FINAL REPORT

60 COLLINS STREET

MELBOURNE, VIC

PEDESTRIAN WIND STUDY
RWDI # 1903881
March 4, 2021

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EXECUTIVE SUMMARY

RWDI was retained to conduct a pedestrian wind assessment for the proposed development at 60 Collins Street in Melbourne, VIC. The pedestrian level wind microclimate assessment has been conducted for two configurations, namely the Existing and Proposed configurations, using the results from a boundary-layer wind tunnel test combined with historical meteorological wind records for the area. The meteorological data for the site indicates that the winds are predominantly from the north, with frequent winds also from the south - southwest throughout the year (although these tend to be lighter than the northerly winds). The results of the assessment were compared against the Melbourne Pedestrian Wind Criteria (C270). Following is a summary of the expected wind conditions assessed:

- Wind conditions at the existing site at grade level were comfortable for pedestrian use at the majority of measurement locations. Localised windy conditions occur along the footpaths at the intersection of Exhibition and Collins Street; and south of Exhibition Street which have the potential to affect the comfort and safety of pedestrians.
- The inclusion of the proposed development was found to result in a minimal impact to the surrounding wind conditions. For most locations, a slight reduction in the wind speeds on and around the site at grade, with the inclusion of the development, with sitting or standing conditions for the majority of areas. The number of locations which experience an exceedance of the wind safety criteria were found to reduce, however a slight increase in conditions were noted at Location 20, remaining a location which exceeds this criterion. On balance, it can be concluded that the impact of the new development on the local wind microclimate would generally be an improvement of the existing conditions.
- The wind conditions at the Level 9 terrace and roof were found to be comfortable for the intended pedestrian use throughout the year with no safety exceedance
- Windy conditions were found at Level 18, which would be uncomfortable for users of this space. Mitigation measures have been recommended within this report to improve the conditions in this area.

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1 INTRODUCTION

RWDI Australia was retained to conduct a pedestrian wind assessment for the proposed development at 60 Collins Street in Melbourne, VIC. This report presents the project objectives, discusses the results from RWDI's wind tunnel assessment and, where necessary, provide conceptual wind control measures.

1.1 Project Description

The project (site shown in Image 1) is bounded by Exhibition Street to the west, Little Collins street to the north and Collins street to the south. The existing site consists of a 73 m tall building which would be demolished and replaced with a 163.4m tall office building. The development would consist of an office tower with retail and entrance lobby at the grade level.

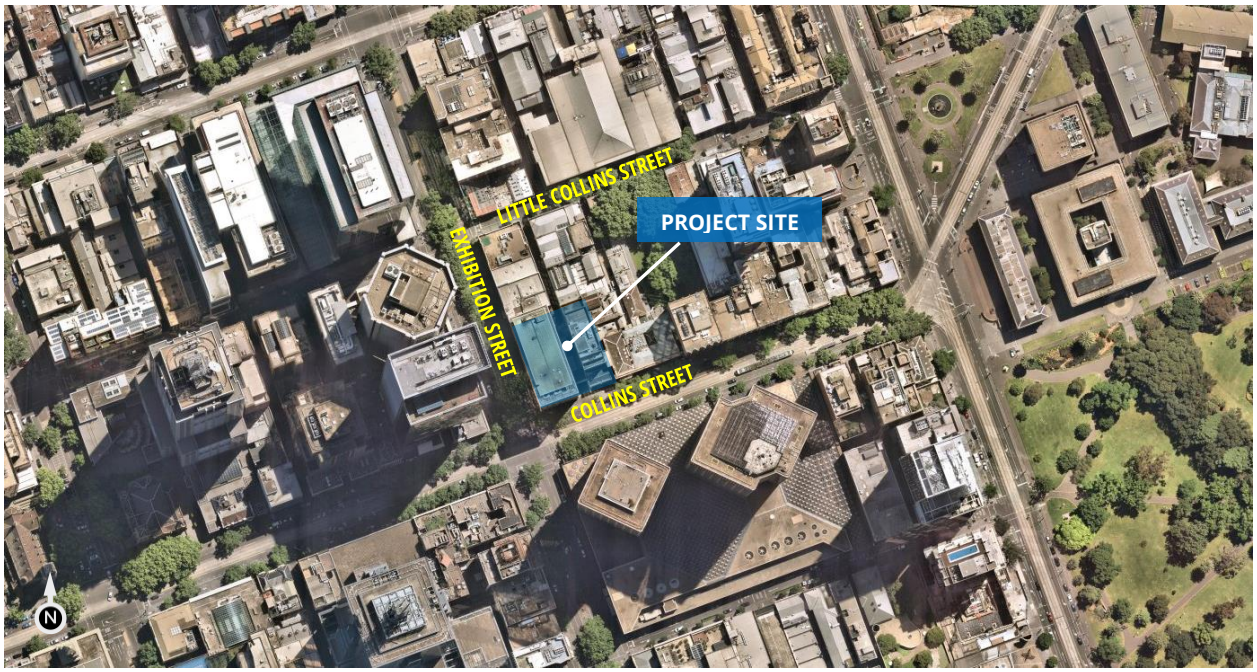


Image 1: Aerial View of Site and Surroundings (Photo Courtesy of Nearmap™)

