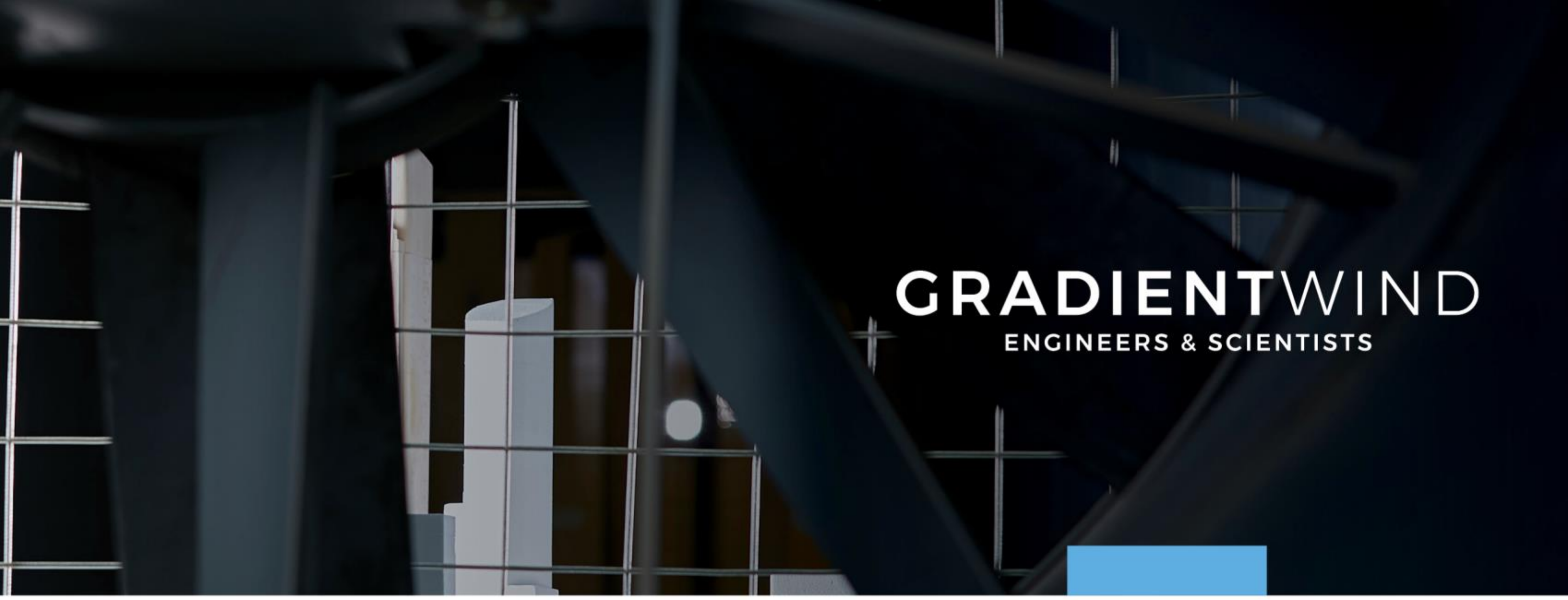
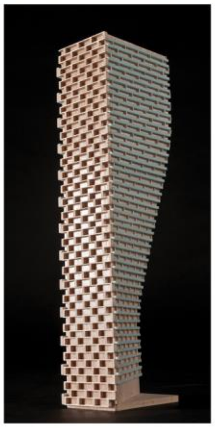
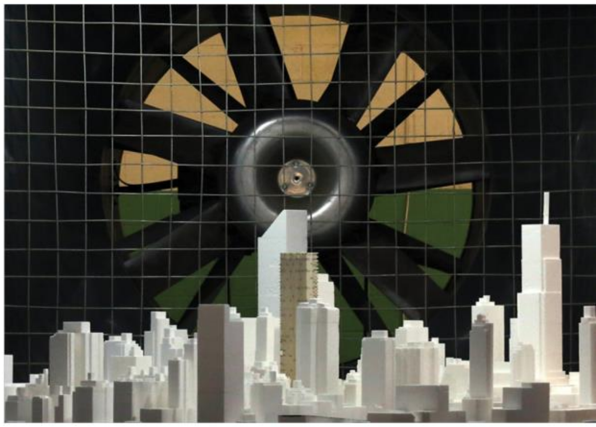


PEDESTRIAN LEVEL WIND STUDY

1034 McGarry Terrace
Ottawa, Ontario

Report: 23-059-PLW





January 26, 2024

PREPARED FOR
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EXECUTIVE SUMMARY

This report describes a pedestrian level wind (PLW) study undertaken to satisfy a concurrent resubmission of the Official Plan Amendment (OPA) and Zoning By-Law Amendment (ZBLA) applications and an initial Site Plan Control application submission for the proposed mixed-use residential development located at 1034 McGarry Terrace in Ottawa, Ontario (hereinafter referred to as "subject site" or "proposed development"). Our mandate within this study is to investigate pedestrian wind conditions within and surrounding the subject site, and to identify areas where conditions may interfere with certain pedestrian activities so that mitigation measures may be considered, where required.

The study involves simulation of wind speeds for selected wind directions in a three-dimensional (3D) computer model using the computational fluid dynamics (CFD) technique, combined with meteorological data integration, to assess pedestrian wind comfort and safety within and surrounding the subject site according to City of Ottawa wind comfort and safety criteria. The results and recommendations derived from these considerations are detailed in the main body of the report (Section 5), illustrated in Figures 3A-9, and summarized as follows:

1) All grade-level areas within and surrounding the subject site are predicted to experience conditions that are considered acceptable for the intended pedestrian uses throughout the year. Specifically, conditions over surrounding sidewalks, nearby transit stops, existing drive aisle to the east, neighbouring existing surface parking lots, the future extension of McGarry Terrace, drop-off areas, walkways, the resident's courtyard, the open courtyard, and in the vicinity of building access points, are considered acceptable.

2) The common amenity terraces at Levels 11 and 12 were modelled with 1.8-m-tall wind screens along their full perimeters. Wind comfort conditions within the amenity terraces serving the proposed development during the typical use period (that is, May to October, inclusive) and recommendations regarding mitigation are described as follows:

a. **Level 11 Amenity Terrace**: With the noted 1.8-m-tall wind screen, wind comfort conditions are predicted to be suitable for sitting to the east and west of the terrace with conditions suitable for standing central to the terrace. Where conditions are suitable for standing, they are also suitable for sitting for at least 76% of the time, where the target is 80% to achieve the sitting comfort class.

b. **Level 12 Amenity Terrace**: With the noted 1.8-m-tall perimeter wind screen, wind comfort conditions are predicted to be suitable for mostly standing, with conditions suitable for sitting to the west of the terrace and at the northeast corner.

c. To improve comfort levels within the amenity terraces serving the proposed development at Levels 11 and 12, mitigation inboard of the terrace perimeters targeted around sensitive areas is recommended, in combination with taller wind screens (that is, greater than 1.8 m as measured from the local walking surface) along the perimeters of the terraces. This inboard mitigation could take the form of inboard wind screens or other common landscape elements.

d. The extent of the mitigation measures is dependent on the programming of the terraces. An appropriate mitigation strategy will be developed in collaboration with the building and landscape architects as the design of the proposed development.

3) The foregoing statements and conclusions apply to common weather systems, during which no dangerous wind conditions, as defined in Section 4.4, are expected anywhere over the subject site. During extreme weather events (for example, 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.

TABLE OF CONTENTS

1. INTRODUCTION

Gradient Wind Engineering Inc. (Gradient Wind) was retained by Katasa Groupe + Developpement to undertake a pedestrian level wind (PLW) study to satisfy a concurrent resubmission of the Official Plan Amendment (OPA) and Zoning By-Law Amendment (ZBLA) applications and an initial Site Plan Control applications for the proposed mixed-use residential development located at 1034 McGarry Terrace in Ottawa, Ontario (hereinafter referred to as “subject site” or “proposed development”). Our mandate within this study is to investigate wind conditions within and surrounding the subject site, and to identify areas where conditions may interfere with certain pedestrian activities so that mitigation measures may be considered, where required.

Our work is based on industry standard computer simulations using the computational fluid dynamics (CFD) technique and data analysis procedures, City of Ottawa wind comfort and safety criteria, architectural drawings prepared by Progressive Architects, Ltd. in January 2024, surrounding street layouts and existing and approved future building massing information obtained from the City of Ottawa, as well as recent satellite imagery.

2. TERMS OF REFERENCE

The subject site is located at 1034 McGarry Terrace in Ottawa, situated to the north at the intersection of Marketplace Avenue and Sue Holloway Drive, on a parcel of land bounded by Marketplace Avenue to the southeast, the future McGarry Terrace extension to the southwest, a high-rise building to the northwest, and a high-rise building and a drive aisle the northeast. Throughout this report, Marketplace Avenue is referred to as project south.

The proposed development comprises two towers, the Eastern Tower (26 storeys) and the Western Tower (35 storeys), rising above a common 11-storey podium comprising a nominally ‘H’-shaped planform, with its short axis-oriented along Marketplace Avenue. The towers share six underground parking levels and are topped with a mechanical penthouse (MPH).

Above the underground parking, the ground floor includes commercial units along the east and south elevations, a residential main entrance to the west, a commercial unit and a loading area at the northwest corner, indoor amenities to the north, and a loading area at the northeast corner. Drop-off areas are located to the east and west of the subject site, a resident's courtyard is located to the north, and an open courtyard is located to the south. Access to underground parking is provided by a ramp near the northeast corner via the drive aisle to the east from Marketplace Avenue. At Level 2, the building steps back central from the north elevation and extends at the northeast corner. Levels 2-9 are reserved for residential use. Private terraces are provided within insets along all elevations at Level 2 and along the north elevation at Level 5. The building steps back from all elevations at Level 5 and private terraces are accommodated within the setbacks from east, south, and west elevations. Level 10 includes central indoor amenities and residential units to the east and west, while Level 11 includes central service spaces and residential units to the east and west. The building steps back from the south elevation at Level 11 to accommodate an outdoor amenity terrace. At Level 12, the Eastern Tower includes indoor amenities to the west and residential units throughout the remainder of the level, while the Western Tower is reserved for residential occupancy. An outdoor amenity terrace is provided between the two towers at this level, with a pool located to the south of the terrace. The Eastern and Western Towers rise with common residential floorplans from Levels 13-26 and 13-35, respectively.

The near-field surroundings, defined as an area within 200-metres (m) of the subject site, include a mid-rise retirement building to the northeast, a school and low-rise residential dwellings to the east, a mix of mid- and high-rise residential buildings from the southeast clockwise to the south, and low-rise commercial buildings from the southwest clockwise to the northwest. Notably, a residential development comprising two towers of 17 and 16 storeys is under construction at 1117 Longfields Drive, to the immediate east of the subject site. The far-field surroundings, defined as an area beyond the near-field but within a 2-kilometre (km) radius of the subject site, are characterized by suburban massing with open exposures of green spaces and fields in all compass directions. The Jock River flows from the southwest to the southeast approximately 1.6 km to the south.

Site plans for the proposed and existing massing scenarios are illustrated in Figures 1A and 1B, while Figures 2A-2H illustrate the computational models used to conduct the study. The existing massing scenario includes the existing massing and any future developments approved by the City of Ottawa.

3. OBJECTIVES

The principal objectives of this study are to (i) determine pedestrian level wind 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; and (iii) recommend suitable mitigation measures, where required.

4. METHODOLOGY

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

4.1 Computer-Based Context Modelling

A computer based PLW 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 Ottawa Macdonald-Cartier International Airport. The general concept and approach to CFD modelling is to represent building and topographic details in the immediate vicinity of the subject 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 stronger wind speeds.

[1] City of Ottawa Terms of References: Wind Analysis
https://documents.ottawa.ca/sites/default/files/torwindanalysis_en.pdf

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. The CFD simulation model was centered on the proposed development, complete with surrounding massing within a radius of 480 m. The process was performed for two context massing scenarios, as noted in Section 2.

