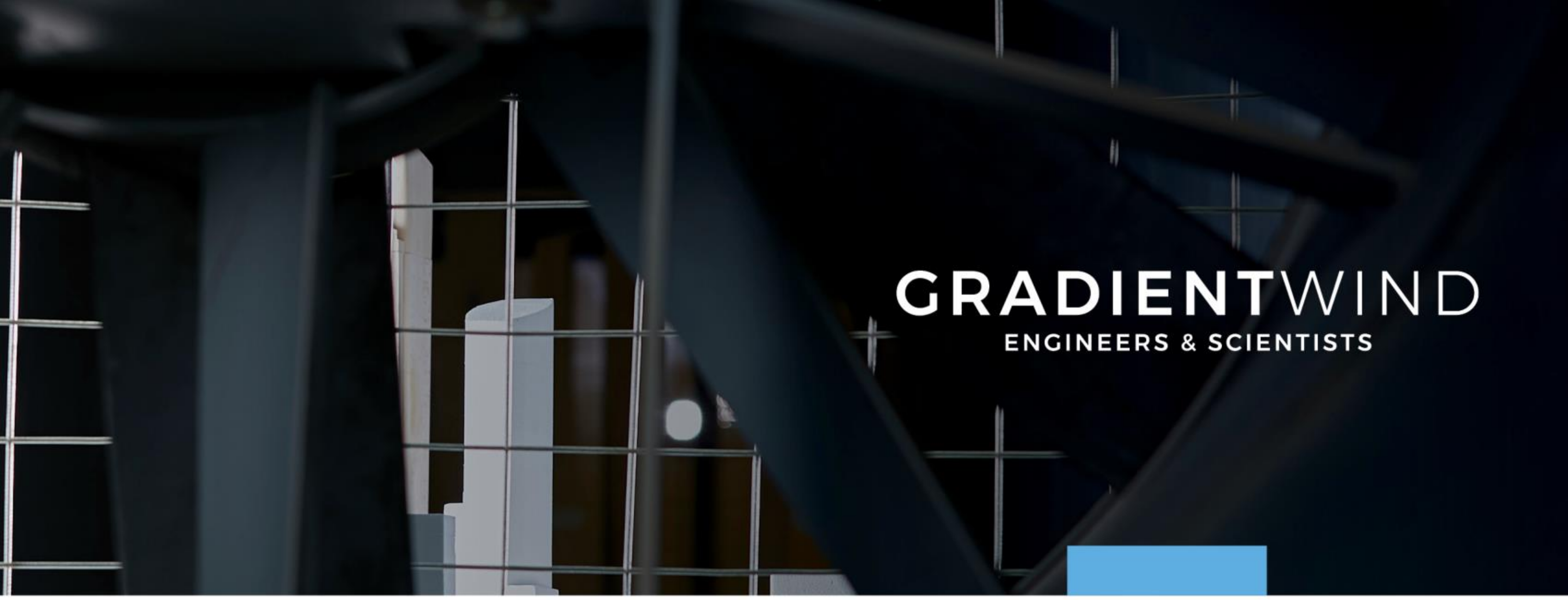
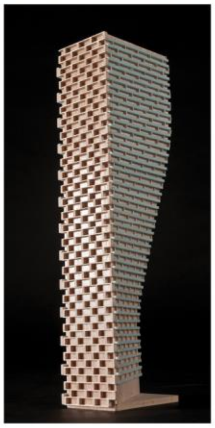


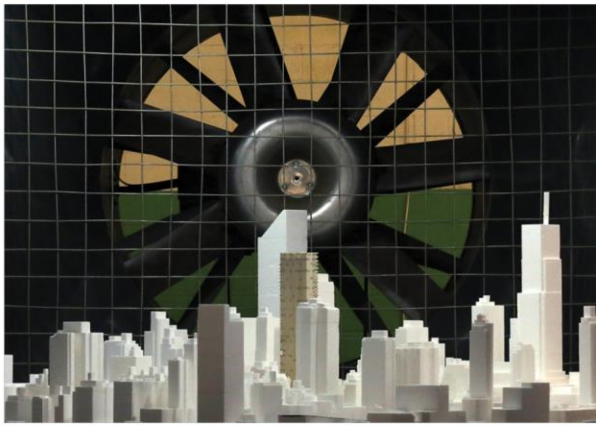
GRADIENTWIND
ENGINEERS & SCIENTISTS

PEDESTRIAN LEVEL WIND STUDY

4099 Erin Mills Parkway
Mississauga, Ontario

REPORT: GWE22-008-WTPLW





August 30, 2022

PREPARED FOR
Queenscorp (Erin Mills) Inc.
2 Queen Elizabeth Boulevard
Toronto, Ontario
M8Z 1L8

PREPARED BY
Patrick Shorey, B.A.Sc., EIT, Junior Wind Scientist
Nick Petersen, P.Eng., Wind Engineer

EXECUTIVE SUMMARY

This report describes a pedestrian level wind study undertaken to assess wind conditions for a proposed mixed-use, multi-building development located at 4099 Erin Mills Parkway in Mississauga, Ontario. The study involves wind tunnel measurements of pedestrian wind speeds using a physical scale model, combined with meteorological data integration, to assess pedestrian comfort at key areas within and surrounding the study site. Grade-level areas investigated include sidewalks, walkways, laneways, parking areas, landscaped spaces, outdoor amenity areas, public transit stops, and building access points. Wind comfort is also evaluated over the larger elevated terraces belonging to Buildings A, B, D, and E. To evaluate the influence of the proposed development on the existing wind conditions surrounding the site, two massing configurations were studied: (i) existing conditions without the proposed development, and (ii) conditions with the proposed development in place. The results and recommendations derived from these considerations are summarized in the following paragraphs and detailed in the subsequent report.

Our work is based on industry standard wind tunnel testing and data analysis procedures, City of Mississauga wind criteria, architectural drawings provided by Turner Fleischer Architects Inc. in May 2022 and updated in August 2022, surrounding street layouts, as well as existing and approved future building massing information and recent site imagery.

A complete summary of the predicted wind conditions is provided in Section 5.2 of this report, and is also illustrated in Figures 2A-3B, as well as Tables A1-A5 and B1-B6 in the appendices. Based on wind tunnel test results, meteorological data analysis, and experience with similar developments in Mississauga, we conclude that conditions over most pedestrian-sensitive areas within and surrounding the development site will be acceptable for the intended pedestrian uses on an annual and seasonal basis. Exceptions are lobby entrances at the northwest corner of Building A, and the internal east elevation of Building C. To ensure these locations are comfortable for standing or better throughout the year, mitigation is recommended, as described in Section 5.2. Over the elevated terraces, conditions will be comfortable for sitting or more sedentary activities throughout the summer months, without mitigation.

A comparison of the existing versus future wind comfort surrounding the study site indicates that the proposed development will have a mixed impact, favouring a reduction in windspeeds. To the north, over sidewalks along Folkway Drive, and the landscaped space to the northeast, wind comfort is generally

unchanged. Reductions in wind comfort are noted over sidewalks to the northeast along Folkway Drive and Sawmill Valley Drive, while improvements are concentrated over sidewalks to the south and west, inclusive of the northbound Erin Mills Parkway transit stop. Where wind comfort is reduced, conditions nevertheless remain acceptable for the intended uses.

Within the context of typical weather patterns, which exclude anomalous localized storm events such as tornadoes and downbursts, no areas over the study site were found to experience conditions too windy for walking, or that could be considered unsafe.

TABLE OF CONTENTS

1. INTRODUCTION

This report describes a pedestrian level wind study undertaken to assess wind conditions for a proposed mixed-use, multi-building development located at 4099 Erin Mills Parkway in Mississauga, Ontario. The study was performed in accordance with industry standard wind tunnel testing techniques, City of Mississauga wind criteria, architectural drawings provided by Turner Fleischer Architects Inc. in May 2022 and updated in August 2022, surrounding street layouts and existing and approved future building massing information, as well as recent site imagery.

2. TERMS OF REFERENCE

The focus of this pedestrian wind study is the proposed mixed-use, multi-building development located at 4099 Erin Mills Parkway in Mississauga, Ontario. With respect to project north, the study site is situated along the south side of Folkway Drive, between Sawmill Valley Drive to the east, and Erin Mills Parkway to the west.

The development comprises Buildings A-E and seven blocks of townhouses. Buildings A (10-storeys) and B (six-storeys) are L-shaped, located along the northwest and northeast corners of the site, respectively. Along the east and south ends of the site are located three and four blocks of four-storey townhouses, respectively, and to the west is Building D (8-storeys). Within the interior of the site, encircled by an interior driveway, Buildings C and E (6-storeys) are arranged to the north and south, with an outdoor amenity located between them. A walkway passes north-south through Building C.

At grade, retail space is located at the south end of Building A and the north end of Building D, with the remaining floorspace occupied by a mix of indoor amenity use, residential units, and residential lobbies. Lobby entrances are located at the northwest corner and internal east elevation of Building A, east and internal west elevations of Building B, north and internal east elevations of Building C, west and east elevations of Building D, and the north and south elevations of Building E. Levels above grade contain residential occupancy. Setbacks accommodate private terraces at Levels 5, 6, 7, and 9, with larger terraces located at Level 5 at the south and east ends of Buildings B and E, respectively, at Level 7 at the south ends of Buildings A and D, and at Level 9 at the east end of Building A. Above each building, setbacks at the rooftop level meet a mechanical penthouse.

Regarding wind exposures, the near-field surroundings of the development (defined as an area falling within a 200-metre radius of the site) are characterized by low-rise suburban buildings in all directions. The far-field surroundings (defined as the area beyond the near field and within a two-kilometer radius) are predominantly a continuation of the nearfield, comprising suburban exposure in all directions.

Grade-level areas investigated include sidewalks, walkways, laneways, parking areas, landscaped spaces, outdoor amenity areas, public transit stops, and building access points. Wind comfort is also evaluated over the larger elevated terraces belonging to Buildings A, B, D, and E. Figures 1A and 1B illustrate the study site and surrounding context for the existing and future test scenarios, respectively, and Photographs 1 through 6 depict the wind tunnel model used to conduct the study.

3. OBJECTIVES

Conforming to the *City of Mississauga Urban Design Terms of Reference, Wind Comfort and Safety Studies*, the principal objectives of this study are to (i) determine pedestrian level wind comfort and safety conditions at key areas within and surrounding the development site; (ii) identify areas where wind conditions may interfere with the intended uses of outdoor spaces; (iii) recommend suitable mitigation measures, where required; and (iv) evaluate the influence of the proposed development on the existing wind conditions surrounding the site.

4. METHODOLOGY

The approach followed to quantify pedestrian wind conditions over the site is based on wind tunnel measurements of wind speeds at selected locations on a reduced-scale physical model, meteorological analysis of the Mississauga area wind climate and synthesis of wind tunnel data with industry-accepted guidelines[1]. The following sections describe the analysis procedures, including a discussion of the pedestrian comfort and safety guidelines.

4.1 Wind Tunnel Context Modelling

A detailed PLW study is performed to determine the influence of local winds at the pedestrian level for a proposed development. The physical model of the proposed development and relevant surroundings,

[1] City of Mississauga Urban Design Terms of Reference, Wind Comfort and Safety Studies, June 2014

illustrated in Photographs 1 through 6 following the main text, was constructed at a scale of 1:400. The wind tunnel model includes all existing buildings and approved future developments within a full-scale diameter of approximately 840 metres. The general concept and approach to wind tunnel modelling is to provide building and topographic detail in the immediate vicinity of the study site on the surrounding model, and to rely on a length of wind tunnel upwind of the model to develop wind properties consistent with known turbulent intensity profiles that represent the surrounding terrain.

An industry standard practice is to omit trees, vegetation, and other existing and planned landscape elements from the wind tunnel model due to the difficulty of providing accurate seasonal representation of vegetation. The omission of trees and other landscaping elements produces slightly more conservative wind speed values.

4.2 Wind Speed Measurements

The PLW study was performed by testing a total of 158 sensor locations on the scale model in Gradient Wind's wind tunnel. Of these 158 sensors, 148 were located at grade and the remaining ten sensors were located over various elevated terraces. Wind speed measurements were performed for each of the 158 sensors for 36 wind directions at 10° intervals. Figures 1A and 1B illustrate a plan of the site and relevant surrounding context for the existing and future test scenarios, respectively, while sensor locations used to investigate wind conditions are illustrated in Figures 2A through 3B.

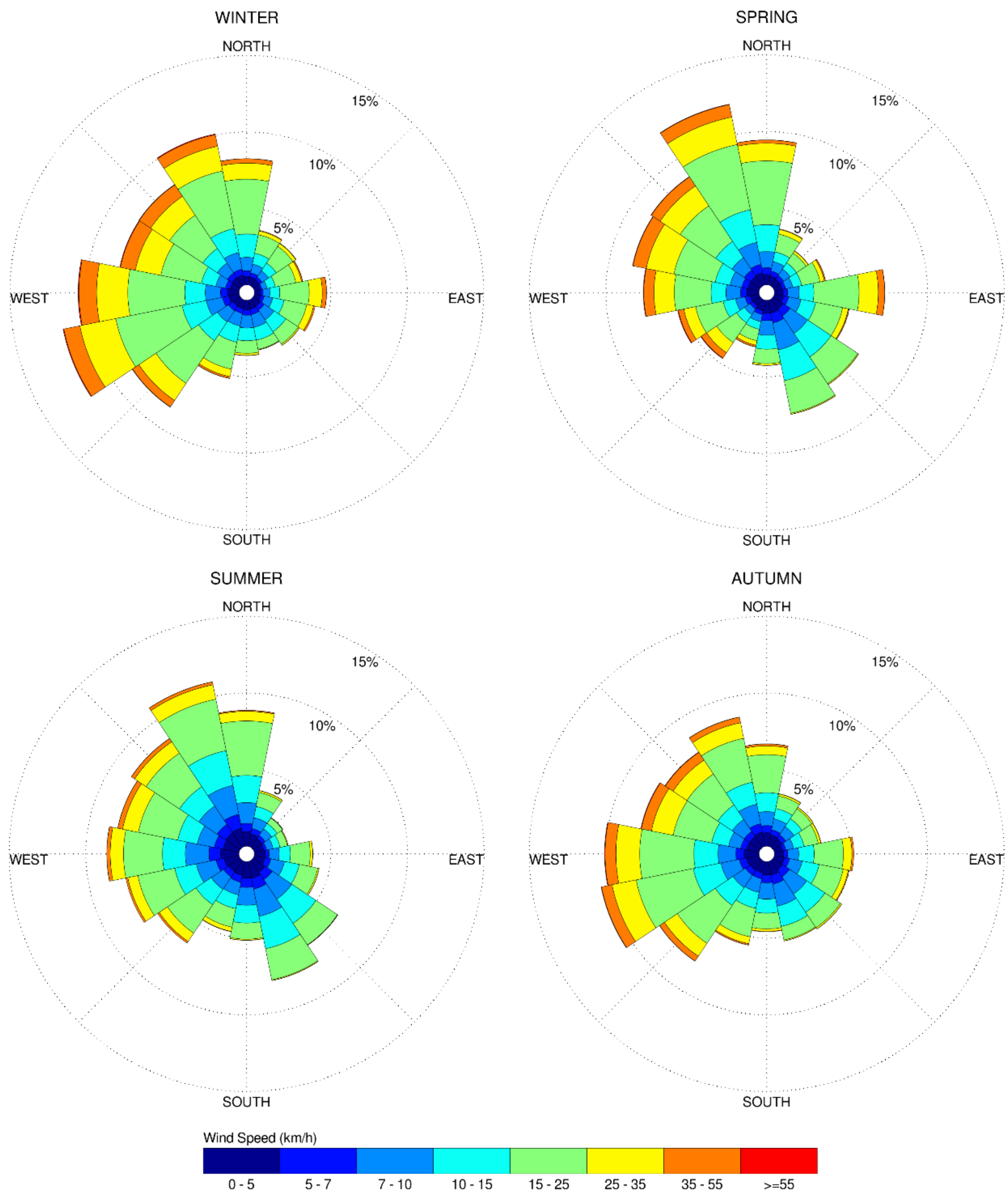
Mean and peak wind speed values for each location and wind direction were calculated from real-time pressure measurements, recorded at a sample rate of 500 samples per second, and taken over a 60-second time period. This period at model-scale corresponds approximately to one hour in full-scale, which matches the time frame of full-scale meteorological observations. Measured mean and gust wind speeds at grade were referenced to the wind speed measured near the ceiling of the wind tunnel to generate mean and peak wind speed ratios. Ceiling height in the wind tunnel represents the depth of the boundary layer of wind flowing over the earth's surface, referred to as the gradient height. Within this boundary layer, mean wind speed increases up to the gradient height and remains constant thereafter. Appendices C and D provide greater detail of the theory behind wind speed measurements. Wind tunnel measurements for this project, conducted in Gradient Wind's wind tunnel facility, meet or exceed guidelines found in the National Building Code of Canada 2015 and of 'Wind Tunnel Studies of Buildings and Structures', ASCE Manual 7 Reports on Engineering Practice No 67.