1.2 Objectives

The objective of the study was to assess the effect of the proposed development on wind speeds in pedestrian areas and provide recommendations for minimising adverse effects, where needed. This quantitative assessment was based on wind speed measurements on a scale model of the building and its surroundings in one of RWDI's boundary-layer wind tunnels. These measurements were combined with the local wind records and compared to appropriate criteria for gauging wind comfort and safety in pedestrian areas. The assessment focused on critical pedestrian areas, including walkways and footpaths around the project Site, building entrances and amenity spaces

2 BACKGROUND AND APPROACH

2.1 Wind Tunnel Study Model

To assess the wind environment around the proposed development, a 1:400 scale model of the site and surroundings was constructed for the wind tunnel test of the following configurations:

Existing: Existing site with existing surrounding (image 2A), and

Proposed: Proposed development with existing surroundings (image 2B)

The wind tunnel model included all relevant surrounding buildings and topography within an approximately 480 m radius of the study site. The wind and turbulence profiles in the atmospheric boundary layer beyond the modelled area were also simulated in RWDI's wind tunnel. The wind tunnel model was instrumented with 50 specially designed wind speed sensors to measure mean and gust speeds at a full-scale height of approximately 1.5 m above local grade in pedestrian areas throughout the study site. Wind speeds were measured for 36 directions in a 10-degree increments. The measurements at each sensor location were recorded in the form of ratios of local mean and gust speeds to the mean wind speed at a reference height above the model. The placement of wind measurement locations was based on our experience and understanding of the pedestrian usage for this site and reviewed by the project team.

Image 2A: Wind Tunnel Study Model – Existing Configuration

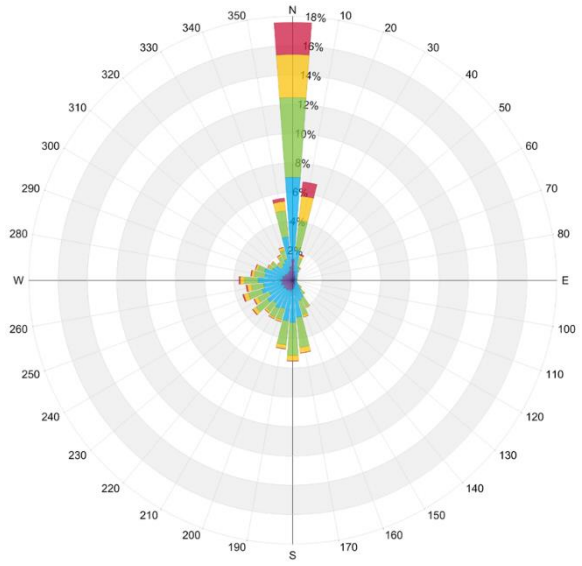
Image 2B: Wind Tunnel Study Model – Proposed Configuration

2.2 Meteorological Data

Wind statistics recorded at Melbourne Airport between 1998 and 2018, inclusive, were analysed on an annual basis. **Image 3** graphically depicts the directional distribution of wind frequencies and speeds.

Winds from the north are predominant and this direction accounts for most of the strongest wind events. Winds also occur from the south and southwest directions throughout the year, albeit with a lower frequency of occurrence compared to northerly winds, as indicated by the wind rose. Strong winds of a mean speed greater than 10 m/s measured at the airport (at an anemometer height of 10 m) occur for 10.7% of the time on an annual basis.

Wind statistics from Melbourne Airport were combined with the wind tunnel data in order to predict the frequency of occurrence of full-scale wind speeds. The full-scale wind predictions were then compared to criteria for pedestrian comfort and safety.



Wind Speed (m/s)	Probability (%)
Calm	1.6
1-3	18.6
4-6	44.0
7-9	25.1
10-12	8.2
>12	2.5

Image 3: Directional Distribution of Winds Approaching Melbourne Airport From 1998 to 2018

2.3 Melbourne Pedestrian Wind Criteria (C270)

The Melbourne pedestrian wind criteria (C270) were used as the basis of assessing pedestrian wind comfort in the current study. The comfort and safety conditions for this criterion are based on mean wind speeds (or gust-equivalent mean wind speed) and 3 second gust speeds, respectively. An annual exceedance of 20% of the time is considered for the mean wind speeds, while an annual exceedance of 0.1% of the time (approximately nine hours per year) is used for the gust speeds. Only gust speeds need to be considered in the wind safety criterion, these are rare events which deserve special attention in city planning and building design due to their potential safety impact on pedestrians.

It should be noted that the wind comfort criteria represent an average wind tolerance and can be subjective in a way that regional differences in wind climate and thermal conditions as well as variations in age, health, clothing, etc. can affect a person's perception of the wind climate. Therefore, comparisons of wind speeds for different Site and surrounding configurations are the most objective way of assessing the local pedestrian wind conditions.
Table 1 below summarises the Melbourne pedestrian wind criteria (C270):

Table 1: Wind Comfort Criteria (Melbourne Planning Scheme C270)

Comfort Category	Mean Wind Speed (m/s) 20% exceedance threshold
Comfortable for Sitting	≤ 3
Comfortable for Standing	3 - 4
Comfortable for Walking	4 - 5
Uncomfortable	> 5
Safety Criterion	**3-Second Gust Speed (m/s) 0.1% exceedance threshold**
Exceeded	> 20

3 RESULTS AND DISCUSSION

The predicted wind conditions are shown on site plans in Figures 1A through 2B located in the "Figures" section of this report. These conditions and the associated wind speeds are represented in Table A1, located in the "Tables" section of this report. The following is a detailed discussion of the suitability of the predicted wind conditions for the anticipated pedestrian use of each area of interest.