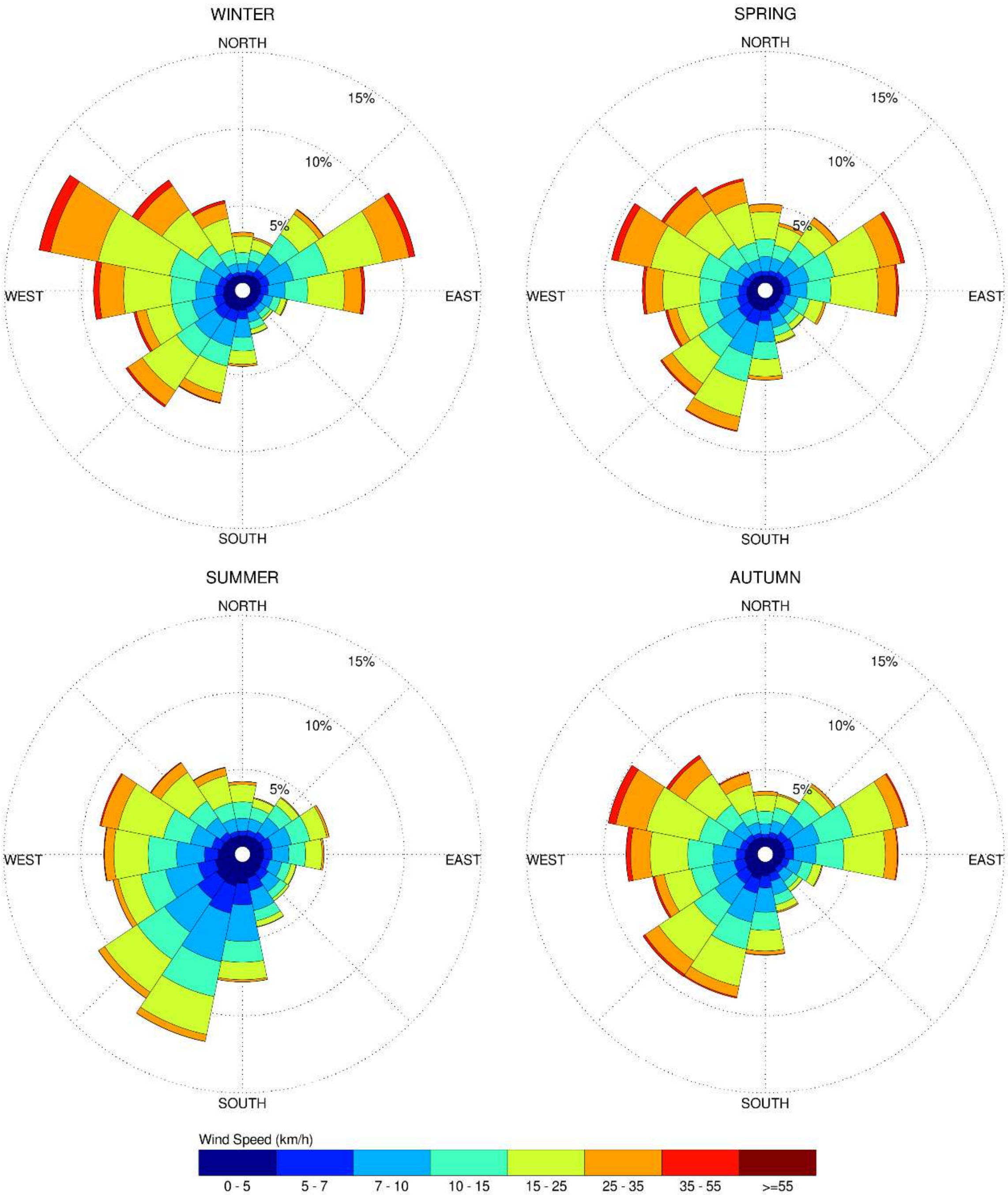
Mean and peak wind speed data obtained over the subject site for each wind direction were interpolated to 36 wind directions at 10° intervals, representing the full compass azimuth. Measured wind speeds approximately 1.5 m above local grade and over the common amenity terraces serving the proposed development were referenced to the wind speed at gradient height to generate mean and peak velocity ratios, which were used to calculate full-scale values. 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 wind flow simulation technique are presented in Appendix A.

4.3 Historical Wind Speed and Direction Data

A statistical model for winds in Ottawa was developed from approximately 40 years of hourly meteorological wind data recorded at Ottawa Macdonald-Cartier International Airport and obtained from Environment and Climate Change Canada. Wind speed and direction data were analyzed for each month of the year to determine the statistically prominent wind directions and corresponding speeds, and to characterize similarities between monthly weather patterns.

The statistical model of the Ottawa 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 kilometers per hour (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 prominent wind speeds and directions can be identified by the longer length of the bars. For Ottawa, the most common winds occur for westerly wind directions, followed by those from the east, while the most common wind speeds are below 36 km/h. The directional prominence and relative magnitude of wind speed changes somewhat from season to season.

SEASONAL DISTRIBUTION OF WIND
OTTAWA MACDONALD-CARTIER INTERNATIONAL AIRPORT



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 Ottawa

Pedestrian wind comfort and safety criteria are based on the mechanical effects of wind without consideration of other meteorological conditions (that is, temperature and relative humidity). The comfort criteria assume that pedestrians are appropriately dressed for a specified outdoor activity during any given season. Five pedestrian comfort classes based on 20% non-exceedance mean wind speed ranges are used to assess pedestrian comfort: (1) Sitting; (2) Standing; (3) Strolling; (4) Walking; and (5) Uncomfortable. The gust speeds, and equivalent mean speeds, are selected based on the Beaufort scale, which describes the effects of forces produced by varying wind speed levels on objects. Wind conditions suitable for sitting are represented by the colour blue, standing by green, strolling by yellow, and walking by orange; uncomfortable conditions are represented by the colour magenta. Specifically, the comfort classes, associated wind speed ranges, and limiting criteria are summarized as follows:

PEDESTRIAN WIND COMFORT CLASS DEFINITIONS

Wind Comfort Class	GEM Speed (km/h)	Description
SITTING	≤ 10	Mean wind speeds no greater than 10 km/h occurring at least 80% of the time. The equivalent gust wind speed is approximately 16 km/h.
STANDING	≤ 14	Mean wind speeds no greater than 14 km/h occurring at least 80% of the time. The equivalent gust wind speed is approximately 22 km/h.
STROLLING	≤ 17	Mean wind speeds no greater than 17 km/h occurring at least 80% of the time. The equivalent gust wind speed is approximately 27 km/h.
WALKING	≤ 20	Mean wind speeds no greater than 20 km/h occurring at least 80% of the time. The equivalent gust wind speed is approximately 32 km/h.
UNCOMFORTABLE	> 20	Uncomfortable conditions are characterized by predicted values that fall below the 80% target for walking. Brisk walking and exercise, such as jogging, would be acceptable for moderate excesses of this criterion.

Regarding wind safety, the pedestrian safety wind speed criterion 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 90 km/h is 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. Notably, pedestrians tend to be more sensitive to wind gusts than to steady winds for lower wind speed ranges. For strong winds approaching dangerous levels, this effect is less important because the mean wind can also create problems for pedestrians.

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 a mean wind speed of 10 km/h (equivalent gust wind speed of approximately 16 km/h) were exceeded for more than 20% of the time most pedestrians would judge that location to be too windy for sitting. Similarly, if mean wind speed of 20 km/h (equivalent gust wind speed of approximately 32 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 subject 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 target comfort classes, which are dictated by the location type for each region (that is, a sidewalk, building entrance, amenity space, or other). An overview of common pedestrian location types and their typical windiest target comfort classes are summarized on the following page. Depending on the programming of a space, the desired comfort class may differ from this table.

TARGET PEDESTRIAN WIND COMFORT CLASSES FOR VARIOUS LOCATION TYPES

Location Types	Comfort Classes
Primary Building Entrance	Standing
Secondary Building Access Point	Walking
Public Sidewalk / Bicycle Path	Walking
Outdoor Amenity Space	Sitting / Standing
Café / Patio / Bench / Garden	Sitting / Standing
Transit Stop (Without Shelter)	Standing
Transit Stop (With Shelter)	Walking
Public Park / Plaza	Sitting / Standing
Garage / Service Entrance	Walking
Parking Lot	Walking
Vehicular Drop-Off Zone	Walking

5. RESULTS AND DISCUSSION

The following discussion of the predicted pedestrian wind conditions for the subject site is accompanied by Figures 3A-6B, illustrating wind conditions at grade level for the proposed and existing massing scenarios, and by Figures 8A-8D, which illustrate conditions over the common amenity terraces serving the proposed development at Levels 11 and 12. Conditions are presented as continuous contours of wind comfort throughout the subject site and correspond to the comfort classes presented in Section 4.4.

Wind comfort conditions are also reported for the typical use period, which is defined as May to October, inclusive. Figures 7 and 9 illustrate comfort conditions at grade level and over the noted common amenity terraces serving the proposed development, respectively, consistent with the comfort classes in Section 4.4. The details of these conditions are summarized in the following pages for each area of interest.

5.1 Wind Comfort Conditions – Grade Level

Drive Aisle East of Subject Site: Following the introduction of the proposed development, conditions over the drive aisle situated to the east of the subject site are predicted to be suitable for a mix of sitting and standing during the summer, becoming suitable for standing, or better, during the autumn, and suitable for strolling, or better, during the winter and spring. The noted conditions are considered acceptable.

Wind conditions over the noted drive aisle with the existing massing are predicted to be suitable for a mix of sitting and standing during the summer, becoming suitable for strolling, or better, throughout the remainder of the year, with small, isolated regions suitable for walking during the winter and spring. Notably, the introduction of the proposed development is predicted to improve comfort levels at some areas over the noted drive aisle, in comparison to existing conditions, and wind conditions with the proposed development are considered acceptable.

Sidewalks and Transit Stops along Marketplace Avenue: Following the introduction of the proposed development, conditions over the public sidewalks along Marketplace Avenue are predicted to be suitable for a mix of sitting and standing during the summer, becoming suitable for strolling, or better, throughout the remainder of the year. Conditions in the vicinity of the nearby eastbound transit stop to the south of Marketplace Avenue are predicted to be suitable for sitting during the summer, becoming suitable for standing, or better, throughout the remainder of the year. Conditions in the vicinity of the nearby westbound transit stop to the southwest of the proposed development are predicted to be suitable for sitting throughout the year.

Wind conditions over the public sidewalks along Marketplace Avenue with the existing massing are predicted to be suitable for a mix of mostly sitting and standing during the summer and autumn, becoming suitable for strolling, or better, during the winter and spring. With the existing massing, conditions in the vicinity of the noted eastbound transit stop are predicted to be suitable for standing, or better, during the spring, summer, and autumn, becoming suitable for a mix of standing and strolling during the winter. Conditions in the vicinity of the westbound transit stop to the southwest of the subject site with the existing massing are predicted to be suitable for sitting during the spring, summer, and autumn, becoming suitable for standing, or better during the winter.

While the introduction of the proposed development produces windier conditions over Marketplace Avenue, conditions over the nearby transit stops are predicted to improve in comparison to existing conditions, and conditions with the proposed development are nevertheless considered acceptable.

Sidewalks along Sue Holloway Drive: Following the introduction of the proposed development, conditions over the public sidewalks along Sue Holloway Drive are predicted to be suitable for mostly sitting during the summer, becoming suitable for mostly standing, or better, throughout the remainder of the year. The noted conditions are considered acceptable.

Wind conditions over the public sidewalks along Sue Holloway Drive with the existing massing are predicted to be suitable for sitting during summer, becoming suitable for standing, or better, throughout the remainder of the year. While the introduction of the proposed development produces windier conditions in comparison to existing conditions, wind comfort conditions are nevertheless considered acceptable.

Neighbouring Existing Surface Parking Lots Southwest of Subject Site: Following the introduction of the proposed development, conditions over the neighbouring existing surface parking lots situated to the southwest of the subject site are predicted to be suitable for sitting during the summer, becoming suitable for a mix of sitting and standing throughout the remainder of the year. The noted conditions are considered acceptable.

Wind conditions over the noted parking lots with the existing massing are predicted to be suitable for sitting during the summer, becoming suitable for standing, or better, during the remaining seasons. While the introduction of the proposed development produces slightly windier conditions in comparison to existing conditions, wind comfort conditions are nevertheless considered acceptable.

Sidewalks along Future McGarry Terrace Extension West of Subject Site: Conditions over the public sidewalks along the future extension of McGarry Terrace along the west elevation of the subject site are predicted to be suitable for standing, or better, during the summer, becoming suitable for a mix of standing and strolling throughout the remainder of the year, with an isolated region suitable for walking at the intersection of the future extension of McGarry Terrace and Marketplace Avenue. The noted conditions are considered acceptable.

Sidewalks along McGarry Terrace: Following the introduction of the proposed development, conditions over the public sidewalks along McGarry Terrace are predicted to be suitable for a mix of sitting and standing during the summer and autumn, becoming suitable for strolling, or better, during the winter and spring. The noted conditions are considered acceptable.

Wind conditions over the public sidewalks along McGarry Terrace with the existing massing are predicted to be suitable for suitable for standing, or better, throughout the year. While the introduction of the proposed development produces windier conditions in comparison to existing conditions, wind comfort conditions are nevertheless considered acceptable.

