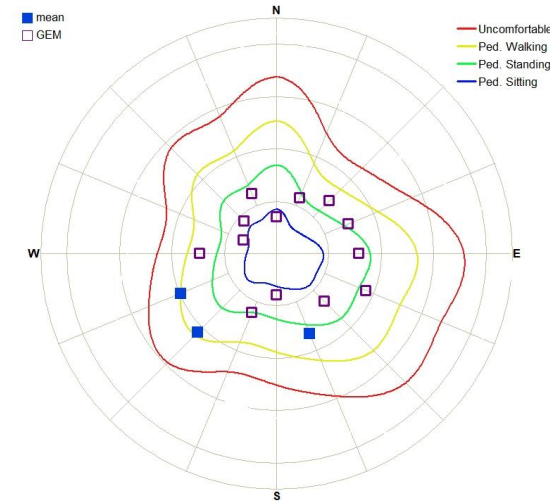
% of time in excess of wind speed V			
V (m/s)	MEAN	GEM	COMBINED
2	33.93	43.83	44.45
4	6.32	10.35	11.29
6	0.76	0.99	1.38
8	0.07	0.05	0.10
10	0.01	0.00	0.01

LOCATION 16.3



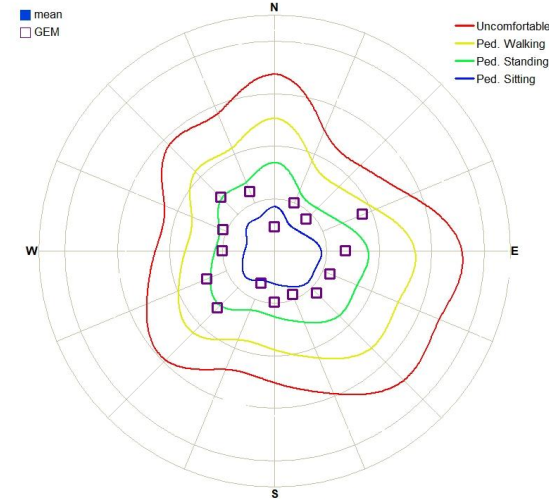
% of time in excess of wind speed V			
V (m/s)	MEAN	GEM	COMBINED
2	30.47	42.54	43.19
4	3.92	6.48	7.39
6	0.42	0.37	0.61
8	0.03	0.01	0.03
10	0.00	0.00	0.00

LOCATION 16.4



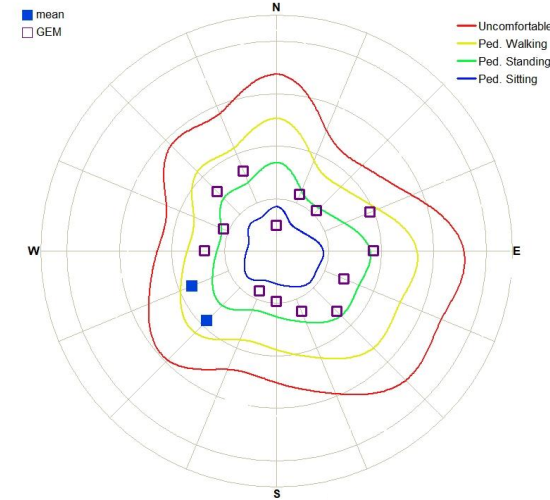
% of time in excess of wind speed V			
V (m/s)	MEAN	GEM	COMBINED
2	31.01	43.59	44.34
4	4.14	6.47	7.47
6	0.49	0.36	0.62
8	0.03	0.02	0.04
10	0.00	0.00	0.00

