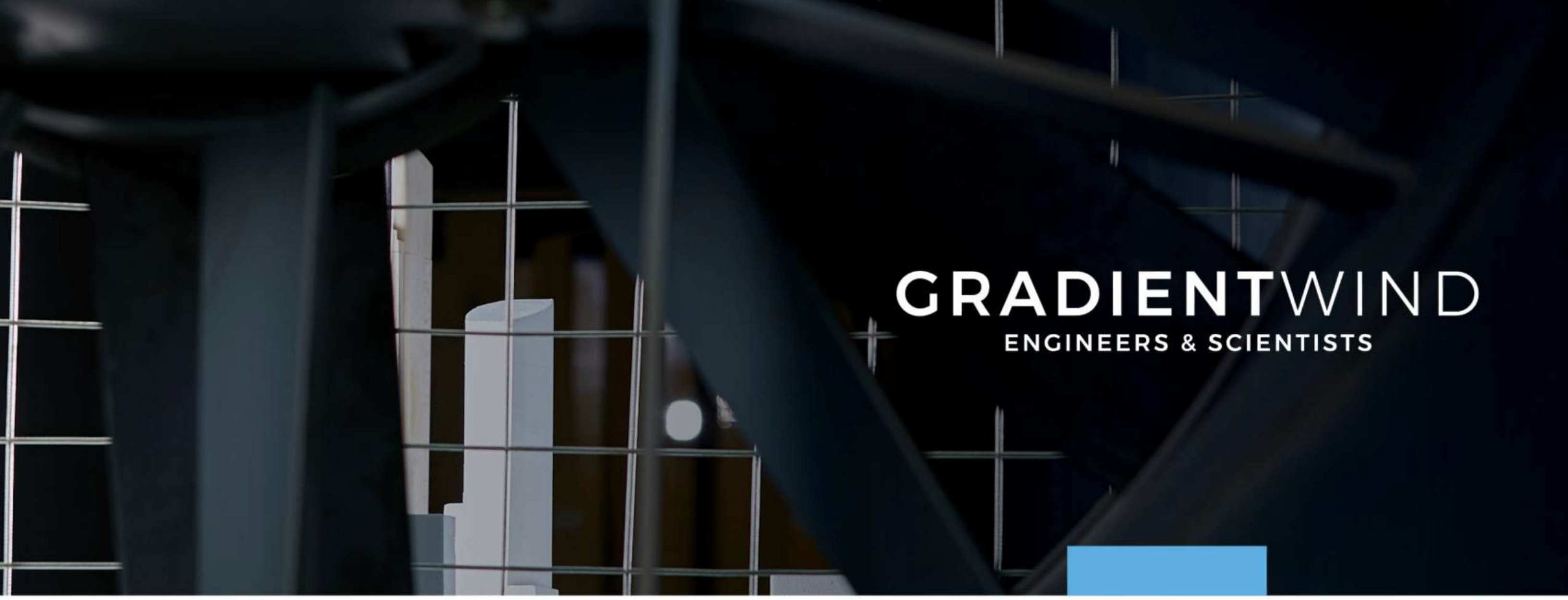
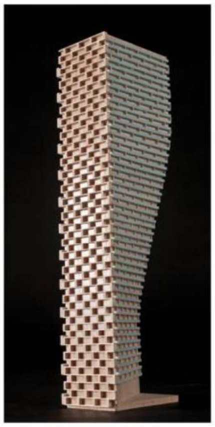


PEDESTRIAN LEVEL WIND STUDY

1209 Michael Street North
Ottawa, Ontario

Report: 25-191-PLW



March 24, 2026

PREPARED FOR
CFCF/QCC 1209 Michael St.
c/o Inside Edge Properties
464 Bank Street, Suite 200
Ottawa, ON K2P 1Z3

PREPARED BY
Omar Rioseco, B.Eng., Junior Wind Scientist
David Huitema, M.Eng., P.Eng., CFD Lead Engineer

EXECUTIVE SUMMARY

This report describes a pedestrian level wind (PLW) study undertaken to satisfy Official Plan Amendment (OPA) and Zoning By-Law Amendment application submission requirements for the proposed residential development located at 1209 Michael Street North 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 wind 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) Most 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, neighbouring surface parking lots, the proposed drive aisle and surface parking, the proposed outdoor amenity, and in the vicinity of the building access points, are considered acceptable.

    a. Wind comfort conditions over the parkland space situated to the northeast of the site are predicted to be suitable for a mix of sitting and standing during the typical use period (May to October, inclusive).

    b. If required by programming, landscaping barriers may be implemented along the west elevation of the parkland in the form of landscaping elements such as dense arrangements of tree plantings, raised wind barriers or a landscape berm, in combination with targeted mitigation at designated seating areas as described in Section 5.1.

2) During the typical use period, wind comfort conditions over the amenity terrace serving the proposed development at Level 7 are predicted to be suitable for mostly standing, or better, with windier conditions located centrally between the two towers.

    a. It is recommended to implement perimeter wind screens of at least 1.8 m in height along the perimeters of the central amenity terrace, in combination with a canopy that wraps around the northwest corner of Building B, and targeted mitigation inboard of the terrace perimeters as described in Section 5.2.

3) The foregoing statements and conclusions apply to common weather systems, during which one area within the subject site may experience conditions that approach the wind safety threshold, as defined in Section 4.4. Within the amenity terrace atop the podium connecting Buildings A and B at Level 7, an isolated area of the terrace near the northwest corner of Building B may experience conditions that exceed the wind safety criterion on an annual basis. It is recommended to implement a wraparound canopy along the west elevation of the tower above the Level 7 terrace that wraps around the northwest corner and along the northern and western façades of the tower, in combination with the above noted mitigation elements, particularly the 1.8-m-tall wind screen along the north perimeter of the amenity terrace.

Addendum: The PLW study was completed based on architectural drawings prepared by Kasian Architecture in November 2025. Updated drawings were distributed to the consultant team in March 2026 with some changes to the proposed development. At grade, the outdoor amenity extending along the north and east sides of Building B has been replaced with an amenity area now only located to the east, new surface parking has been added at the southwest corner of Building B, and minor changes have been made to the layout of the drive aisle and walkways. Furthermore, Level 7 is now served by one central common amenity terrace, which has slightly decreased in area as the terrace has stepped back from the north and south podium edge and private terraces have been added to the east of Building A. Notably, the amenity terrace includes 3 metre (m)-tall perimeter wind screens.

The noted revisions are not expected to significantly influence the pedestrian wind conditions at grade and the results and recommendations provided herein are expected remain representative of the current architectural design. While the addition of the above-noted perimeter wind screens is predicted to improve wind comfort conditions within the Level 7 amenity terrace, mitigation inboard of the terrace perimeters as described in Section 5.2 continues to be recommended.

TABLE OF CONTENTS

1. INTRODUCTION

Gradient Wind Engineering Inc. (Gradient Wind) was retained by Inside Edge Properties on behalf of CFCF/QCC 1209 Michael St. to undertake a pedestrian level wind (PLW) study to satisfy Official Plan Amendment (OPA) and Zoning By-Law Amendment application submission requirements for the proposed mixed-use residential development located at 1209 Michael Street North in Ottawa, Ontario (hereinafter referred to as "subject site" or "proposed development"). Our mandate within the current study is to investigate pedestrian wind conditions within and surrounding the subject site for the revised architectural massing design, and to identify areas where wind 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 Kasian Architecture in November 2025, 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 1209 Michael Street North in Ottawa, situated to the southwest of the intersection of Cyrville Road and Labelle Street on a parcel of land bordered by Labelle Street to the south, Michael Street North to the west, and existing low- and mid-rise buildings with surface parking to the north.

The proposed development comprises two rectangular buildings, Building A to the west and Building B to east, rising to 30- and 28-storeys, respectively, sharing a six-storey 'L' shaped podium, and topped with a mechanical penthouse (MPH) level. At the ground floor above the underground parking levels, Building A includes a multi-purpose space to the west, mechanical/electrical services space to the northeast, and a lobby to the southeast, while Building B includes a lobby at the southwest corner, a garbage space and loading bay to the northwest, amenity/retail along the south elevation fronting Labelle Street, and residential space in the remainder of the level. A drive aisle provides access from Labelle Street and crosses the subject site between Buildings A and B, connecting to Michael Street at the northwest corner of the site and providing access to the underground parking ramp.

Outdoor amenities and a parkland space are programmed to the northeast of Building B. Both buildings are connected by a podium from Levels 2-6, with a shared outdoor amenity on top of the podium at Level 7. The remaining levels of both buildings are reserved for residential occupancy.

The near-field surroundings (defined as an area within 200 metres (m) of the subject site) include surface parking lots in all directions, a low-rise church to the northwest, mid-rise commercial buildings to the north, and sparse low- and mid-rise buildings from the east clockwise to the west. A high-rise building is under construction to the northwest at 1125-1149 Cyrville Road. 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 low-rise suburban and commercial massing with sparse mid- and high-rise buildings. Highway 417 is located at approximately 200m 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 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.

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

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.

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 16 wind directions. The CFD simulation model was centered on the proposed development, complete with surrounding massing within a radius of 525 m. The process was performed for two context massing scenarios, as noted in Section 2.

