



March 19, 2026

Reference: **Subject: Wind Mitigation**
 Project: Mohawk Road

A preliminary wind study has been completed to assess pedestrian-level wind conditions for the proposed development. The study identified areas requiring further mitigation, the project team is actively reviewing these locations and exploring additional measures, including refinements to building form, targeted interventions, and enhanced landscape strategies.

The building massing and site layout have been developed with mitigation in mind, including podium elements to reduce downdraft and tower spacing and orientation to limit wind corridors. Step backs, balconies, and façade articulation help break down wind flow, while canopies, recessed entrances, and landscaping provide additional shelter at grade.

The project team will continue to refine the design in consultation with wind consultants and City staff to achieve appropriate pedestrian-level wind conditions.

Regards,
Przemyslaw (Shem) Myszkowski, Architect, President
A.T. Dipl., B.A.S., M. Arch., OAA, MRAIC

**PEDESTRIAN LEVEL
WIND STUDY**

416 Mohawk Road East,
Hamilton, Ontario

REPORT: GW26-023-WTPLW



March 11, 2026

DRAFT

PREPARED FOR

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EXECUTIVE SUMMARY

This report describes a pedestrian level wind study undertaken to assess wind conditions for a proposed mixed-use multi-phase development located at 416 Mohawk Road East in Hamilton, Ontario. In support of a Site Plan Control (SPA) application submission, 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, schoolyards, nearby transit stops, and building access points. Wind comfort is also evaluated over the various elevated terraces. 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 Hamilton wind criteria, architectural drawings provided by KNYMH Inc. in February 2026, 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-6B, as well as Tables A1-A3 and B1-B4 in the appendices. Based on wind tunnel test results, meteorological data analysis, and experience with similar developments in the area, we conclude that conditions over many grade level pedestrian-sensitive areas within and surrounding the development site will be acceptable for the intended pedestrian uses on an annual and seasonal basis. Exceptions include areas between the towers, various building exits, and some retail entrances, for which mitigation is recommended as described in Section 5.2.

The Tower B level 4 terrace is expected to experience wind conditions comfortable for sitting or more sedentary activities during the summer months, without the need for mitigation. Depending on the intended use of the remaining terraces, mitigation is recommended as described in Section 5.2.



Within the context of typical weather patterns, which exclude anomalous localized storm events such as tornadoes and downbursts, no areas over the study site, apart from the Tower B northwest corner, were found to experience conditions that are uncomfortable for walking or could be considered unsafe.



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1. INTRODUCTION

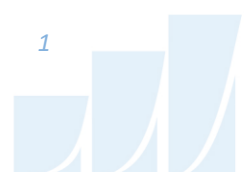
This report describes a pedestrian level wind study undertaken to assess wind conditions for a proposed mixed-use multi-phase development located at 416 Mohawk Road East in Hamilton, Ontario, in support of a Site Plan Control (SPA) application submission. Two conditions were studied: (i) existing conditions, including all approved, surrounding developments and without the proposed development, and (ii) conditions with the proposed development in place. The study was performed in accordance with industry standard wind tunnel testing techniques, City of Hamilton wind criteria, architectural drawings provided by KNYMH Inc. in February 2026, 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 multi-phase development located at 416 Mohawk Road East in Hamilton, Ontario. The study site is situated at the south corner of the intersection of Mohawk Road East and Mall Road.

The proposed development comprises Phases 1, 2, and 3, respectively aligned south-north, relative to Project north, along Mall Road. A driveway connecting to Mall Road, separating Phase 1 from Phase 2, and continuing along the east perimeter of the site provides access to loading areas, surface parking, and underground parking ramps located at the central north of Phase 1 and the northeast of Phase 2. Phase 1 comprises a 19-storey tower (Tower A) rising from a 6-storey podium. The ground floor comprises retail spaces along the west elevation fronting Mall Road, a residential lobby to the central north, an indoor amenity with an adjacent outdoor amenity to the south, and building support services in the remaining spaces. The levels above are reserved for residential use. At Level 7, the floorplate steps back to the typical tower floorplate, above which the tower rises uniformly to its full height, with an additional stepback from the west elevation at Level 17.

Phase 2 comprises a 20-storey tower (Tower B) with a stepped 6-storey podium of approximately rectangular planform. The ground floor comprises a retail space along the north end of the west elevation fronting Mall Road, a central residential lobby accessed at the southwest and southeast corners, and building support services in the remaining spaces. Levels 2 and 3 comprise residential spaces along the



west elevation and parking spaces elsewhere. The above Levels are reserved for residential occupancy. At Level 4, the floorplate steps back from the east, accommodating a rooftop terrace. The podium rises to Level 7, where the floorplate steps back to the typical tower's floorplate and rises uniformly to the full height.

Phase 3 comprises a 13-storey tower (Tower C) with a 4-storey podium of approximately rectangular planform. The ground floor comprises retail spaces along the north and west elevations, a residential lobby accessed at the central north and south, and indoor amenities and service spaces in the remaining spaces. The levels above are reserved for residential use. At Level 5, the podium steps back to the typical tower's floorplate and rises uniformly to the full height, with an additional step back from the north at Level 11.

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 predominantly by low-rise buildings in all directions, with the Our Lady of Lourdes Catholic Elementary School to the east of the site. The far-field surroundings (defined as the area beyond the near field and within a two-kilometer radius) comprise predominantly suburban exposure in all directions with isolated mid-rise buildings to the east and west along Mohawk Road East.

Grade-level areas investigated include sidewalks, walkways, laneways, parking areas, landscaped spaces, outdoor amenity areas, schoolyards, nearby transit stops, and building access points. Wind comfort is also evaluated over the various elevated terraces. 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

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 Hamilton area wind climate and synthesis of wind tunnel data with industry-accepted guidelines. 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, 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 123 sensor locations on the scale model in Gradient Wind's wind tunnel, with 100 sensors located at grade and the remaining 23 sensors over the various elevated terraces. Wind speed measurements were performed for each of the 123 sensors for 36 wind directions at 10° intervals. Figures 1A and 6B 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 6B.

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.

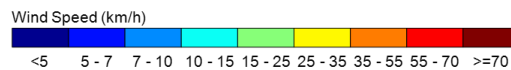
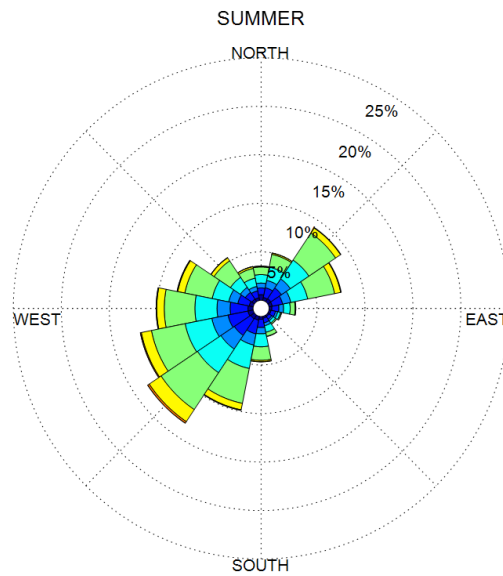
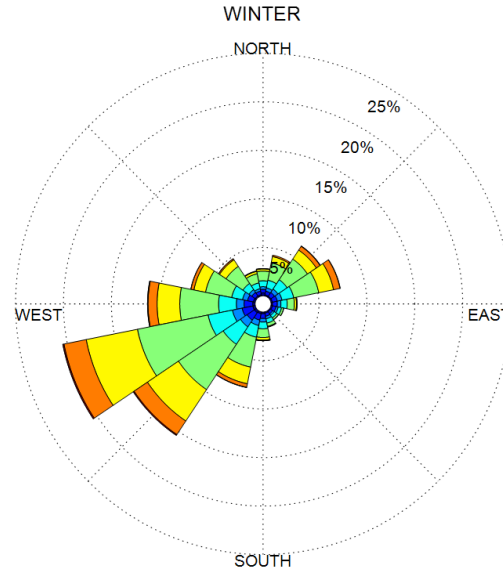
4.3 Meteorological Data Analysis

A statistical model for winds in Hamilton was developed from approximately 40-years of hourly meteorological wind data recorded at John C. Munro Hamilton 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. Following the Terms of Reference: Pedestrian Level Wind Study for Downtown Hamilton, the year is represented by a two-season model, and not according to the traditional calendar method.

The statistical model of the Hamilton 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 Hamilton, the most common winds concerning pedestrian comfort occur from the southwest, followed by those from the northeast. The directional preference and relative magnitude of the wind speed varies somewhat from season to season, with the summer months displaying calmer winds relative to the winter.



SEASONAL DISTRIBUTION OF WINDS FOR VARIOUS PROBABILITIES JOHN C. MUNRO HAMILTON INTERNATIONAL AIRPORT, HAMILTON, 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. Four pedestrian comfort classes are based on 80% non-exceedance Guest Equivalent Mean (GEM) wind speed ranges, which include (i) Sitting; (ii) Standing; (iii) Strolling; (iv) Walking; and (v) Uncomfortable. More specifically, the comfort classes and associated GEM wind speed ranges are summarized as follows:

- (i) **Sitting** – A wind speed below 10 km/h (i.e. 0 – 10 km/h) would be considered acceptable for sedentary activities, including sitting.
- (ii) **Standing** – A wind speed below 14 km/h (i.e. 10 km/h – 14 km/h) is acceptable for activities such as standing.
- (iii) **Strolling** – A wind speed below 17 km/h (i.e. 14 km/h – 17 km/h) is acceptable for activities such as strolling.
- (iv) **Walking** – A wind speed below 20 km/h (i.e. 17 km/h – 20 km/h) is acceptable for walking or more vigorous activities.
- (v) **Uncomfortable** – A wind speed over 20 km/h is classified as uncomfortable from a pedestrian comfort standpoint. Brisk walking and exercise, such as jogging, would be acceptable for moderate excesses of this criterion.

The pedestrian safety wind speed guideline is based on the approximate threshold that would cause a vulnerable member of the population to fall. A 0.1% exceedance gust wind speed of greater than 90 km/h is classified as dangerous.

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 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 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 at tested locations, 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 represented by the sensor (i.e. a sidewalk, building entrance, amenity space, or other). An overview of common pedestrian location types and their desired comfort classes are summarized below.

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 / Strolling
Outdoor Amenity Spaces	Sitting / Standing
Cafés / Patios / Benches / Gardens	Sitting / Standing / Strolling
Plazas	Strolling
Transit Stops	Standing
Public Parks	Sitting - Walking
Garage / Service Entrances	Walking
Vehicular Drop-Off Zones	Walking
Laneways / Loading Zones	Walking

5. RESULTS AND DISCUSSION

Tables A1-A3 in Appendix A provide a summary of seasonal comfort predictions for each sensor location under the *existing* massing scenario. Similarly, Tables B1-B4 in Appendix B provide the seasonal comfort predictions for under the *proposed* massing scenario. The tables indicate the 80% non-exceedance GEM wind speeds and corresponding comfort classifications as defined in Section 4.4. In other words, a wind speed threshold of 19.1 for the summer season indicates that 80% of the measured data falls at or below

19.1 km/h during the summer months and conditions are therefore suitable for walking, as the 80% threshold value falls within the exceedance range of 17-20 km/h for walking. 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, strolling, walking, etc.).