Resident's Courtyard and Open Courtyard: During the typical use period, wind conditions within the resident's courtyard and the open courtyard situated to the north and south of the subject site, respectively, are predicted to be suitable for sitting, as illustrated in Figure 7. The noted conditions are considered acceptable.

Drop-off Areas and Walkways Within Subject Site: Wind conditions over the drop-off area to the east of the subject site are predicted to be suitable for mostly sitting during the summer, becoming suitable for standing throughout the remainder of the year, while conditions over the drop-off area to the west of the subject site are predicted to be suitable for standing during the summer, becoming suitable for a mix of standing and strolling throughout the remainder of the year. Conditions over the walkways within the subject site are predicted to be suitable for standing, or better, during the summer, becoming suitable for mostly strolling, or better, throughout the remainder of the year. The noted conditions are considered acceptable.

Building Access Points: Wind conditions in the vicinity of the building access points serving the proposed development are predicted to be suitable for sitting during the summer, becoming suitable for standing, or better, throughout the remainder of the year. The noted conditions are considered acceptable.

5.2 Wind Comfort Conditions – Common Amenity Terraces

The common amenity terraces at Levels 11 and 12 were modelled with 1.8-m-tall wind screens along their full perimeters. Wind comfort conditions during the typical use period within the common amenity terraces serving the proposed development and recommendations regarding mitigation are described as follows:

Level 11 Amenity Terrace: With the noted wind mitigation along the terrace perimeter as described in the introductory paragraph, conditions within the common amenity terrace serving the proposed development at Level 11 are predicted to be suitable for sitting to the east and west of the terrace with conditions predicted to be suitable for standing central to the terrace, as illustrated in Figure 9. Where conditions are suitable for standing, they are also suitable for sitting for at least 76% of the time, where the target is 80% to achieve the sitting comfort class.

Level 12 Amenity Terrace: With the noted wind mitigation along the terrace perimeter as described in the introductory paragraph, conditions within the common amenity terrace serving the proposed development at Level 12 are predicted to be suitable for mostly standing, with conditions predicted to be suitable for sitting to the west of the terrace and at the northeast corner, as illustrated in Figure 9.

To improve comfort levels within the amenity terraces serving the proposed development at Levels 11 and 12, mitigation inboard of the terrace perimeters targeted around sensitive areas is recommended, in combination with taller wind screens (that is, greater than 1.8 m as measured from the local walking surface) along the perimeters of the terraces. This inboard mitigation could take the form of inboard wind screens or other common landscape elements.

The extent of the mitigation measures is dependent on the programming of the terraces. An appropriate mitigation strategy will be developed in collaboration with the building and landscape architects as the design of the proposed development progresses.

5.3 Wind Safety

Within the context of typical weather patterns, which exclude anomalous localized storm events such as tornadoes and downbursts, no pedestrian areas within or surrounding the subject site are expected to experience conditions that could be considered dangerous, as defined in Section 4.4.

5.4 Applicability of Results

Pedestrian wind comfort and safety have been quantified for the specific configuration of existing and foreseeable construction around the subject site. Future changes (that is, 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 subject site would alter the wind profile approaching the subject site; and (ii) development in proximity to the subject site would cause changes to local flow patterns.

6. CONCLUSIONS AND RECOMMENDATIONS

A complete summary of the predicted wind conditions is provided in Section 5 and illustrated in Figures 3A-9. Based on computer simulations using the CFD technique, meteorological data analysis of the Ottawa wind climate, City of Ottawa wind comfort and safety criteria, and experience with numerous similar developments, the study concludes the following:

1) All grade-level areas within and surrounding the subject site are predicted to experience conditions that are considered acceptable for the intended pedestrian uses throughout the year. Specifically, conditions over surrounding sidewalks, nearby transit stops, existing drive aisle to the east, neighbouring existing surface parking lots, the future extension of McGarry Terrace, drop-off areas, walkways, the resident's courtyard, the open courtyard, and in the vicinity of building access points, are considered acceptable.

2) The common amenity terraces at Levels 11 and 12 were modelled with 1.8-m-tall wind screens along their full perimeters. Wind comfort conditions within the amenity terraces serving the proposed development during the typical use period (that is, May to October, inclusive) and recommendations regarding mitigation are described as follows:

    a. **Level 11 Amenity Terrace**: With the noted 1.8-m-tall wind screen, wind comfort conditions are predicted to be suitable for sitting to the east and west of the terrace with conditions suitable for standing central to the terrace. Where conditions are suitable for standing, they are also suitable for sitting for at least 76% of the time, where the target is 80% to achieve the sitting comfort class.

b. **Level 12 Amenity Terrace**: With the noted 1.8-m-tall perimeter wind screen, wind comfort conditions are predicted to be suitable for mostly standing, with conditions suitable for sitting to the west of the terrace and at the northeast corner.

c. To improve comfort levels within the amenity terraces serving the proposed development at Levels 11 and 12, mitigation inboard of the terrace perimeters targeted around sensitive areas is recommended, in combination with taller wind screens (that is, greater than 1.8 m as measured from the local walking surface) along the perimeters of the terraces. This inboard mitigation could take the form of inboard wind screens or other common landscape elements.

d. The extent of the mitigation measures is dependent on the programming of the terraces. An appropriate mitigation strategy will be developed in collaboration with the building and landscape architects as the design of the proposed development.

3) The foregoing statements and conclusions apply to common weather systems, during which no dangerous wind conditions, as defined in Section 4.4, are expected anywhere over the subject site. During extreme weather events (for example, 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.

Sincerely,

Gradient Wind Engineering Inc.

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Wind Scientist

Justin Ferraro, P.Eng.
Principal

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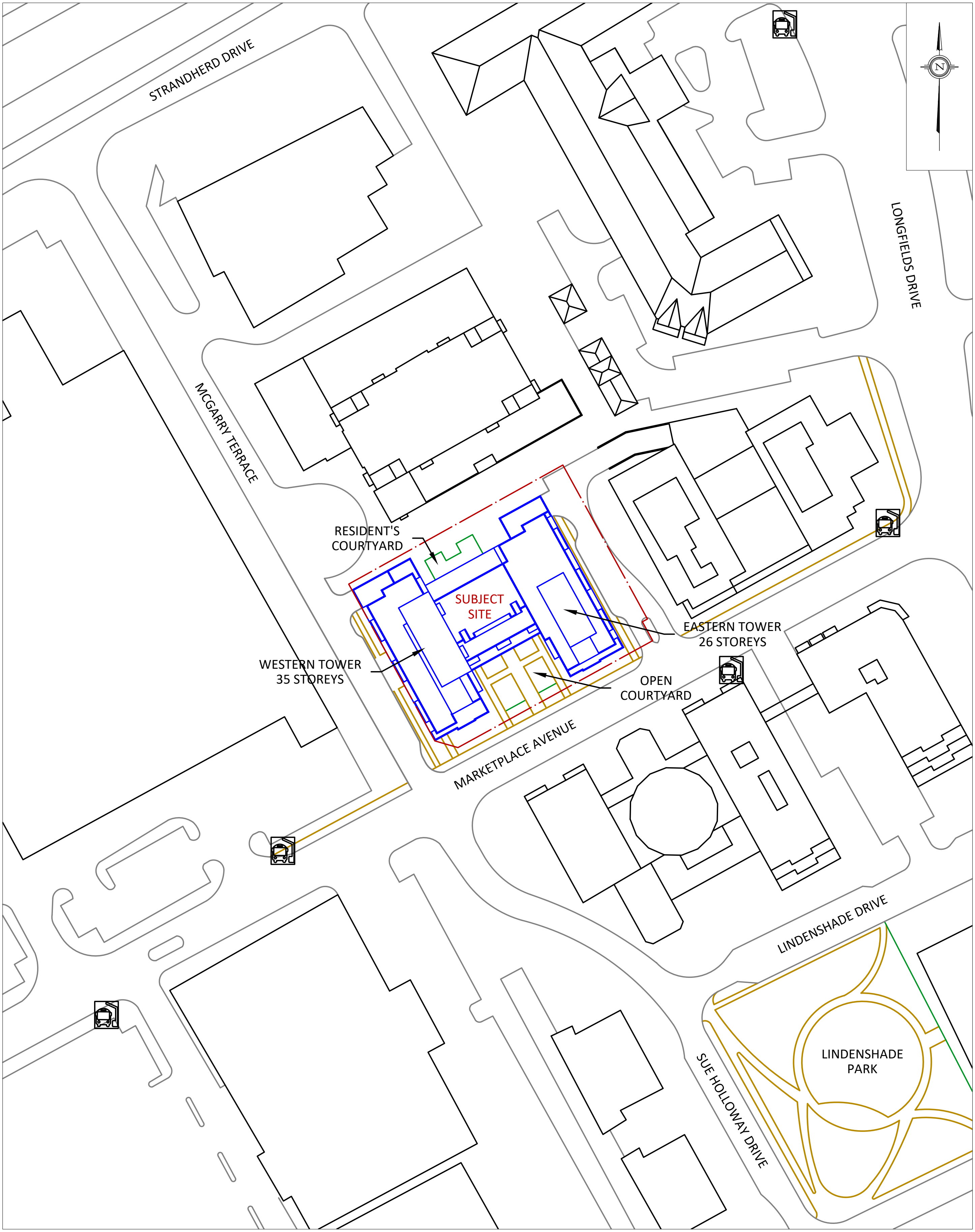
Junior Wind Scientist



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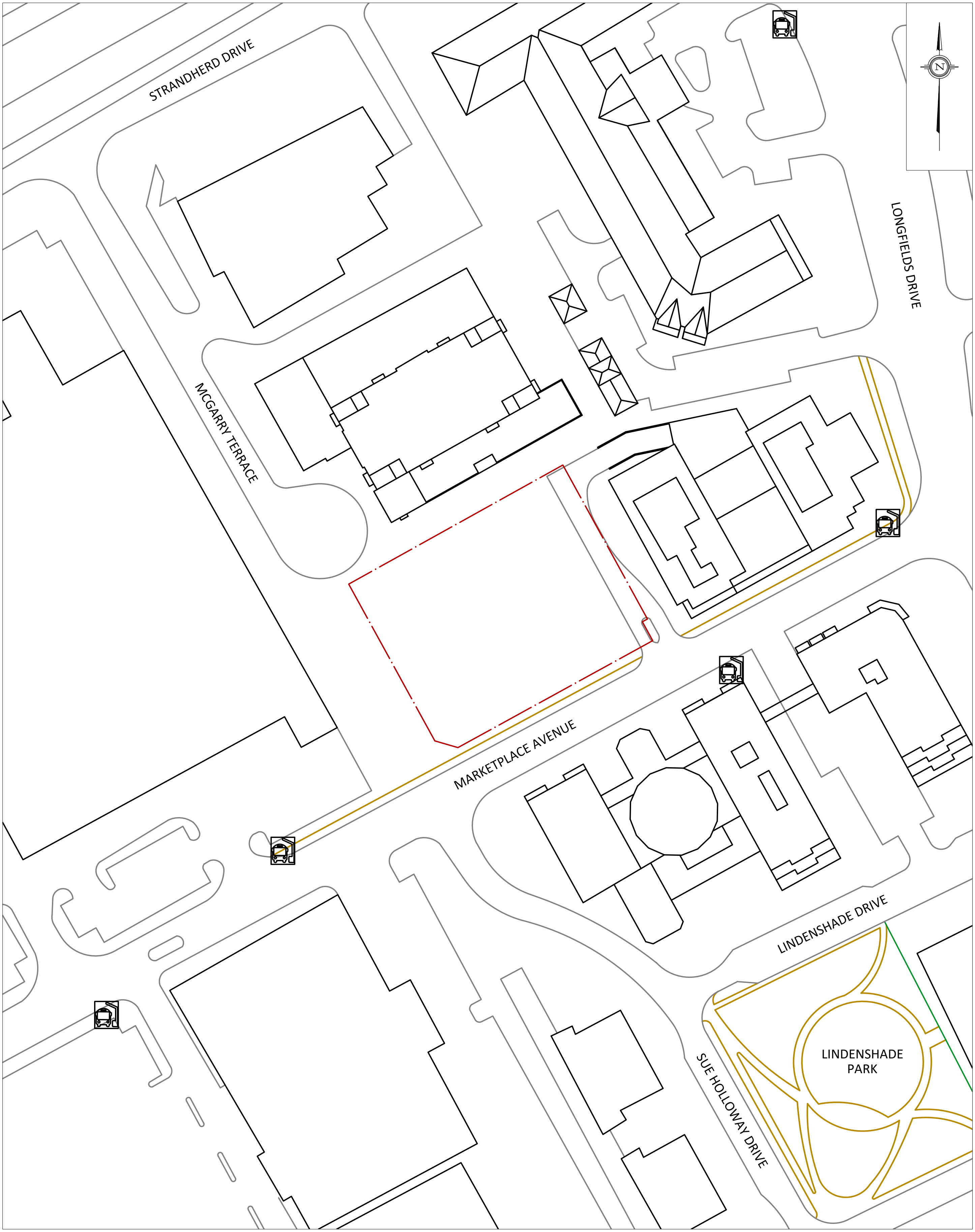
PROJECT	1034 MCGARRY TERRACE, OTTAWA PEDESTRIAN LEVEL WIND STUDY		
SCALE	1:1500	DRAWING NO.	23-059-PLW-1A
DATE	JANUARY 26, 2024	DRAWN BY	S.K.