In the discussion of the anticipated wind conditions, references will be made to the following generalised wind flow patterns. If these building/wind combinations occur for prevailing winds, there is a greater potential for windy conditions to occur.

- Tall buildings tend to intercept the stronger winds at higher elevations and redirect them to the ground level which is called down washing (Image 4a)
- When winds approach at an oblique angle to a tall façade and are deflected down, a localised increase in the wind activity, or corner acceleration, can be expected around the exposed building corners at pedestrian level (Image 4b)

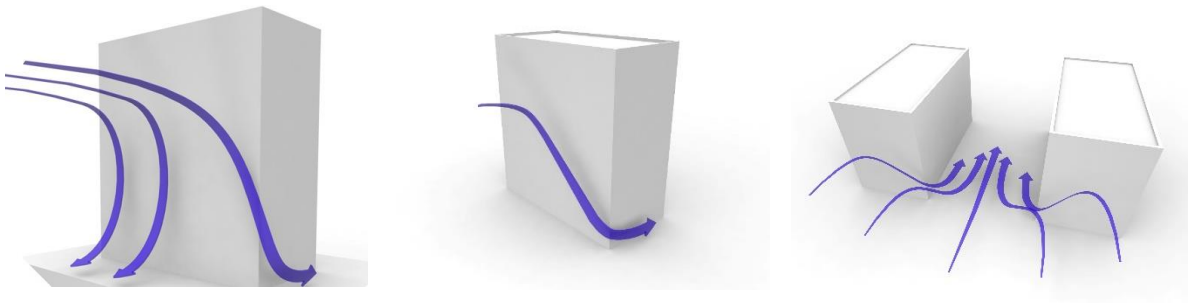


Image 4: General Wind Flow patterns: (a) Down washing and (b) Corner Acceleration (c) Channelling

The following is a detailed discussion of the suitability of the predicted wind comfort conditions for the anticipated pedestrian use of each areas of interest.

3.1 Wind Comfort - Grade Level (Locations 1 through 42)

Wind conditions comfortable for walking are appropriate for footpaths, walkways and service lanes as pedestrians will be active and less likely to remain in one area for prolonged periods of time. Lower wind speeds conducive to standing are preferred at main entrances where pedestrians are likely to linger. Wind speeds comfortable for sitting are preferred for areas intended for passive activities.

3.1.1 Existing Configuration

The wind speeds around the site are comfortable for sitting or standing use at the majority of the probe locations. Wind speeds suitable for walking use occur at a localised off-site areas like including the intersection of Exhibition Street and Collins Street (Locations 13 and 24 in Figure 1A) and south of Exhibition Street (Location 16 in Figure 1A) due to the exposure to the prevailing winds and interaction with the existing built forms. The walking conditions in these areas would typically be appropriate as pedestrians will be active along footpaths

and less likely to remain in one area for a prolonged period. However, we would note that the gusty conditions in Locations 13 and 16 exceed the criterion for pedestrian safety as noted below.

The wind speeds assessed at the grade level were found to exceed the safety criterion at three off-site locations, namely Locations 13, 16 and 20 as shown in Figure 2A. Exceedance of this criterion indicates that pedestrians in these localised areas would be subjected to high-speed gusts during the windier times of the year.

3.1.2 Proposed Configuration

With the incorporation of the proposed development on the site in the surroundings, wind speeds would be similar, or in some cases slightly reduced compared to the current existing conditions and would be comfortable for sitting or standing use in the majority of areas. Isolated walking conditions were noted at the intersection of Exhibition Street and Collins Street (Locations 13 and 24 as in Figure 1B), which is unchanged from the existing conditions and hence would remain appropriate for active pedestrians along footpaths. The presence of existing landscaping along the streets would likely reduce the wind speeds in these areas. Wind speeds at the main entrances to the proposed development (Locations 1, 4 and 6 as shown in Figure 1B) would be suitable for the intended pedestrian use with conditions comfortable for sitting or standing throughout the year.

The wind speeds assessed at the grade level were found to exceed the safety criterion at Location 20. The conditions in this area are noted to currently exceed the safety criterion due to the existing built form with minimal difference between the configurations, hence can conclude that the new development would not have a materially adverse impact. Any consideration to improve the existing windy conditions (through the development of a landscaping strategy) would be beneficial to pedestrians in these areas, and be applicable for the future wind conditions. Appropriate strategies could include street art or porous screens in the locations nearby to the existing planter boxes in this location.