The most significant findings of the PLW study are summarized in Sections 5.1 and 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 6B. Conditions suitable for sitting are represented by the colour blue, while standing is represented by green, strolling by yellow, and walking by orange. Conditions considered uncomfortable for walking are represented by the colour magenta.

5.1 Pedestrian Comfort Suitability – Existing Scenario

Based on the analysis of the measured data, consideration of local climate data, and the suitability descriptors provided in Tables A1-A3 in Appendix A and illustrated in Figures 2A through 2B, this section summarizes the significant findings of the PLW study with respect to the *existing scenario*, as follows:

1. All public sidewalks, walkways, laneways, parking areas, and landscaped spaces within and surrounding the proposed development currently experience wind conditions suitable for walking or better during each seasonal period, with most comfortable for strolling or better.
2. The nearby transit stops along the Mohawk Road East (Sensors 2 & 42) are currently suitable for standing during the summer, with the north transit stop (Sensor 2) suitable for strolling during the winter.
3. The primary entrance to the existing Villa Kiev Apartments at 18 Mall Road, southwest of the site (Sensor 36), is currently suitable for standing or better throughout the year.
4. The tested areas of the Our Lady of Lourdes Catholic Elementary School yard, southeast of the site (Sensors 15-17 & 22), currently experiences wind conditions largely suitable for sitting during the summer months and strolling or better during the winter months.
5. 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 wind conditions that are considered unsafe.



5.2 Pedestrian Comfort Suitability – *Proposed Scenario*

Based on the analysis of the measured data, consideration of local climate data, and the suitability descriptors provided in Tables B1-B4 in Appendix B and illustrated in Figures 3A through 6B, this section summarizes the significant findings of the PLW study with respect to the *proposed scenario*, as follows:

1. Most public sidewalks, walkways, laneways, landscaped spaces, and parking areas 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 space. Exceptions include portions of sidewalks along Mall Road (Sensors 44 & 48), the northwest corners of Towers A, B, and C (Sensors 69, 85, and 45, respectively), the areas between the towers (Sensors 65-68, 70, 83, 89, 90, & 92-94), and an isolated landscaped area to the southeast of Tower A (Sensor 25), where conditions intermittently transition to uncomfortable for walking during the winter months, with the area denoted by Sensor 67 also experiencing uncomfortable conditions during the summer. Additionally, the northwest corner of Tower B (Sensor 85) will exceed the annual safety criterion, as defined in Section 4.4.

For the isolated landscaped area southeast of Tower A (Sensor 25), the uncomfortable conditions are limited to the colder months, are considered marginal, and wind speeds remain safe, as defined in Section 4.4. Therefore, these conditions are considered acceptable.

For the remaining uncomfortable areas towards the northwest corners of the towers and between the buildings, the low-rise surroundings of the area combined with the orientation of the towers results in the prominent southwest and northeast winds accelerating around the building corners and between the towers, likely causing down-washing. To improve these uncomfortable and dangerous conditions, it is recommended to cluster or flank the northwest building corners with targeted wind barriers to mitigate accelerated corner winds, and it is recommended to provide targeted wind barriers along the south and north sides of the laneways, angled perpendicular to the southwest, to mitigate channelled winds between the buildings. Barriers may take the form of dense coniferous plantings in planters, high-solidity wind screens, or a combination thereof, and should measure at least 2.0 metres tall. It is further recommended to provide canopies along the north and south sides of the adjacent building faces, to deflect potential down-washing. The exact composition and configuration of such mitigation can be

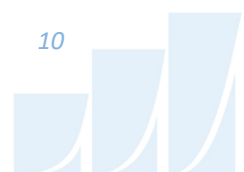


refined as the design progresses. Given the severity of the wind conditions, it may also be beneficial to consider building massing changes, such as deeper low-rise setbacks, or angling the orientation of the towers, to mitigate the predicted uncomfortable and dangerous conditions.

2. Most primary access points throughout the proposed development will be comfortable for standing or better throughout the year, which is acceptable. Exceptions include the retail entrances near the northwest corners of Tower B (Sensor 85) and Tower C (Sensors 45 & 46), which exceed the standing criterion during the winter months. It is recommended that these entrances either be recessed within the building façade, or flanked with vertical 1.8-metre-tall wind barriers, such as wind screens or tall coniferous plantings. It is notable that many residential and retail entrances throughout the site are currently recessed within the building façade, and will not require further mitigation.

Most secondary building access points (including vehicular entrances, building exits, and loading areas) will be suitable for walking or better on a seasonal basis, which is appropriate. Exceptions include the below-grade parking entrance north of Tower B (Sensor 83), and various access points along the south elevation of Tower C (Sensors 92-94), which become uncomfortable for walking during the winter months. Notably, the mitigation recommended in 5.2.1 is expected to improve the noted conditions. Therefore, further mitigation along this laneway is likely not necessary.

3. The outdoor amenity along the south elevation of Tower A (Sensors 55-59) will be suitable for sitting or more sedentary activities during the summer months and generally standing or better during the winter months, which is appropriate for the intended use.
4. The nearby transit stops along the Mohawk Road East (Sensors 2 & 42) will be suitable for standing during the summer months and exceed the standing criterion during the winter months. These stops are currently equipped with transit shelters, so further mitigation is not necessary.
5. The primary entrance to the existing Villa Kiev Apartments at 18 Mall Road, southwest of the site (Sensor 36), will be suitable for standing during the summer months and strolling during the winter months. Notably, the exceedance of the standing criterion is marginal (0.8km/h; See Appendix B), and the entrance is currently flanked by plantings and equipped with a canopy. Therefore, further mitigation is not required.



6. The tested areas of the Our Lady of Lourdes Catholic Elementary School yard, southeast of the site (Sensors 15-17 & 22), will experience wind conditions suitable for sitting during the summer months, and standing or better during the winter months, which is acceptable and represents a marginal improvement over the *existing* conditions.
7. Regarding the elevated terraces, the Tower B Level 4 outdoor amenity terrace (Sensors 108-114) will be suitable for sitting or more sedentary activities throughout the summer months, which is acceptable.

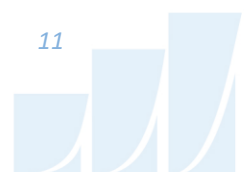
The remaining terraces (Sensors 101-107 & 115-123) will experience a range of conditions from sitting to walking during the summer. Should any of these terraces be utilized as outdoor amenity space, mitigation in the form of raised perimeter guards, localized wind barriers within the landscape plans, and overhead protection such as canopies or pergolas will be necessary, and can be coordinated with the design team, as required.

8. Within the context of typical weather patterns, which exclude anomalous localized storm events such as tornadoes and downbursts, no areas over the study site, apart from the noted Tower B northwest corner, were found to experience wind conditions that are considered unsafe.

6. CONCLUSIONS AND RECOMMENDATIONS

This report summarizes the methodology, results, and recommendations related to a pedestrian level wind study for a proposed mixed-use development located at 416 Mohawk Road East in Hamilton, 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-6B, as well as Tables A1-A3 and B1-B4 in the appendices. Based on wind tunnel test results, meteorological data analysis, and experience with similar developments in the area, we conclude that conditions over many grade level pedestrian-sensitive areas within and surrounding the development site will be acceptable for the intended pedestrian uses on an annual and seasonal basis. Exceptions include areas between the towers, various building exits, and some retail entrances, for which mitigation is recommended as described in Section 5.2.



The Tower B level 4 terrace is expected to experience wind conditions comfortable for sitting or more sedentary activities during the summer months, without the need for mitigation. Depending on the intended use of the remaining terraces, mitigation is recommended as described in Section 5.2.

Within the context of typical weather patterns, which exclude anomalous localized storm events such as tornadoes and downbursts, no areas over the study site, apart from the Tower B northwest corner, were found to experience conditions that are uncomfortable for walking or could be considered unsafe.

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

Sincerely,

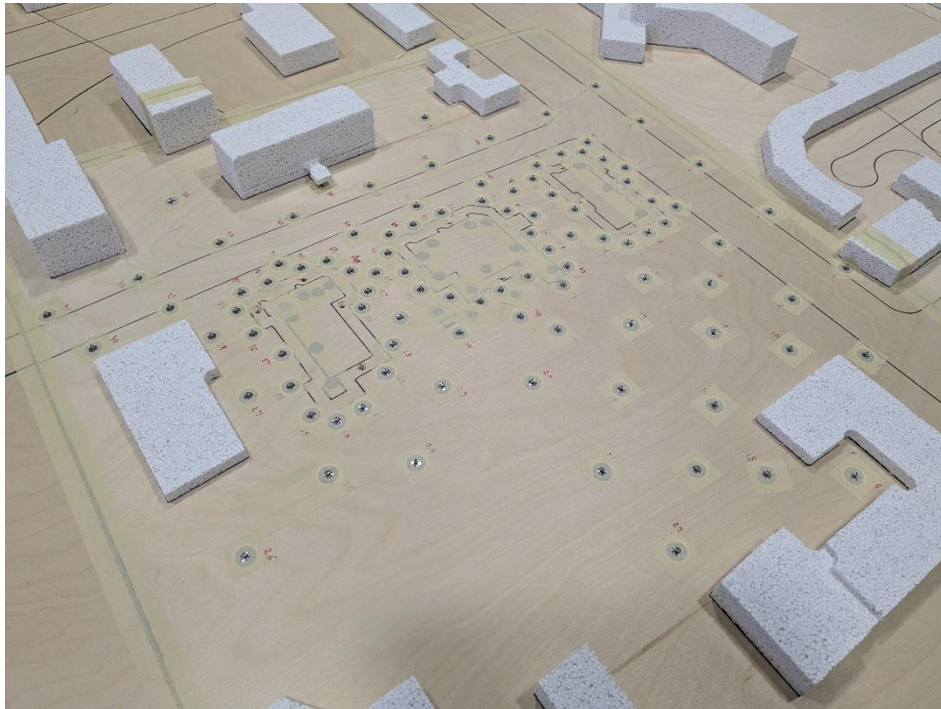
Gradient Wind Engineering Inc.