DESCRIPTION

FIGURE 1A:
PROPOSED SITE PLAN AND SURROUNDING CONTEXT



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PROJECT	1034 MCGARRY TERRACE, OTTAWA PEDESTRIAN LEVEL WIND STUDY	DESCRIPTION	FIGURE 1B: EXISTING SITE PLAN AND SURROUNDING CONTEXT
SCALE	1:1500	DRAWING NO.	23-059-PLW-1B
DATE	JANUARY 26, 2024	DRAWN BY	S.K.

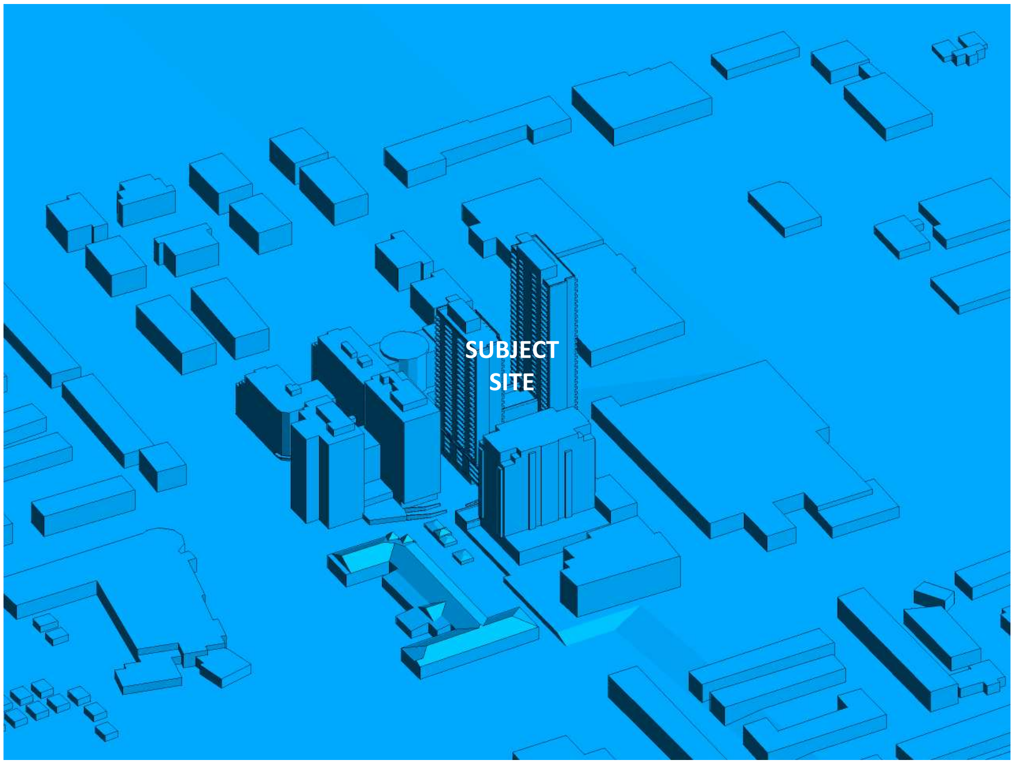


FIGURE 2A: COMPUTATIONAL MODEL, PROPOSED MASSING, NORTH PERSPECTIVE

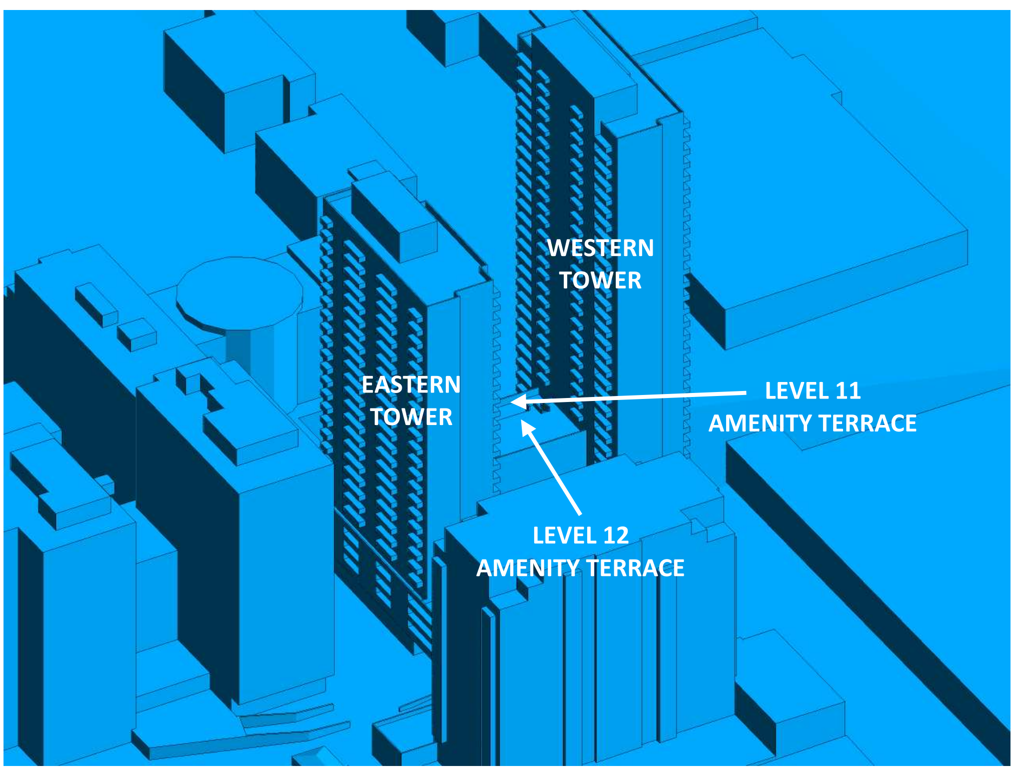


FIGURE 2B: CLOSE UP OF FIGURE 2A

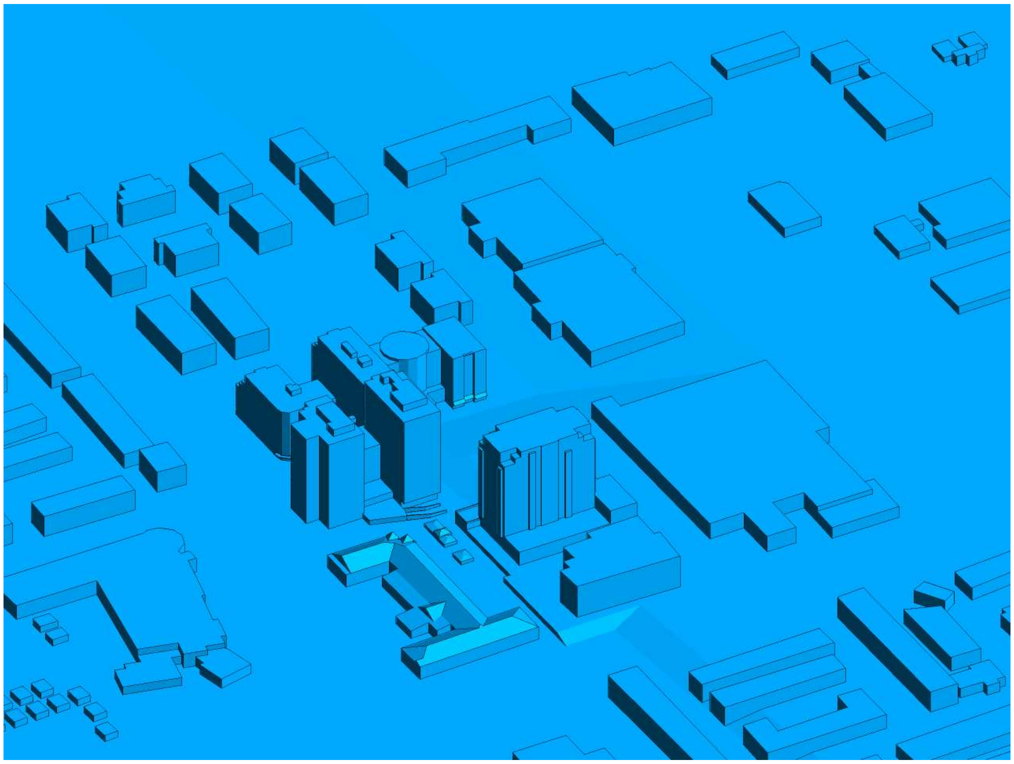


FIGURE 2C: COMPUTATIONAL MODEL, EXISTING MASSING, NORTH PERSPECTIVE

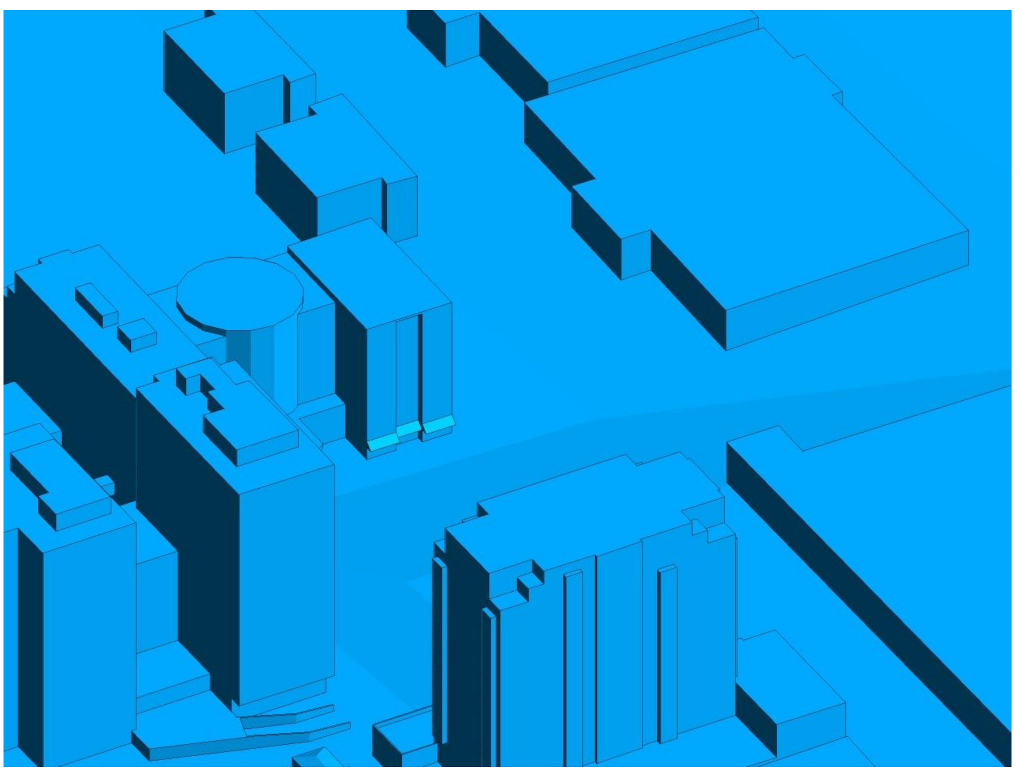


FIGURE 2D: CLOSE UP OF FIGURE 2C

