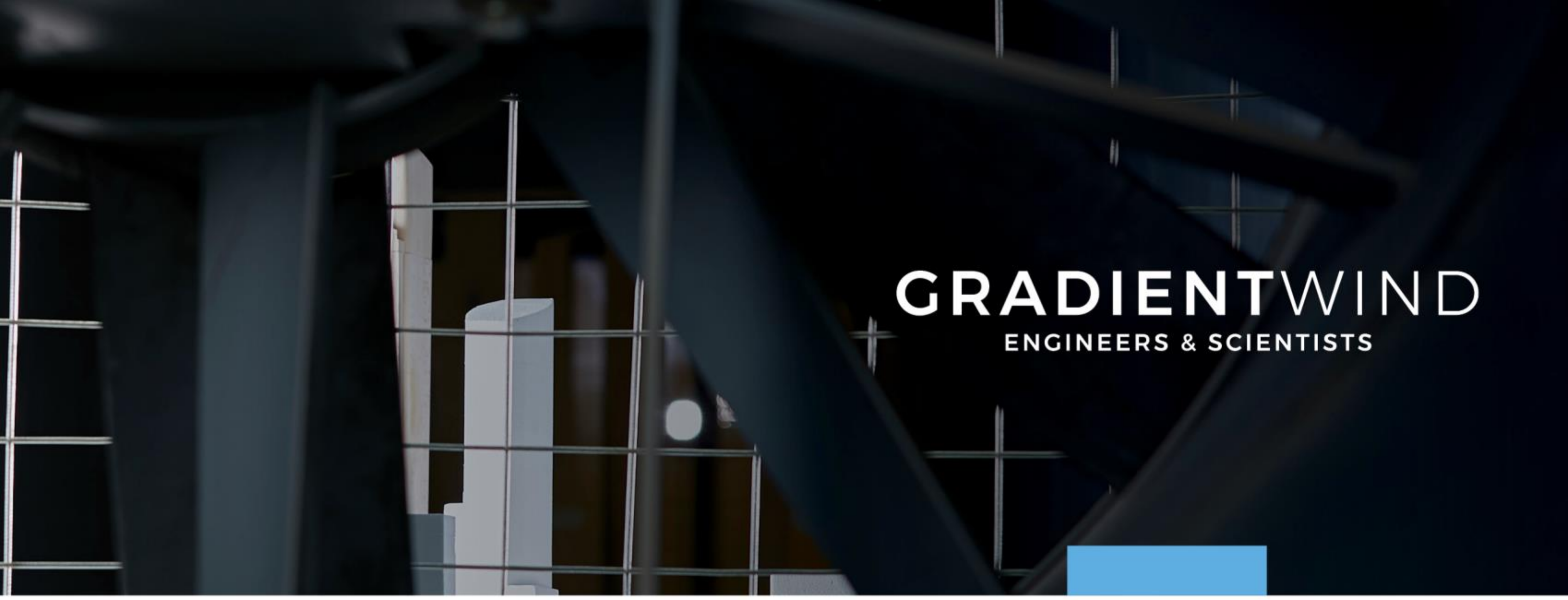
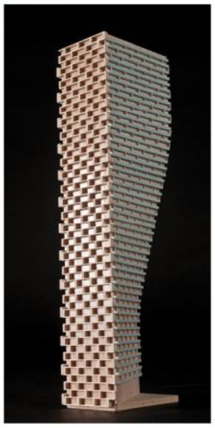
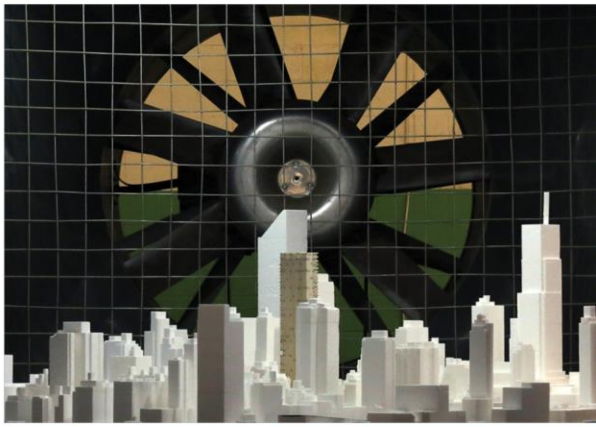


PEDESTRIAN LEVEL WIND STUDY

Elia Land
Mississauga, Ontario

Report: 20-235-PLW-R1





May 17, 2021

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EXECUTIVE SUMMARY

This report summarizes the results of a comparative computer based pedestrian level wind (PLW) study undertaken to satisfy Official Plan Amendment (OPA) and Zoning By-law Amendment (ZBA) application requirements for Elia Land, a proposed multi building mixed-use development in Mississauga, Ontario. This work is based on industry standard computer simulations using the computational fluid dynamics (CFD) technique and data analysis procedures, City of Mississauga wind comfort and safety criteria, architectural drawings provided by BDP Quadrangle Architects in November 2020, surrounding street layouts and existing and approved future building massing information obtained from the City of Mississauga, as well as recent site imagery.

A complete summary of the predicted wind comfort and safety conditions is provided in Section 5 of this report and illustrated in Figures 3A-5B, following the main text. Based on CFD test results, interpretation, and experience with similar developments, most grade level areas within and surrounding the development site will be acceptable for the intended pedestrian uses following the introduction of the proposed development.

As the design progresses, if the landscape plan calls for any sitting areas within the public park, situated to the immediate south of Block 3, as well as atop the podia serving Blocks 1-5, the requirement and extent of any mitigation measures to ensure sitting comfort levels are provided in key areas during the summer season will be addressed by a detailed wind tunnel study on a physical scale model of the subject site within its surroundings, which is required for the future Site Plan Control application.

Within the context of typical weather patterns, which exclude anomalous localized storm events such as tornadoes and downbursts, no pedestrian areas surrounding the subject site at grade level were found to experience conditions that could be considered uncomfortable or dangerous.

Addendum: The detailed PLW study was performed based on drawings prepared on November 7, 2020. An updated design was provided on May 17, 2021. For the purposes of this wind study, the changes are considered minor and will not change the conclusions of this study.

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1. INTRODUCTION

Gradient Wind Engineering Inc. (Gradient Wind) was retained by The Elia Corporation to undertake a comparative pedestrian level wind (PLW) study to satisfy Official Plan Amendment (OPA) and Zoning By-law Amendment (ZBA) application requirements for Elia Land, a proposed multi building mixed-use development in Mississauga, Ontario (hereinafter referred to as the "subject site"). Our mandate within this study is to investigate pedestrian wind comfort within and surrounding the subject site, and to identify any areas where wind conditions may interfere with certain pedestrian activities so that mitigation measures may be considered, where necessary.

Our work is based on industry standard computer simulations using the computational fluid dynamics (CFD) technique and data analysis procedures, City of Mississauga wind comfort and safety criteria, architectural drawings provided by BDP Quadrangle Architects in November 2020, surrounding street layouts and existing and approved future building massing information obtained from the City of Mississauga, as well as recent site imagery.

2. TERMS OF REFERENCE

Elia Land is located on an 'L'-shaped parcel of land situated at the intersection of Hurontario Street and Eglinton Avenue East, adjacent to the existing commercial and retail district to the immediate northwest. The development features the following characteristics:

- Five (5) blocks of mixed-use buildings, including nine (9) residential towers ranging between 28 and 45 storeys with podia ranging between 5 and 8 storeys and eight (8) blocks of three-storey back-to-back townhomes along the eastern perimeter.

- Block 1 (25, 35, 55 Elia Avenue) is situated at the intersection of Hurontario Street and Elia Avenue opposite to Block 4 and comprises two buildings: a 45-storey mixed-use office and residential building with a 5-storey podium (Building A) to the west and a 36-storey primarily residential building with a 6-storey podium (Building B) to the east.

- Block 2 (136 Eglinton Avenue East), situated at the northeast corner of the site, bordering Eglinton Avenue East and Sorrento Drive, comprises two primarily residential buildings as well as two blocks of townhomes. The residential buildings include a 42-storey tower atop an 8-storey podium to the north (Building A), and a 36-storey tower atop a 6-storey podium (Building B).

- Block 3 (105 Elia Avenue) is directly south of Block 2 and comprises two residential buildings of 36 storeys each, both with an 8-storey podium (Building A to the north, and Building B to the south), and four blocks of townhomes. A public park lies immediately to the south, between Building B and Elia Avenue.

- Block 4 (4615 Hurontario Street) is directly south of Block 1 and comprises a 36-storey building with a 6-storey podium to the west (Building A), and a 30-storey building with a 6-storey podium to the east (Building B).

- Block 5 (110 Elia Avenue), on the southeast corner of the site at the intersection of Elia Avenue and Acorn Place, comprises a single 28-storey building atop a 6-storey podium to the west (Building A) and two blocks of townhomes to the east.

Regarding wind exposures, the near-field surroundings of the development (defined as an area falling within 200-metres (m) of the site) are characterized by mostly low-rise suburban buildings from the north-northwest clockwise to the east, by a mix of low-, mid-, and high-rise buildings from the east clockwise to the southeast, by low-rise suburban buildings from the southeast clockwise to the south, by a mix of mid- and high-rise buildings from the south clockwise to the southwest, by a mix of low-, mid-, and high-rise buildings from the southwest clockwise to the west, and by a mix of greenspace and low-rise commercial buildings in the remaining directions. Notably, the Mississauga Marketplace shopping centre lies to the immediate west of the site and several high-rise buildings lie along the southwest elevation of Hurontario Street. The far-field surroundings (defined as the area beyond the near field and within a two-kilometer (km) radius) are characterized by a mix of greenspace and mostly low-rise buildings from the west-northwest clockwise to the east-southeast, and by a mix of greenspace and low-, mid-, and high-rise buildings from the east-southeast clockwise in the remaining directions. The Mississauga downtown core lies approximately 1.5 km to the southeast.

Site plans for the proposed and existing massing scenarios are illustrated in Figures 1A and 1B, respectively, while Figures 2A-2D illustrate the computational models used to conduct the study.

3. OBJECTIVES

The principal objectives of this study are to: (i) determine comparative pedestrian level wind comfort and safety conditions at key outdoor areas; (ii) identify areas where future wind conditions may interfere with the intended uses of outdoor spaces; and (iii) recommend suitable mitigation measures, where required.

4. METHODOLOGY

The approach followed to quantify pedestrian wind conditions over the subject site is based on CFD simulations of wind speeds across the subject site within a virtual environment, meteorological analysis of the Mississauga wind climate, and synthesis of computational data with industry-accepted criteria[1]. The following sections describe the analysis procedures, including a discussion of the comfort criteria.

