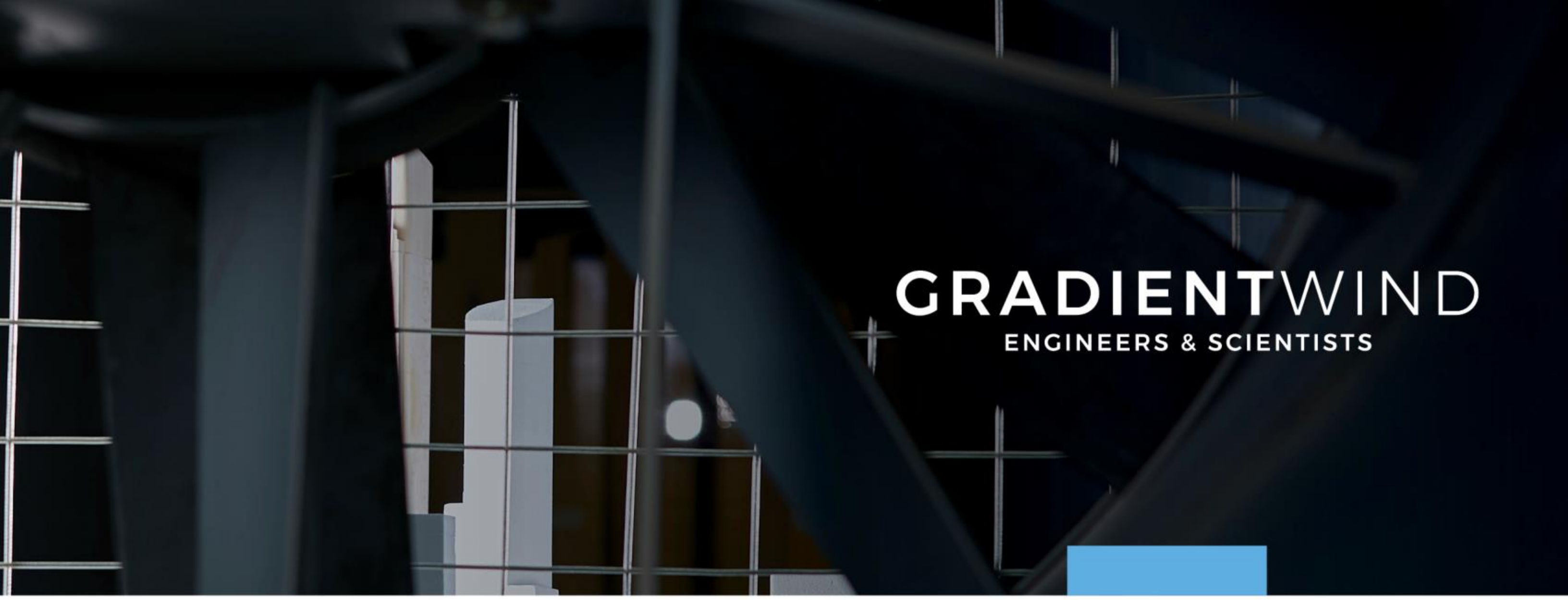
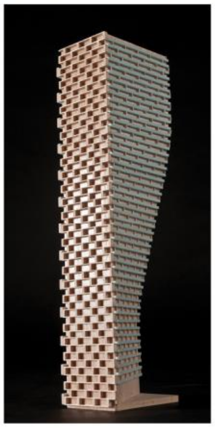
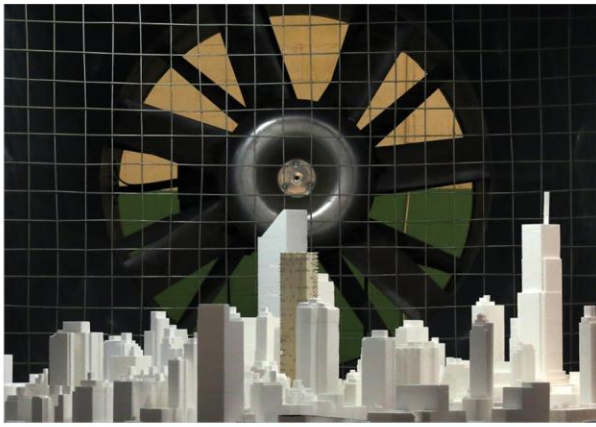


PEDESTRIAN LEVEL WIND STUDY

335 Roosevelt Avenue
Ottawa, Ontario

Report: 20-091-PLW-2024





July 22, 2024

PREPARED FOR
Uniform Urban Developments
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EXECUTIVE SUMMARY

This report describes a pedestrian level wind (PLW) study undertaken to satisfy concurrent Official Plan Amendment (OPA) and Zoning By-Law Amendment (ZBLA) application resubmission requirements for the proposed residential development located at 335 Roosevelt Avenue 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, the existing multi-use pathway to the north, the proposed walkways, outdoor amenities, surface parking, and loading areas, and in the vicinity of building access points, are considered acceptable.

    a. Following the introduction of the proposed development, a region over the roundabout and drop-off area between the East and West Buildings is predicted to experience conditions that may occasionally be considered uncomfortable for walking during the spring and winter seasons, exceeding the walking threshold for approximately 2% of the time during these seasons. As the uncomfortable conditions are limited to primarily over the roadway surface and the landscaped area at the northwest corner of the parkland and the noted exceedances may be considered marginal, the noted wind conditions are considered satisfactory.

b. Regarding the parkland to the south of the East Building, wind comfort conditions during the typical use period (that is, May to October, inclusive) are predicted to be suitable for standing, or better, with an isolated region suitable for strolling at the northwest corner of the parkland.