Cristiano Kondo, MEng., P.Eng.,
Wind Engineer

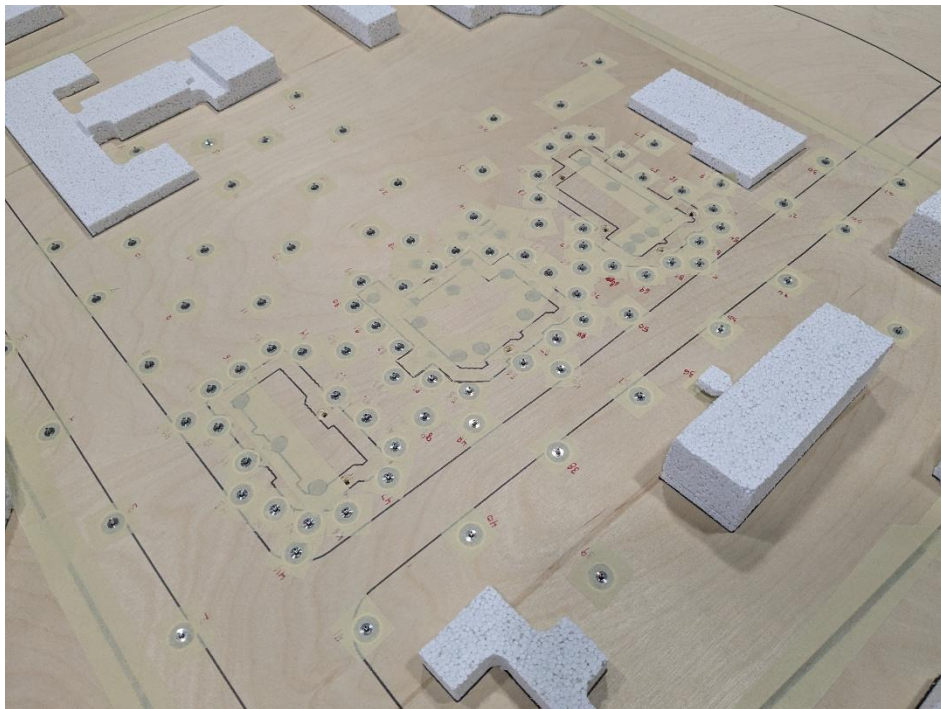
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Angelina Gomes, P.Eng.,
Wind Engineer



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

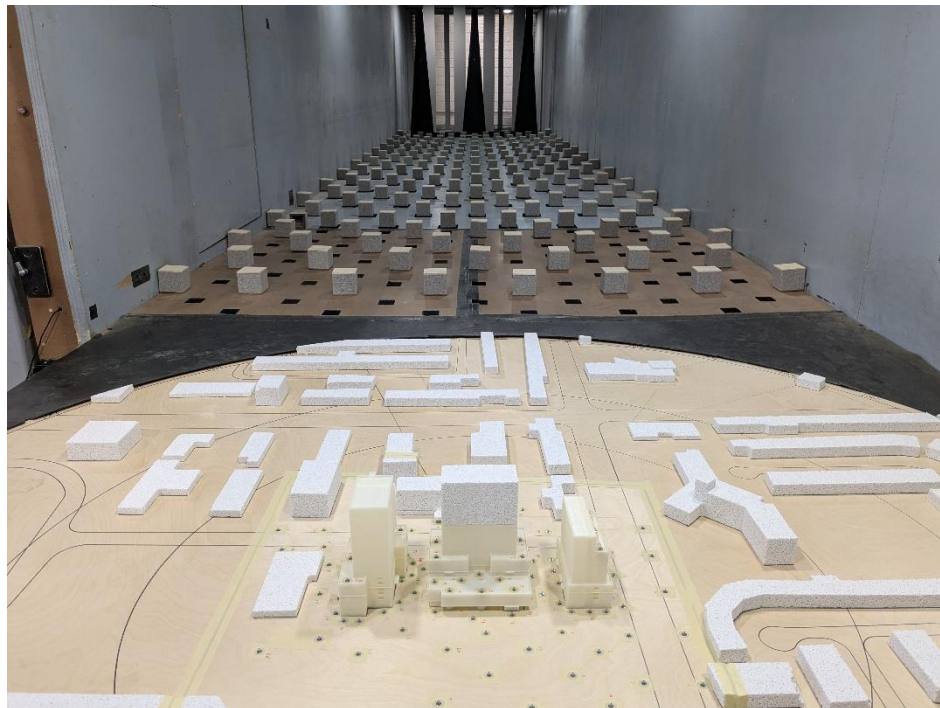


PHOTOGRAPH 2: CLOSE-UP VIEW OF EXISTING CONTEXT MODEL LOOKING SOUTH





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

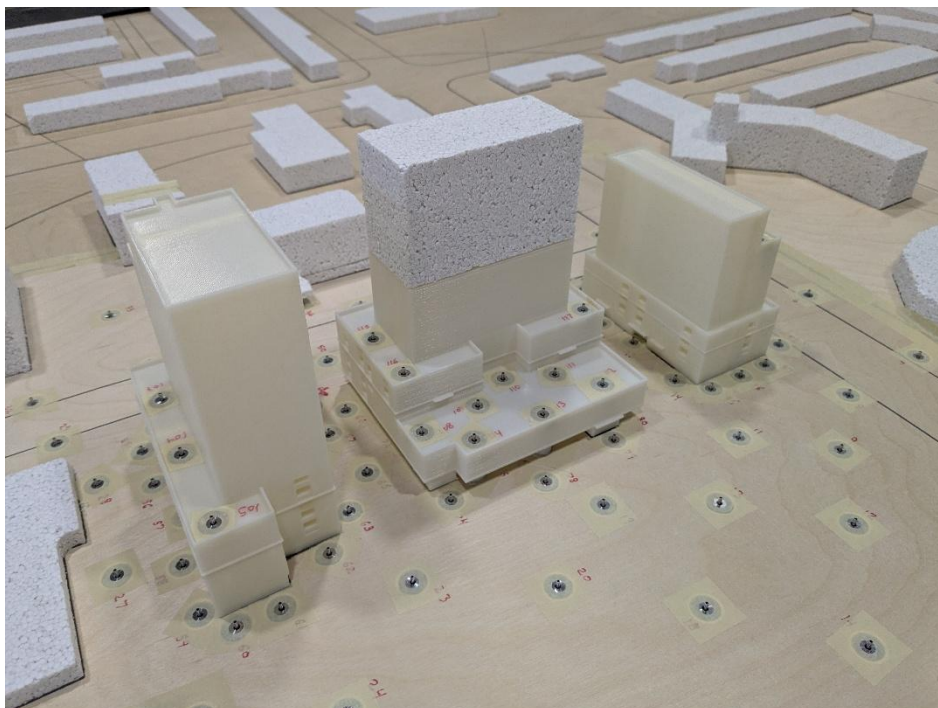


PHOTOGRAPH 4: PROPOSED STUDY MODEL INSIDE THE GWE WIND TUNNEL LOOKING UPWIND



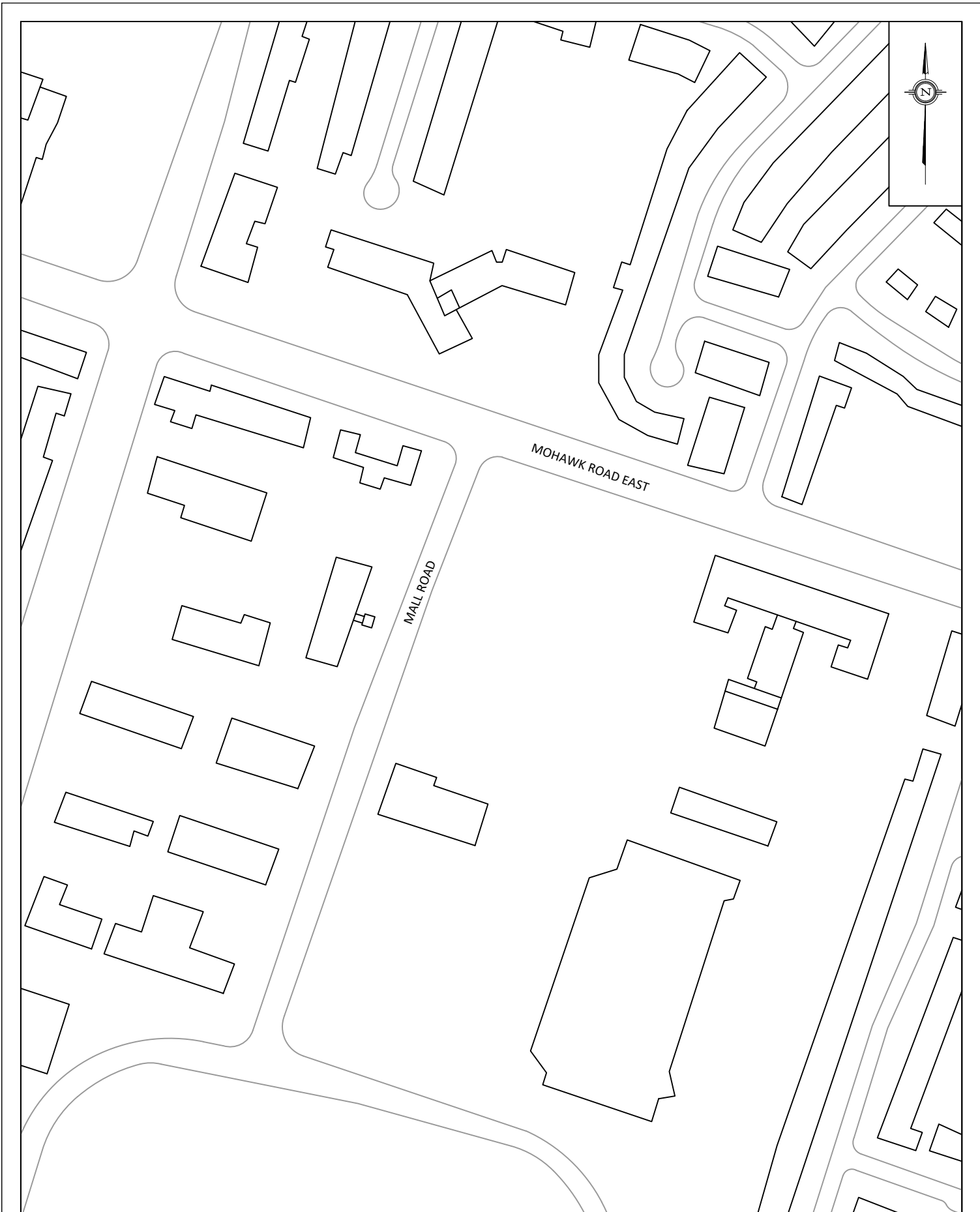


PHOTOGRAPH 5: CLOSE-UP VIEW OF STUDY MODEL LOOKING SOUTH



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





PROJECT	416 MOHAWK ROAD, HAMILTON PEDESTRIAN LEVEL WIND STUDY	
SCALE	1:2500 (APPROX.)	DRAWING NO. GW26-023-PLW-1A
DATE	MARCH 11, 2026	DRAWN BY C.E.



GRADIENTWIND
ENGINEERS & SCIENTISTS

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PROJECT

416 MOHAWK ROAD, HAMILTON
PEDESTRIAN LEVEL WIND STUDY

SCALE

1:2500 (APPROX.)

DRAWING NO.