4.1 Computer-Based Context Modelling

A computer based PLW wind study was performed to determine the influence of the wind environment on pedestrian comfort over the proposed development site. Pedestrian comfort predictions, based on the mechanical effects of wind, were determined by combining measured wind speed data from CFD simulations with statistical weather data obtained from Lester B. Pearson International Airport.

The general concept and approach to CFD modelling is to represent building and topographic details in the immediate vicinity of the study site on the surrounding model, and to create suitable atmospheric wind profiles at the model boundary. The wind profiles are designed to have similar mean and turbulent wind properties consistent with actual site exposures. An industry standard practice is to omit trees, vegetation, and other existing and planned landscape elements from the model due to the difficulty of providing accurate seasonal representation of vegetation. The omission of trees and other landscaping elements produces slightly more conservative (i.e., windier) wind speed values.

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

4.2 Wind Speed Measurements

The PLW analysis was performed by simulating wind flows and gathering velocity data over a CFD model of the site for 12 wind directions and two massing scenarios, as noted in Section 2. The simulation model was centered on the subject site and included surrounding massing within a diameter of 1.5 km.

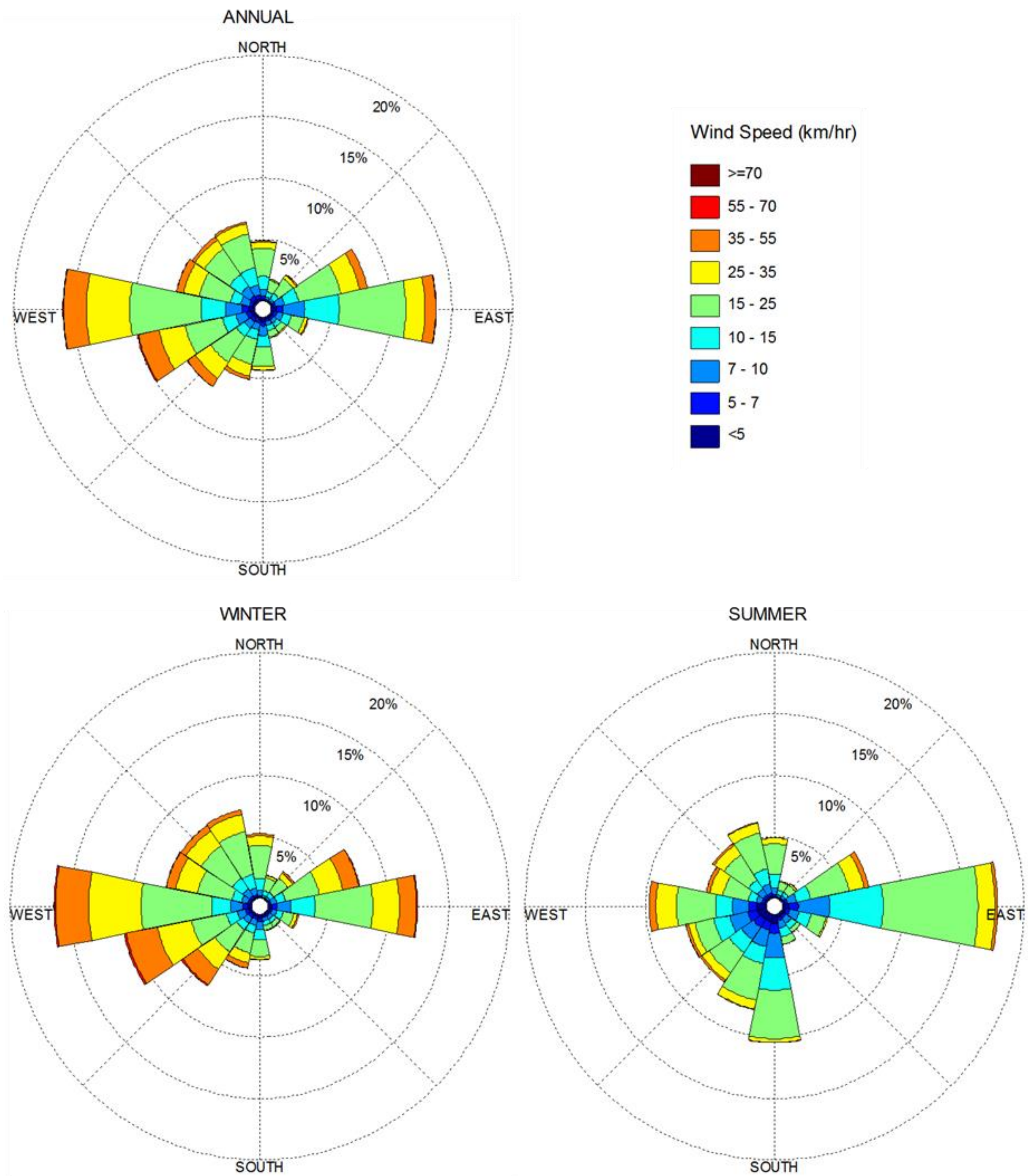
Mean and peak wind speed data obtained over the study site for each wind direction were interpolated to 36 wind directions at 10° intervals, representing the full compass azimuth. Measured wind speeds on a continuous measurement plane 1.5 m above local grade, as well as 1.5 m above the podia, were referenced to the wind speed at gradient height to generate mean and peak velocity ratios, which were used to calculate full-scale values. The gradient height represents the theoretical depth of the boundary layer of the earth's atmosphere, above which the mean wind speed remains constant. Further details of the CFD wind flow simulation technique are presented in Appendix A.

4.3 Meteorological Data Analysis

A statistical model for winds in Mississauga was developed from approximately 40 years of hourly meteorological wind data recorded at Lester B. Pearson International Airport and obtained from Environment and Climate Change Canada. Wind speed and direction data were analyzed during the appropriate hours of pedestrian usage (i.e., between 06:00 and 23:00) and divided into two distinct seasons, as stipulated in the wind criteria. Specifically, the summer season is defined as May through October, while the winter season is defined as November through April, inclusive.

The statistical model of the Mississauga 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 Mississauga (north of the Queen Elizabeth Way, or QEW), the common winds concerning pedestrian comfort occur from the south 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 WIND
LESTER B. PEARSON INTERNATIONAL AIRPORT, MISSISSUAGA, 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 Wind Comfort and Safety Criteria – City of Mississauga

Pedestrian wind comfort criteria are based on mechanical wind effects without consideration of other meteorological conditions (i.e., temperature and relative humidity). The criteria provide an assessment of comfort, assuming 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. 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 gust wind speed ranges are used to assess pedestrian comfort, which include: (i) Sitting; (ii) Standing; (iii) Walking; and (iv) Uncomfortable. Specifically, the comfort classes, associated wind speed ranges, and limiting criteria are summarized as follows:

(i) **Sitting** – GEM wind speeds no greater than 10 km/h (i.e., 0-10 km/h) occurring at least 80% of the time would be considered acceptable for sedentary activities, including sitting.

(ii) **Standing** – GEM wind speeds no greater than 15 km/h (i.e., 0-15 km/h) occurring at least 80% of the time are acceptable for activities such as standing, strolling or more vigorous activities.

(iii) **Walking** – GEM wind speeds no greater than 20 km/h (i.e., 0-20 km/h) occurring at least 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.

Regarding wind safety, 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 an average elderly person in good health to fall.

THE BEAUFORT SCALE

Number	Description	Wind Speed (km/h)		Description
		Mean	Gust	
2	Light Breeze	6-11	9-17	Wind felt on faces
3	Gentle Breeze	12-19	18-29	Leaves and small twigs in constant motion; wind extends light flags
4	Moderate Breeze	20-28	30-42	Wind raises dust and loose paper; small branches are moved
5	Fresh Breeze	29-38	43-57	Small trees in leaf begin to sway
6	Strong Breeze	39-49	58-74	Large branches in motion; Whistling heard in electrical wires; umbrellas used with difficulty
7	Moderate Gale	50-61	75-92	Whole trees in motion; inconvenient walking against wind
8	Gale	62-74	93-111	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 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 throughout the site, the assessment of pedestrian comfort involves determining the suitability of the predicted wind conditions for discrete regions within and surrounding the subject site. This step involves comparing the predicted comfort classes to the desired comfort classes, which are dictated by the location type for each region (i.e., a sidewalk, building entrance, amenity space, or other). 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	Standing / Walking
Public Sidewalks / Pedestrian Walkways	Walking
Outdoor Amenity Spaces	Sitting / Standing
Cafés / Patios / Benches / Gardens	Sitting / Standing
Plazas	Sitting / Standing / Walking
Transit Stops	Sitting / Standing
Public Parks	Sitting / Standing / Walking
Garage / Service Entrances	Walking
Vehicular Drop-Off Zones	Standing / Walking
Laneways / Loading Zones	Walking

5. RESULTS AND DISCUSSION

The following discussion of the predicted pedestrian wind conditions for the subject site is accompanied by Figures 3A-4B, which illustrate seasonal wind conditions at grade level for the proposed and existing massing scenarios, as well as by Figures 5A-5B, which illustrate seasonal wind conditions over the podia serving the proposed massing scenario. The wind conditions are presented as continuous contours of wind comfort within and surrounding the subject site. The colour contours indicate predicted regions of the various comfort classes noted in Section 4.4. Wind conditions suitable for sitting are represented by the colour green, standing by yellow, and walking by blue.

5.1 Block 1 – Grade Level

Sidewalk and Building Entrances along Elia Avenue: While southwesterly and northeasterly winds may produce channelling effects along Elia Avenue, the surrounding building massing will provide shelter from prominent northwesterly winds. Regarding higher level winds, downwash effects are not expected due to the stepbacks of the towers of Buildings A and B above their respective podia, the narrow width of the towers, and due to the low frequency of southeasterly winds.

Overall, conditions along the sidewalk, including the existing bus stop, are predicted to be suitable mostly for sitting during the summer season, becoming suitable for standing during the winter season. Owing to the protection provided by the building façade, conditions in the vicinity of building entrances are expected to be somewhat calmer than those predicted for the sidewalks. The noted wind comfort conditions are considered acceptable according to the criteria in Section 4.4. Additionally, these wind conditions are also considered acceptable for the existing bus stops. Similar wind conditions during the summer and winter seasons are predicted for the existing massing scenario.

Sidewalk and Building Entrances along Hurontario Street: While the sidewalk along Hurontario Street will be exposed to direct northwesterly winds, channelling effects will be reduced by the width of the street. Regarding higher level winds, downwash effects are not expected due to the stepback of the Building A tower from its podium, including the narrow width of the tower.