- If the western extent of the parkland will include seating or lounging areas, it is recommended to implement targeted wind barriers adjacent to the seating areas, which may take the form of targeted wind screens or dense arrangements of coniferous plantings, in combination with canopy structures above designated seating areas.

- The extent of wind mitigation measures is dependent on programming. If required, an appropriate mitigation strategy may be developed in coordination with the building and landscape architects as the design of the proposed development progresses. This work is expected to support the future Site Plan Control application.

2) During the typical use period, conditions over the common amenity terrace serving the East Building at the MPH Level are predicted to be suitable for mostly sitting with isolated areas of standing conditions, while conditions during the same period over the terrace serving the West Building at the MPH Level are predicted to be suitable for standing to the west and sitting to the northeast and southwest.

a. Depending on the programming of the terrace serving the East Building, the noted conditions may be considered acceptable. Specifically, if the windier areas at the west and northwest elevations of the terrace will not accommodate seating or more sedentary activities, the noted wind conditions would be considered acceptable.

b. To improve comfort levels within the amenity terrace serving the West Building, and within the amenity terrace serving the East Building if required by programming, mitigation inboard of the terrace perimeters and targeted around sensitive areas is recommended, in combination with taller perimeter wind screens that rise to at least 1.8 m above the local walking surface along the full perimeter of the terraces. Inboard mitigation could take the form of wind screens or other common landscape elements. Canopies may also be required above sensitive areas.

c. The extent of 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. This work is expected to support the future Site Plan Control application.

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 Uniform Urban Developments to undertake a pedestrian level wind (PLW) study to satisfy concurrent Official Plan Amendment (OPA) and Zoning By-Law Amendment (ZBLA) application resubmission requirements for the proposed residential development located at 335 Roosevelt Avenue in Ottawa, Ontario (hereinafter referred to as "subject site" or "proposed development"). A PLW study was conducted in July 2020[1] for the previous design of the proposed development. Our mandate within the current 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.

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 Hobin Architecture in July 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 335 Roosevelt Avenue in Ottawa, situated on an irregular parcel of land bounded by Roosevelt Avenue to the west, the OC Transpo Transitway to the north, and Wilmont Avenue to the southeast. The proposed development comprises two residential buildings both topped with a mechanical penthouse (MPH): an East Building (13 storeys) and a West Building (14 storeys). A parkland is provided to the south of the East Building. Winston Avenue divides the site into the east and west parcels and provides access to a drop-off area between the two buildings and surface parking and a loading area near the southeast corner of the West Building, while Wilmont Avenue provides access to a loading area to the south of the East Building. The two buildings share three underground parking levels, accessed by a parking ramp to the south of the East Building via Wilmont Avenue and by a parking ramp at the southwest corner of the West Building accessed from Roosevelt Avenue.

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[1] Gradient Wind Engineering Inc., '*335 Roosevelt Avenue – Pedestrian Level Wind Study*', [July 30, 2020]

The ground floor of the East Building includes a main entrance at the northwest corner, residential units along the north and east elevations, a move in/move out space to the south, and an indoor amenity at the southwest corner, while the ground floor of the West Building includes a main entrance at the northwest corner, residential units to the north, a move in/move out space to the south, and indoor amenities to the east and at the southwest corner. Outdoor amenity spaces adjoin the indoor amenities along the south elevations of the two buildings. The remaining residential levels above the ground floor comprise residential units. The East and West Buildings extend at the southwest corner and from the east elevation at Level 2, respectively, and the East Building steps back from the west elevation at Level 2. Private terraces serving both buildings are accommodated within setbacks at the southeast corner at Level 4, from the south and west elevations at Levels 8, 9, and 11, and from the south elevation at Level 12. Additionally, the West Tower includes private terraces within setbacks from the east elevation at Level 8, from the north elevation at Level 12, and from the north and east elevations at Level 14. The MPH Level of both buildings include indoor amenities at the northeast corner and to the west and mechanical spaces throughout the remainder of the level. The East and West Buildings are served by common amenity terraces along the north and west elevations at their respective MPH Levels.

The near-field surroundings (defined as an area within 200 metres (m) of the subject site) are composed of low-rise residential dwellings in all directions, and a mid-rise residential building directly to the northeast. The OC Transpo Transitway runs southwest-northeast directly to the north of the site. Notably, the future Kichi Zipi LRT stop is under construction approximately 130 m to the southwest of the proposed development. The far-field surroundings (defined as an area beyond the near-field but within a 5-kilometre (km) radius of the subject site) contribute primarily suburban wind exposures with isolated clusters of mid- and high-rise buildings from the northeast clockwise to the southwest, and hybrid open-suburban exposures from the southwest clockwise to the northeast, owing to the Ottawa River and Gatineau beyond.

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 which have been 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[2]. 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.

[2] 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 16 wind directions. The CFD simulation model was centered on the proposed development, complete with surrounding massing within a radius of 500 m. The process was performed for two context massing scenarios, as noted in Section 2.