The Melbourne Club Gardens located to the north-east of the site off Little Collins Street are expected to not be affected by the inclusion of the subject development. Locations 40 and 41 which are located along the northern aspect of the gardens on Little Collins Street, indicate that the wind conditions will be slightly improved with the inclusion of the development, compared to the current conditions. The conditions at these locations are noted to satisfy the sitting criteria. Conditions throughout the gardens are expected to be of similar nature and also further benefit from the significant tree planting in this location.

The existing strong winds at Locations 13 and 24 are noted to be improved with the inclusion of the new development, such that the conditions in these areas will no longer exceed the safety criterion.

3.2 Above-Grade Levels (Locations 43 through 50)

It is generally desirable for wind conditions at amenity spaces intended for passive activities to be suitable for sitting or standing use more than 80% of the time during appropriate weather conditions. The proposed development has amenity spaces at multiple terrace levels – Level 9 (Locations 43 and 44), Level 18 (Locations 45 – 48) and the rooftop (Locations 49 – 50).

The wind conditions on all the amenity spaces at Level 9 and on the rooftop would be comfortable for sitting and standing conditions which are appropriate for the intended pedestrian use. However, uncomfortable and walking wind conditions were found on the Level 18 terrace, at Locations 46 and 48 respectively. These conditions would be considered too windy for passive pedestrian activity, as was found to be due to the channelling of the south-southwest winds. The standing conditions (Location 45) found in the north-western corner are likely to be acceptable as a slight breeze is always welcome but would be slightly too windy for long-term outdoor seating. If intended for seating areas further measures are required. The terrace design currently includes 1.8m balustrades and a 2.5m solid canopy. We recommend the design be updated to include vertical partition screens and/or the addition of landscaping in planters with an overall height of 2m be introduced to help block and break up these noted wind conditions on the terrace.

There was no exceedance of the safety criterion at any of the measured terrace locations.

4 APPLICABILITY OF RESULTS

The drawings and information listed below were received from Bates Smart and were used to construct the scale model of the proposed development located at 60 Collins Street in Melbourne. The wind conditions presented in this report pertain to the proposed design of the development as detailed in the architectural design drawings listed in the table below. Should there be any design changes that deviate from this list of drawings, the wind condition predictions presented may change. Therefore, if changes in the design are made, it is recommended that RWDI be contacted and requested to review their potential effects on wind conditions.

File Name	File Type	Date Received (dd/mm/yyyy)
201218_52-60_Collins_Proposed_3D_Model	.3dm (Rhino)	18/12/2020

5 REFERENCES

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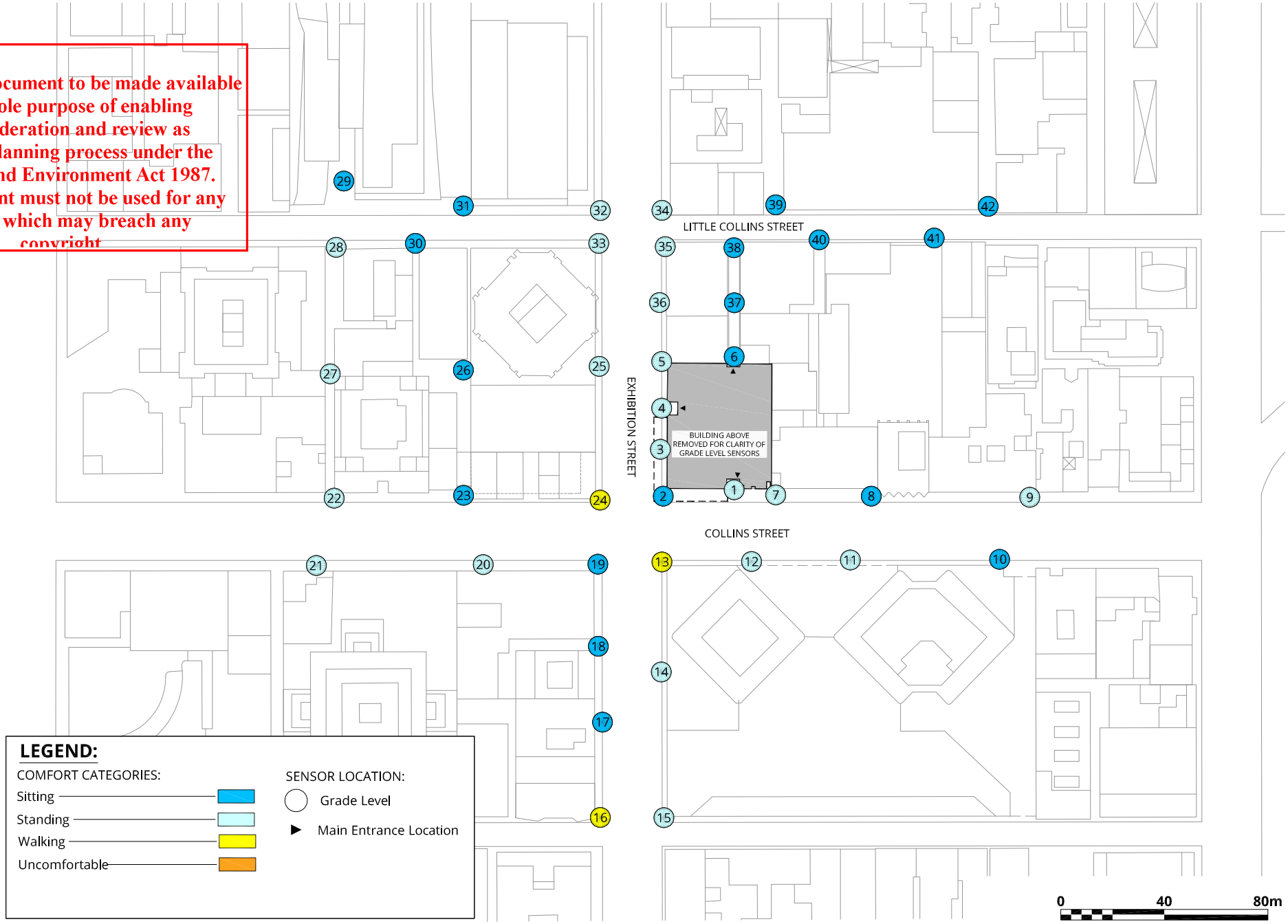
FIGURES