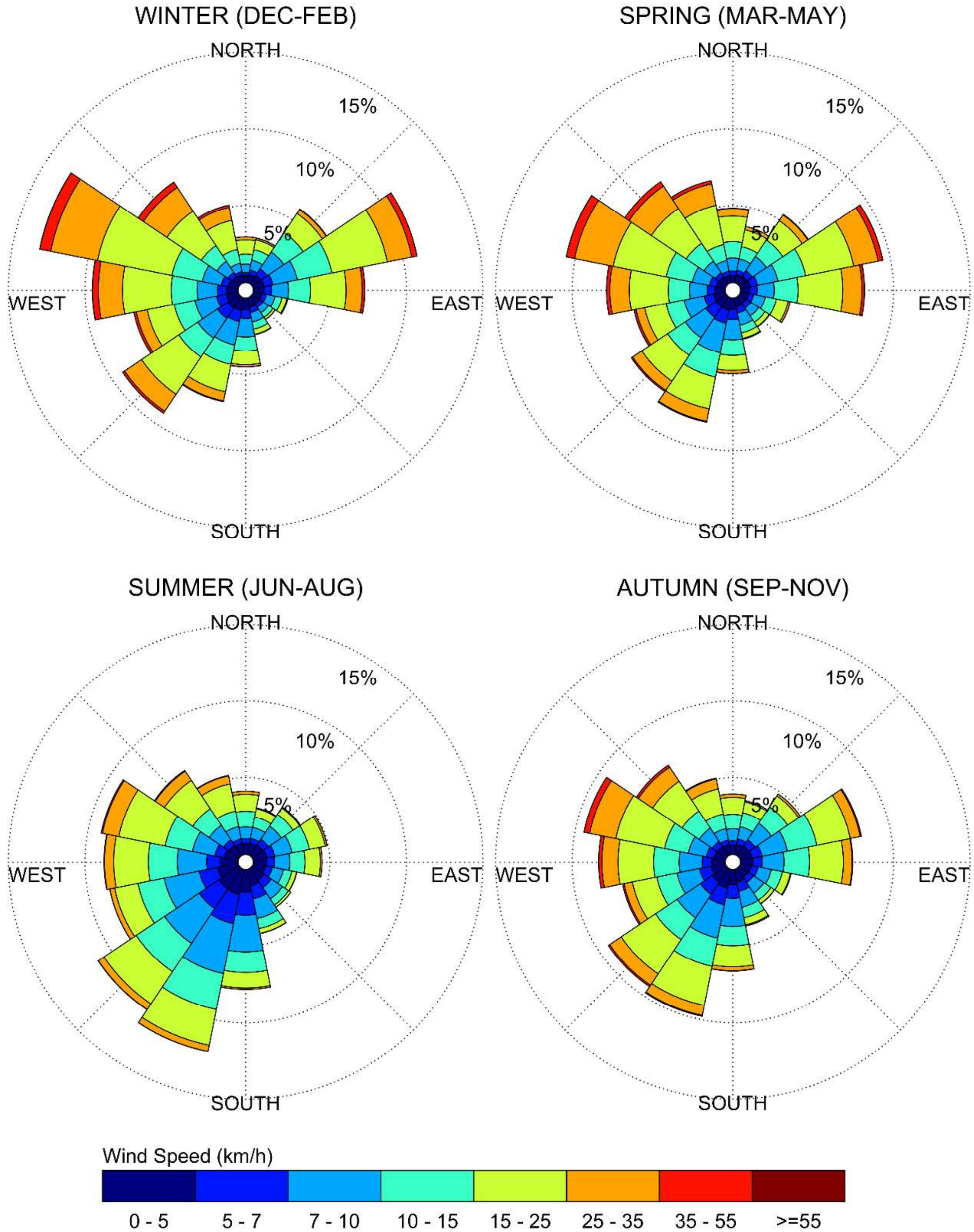
Mean and peak wind speed data obtained over the subject site for each wind direction were interpolated to 36 wind directions at 10° intervals, representing the full compass azimuth. Measured wind speeds approximately 1.5 m above local grade and the amenity terrace at Level 7 serving the proposed development 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 during the appropriate hours of pedestrian usage (that is, between 06:00 and 23:00) and divided into four distinct seasons, as stipulated in the wind criteria. Specifically, the spring season is defined as March through May, the summer season is defined as June through August, the autumn season is defined as September through November, and the winter season is defined as December through February, inclusive.

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	Mean 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	Target 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, which illustrate wind conditions at grade level for the proposed and existing massing scenarios, and by Figures 8A-D, which illustrate wind conditions over the common amenity terrace serving the proposed development at Level 7. Conditions are presented as continuous contours of wind comfort within and surrounding the subject site and correspond to the various comfort classes noted 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 wind comfort conditions at grade and over the amenity terrace serving the proposed development at Level 7, during this period, 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

Sidewalks along Labelle Street, Michael Street North, and Cyrville Road: Wind comfort conditions over the nearby public sidewalks along Labelle Street, Michael Street North, and Cyrville Road under the existing massing are predicted to be suitable for standing, or better, throughout the year.

Following the introduction of the proposed development, wind comfort conditions over the noted nearby public sidewalks are predicted to be suitable for standing, or better, during the summer, becoming suitable for strolling, or better, during the autumn, and walking, or better, during the winter and spring. While the introduction of the proposed development produces modestly windier conditions in comparison to existing conditions over the neighbouring sidewalks, wind conditions with the proposed development are nevertheless considered acceptable for public sidewalks.

Neighbouring Surface Parking Lots: Following the introduction of the proposed development, conditions over the existing neighbouring surface parking lots located immediately to the north and from the east clockwise to the southwest of the proposed development are predicted to be suitable for walking, or better, throughout the year, which is considered acceptable.

Conditions over the noted neighbouring surface parking lots under the existing massing are predicted to be suitable for standing, or better, throughout the year. While the introduction of the proposed development produces modestly windier conditions in comparison to existing conditions over the neighbouring surface parking lots, wind conditions with the proposed development are nevertheless considered acceptable for the noted surface parking lots.

Outdoor Amenity: During the typical use period, conditions over the outdoor amenity to the northeast of Building B are predicted to be suitable for mostly sitting, which is considered acceptable.

Proposed Parkland: During the typical use period, conditions over the proposed parkland are predicted to be suitable for a mix of sitting and standing. Specifically, sitting conditions are located to the north of the parkland, while standing conditions are predicted to the south.

Depending on programming, the noted conditions may be considered acceptable. Specifically, if the areas suitable for standing during the typical use period will not accommodate designated seating or lounging areas, the noted conditions may be considered acceptable. If required by programming, mitigation may be implemented along the west elevation of the parkland in the form of landscaping elements such as dense arrangements of tree plantings, raised wind barriers or a landscape berm, in combination with other similar typical landscape elements for wind mitigation within these spaces including overhead pergolas/trellises and vertical wind barriers around and above designated seating areas.

Proposed Drive Aisle and Surface Parking: Wind conditions over the proposed drive aisle and surface parking within the subject site are predicted to be suitable for strolling, or better, throughout the year. The noted conditions are considered acceptable.

Building Access Points: Owing to the protection of the building façade, wind conditions in the vicinity of the building access points serving the proposed development are predicted to be suitable for standing, or better, throughout the year, with the exception of the access point to the east of Building A, where conditions are suitable for strolling, or better throughout the year. The noted conditions are considered acceptable.

5.2 Wind Comfort Conditions – Common Amenity Terrace

Central Amenity Terrace: During the typical use period, wind conditions within the common amenity terrace serving the proposed development atop the podium connecting Buildings A and B are predicted to be suitable for standing, or better, over most of the terrace, with walking conditions near the northwest corner of Building B and strolling conditions over the central portion of the terrace. Notably, this terrace was modelled with a 1.8-m-tall wind screen along the southern perimeter of the terrace.

To improve wind comfort conditions over the common amenity terrace serving the proposed development at Level 7, targeted mitigation inboard of the terrace perimeters is recommended. Inboard mitigation may include free-standing pergolas or trellises over designated seating areas, strategically placed wind screens and planters with dense planting arrangements, and other common mitigation elements, targeted and located adjacent to and above designated seating areas. The extent of mitigation measures is dependent on the programming of the terrace. In addition, it is recommended to include canopies that wrap around the northwest corner of Building B at Level 7 to diffuse northerly winds downwashing from the facades of the tower, and to include wind screens of at least 1.8 m in height around the full perimeter of the central amenity terrace between the towers.

5.3 Wind Safety

Within the context of typical weather patterns, which exclude anomalous localized storm events such as tornadoes and downbursts, one pedestrian area within the subject site may experience conditions that approach the wind safety threshold, as defined in Section 4.4. Within the central amenity terrace at Level 7, an isolated area of the terrace near the northwest corner of Building B where winds are predicted to accelerate around the northwest corner of the tower may experience conditions that exceed the wind safety criterion on an annual basis. Mitigation elements as described above for the amenity terrace are expected to be effective in improving wind conditions over the area and eliminating the potential wind safety exceedance. Particularly, it is recommended to implement a wraparound canopy along the north and west elevations of the tower above the Level 7 terrace that wraps around the northwest corner of the tower to diffuse downwashing winds to the terrace level, and to include the noted 1.8-m-tall wind screen along the north terrace perimeter.

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) Most 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, neighbouring surface parking lots, the proposed drive aisle and surface parking, the proposed outdoor amenity, and in the vicinity of the building access points, are considered acceptable.

    a. Wind comfort conditions over the parkland space situated to the northeast of the site are predicted to be suitable for a mix of sitting and standing during the typical use period (May to October, inclusive).

    b. If required by programming, landscaping barriers may be implemented along the west elevation of the parkland in the form of landscaping elements such as dense arrangements of tree plantings, raised wind barriers or a landscape berm, in combination with targeted mitigation at designated seating areas as described in Section 5.1.

2) During the typical use period, wind comfort conditions over the amenity terrace serving the proposed development at Level 7 are predicted to be suitable for mostly standing, or better, with windier conditions located centrally between the two towers.

    a. It is recommended to implement perimeter wind screens of at least 1.8 m in height along the perimeters of the central amenity terrace, in combination with a canopy that wraps around the northwest corner of Building B, and targeted mitigation inboard of the terrace perimeters as described in Section 5.2.

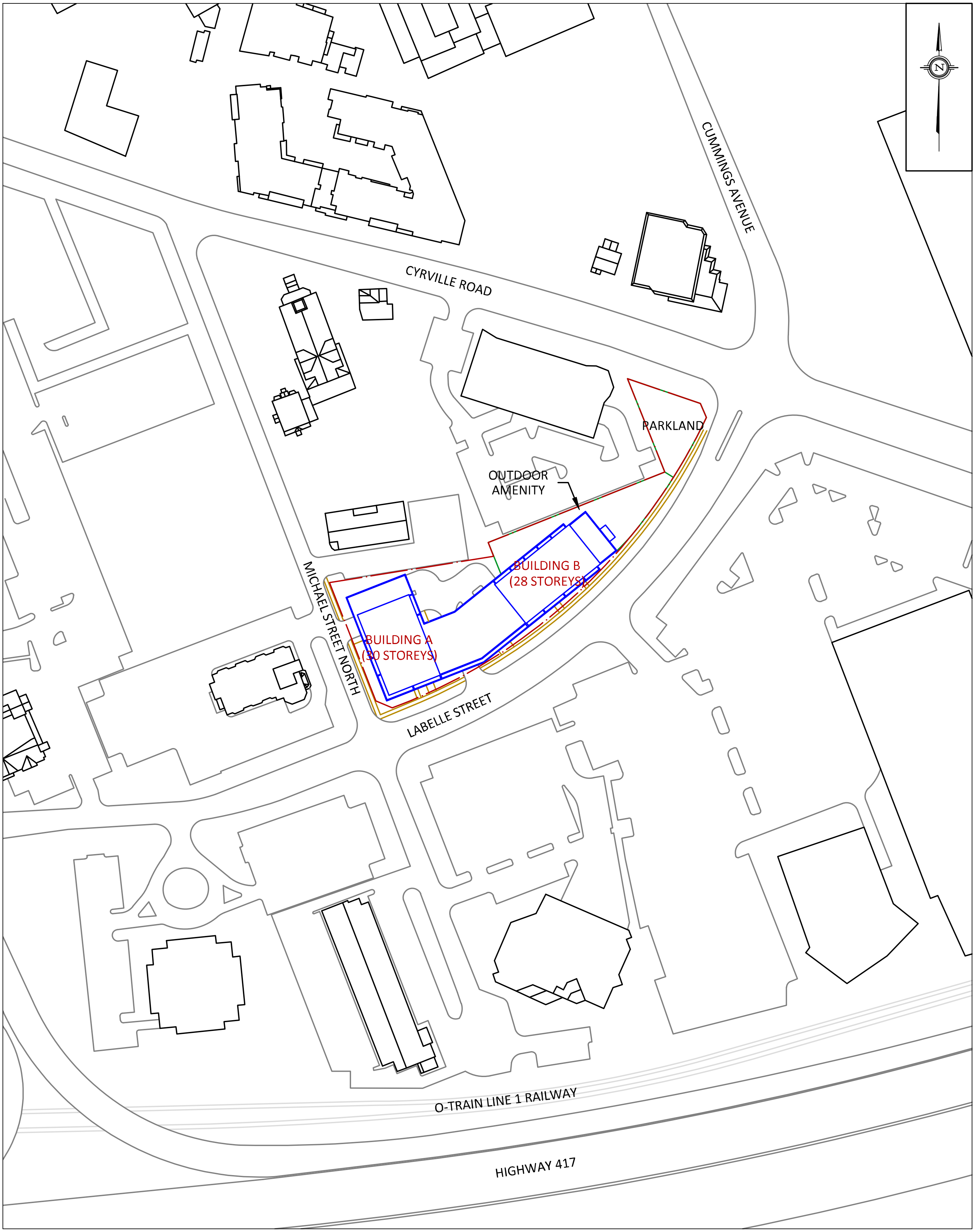
3) The foregoing statements and conclusions apply to common weather systems, during which one area within the subject site may experience conditions that approach the wind safety threshold, as defined in Section 4.4. Within the amenity terrace atop the podium connecting Buildings A and B at Level 7, an isolated area of the terrace near the northwest corner of Building B may experience conditions that exceed the wind safety criterion on an annual basis. It is recommended to implement a wraparound canopy along the west elevation of the tower above the Level 7 terrace that wraps around the northwest corner and along the northern and western façades of the tower, in combination with the above noted mitigation elements, particularly the 1.8-m-tall wind screen along the north perimeter of the amenity terrace.