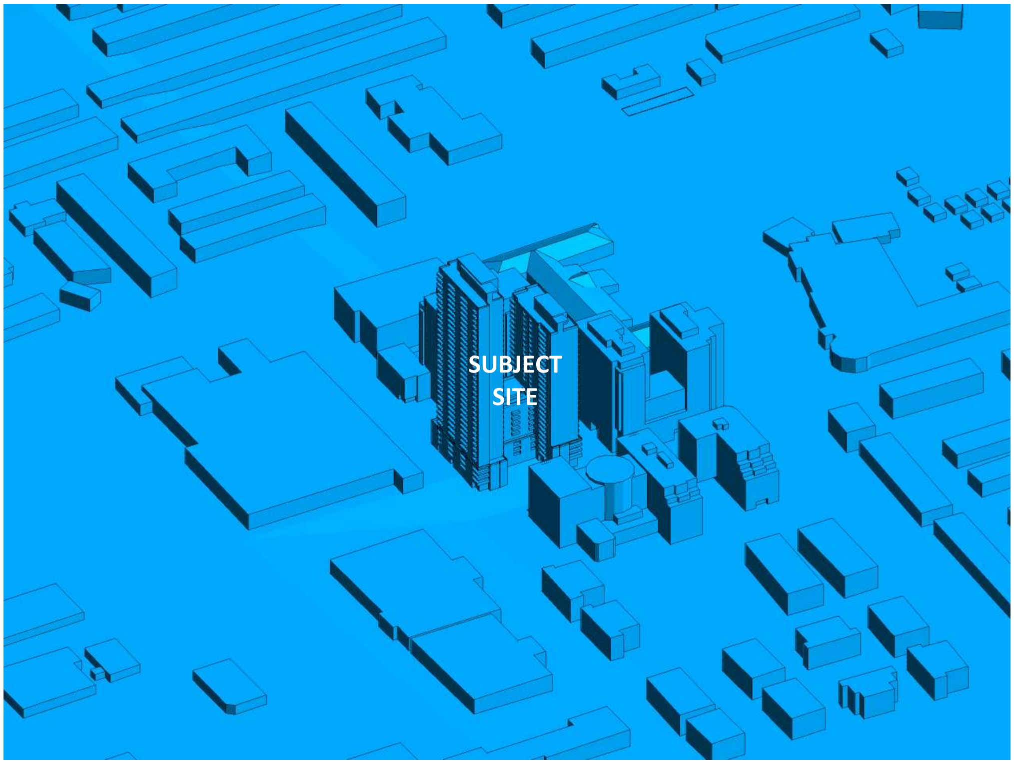


FIGURE 2E: COMPUTATIONAL MODEL, PROPOSED MASSING, SOUTH PERSPECTIVE

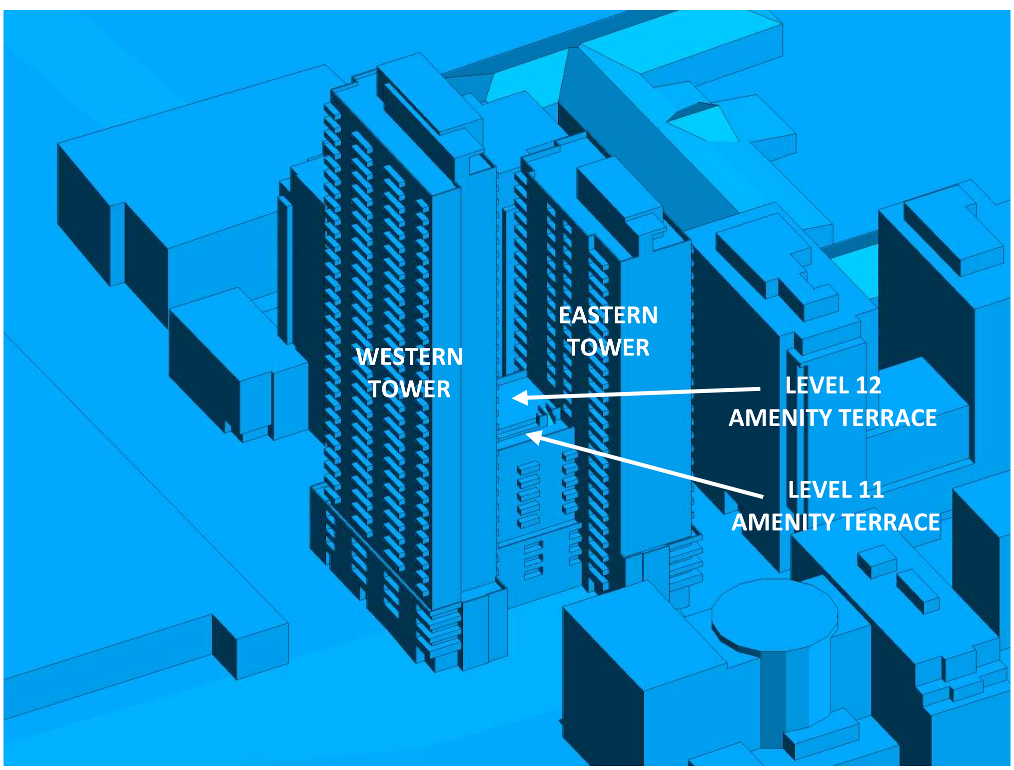


FIGURE 2F: CLOSE UP OF FIGURE 2E

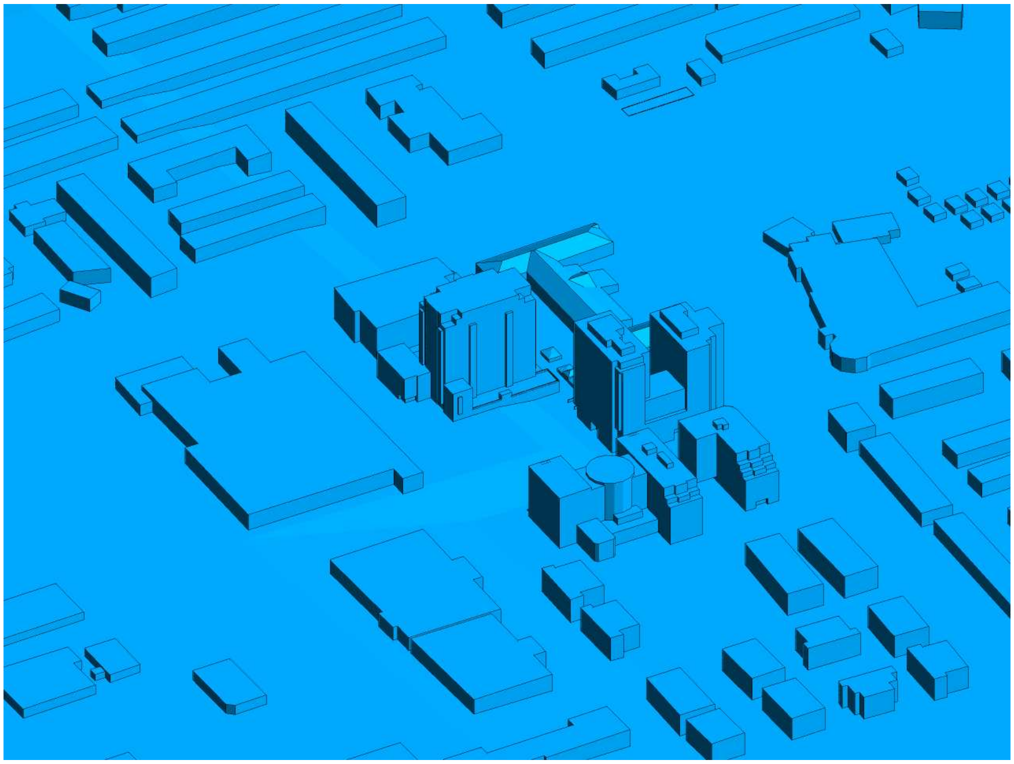


FIGURE 2G: COMPUTATIONAL MODEL, EXISTING MASSING, SOUTH PERSPECTIVE

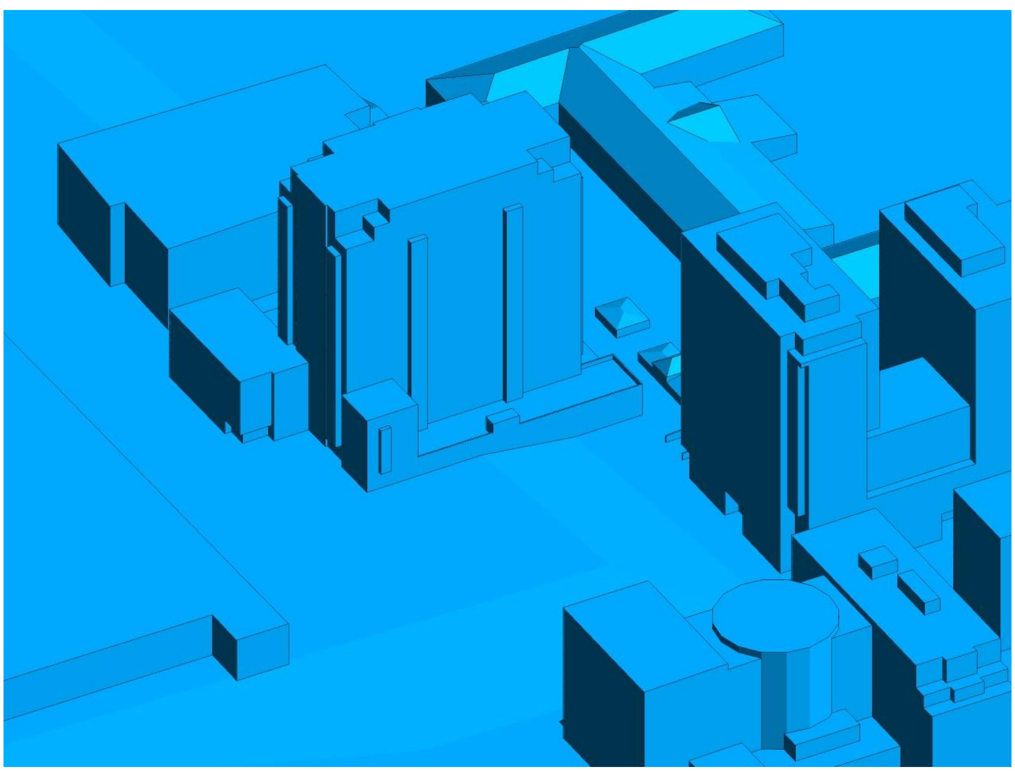


FIGURE 2H: CLOSE UP OF FIGURE 2G

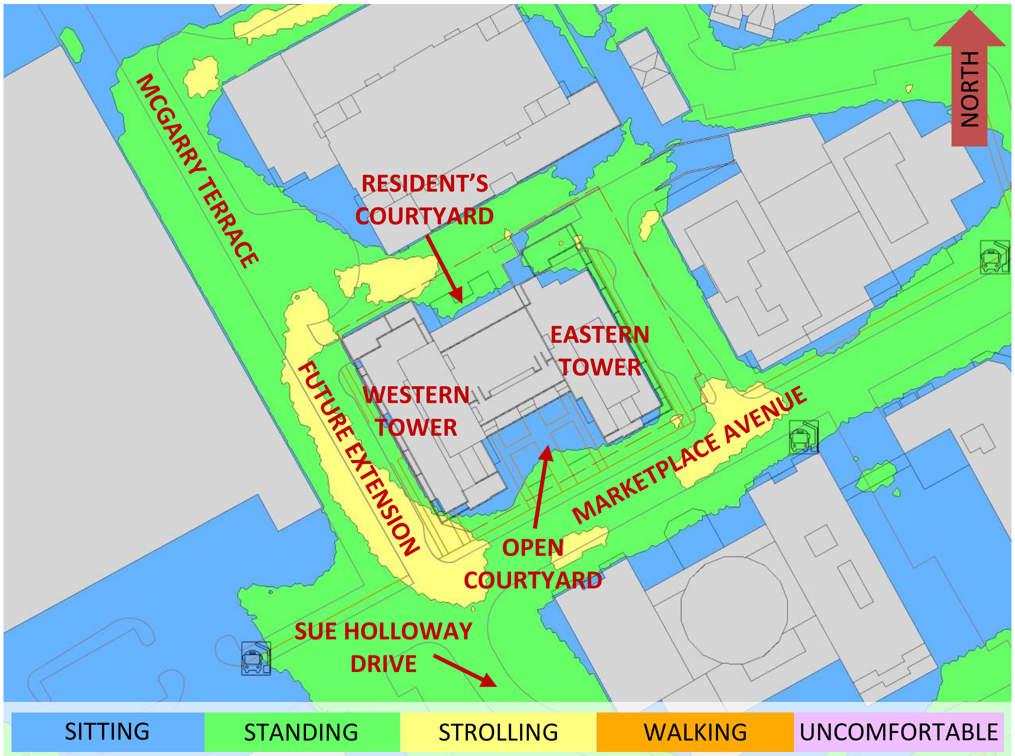


FIGURE 3A: SPRING – WIND COMFORT, GRADE LEVEL – PROPOSED MASSING

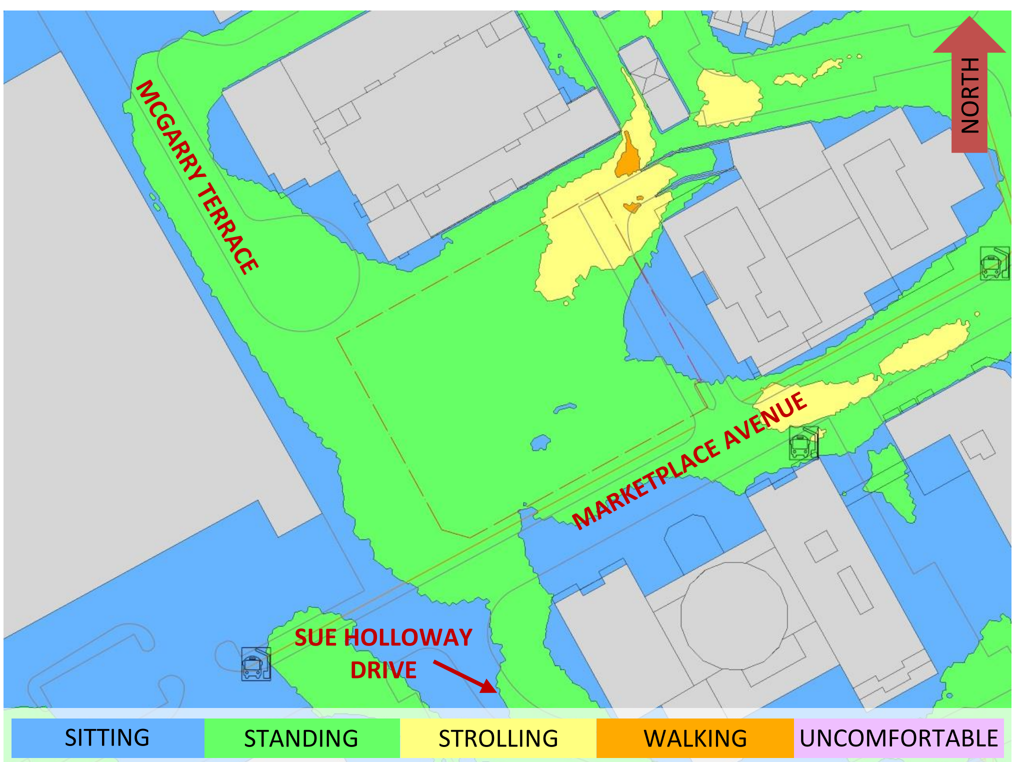


FIGURE 3B: SPRING – WIND COMFORT, GRADE LEVEL – EXISTING MASSING

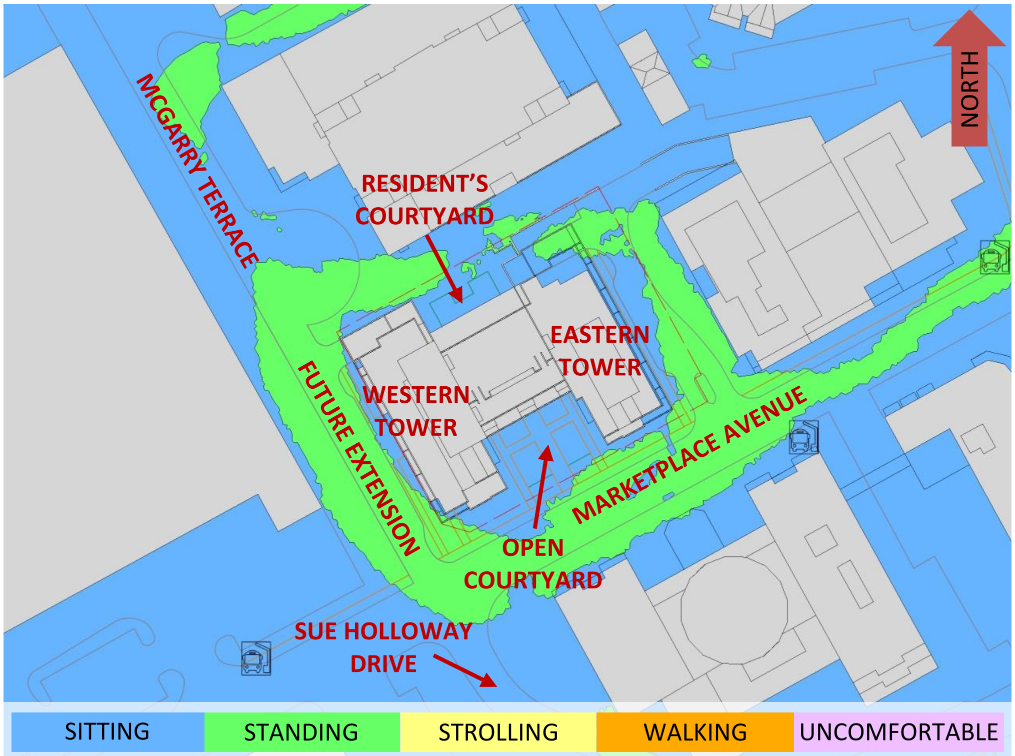


FIGURE 4A: SUMMER – WIND COMFORT, GRADE LEVEL – PROPOSED MASSING