GW26-023-PLW-1B

DATE

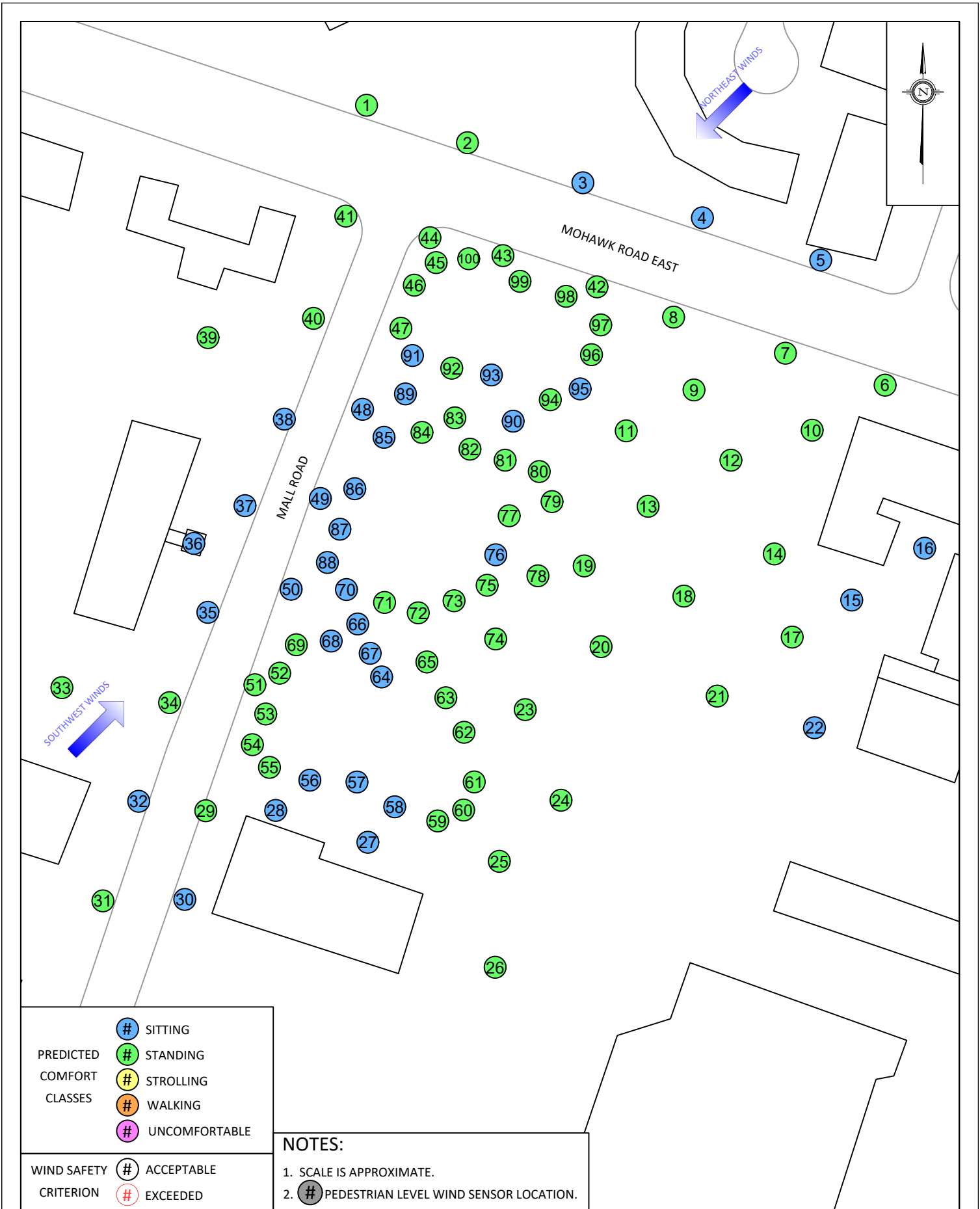
MARCH 11, 2026

DRAWN BY

C.E.

DESCRIPTION

FIGURE 1B:
PROPOSED SITE PLAN
AND SURROUNDING CONTEXT

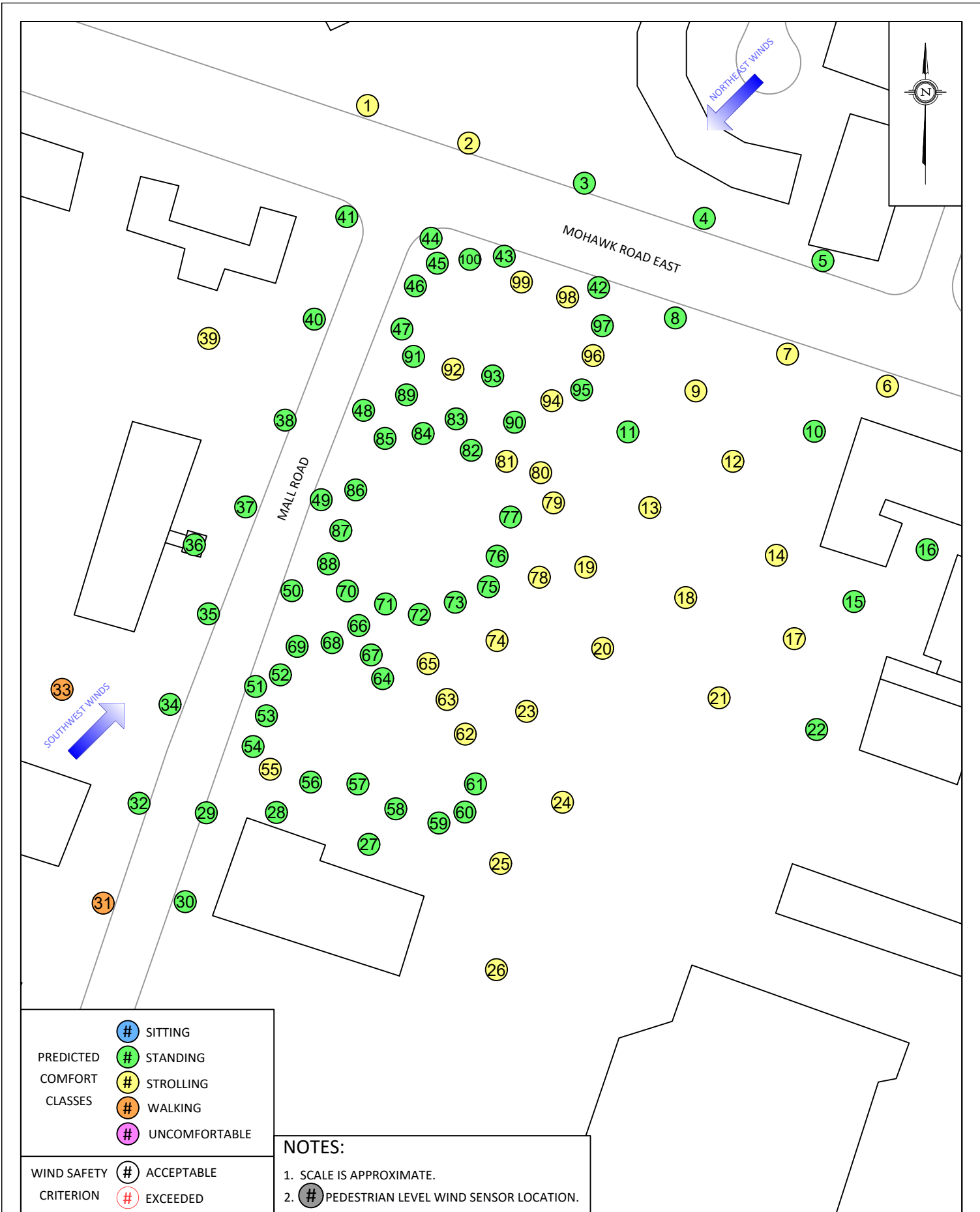


	#	SITTING
PREDICTED	#	STANDING
COMFORT	#	STROLLING
CLASSES	#	WALKING
	#	UNCOMFORTABLE

WIND SAFETY	#	ACCEPTABLE
CRITERION	#	EXCEEDED

NOTES:

- SCALE IS APPROXIMATE.
- # PEDESTRIAN LEVEL WIND SENSOR LOCATION.

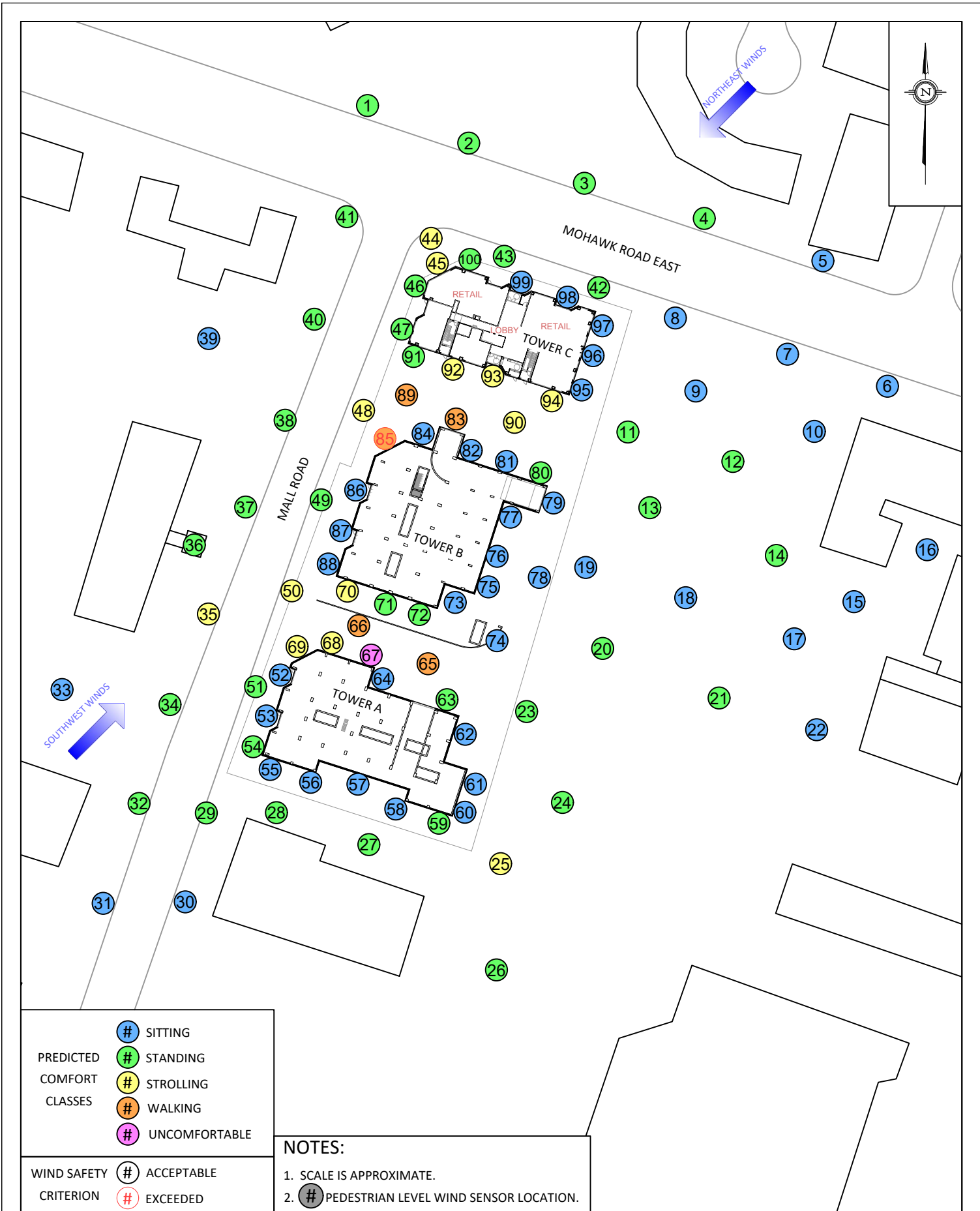


	(#) SITTING
PREDICTED	(#) STANDING
COMFORT	(#) STROLLING
CLASSES	(#) WALKING
	(#) UNCOMFORTABLE

WIND SAFETY	(#) ACCEPTABLE
CRITERION	(#) EXCEEDED

NOTES:

- SCALE IS APPROXIMATE.
- (#) PEDESTRIAN LEVEL WIND SENSOR LOCATION.