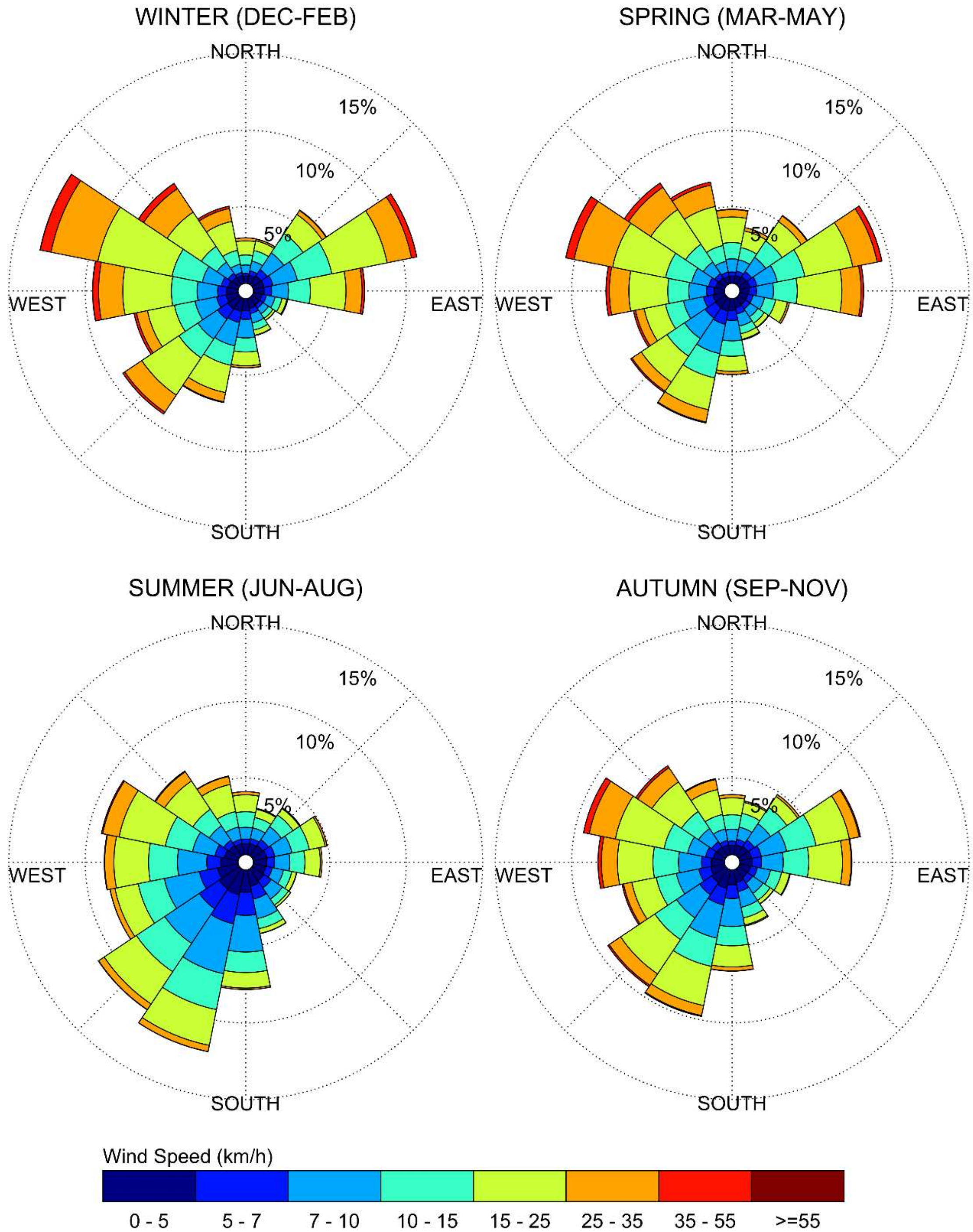
Mean and peak wind speed data obtained over the subject site for each wind direction were interpolated to 36 wind directions at 10° intervals, representing the full compass azimuth. Measured wind speeds approximately 1.5 m above local grade and over the MPH Level common amenity terraces serving the East and West Buildings 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 conditions over the common amenity terraces serving the East and West Buildings at their respective MPH Levels. 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 wind comfort conditions at grade level and within the noted amenity terraces serving the proposed development, respectively, consistent with the comfort classes illustrated 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 Roosevelt Avenue: Following the introduction of the proposed development, wind comfort conditions over the nearby public sidewalks along Roosevelt Avenue are predicted to be suitable for standing, or better, during the summer and autumn, becoming suitable for a mix of standing and strolling during the spring and winter. The noted conditions are considered acceptable.

Conditions over the sidewalks along Roosevelt Avenue under the existing massing are predicted to be suitable for mostly sitting during the summer and autumn, becoming suitable for a mix of sitting and standing during the spring and winter. While the introduction of the proposed development produces windier conditions in comparison to existing conditions along Roosevelt Avenue, wind comfort conditions with the proposed development are nevertheless considered acceptable for public sidewalks.

Multi-Use Pathway North of Subject Site: Following the introduction of the proposed development, wind conditions over the neighbouring multi-use pathway, which runs along the Transitway situated to the north of the subject site, are predicted to be suitable for standing, or better, during the summer and autumn, becoming suitable for strolling, or better, during the spring and winter. The noted conditions are considered acceptable.

Conditions over the noted pathway under the existing massing are predicted to be suitable for a mix of sitting and standing during the summer, becoming suitable for standing, or better, throughout the remaining three seasons, with an isolated region suitable for strolling during the spring and winter. While the introduction of the proposed development produces windier conditions over the pathway in comparison to existing conditions, wind comfort conditions are nevertheless considered acceptable.

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

Conditions over the sidewalks along Wilmont Avenue under the existing massing are predicted to be suitable for sitting during the summer and autumn, becoming suitable for a mix of sitting and standing during the spring and winter. While the introduction of the proposed development produces windier conditions in comparison to existing conditions, wind comfort conditions along Wilmont Avenue are nevertheless considered acceptable.