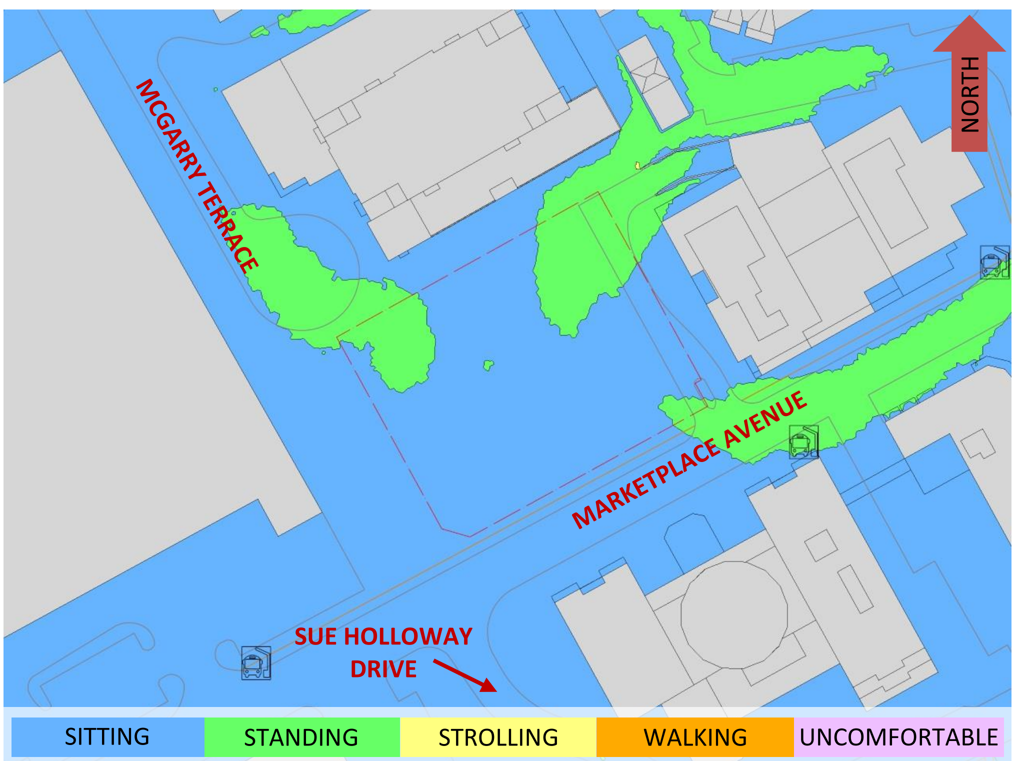


FIGURE 4B: SUMMER – WIND COMFORT, GRADE LEVEL – EXISTING MASSING

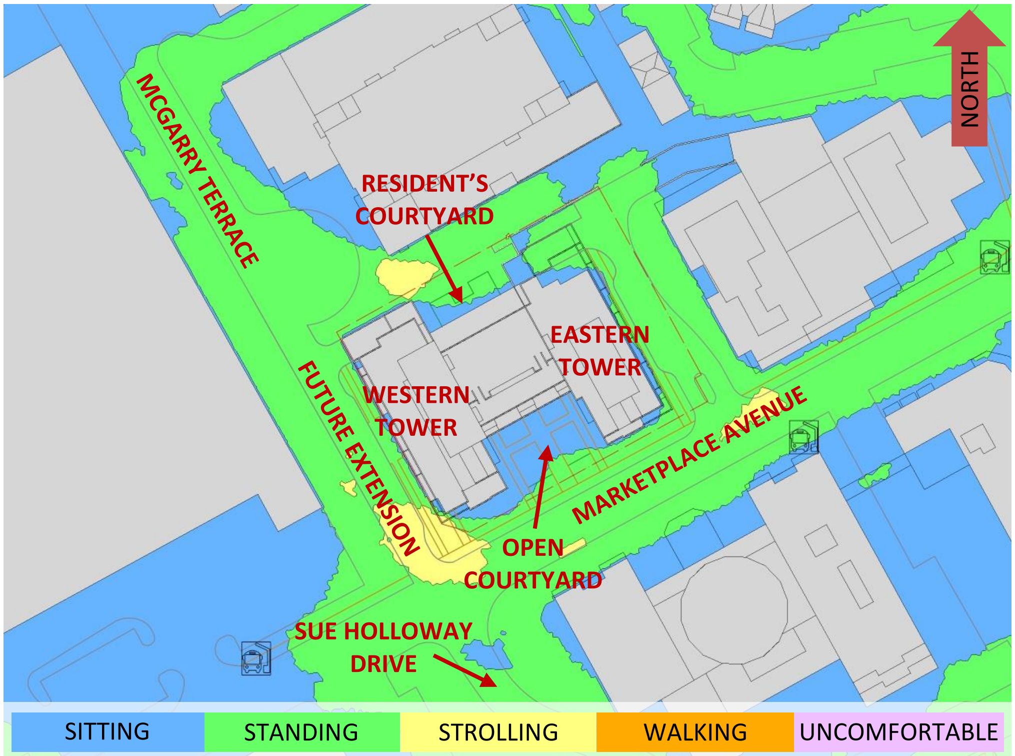


FIGURE 5A: AUTUMN – WIND COMFORT, GRADE LEVEL – PROPOSED MASSING

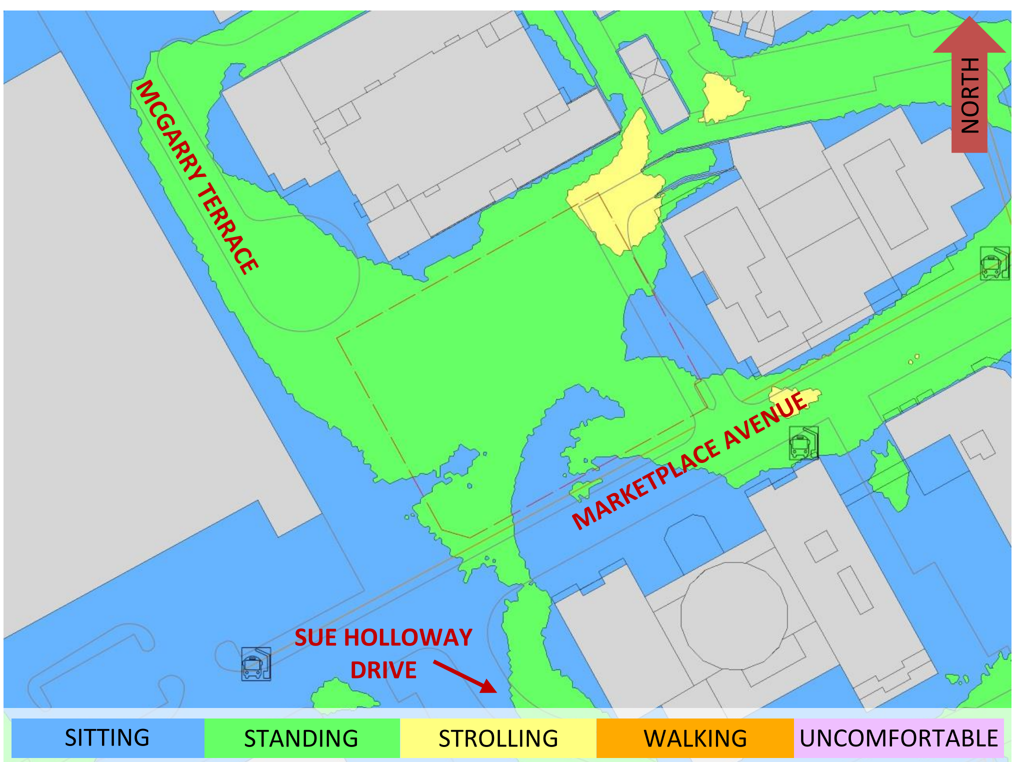


FIGURE 5B: AUTUMN – WIND COMFORT, GRADE LEVEL – EXISTING MASSING

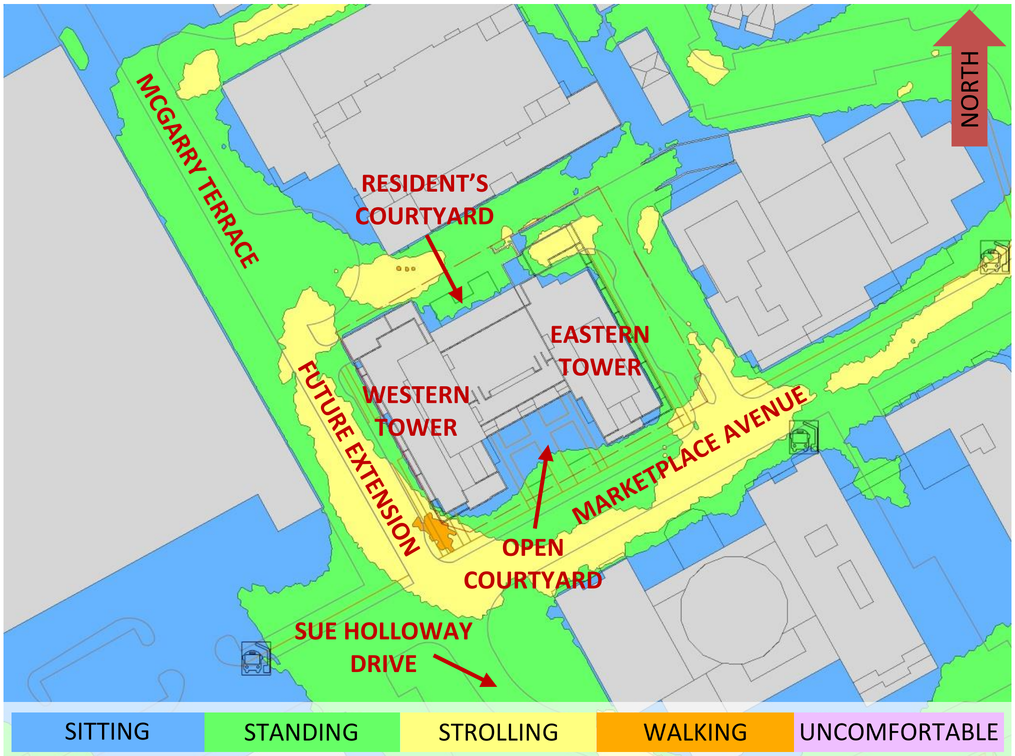


FIGURE 6A: WINTER – WIND COMFORT, GRADE LEVEL – PROPOSED MASSING

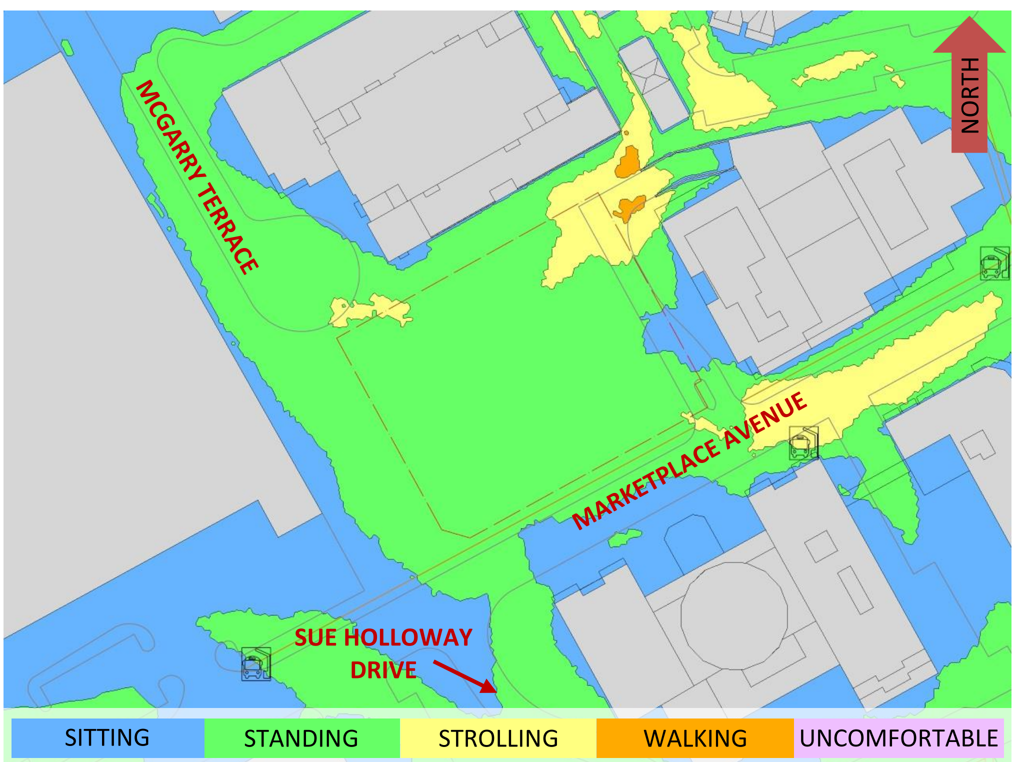


FIGURE 6B: WINTER – WIND COMFORT, GRADE LEVEL – EXISTING MASSING

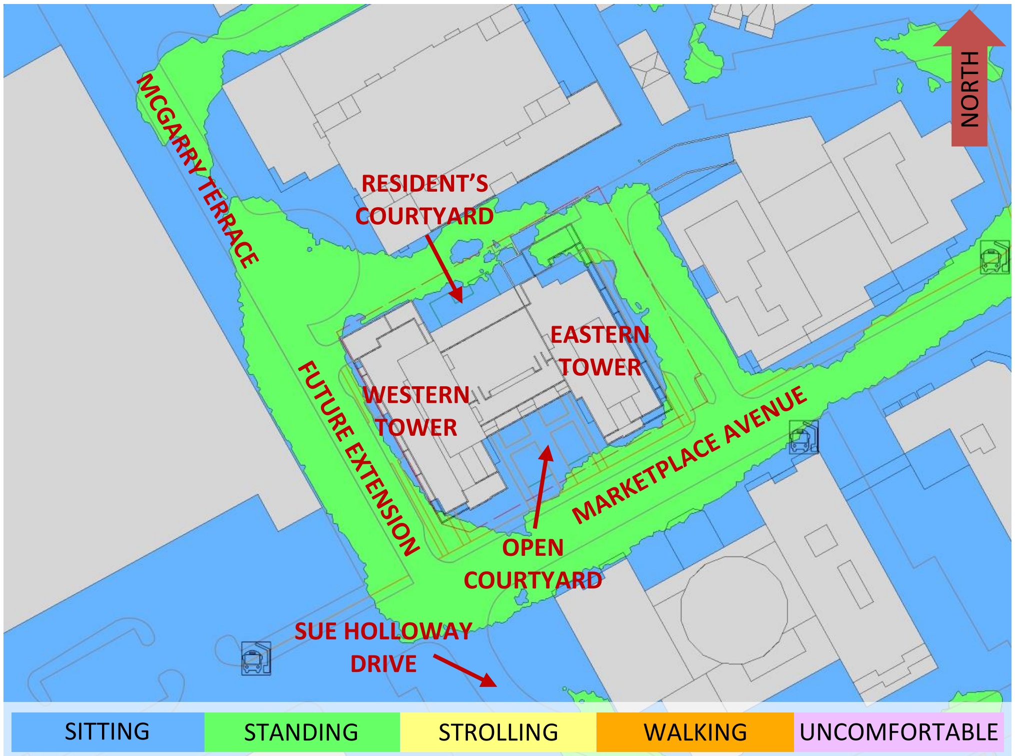


FIGURE 7: TYPICAL USE PERIOD – WIND COMFORT, GRADE LEVEL – PROPOSED MASSING

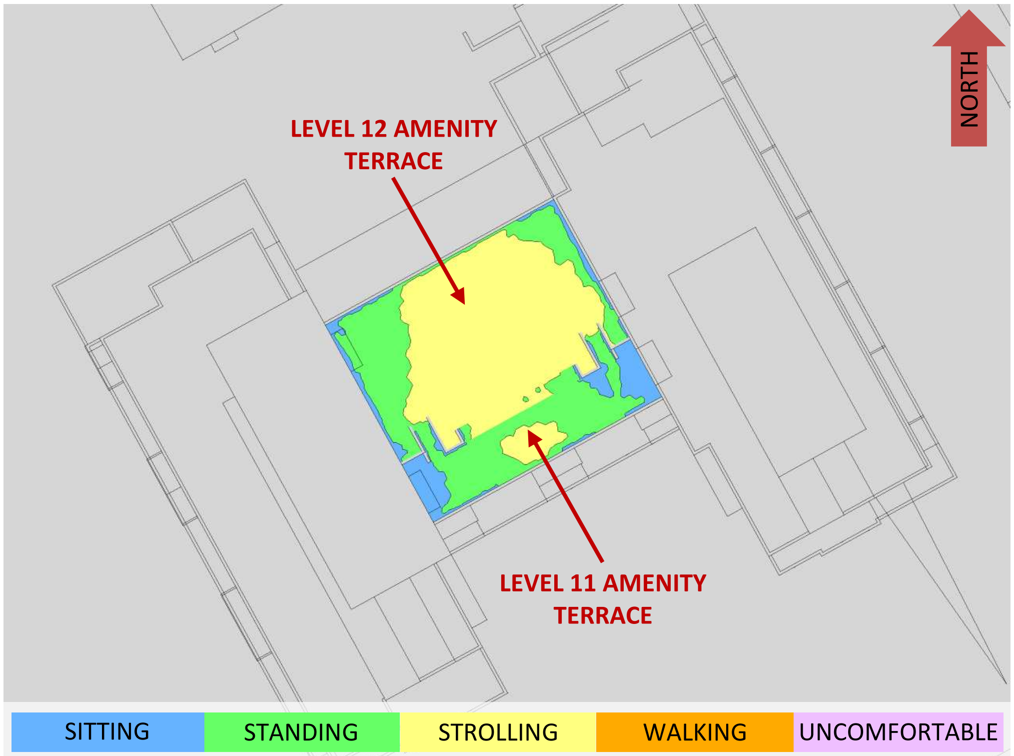