4.3 Meteorological Data Analysis

A statistical model for winds in Mississauga was developed from approximately 50-years of hourly meteorological wind data recorded at Pearson International Airport, and obtained from the local branch of Atmospheric Environment Services of Environment Canada. Wind speed and direction data were analyzed for each month of the year in order to determine the statistically prominent wind directions and corresponding speeds, and to characterize similarities between monthly weather patterns. Based on this portion of the analysis, the four seasons are represented by grouping data from consecutive months based on similarity of weather patterns, and not according to the traditional calendar method.

The statistical model of the Mississauga area wind climate, which indicates the directional character of local winds on a seasonal basis, is illustrated on the following page. The plots illustrate seasonal distribution of measured wind speeds and directions in km/h. Probabilities of occurrence of different wind speeds are represented as stacked polar bars in sixteen azimuth divisions. The radial direction represents the percentage of time for various wind speed ranges per wind direction during the measurement period. The preferred wind speeds and directions can be identified by the longer length of the bars. For Toronto, the most common winds concerning pedestrian comfort occur from the southwest clockwise to the north, as well as those from the east. The directional preference and relative magnitude of the wind speed varies somewhat from season to season, with the summer months displaying the calmest winds relative to the remaining seasonal periods.

SEASONAL DISTRIBUTION OF WINDS FOR VARIOUS PROBABILITIES
PEARSON INTERNATIONAL AIRPORT, TORONTO, ONTARIO



Notes:

1. Radial distances indicate percentage of time of wind events.
2. Wind speeds are mean hourly in km/h, measured at 10 m above the ground.

4.4 Pedestrian Comfort and Safety Guidelines

Pedestrian comfort and safety guidelines are based on the mechanical effects of wind without consideration of other meteorological conditions (i.e. temperature, relative humidity). The comfort guidelines assume that pedestrians are appropriately dressed for a specified outdoor activity during any given season. Since both mean and gust wind speeds affect pedestrian comfort, their combined effect is defined in the City of Mississauga Urban Design Terms of Reference[1]. More specifically, the criteria are defined as a Gust Equivalent Mean (GEM) wind speed, which is the greater of the mean wind speed or the gust wind speed divided by 1.85. The wind speed ranges are selected based on 'The Beaufort Scale' (presented on the following page), which describes the effects of forces produced by varying wind speed levels on objects.

Four pedestrian comfort classes and corresponding GEM wind speed ranges are used to assess pedestrian comfort, which include: (i) Sitting; (ii) Standing; (iii) Walking; and (iv) Uncomfortable. More specifically, the comfort classes, wind speed ranges, and limiting criteria are summarized as follows:

(i) **Sitting** – GEM wind speeds below 10 km/h occurring more than 80% of the time would be considered acceptable for sedentary activities, including sitting.

(ii) **Standing** – GEM wind speeds below 15 km/h (i.e. 10-15 km/h) occurring more than 80% of the time are acceptable for activities such as standing, strolling or more vigorous activities.

(iii) **Walking** – GEM wind speeds below 20 km/h (i.e. 15-20 km/h) occurring more than 80% of the time are acceptable for walking or more vigorous activities.

(iv) **Uncomfortable** – Uncomfortable conditions are characterized by predicted values that fall below the 80% criterion for walking. Brisk walking and exercise, such as jogging, would be acceptable for moderate excesses of this criterion.

Gust wind speeds greater than 90 km/h, occurring more than 0.1% of the time on an annual basis, are classified as dangerous. From calculations of stability, it can be shown that gust wind speeds of 90 km/h would be the approximate threshold wind speed that would cause a vulnerable member of the population to fall.

THE BEAUFORT SCALE

NUMBER	DESCRIPTION	WIND SPEED (KM/H)	DESCRIPTION
2	Light Breeze	4-8	Wind felt on faces
3	Gentle Breeze	8-15	Leaves and small twigs in constant motion; Wind extends light flags
4	Moderate Breeze	15-22	Wind raises dust and loose paper; Small branches are moved
5	Fresh Breeze	22-30	Small trees in leaf begin to sway
6	Strong Breeze	30-40	Large branches in motion; Whistling heard in electrical wires; Umbrellas used with difficulty
7	Moderate Gale	40-50	Whole trees in motion; Inconvenient walking against wind
8	Gale	50-60	Breaks twigs off trees; Generally impedes progress

Experience and research on people's perception of mechanical wind effects has shown that if the wind speed levels are exceeded for more than 20% of the time, the activity level would be judged to be uncomfortable by most people. For instance, if GEM wind speeds of 10 km/h were exceeded for more than 20% of the time, most pedestrians would judge that location to be too windy for sitting or more sedentary activities. Similarly, if GEM wind speeds of 20 km/h at a location were exceeded for more than 20% of the time, walking or less vigorous activities would be considered uncomfortable. As most of these criteria are based on subjective reactions of a population to wind forces, their application is partly based on experience and judgment.

Once the pedestrian wind speed predictions have been established across the study site, the assessment of pedestrian comfort involves determining the suitability of the predicted wind conditions for their associated spaces. This step involves comparing the predicted comfort class to the desired comfort class, which is dictated by the location type. An overview of common pedestrian location types and their desired comfort classes are summarized on the following page.

DESIRED PEDESTRIAN COMFORT CLASSES FOR VARIOUS LOCATION TYPES

Location Types	Desired Comfort Classes
Primary Building Entrance	Standing
Secondary Building Access Point	Walking
Public Sidewalks / Pedestrian Walkways	Walking
Outdoor Amenity Spaces	Sitting / Standing
Cafés / Patios / Benches / Gardens	Sitting / Standing
Plazas	Standing / Walking
Transit Stops	Standing
Public Parks	Sitting / Walking
Garage / Service Entrances	Walking
Vehicular Drop-Off Zones	Walking
Laneways / Loading Zones	Walking

Following the comparison, the location is assigned a descriptor that indicates the suitability of the location for its intended use. The suitability descriptors are summarized as follows:

- **Acceptable**: The predicted wind conditions are suitable for the intended uses of the associated outdoor spaces without the need for mitigation.
- **Acceptable with Mitigation**: The predicted wind conditions are not acceptable for the intended use of a space; however, following the implementation of typical mitigation measures, the wind conditions are expected to satisfy the required comfort guidelines.
- **Mitigation Testing Recommended**: The effectiveness of typical mitigation measures is uncertain, and additional wind tunnel testing is recommended to explore other options and to ensure compliance with the comfort guidelines.
- **Incompatible**: The predicted wind conditions will interfere with the comfortable and/or safe use of a space and cannot be feasibly mitigated to acceptable levels.

5. RESULTS AND DISCUSSION

5.1 Pedestrian Comfort Suitability – Future Conditions

Tables A1 through A5 in Appendix A provide a summary of seasonal comfort predictions for each sensor location under the future massing scenario considering the study building and all approved surrounding developments. The tables indicate the 80% non-exceedance gust wind speeds and corresponding comfort classifications as defined in Section 4.4. In other words, a gust wind speed threshold of 12.1 for the summer season indicates that 80% of the measured data falls at or below 12.1 km/h during the summer months and conditions are therefore suitable for standing, as the 80% threshold value falls within the exceedance range of 10-15 km/h for standing. The tables include the predicted threshold values for each sensor location during each season, accompanied by the corresponding predicted comfort class (i.e. sitting, standing, walking, etc.).

The most significant findings of the PLW are summarized in the Section 5.2. To assist with understanding and interpretation, predicted conditions for the proposed development are also illustrated in colour-coded format in Figures 2A through 3B. Conditions suitable for sitting are represented by the colour green, while standing is represented by yellow, and walking by blue. Measured mean and gust velocity ratios, which constitutes the raw data upon which the results are based, will be made available upon request.

5.2 Summary of Findings – Future Conditions

Based on the analysis of the measured data, consideration of local climate data, and the suitability descriptors provided in Tables A1-A5 in Appendix A, this section summarizes the most significant findings of the PLW study with respect to future conditions, as follows:

1. All sidewalks, walkways, landscaped spaces, laneways, and surface parking, within and surrounding the proposed development, will experience wind conditions suitable for walking or better during each seasonal period, which is acceptable for the intended uses of the spaces.
2. Most primary and secondary building access points serving the development will be comfortable for standing or better throughout the year, which is considered appropriate. Exceptions are the lobby entrances at the northwest corner of Building A (Sensor 55) and internal east elevation of Building C (Sensor 85), where wind speeds exceed the standing criterion during the winter

months. At these windier locations, to ensure conditions are comfortable for standing or better throughout the year, it is recommended to either recess the entrance within the building façade, or flank with vertical wind barriers and, in the case of Building A, provide a canopy overhead. Alternatively, the Building A northwest lobby entrance could be relocated to the west elevation (Sensor 139), and the Building C internal east elevation lobby entrance could be relocated to the north elevation (Sensor 131), where conditions are suitable for standing on a seasonal basis, without mitigation.

Regarding the Building D retail entrances, it is noteworthy that the east (Sensors 73 & 95) and west (Sensors 62 & 63) retail elevations will be comfortable for sitting throughout the year, which is appropriate, while the north retail elevation (Sensors 74 & 96) exceeds the standing criterion during the winter months. If entrances are located along the north elevation, then mitigation similar to that described for Building A, above, is recommended.

3. The outdoor amenity at the centre of the site (Sensors 77, 79, 125, & 126) will be comfortable for a mix of sitting and standing throughout the year. As the exceedance of the summer sitting criterion is marginal and confined to a single sensor (Sensor 79), mitigation is not considered necessary.

4. The nearby Erin Mills Parkway northbound transit stop (Sensor 57) will be comfortable for standing or better throughout the year, which is acceptable.

5. The Terraces at Level 5 of Buildings B (Sensors 153-155) and E (Sensors 151-152), Level 7 of Buildings A (Sensors 156-157) and D (Sensors 149-150), and Level 9 of Building A (Sensor 158), will be comfortable for sitting or more sedentary activities during the summer months, and for standing or better throughout the remaining seasonal periods, without the need for mitigation.

6. Within the context of typical weather patterns, which exclude anomalous localized storm events such as tornadoes and downbursts, no areas over the study site were found to experience conditions too windy for walking, or that are considered unsafe.

5.3 Pedestrian Comfort Suitability – Existing Versus Future Conditions

To evaluate the influence of the study building on existing wind conditions at and near the study site, an additional pedestrian level wind test was performed for the existing site massing without the study building present. A comparison of wind comfort results for the existing and future configurations is provided in Tables B1 to B6 in Appendix B, which provide a seasonal summary of the comparative wind comfort predictions. The future and existing massing scenarios are shown in Photographs 1 through 6 following the main text.

Pedestrian wind comfort resulting from the construction of the study building and future surrounding developments may be described as being *unchanged*, *improved*, or *reduced* as compared to the existing conditions. These designations are not strictly determined by the predicted percentage values, rather by the change to the predicted comfort class.

A review of Tables B1 to B6 indicates that the introduction of the proposed development will have a mixed impact on grade-level wind conditions, favouring a reduction in windspeeds. To the north, over sidewalks along Folkway Drive (Sensors 8-11, 13-15, 49, 51, & 54) and the landscaped space to the northeast (Sensor 16), wind comfort is generally unchanged. Reductions in wind comfort are noted over sidewalks to the northeast along Folkway Drive (Sensors 12 & 47) and Sawmill Valley Drive (Sensors 17, 18, 35, & 42), while improvements are concentrated over sidewalks to the south (Sensors 24-26, & 28) and west (Sensors 4, 6, 7, 57, 61, & 64), inclusive of the northbound Erin Mills Parkway transit stop (Sensor 57). Where wind comfort is reduced, conditions nevertheless remain acceptable for the intended uses.

6. CONCLUSIONS AND RECOMMENDATIONS

This report summarizes the methodology, results, and recommendations related to a pedestrian level wind study for the proposed mixed-use, multi-building development located at 4099 Erin Mills Parkway in Mississauga, Ontario. The study was performed in accordance with industry standard wind tunnel testing and data analysis procedures.

A complete summary of the predicted wind conditions is provided in Section 5.2 of this report, and is also illustrated in Figures 2A-3B, as well as Tables A1-A5 and B1-B6 in the appendices. Based on wind tunnel test results, meteorological data analysis, and experience with similar developments in Mississauga, we conclude that conditions over most pedestrian-sensitive areas within and surrounding the development site will be acceptable for the intended pedestrian uses on an annual and seasonal basis. Exceptions are lobby entrances at the northwest corner of Building A, and the internal east elevation of Building C. To ensure these locations are comfortable for standing or better throughout the year, mitigation is recommended, as described in Section 5.2. Over the elevated terraces, conditions will be comfortable for sitting or more sedentary activities throughout the summer months, without mitigation.