Sidewalks along Winston Avenue and the Drop-Off Area Between the East and West Buildings: Following the introduction of the proposed development, wind comfort conditions over the nearby existing public sidewalks to the south along Winston Avenue are predicted to be suitable for mostly sitting during the summer and autumn, becoming suitable for a mix of sitting and standing during the spring and winter. The noted conditions are considered acceptable.

Wind conditions over the proposed walkways along the roundabout and the drop-off area situated between the East and West Buildings are predicted to be suitable for a mix of standing and strolling during the summer and autumn, becoming suitable for a mix of standing, strolling, and walking during the spring and winter. An isolated region of conditions that may occasionally be considered uncomfortable for walking during the spring and winter is predicted between the East and West Buildings. Conditions over the noted area are predicted to be suitable for walking for approximately 78% of the time during the spring and winter seasons, representing 2% exceedances of the walking threshold. The noted wind conditions may be considered satisfactory, as the uncomfortable conditions are primarily limited to over the roadway surface and the landscaped area at the northwest corner of the parkland and the noted exceedances may be considered marginal.

Conditions over the existing sidewalks along Winston Avenue under the existing massing are predicted to be suitable for sitting throughout the year. While the introduction of the proposed development produces windier conditions over the existing sidewalks in comparison to existing conditions, wind comfort conditions over the existing sidewalks along Winston Avenue following the introduction of the proposed development are nevertheless considered acceptable.

Outdoor Amenities: Wind conditions during the typical use period within the grade-level outdoor amenity spaces serving the East and West Buildings are predicted to be suitable for sitting, as illustrated in Figure 7, which is considered acceptable.

Parkland South of East Building: During the typical use period, wind comfort conditions over the parkland to the south of the East Building are predicted to be suitable for sitting to the east and suitable for standing to the west, with an isolated region of strolling conditions at the northwest corner of the parkland. If the western extent of the parkland will include seating or lounging areas, it is recommended to implement wind barriers that are targeted adjacent to the seating areas, which may take the form of targeted wind screens or dense arrangements of coniferous plantings, in combination with canopy structures above designated seating areas.

The extent of wind mitigation measures is dependent on programming. If required, an appropriate mitigation strategy may be developed in coordination with the building and landscape architects as the design of the proposed development progresses. This work is expected to support the future Site Plan Control application.

Walkways, Surface Parking, and Loading Areas within Subject Site: With the exception of the above-noted windier area between the East and West Buildings, wind conditions over the proposed walkways within the subject site are predicted to be suitable for standing, or better, during the summer and autumn, with an isolated region suitable for strolling between the two buildings, becoming suitable for strolling, or better, during the spring and winter, with an isolated region suitable for walking between the two buildings. Conditions over the loading area to the south of the East Building are predicted to be suitable for sitting throughout the year, while conditions over the surface parking and the loading area to the southeast of the West Building are predicted to be suitable for sitting during the summer and autumn, becoming suitable for a mix of sitting and standing during the spring and winter. 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 standing, or better, throughout the year, which is considered acceptable.

5.2 Wind Comfort Conditions – MPH Level Common Amenity Terraces

East Building, MPH Level Amenity Terrace: As illustrated in Figure 9, wind comfort conditions over the common amenity terrace serving the East Building at the MPH Level are predicted to be suitable for mostly sitting during the typical use period, with isolated regions of standing conditions.

Depending on the programming of the MPH Level amenity terrace serving the East Building, the noted conditions may be considered acceptable. Specifically, if the noted windier areas will not accommodate seating or more sedentary activities, the noted wind conditions would be considered acceptable.

West Building, MPH Level Amenity Terrace: Wind comfort conditions during the typical use period within the common amenity terrace serving the West Building at the MPH Level are predicted to be suitable for standing to the west and sitting to the southwest and northeast.

To improve comfort levels within the MPH Level terrace serving the West Building, and within the MPH Level terrace serving the East Building if required by programming, mitigation inboard of the terrace perimeters and targeted around sensitive areas is recommended, in combination with taller perimeter wind screens, rising to at least 1.8 m above the local walking surface along the full perimeter of the terraces. Inboard mitigation could take the form of wind screens or other common landscape elements. Canopies may also be required above sensitive areas.

The extent of 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. This work is expected to support the future Site Plan Control application.

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) 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, the existing multi-use pathway to the north, the proposed walkways, outdoor amenities, surface parking, and loading areas, and in the vicinity of building access points, are considered acceptable.

   a. Following the introduction of the proposed development, a region over the roundabout and drop-off area between the East and West Buildings is predicted to experience conditions that may occasionally be considered uncomfortable for walking during the spring and winter seasons, exceeding the walking threshold for approximately 2% of the time during these seasons. As the uncomfortable conditions are limited to primarily over the roadway surface and the landscaped area at the northwest corner of the parkland and the noted exceedances may be considered marginal, the noted wind conditions are considered satisfactory.

   b. Regarding the parkland to the south of the East Building, wind comfort conditions during the typical use period (that is, May to October, inclusive) are predicted to be suitable for standing, or better, with an isolated region suitable for strolling at the northwest corner of the parkland.

      - If the western extent of the parkland will include seating or lounging areas, it is recommended to implement targeted wind barriers adjacent to the seating areas, which may take the form of targeted wind screens or dense arrangements of coniferous plantings, in combination with canopy structures above designated seating areas.

- The extent of wind mitigation measures is dependent on programming. If required, an appropriate mitigation strategy may be developed in coordination with the building and landscape architects as the design of the proposed development progresses. This work is expected to support the future Site Plan Control application.