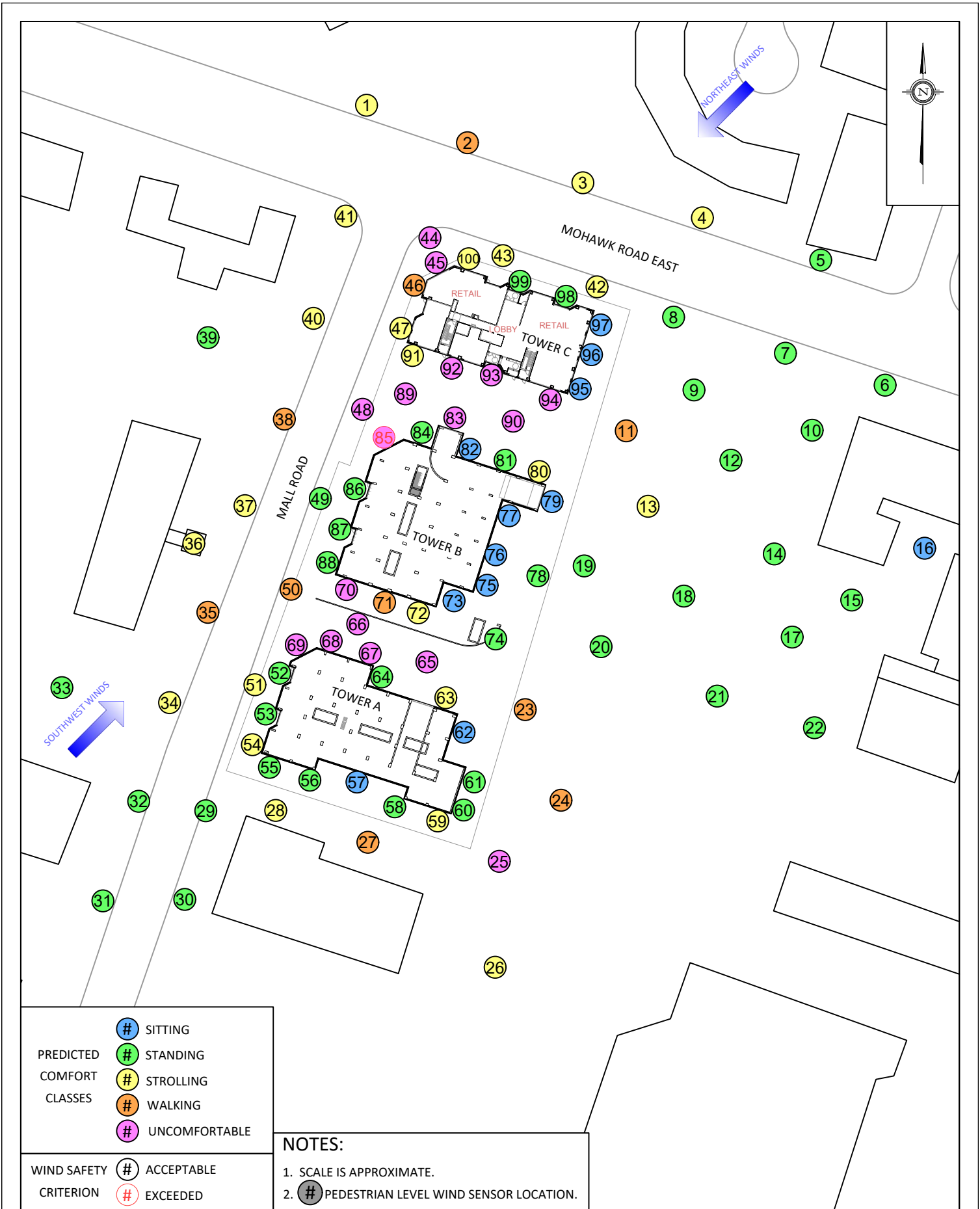


	(#) SITTING
PREDICTED	(#) STANDING
COMFORT	(#) STROLLING
CLASSES	(#) WALKING
	(#) UNCOMFORTABLE

WIND SAFETY	(#) ACCEPTABLE
CRITERION	(#) EXCEEDED

NOTES:

- SCALE IS APPROXIMATE.
- (#) PEDESTRIAN LEVEL WIND SENSOR LOCATION.

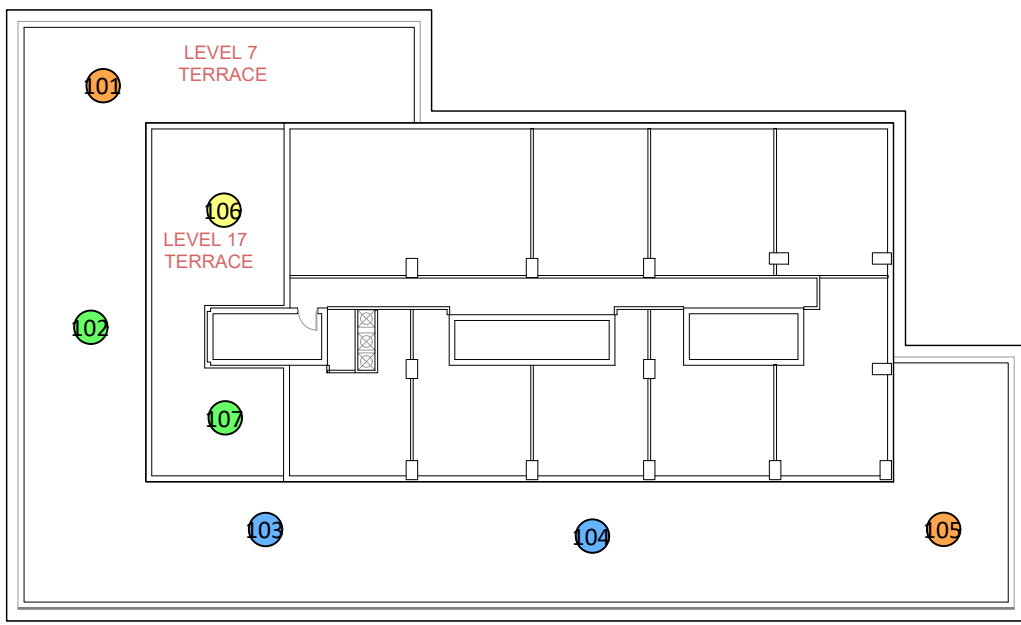
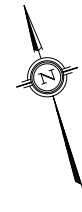


	#	SITTING
PREDICTED	#	STANDING
COMFORT	#	STROLLING
CLASSES	#	WALKING
	#	UNCOMFORTABLE

WIND SAFETY	#	ACCEPTABLE
CRITERION	#	EXCEEDED

NOTES:

- SCALE IS APPROXIMATE.
- # PEDESTRIAN LEVEL WIND SENSOR LOCATION.

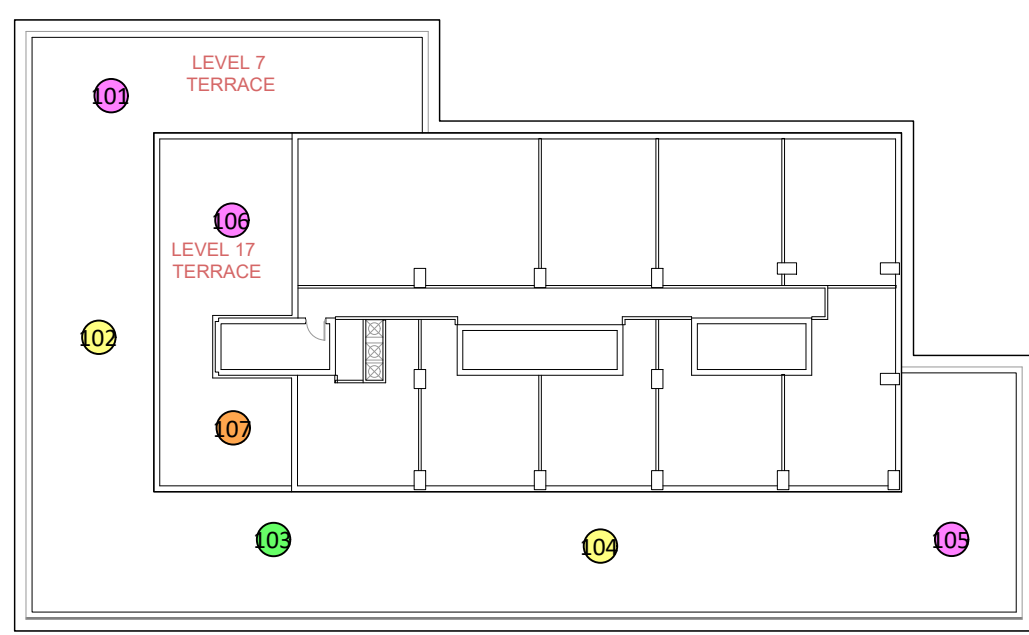
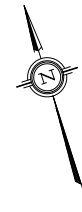


TOWER A

PREDICTED COMFORT CLASSES		SITTING
		STANDING
		STROLLING
		WALKING
		UNCOMFORTABLE
WIND SAFETY CRITERION		ACCEPTABLE
		EXCEEDED

NOTES:

- SCALE IS APPROXIMATE.
- PEDESTRIAN LEVEL WIND SENSOR LOCATION.