FIGURE 8A: SPRING – WIND COMFORT, COMMON AMENITY TERRACES

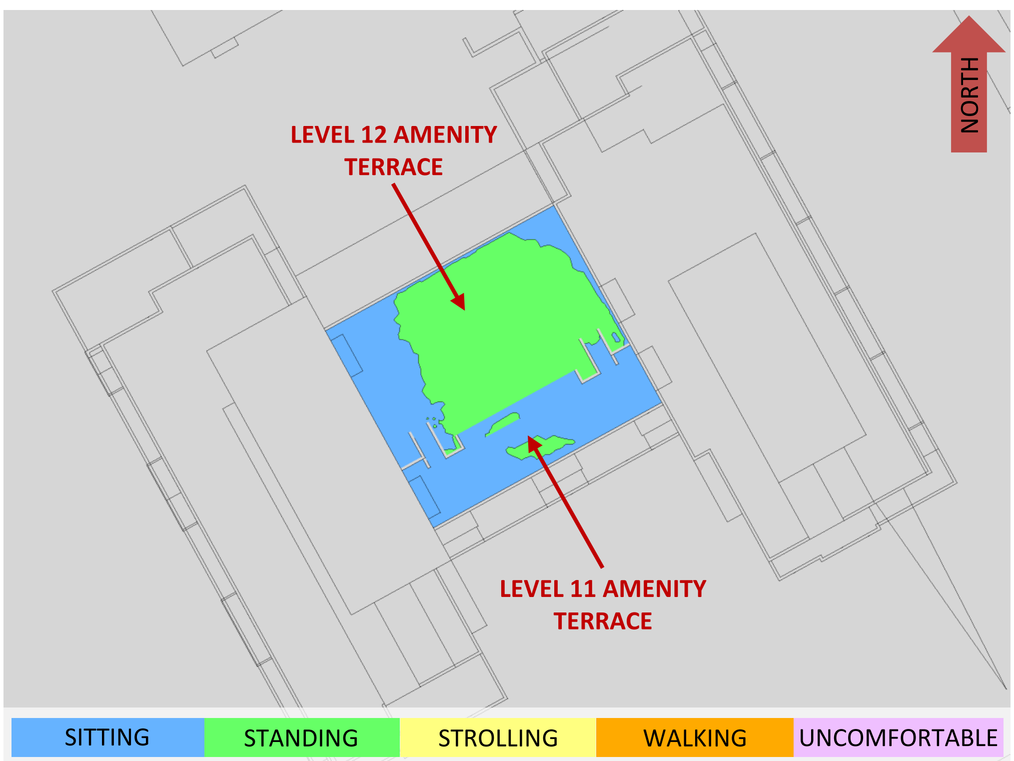


FIGURE 8B: SUMMER – WIND COMFORT, COMMON AMENITY TERRACES

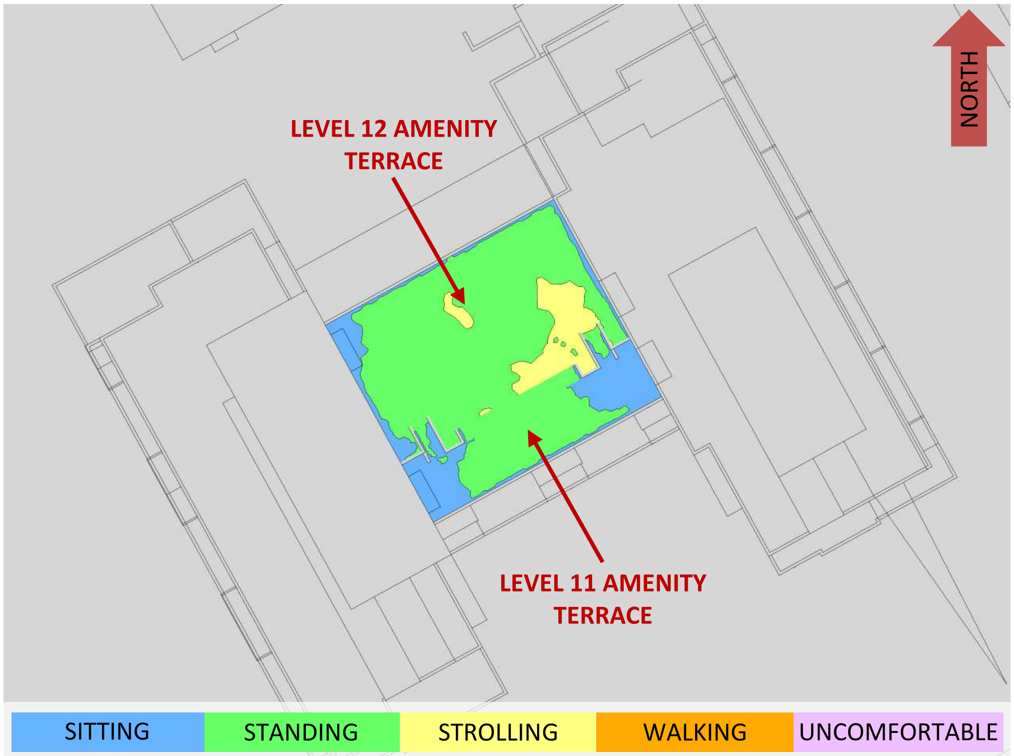


FIGURE 8C: AUTUMN – WIND COMFORT, COMMON AMENITY TERRACES

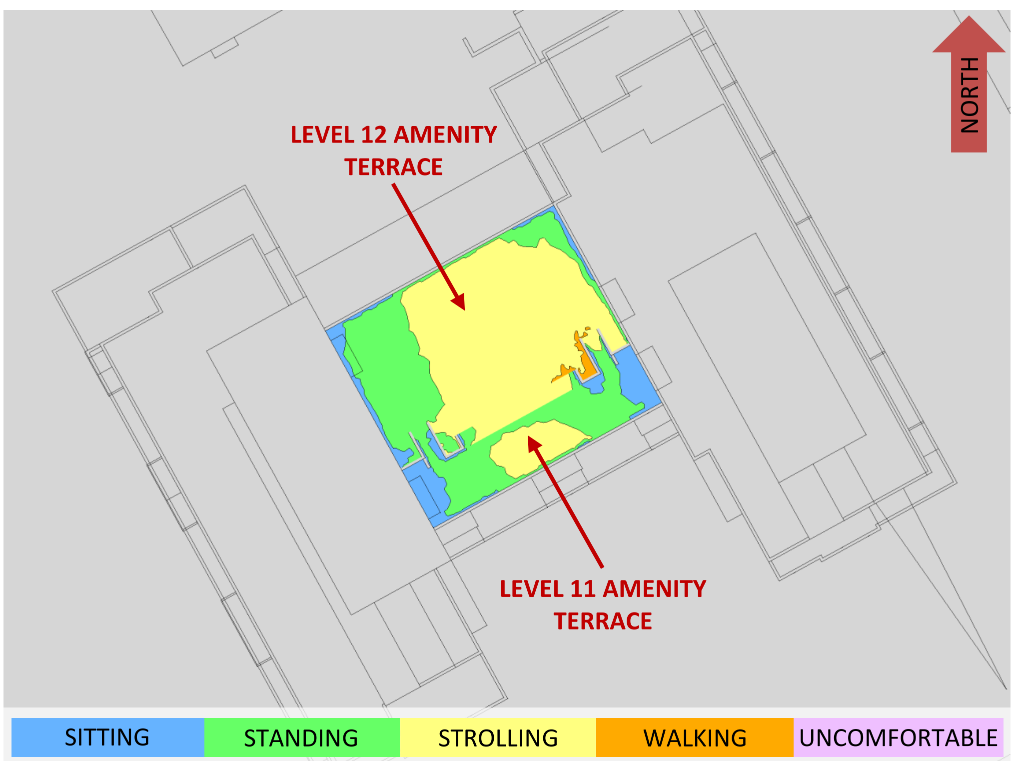


FIGURE 8D: WINTER – WIND COMFORT, COMMON AMENITY TERRACES

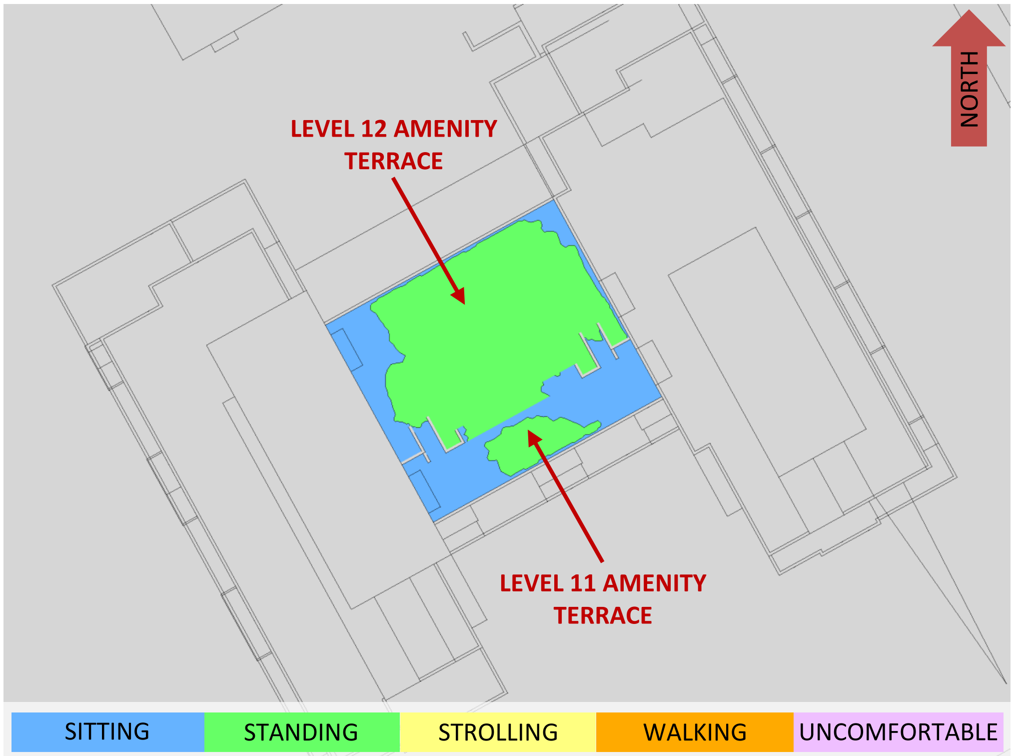
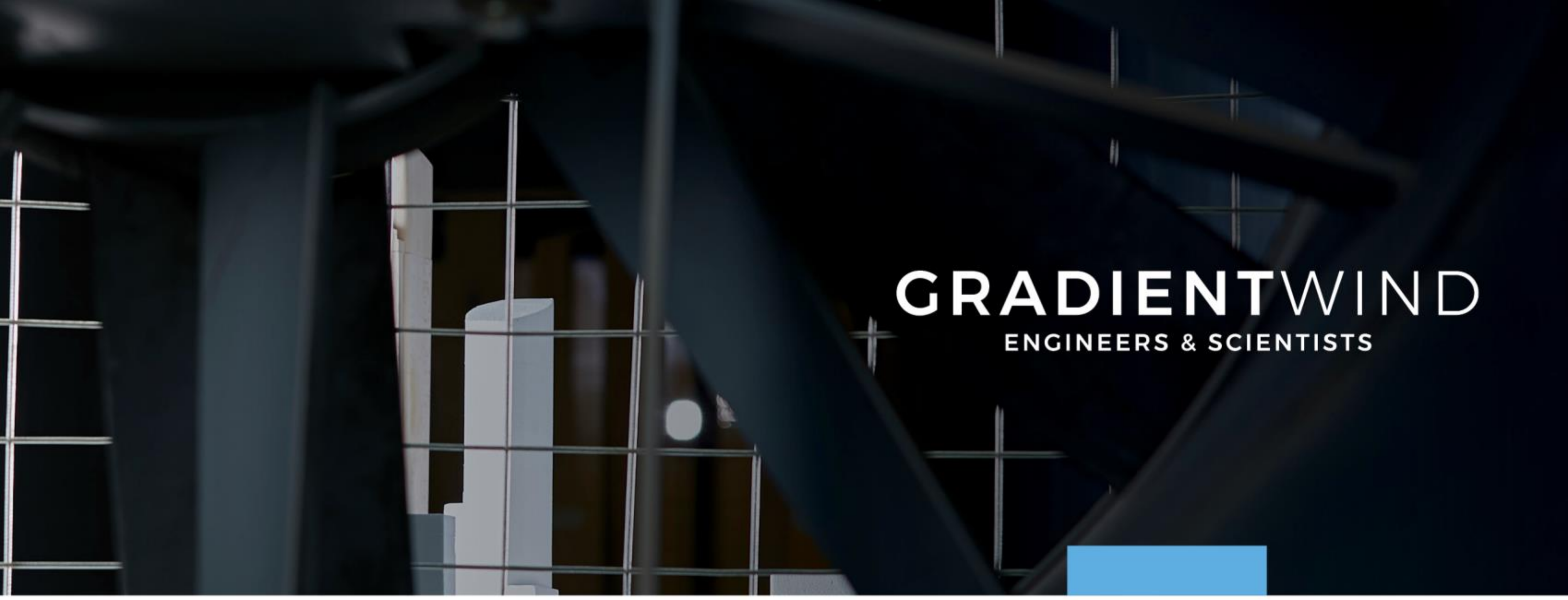
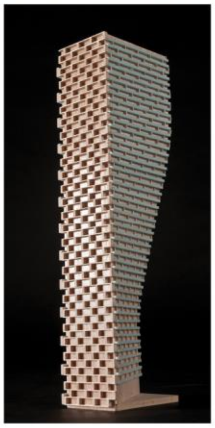
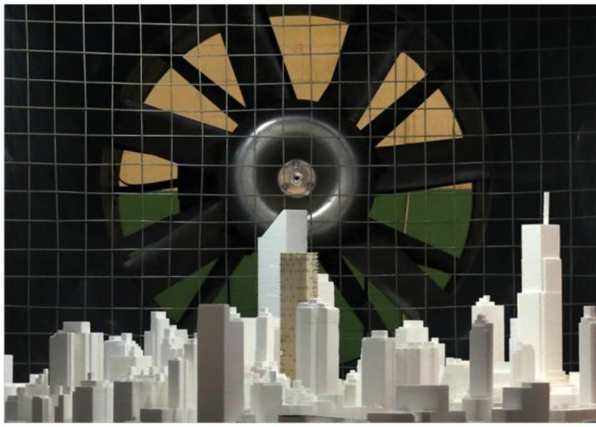


FIGURE 9: TYPICAL USE PERIOD – WIND COMFORT, COMMON AMENITY TERRACES







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).

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

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, which approximately corresponds to the 60% mean wind speed for Ottawa based on historical climate 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 (that is, 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	0.22
49	0.23
74	0.24
103	0.25
167	0.22
197	0.21
217	0.20
237	0.22
262	0.23
282	0.24
301	0.23
324	0.21

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).

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

$$L_t(Z) = \begin{cases} 100\text{ m}\sqrt{\frac{Z}{30}}, & Z > 30\text{ m} \\ 100\text{ m}, & Z \leq 30\text{ m} \end{cases}$$ 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 Engineering Symposium, IWES 2003*, Taiwan, 2003.