Sincerely,

Gradient Wind Engineering Inc.

Omar Rioseco, B.Eng.
Junior Wind Scientist

David Huitema, M.Eng., P.Eng.
CFD Lead Engineer



GRADIENTWIND
ENGINEERS & SCIENTISTS

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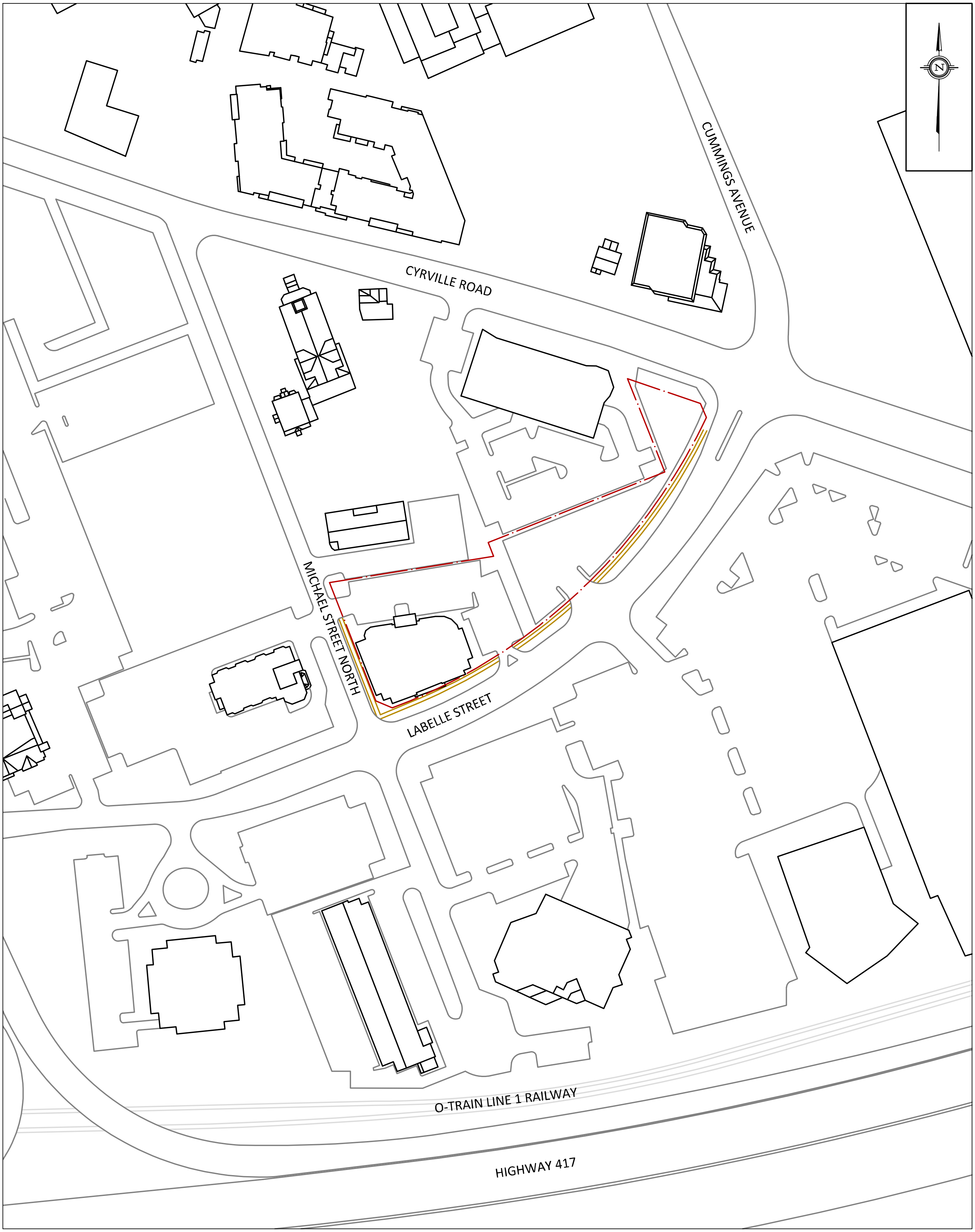
PROJECT	1209 MICHAEL STREET NORTH, OTTAWA PEDESTRIAN LEVEL WIND STUDY		
SCALE	1:1500	DRAWING NO.	25-191-PLW-1A
DATE	NOVEMBER 17, 2025	DRAWN BY	S.K.

DESCRIPTION

FIGURE 1A:
PROPOSED SITE PLAN AND SURROUNDING CONTEXT



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PROJECT	1209 MICHAEL STREET NORTH, OTTAWA PEDESTRIAN LEVEL WIND STUDY		
SCALE	1:1500	DRAWING NO.	25-191-PLW-1B
DATE	NOVEMBER 17, 2025	DRAWN BY	S.K.