Pedestrian Wind Comfort Conditions
Existing Configuration
Annual (January to December, 0:00 to 23:00)

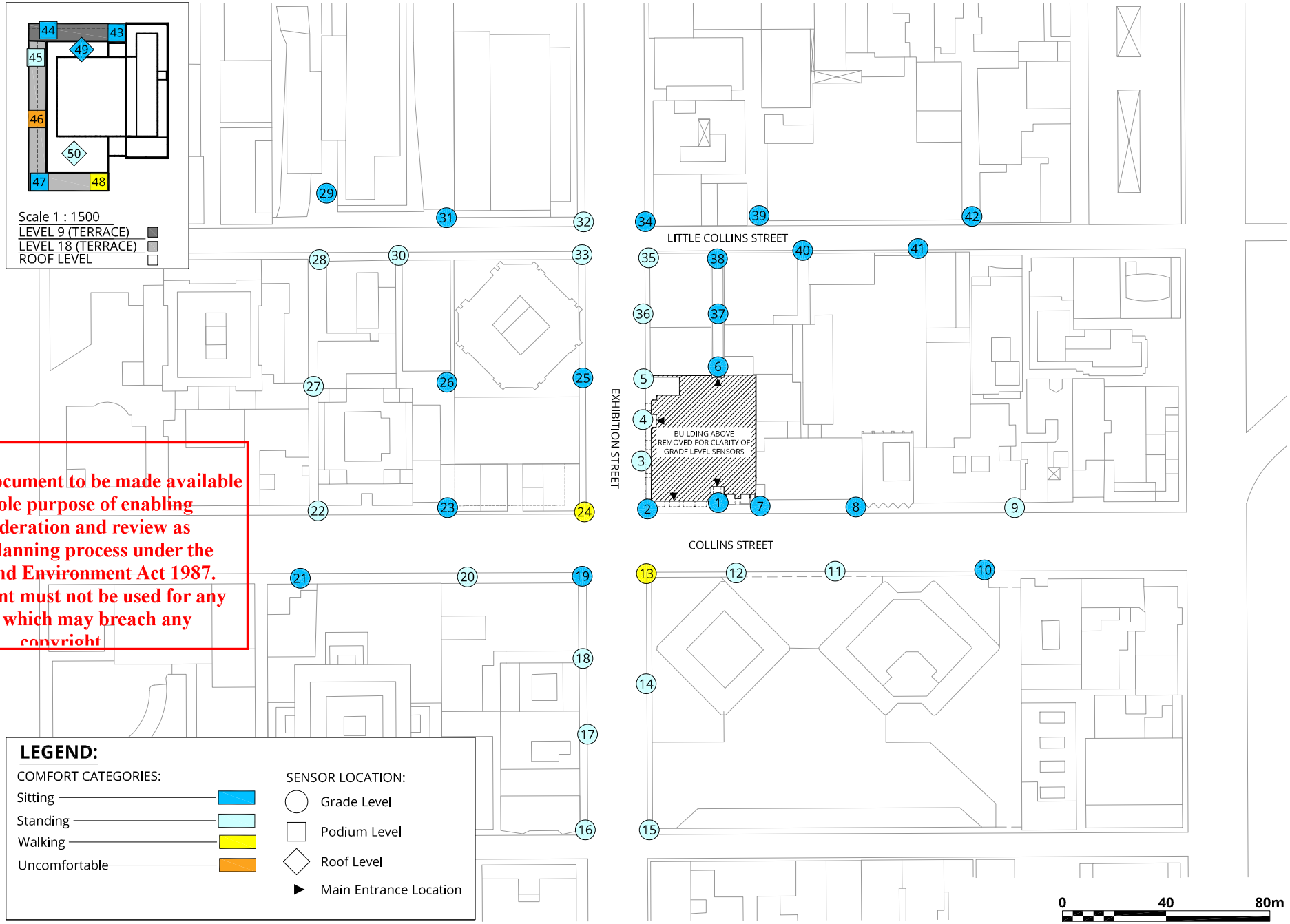
60 Collins Street - Melbourne, VIC

ADVERTISED PLAN

True North

Project #1903881