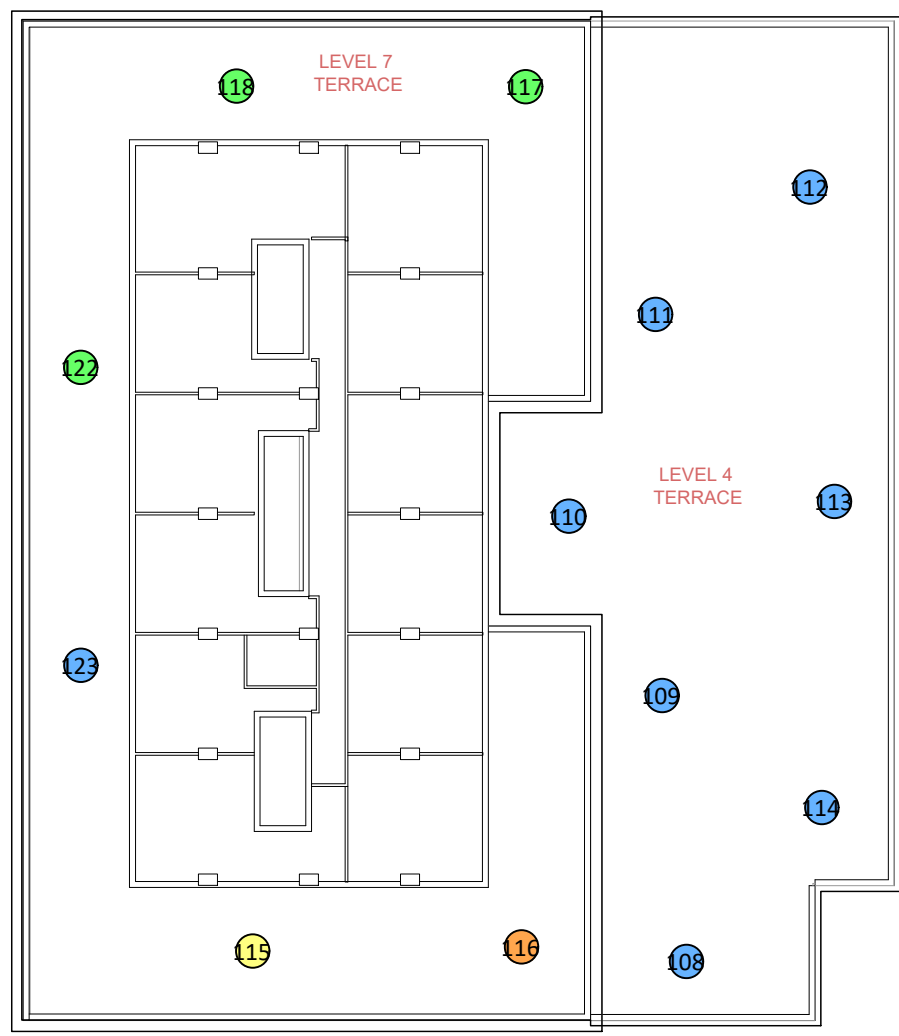
TOWER A

PREDICTED COMFORT CLASSES		SITTING
		STANDING
		STROLLING
		WALKING
		UNCOMFORTABLE
WIND SAFETY CRITERION		ACCEPTABLE
		EXCEEDED

NOTES:

- SCALE IS APPROXIMATE.
- PEDESTRIAN LEVEL WIND SENSOR LOCATION.

GRADIENTWIND ENGINEERS & SCIENTISTS 127 WALGREEN ROAD, OTTAWA, ON 613 836 0934 • GRADIENTWIND.COM	PROJECT	416 MOHAWK ROAD, HAMILTON PEDESTRIAN LEVEL WIND STUDY		DESCRIPTION FIGURE 4B: WINTER BUILDING A AMENITY PLAN PEDESTRIAN COMFORT PREDICTIONS	
	SCALE	1:1300 (APPROX.)	DRAWING NO.		GW26-023-PLW-4B
	DATE	MARCH 11, 2026	DRAWN BY		C.E.

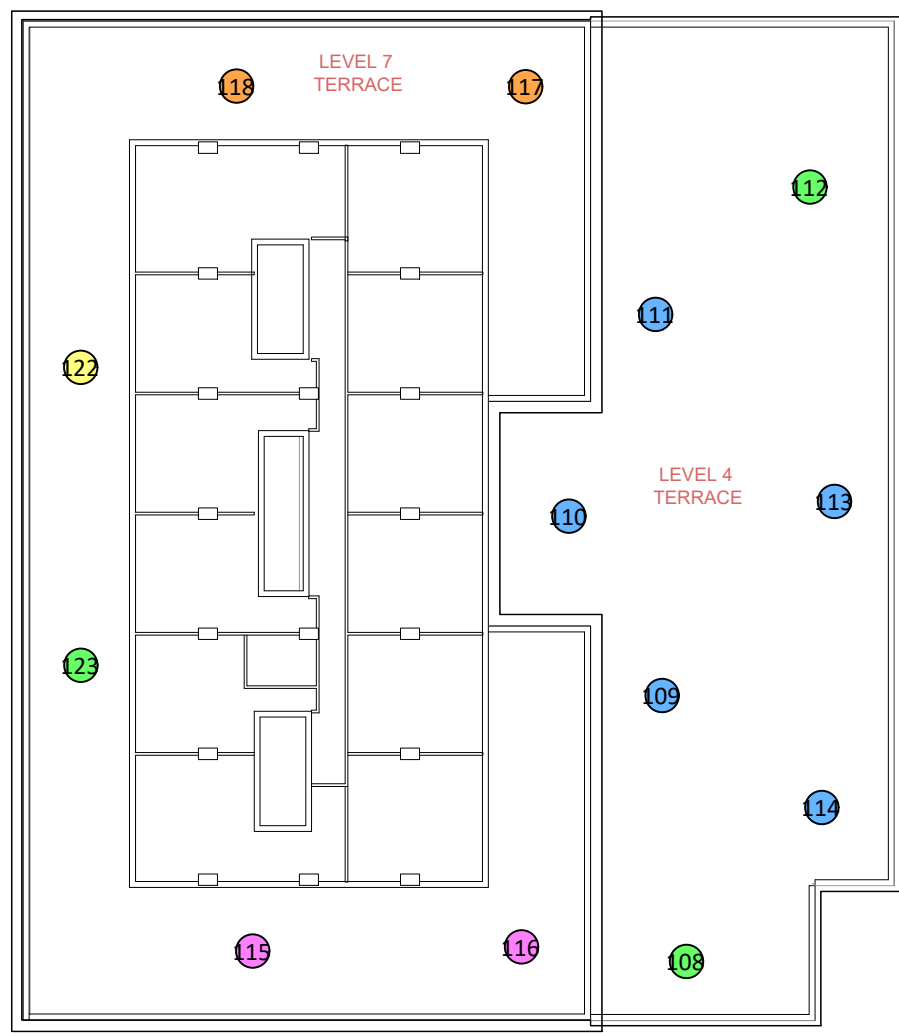


TOWER B

PREDICTED COMFORT CLASSES		SITTING
		STANDING
		STROLLING
		WALKING
		UNCOMFORTABLE
WIND SAFETY CRITERION		ACCEPTABLE
		EXCEEDED

NOTES:

- SCALE IS APPROXIMATE.
- PEDESTRIAN LEVEL WIND SENSOR LOCATION.



TOWER B



PREDICTED COMFORT CLASSES		SITTING
		STANDING
		STROLLING
		WALKING
		UNCOMFORTABLE
WIND SAFETY CRITERION		ACCEPTABLE
		EXCEEDED

NOTES:

- SCALE IS APPROXIMATE.
- PEDESTRIAN LEVEL WIND SENSOR LOCATION.



TOWER C

PREDICTED COMFORT CLASSES		SITTING
		STANDING
		STROLLING
		WALKING
		UNCOMFORTABLE

WIND SAFETY CRITERION		ACCEPTABLE
		EXCEEDED

NOTES:
 1. SCALE IS APPROXIMATE.
 2. PEDESTRIAN LEVEL WIND SENSOR LOCATION.

GRADIENTWIND ENGINEERS & SCIENTISTS 127 WALGREEN ROAD, OTTAWA, ON 613 836 0934 • GRADIENTWIND.COM	PROJECT	416 MOHAWK ROAD, HAMILTON PEDESTRIAN LEVEL WIND STUDY		DESCRIPTION	FIGURE 6A: SUMMER TOWER C AMENITY PLAN PEDESTRIAN COMFORT PREDICTIONS	
	SCALE	1:1300 (APPROX.)	DRAWING NO.			GW26-023-PLW-6A
	DATE	MARCH 11, 2026	DRAWN BY			C.E.



TOWER C

PREDICTED COMFORT CLASSES		SITTING
		STANDING
		STROLLING
		WALKING
		UNCOMFORTABLE
WIND SAFETY CRITERION		ACCEPTABLE
		EXCEEDED

NOTES:
 1. SCALE IS APPROXIMATE.
 2. PEDESTRIAN LEVEL WIND SENSOR LOCATION.

GRADIENTWIND ENGINEERS & SCIENTISTS 127 WALGREEN ROAD, OTTAWA, ON 613 836 0934 • GRADIENTWIND.COM	PROJECT	416 MOHAWK ROAD, HAMILTON PEDESTRIAN LEVEL WIND STUDY		DESCRIPTION FIGURE 6B: WINTER BUILDING C AMENITY PLAN PEDESTRIAN COMFORT PREDICTIONS	
	SCALE	1:1300 (APPROX.)	DRAWING NO.		GW26-023-PLW-6B
	DATE	MARCH 11, 2026	DRAWN BY		C.E.

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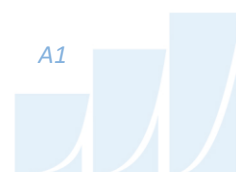
APPENDIX A

PEDESTRIAN COMFORT SUITABILITY, TABLES A1-A3 (EXISTING SCENARIO)

Guidelines	
Pedestrian Comfort	20% exceedance wind speed 0-10 km/h = Sitting, 10-14 km/h = Standing, 14-17 km/h = Strolling, 17-20 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 (EXISTING SCENARIO)

Sensor	Pedestrian Comfort				Pedestrian Safety	
	Summer		Winter		Annual	
	Wind Speed	Comfort Class	Wind Speed	Comfort Class	Wind Speed	Safety Class
1	10.9	Standing	15.4	Strolling	52.8	Safe
2	10.9	Standing	14.8	Strolling	49.9	Safe
3	9.9	Sitting	13.1	Standing	45.1	Safe
4	8.9	Sitting	12.5	Standing	45.0	Safe
5	8.8	Sitting	12.2	Standing	45.8	Safe
6	10.6	Standing	15.6	Strolling	55.0	Safe
7	10.9	Standing	14.9	Strolling	50.9	Safe
8	10.5	Standing	14.0	Standing	48.4	Safe
9	10.8	Standing	14.7	Strolling	51.5	Safe
10	10.4	Standing	13.9	Standing	47.7	Safe
11	10.4	Standing	13.8	Standing	47.7	Safe
12	11.2	Standing	15.0	Strolling	48.8	Safe
13	10.8	Standing	14.3	Strolling	46.2	Safe
14	10.7	Standing	14.3	Strolling	47.2	Safe
15	9.1	Sitting	12.8	Standing	45.5	Safe
16	7.8	Sitting	10.5	Standing	38.5	Safe
17	10.6	Standing	14.3	Strolling	47.6	Safe
18	11.4	Standing	15.2	Strolling	49.0	Safe
19	11.5	Standing	15.4	Strolling	48.6	Safe
20	11.6	Standing	15.5	Strolling	49.8	Safe
21	11.8	Standing	15.4	Strolling	51.8	Safe
22	8.8	Sitting	11.3	Standing	38.4	Safe
23	12.1	Standing	15.7	Strolling	50.9	Safe
24	11.9	Standing	15.6	Strolling	49.5	Safe
25	11.2	Standing	14.3	Strolling	47.0	Safe
26	11.3	Standing	14.5	Strolling	48.4	Safe
27	7.9	Sitting	10.4	Standing	38.2	Safe
28	7.7	Sitting	10.3	Standing	39.2	Safe
29	10.5	Standing	13.1	Standing	47.7	Safe
30	9.8	Sitting	12.7	Standing	46.4	Safe
31	12.8	Standing	17.1	Walking	58.3	Safe
32	9.0	Sitting	11.5	Standing	40.5	Safe
33	12.4	Standing	17.2	Walking	59.3	Safe
34	10.7	Standing	13.9	Standing	51.4	Safe
35	9.9	Sitting	12.5	Standing	50.4	Safe