A comparison of the existing versus future wind comfort surrounding the study site indicates that the proposed development will have a mixed impact, favouring a reduction in windspeeds. To the north, over sidewalks along Folkway Drive, and the landscaped space to the northeast, wind comfort is generally unchanged. Reductions in wind comfort are noted over sidewalks to the northeast along Folkway Drive and Sawmill Valley Drive, while improvements are concentrated over sidewalks to the south and west, inclusive of the northbound Erin Mills Parkway transit stop. Where wind comfort is reduced, conditions nevertheless remain acceptable for the intended uses.

Within the context of typical weather patterns, which exclude anomalous localized storm events such as tornadoes and downbursts, no areas over the study site were found to experience conditions too windy for walking, or that could be considered unsafe.

This concludes our pedestrian level wind study and report. Please advise the undersigned of any questions or comments.

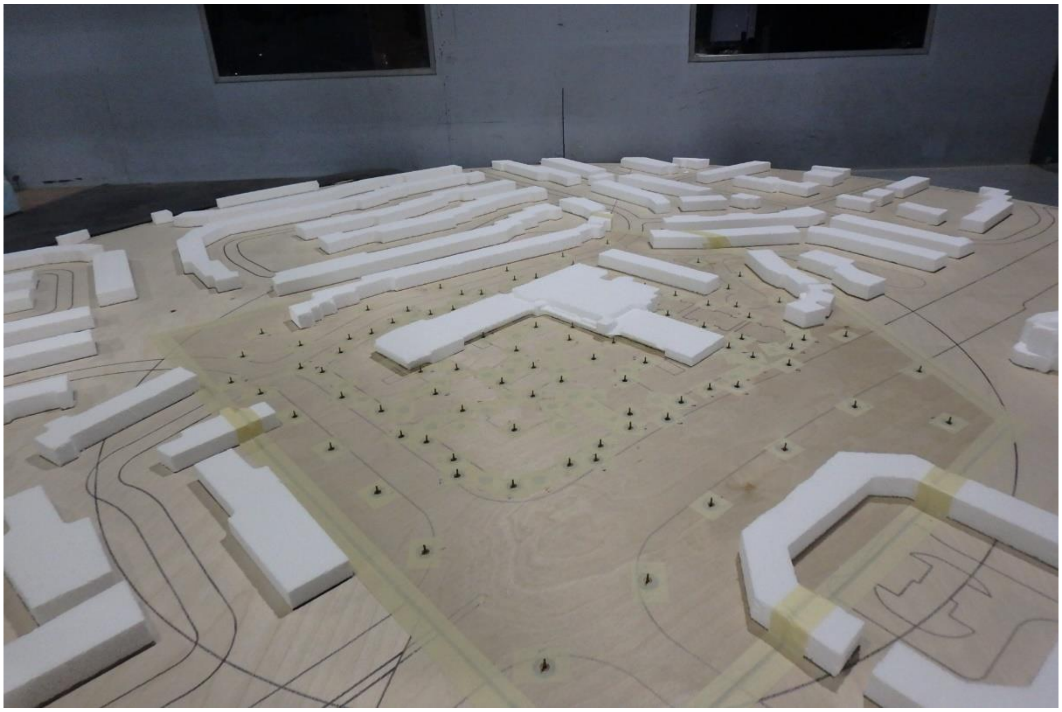
Sincerely,

Gradient Wind Engineering Inc.

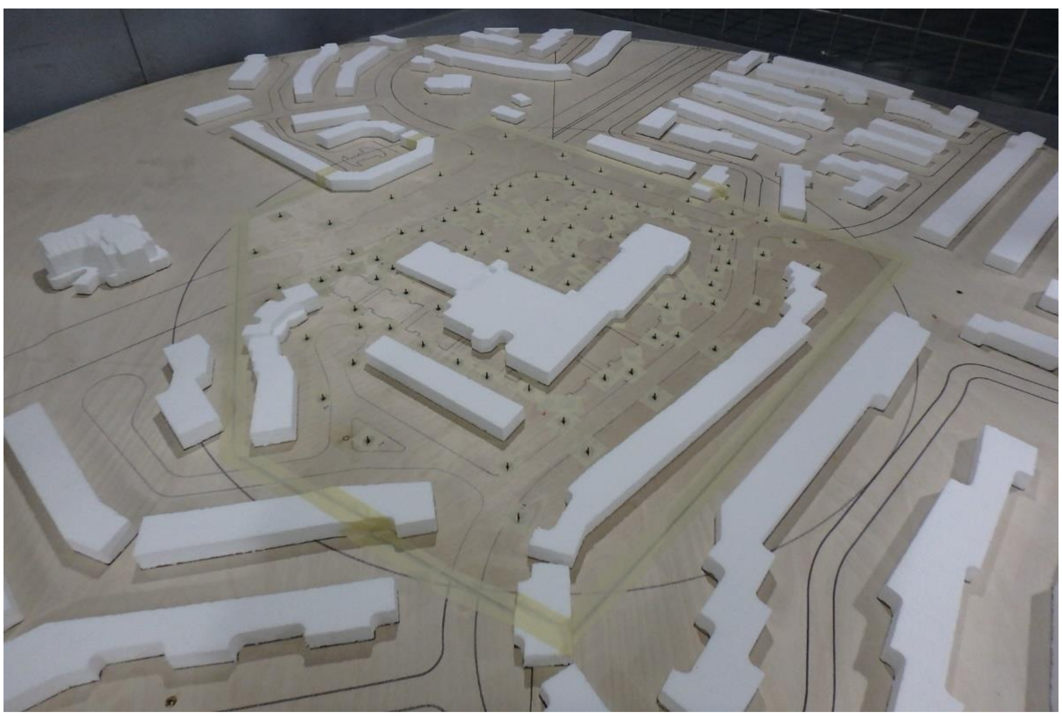
Patrick Shorey, B.A.Sc., EIT
Junior Wind Scientist

Nick Petersen, P.Eng.
Wind Engineer

GW22-008-WTPLW



PHOTOGRAPH 1: CLOSE-UP VIEW OF EXISTING CONTEXT MODEL LOOKING EAST



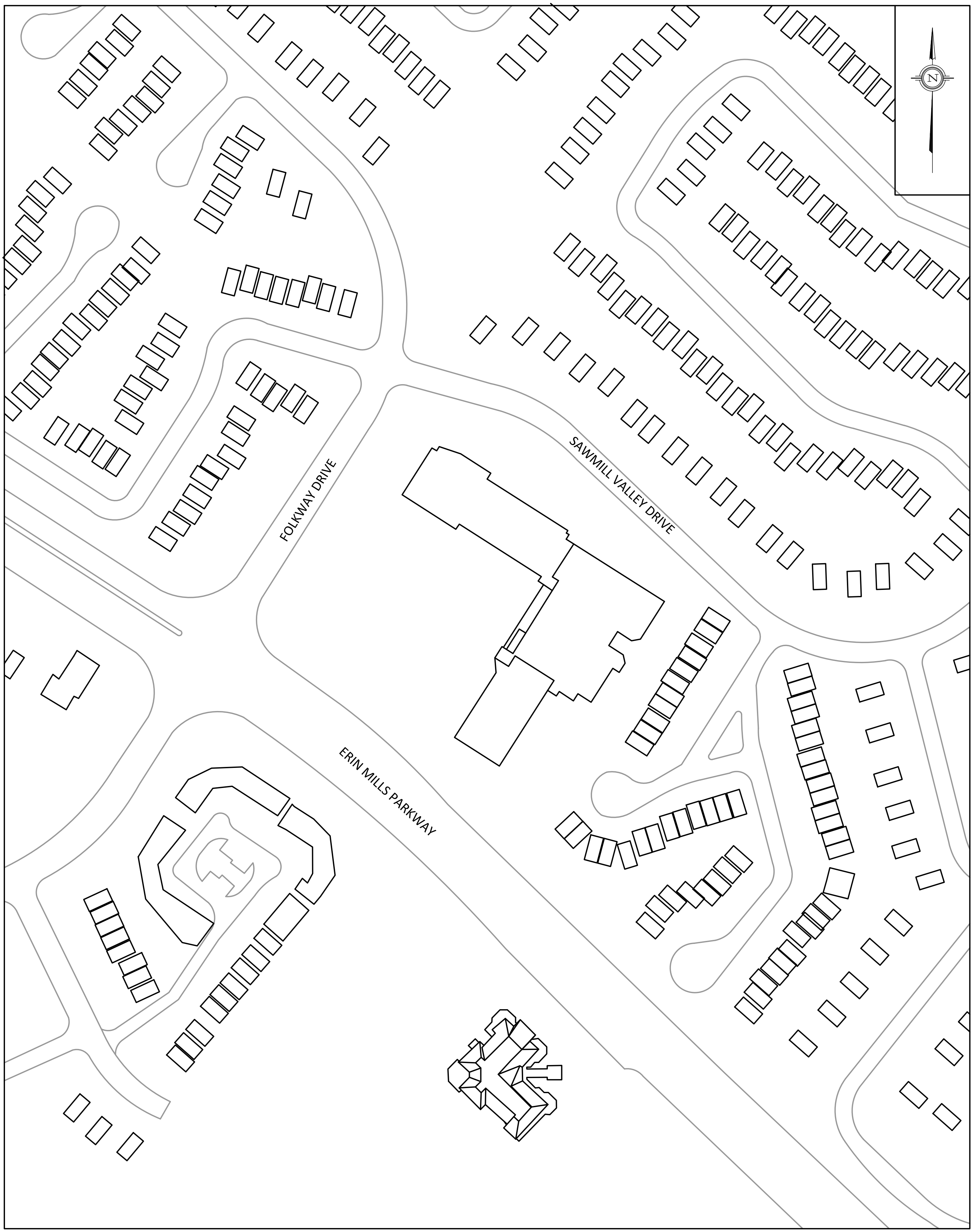
PHOTOGRAPH 2: CLOSE-UP VIEW OF EXISTING CONTEXT MODEL LOOKING WEST

PHOTOGRAPH 3: STUDY MODEL INSIDE THE GWE WIND TUNNEL LOOKING DOWNWIND

PHOTOGRAPH 4: STUDY MODEL INSIDE THE GWE WIND TUNNEL LOOKING UPWIND

PHOTOGRAPH 5: CLOSE-UP VIEW OF STUDY MODEL LOOKING NORTHWEST

PHOTOGRAPH 6: CLOSE-UP VIEW OF STUDY MODEL LOOKING EAST



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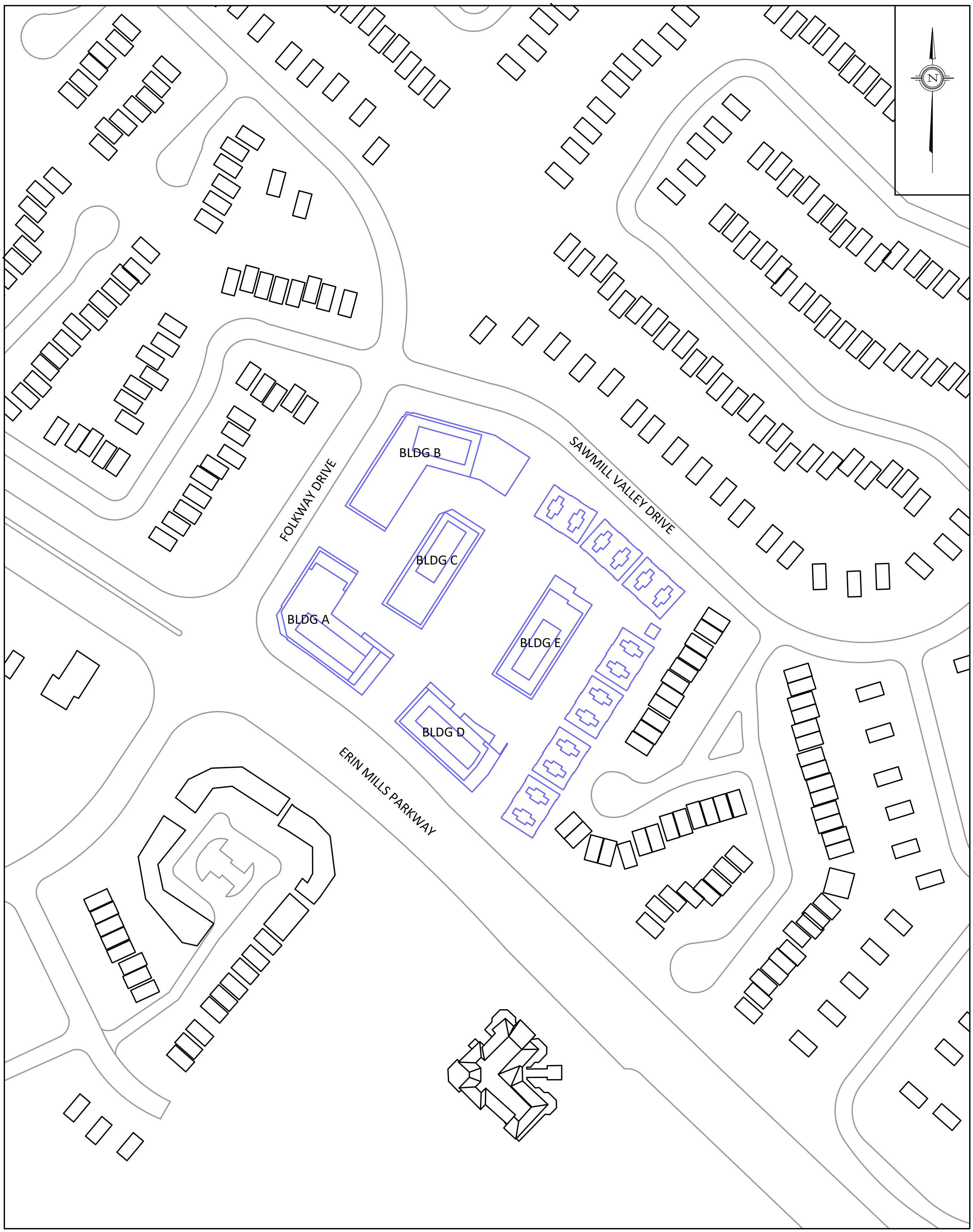
PROJECT	4099 ERIN MILLS PARKWAY, MISSISSAUGA PEDESTRIAN LEVEL WIND STUDY		DESCRIPTION FIGURE 1A: EXISITING SITE PLAN AND SURROUNDING CONTEXT
SCALE	1:2500 (APPROX.)	DRAWING NO. GW22-008-PLW-1A	
DATE	JULY 11, 2022	DRAWN BY K.A.	