Overall, conditions along the sidewalk, including the existing bus stop which has a shelter, are expected to be suitable for sitting during the summer season, becoming suitable mostly for standing during the winter season. Similar wind conditions are expected in the vicinity of building entrances. These conditions are considered acceptable according to the criteria in Section 4.4. Similar wind conditions during the summer and winter seasons are predicted for the existing massing scenario.

Sidewalk and Building Entrances along Sorrento Drive: The bends in Sorrento Drive to the north and Acorn Place to the south are expected to prevent significant channelling effects. Regarding higher level winds, downwash effects are not expected due to the stepback of the Building B tower from its podium, due to the narrow width of the building, and due to the low frequency of northeasterly winds.

Overall, conditions along the sidewalk, including the existing bus stop which includes a shelter, are predicted to be suitable for sitting during the summer season, becoming suitable for a mix of sitting and standing during the winter season. Similar conditions are expected in the vicinity of building entrances. Additionally, the introduction of the proposed development is predicted to result in similar conditions over the pedestrian areas along Sorrento Drive and Acorn Place when compared against the comfort predictions for the existing massing scenario. The noted wind comfort conditions are considered acceptable according to the criteria in Section 4.4.

Sidewalks and Building Entrances along Laneway Between Buildings A and B: The surrounding building massing will provide shelter from prominent northwesterly winds over the laneway between Buildings A and B. Regarding higher level winds, downwash effects are not expected due to the stepbacks of the towers of Buildings A and B above their respective podia, and due to the narrow width of the towers. As such, wind conditions in the general area are predicted to be suitable for sitting throughout the year. The noted wind conditions are considered acceptable according to the criteria in Section 4.4.

Sidewalk and Building Entrances along North Elevation of Block 1: The surrounding building massing will provide shelter from direct winds over the sidewalk along the north elevation of Block 1. Regarding higher level winds, downwash effects are expected to be reduced by the stepbacks of the towers of Buildings A and B above their respective podia, and due to the narrow width of the towers.

Overall, wind conditions are predicted to be suitable for sitting during the summer season, becoming suitable mostly for sitting during the winter season. Similar conditions are expected in the immediate vicinity of building entrances. Similar wind conditions are also predicted for the existing massing scenario, which are considered acceptable according to the criteria in Section 4.4.

5.2 Block 1 – Podia Roofs

Building A (Level 6) and Building B (Level 7): The Level 6 roof serving Building A will be exposed to direct winds, including prominent northwesterly winds. Regarding higher level winds, downwash effects are predicted to impact the base of the tower. Overall, wind conditions are predicted to be suitable for a mix of sitting and standing during the summer season, and mostly suitable for standing during the winter.

The Level 7 roof serving Building B will be exposed to direct winds, including prominent northwesterly winds. Regarding higher level winds, downwash effects are predicted to impact the base of the tower. Overall, wind conditions are predicted to be suitable mostly for sitting during the summer season, and mostly suitable for standing during the winter season.

If common amenity areas will be provided within these roof areas, mitigation will be required to provide comfortable conditions that achieve the sitting criteria during the summer season. Typical measures include introducing tall wind barriers (e.g., glazed guards) around the perimeter of the roof and, if required, around local areas inboard of the perimeter. Solid canopies around the tower may also be required to protect the roof area from downwash winds, among other considerations. It is expected that mitigation strategies will be developed in collaboration with the building and landscape architects during design development to achieve the comfort criteria noted in Section 4.4.

5.3 Block 2 – Grade Level

Sidewalk and Building Entrances along Sorrento Drive: The bend in Sorrento Drive to the south is expected to prevent significant channelling effects. Regarding higher level winds, downwash effects are also not expected due to the stepbacks of the towers of Buildings A and B above their respective podia, and due to the low frequency of southeasterly winds.

Overall, conditions along the sidewalk, including the existing bus stop, are predicted to be suitable mostly for sitting during the summer season, becoming mostly suitable for standing during the winter season. The intersection of Sorrento Drive and Eglinton Avenue East is predicted to be suitable for standing throughout the year. Owing to the protection provided by the building façade, conditions in the vicinity of building entrances are expected to be somewhat calmer than those predicted for the sidewalks. The noted wind comfort conditions are considered acceptable according to the criteria in Section 4.4. Additionally, these wind conditions are also considered acceptable for the existing bus stops. Similar wind conditions are predicted under the existing massing scenario along Sorrento Drive.

Sidewalk and Building Entrances along Eglinton Avenue East: While the sidewalk along Eglinton Avenue East will be exposed to direct winds from the northwest, the low surrounding building massing will prevent significant channelling effects. Regarding higher level winds, downwash effects are expected to be reduced by the stepback of the Building A tower from its podium, and due to the narrow width of the tower. Overall, conditions along the sidewalk are predicted to be suitable for a mix of sitting and standing during the summer seasons, becoming suitable mostly for standing during the winter season. Owing to the protection provided by the building façade, conditions in the vicinity of building entrances are expected to be somewhat calmer than those predicted for the sidewalks. The noted wind comfort conditions are considered acceptable according to the criteria in Section 4.4. Under the existing massing scenario, somewhat calmer winds are predicted along the sidewalk, while similar wind conditions are predicted during the winter season for both massing scenarios.

Sidewalk and Building Entrances along Trudeau Avenue: The sidewalks along Trudeau Avenue, between proposed Blocks 2 and 3, are predicted to be mostly suitable for standing during the summer season, becoming suitable for a mix of standing and walking during the winter season. These conditions are considered acceptable according to the comfort criteria in Section 4.4. Owing to the protection provided by the building façade, conditions in the vicinity of building entrances are expected to be somewhat calmer than those predicted for the sidewalks.

Wind conditions in the vicinity of the existing bus stop, which is presently fully exposed to the elements, are predicted to be similar to those for the sidewalks along Trudeau Avenue. Under the existing massing scenario, the area is predicted to be suitable for sitting throughout the year. Therefore, conditions with the proposed building massing are windier than those predicted for the existing massing scenario. For the noted bus stop, the introduction of a typical transit shelter would provide pedestrians an opportunity to seek shelter during windier periods. Wind comfort conditions will be confirmed for the general area via wind tunnel testing on a physical scale model of the subject site as part of the design development stage.

Sidewalk and Building Entrances along Laneway between Townhouses and Buildings A & B: The surrounding building massing will provide shelter from direct winds over the laneway between the townhouses and Buildings A and B. Regarding higher level winds, downwash effects are expected to be reduced by the stepbacks of the towers of Buildings A and B above their respective podia. Overall, conditions along the sidewalk along the laneway between the townhouses and Buildings A and B are predicted to be suitable mostly for sitting during the summer season, becoming suitable for standing during the winter season. Owing to the protection provided by the building façade, conditions in the vicinity of building entrances are expected to be somewhat calmer. These conditions are considered acceptable according to the comfort criteria in Section 4.4.

Walkway and Building Entrances along East Elevation of Block 2: Owing to the protection of the Block 2 massing from prominent westerly winds, the walkway along the east side of the buildings is predicted to be suitable for sitting during the summer season, becoming suitable for standing during the winter season. Conditions in the vicinity of building entrances are expected to be calmer throughout the year. These conditions are considered acceptable according to the comfort criteria in Section 4.4.

5.4 Block 2 – Podia Roofs

Building A (Level 7): While the Level 7 roof serving Building A will be exposed to prominent northwesterly winds, the roof area is sheltered by the massing of Block 2 itself for most other wind directions. Overall, wind conditions are predicted to be suitable for sitting during the summer season, becoming mostly suitable for sitting during the winter season. The stepback of the building at the north end is an effective strategy to increase comfort levels in this area. These conditions are considered acceptable according to the comfort criteria in Section 4.4.

Building A (Level 9): The Level 9 roof serving Building A will be exposed to direct winds, including prominent northwesterly winds. Regarding higher level winds, downwash effects are predicted to impact the base of the tower. Overall, wind conditions are predicted to be suitable mostly for sitting during the summer season, becoming mostly suitable for standing during the winter season. During the winter season, walking conditions may also form around the base of the tower.

If common amenity areas will be provided within these roof areas, mitigation will be required to provide comfortable conditions that achieve the sitting criterion during the summer season. Typical measures include introducing tall wind barriers (e.g., glazed guards) around the perimeter of the roof and, if required, around local areas inboard of the perimeter. Solid canopies around the tower may also be required to protect the roof area from downwash winds, among other considerations. It is expected that mitigation strategies will be developed in collaboration with the building and landscape architects during design development to achieve the comfort criteria noted in Section 4.4.

Building B, Level 7 (North and South Sides): The Level 7 roof serving Building B on its north side is predicted to be moderately windy throughout the year. During the summer season, conditions are predicted to be suitable for standing, while walking conditions are predicted during the winter season.

The Level 7 roof serving Building B on its south side is predicted to be calmer than the north side presented above. Specifically, the south roof is predicted to be suitable mostly for sitting during the summer season, becoming suitable for a mix of sitting and standing during the winter season.

If either the north or south roofs are intended to accommodate an amenity terrace, mitigation measures will be required to provide comfortable conditions that achieve the sitting criterion during the summer season. Typical measures include introducing tall wind barriers (e.g., glazed guards) around the perimeter of the roof and, if required, around local areas inboard of the perimeter. Solid canopies around the tower may also be required to protect the roof area from downwash winds, among other considerations. It is expected that mitigation strategies will be developed in collaboration with the building and landscape architects during design development to achieve the comfort criteria noted in Section 4.4.

5.5 Block 3 – Grade Level

Sidewalk and Building Entrances along Sorrento Drive: The bend in Sorrento Drive to the north and Acorn Place to the south is expected to prevent significant channelling effects. Regarding higher level winds, downwash effects are not expected due to the stepbacks of the towers of Buildings A and B above their respective podia, and due to the low frequency of southeasterly winds.

Overall, conditions along the sidewalk are predicted to be suitable mostly for sitting during the summer season, becoming suitable mostly for standing during the winter season. Owing to the protection provided by the building façade, conditions in the vicinity of building entrances are expected to be somewhat calmer than those predicted for the sidewalks. The building massing at the south end of Block 3, particularly the southwest corner of Building B, is predicted to be moderately windy and suitable for walking during the winter season. The noted wind comfort conditions are considered acceptable according to the criteria in Section 4.4. Except for the south end of Block 3, similar wind conditions are predicted under the existing massing scenario along Sorrento Drive.