2) During the typical use period, conditions over the common amenity terrace serving the East Building at the MPH Level are predicted to be suitable for mostly sitting with isolated areas of standing conditions, while conditions during the same period over the terrace serving the West Building at the MPH Level are predicted to be suitable for standing to the west and sitting to the northeast and southwest.

    a. Depending on the programming of the terrace serving the East Building, the noted conditions may be considered acceptable. Specifically, if the windier areas at the west and northwest elevations of the terrace will not accommodate seating or more sedentary activities, the noted wind conditions would be considered acceptable.

    b. To improve comfort levels within the amenity terrace serving the West Building, and within the amenity terrace serving the East Building if required by programming, mitigation inboard of the terrace perimeters and targeted around sensitive areas is recommended, in combination with taller perimeter wind screens that rise to at least 1.8 m above the local walking surface along the full perimeter of the terraces. Inboard mitigation could take the form of wind screens or other common landscape elements. Canopies may also be required above sensitive areas.

    c. The extent of 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. This work is expected to support the future Site Plan Control application.

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.

LICENSED PROFESSIONAL ENGINEER
D. T. HUITEMA
100561777
July 22, 2024
PROVINCE OF ONTARIO

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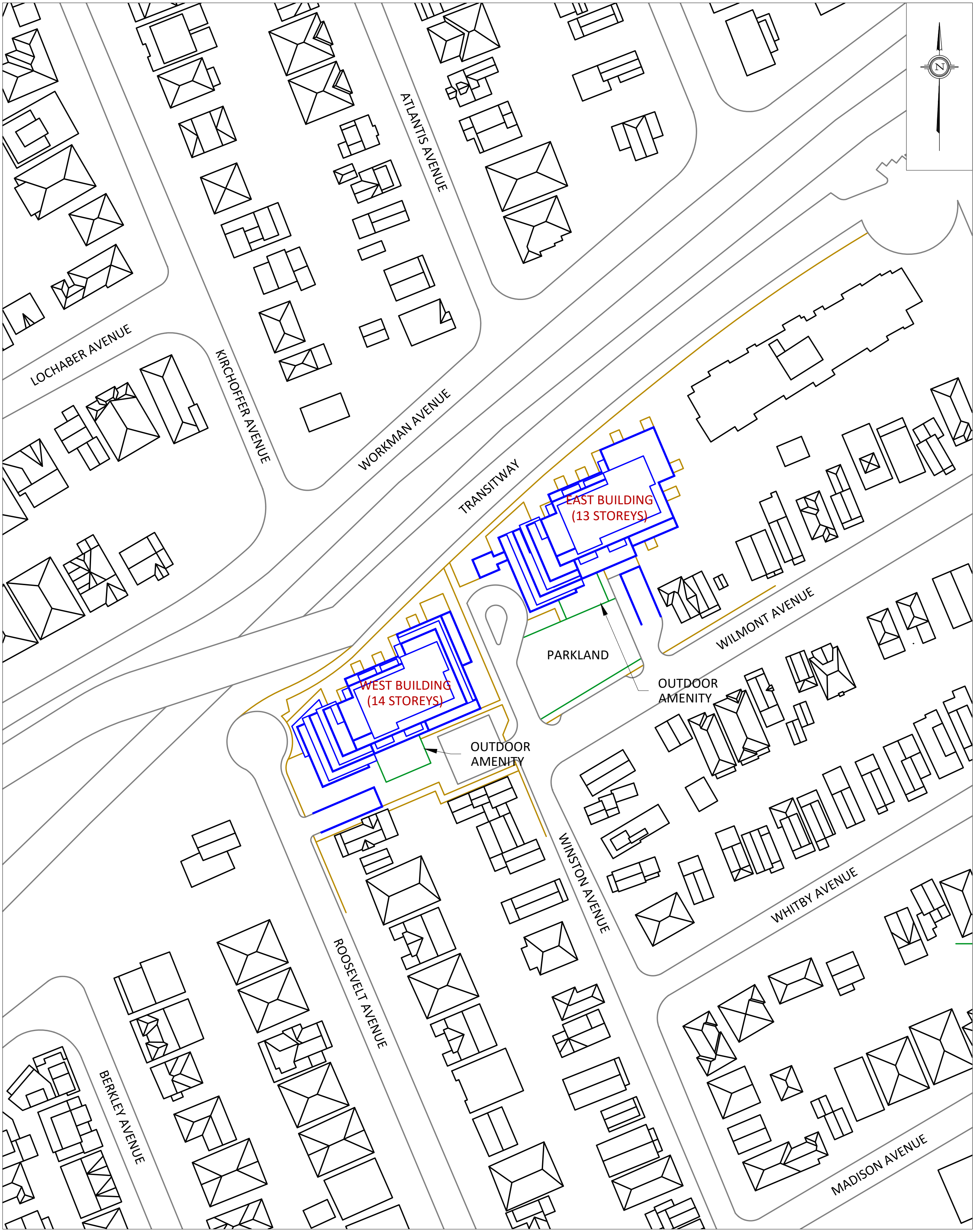

GRADIENTWIND ENGINEERS & SCIENTISTS 127 WALGREEN ROAD, OTTAWA, ON 613 836 0934 • GRADIENTWIND.COM	PROJECT 335 ROOSEVELT AVENUE, OTTAWA PEDESTRIAN LEVEL WIND STUDY		DESCRIPTION FIGURE 1A: PROPOSED SITE PLAN AND SURROUNDING CONTEXT
	SCALE 1:1500	DRAWING NO. 20-091-PLW-2024-1A	
	DATE JULY 22, 2024	DRAWN BY S.K.	