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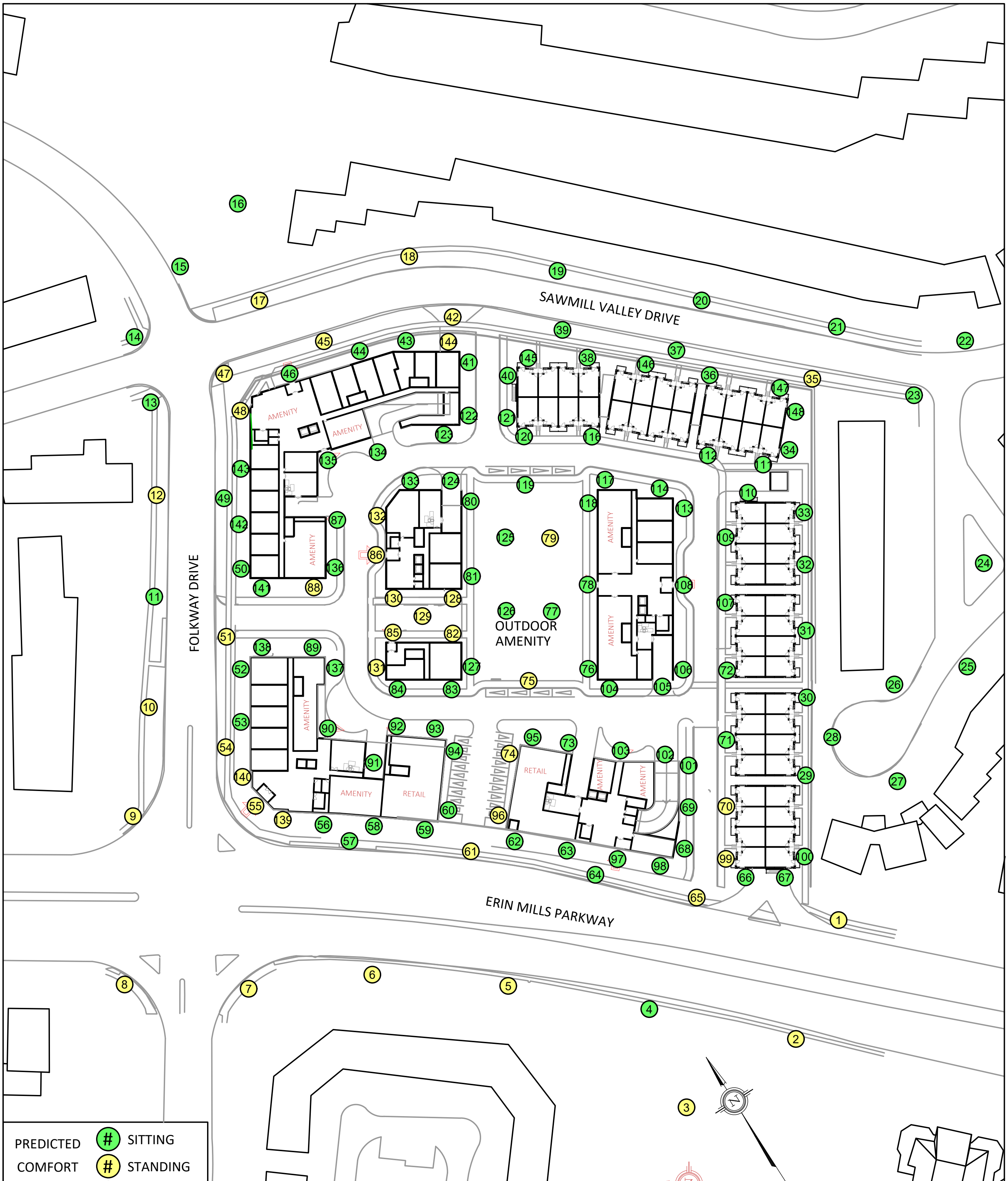
PROJECT: 4099 ERIN MILLS PARKWAY, MISSISSAUGA PEDESTRIAN LEVEL WIND STUDY		DESCRIPTION: FIGURE 1B: FUTURE SITE PLAN AND SURROUNDING CONTEXT
SCALE: 1:2500 (APPROX.)	DRAWING NO.: GW22-008-PLW-1B	
DATE: JULY 11, 2022	DRAWN BY: K.A.	



NOTES:

1. SCALE IS APPROXIMATE.
2. # PEDESTRIAN LEVEL WIND SENSOR LOCATION.

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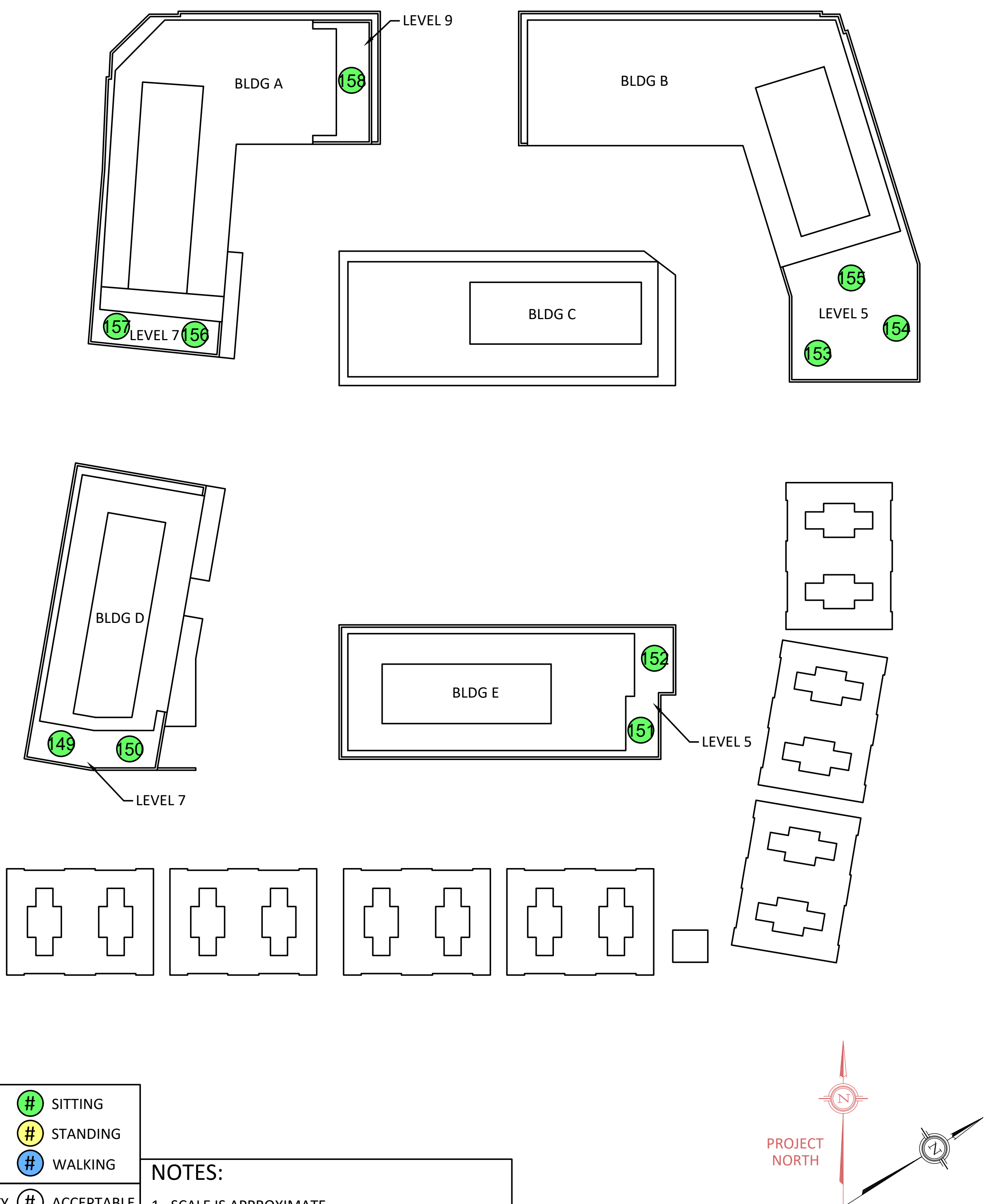
PROJECT	4099 ERIN MILLS PARKWAY, MISSISSAUGA PEDESTRIAN LEVEL WIND STUDY
SCALE	1:1600 (APPROX.)
DRAWING NO.	GW22-008-PLW-2A
DATE	JULY 11, 2022
DRAWN BY	K.A.
DESCRIPTION	FIGURE 2A: SUMMER GROUND FLOOR PLAN PEDESTRIAN COMFORT PREDICTIONS



PREDICTED COMFORT CATEGORY	#	SITTING
	#	STANDING
	#	WALKING
WIND SAFETY CRITERION	#	ACCEPTABLE
	#	EXCEEDED

NOTES:

1. SCALE IS APPROXIMATE.
2. # PEDESTRIAN LEVEL WIND SENSOR LOCATION.

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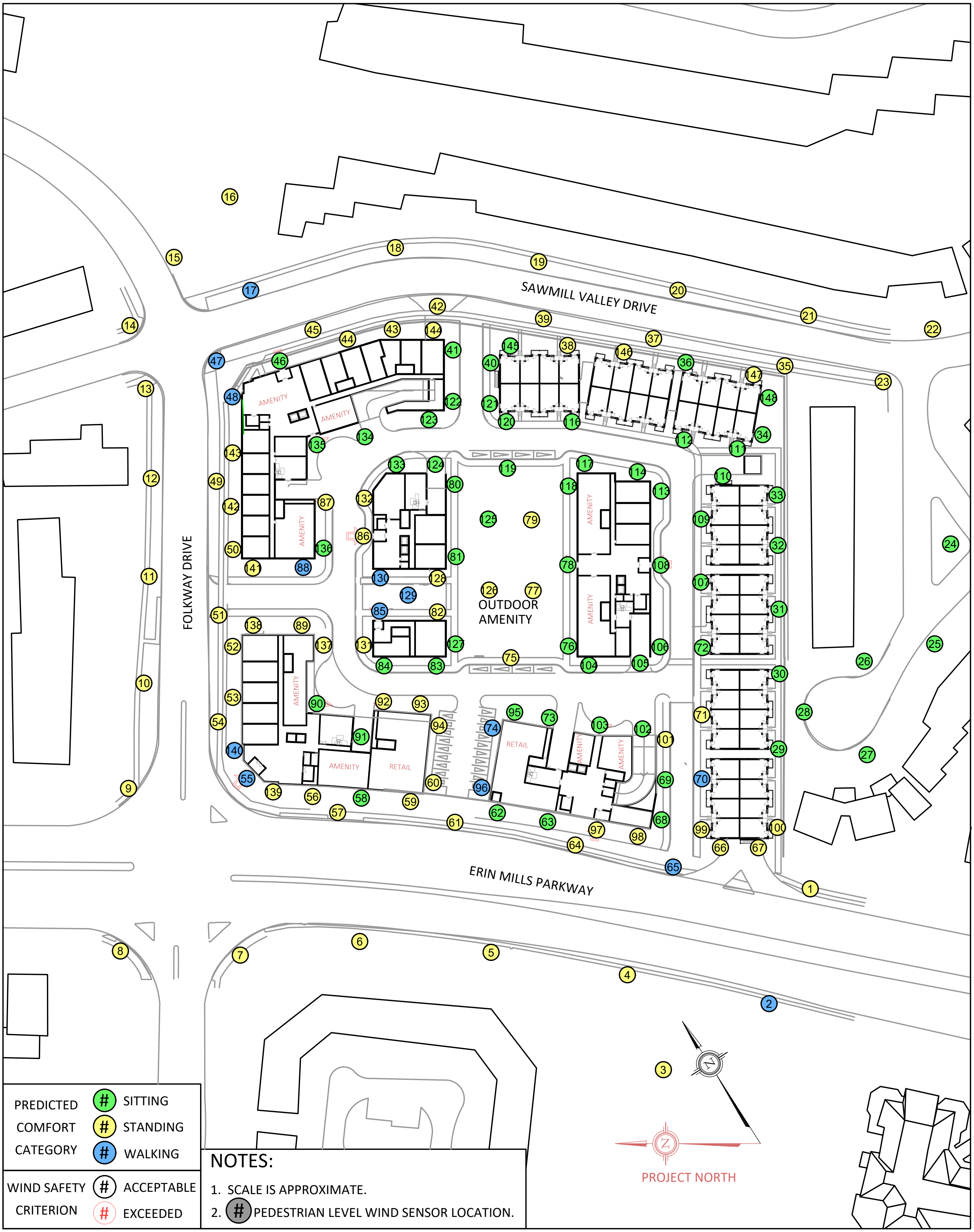
PROJECT	4099 ERIN MILLS PARKWAY, MISSISSAUGA PEDESTRIAN LEVEL WIND STUDY
SCALE	1:1000 (APPROX.)
DRAWING NO.	GW22-008-PLW-2B
DATE	JULY 11, 2022
DRAWN BY	K.A.
DESCRIPTION	FIGURE 2B: SUMMER OUTDOOR AMENITY TERRACES PEDESTRIAN COMFORT PREDICTIONS



PREDICTED COMFORT CATEGORY: # SITTING; # STANDING; # WALKING

WIND SAFETY CRITERION: # ACCEPTABLE; # EXCEEDED

NOTES:

1. SCALE IS APPROXIMATE.
2. # PEDESTRIAN LEVEL WIND SENSOR LOCATION.

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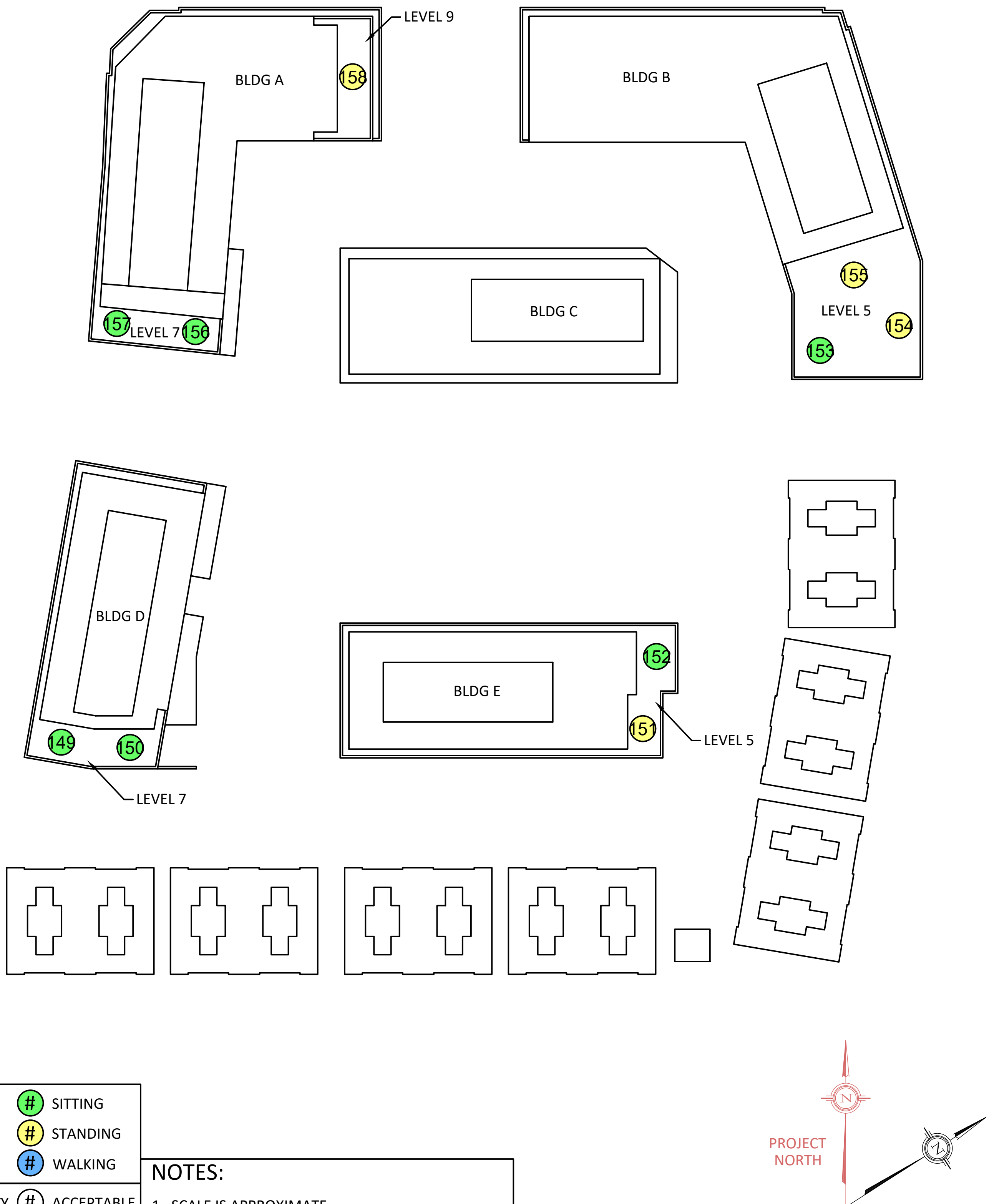
PROJECT	4099 ERIN MILLS PARKWAY, MISSISSAUGA PEDESTRIAN LEVEL WIND STUDY
SCALE	1:1600 (APPROX.)
DRAWING NO.	GW22-008-PLW-3A
DATE	JULY 11, 2022
DRAWN BY	K.A.
DESCRIPTION	FIGURE 3A: WINTER GROUND FLOOR PLAN PEDESTRIAN COMFORT PREDICTIONS



PREDICTED COMFORT CATEGORY	#	SITTING
	#	STANDING
	#	WALKING
WIND SAFETY CRITERION	#	ACCEPTABLE
	#	EXCEEDED

NOTES:

1. SCALE IS APPROXIMATE.
2. # PEDESTRIAN LEVEL WIND SENSOR LOCATION.

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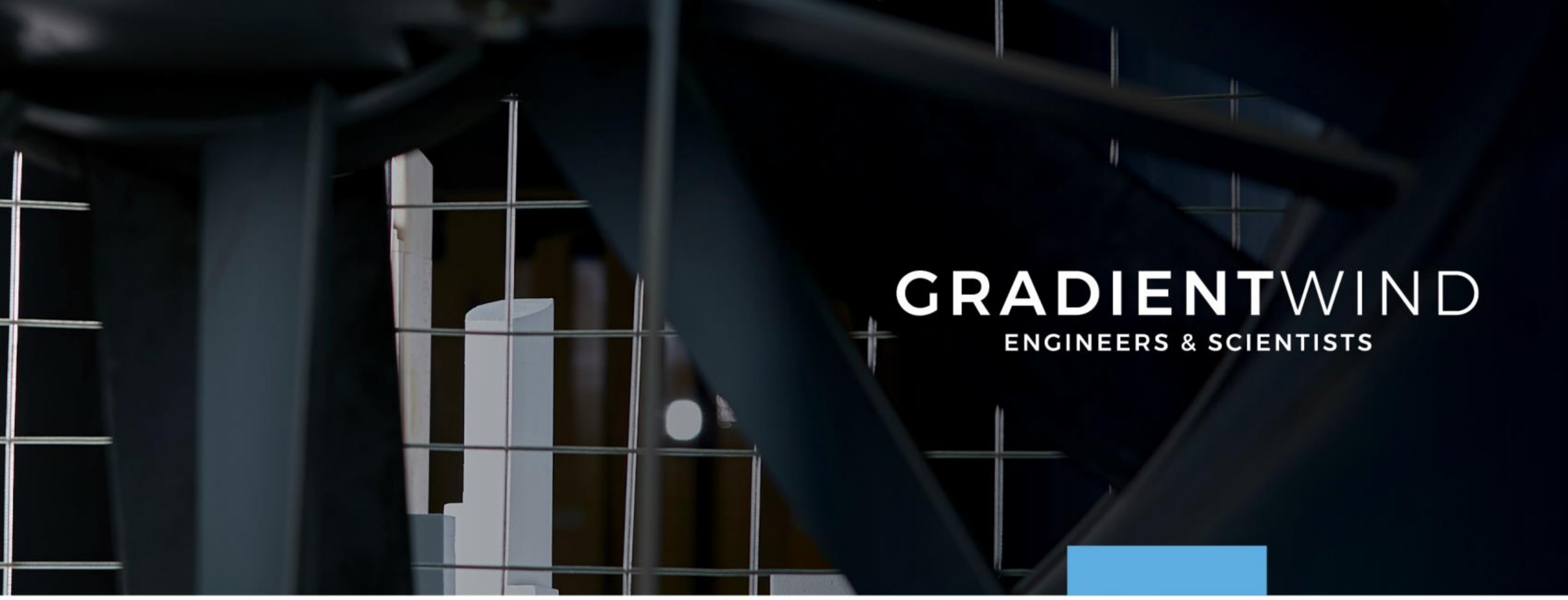
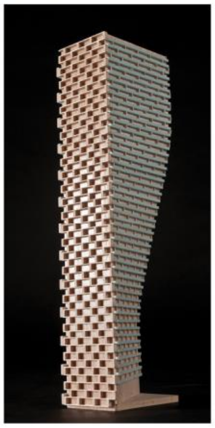
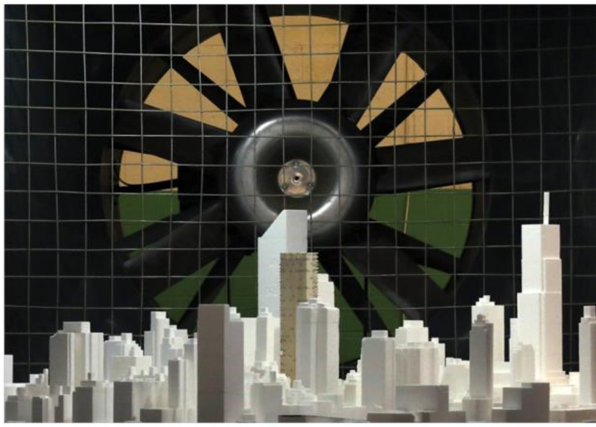
PROJECT	4099 ERIN MILLS PARKWAY, MISSISSAUGA PEDESTRIAN LEVEL WIND STUDY		
SCALE	1:1000 (APPROX.)	DRAWING NO.	GW22-008-PLW-3B
DATE	JULY 11, 2022	DRAWN BY	K.A.

DESCRIPTION

FIGURE 3B: WINTER
OUTDOOR AMENITY TERRACES
PEDESTRIAN COMFORT PREDICTIONS





APPENDIX A

PEDESTRIAN COMFORT SUITABILITY, TABLES A1-A5 (FUTURE CONDITIONS)

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Guidelines	
Pedestrian Comfort	**20% exceedance wind speed** 0-10 km/h = Sitting, 10-15 km/h = Standing, 15-20 km/h = Walking, >20 km/h = Uncomfortable
Pedestrian Safety	**0.1% exceedance wind speed** 0-90 km/h = Safe

TABLE A1: SUMMARY OF PEDESTRIAN COMFORT (FUTURE CONDITIONS)

Sensor	Pedestrian Comfort				Pedestrian Safety	
	Summer		Winter		Annual	
	Wind Speed	Comfort Class	Wind Speed	Comfort Class	Wind Speed	Safety Class
1	10.3	Standing	14.1	Standing	55.4	Safe
2	11.4	Standing	15.1	Walking	52.6	Safe
3	10.1	Standing	13.3	Standing	47.6	Safe
4	9.6	Sitting	12.6	Standing	49.4	Safe
5	10.4	Standing	13.4	Standing	53.3	Safe
6	11.3	Standing	14.6	Standing	55.8	Safe
7	11.1	Standing	13.9	Standing	49.0	Safe
8	10.7	Standing	13.0	Standing	46.7	Safe
9	11.5	Standing	13.9	Standing	48.4	Safe
10	10.9	Standing	13.7	Standing	50.1	Safe
11	8.9	Sitting	11.9	Standing	46.3	Safe
12	10.2	Standing	13.5	Standing	50.1	Safe
13	7.9	Sitting	10.2	Standing	39.4	Safe
14	9.3	Sitting	12.2	Standing	46.7	Safe
15	8.6	Sitting	11.3	Standing	44.0	Safe
16	9.4	Sitting	12.1	Standing	44.0	Safe
17	11.1	Standing	15.3	Walking	60.0	Safe
18	10.2	Standing	12.8	Standing	48.4	Safe
19	9.8	Sitting	12.0	Standing	45.2	Safe
20	10.0	Sitting	12.5	Standing	47.6	Safe
21	8.4	Sitting	10.3	Standing	42.1	Safe
22	8.0	Sitting	10.2	Standing	38.6	Safe
23	9.5	Sitting	11.3	Standing	44.2	Safe
24	8.2	Sitting	9.8	Sitting	36.7	Safe
25	6.5	Sitting	8.2	Sitting	33.4	Safe
26	6.6	Sitting	8.3	Sitting	31.9	Safe
27	6.4	Sitting	7.9	Sitting	30.0	Safe
28	6.3	Sitting	7.6	Sitting	28.3	Safe
29	6.4	Sitting	7.7	Sitting	29.0	Safe
30	6.6	Sitting	7.8	Sitting	30.2	Safe
31	6.8	Sitting	8.2	Sitting	29.9	Safe
32	6.7	Sitting	7.9	Sitting	28.5	Safe
33	6.4	Sitting	7.6	Sitting	28.1	Safe
34	6.6	Sitting	8.1	Sitting	31.5	Safe
35	10.2	Standing	12.0	Standing	48.2	Safe

Guidelines	
Pedestrian Comfort	**20% exceedance wind speed** 0-10 km/h = Sitting, 10-15 km/h = Standing, 15-20 km/h = Walking, >20 km/h = Uncomfortable
Pedestrian Safety	**0.1% exceedance wind speed** 0-90 km/h = Safe

TABLE A2: SUMMARY OF PEDESTRIAN COMFORT (FUTURE CONDITONS)

Sensor	Pedestrian Comfort				Pedestrian Safety	
	Summer		Winter		Annual	
	Wind Speed	Comfort Class	Wind Speed	Comfort Class	Wind Speed	Safety Class
36	8.0	Sitting	9.9	Sitting	47.2	Safe
37	8.9	Sitting	11.1	Standing	49.5	Safe
38	9.0	Sitting	11.4	Standing	53.0	Safe
39	9.6	Sitting	12.0	Standing	54.7	Safe
40	7.7	Sitting	9.1	Sitting	41.8	Safe
41	6.8	Sitting	7.6	Sitting	31.2	Safe
42	10.9	Standing	13.2	Standing	57.5	Safe
43	9.2	Sitting	11.9	Standing	53.6	Safe
44	8.5	Sitting	11.1	Standing	48.5	Safe
45	10.7	Standing	13.5	Standing	51.8	Safe
46	7.6	Sitting	10.0	Sitting	43.1	Safe
47	12.1	Standing	16.5	Walking	61.4	Safe
48	11.0	Standing	15.1	Walking	64.9	Safe
49	9.6	Sitting	12.7	Standing	50.8	Safe
50	9.9	Sitting	12.5	Standing	51.7	Safe
51	10.3	Standing	13.6	Standing	55.8	Safe
52	9.2	Sitting	12.5	Standing	54.8	Safe
53	9.0	Sitting	12.0	Standing	55.8	Safe
54	11.9	Standing	15.0	Standing	55.9	Safe
55	13.8	Standing	16.3	Walking	73.5	Safe
56	9.4	Sitting	11.3	Standing	57.6	Safe
57	9.7	Sitting	12.0	Standing	58.1	Safe
58	7.6	Sitting	9.4	Sitting	48.4	Safe
59	8.5	Sitting	12.5	Standing	58.5	Safe
60	8.4	Sitting	10.1	Standing	45.4	Safe
61	11.6	Standing	15.0	Walking	56.6	Safe
62	8.1	Sitting	10.0	Sitting	48.2	Safe
63	7.6	Sitting	9.8	Sitting	49.8	Safe
64	9.2	Sitting	12.5	Standing	55.8	Safe
65	12.1	Standing	16.1	Walking	59.5	Safe
66	9.3	Sitting	13.3	Standing	66.3	Safe
67	7.9	Sitting	11.8	Standing	56.4	Safe
68	6.8	Sitting	8.2	Sitting	43.4	Safe
69	8.1	Sitting	9.9	Sitting	39.9	Safe
70	11.4	Standing	15.5	Walking	71.0	Safe

Guidelines	
Pedestrian Comfort	**20% exceedance wind speed** 0-10 km/h = Sitting, 10-15 km/h = Standing, 15-20 km/h = Walking, >20 km/h = Uncomfortable
Pedestrian Safety	**0.1% exceedance wind speed** 0-90 km/h = Safe

TABLE A3: SUMMARY OF PEDESTRIAN COMFORT (FUTURE CONDITONS)

Sensor	Pedestrian Comfort				Pedestrian Safety	
	Summer		Winter		Annual	
	Wind Speed	Comfort Class	Wind Speed	Comfort Class	Wind Speed	Safety Class
71	8.1	Sitting	10.4	Standing	54.5	Safe
72	6.2	Sitting	7.8	Sitting	30.3	Safe
73	6.1	Sitting	7.5	Sitting	29.0	Safe
74	12.6	Standing	17.7	Walking	76.0	Safe
75	10.3	Standing	13.0	Standing	51.8	Safe
76	7.9	Sitting	10.0	Sitting	41.5	Safe
77	9.7	Sitting	11.9	Standing	44.8	Safe
78	5.9	Sitting	7.7	Sitting	32.6	Safe
79	10.1	Standing	12.3	Standing	42.1	Safe
80	6.8	Sitting	7.6	Sitting	29.6	Safe
81	6.2	Sitting	7.6	Sitting	28.9	Safe
82	10.8	Standing	14.1	Standing	52.5	Safe
83	7.6	Sitting	9.5	Sitting	37.3	Safe
84	8.4	Sitting	9.9	Sitting	41.3	Safe
85	12.0	Standing	15.4	Walking	62.9	Safe
86	10.5	Standing	13.7	Standing	56.9	Safe
87	8.7	Sitting	10.1	Standing	39.0	Safe
88	11.5	Standing	17.3	Walking	73.6	Safe
89	9.5	Sitting	11.8	Standing	56.5	Safe
90	7.2	Sitting	9.0	Sitting	37.8	Safe
91	4.9	Sitting	6.3	Sitting	22.8	Safe
92	9.8	Sitting	12.4	Standing	46.8	Safe
93	8.7	Sitting	10.9	Standing	44.6	Safe
94	9.5	Sitting	10.7	Standing	47.1	Safe
95	6.8	Sitting	8.2	Sitting	33.9	Safe
96	11.3	Standing	15.4	Walking	58.4	Safe
97	7.9	Sitting	10.9	Standing	56.9	Safe
98	9.8	Sitting	12.4	Standing	45.9	Safe
99	10.5	Standing	13.3	Standing	49.8	Safe
100	8.8	Sitting	11.1	Standing	54.8	Safe
101	9.0	Sitting	10.4	Standing	40.9	Safe
102	7.5	Sitting	9.3	Sitting	36.0	Safe
103	7.1	Sitting	8.4	Sitting	32.6	Safe
104	7.4	Sitting	8.5	Sitting	37.9	Safe
105	6.0	Sitting	7.5	Sitting	34.7	Safe