LOCATION 17.1



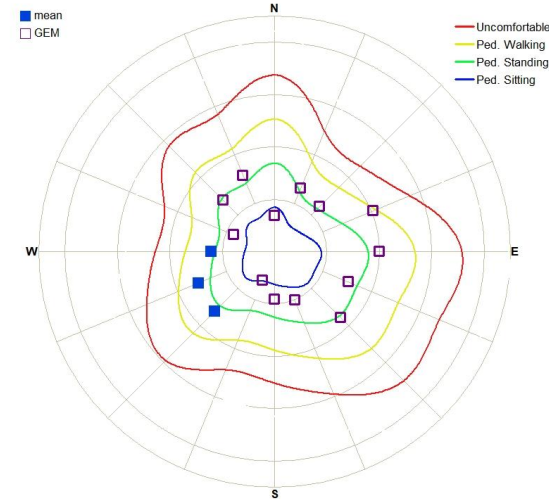
% of time in excess of wind speed V			
V (m/s)	MEAN	GEM	COMBINED
2	12.27	32.91	32.91
4	0.70	3.16	3.16
6	0.04	0.13	0.13
8	0.00	0.01	0.01
10	0.00	0.00	0.00

LOCATION 17.2



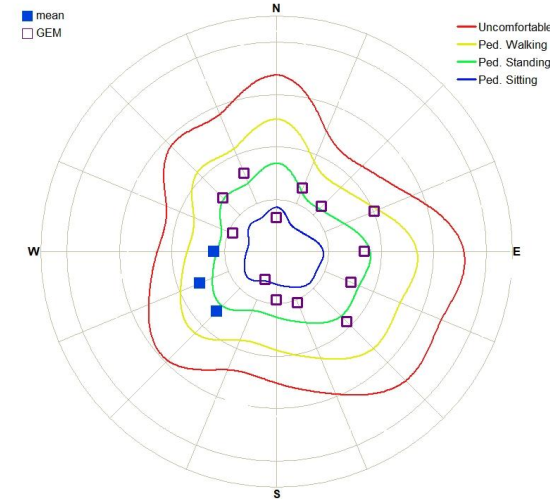
% of time in excess of wind speed V			
V (m/s)	MEAN	GEM	COMBINED
2	25.63	46.59	46.88
4	4.79	6.17	6.65
6	0.35	0.39	0.48
8	0.02	0.02	0.03
10	0.00	0.00	0.00

LOCATION 17.3



% of time in excess of wind speed V			
V (m/s)	MEAN	GEM	COMBINED
2	23.78	41.79	42.18
4	3.99	6.41	6.70
6	0.23	0.33	0.36
8	0.01	0.02	0.02
10	0.00	0.00	0.00

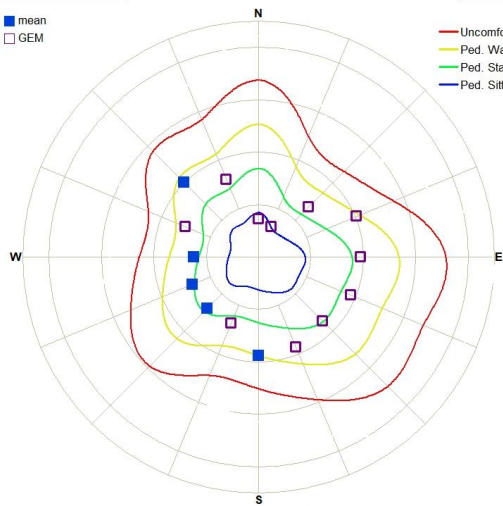
LOCATION 17.4



% of time in excess of wind speed V			
V (m/s)	MEAN	GEM	COMBINED
2	24.01	42.62	43.03
4	3.88	6.33	6.63
6	0.21	0.33	0.37
8	0.01	0.02	0.02
10	0.00	0.00	0.00