Drawn by:	AFR	Figure:	1A
Approx. Scale:	1:2000		
Date Revised:	Aug. 7, 2019		



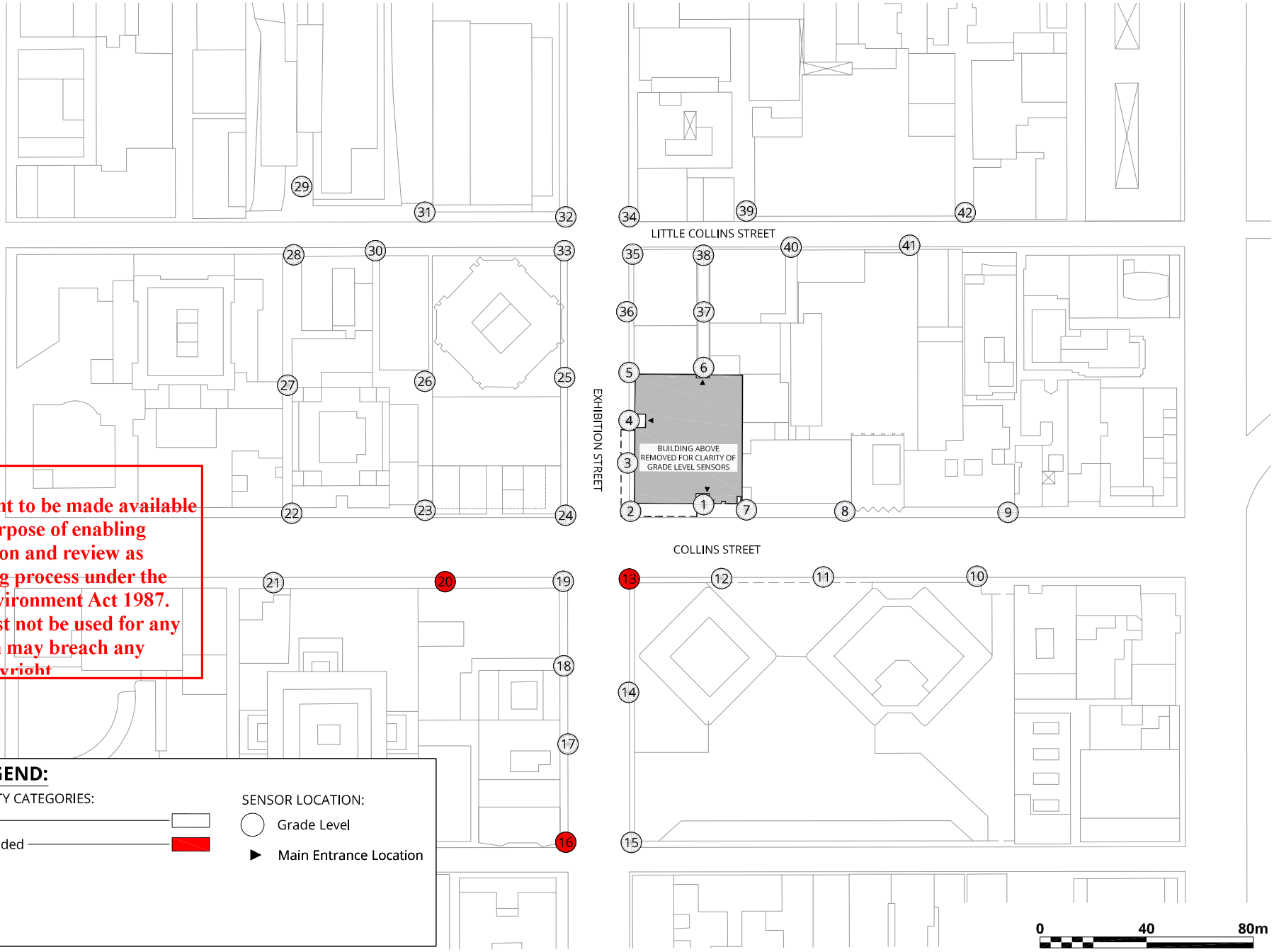
Pedestrian Wind Comfort Conditions
Proposed Configuration
Annual (January to December, 0:00 to 23:00)