Sidewalk and Building Entrances along Trudeau Avenue: The sidewalks along Trudeau Avenue, between proposed Blocks 2 and 3, are predicted to be mostly suitable for standing during the summer season, becoming suitable for a mix of standing and walking during the winter season. These conditions are considered acceptable according to the comfort criteria in Section 4.4. Owing to the protection provided by the building façade, conditions in the vicinity of building entrances are expected to be somewhat calmer than those predicted for the sidewalks.

Sidewalks and Building Entrances along Laneway between Townhouses and Buildings A and B: The surrounding building massing will provide shelter from prominent northwesterly winds over the laneway between Buildings A and B. Regarding higher level winds, downwash effects are not expected due to the stepbacks of the towers of Buildings A and B above their respective podia, and due to the narrow width of the towers. As such, wind conditions in the general area are predicted to be suitable for sitting during the summer season, becoming suitable for standing during the winter season. The noted wind conditions are considered acceptable according to the criteria in Section 4.4.

Walkway and Building Entrances along East Elevation of Block 3: Owing to the protection of the Block 3 massing from prominent westerly winds, the walkway along the east side of the buildings is predicted to be suitable for sitting throughout the year. Conditions suitable for sitting are also expected in the vicinity of building entrances throughout the year. These conditions are considered acceptable according to the comfort criteria in Section 4.4.

Public Park along South Elevation of Block 3 and Sidewalk along Elia Avenue: The public park to the south of Block 3 is predicted to be suitable for a mix of sitting and standing during the summer season, becoming suitable for standing during the winter season. The southwest corner of Building B is predicted to direct moderately windy conditions towards the park area, resulting in the northwest quadrant of the park becoming suitable for walking during the winter season. Mitigation measures will be required to provide comfortable conditions that achieve the sitting criterion during the summer season. Mitigation could include tall solid wind barriers or tall coniferous trees in dense arrangements along the west perimeter of the park, inboard of Sorrento Drive. It is expected that mitigation strategies will be developed in collaboration with the building and landscape architects during design development to create comfortable wind conditions within the park during the typical use period.

5.6 Block 3 – Podia Roofs

Building A (Level 7): The Level 7 roof serving Building A on its north side is predicted to be moderately windy throughout the year. During the summer season, conditions are predicted to be suitable for a mix of sitting and standing, while a mix of standing and walking is predicted during the winter season.

If the roof is intended to accommodate an amenity terrace, mitigation measures will be required to provide comfortable conditions that achieve the sitting criterion during the summer season. Typical measures include introducing tall wind barriers (e.g., glazed guards) around the perimeter of the roof and, if required, around local areas inboard of the perimeter. Solid canopies around the tower may also be required to protect the roof area from downwash winds, among other considerations. It is expected that mitigation strategies will be developed in collaboration with the building and landscape architects during design development to achieve the comfort criteria noted in Section 4.4.

Building B (Level 7): The Level 7 roof serving Building B on its east side is predicted to be suitable for sitting during the summer season, becoming suitable for a mix of sitting and standing during the winter season. If the roof is intended to accommodate an amenity terrace, the implementation of tall wind barriers (e.g., glazed guards) around the perimeter of the roof is expected to particularly increase comfort levels during the colder months of the year. It is expected that mitigation strategies will be developed in collaboration with the building and landscape architects during design development to achieve the comfort criteria noted in Section 4.4.

5.7 Block 4 – Grade Level

East Side of Block 4: Based on the blockage provided by the subject site from most prominent winds, the east side of Block 4 is predicted to be calm and suitable for sitting throughout the year, which is considered acceptable according to the comfort criteria in Section 4.4. Under the existing massing scenario, wind conditions are predicted to be suitable for sitting during the summer season, becoming mostly suitable for standing during the winter season.

5.8 Block 4 – Podia Roofs

Buildings A and B, Level 7: The roofs serving the podia of Buildings A and B are predicted to be suitable for sitting during the summer season, becoming mostly suitable for standing during the winter season. If the roofs are intended to accommodate amenity functions, the implementation of tall wind barriers (e.g., glazed guards) around select roof perimeters is expected to particularly increase comfort levels during the colder months of the year. It is expected that mitigation strategies will be developed in collaboration with the building and landscape architects during design development to achieve the comfort criteria noted in Section 4.4.

5.9 Block 5 – Grade Level

Sidewalk and Building Entrances along Elia Avenue: The sidewalk along Elia Avenue, in the vicinity of Block 5, is predicted to be suitable for sitting during the summer season, becoming suitable for standing during the winter season. The sidewalk area at the southeast corner of Block 5 is predicted to be suitable for standing throughout the year, which is considered acceptable according to the comfort criteria in Section 4.4. Owing to the protection provided by the building façade, conditions in the vicinity of building entrances are expected to be somewhat calmer than those along the sidewalk, which are also considered acceptable.

Sidewalk and Building Entrances along Acorn Place: Conditions along the sidewalk are predicted to be suitable for a mix of sitting and standing during the summer season, becoming mostly suitable for standing during the winter season. These conditions are considered acceptable according to the comfort criteria in Section 4.4. Similar conditions are expected in the vicinity of the building entrances fronting Acorn Place, which are considered acceptable.

Building Entrances along North Elevation of Building A: The area to the immediate north of Block 5 is predicted to be suitable for sitting during the summer season, becoming mostly suitable for standing during the winter season. These conditions are considered acceptable according to the comfort criteria in Section 4.4. Calm conditions are expected in the vicinity of the building entrances serving the north elevation of Block 5.

Walkway and Building Entrances along East Elevation: While the walkway along the east elevation of Block 5 may experience channelling effects from the northwest, the surrounding building massing is expected to provide shelter from other prominent wind directions. Overall, conditions along the east side of Block 5 are predicted to be suitable for sitting during the summer season, and mostly suitable for a mix of sitting and standing during the winter season. These conditions are considered acceptable according to the comfort criteria in Section 4.4. Similar wind conditions are expected in the vicinity of the building entrances, which are considered acceptable.

5.10 Block 5 – Podia Roofs

Building A, Level 7: The roofs serving the podia of Building A are predicted to be suitable for a mix of sitting and standing during the summer season, becoming suitable mostly for standing during the winter season. If the roofs are intended to accommodate amenity functions, the implementation of tall wind barriers (e.g., glazed guards) around select roof perimeters is expected to increase comfort levels during the colder months of the year. It is expected that mitigation strategies will be developed in collaboration with the building and landscape architects during design development to achieve the comfort criteria noted in Section 4.4.

5.11 Beyond the Subject Site – Grade Level

Influence of the Proposed Development on Existing Wind Conditions near the Subject Site: The introduction of the proposed multi building development is not expected to significantly influence pedestrian wind comfort over neighbouring areas. Most nearby building entrances, sidewalks, laneways, parking areas, transit stops, and other pedestrian-sensitive areas beyond the development site are expected to continue to receive wind conditions similar to those that presently exist prior to the introduction of the proposed future Elia Land development.

Pedestrian wind comfort and safety have been quantified for the specific configuration of existing and foreseeable construction around the study site. Future changes (i.e., construction or demolition) of these surroundings may cause changes to the wind effects in two ways, namely: (i) changes beyond the immediate vicinity of the site would alter the wind profile approaching the site; and (ii) development in proximity to the site would cause changes to local flow patterns. In general, development in urban centers creates reduction in the mean wind speeds and localized increases in the gustiness of the wind.

5.12 Wind Safety – Grade Level

The forgoing statements and conclusions apply to common weather systems, during which no dangerous or consistently strong wind conditions are expected anywhere over the subject site. During extreme weather events, (e.g., thunderstorms, tornadoes, and downbursts), pedestrian safety is the main concern. However, these events are generally short-lived and infrequent and there is often sufficient warning for pedestrians to take appropriate cover.

6. SUMMARY AND RECOMMENDATIONS

This report summarizes the results of a comparative computer based PLW study undertaken to satisfy Official Plan Amendment (OPA) and Zoning By-law Amendment (ZBA) application requirements for Elia Land, a proposed multi building mixed-use development in Mississauga, Ontario. This work is based on industry standard computer simulations using the computational fluid dynamics (CFD) technique and data analysis procedures, City of Mississauga wind comfort and safety criteria, architectural drawings provided by BDP Quadrangle Architects in November 2020, surrounding street layouts and existing and approved future building massing information obtained from the City of Mississauga, as well as recent site imagery.

A complete summary of the predicted wind comfort and safety conditions is provided in Section 5 of this report and illustrated in Figures 3A-5B, following the main text. Based on CFD test results, interpretation, and experience with similar developments, most grade level areas within and surrounding the development site will be acceptable for the intended pedestrian uses following the introduction of the proposed development.

As the design progresses, if the landscape plan calls for any sitting areas within the public park, situated to the immediate south of Block 3, as well as atop the podia serving Blocks 1-5, the requirement and extent of any mitigation measures to ensure sitting comfort levels are provided in key areas during the summer season will be addressed by a detailed wind tunnel study on a physical scale model of the subject site within its surroundings, which is required for the future Site Plan Control application.

Within the context of typical weather patterns, which exclude anomalous localized storm events such as tornadoes and downbursts, no pedestrian areas surrounding the subject site at grade level were found to experience conditions that could be considered uncomfortable or dangerous.

Sincerely,

Gradient Wind Engineering Inc.