DESCRIPTION

FIGURE 1B:
EXISTING SITE PLAN AND SURROUNDING CONTEXT

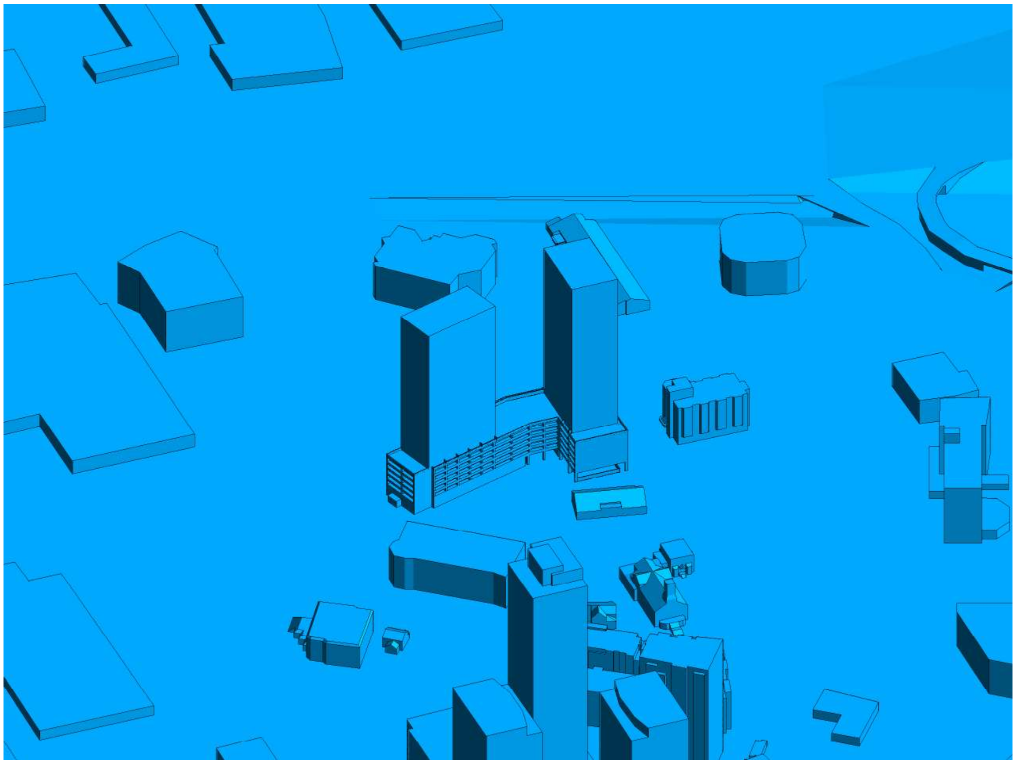

FIGURE 2A: COMPUTATIONAL MODEL, PROPOSED MASSING, NORTH PERSPECTIVE

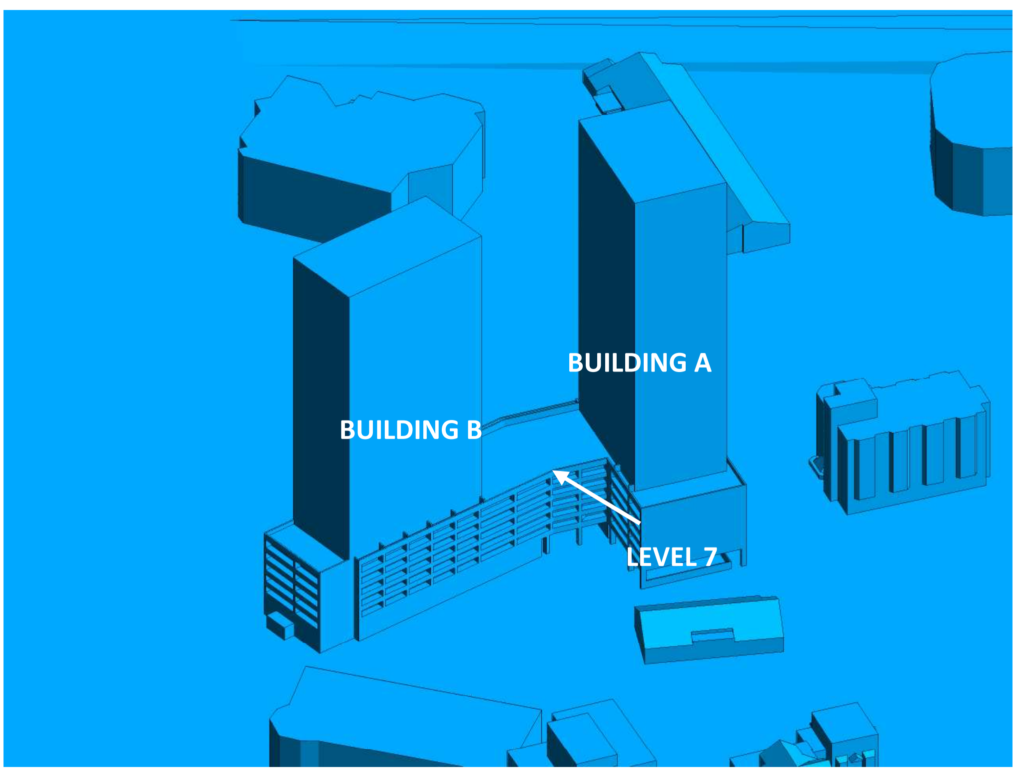

FIGURE 2B: CLOSE UP OF FIGURE 2A

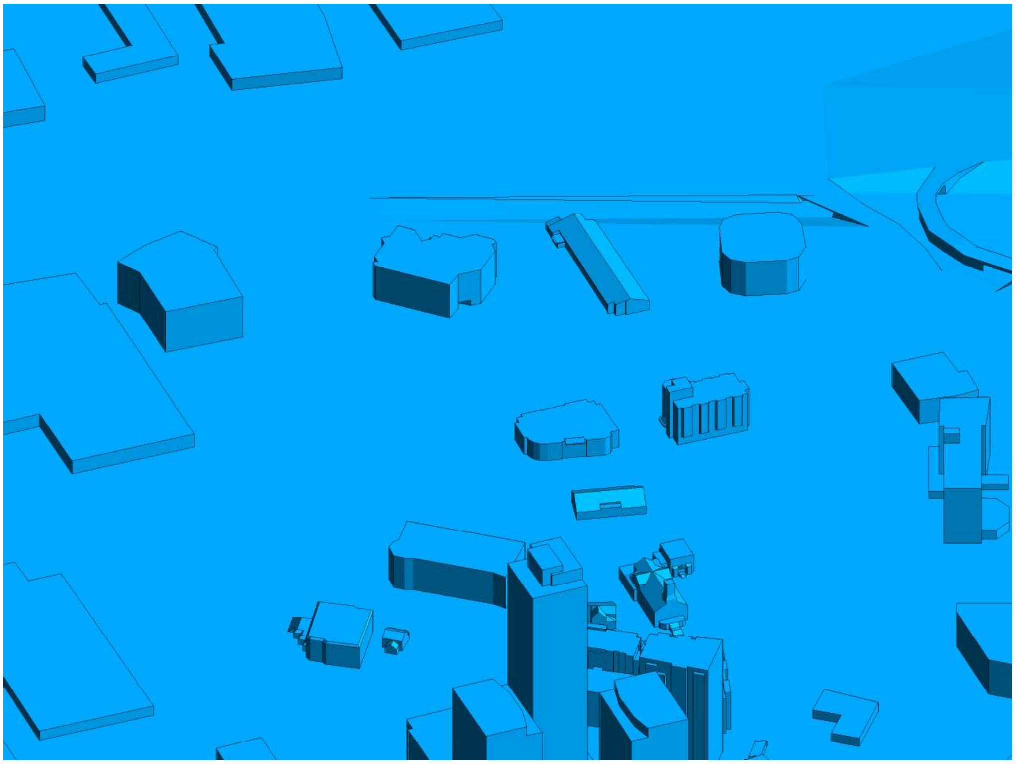

FIGURE 2C: COMPUTATIONAL MODEL, EXISTING MASSING, NORTH PERSPECTIVE

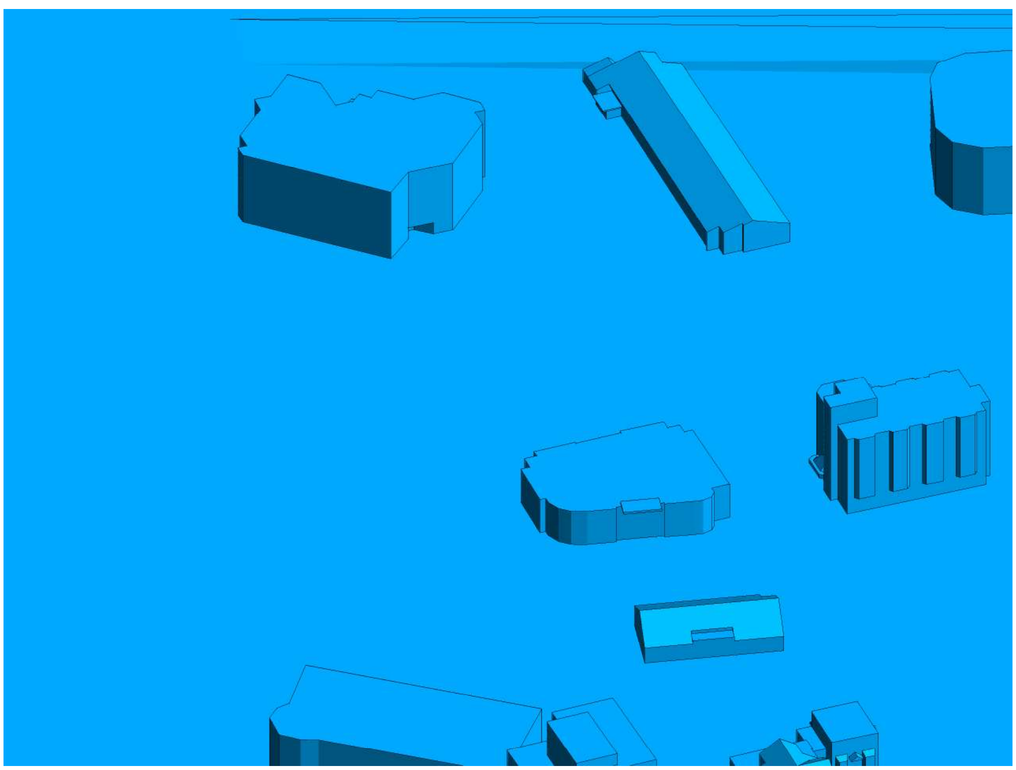

FIGURE 2D: CLOSE UP OF FIGURE 2C

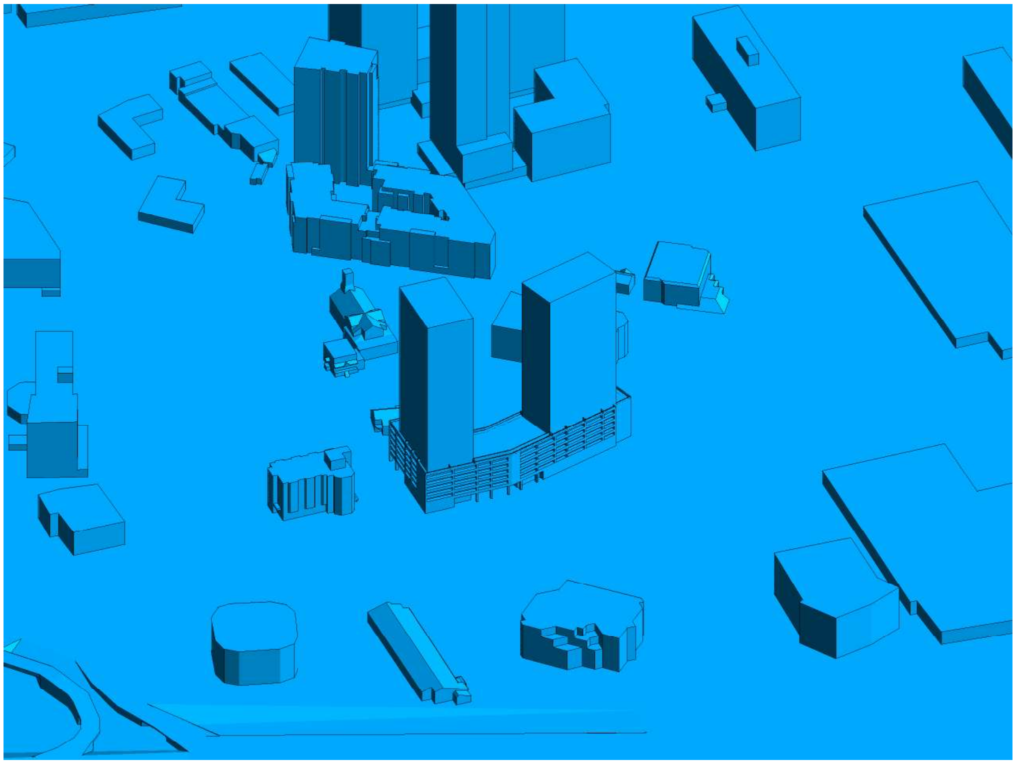

FIGURE 2E: COMPUTATIONAL MODEL, PROPOSED MASSING, SOUTH PERSPECTIVE

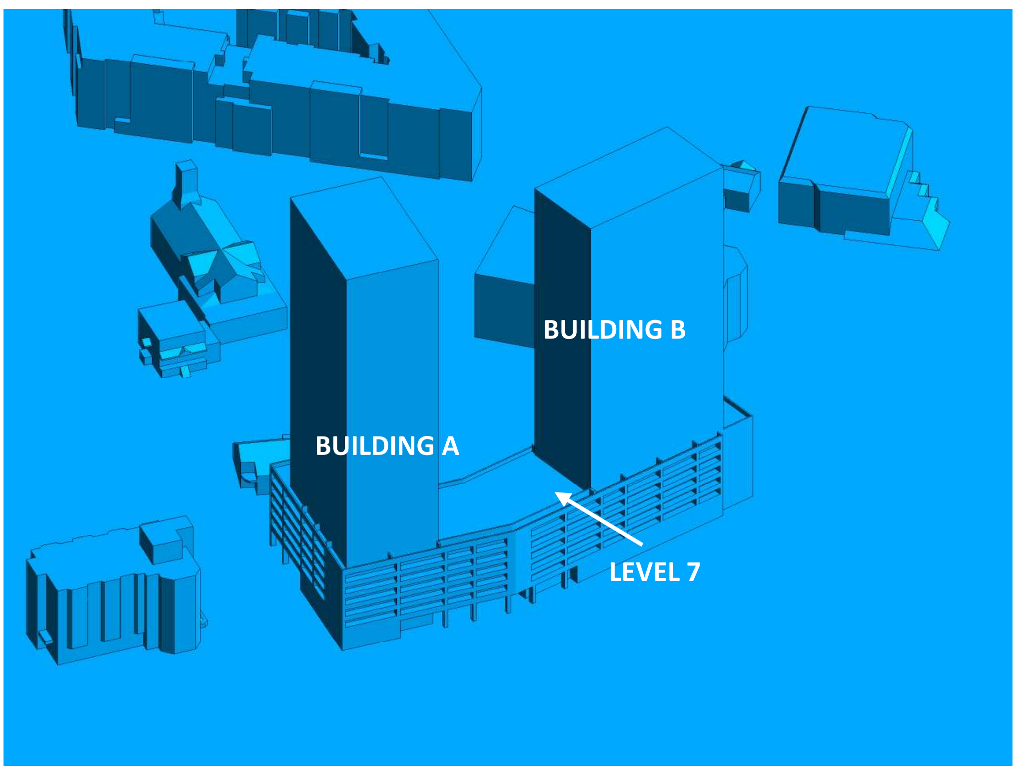