LOCATION 18.1

■ mean
□ GEM



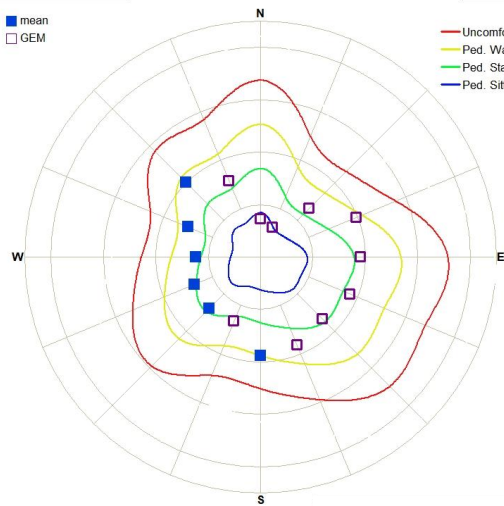
% of time in excess of wind speed V			
V (m/s)	MEAN	GEM	COMBINED
2	47.52	55.04	56.79
4	8.97	11.54	13.00
6	1.20	1.13	1.51
8	0.12	0.08	0.13
10	0.02	0.01	0.02

THRESHOLD

— Uncomfortable
— Ped. Walking
— Ped. Standing
— Ped. Sitting

LOCATION 18.2

■ mean
□ GEM



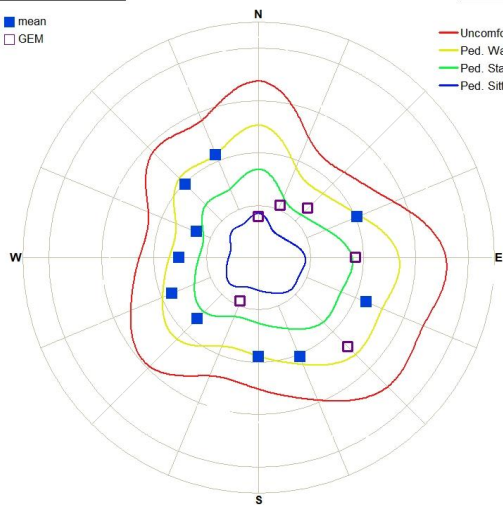
% of time in excess of wind speed V			
V (m/s)	MEAN	GEM	COMBINED
2	47.34	53.25	55.69
4	8.90	10.30	12.16
6	1.19	0.94	1.40
8	0.11	0.06	0.12
10	0.01	0.01	0.01

THRESHOLD

— Uncomfortable
— Ped. Walking
— Ped. Standing
— Ped. Sitting

LOCATION 18.3

■ mean
□ GEM



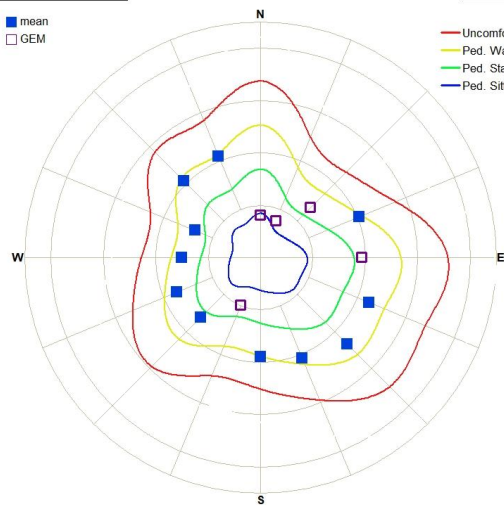
% of time in excess of wind speed V			
V (m/s)	MEAN	GEM	COMBINED
2	56.03	58.95	62.32
4	15.43	12.63	16.68
6	2.03	1.00	2.07
8	0.21	0.08	0.21
10	0.02	0.01	0.02

THRESHOLD

— Uncomfortable
— Ped. Walking
— Ped. Standing
— Ped. Sitting

LOCATION 18.4

■ mean
□ GEM



% of time in excess of wind speed V			
V (m/s)	MEAN	GEM	COMBINED
2	57.05	57.35	60.91
4	15.43	12.42	16.72
6	2.04	0.96	2.08
8	0.21	0.07	0.21
10	0.02	0.01	0.02

THRESHOLD

— Uncomfortable
— Ped. Walking
— Ped. Standing
— Ped. Sitting