LICENSED PROFESSIONAL ENGINEER
J. D. FERRARO
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May 17, 2021
PROVINCE OF ONTARIO

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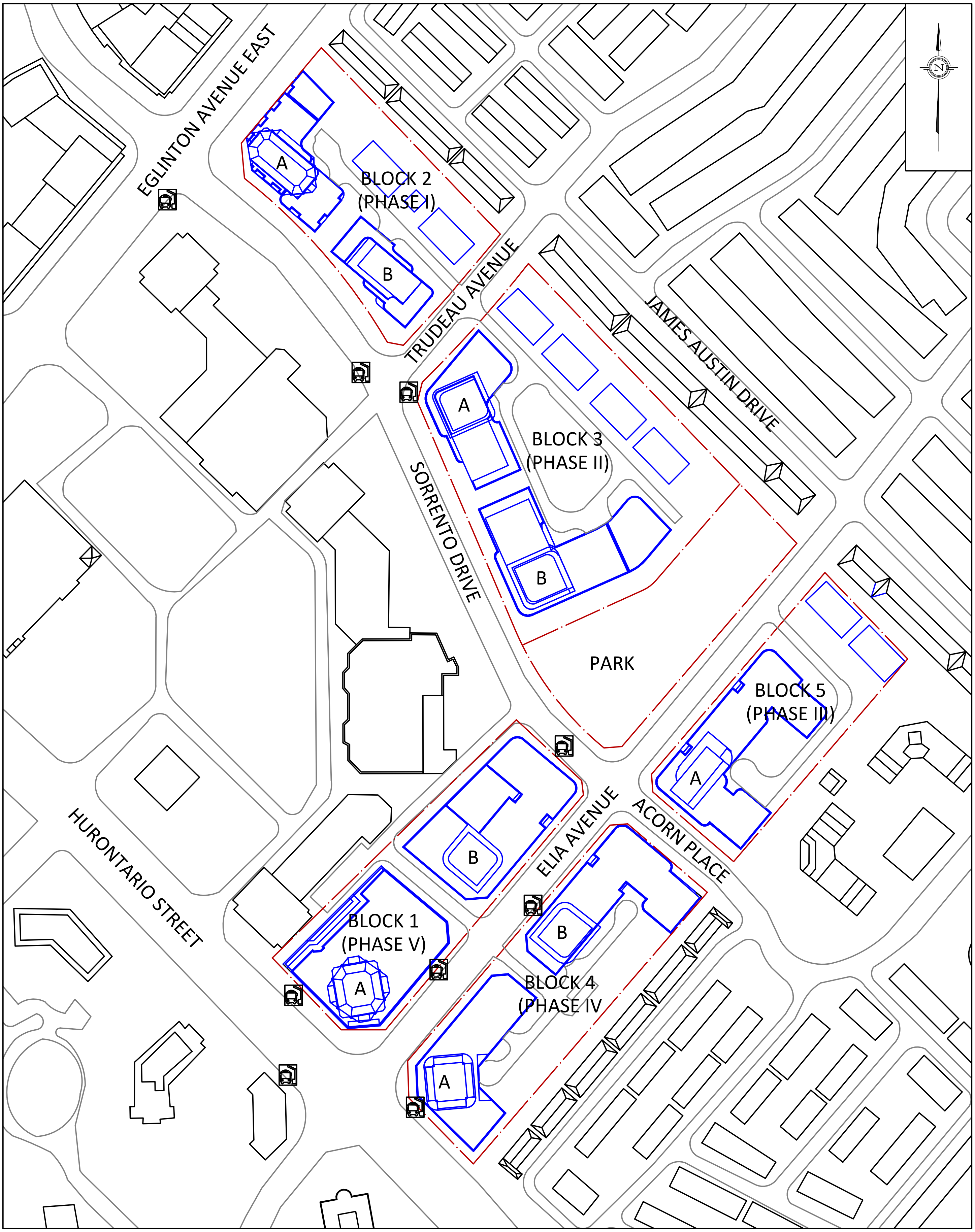

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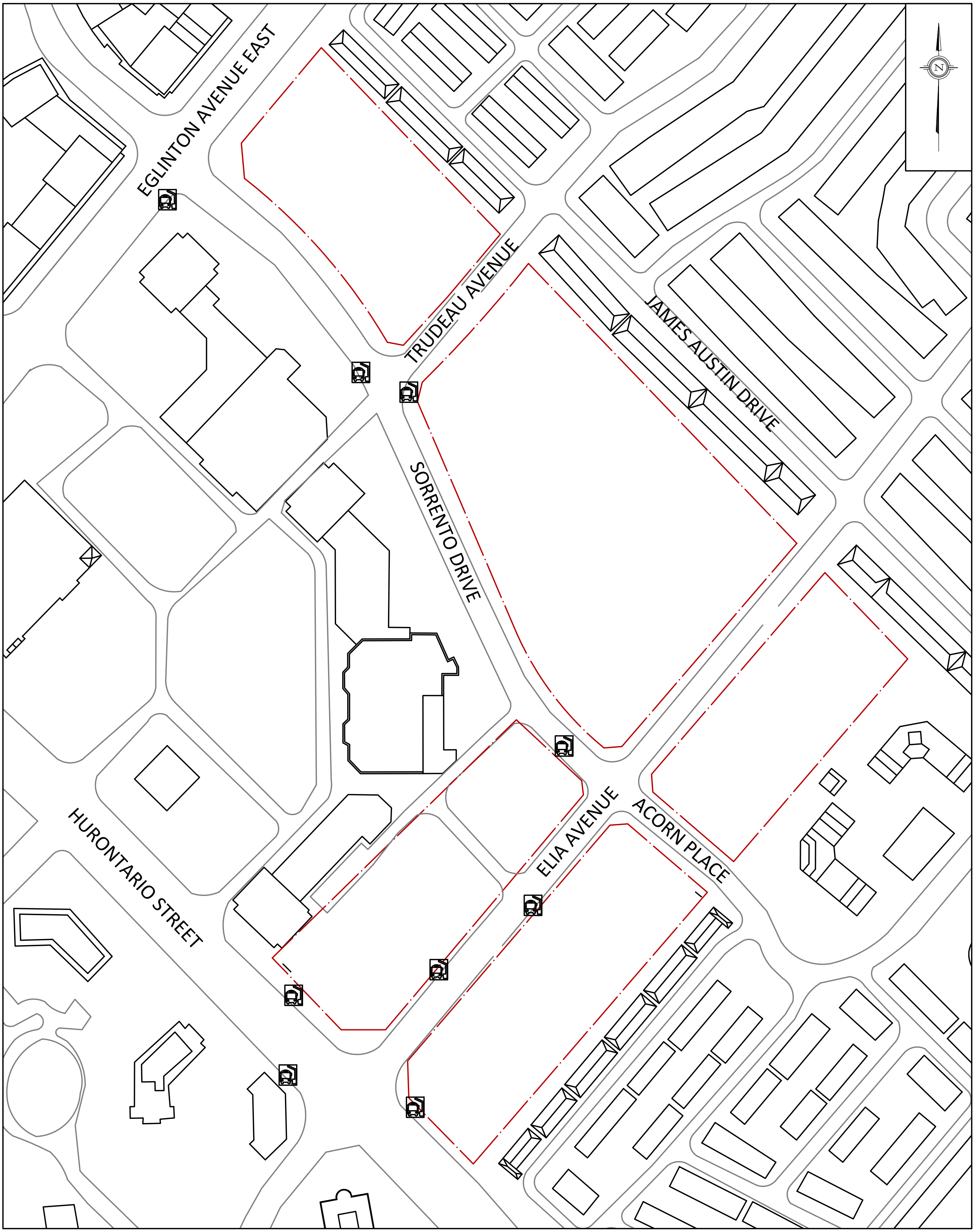
PROJECT: ELIA LAND, MISSISSAUGA PEDESTRIAN LEVEL WIND STUDY		DESCRIPTION: FIGURE 1A: PROPOSED SITE PLAN AND SURROUNDING CONTEXT
SCALE: 1:2000	DRAWING NO.: 20-235-PLW-1A	
DATE: DECEMBER 6, 2020	DRAWN BY: N.M.P.	



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PROJECT: ELIA LAND, MISSISSAUGA PEDESTRIAN LEVEL WIND STUDY		DESCRIPTION: FIGURE 1B: EXISTING SITE PLAN AND SURROUNDING CONTEXT	
SCALE: 1:2000	DRAWING NO.: 20-253-PLW-1B		
DATE: DECEMBER 6, 2020	DRAWN BY: N.M.P.		