FIGURE 2F: CLOSE UP OF FIGURE 2E

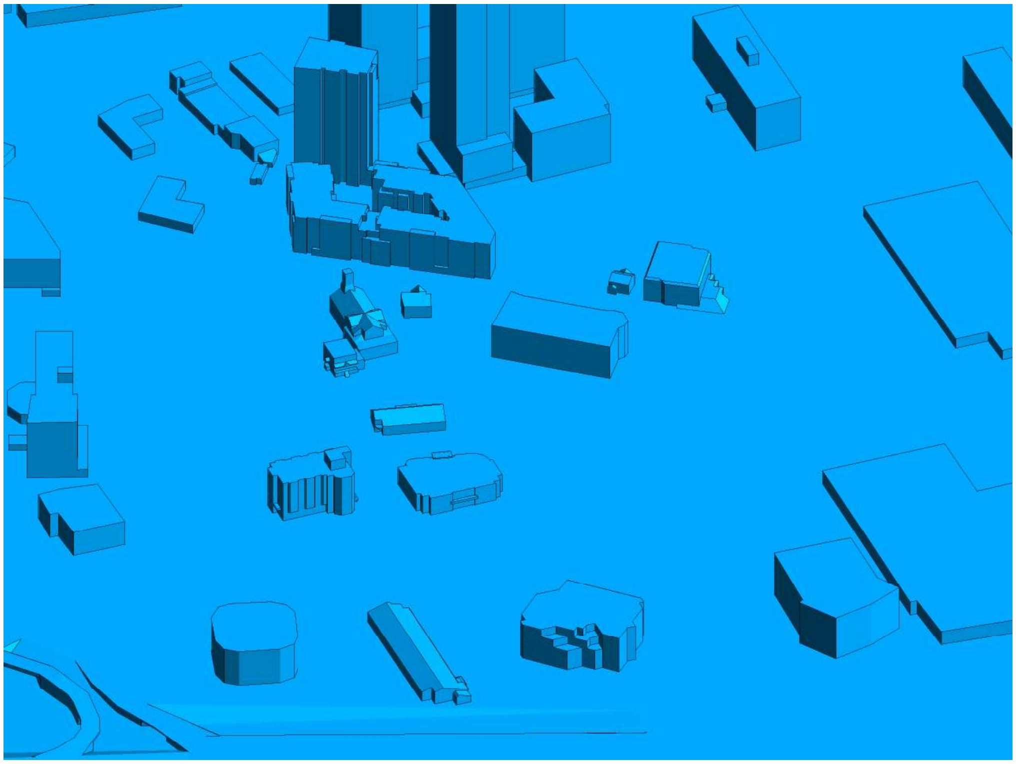

FIGURE 2G: COMPUTATIONAL MODEL, EXISTING MASSING, SOUTH PERSPECTIVE

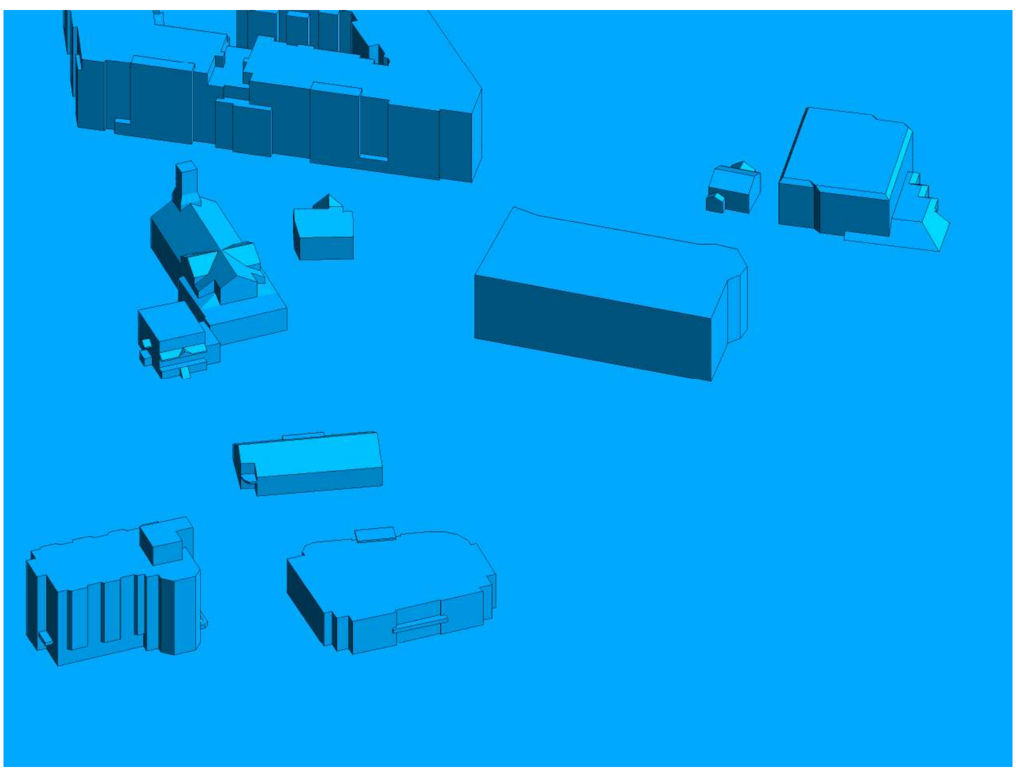

FIGURE 2H: CLOSE UP OF FIGURE 2G

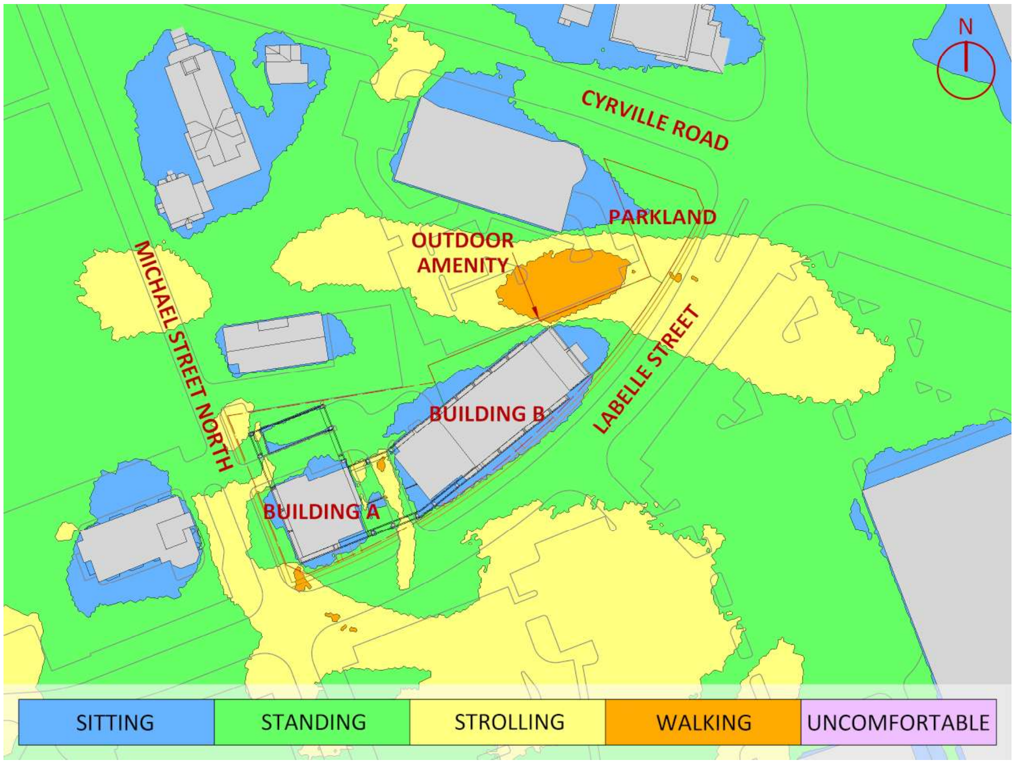

FIGURE 3A: SPRING – WIND COMFORT, GRADE LEVEL – PROPOSED MASSING

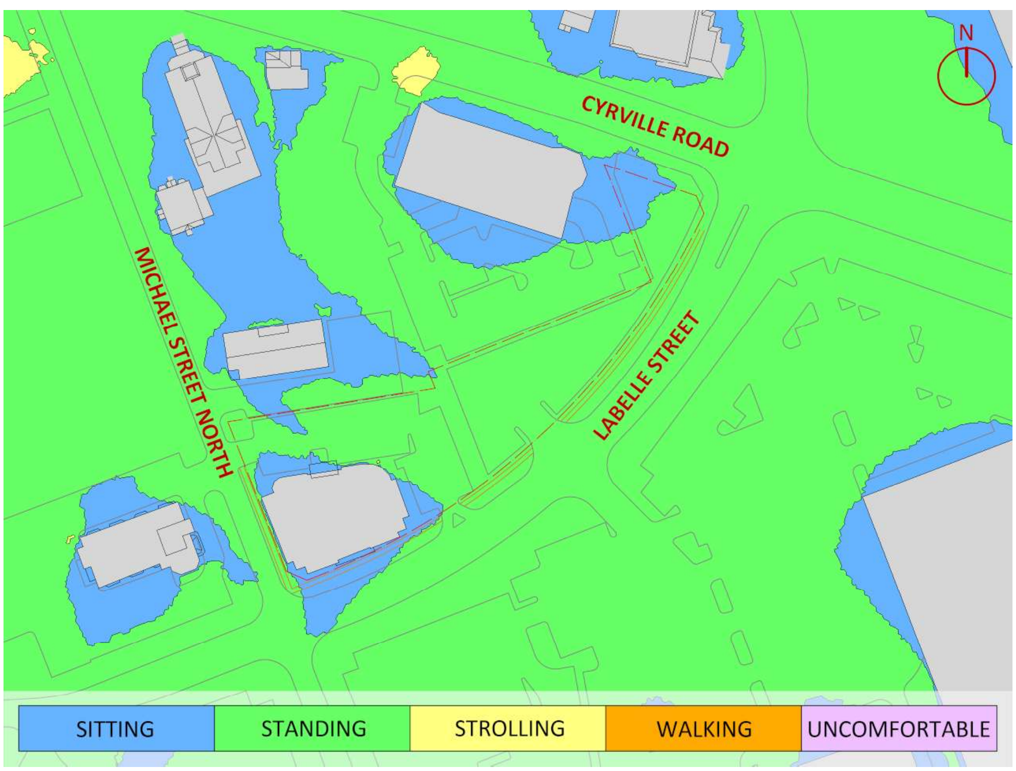

FIGURE 3B: SPRING – WIND COMFORT, GRADE LEVEL– EXISTING MASSING

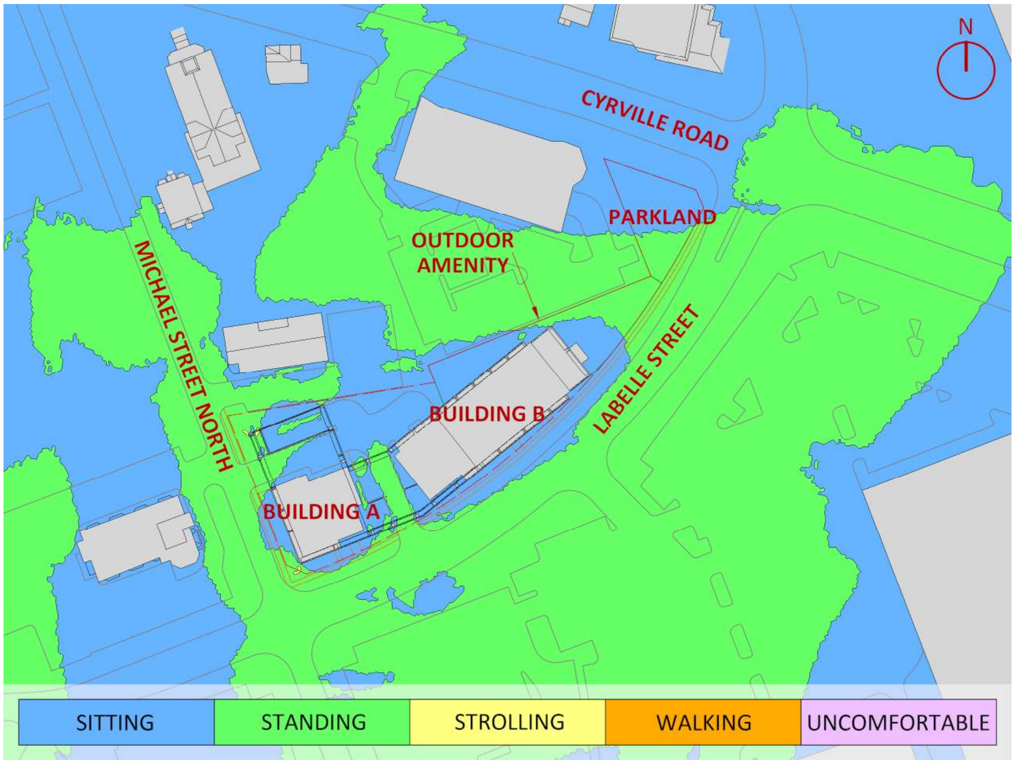

FIGURE 4A: SUMMER – WIND COMFORT, GRADE LEVEL – PROPOSED MASSING

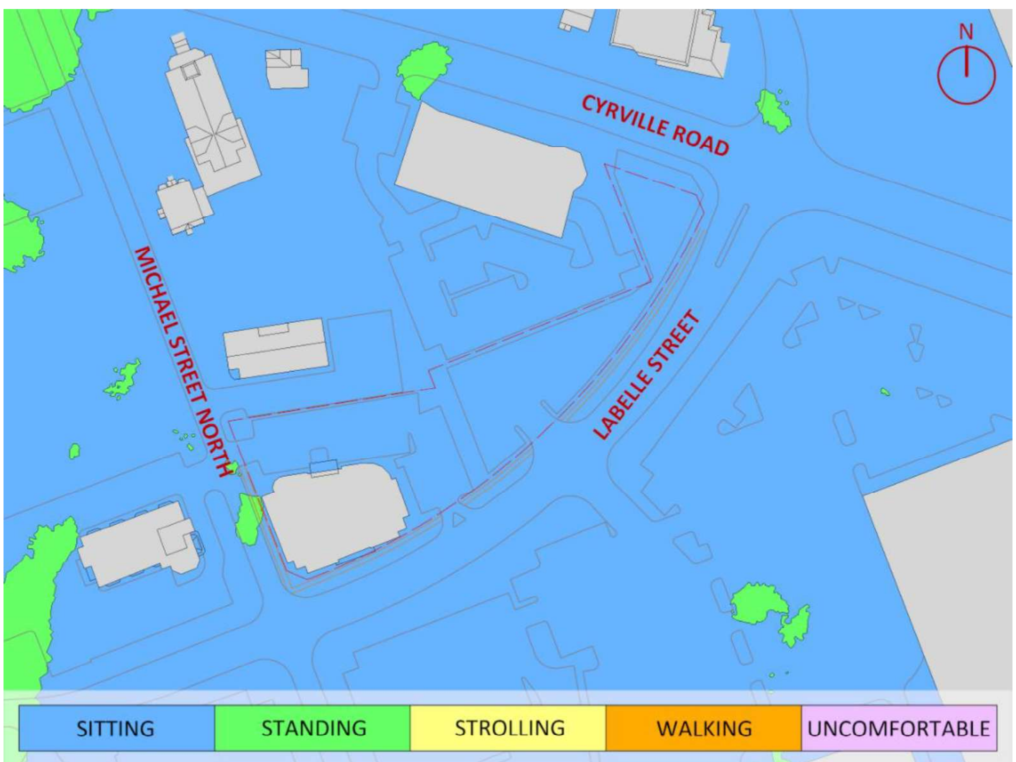