Guidelines	
Pedestrian Comfort	**20% exceedance wind speed** 0-10 km/h = Sitting, 10-15 km/h = Standing, 15-20 km/h = Walking, >20 km/h = Uncomfortable
Pedestrian Safety	**0.1% exceedance wind speed** 0-90 km/h = Safe

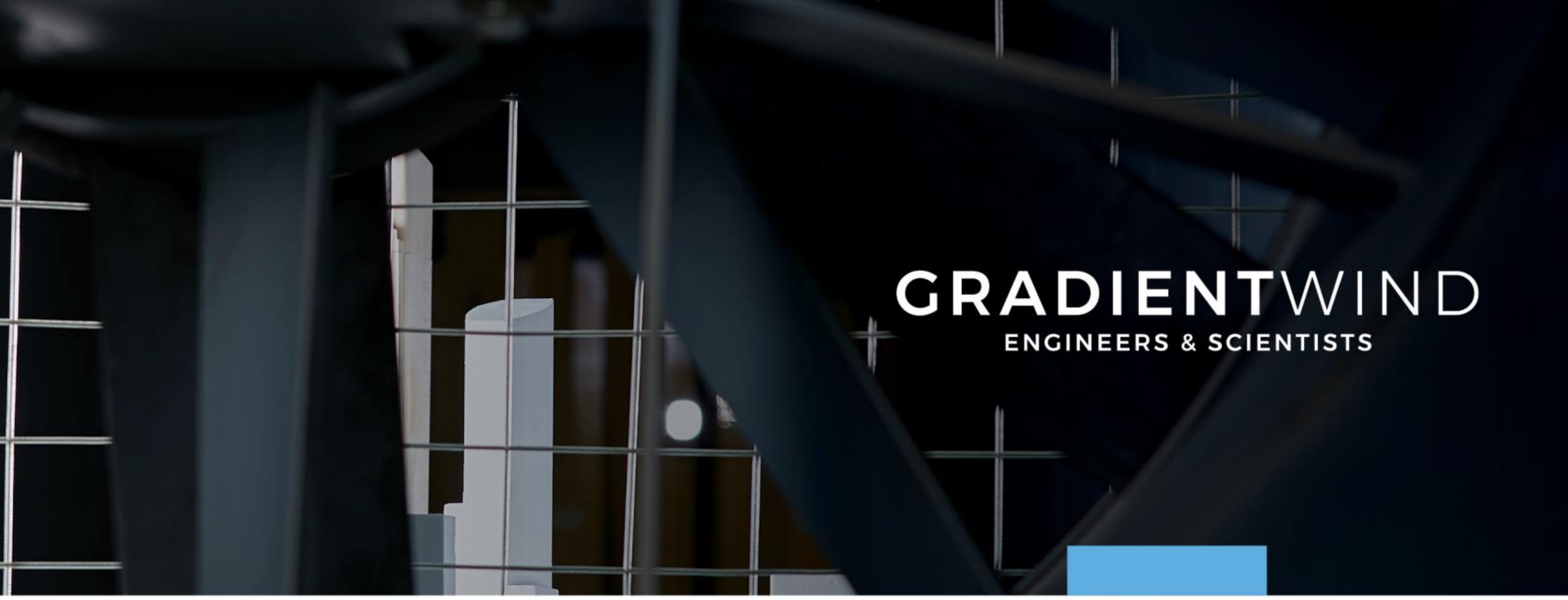
TABLE A4: SUMMARY OF PEDESTRIAN COMFORT (FUTURE CONDITONS)

Sensor	Pedestrian Comfort				Pedestrian Safety	
	Summer		Winter		Annual	
	Wind Speed	Comfort Class	Wind Speed	Comfort Class	Wind Speed	Safety Class
106	6.3	Sitting	7.8	Sitting	30.0	Safe
107	6.9	Sitting	8.8	Sitting	39.8	Safe
108	6.3	Sitting	7.6	Sitting	29.1	Safe
109	7.9	Sitting	9.7	Sitting	41.0	Safe
110	6.9	Sitting	8.8	Sitting	36.3	Safe
111	6.0	Sitting	7.2	Sitting	26.8	Safe
112	6.6	Sitting	8.0	Sitting	31.4	Safe
113	7.1	Sitting	8.7	Sitting	35.2	Safe
114	6.2	Sitting	7.9	Sitting	29.2	Safe
116	6.7	Sitting	8.1	Sitting	29.9	Safe
117	6.0	Sitting	7.4	Sitting	29.8	Safe
118	6.5	Sitting	8.4	Sitting	35.6	Safe
119	6.6	Sitting	7.5	Sitting	28.7	Safe
120	5.7	Sitting	6.9	Sitting	29.5	Safe
121	8.6	Sitting	9.8	Sitting	43.8	Safe
122	7.4	Sitting	8.5	Sitting	34.0	Safe
123	7.3	Sitting	8.9	Sitting	38.9	Safe
124	6.4	Sitting	7.9	Sitting	32.5	Safe
125	7.7	Sitting	9.1	Sitting	35.9	Safe
126	9.7	Sitting	12.3	Standing	48.5	Safe
127	6.9	Sitting	8.7	Sitting	40.3	Safe
128	10.8	Standing	13.9	Standing	54.4	Safe
129	12.9	Standing	17.0	Walking	63.0	Safe
130	12.4	Standing	16.4	Walking	67.5	Safe
131	11.2	Standing	14.6	Standing	54.5	Safe
132	11.5	Standing	14.6	Standing	61.3	Safe
133	6.6	Sitting	8.3	Sitting	40.2	Safe
134	7.7	Sitting	9.1	Sitting	33.9	Safe
135	5.3	Sitting	6.6	Sitting	24.5	Safe
136	8.1	Sitting	9.4	Sitting	36.9	Safe
137	8.9	Sitting	11.6	Standing	48.3	Safe
138	9.0	Sitting	11.2	Standing	59.4	Safe
139	10.5	Standing	12.1	Standing	68.8	Safe
140	12.1	Standing	15.1	Walking	61.1	Safe

Guidelines	
Pedestrian Comfort	**20% exceedance wind speed** 0-10 km/h = Sitting, 10-15 km/h = Standing, 15-20 km/h = Walking, >20 km/h = Uncomfortable
Pedestrian Safety	**0.1% exceedance wind speed** 0-90 km/h = Safe

TABLE A5: SUMMARY OF PEDESTRIAN COMFORT (FUTURE CONDITONS)

Sensor	Pedestrian Comfort				Pedestrian Safety	
	Summer		Winter		Annual	
	Wind Speed	Comfort Class	Wind Speed	Comfort Class	Wind Speed	Safety Class
141	9.3	Sitting	12.7	Standing	53.8	Safe
142	9.8	Sitting	12.8	Standing	53.9	Safe
143	8.6	Sitting	11.6	Standing	51.5	Safe
144	10.4	Standing	12.8	Standing	55.3	Safe
145	7.4	Sitting	9.3	Sitting	39.0	Safe
146	8.8	Sitting	10.7	Standing	49.2	Safe
147	9.0	Sitting	10.8	Standing	47.9	Safe
148	6.7	Sitting	7.7	Sitting	27.6	Safe
149	7.8	Sitting	8.8	Sitting	43.4	Safe
150	8.3	Sitting	9.0	Sitting	39.2	Safe
151	8.2	Sitting	10.3	Standing	40.8	Safe
152	7.6	Sitting	9.5	Sitting	36.0	Safe
153	6.7	Sitting	8.3	Sitting	32.1	Safe
154	8.8	Sitting	10.6	Standing	42.2	Safe
155	8.4	Sitting	10.3	Standing	38.6	Safe
156	6.5	Sitting	7.4	Sitting	31.4	Safe
157	6.6	Sitting	7.7	Sitting	31.1	Safe
158	8.1	Sitting	10.2	Standing	44.6	Safe



APPENDIX B

PEDESTRIAN COMFORT SUITABILITY, TABLES B1-B6
(EXISTING VS FUTURE CONDITIONS)

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Guidelines	
Pedestrian Comfort	**20% exceedance wind speed** (0-10 km/h = Sitting, 10-15 km/h = Standing, 15-20 km/h = Walking, >20 km/h = Uncomfortable
Pedestrian Safety	**0.1% exceedance wind speed** 0-90 km/h = Safe

TABLE B1: COMPARATIVE SUMMARY OF PEDESTRIAN COMFORT

Sensor	Massing Scenario	Summer Pedestrian Comfort			Winter Pedestrian Comfort		
		Wind Speed (km/h) 80% data ≤	Predicted Comfort Class	Future Comfort Class Compared to Existing	Wind Speed (km/h) 80% data ≤	Predicted Comfort Class	Future Comfort Class Compared to Existing
1	Existing	11.0	Standing	-	14.0	Standing	-
	Future	10.3	Standing	Unchanged	14.1	Standing	Unchanged
2	Existing	12.4	Standing	-	16.0	Walking	-
	Future	11.4	Standing	Unchanged	15.1	Walking	Unchanged
3	Existing	11.8	Standing	-	14.7	Standing	-
	Future	10.1	Standing	Unchanged	13.3	Standing	Unchanged
4	Existing	11.4	Standing	-	14.1	Standing	-
	Future	9.6	Sitting	Improved	12.6	Standing	Unchanged
5	Existing	11.9	Standing	-	14.6	Standing	-
	Future	10.4	Standing	Unchanged	13.4	Standing	Unchanged
6	Existing	12.0	Standing	-	15.6	Walking	-
	Future	11.3	Standing	Unchanged	14.6	Standing	Improved
7	Existing	11.7	Standing	-	15.1	Walking	-
	Future	11.1	Standing	Unchanged	13.9	Standing	Improved
8	Existing	11.2	Standing	-	13.8	Standing	-
	Future	10.7	Standing	Unchanged	13.0	Standing	Unchanged
9	Existing	11.4	Standing	-	14.3	Standing	-
	Future	11.5	Standing	Unchanged	13.9	Standing	Unchanged
10	Existing	10.7	Standing	-	13.4	Standing	-
	Future	10.9	Standing	Unchanged	13.7	Standing	Unchanged
11	Existing	9.0	Sitting	-	11.0	Standing	-
	Future	8.9	Sitting	Unchanged	11.9	Standing	Unchanged
12	Existing	8.6	Sitting	-	11.1	Standing	-
	Future	10.2	Standing	Reduced	13.5	Standing	Unchanged
13	Existing	8.5	Sitting	-	10.3	Standing	-
	Future	7.9	Sitting	Unchanged	10.2	Standing	Unchanged
14	Existing	9.0	Sitting	-	11.6	Standing	-
	Future	9.3	Sitting	Unchanged	12.2	Standing	Unchanged
15	Existing	9.9	Sitting	-	11.7	Standing	-
	Future	8.6	Sitting	Unchanged	11.3	Standing	Unchanged

Guidelines	
Pedestrian Comfort	**20% exceedance wind speed** (0-10 km/h = Sitting, 10-15 km/h = Standing, 15-20 km/h = Walking, >20 km/h = Uncomfortable
Pedestrian Safety	**0.1% exceedance wind speed** 0-90 km/h = Safe

TABLE B2: COMPARATIVE SUMMARY OF PEDESTRIAN COMFORT

Sensor	Massing Scenario	Summer Pedestrian Comfort			Winter Pedestrian Comfort		
		Wind Speed (km/h) 80% data ≤	Predicted Comfort Class	Future Comfort Class Compared to Existing	Wind Speed (km/h) 80% data ≤	Predicted Comfort Class	Future Comfort Class Compared to Existing
16	Existing	9.2	Sitting	-	11.8	Standing	-
	Future	9.4	Sitting	Unchanged	12.1	Standing	Unchanged
17	Existing	11.1	Standing	-	13.8	Standing	-
	Future	11.1	Standing	Unchanged	15.3	Walking	Reduced
18	Existing	8.4	Sitting	-	10.7	Standing	-
	Future	10.2	Standing	Reduced	12.8	Standing	Unchanged
19	Existing	9.0	Sitting	-	11.1	Standing	-
	Future	9.8	Sitting	Unchanged	12.0	Standing	Unchanged
20	Existing	9.3	Sitting	-	12.3	Standing	-
	Future	10.0	Sitting	Unchanged	12.5	Standing	Unchanged
21	Existing	7.9	Sitting	-	10.1	Standing	-
	Future	8.4	Sitting	Unchanged	10.3	Standing	Unchanged
22	Existing	8.6	Sitting	-	11.4	Standing	-
	Future	8.0	Sitting	Unchanged	10.2	Standing	Unchanged
23	Existing	10.0	Sitting	-	12.1	Standing	-
	Future	9.5	Sitting	Unchanged	11.3	Standing	Unchanged
24	Existing	9.2	Sitting	-	11.6	Standing	-
	Future	8.2	Sitting	Unchanged	9.8	Sitting	Improved
25	Existing	8.0	Sitting	-	10.6	Standing	-
	Future	6.5	Sitting	Unchanged	8.2	Sitting	Improved
26	Existing	9.4	Sitting	-	13.1	Standing	-
	Future	6.6	Sitting	Unchanged	8.3	Sitting	Improved
27	Existing	6.6	Sitting	-	8.6	Sitting	-
	Future	6.4	Sitting	Unchanged	7.9	Sitting	Unchanged
28	Existing	9.0	Sitting	-	12.0	Standing	-
	Future	6.3	Sitting	Unchanged	7.6	Sitting	Improved
29	Existing	8.9	Sitting	-	11.9	Standing	-
	Future	6.4	Sitting	Unchanged	7.7	Sitting	Improved
30	Existing	8.8	Sitting	-	11.1	Standing	-
	Future	6.6	Sitting	Unchanged	7.8	Sitting	Improved