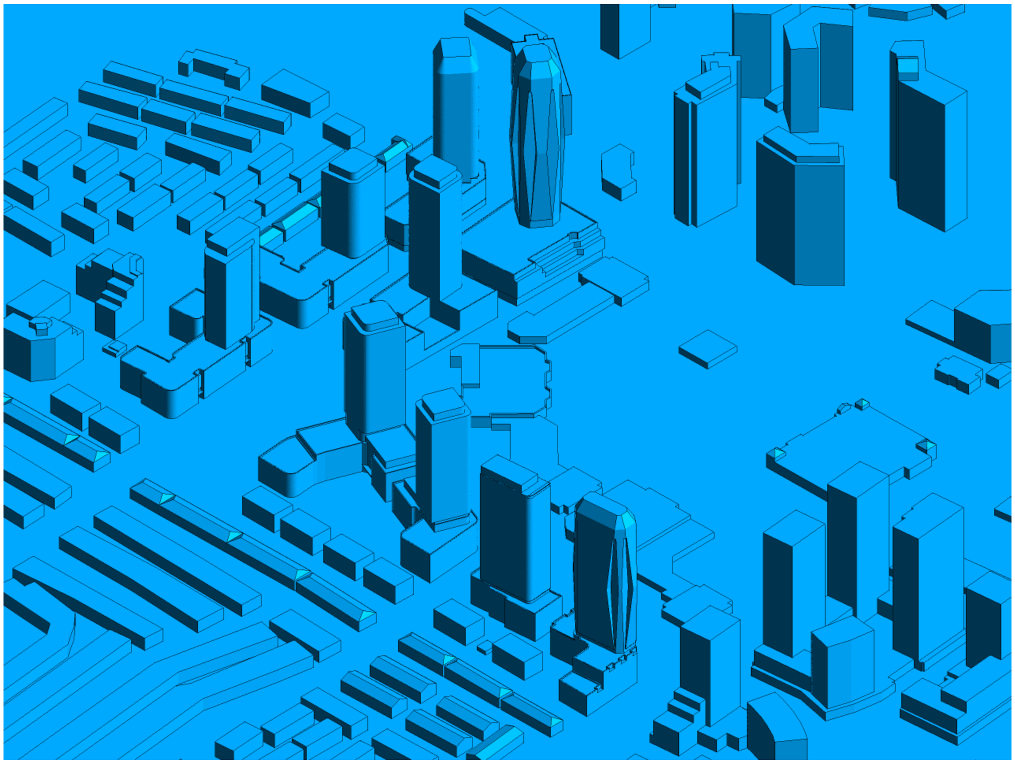


FIGURE 2A: COMPUTATIONAL MODEL, PROPOSED MASSING SCENARIO, NORTH PERSPECTIVE

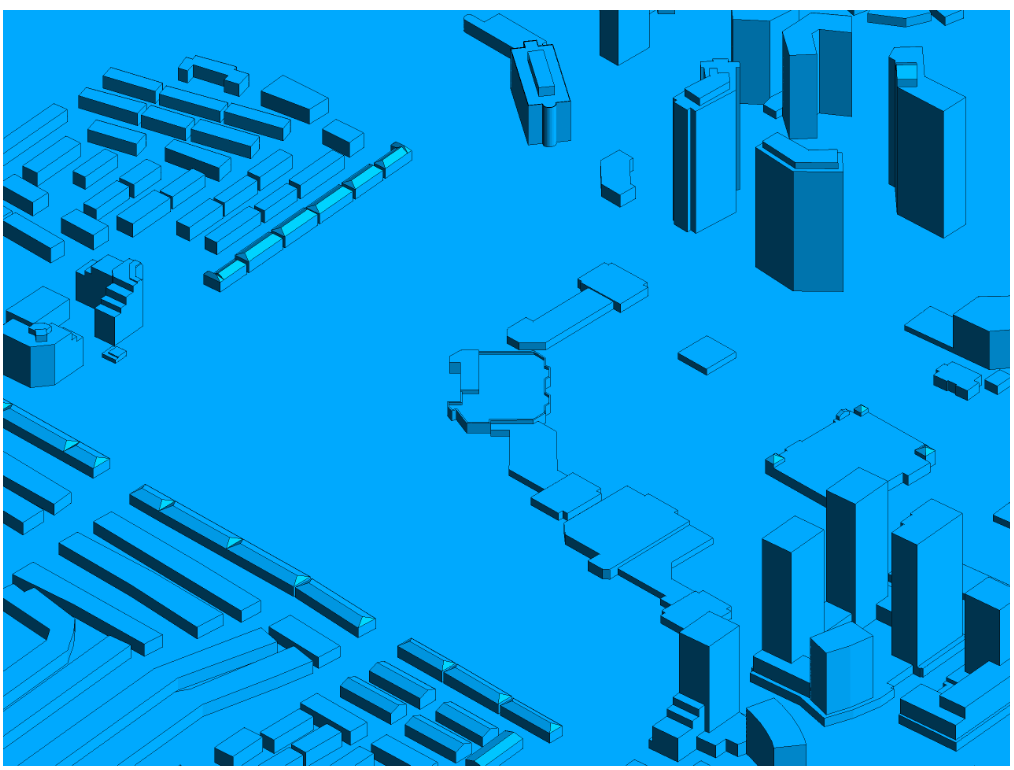


FIGURE 2B: COMPUTATIONAL MODEL, EXISTING MASSING SCENARIO, NORTH PERSPECTIVE

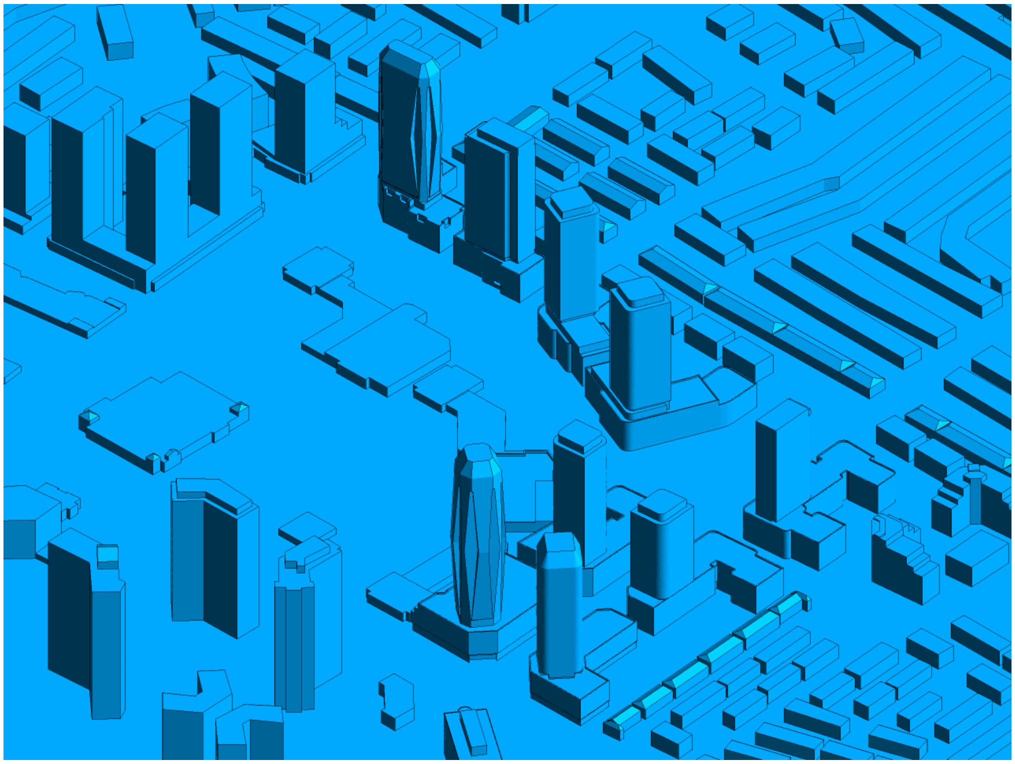


FIGURE 2C: COMPUTATIONAL MODEL, PROPOSED MASSING SCENARIO, SOUTH PERSPECTIVE

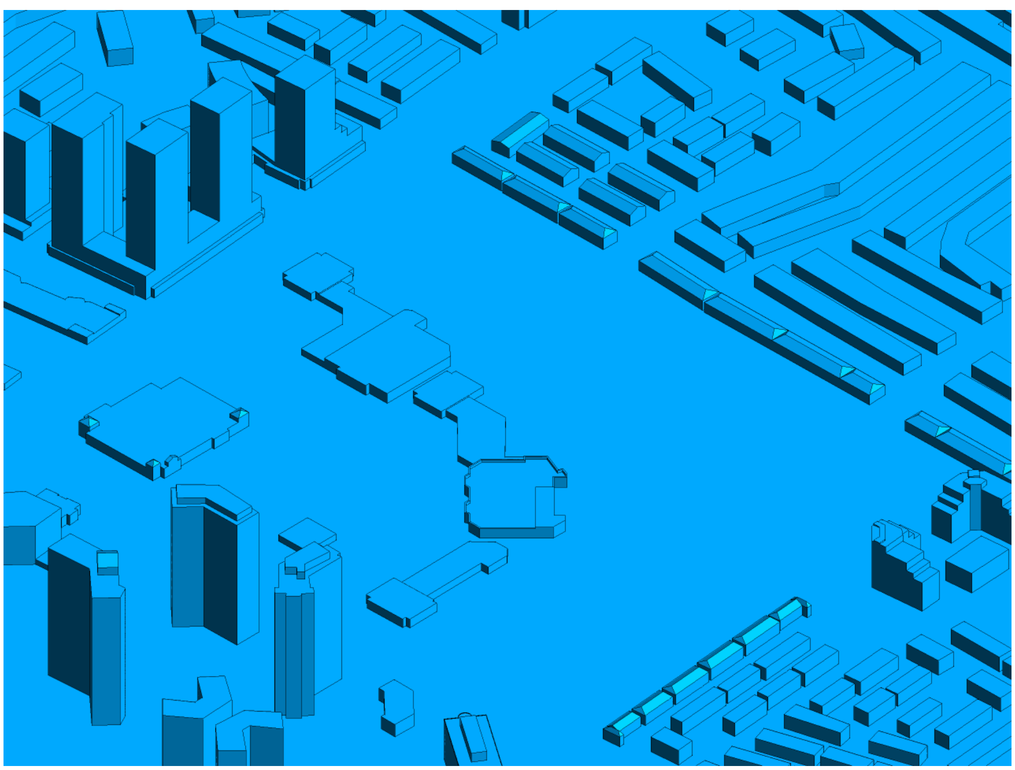


FIGURE 2D: COMPUTATIONAL MODEL, EXISTING MASSING SCENARIO, SOUTH PERSPECTIVE

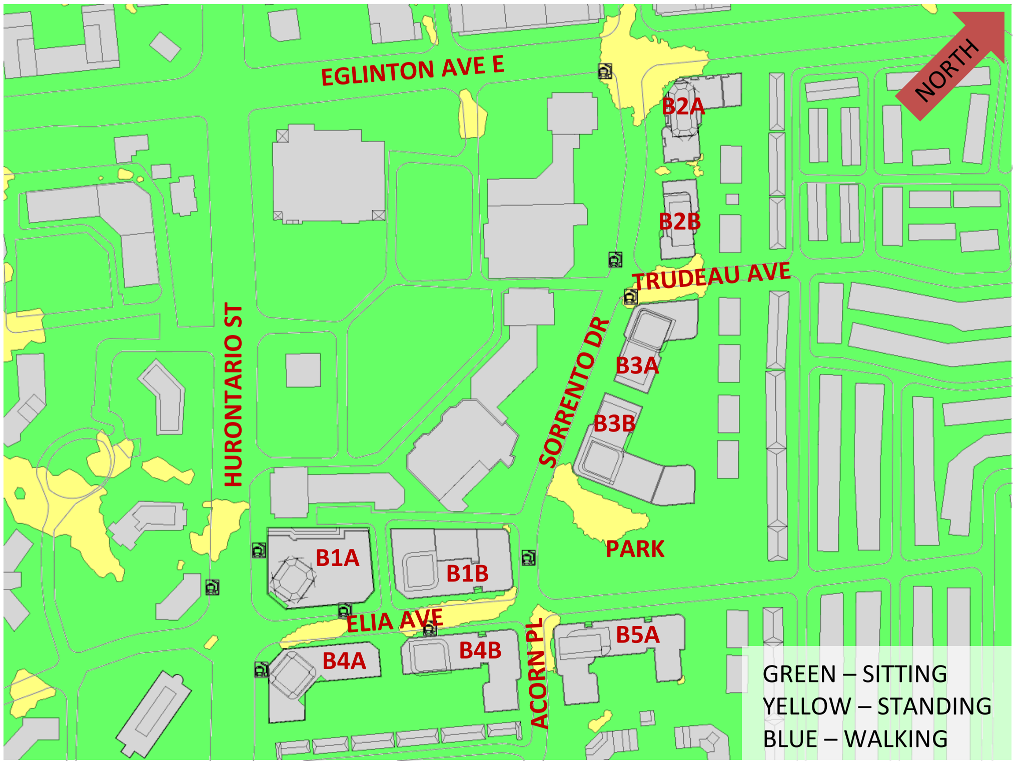


FIGURE 3A: SUMMER – PROPOSED MASSING – WIND COMFORT CONDITIONS, GRADE LEVEL

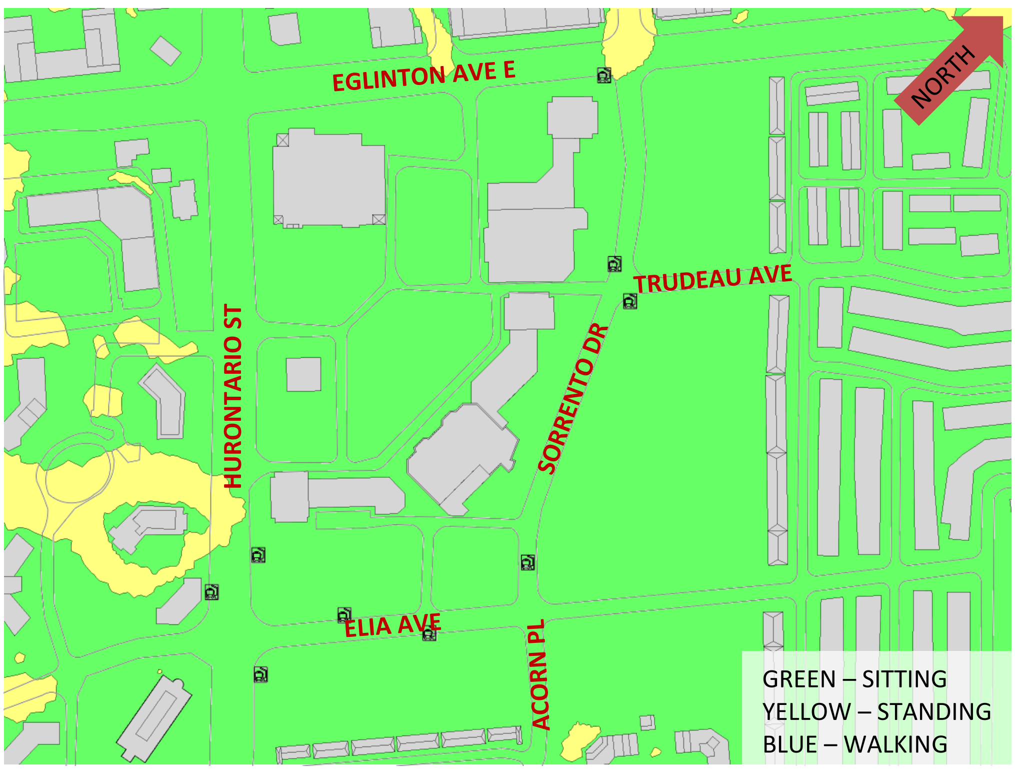


FIGURE 3B: SUMMER – EXISTING MASSING – WIND COMFORT CONDITIONS, GRADE LEVEL

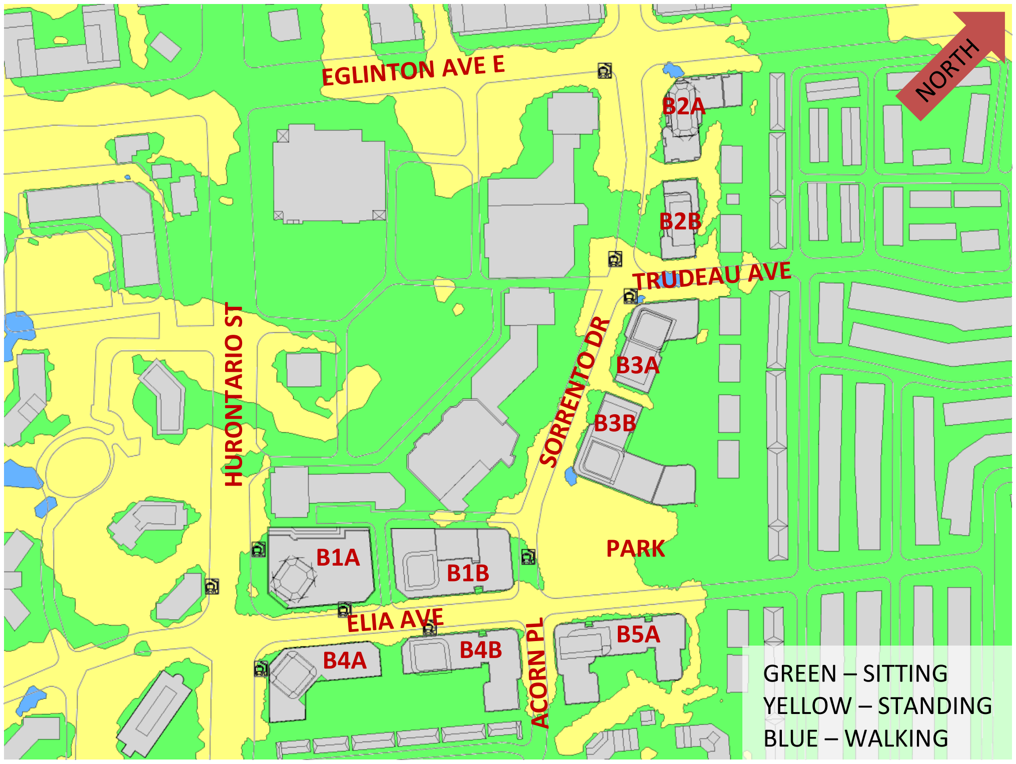


FIGURE 4A: WINTER – PROPOSED MASSING – WIND COMFORT CONDITIONS, GRADE LEVEL

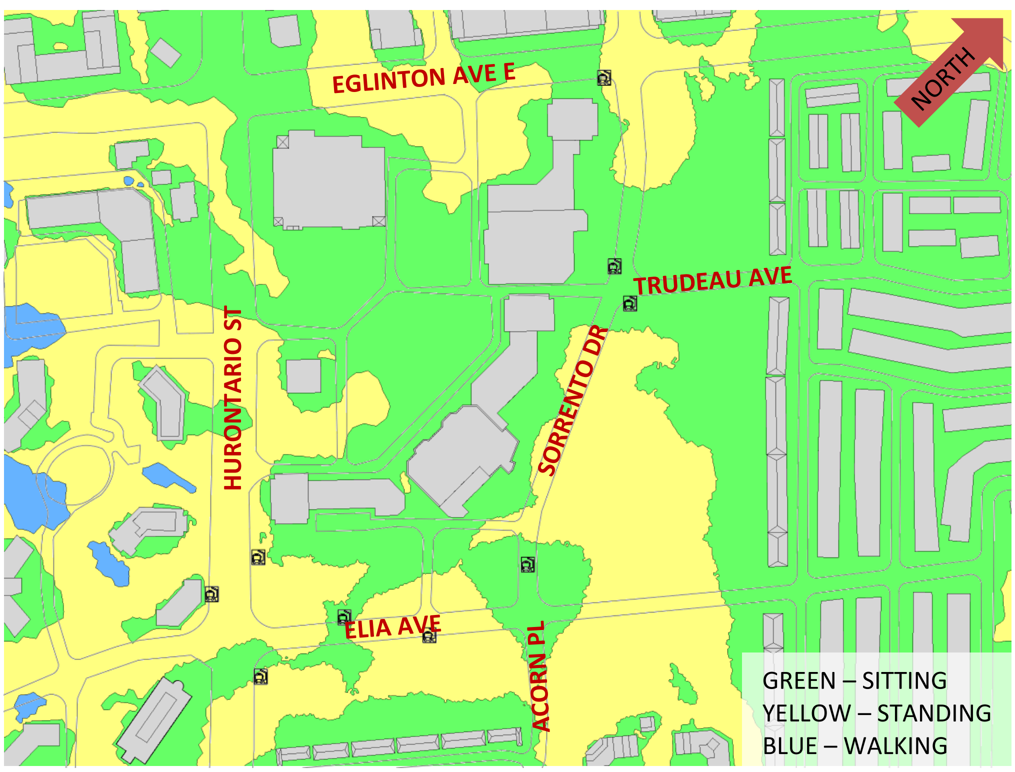


FIGURE 4B: WINTER – EXISTING MASSING – WIND COMFORT CONDITIONS, GRADE LEVEL

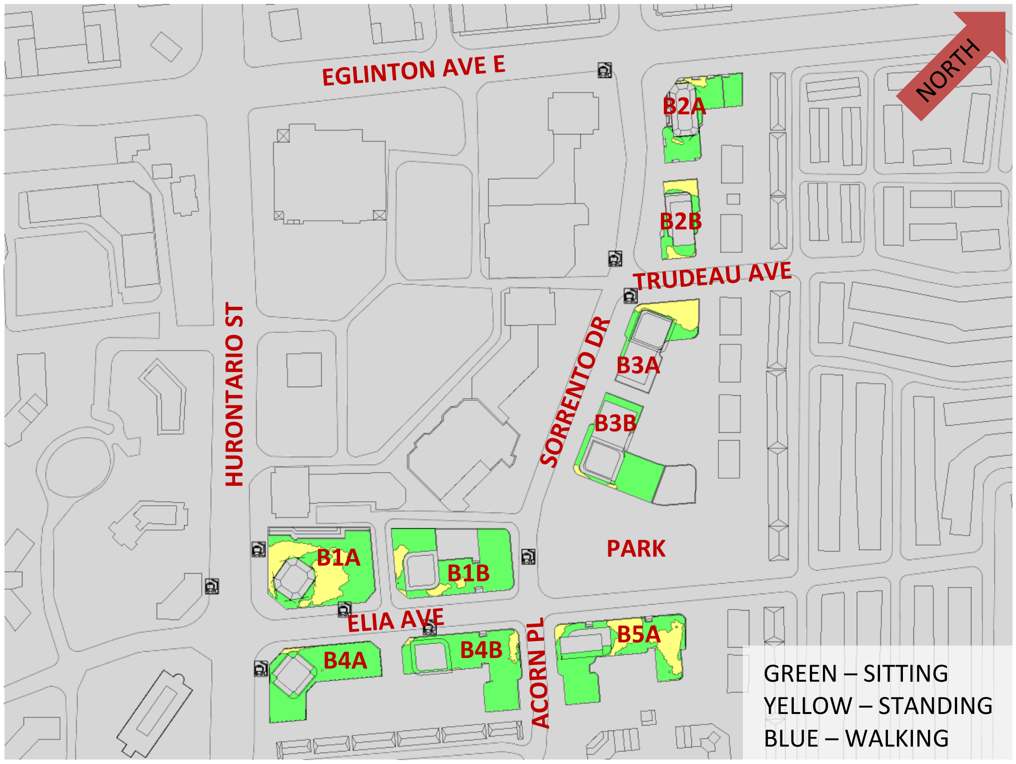


FIGURE 5A: SUMMER – PROPOSED MASSING – WIND COMFORT CONDITIONS, PODIA

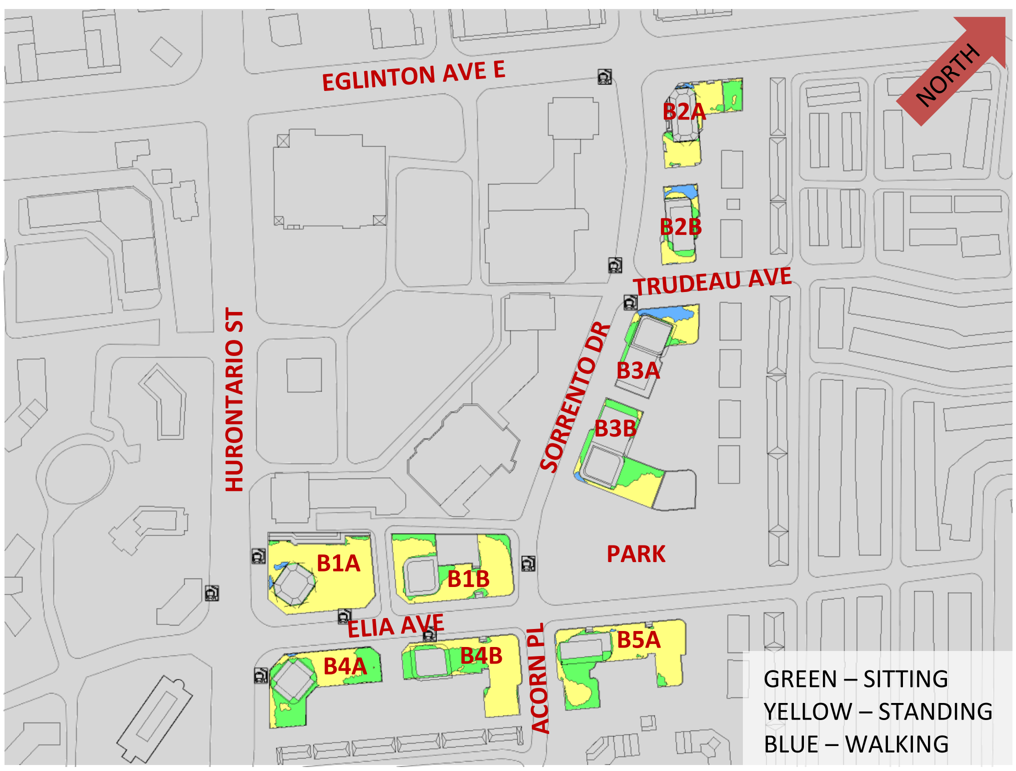
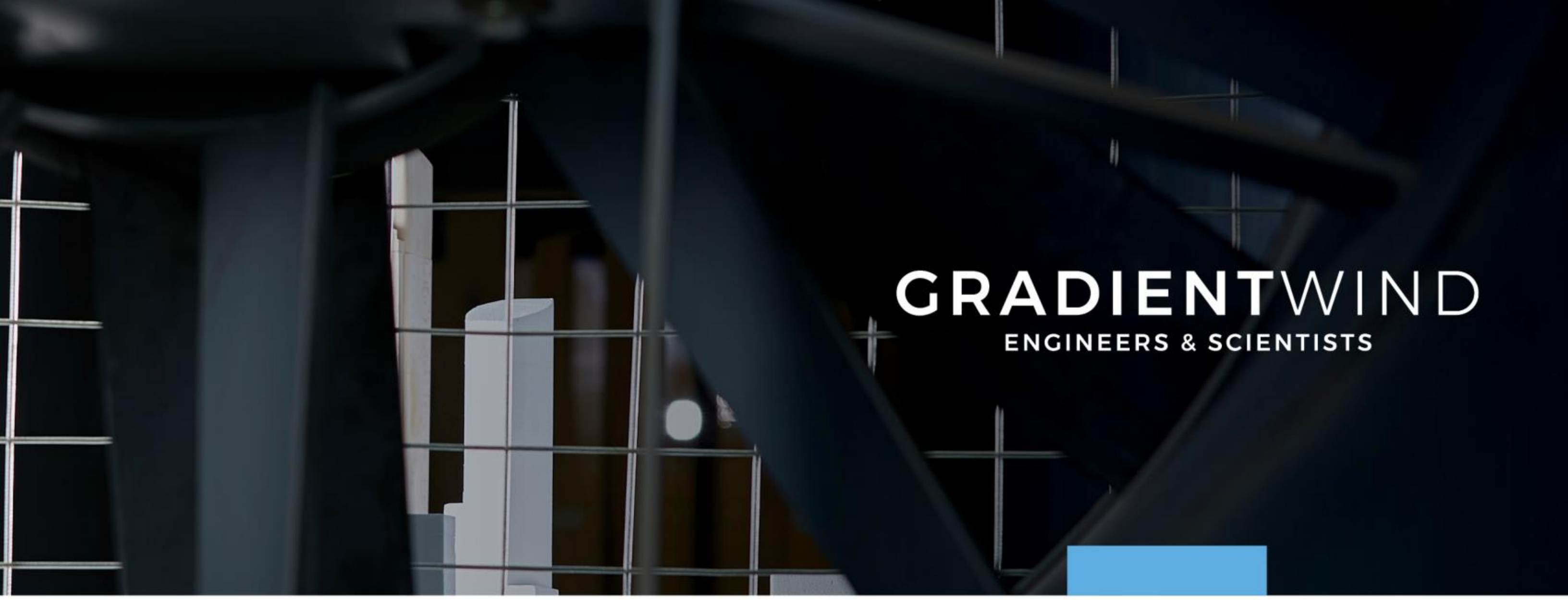
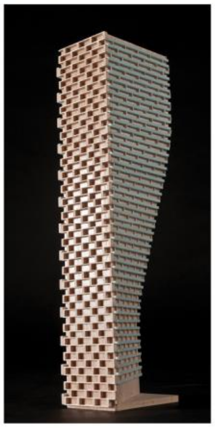
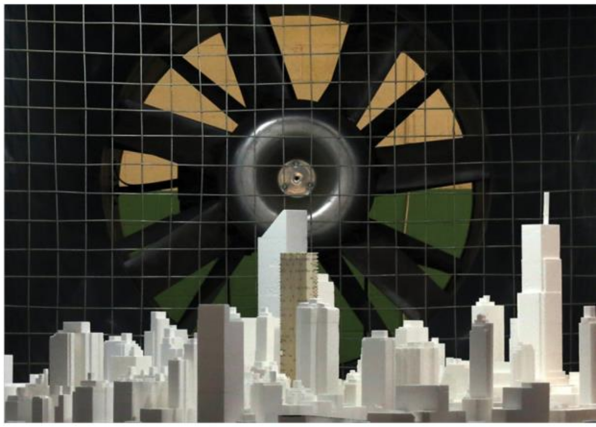


FIGURE 5B: WINTER – PROPOSED MASSING – WIND COMFORT CONDITIONS, PODIA







APPENDIX A

SIMULATION OF THE ATMOSPHERIC BOUNDARY LAYER

SIMULATION OF THE ATMOSPHERIC BOUNDARY LAYER

The atmospheric boundary layer (ABL) is defined by the velocity and turbulence profiles according to industry standard practices. The mean wind profile can be represented, to a good approximation, by a power law relation, Equation (1), giving height above ground versus wind speed [1], [2].