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PROJECT	335 ROOSEVELT AVENUE, OTTAWA PEDESTRIAN LEVEL WIND STUDY		DESCRIPTION FIGURE 1B: EXISTING SITE PLAN AND SURROUNDING CONTEXT
SCALE	1:1500	DRAWING NO. 20-091-PLW-2024-1B	
DATE	JULY 22, 2024	DRAWN BY S.K.	

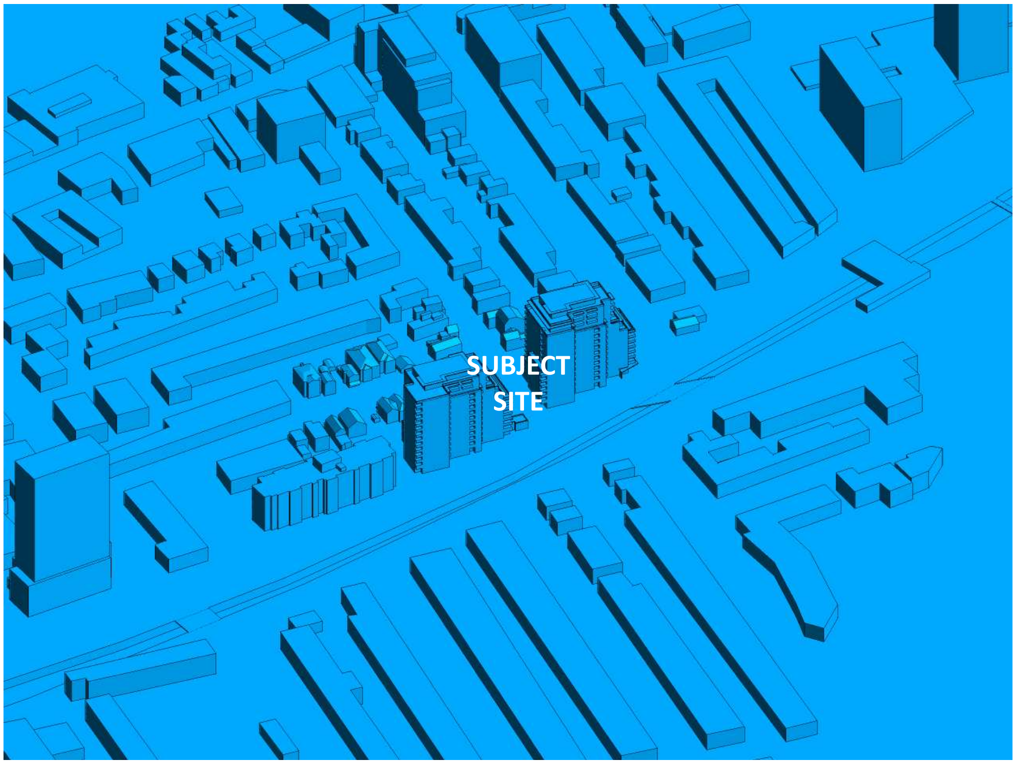


FIGURE 2A: COMPUTATIONAL MODEL, PROPOSED MASSING, NORTH PERSPECTIVE

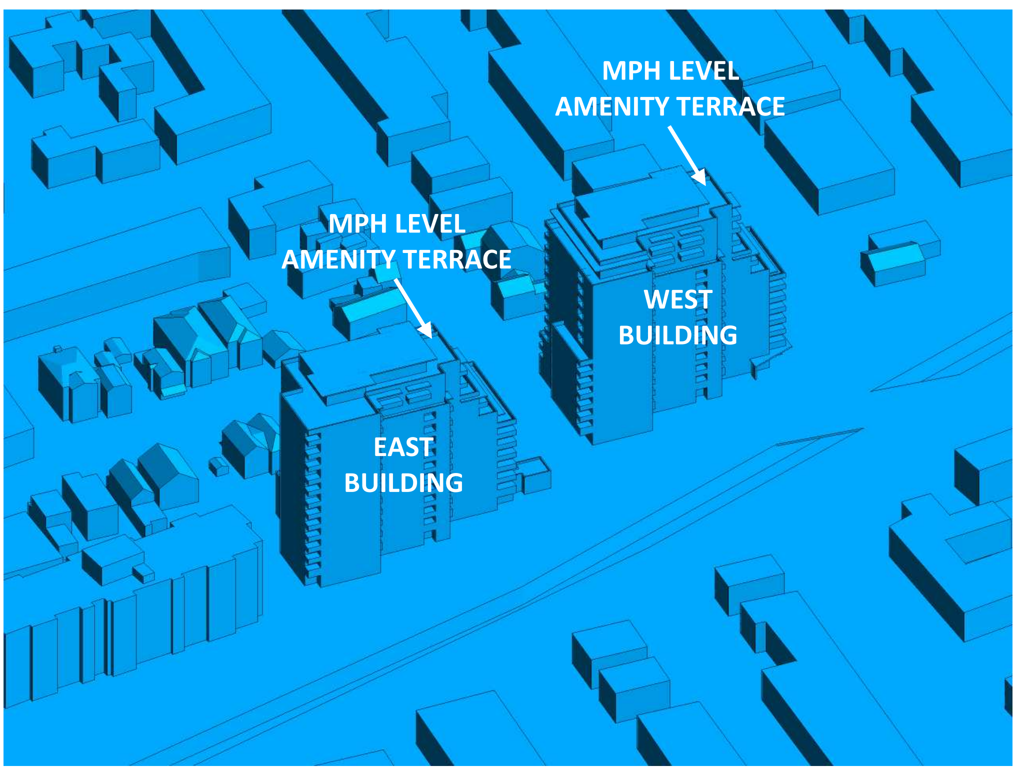


FIGURE 2B: CLOSE UP OF FIGURE 2A

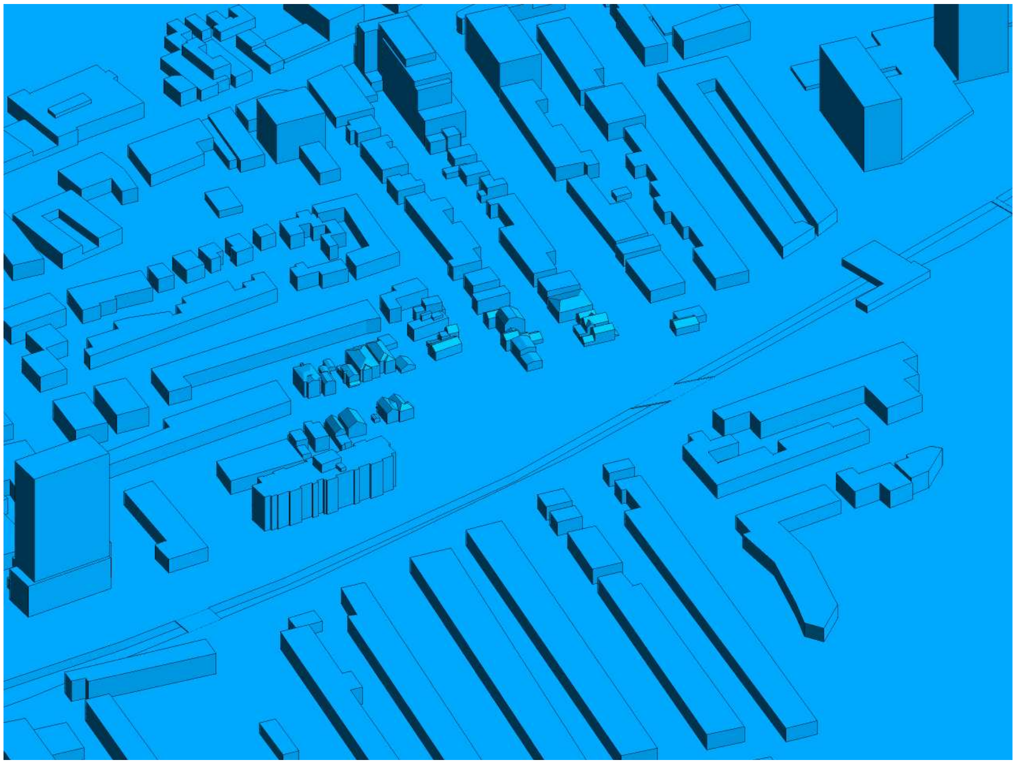


FIGURE 2C: COMPUTATIONAL MODEL, EXISTING MASSING, NORTH PERSPECTIVE