Guidelines	
Pedestrian Comfort	**20% exceedance wind speed** (0-10 km/h = Sitting, 10-15 km/h = Standing, 15-20 km/h = Walking, >20 km/h = Uncomfortable
Pedestrian Safety	**0.1% exceedance wind speed** 0-90 km/h = Safe

TABLE B3: COMPARATIVE SUMMARY OF PEDESTRIAN COMFORT

Sensor	Massing Scenario	Summer Pedestrian Comfort			Winter Pedestrian Comfort		
		Wind Speed (km/h) 80% data ≤	Predicted Comfort Class	Future Comfort Class Compared to Existing	Wind Speed (km/h) 80% data ≤	Predicted Comfort Class	Future Comfort Class Compared to Existing
31	Existing	9.4	Sitting	-	12.1	Standing	-
	Future	6.8	Sitting	Unchanged	8.2	Sitting	Improved
32	Existing	10.7	Standing	-	13.1	Standing	-
	Future	6.7	Sitting	Improved	7.9	Sitting	Improved
33	Existing	10.2	Standing	-	12.5	Standing	-
	Future	6.4	Sitting	Improved	7.6	Sitting	Improved
34	Existing	8.5	Sitting	-	9.9	Sitting	-
	Future	6.6	Sitting	Unchanged	8.1	Sitting	Unchanged
35	Existing	9.4	Sitting	-	12.0	Standing	-
	Future	10.2	Standing	Reduced	12.0	Standing	Unchanged
36	Existing	8.8	Sitting	-	11.6	Standing	-
	Future	8.0	Sitting	Unchanged	9.9	Sitting	Improved
37	Existing	9.1	Sitting	-	11.9	Standing	-
	Future	8.9	Sitting	Unchanged	11.1	Standing	Unchanged
38	Existing	9.5	Sitting	-	11.9	Standing	-
	Future	9.0	Sitting	Unchanged	11.4	Standing	Unchanged
39	Existing	9.8	Sitting	-	12.6	Standing	-
	Future	9.6	Sitting	Unchanged	12.0	Standing	Unchanged
40	Existing	8.6	Sitting	-	10.9	Standing	-
	Future	7.7	Sitting	Unchanged	9.1	Sitting	Improved
41	Existing	9.0	Sitting	-	11.4	Standing	-
	Future	6.8	Sitting	Unchanged	7.6	Sitting	Improved
42	Existing	9.3	Sitting	-	11.6	Standing	-
	Future	10.9	Standing	Reduced	13.2	Standing	Unchanged
43	Existing	9.0	Sitting	-	11.4	Standing	-
	Future	9.2	Sitting	Unchanged	11.9	Standing	Unchanged
44	Existing	10.2	Standing	-	13.4	Standing	-
	Future	8.5	Sitting	Improved	11.1	Standing	Unchanged
45	Existing	10.9	Standing	-	14.1	Standing	-
	Future	10.7	Standing	Unchanged	13.5	Standing	Unchanged

Guidelines	
Pedestrian Comfort	**20% exceedance wind speed** (0-10 km/h = Sitting, 10-15 km/h = Standing, 15-20 km/h = Walking, >20 km/h = Uncomfortable
Pedestrian Safety	**0.1% exceedance wind speed** 0-90 km/h = Safe

TABLE B4: COMPARATIVE SUMMARY OF PEDESTRIAN COMFORT

Sensor	Massing Scenario	Summer Pedestrian Comfort			Winter Pedestrian Comfort		
		Wind Speed (km/h) 80% data ≤	Predicted Comfort Class	Future Comfort Class Compared to Existing	Wind Speed (km/h) 80% data ≤	Predicted Comfort Class	Future Comfort Class Compared to Existing
46	Existing	10.9	Standing	-	14.2	Standing	-
	Future	7.6	Sitting	Improved	10.0	Sitting	Improved
47	Existing	10.4	Standing	-	13.4	Standing	-
	Future	12.1	Standing	Unchanged	16.5	Walking	Reduced
48	Existing	10.9	Standing	-	14.0	Standing	-
	Future	11.0	Standing	Unchanged	15.1	Walking	Reduced
49	Existing	9.6	Sitting	-	11.6	Standing	-
	Future	9.6	Sitting	Unchanged	12.7	Standing	Unchanged
50	Existing	10.9	Standing	-	13.4	Standing	-
	Future	9.9	Sitting	Improved	12.5	Standing	Unchanged
51	Existing	10.4	Standing	-	12.9	Standing	-
	Future	10.3	Standing	Unchanged	13.6	Standing	Unchanged
52	Existing	11.9	Standing	-	15.1	Walking	-
	Future	9.2	Sitting	Improved	12.5	Standing	Improved
53	Existing	12.5	Standing	-	15.7	Walking	-
	Future	9.0	Sitting	Improved	12.0	Standing	Improved
54	Existing	12.0	Standing	-	15.0	Standing	-
	Future	11.9	Standing	Unchanged	15.0	Standing	Unchanged
55	Existing	13.0	Standing	-	16.5	Walking	-
	Future	13.8	Standing	Unchanged	16.3	Walking	Unchanged
56	Existing	12.9	Standing	-	16.4	Walking	-
	Future	9.4	Sitting	Improved	11.3	Standing	Improved
57	Existing	12.1	Standing	-	15.1	Walking	-
	Future	9.7	Sitting	Improved	12.0	Standing	Improved
58	Existing	11.6	Standing	-	14.6	Standing	-
	Future	7.6	Sitting	Improved	9.4	Sitting	Improved
59	Existing	11.6	Standing	-	14.8	Standing	-
	Future	8.5	Sitting	Improved	12.5	Standing	Unchanged
60	Existing	12.3	Standing	-	15.5	Walking	-
	Future	8.4	Sitting	Improved	10.1	Standing	Improved

Guidelines	
Pedestrian Comfort	**20% exceedance wind speed** (0-10 km/h = Sitting, 10-15 km/h = Standing, 15-20 km/h = Walking, >20 km/h = Uncomfortable
Pedestrian Safety	**0.1% exceedance wind speed** 0-90 km/h = Safe

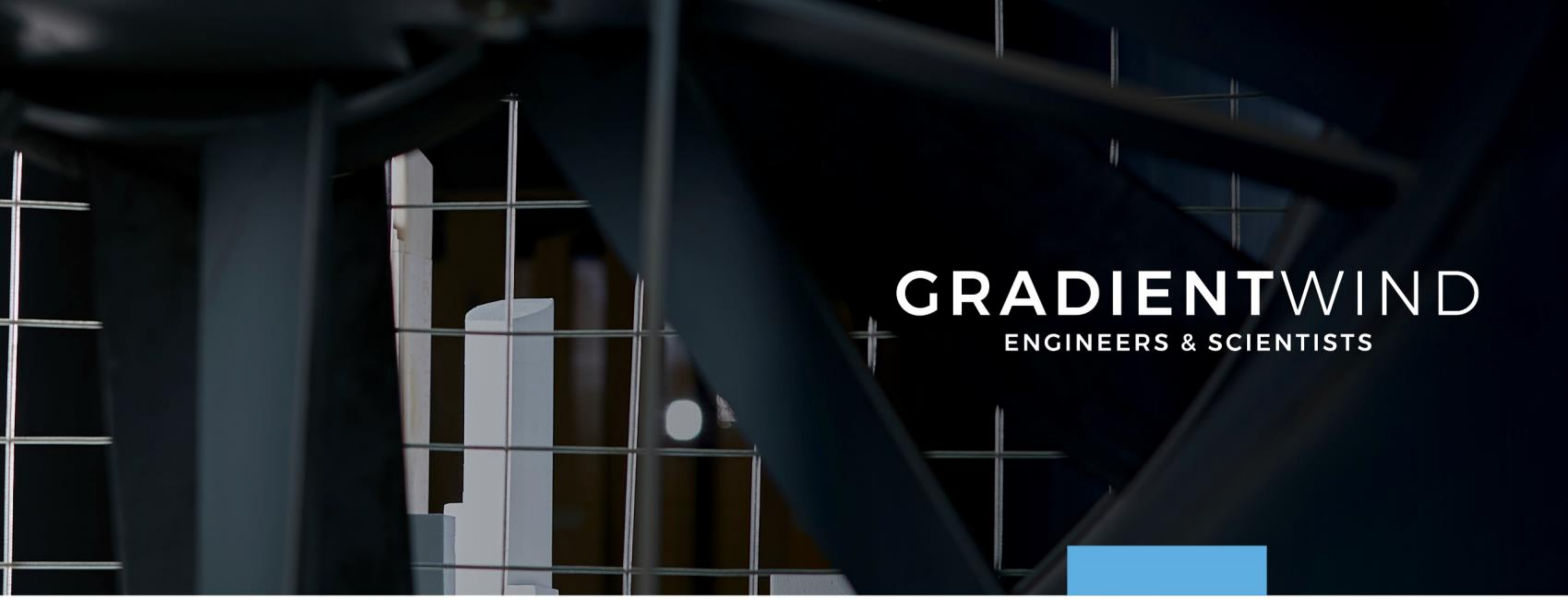
TABLE B5: COMPARATIVE SUMMARY OF PEDESTRIAN COMFORT

Sensor	Massing Scenario	Summer Pedestrian Comfort			Winter Pedestrian Comfort		
		Wind Speed (km/h) 80% data ≤	Predicted Comfort Class	Future Comfort Class Compared to Existing	Wind Speed (km/h) 80% data ≤	Predicted Comfort Class	Future Comfort Class Compared to Existing
61	Existing	12.6	Standing	-	15.7	Walking	-
	Future	11.6	Standing	Unchanged	15.0	Standing	Improved
62	Existing	12.5	Standing	-	15.7	Walking	-
	Future	8.1	Sitting	Improved	10.0	Sitting	Improved
63	Existing	11.2	Standing	-	14.0	Standing	-
	Future	7.6	Sitting	Improved	9.8	Sitting	Improved
64	Existing	12.7	Standing	-	16.1	Walking	-
	Future	9.2	Sitting	Improved	12.5	Standing	Improved
65	Existing	12.7	Standing	-	16.0	Walking	-
	Future	12.1	Standing	Unchanged	16.1	Walking	Unchanged
66	Existing	10.9	Standing	-	13.5	Standing	-
	Future	9.3	Sitting	Improved	13.3	Standing	Unchanged
67	Existing	10.8	Standing	-	13.1	Standing	-
	Future	7.9	Sitting	Improved	11.8	Standing	Unchanged
68	Existing	9.7	Sitting	-	12.9	Standing	-
	Future	6.8	Sitting	Unchanged	8.2	Sitting	Improved
69	Existing	9.8	Sitting	-	13.4	Standing	-
	Future	8.1	Sitting	Unchanged	9.9	Sitting	Improved
70	Existing	10.5	Standing	-	14.0	Standing	-
	Future	11.4	Standing	Unchanged	15.5	Walking	Reduced
71	Existing	7.1	Sitting	-	9.1	Sitting	-
	Future	8.1	Sitting	Unchanged	10.4	Standing	Reduced
72	Existing	5.6	Sitting	-	6.9	Sitting	-
	Future	6.2	Sitting	Unchanged	7.8	Sitting	Unchanged
73	Existing	10.0	Sitting	-	12.7	Standing	-
	Future	6.1	Sitting	Unchanged	7.5	Sitting	Improved
74	Existing	11.0	Standing	-	13.6	Standing	-
	Future	12.6	Standing	Unchanged	17.7	Walking	Reduced
75	Existing	11.0	Standing	-	14.0	Standing	-
	Future	10.3	Standing	Unchanged	13.0	Standing	Unchanged

Guidelines	
Pedestrian Comfort	**20% exceedance wind speed** (0-10 km/h = Sitting, 10-15 km/h = Standing, 15-20 km/h = Walking, >20 km/h = Uncomfortable
Pedestrian Safety	**0.1% exceedance wind speed** 0-90 km/h = Safe

TABLE B6: COMPARATIVE SUMMARY OF PEDESTRIAN COMFORT

Sensor	Massing Scenario	Summer Pedestrian Comfort			Winter Pedestrian Comfort		
		Wind Speed (km/h) 80% data ≤	Predicted Comfort Class	Future Comfort Class Compared to Existing	Wind Speed (km/h) 80% data ≤	Predicted Comfort Class	Future Comfort Class Compared to Existing
76	Existing	8.1	Sitting	-	10.3	Standing	-
	Future	7.9	Sitting	Unchanged	10.0	Sitting	Improved
77	Existing	8.8	Sitting	-	11.5	Standing	-
	Future	9.7	Sitting	Unchanged	11.9	Standing	Unchanged
78	Existing	5.4	Sitting	-	7.4	Sitting	-
	Future	5.9	Sitting	Unchanged	7.7	Sitting	Unchanged
79	Existing	7.6	Sitting	-	10.3	Standing	-
	Future	10.1	Standing	Reduced	12.3	Standing	Unchanged
80	Existing	4.7	Sitting	-	5.9	Sitting	-
	Future	6.8	Sitting	Unchanged	7.6	Sitting	Unchanged
81	Existing	9.3	Sitting	-	12.3	Standing	-
	Future	6.2	Sitting	Unchanged	7.6	Sitting	Improved
82	Existing	11.2	Standing	-	14.2	Standing	-
	Future	10.8	Standing	Unchanged	14.1	Standing	Unchanged
83	Existing	12.1	Standing	-	15.3	Walking	-
	Future	7.6	Sitting	Improved	9.5	Sitting	Improved
84	Existing	12.8	Standing	-	16.1	Walking	-
	Future	8.4	Sitting	Improved	9.9	Sitting	Improved
85	Existing	11.5	Standing	-	14.8	Standing	-
	Future	12.0	Standing	Unchanged	15.4	Walking	Reduced
86	Existing	10.2	Standing	-	12.8	Standing	-
	Future	10.5	Standing	Unchanged	13.7	Standing	Unchanged
87	Existing	8.7	Sitting	-	10.5	Standing	-
	Future	8.7	Sitting	Unchanged	10.1	Standing	Unchanged
88	Existing	12.0	Standing	-	15.3	Walking	-
	Future	11.5	Standing	Unchanged	17.3	Walking	Unchanged
89	Existing	12.3	Standing	-	15.6	Walking	-
	Future	9.5	Sitting	Improved	11.8	Standing	Improved
90	Existing	12.9	Standing	-	16.5	Walking	-
	Future	7.2	Sitting	Improved	9.0	Sitting	Improved



APPENDIX C

WIND TUNNEL SIMULATION OF THE NATURAL WIND

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WIND TUNNEL SIMULATION OF THE NATURAL WIND

Wind flowing over the surface of the earth develops a boundary layer due to the drag produced by surface features such as vegetation and man-made structures. Within this boundary layer, the mean wind speed varies from zero at the surface to the gradient wind speed at the top of the layer. The height of the top of the boundary layer is referred to as the gradient height, above which the velocity remains more-or-less constant for a given synoptic weather system. The mean wind speed is taken to be the average value over one hour. Superimposed on the mean wind speed are fluctuating (or turbulent) components in the longitudinal (i.e. along wind), vertical and lateral directions. Although turbulence varies according to the roughness of the surface, the turbulence level generally increases from nearly zero (smooth flow) at gradient height to maximum values near the ground. While for a calm ocean the maximum could be 20%, the maximum for a very rough surface such as the center of a city could be 100%, or equal to the local mean wind speed. The height of the boundary layer varies in time and over different terrain roughness within the range of 400 metres (m) to 600 m.