Guidelines	
Pedestrian Comfort	20% exceedance wind speed 0-10 km/h = Sitting, 10-14 km/h = Standing, 14-17 km/h = Strolling, 17-20 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 (EXISTING SCENARIO)

Sensor	Pedestrian Comfort				Pedestrian Safety	
	Summer		Winter		Annual	
	Wind Speed	Comfort Class	Wind Speed	Comfort Class	Wind Speed	Safety Class
36	8.8	Sitting	10.7	Standing	48.7	Safe
37	8.3	Sitting	10.7	Standing	41.2	Safe
38	9.4	Sitting	11.8	Standing	43.2	Safe
39	11.1	Standing	15.6	Strolling	54.3	Safe
40	10.5	Standing	13.5	Standing	46.6	Safe
41	10.6	Standing	13.6	Standing	44.4	Safe
42	10.4	Standing	13.5	Standing	47.1	Safe
43	10.5	Standing	13.3	Standing	47.4	Safe
44	11.1	Standing	14.0	Standing	47.1	Safe
45	10.1	Standing	12.8	Standing	44.9	Safe
46	10.4	Standing	13.2	Standing	46.2	Safe
47	10.2	Standing	12.9	Standing	47.1	Safe
48	10.0	Sitting	12.7	Standing	46.2	Safe
49	9.8	Sitting	12.5	Standing	44.3	Safe
50	9.7	Sitting	12.4	Standing	46.3	Safe
51	10.4	Standing	13.3	Standing	49.4	Safe
52	10.1	Standing	12.6	Standing	47.6	Safe
53	10.4	Standing	13.9	Standing	53.3	Safe
54	10.2	Standing	13.6	Standing	50.0	Safe
55	10.6	Standing	14.2	Strolling	49.7	Safe
56	9.8	Sitting	13.0	Standing	46.1	Safe
57	9.7	Sitting	12.7	Standing	45.8	Safe
58	9.5	Sitting	12.7	Standing	44.8	Safe
59	10.2	Standing	13.2	Standing	45.1	Safe
60	10.5	Standing	13.5	Standing	46.5	Safe
61	10.4	Standing	13.4	Standing	47.4	Safe
62	11.1	Standing	14.4	Strolling	48.7	Safe
63	10.7	Standing	14.2	Strolling	48.7	Safe
64	10.0	Sitting	12.8	Standing	46.4	Safe
65	10.9	Standing	14.3	Strolling	48.5	Safe
66	9.9	Sitting	12.6	Standing	45.4	Safe
67	10.0	Sitting	12.9	Standing	48.6	Safe
68	10.0	Sitting	12.6	Standing	46.3	Safe
69	10.6	Standing	13.4	Standing	48.9	Safe
70	10.0	Sitting	12.8	Standing	48.5	Safe



Guidelines	
Pedestrian Comfort	20% exceedance wind speed 0-10 km/h = Sitting, 10-14 km/h = Standing, 14-17 km/h = Strolling, 17-20 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 (EXISTING SCENARIO)

Sensor	Pedestrian Comfort				Pedestrian Safety	
	Summer		Winter		Annual	
	Wind Speed	Comfort Class	Wind Speed	Comfort Class	Wind Speed	Safety Class
71	10.2	Standing	13.0	Standing	46.5	Safe
72	10.1	Standing	13.2	Standing	47.4	Safe
73	10.5	Standing	13.7	Standing	46.5	Safe
74	10.9	Standing	14.2	Strolling	48.3	Safe
75	10.5	Standing	13.8	Standing	47.5	Safe
76	9.6	Sitting	12.7	Standing	45.5	Safe
77	10.4	Standing	13.7	Standing	48.4	Safe
78	11.0	Standing	14.5	Strolling	48.1	Safe
79	10.8	Standing	14.1	Strolling	49.2	Safe
80	11.1	Standing	14.4	Strolling	50.8	Safe
81	11.5	Standing	14.7	Strolling	49.5	Safe
82	10.4	Standing	13.4	Standing	46.5	Safe
83	10.7	Standing	13.6	Standing	47.9	Safe
84	10.6	Standing	13.5	Standing	46.8	Safe
85	8.9	Sitting	11.2	Standing	41.9	Safe
86	9.8	Sitting	12.2	Standing	44.4	Safe
87	10.0	Sitting	12.6	Standing	45.0	Safe
88	9.0	Sitting	11.2	Standing	44.4	Safe
89	9.9	Sitting	12.6	Standing	45.8	Safe
90	9.9	Sitting	13.1	Standing	48.3	Safe
91	9.7	Sitting	12.2	Standing	46.4	Safe
92	11.3	Standing	14.5	Strolling	48.9	Safe
93	9.9	Sitting	12.6	Standing	46.5	Safe
94	11.7	Standing	15.5	Strolling	50.3	Safe
95	9.0	Sitting	11.6	Standing	44.3	Safe
96	11.2	Standing	14.7	Strolling	49.9	Safe
97	10.1	Standing	13.1	Standing	48.2	Safe
98	11.8	Standing	15.5	Strolling	49.8	Safe
99	11.2	Standing	14.4	Strolling	48.3	Safe
100	10.3	Standing	13.0	Standing	45.9	Safe

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APPENDIX B

PEDESTRIAN COMFORT SUITABILITY, TABLES B1-B4 (PROPOSED SCENARIO)

Guidelines	
Pedestrian Comfort	20% exceedance wind speed 0-10 km/h = Sitting, 10-14 km/h = Standing, 14-17 km/h = Strolling, 17-20 km/h = Walking, >20 km/h = Uncomfortable
Pedestrian Safety	0.1% exceedance wind speed 0-90 km/h = Safe

TABLE B1: SUMMARY OF PEDESTRIAN COMFORT (PROPOSED SCENARIO)

Sensor	Pedestrian Comfort				Pedestrian Safety	
	Summer		Winter		Annual	
	Wind Speed	Comfort Class	Wind Speed	Comfort Class	Wind Speed	Safety Class
1	11.5	Standing	16.1	Strolling	55.0	Safe
2	13.2	Standing	18.7	Walking	62.6	Safe
3	11.1	Standing	15.5	Strolling	56.5	Safe
4	10.2	Standing	14.1	Strolling	51.5	Safe
5	7.8	Sitting	10.6	Standing	42.5	Safe
6	8.5	Sitting	11.5	Standing	42.9	Safe
7	9.3	Sitting	12.1	Standing	44.9	Safe
8	9.8	Sitting	12.9	Standing	48.3	Safe
9	8.3	Sitting	10.4	Standing	40.2	Safe
10	8.8	Sitting	11.0	Standing	40.0	Safe
11	12.4	Standing	17.9	Walking	76.5	Safe
12	10.1	Standing	13.3	Standing	52.9	Safe
13	11.6	Standing	15.9	Strolling	70.4	Safe
14	10.2	Standing	13.4	Standing	54.5	Safe
15	8.0	Sitting	10.6	Standing	43.6	Safe
16	7.3	Sitting	9.4	Sitting	38.9	Safe
17	9.3	Sitting	12.0	Standing	47.1	Safe
18	9.5	Sitting	12.0	Standing	47.0	Safe
19	9.7	Sitting	12.7	Standing	45.1	Safe
20	10.2	Standing	13.2	Standing	51.4	Safe
21	11.0	Standing	13.7	Standing	53.3	Safe
22	9.0	Sitting	11.4	Standing	43.0	Safe
23	13.8	Standing	18.9	Walking	67.9	Safe
24	13.3	Standing	17.3	Walking	66.6	Safe
25	15.7	Strolling	21.2	Uncomfortable	69.8	Safe
26	12.2	Standing	15.8	Strolling	55.7	Safe
27	12.9	Standing	17.4	Walking	62.8	Safe
28	11.0	Standing	14.2	Strolling	55.7	Safe
29	10.2	Standing	13.3	Standing	61.7	Safe
30	9.4	Sitting	12.4	Standing	48.0	Safe
31	10.0	Sitting	13.7	Standing	52.6	Safe
32	10.1	Standing	12.9	Standing	44.2	Safe
33	9.6	Sitting	13.2	Standing	49.6	Safe
34	11.9	Standing	15.0	Strolling	54.4	Safe
35	14.5	Strolling	18.1	Walking	62.5	Safe



Guidelines	
Pedestrian Comfort	20% exceedance wind speed 0-10 km/h = Sitting, 10-14 km/h = Standing, 14-17 km/h = Strolling, 17-20 km/h = Walking, >20 km/h = Uncomfortable
Pedestrian Safety	0.1% exceedance wind speed 0-90 km/h = Safe

TABLE B2: SUMMARY OF PEDESTRIAN COMFORT (PROPOSED SCENARIO)

Sensor	Pedestrian Comfort				Pedestrian Safety	
	Summer		Winter		Annual	
	Wind Speed	Comfort Class	Wind Speed	Comfort Class	Wind Speed	Safety Class
36	12.0	Standing	14.8	Strolling	55.4	Safe
37	12.4	Standing	16.5	Strolling	59.0	Safe
38	12.5	Standing	17.4	Walking	66.4	Safe
39	9.7	Sitting	12.9	Standing	50.9	Safe
40	11.5	Standing	15.3	Strolling	57.6	Safe
41	11.1	Standing	14.2	Strolling	54.0	Safe
42	10.8	Standing	14.2	Strolling	54.1	Safe
43	11.3	Standing	16.0	Strolling	64.2	Safe
44	16.6	Strolling	23.4	Uncomfortable	73.5	Safe
45	15.2	Strolling	21.9	Uncomfortable	76.9	Safe
46	12.1	Standing	17.8	Walking	73.0	Safe
47	10.4	Standing	14.6	Strolling	60.4	Safe
48	16.0	Strolling	21.3	Uncomfortable	71.8	Safe
49	10.5	Standing	13.8	Standing	52.4	Safe
50	14.1	Strolling	17.9	Walking	70.9	Safe
51	12.2	Standing	15.5	Strolling	55.6	Safe
52	9.0	Sitting	11.7	Standing	47.1	Safe
53	8.5	Sitting	11.0	Standing	40.9	Safe
54	12.3	Standing	15.3	Strolling	63.9	Safe
55	8.1	Sitting	11.0	Standing	50.5	Safe
56	7.5	Sitting	10.2	Standing	42.5	Safe
57	6.6	Sitting	8.9	Sitting	32.9	Safe
58	8.7	Sitting	12.7	Standing	50.7	Safe
59	11.3	Standing	16.2	Strolling	62.0	Safe
60	9.9	Sitting	11.5	Standing	56.9	Safe
61	9.8	Sitting	11.8	Standing	66.0	Safe
62	6.6	Sitting	8.4	Sitting	32.9	Safe
63	11.8	Standing	16.6	Strolling	59.2	Safe
64	8.3	Sitting	10.9	Standing	45.2	Safe
65	17.5	Walking	24.0	Uncomfortable	75.6	Safe
66	20.0	Walking	27.1	Uncomfortable	79.1	Safe
67	20.5	Uncomfortable	27.5	Uncomfortable	86.3	Safe
68	16.9	Strolling	24.2	Uncomfortable	83.3	Safe
69	14.8	Strolling	20.4	Uncomfortable	77.6	Safe
70	16.2	Strolling	22.5	Uncomfortable	75.7	Safe