60 Collins Street - Melbourne, VIC

True North

Project #1903881

Drawn by:	SSU	Figure:	1B
Approx. Scale:	1:2000		
Date Revised:	Jan. 27, 2021		



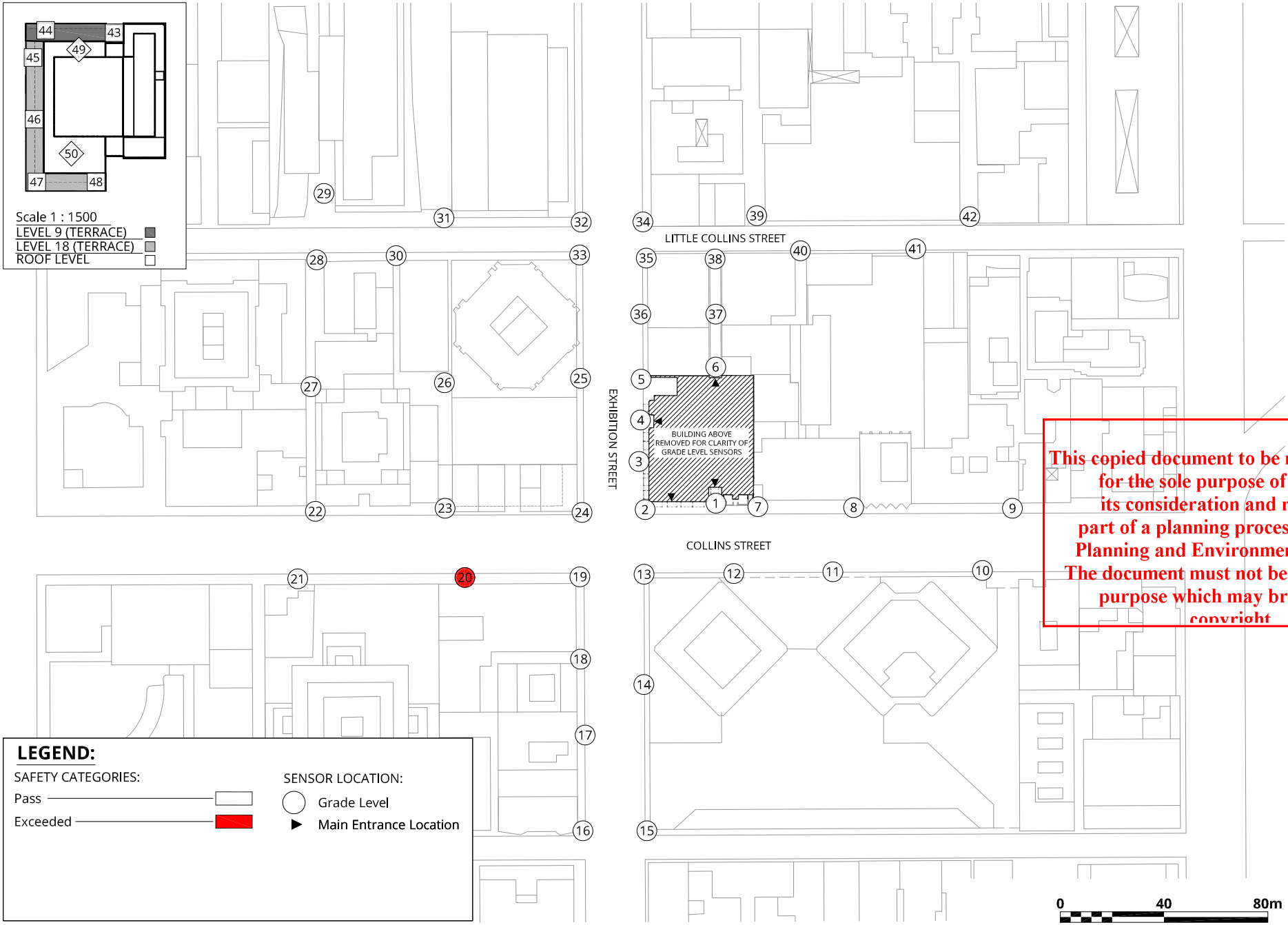
Pedestrian Wind Safety Conditions
Existing Configuration
Annual (January to December, 0:00 to 23:00)

60 Collins Street - Melbourne, VIC

True North

Project #1903881

Drawn by:	AFR	Figure:	2A
Approx. Scale:	1:2000		
Date Revised:	Aug. 7, 2019		



Pedestrian Wind Comfort Conditions
Proposed Configuration
Annual (January to December, 0:00 to 23:00)

60 Collins Street - Melbourne, VIC

True North

Project #1903881

Drawn by: SSU	Figure: 2B
Approx. Scale:	1:2000
Date Revised:	Jan. 27, 2021

TABLES

Table A1: Pedestrian Wind Comfort and Safety Conditions

Location	Season	Configuration	Wind Comfort		Wind Safety	
			Speed (m/s)	Rating	Speed (m/s)	Rating
1	Annual	Existing	3.4	Standing	16.1	Pass
		Proposed	3.0	Sitting	11.4	Pass
2	Annual	Existing	2.6	Sitting	12.8	Pass
		Proposed	2.9	Sitting	12.8	Pass
3	Annual	Existing	3.6	Standing	14.0	Pass
		Proposed	3.6	Standing	14.2	Pass
4	Annual	Existing	3.9	Standing	15.1	Pass
		Proposed	3.6	Standing	14.4	Pass
5	Annual	Existing	3.6	Standing	15.5	Pass
		Proposed	3.3	Standing	14.6	Pass
6	Annual	Existing	1.1	Sitting	7.2	Pass
		Proposed	1.6	Sitting	7.9	Pass
7	Annual	Existing	3.8	Standing	15.5	Pass
		Proposed	2.8	Sitting	13.9	Pass
8	Annual	Existing	2.6	Sitting	12.5	Pass
		Proposed	2.7	Sitting	12.1	Pass
9	Annual	Existing	3.1	Standing	17.4	Pass
		Proposed	3.5	Standing	16.4	Pass
10	Annual	Existing	2.8	Sitting	18.3	Pass
		Proposed	2.9	Sitting	17.1	Pass
11	Annual	Existing	3.1	Standing	15.6	Pass
		Proposed	3.7	Standing	16.7	Pass
12	Annual	Existing	3.4	Standing	15.4	Pass
		Proposed	3.8	Standing	16.9	Pass
13	Annual	Existing	4.7	Walking	21.5	Exceeded
		Proposed	4.7	Walking	19.1	Pass
14	Annual	Existing	4.0	Standing	16.7	Pass
		Proposed	3.7	Standing	14.8	Pass
15	Annual	Existing	3.5	Standing	16.4	Pass
		Proposed	3.3	Standing	14.7	Pass
16	Annual	Existing	4.5	Walking	20.5	Exceeded
		Proposed	3.6	Standing	16.9	Pass
17	Annual	Existing	2.9	Sitting	17.4	Pass
		Proposed	3.1	Standing	17.7	Pass
18	Annual	Existing	2.9	Sitting	15.8	Pass
		Proposed	3.4	Standing	18.8	Pass
19	Annual	Existing	2.5	Sitting	16.0	Pass
		Proposed	2.9	Sitting	14.2	Pass