$$U = U_g \left(\frac{Z}{Z_g}\right)^{\alpha} \quad \text{Equation (1)}$$

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.

For the model, U_g is set to 6.5 metres per second (m/s), which approximately corresponds to the 50% mean wind speed for Mississauga based on historical data and statistical analyses. When the results are normalized by this velocity, they are relatively insensitive to the selection of gradient wind speed.

Z_g is set to 540 m. The selection of gradient height is relatively unimportant, so long as it exceeds the building heights surrounding the subject site. The value has been selected to correspond to our physical wind tunnel reference value.

α is determined based on the upstream exposure of the far-field surroundings (i.e., the area that it not captured within the simulation model).

Table 1 presents the values of α used in this study, while Table 2 presents several reference values of α. When the upstream exposure of the far-field surroundings is a mixture of multiple types of terrain, the α values are a weighted average with terrain that is closer to the subject site given greater weight.

TABLE 1: UPSTREAM EXPOSURE (ALPHA VALUE) VS TRUE WIND DIRECTION

Wind Direction (Degrees True)	Alpha Value (α)
0	0.25
40	0.24
97	0.25
136	0.29
170	0.27
210	0.23
237	0.25
258	0.25
278	0.24
300	0.26
322	0.25
341	0.25

TABLE 2: DEFINITION OF UPSTREAM EXPOSURE (ALPHA VALUE)

Upstream Exposure Type	Alpha Value (α)
Open Water	0.14-0.15
Open Field	0.16-0.19
Light Suburban	0.21-0.24
Heavy Suburban	0.24-0.27
Light Urban	0.28-0.30
Heavy Urban	0.31-0.33