Guidelines	
Pedestrian Comfort	20% exceedance wind speed 0-10 km/h = Sitting, 10-14 km/h = Standing, 14-17 km/h = Strolling, 17-20 km/h = Walking, >20 km/h = Uncomfortable
Pedestrian Safety	0.1% exceedance wind speed 0-90 km/h = Safe

TABLE B3: SUMMARY OF PEDESTRIAN COMFORT (PROPOSED SCENARIO)

Sensor	Pedestrian Comfort				Pedestrian Safety	
	Summer		Winter		Annual	
	Wind Speed	Comfort Class	Wind Speed	Comfort Class	Wind Speed	Safety Class
71	13.3	Standing	18.2	Walking	64.8	Safe
72	11.2	Standing	16.0	Strolling	62.9	Safe
73	5.8	Sitting	7.5	Sitting	27.7	Safe
74	8.1	Sitting	10.3	Standing	44.7	Safe
75	6.2	Sitting	8.2	Sitting	29.3	Safe
76	5.5	Sitting	7.5	Sitting	26.3	Safe
77	5.2	Sitting	7.0	Sitting	23.5	Safe
78	7.8	Sitting	10.1	Standing	37.2	Safe
79	7.5	Sitting	9.8	Sitting	35.2	Safe
80	11.4	Standing	15.5	Strolling	56.2	Safe
81	9.1	Sitting	12.0	Standing	42.9	Safe
82	6.2	Sitting	8.0	Sitting	32.4	Safe
83	18.3	Walking	24.9	Uncomfortable	78.0	Safe
84	8.6	Sitting	12.1	Standing	43.3	Safe
85	17.6	Walking	25.5	Uncomfortable	93.6	Dangerous
86	8.6	Sitting	11.3	Standing	47.6	Safe
87	8.8	Sitting	11.2	Standing	45.2	Safe
88	8.4	Sitting	10.9	Standing	40.4	Safe
89	17.7	Walking	24.1	Uncomfortable	77.5	Safe
90	16.9	Strolling	23.9	Uncomfortable	82.0	Safe
91	11.2	Standing	14.5	Strolling	56.9	Safe
92	16.0	Strolling	22.2	Uncomfortable	70.8	Safe
93	15.6	Strolling	22.1	Uncomfortable	79.7	Safe
94	15.7	Strolling	22.6	Uncomfortable	79.5	Safe
95	7.7	Sitting	9.6	Sitting	49.4	Safe
96	6.8	Sitting	8.6	Sitting	33.0	Safe
97	6.8	Sitting	8.4	Sitting	35.2	Safe
98	7.8	Sitting	10.5	Standing	40.7	Safe
99	8.1	Sitting	11.0	Standing	42.0	Safe
100	12.2	Standing	16.7	Strolling	66.8	Safe
101	19.0	Walking	26.7	Uncomfortable	82.0	Safe
102	12.0	Standing	15.5	Strolling	68.0	Safe
103	9.2	Sitting	13.0	Standing	64.3	Safe
104	9.8	Sitting	14.8	Strolling	66.5	Safe
105	17.3	Walking	23.2	Uncomfortable	74.8	Safe

Guidelines	
Pedestrian Comfort	20% exceedance wind speed 0-10 km/h = Sitting, 10-14 km/h = Standing, 14-17 km/h = Strolling, 17-20 km/h = Walking, >20 km/h = Uncomfortable
Pedestrian Safety	0.1% exceedance wind speed 0-90 km/h = Safe

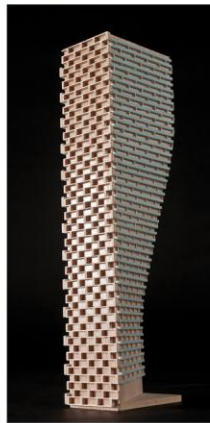
TABLE B4: SUMMARY OF PEDESTRIAN COMFORT (PROPOSED SCENARIO)

Sensor	Pedestrian Comfort				Pedestrian Safety	
	Summer		Winter		Annual	
	Wind Speed	Comfort Class	Wind Speed	Comfort Class	Wind Speed	Safety Class
106	14.4	Strolling	21.1	Uncomfortable	76.5	Safe
107	12.7	Standing	17.9	Walking	71.0	Safe
108	8.3	Sitting	10.6	Standing	49.2	Safe
109	7.9	Sitting	10.0	Sitting	41.0	Safe
110	6.0	Sitting	7.9	Sitting	30.3	Safe
111	6.8	Sitting	8.9	Sitting	32.7	Safe
112	7.9	Sitting	10.2	Standing	37.3	Safe
113	7.3	Sitting	9.2	Sitting	37.2	Safe
114	7.7	Sitting	9.8	Sitting	43.8	Safe
115	14.9	Strolling	22.3	Uncomfortable	87.6	Safe
116	17.7	Walking	24.1	Uncomfortable	77.7	Safe
117	13.8	Standing	17.6	Walking	71.8	Safe
118	13.1	Standing	17.3	Walking	75.8	Safe
119	10.1	Standing	13.3	Standing	56.8	Safe
120	11.6	Standing	14.9	Strolling	63.2	Safe
121	10.7	Standing	13.5	Standing	67.7	Safe
122	10.6	Standing	14.4	Strolling	68.2	Safe
123	9.9	Sitting	12.8	Standing	53.9	Safe



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APPENDIX C

WIND TUNNEL SIMULATION OF THE NATURAL WIND

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; U = mean wind speed, U_g = gradient wind speed, Z = height above ground, 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.

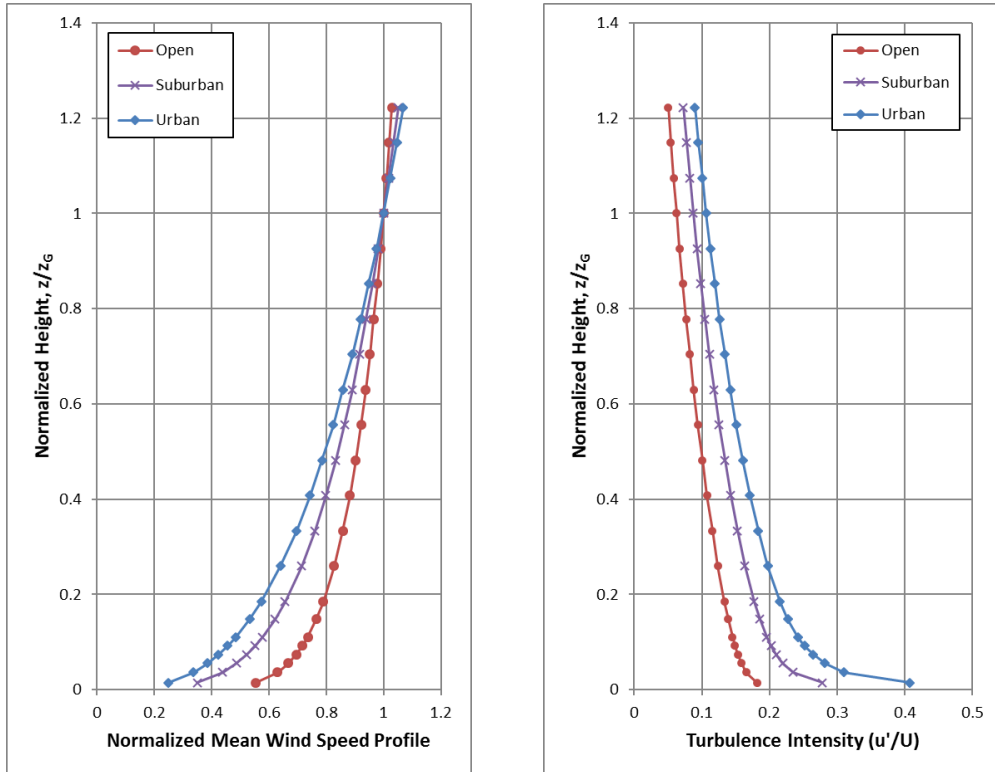
The exponent α varies according to the type of upwind terrain; α ranges from 0.14 for open country to 0.33 for an urban exposure. Figure C2 illustrates the theoretical variation of turbulence for open country, suburban and urban exposures.

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:

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

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.



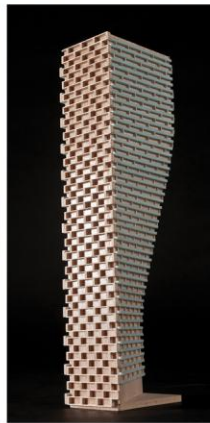
**FIGURE C1 (LEFT): MEAN WIND SPEED PROFILES;
FIGURE C2 (RIGHT): TURBULENCE INTENSITY PROFILES**

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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:

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

Where,

$P(>U_g)$ is the probability, fraction of time, that the gradient wind speed U_g is exceeded; θ 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). A_θ is the fraction of time wind blows from a 10° sector centered on θ .

Analysis of the hourly wind data recorded for a length of time, on the order of 10 to 30 years, yields the A_θ , C_θ and K_θ values. The probability of exceeding a chosen wind speed level, say 20 km/h, at sensor N is given by the following expression:

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

$$P_N(>20) = \sum_\theta P\{>20/(U_N/U_g)\}$$

Where, 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.

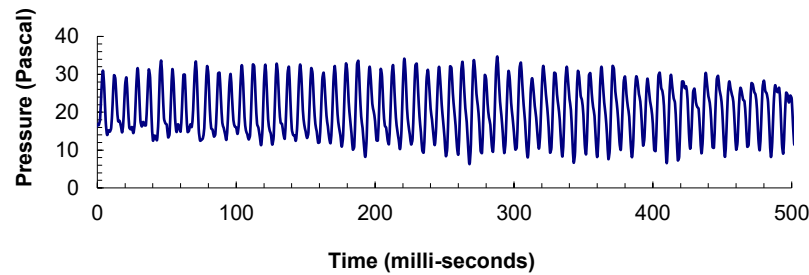


FIGURE D1: TIME VERSUS VELOCITY TRACE FOR A TYPICAL WIND SENSOR

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