FIGURE 4B: SUMMER – WIND COMFORT, GRADE LEVEL– EXISTING MASSING

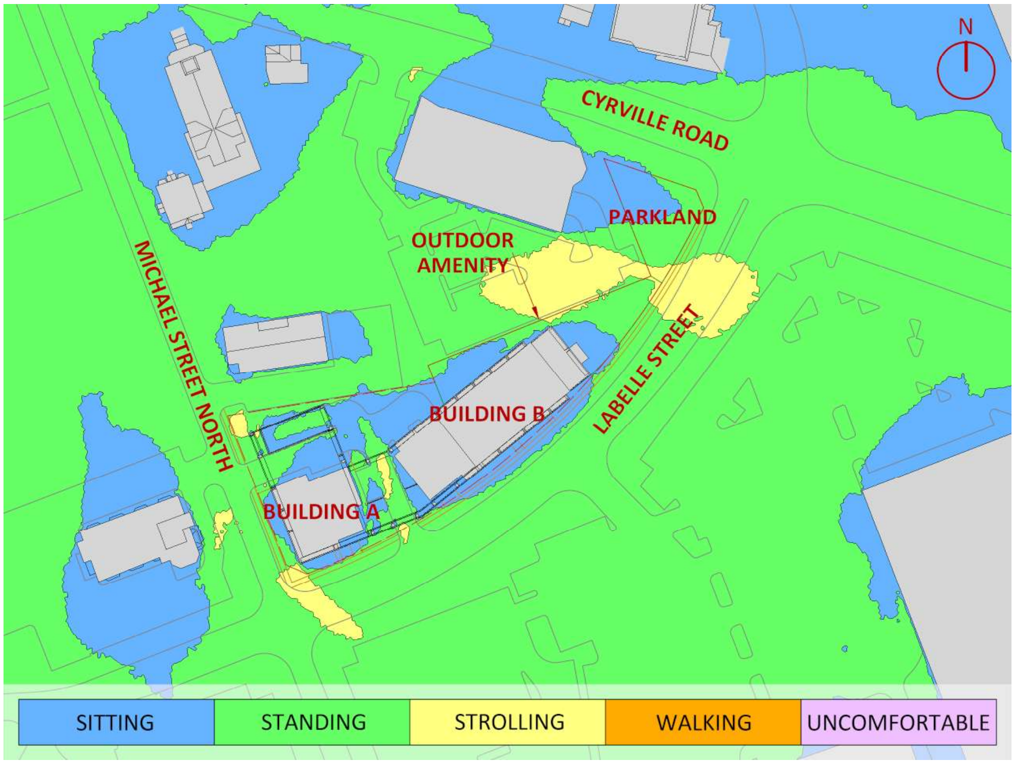

FIGURE 5A: AUTUMN – WIND COMFORT, GRADE LEVEL – PROPOSED MASSING

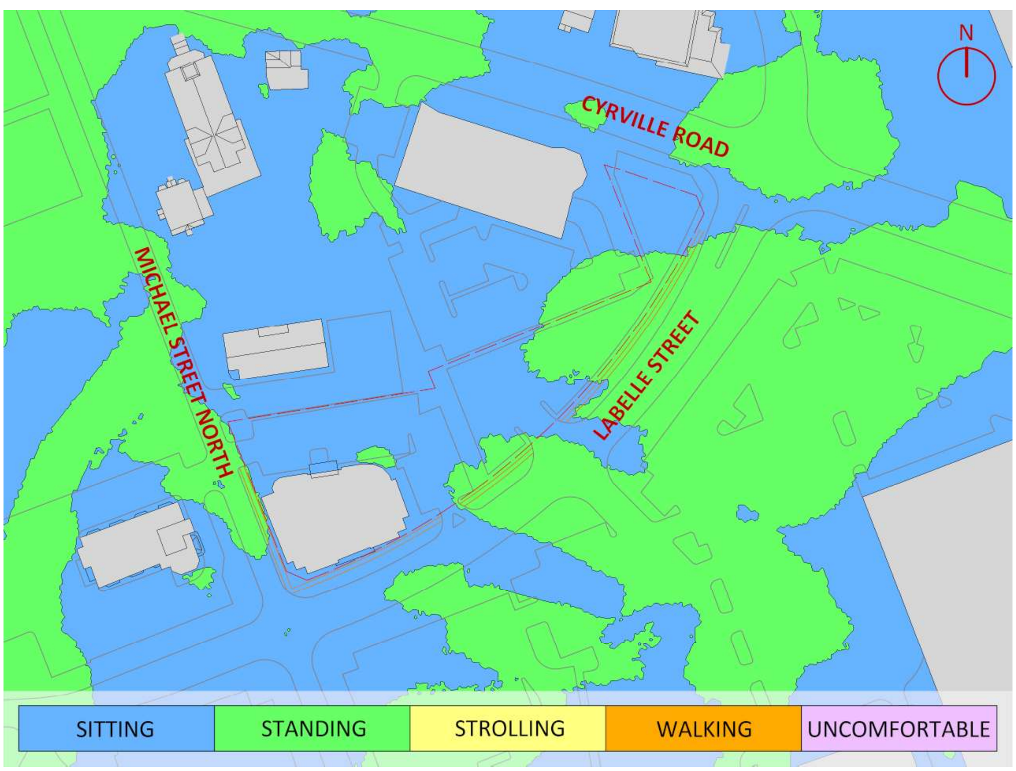

FIGURE 5B: AUTUMN – WIND COMFORT, GRADE LEVEL– EXISTING MASSING

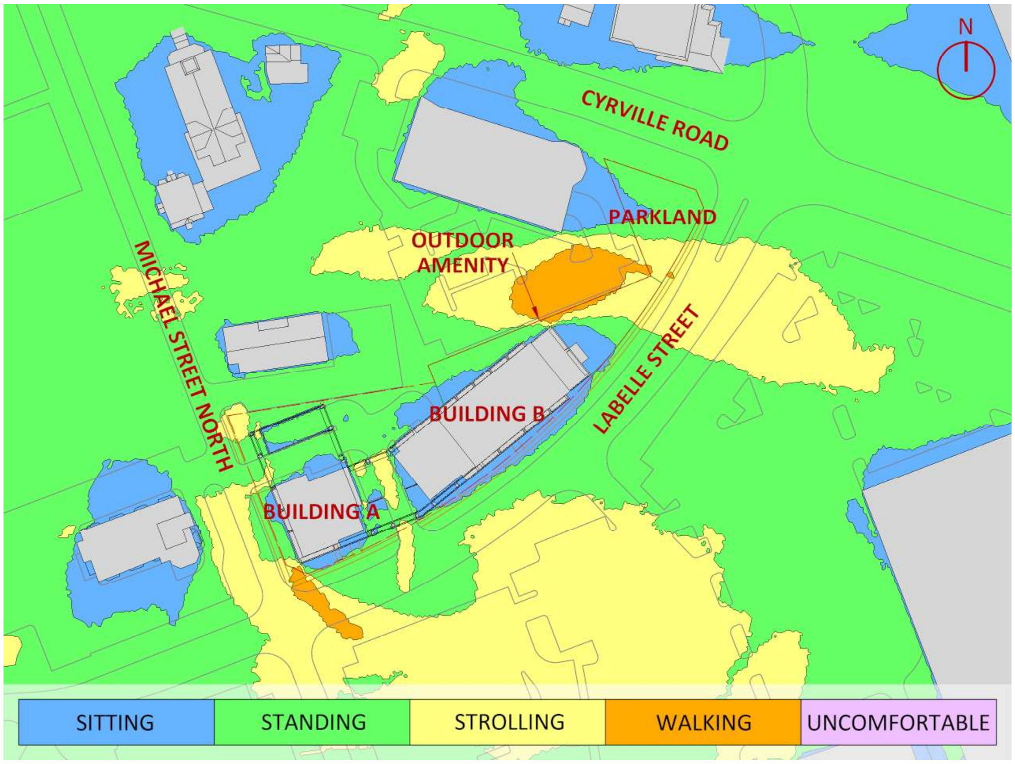

FIGURE 6A: WINTER – WIND COMFORT, GRADE LEVEL – PROPOSED MASSING

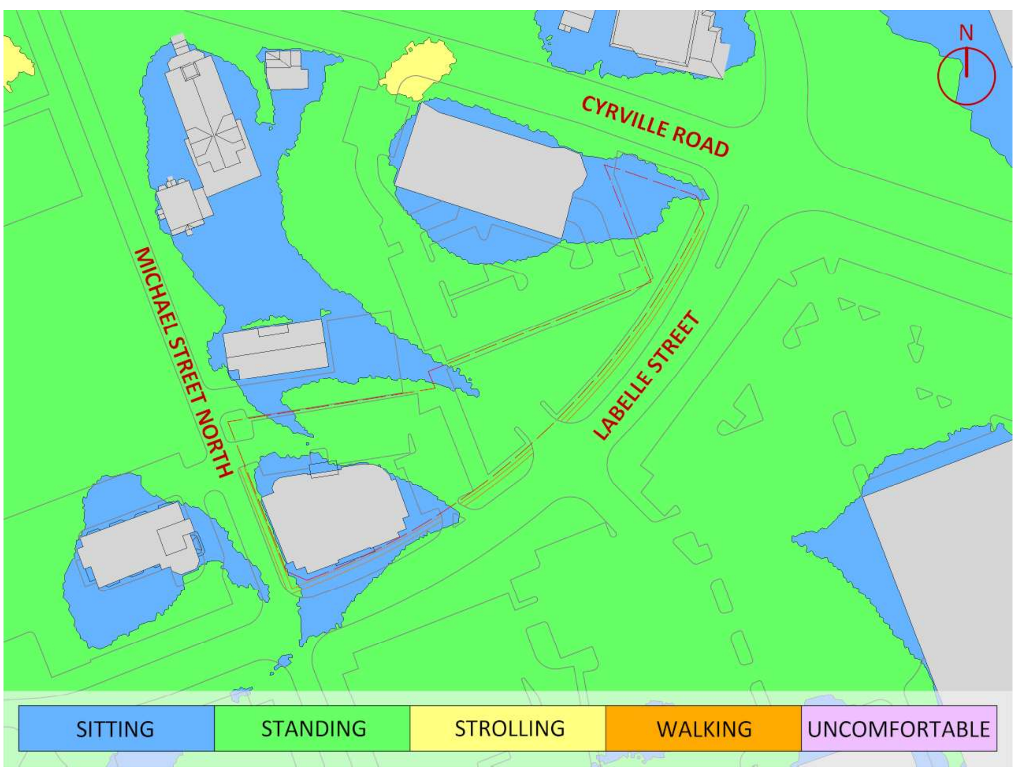

FIGURE 6B: WINTER – WIND COMFORT, GRADE LEVEL– EXISTING MASSING

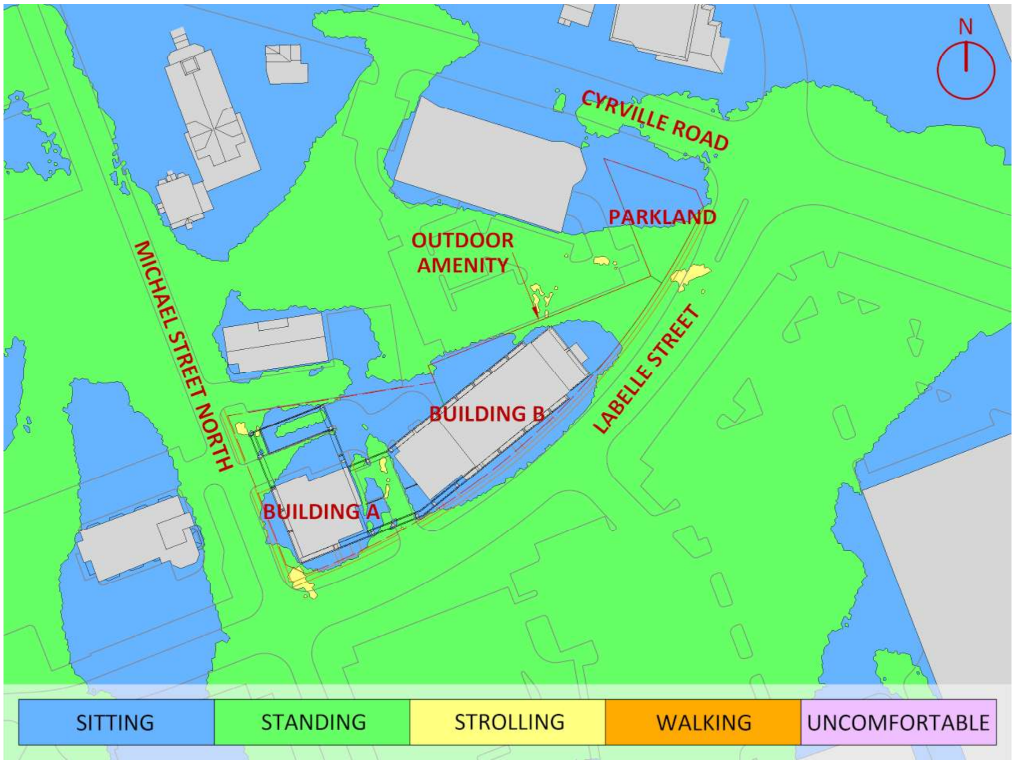

FIGURE 7: TYPICAL USE PERIOD – WIND COMFORT, GRADE LEVEL – PROPOSED MASSING