The turbulence model in the computational fluid dynamics (CFD) simulations is a two-equation shear-stress transport (SST) model, and thus the ABL turbulence profile requires that two parameters be defined at the inlet of the domain. The turbulence profile is defined following the recommendations of the Architectural Institute of Japan for flat terrain [3].

$$I(Z) = \begin{cases} 0.1\left(\dfrac{Z}{Z_g}\right)^{-\alpha-0.05}, & Z > 10\text{ m} \\ 0.1\left(\dfrac{10}{Z_g}\right)^{-\alpha-0.05}, & Z \leq 10\text{ m} \end{cases}$$ Equation (2)

$$L_t(Z) = \begin{cases} 100\text{ m}\sqrt{\dfrac{Z}{30}}, & Z > 30\text{ m} \\ 100\text{ m}, & Z \leq 30\text{ m} \end{cases}$$ Equation (3)

where, I = turbulence intensity, L_t = turbulence length scale, Z = height above ground, and α is the power law exponent used for the velocity profile in Equation (1).

Boundary conditions on all other domain boundaries are defined as follows: the ground is a no-slip surface; the side walls of the domain have a symmetry boundary condition; the top of the domain has a specified shear, which maintains a constant wind speed at gradient height; and the outlet has a static pressure boundary condition.

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[1] P. Arya, "Chapter 10: Near-neutral Boundary Layers," in *Introduction to Micrometeorology*, San Diego, California, Academic Press, 2001.

[2] S. A. Hsu, E. A. Meindl and D. B. Gilhousen, "Determining the Power-Law WInd Profile Exponent under Near-neutral Stability Conditions at Sea," vol. 33, no. 6, 1994.

[3] Y. Tamura, H. Kawai, Y. Uematsu, K. Kondo and T. Okhuma, "Revision of AIJ Recommendations for Wind Loads on Buildings," in *The International Wind Engieering Symposium, IWES 2003*, Taiwan, 2003.