Simulating real wind behaviour in a wind tunnel requires simulating the variation of mean wind speed with height, simulating the turbulence intensity, and matching the typical length scales of turbulence. It is the ratio between wind tunnel turbulence length scales and turbulence scales in the atmosphere that determines the geometric scales that models can assume in a wind tunnel. Hence, when a 1:200 scale model is quoted, this implies that the turbulence scales in the wind tunnel and the atmosphere have the same ratios. Some flexibility in this requirement has been shown to produce reasonable wind tunnel predictions compared to full scale. In model scale the mean and turbulence characteristics of the wind are obtained with the use of spires at one end of the tunnel and roughness elements along the floor of the tunnel. The fan is located at the model end and wind is pulled over the spires, roughness elements and model. It has been found that, to a good approximation, the mean wind profile can be represented by a power law relation, shown below, giving height above ground versus wind speed.

$$U = U_g \left(\frac{Z}{Z_g} \right)^{\alpha}$$

Where; $\boldsymbol{U}$ = mean wind speed, $\boldsymbol{U_g}$ = gradient wind speed, $\boldsymbol{Z}$ = height above ground, $\boldsymbol{Z_g}$ = depth of the boundary layer (gradient height) and α is the power law exponent.

Figure B1 on the following page plots three velocity profiles for open country, and suburban and urban exposures.

The exponent α varies according to the type of upwind terrain; α ranges from 0.14 for open country to 0.33 for an urban exposure. Figure C2 illustrates the theoretical variation of turbulence for open country, suburban and urban exposures.

The integral length scale of turbulence can be thought of as an average size of gust in the atmosphere. Although it varies with height and ground roughness, it has been found to generally be in the range of 100 m to 200 m in the upper half of the boundary layer. Thus, for a 1:300 scale, the model value should be between 1/3 and 2/3 of a metre. Integral length scales are derived from power spectra, which describe the energy content of wind as a function of frequency. There are several ways of determining integral length scales of turbulence. One way is by comparison of a measured power spectrum in model scale to a non-dimensional theoretical spectrum such as the Davenport spectrum of longitudinal turbulence. Using the Davenport spectrum, which agrees well with full-scale spectra, one can estimate the integral scale by plotting the theoretical spectrum with varying L until it matches as closely as possible the measured spectrum:

$$f \times S(f) = \frac{\dfrac{4(Lf)^2}{U_{10}{}^2}}{\left[1 + \dfrac{4(Lf)^2}{U_{10}{}^2}\right]^{\frac{4}{3}}}$$

Where, f is frequency, S(f) is the spectrum value at frequency f, U10 is the wind speed 10 m above ground level, and L is the characteristic length of turbulence.

Once the wind simulation is correct, the model, constructed to a suitable scale, is installed at the center of the working section of the wind tunnel. Different wind directions are represented by rotating the model to align with the wind tunnel center-line axis.

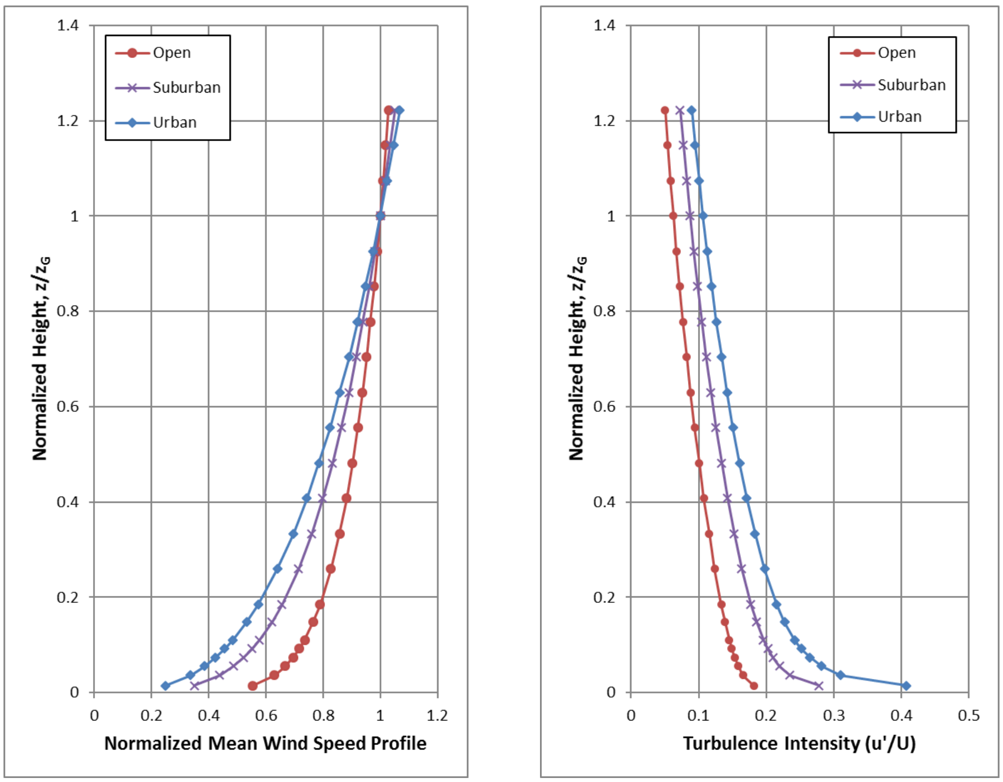

FIGURE C1 (LEFT): MEAN WIND SPEED PROFILES;
FIGURE C2 (RIGHT): TURBULENCE INTENSITY PROFILES

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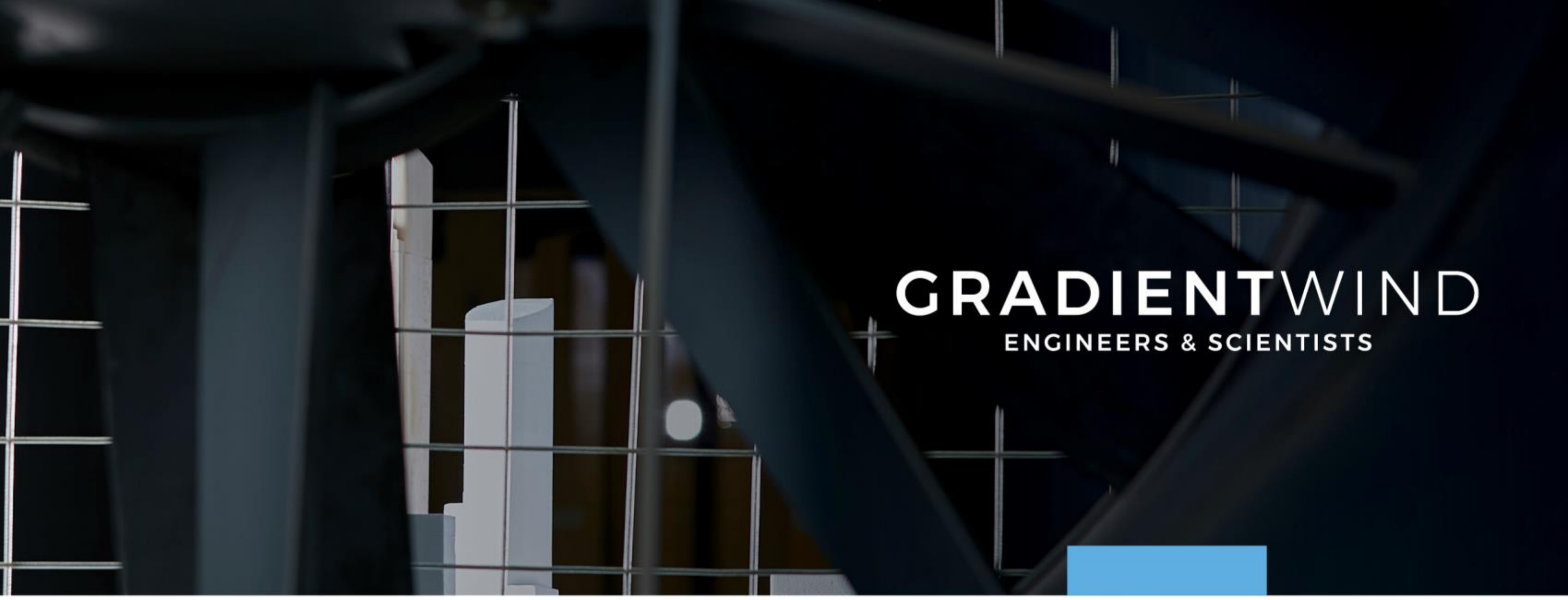

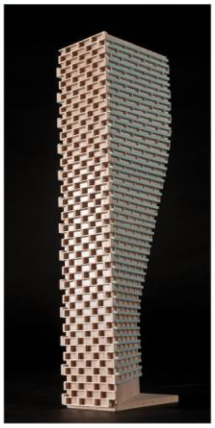

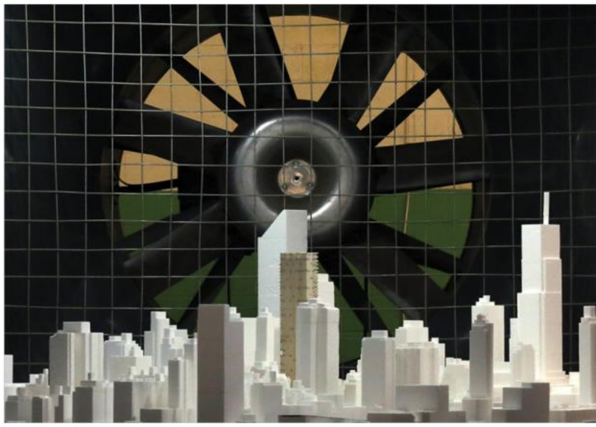

APPENDIX D

PEDESTRIAN LEVEL WIND MEASUREMENT METHODOLOGY

PEDESTRIAN LEVEL WIND MEASUREMENT METHODOLOGY

Pedestrian level wind studies are performed in a wind tunnel on a physical model of the study buildings at a suitable scale. Instantaneous wind speed measurements are recorded at a model height corresponding to 1.5 m full scale using either a hot wire anemometer or a pressure-based transducer. Measurements are performed at any number of locations on the model and usually for 36 wind directions. For each wind direction, the roughness of the upwind terrain is matched in the wind tunnel to generate the correct mean and turbulent wind profiles approaching the model.

The hot wire anemometer is an instrument consisting of a thin metallic wire conducting an electric current. It is an omni-directional device equally sensitive to wind approaching from any direction in the horizontal plane. By compensating for the cooling effect of wind flowing over the wire, the associated electronics produce an analog voltage signal that can be calibrated against velocity of the air stream. For all measurements, the wire is oriented vertically so as to be sensitive to wind approaching from all directions in a horizontal plane.

The pressure sensor is a small cylindrical device that measures instantaneous pressure differences over a small area. The sensor is connected via tubing to a transducer that translates the pressure to a voltage signal that is recorded by computer. With appropriately designed tubing, the sensor is sensitive to a suitable range of fluctuating velocities.

For a given wind direction and location on the model, a time history of the wind speed is recorded for a period of time equal to one hour in full-scale. The analog signal produced by the hot wire or pressure sensor is digitized at a rate of 400 samples per second. A sample recording for several seconds is illustrated in Figure D1. This data is analyzed to extract the mean, root-mean-square (rms) and the peak of the signal. The peak value, or gust wind speed, is formed by averaging a number of peaks obtained from sub-intervals of the sampling period. The mean and gust speeds are then normalized by the wind tunnel gradient wind speed, which is the speed at the top of the model boundary layer, to obtain mean and gust ratios. At each location, the measurements are repeated for 36 wind directions to produce normalized polar plots, which will be provided upon request.

In order to determine the duration of various wind speeds at full scale for a given measurement location the gust ratios are combined with a statistical (mathematical) model of the wind climate for the project site. This mathematical model is based on hourly wind data obtained from one or more meteorological stations (usually airports) close to the project location. The probability model used to represent the data is the Weibull distribution expressed as:

$$P\left(>U_g\right) = A_\theta \bullet \exp\left[\left(-\frac{U_g}{C_\theta}\right)^{K_\theta}\right]$$

Where,

P (> $\boldsymbol{U_g}$***)*** is the probability, fraction of time, that the gradient wind speed $\boldsymbol{U_g}$ is exceeded; $\boldsymbol{\theta}$ is the wind direction measured clockwise from true north, ***A***, ***C***, ***K*** are the Weibull coefficients, (Units: A - dimensionless, C - wind speed units [km/h] for instance, K - dimensionless). $\boldsymbol{A_\theta}$ is the fraction of time wind blows from a 10° sector centered on $\boldsymbol{\theta}$.

Analysis of the hourly wind data recorded for a length of time, on the order of 10 to 30 years, yields the $\boldsymbol{A_\theta}$, $\boldsymbol{C_\theta}$ and $\boldsymbol{K_\theta}$ values. The probability of exceeding a chosen wind speed level, say 20 km/h, at sensor *N* is given by the following expression:

$$P_N(>20) = \Sigma_\theta P\left[\frac{(>20)}{\left(\frac{U_N}{U_g}\right)}\right]$$

$$\boldsymbol{P_N (> 20) \quad = \quad \Sigma_\theta P \{ > 20/(U_N/Ug) \}}$$

Where, $\boldsymbol{U_N/U_g}$ is the gust velocity ratios, where the summation is taken over all 36 wind directions at 10° intervals.

If there are significant seasonal variations in the weather data, as determined by inspection of the C_θ and K_θ values, then the analysis is performed separately for two or more times corresponding to the groupings of seasonal wind data. Wind speed levels of interest for predicting pedestrian comfort are based on the comfort guidelines chosen to represent various pedestrian activity levels as discussed in the main text.

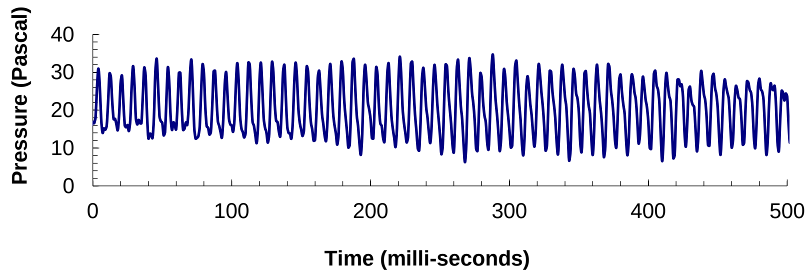

FIGURE D1: TIME VERSUS VELOCITY TRACE FOR A TYPICAL WIND SENSOR

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