20	Annual	Existing	3.7	Standing	20.3	Exceeded
		Proposed	3.8	Standing	22.3	Exceeded
21	Annual	Existing	3.1	Standing	16.5	Pass
		Proposed	2.8	Sitting	13.9	Pass
22	Annual	Existing	3.1	Standing	14.0	Pass
		Proposed	3.3	Standing	13.7	Pass
23	Annual	Existing	2.4	Sitting	12.0	Pass
		Proposed	2.7	Sitting	11.8	Pass
24	Annual	Existing	4.4	Walking	18.3	Pass
		Proposed	4.6	Walking	17.9	Pass
25	Annual	Existing	3.1	Standing	15.7	Pass
		Proposed	3.0	Sitting	16.4	Pass
26	Annual	Existing	1.3	Sitting	7.5	Pass
		Proposed	1.8	Sitting	8.9	Pass
27	Annual	Existing	3.4	Standing	11.7	Pass
		Proposed	3.3	Standing	11.4	Pass
28	Annual	Existing	3.2	Standing	14.1	Pass
		Proposed	3.3	Standing	15.8	Pass
29	Annual	Existing	2.3	Sitting	14.3	Pass
		Proposed	2.0	Sitting	13.9	Pass
30	Annual	Existing	2.9	Sitting	13.8	Pass
		Proposed	3.1	Standing	14.7	Pass
31	Annual	Existing	2.8	Sitting	15.3	Pass
		Proposed	2.8	Sitting	14.5	Pass
32	Annual	Existing	3.1	Standing	16.1	Pass
		Proposed	3.4	Standing	16.0	Pass
33	Annual	Existing	3.2	Standing	16.8	Pass
		Proposed	3.6	Standing	17.2	Pass
34	Annual	Existing	3.2	Standing	13.9	Pass
		Proposed	3.0	Sitting	13.0	Pass
35	Annual	Existing	3.5	Standing	13.7	Pass
		Proposed	3.3	Standing	12.8	Pass
36	Annual	Existing	3.5	Standing	15.1	Pass
		Proposed	3.4	Standing	14.5	Pass
37	Annual	Existing	1.6	Sitting	14.5	Pass
		Proposed	1.8	Sitting	13.0	Pass
38	Annual	Existing	2.3	Sitting	17.3	Pass
		Proposed	2.7	Sitting	17.8	Pass
39	Annual	Existing	2.3	Sitting	11.8	Pass
		Proposed	2.1	Sitting	9.1	Pass
40	Annual	Existing	2.1	Sitting	12.9	Pass
		Proposed	1.9	Sitting	10.3	Pass
41	Annual	Existing	2.3	Sitting	16.1	Pass
		Proposed	2.1	Sitting	14.6	Pass
42	Annual	Existing	1.8	Sitting	13.0	Pass
		Proposed	1.8	Sitting	10.6	Pass

43	Annual	Existing	-	N/A	-	N/A
		Proposed	1.9	Sitting	11.7	Pass
44	Annual	Existing	-	N/A	-	N/A
		Proposed	2.2	Sitting	15.7	Pass
45	Annual	Existing	-	N/A	-	N/A
		Proposed	3.9	Standing	14.4	Pass
46	Annual	Existing	-	N/A	-	N/A
		Proposed	5.1	Uncomfortable	19.9	Pass
47	Annual	Existing	-	N/A	-	N/A
		Proposed	3.0	Sitting	12.0	Pass
48	Annual	Existing	-	N/A	-	N/A
		Proposed	4.1	Walking	15.9	Pass
49	Annual	Existing	-	N/A	-	N/A
		Proposed	1.9	Sitting	11.2	Pass
50	Annual	Existing	-	N/A	-	N/A
		Proposed	3.2	Standing	14.8	Pass

Seasons	Months	Hours	Wind Comfort Speed (m/s)		Wind Safety Speed (m/s)	
Annual	January - December	0:00 - 23:00 for safety	≤ 3	Sitting	≤ 20	Pass
			≤ 4	Standing	> 20	Exceeded
			≤ 5	Walking		
			> 5	Uncomfortable		