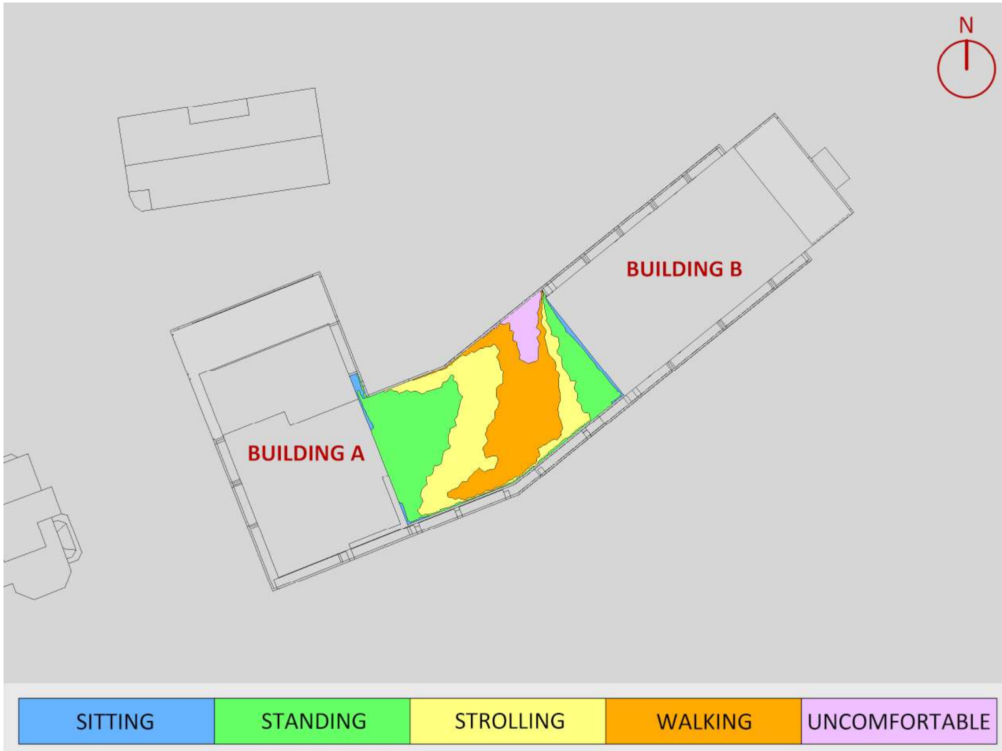

FIGURE 8A: SPRING – WIND COMFORT, LEVEL 7 COMMON AMENITY TERRACE

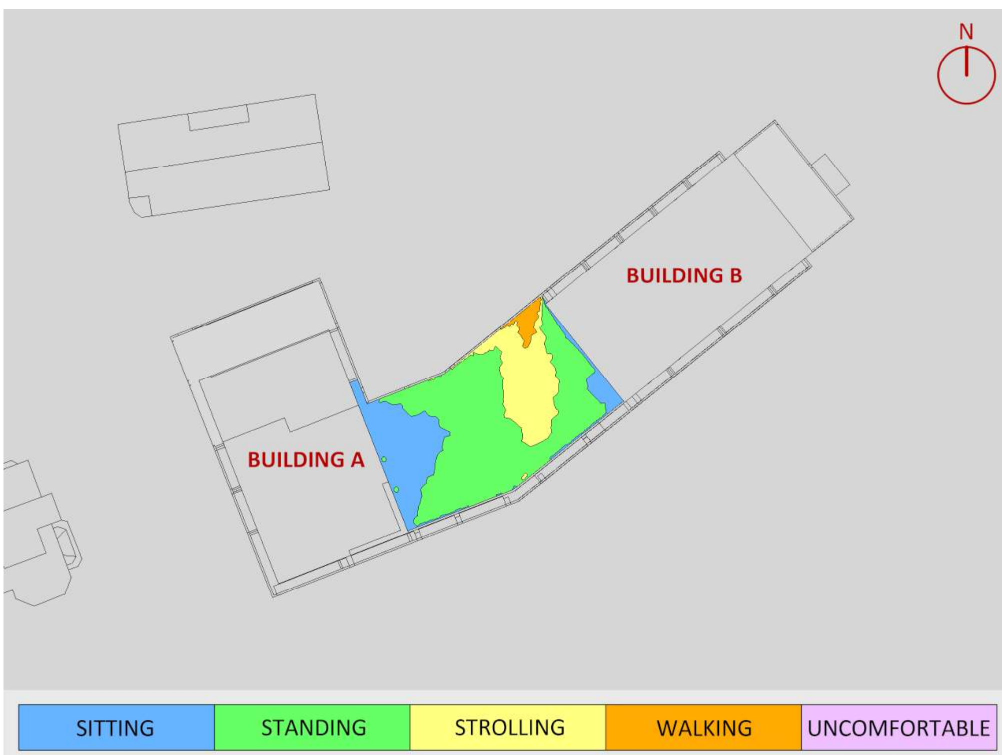

FIGURE 8B: SUMMER – WIND COMFORT, LEVEL 7 COMMON AMENITY TERRACE

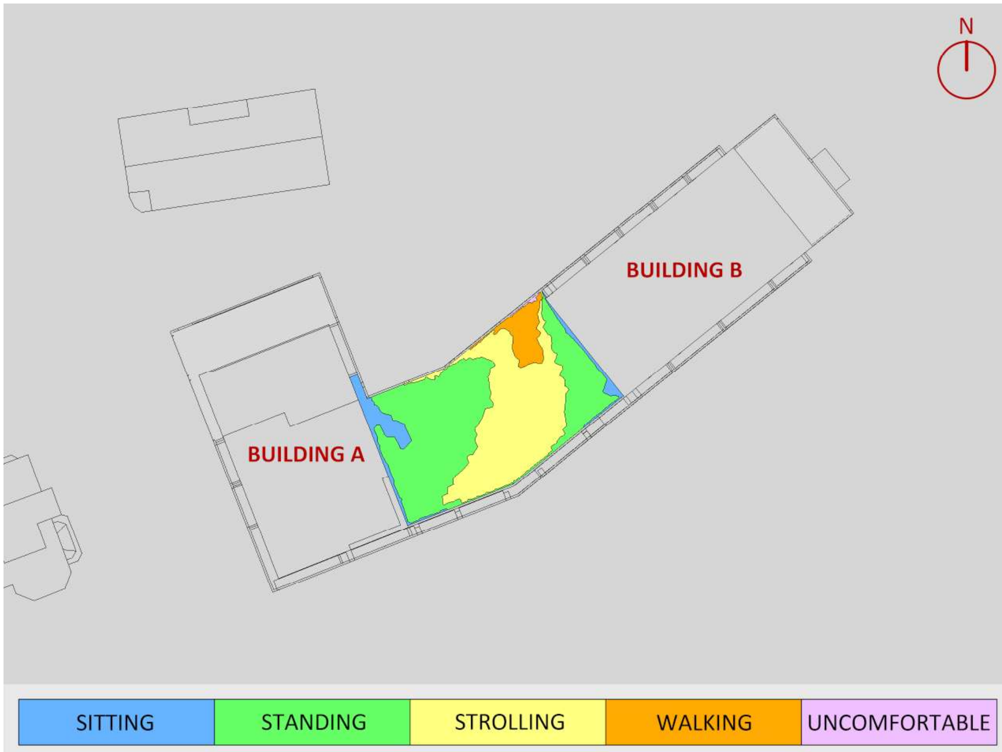

FIGURE 8C: AUTUMN – WIND COMFORT LEVEL 7 COMMON AMENITY TERRACE

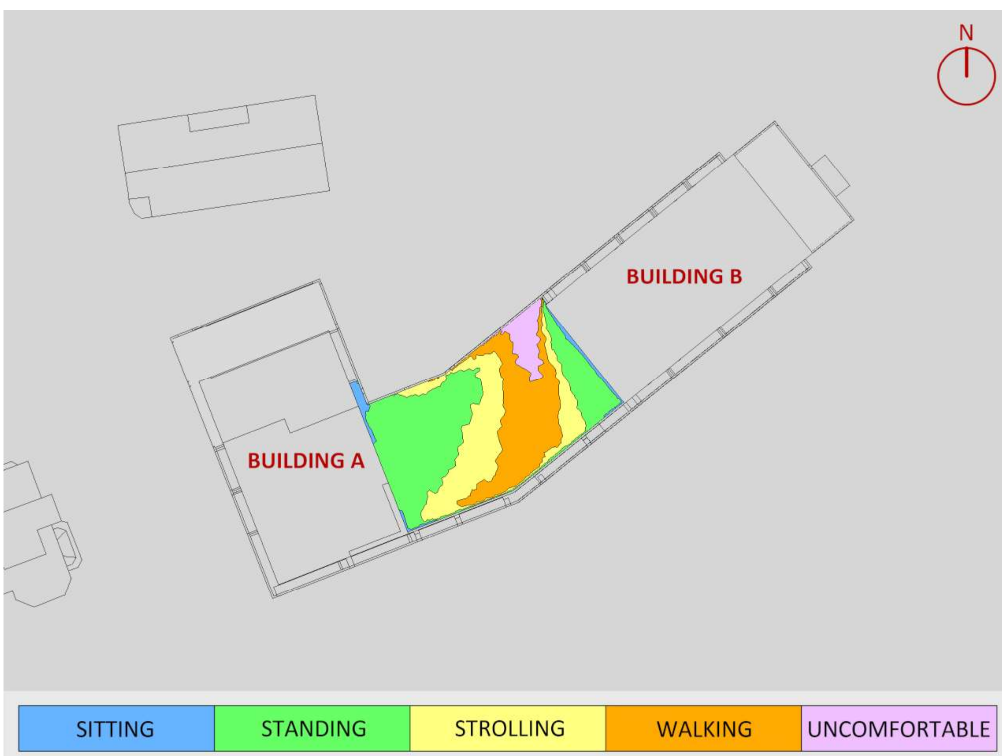

FIGURE 8D: WINTER – WIND COMFORT, LEVEL 7 COMMON AMENITY TERRACE

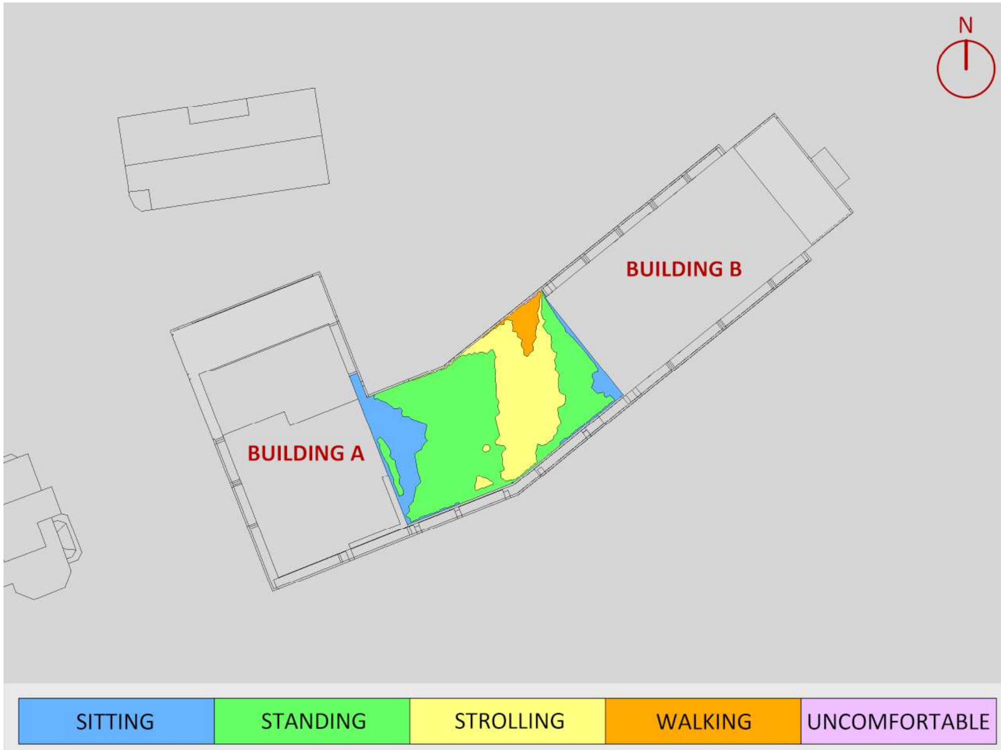

FIGURE 9: TYPICAL USE PERIOD – WIND COMFORT, LEVEL 7 COMMON AMENITY TERRACE

APPENDIX A

SIMULATION OF THE ATMOSPHERIC BOUNDARY LAYER

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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 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 is 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	0.23
22.5	0.22
45	0.23
67.5	0.22
90	0.23
112.5	0.23
135	0.24
157.5	0.25
180	0.25
202.5	0.23
225	0.23
247.5	0.24
270	0.25
292.5	0.25
315	0.25
337.5	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).

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

REFERENCES

[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.