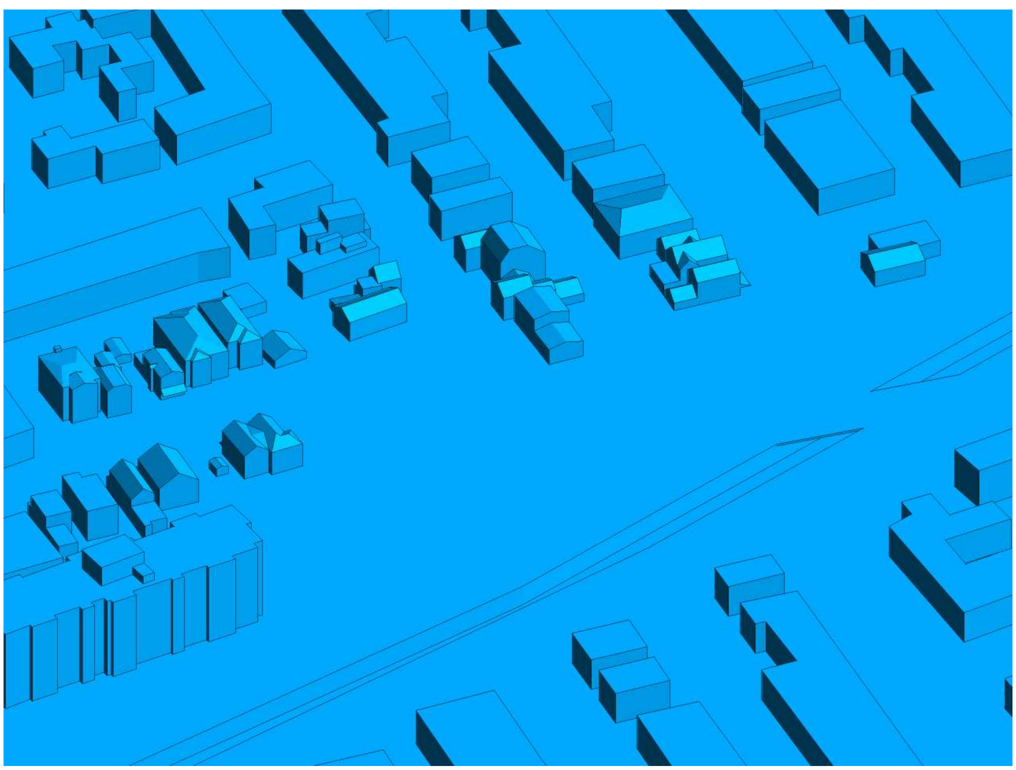


FIGURE 2D: CLOSE UP OF FIGURE 2C

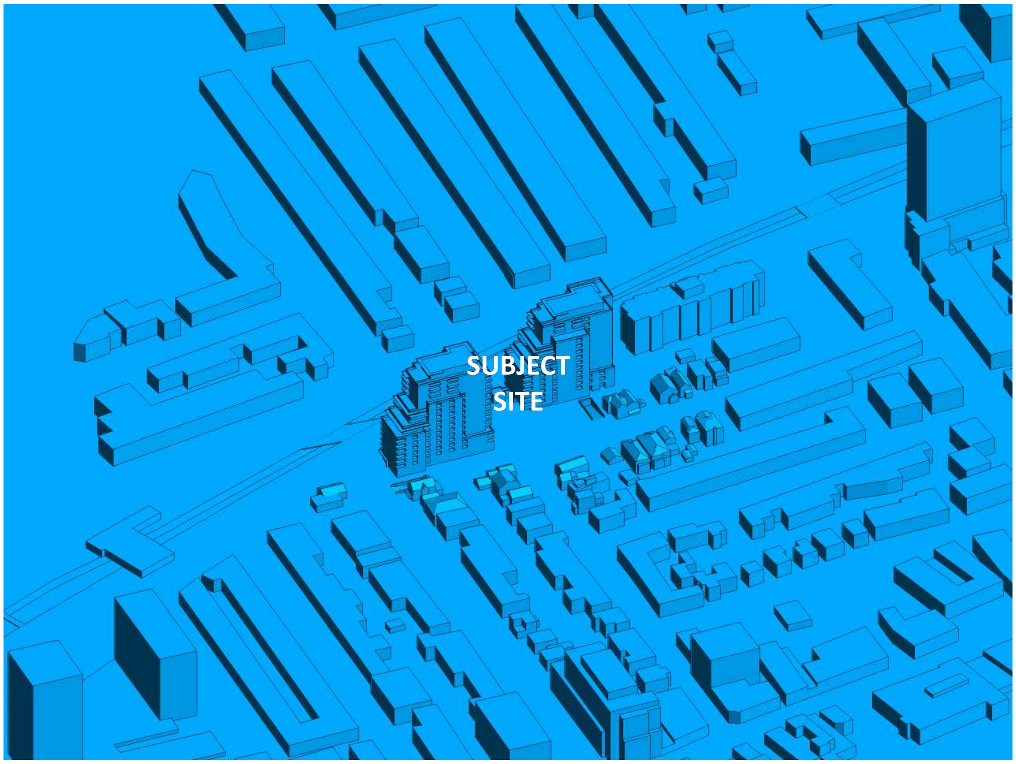


FIGURE 2E: COMPUTATIONAL MODEL, PROPOSED MASSING, SOUTH PERSPECTIVE

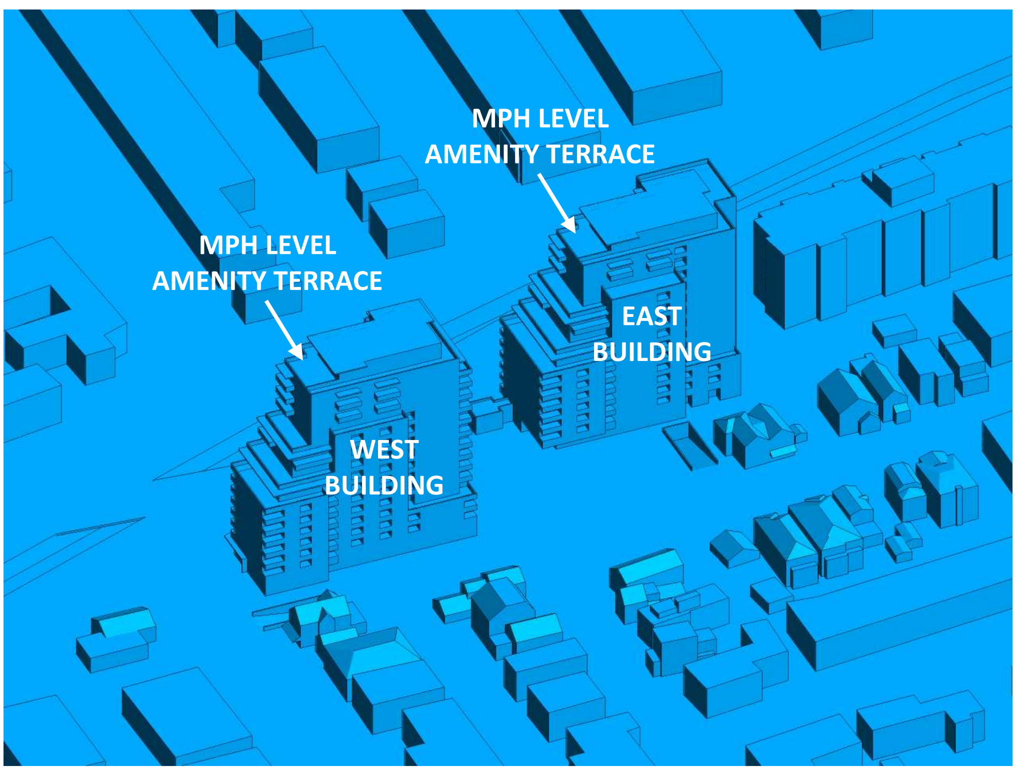


FIGURE 2F: CLOSE UP OF FIGURE 2E

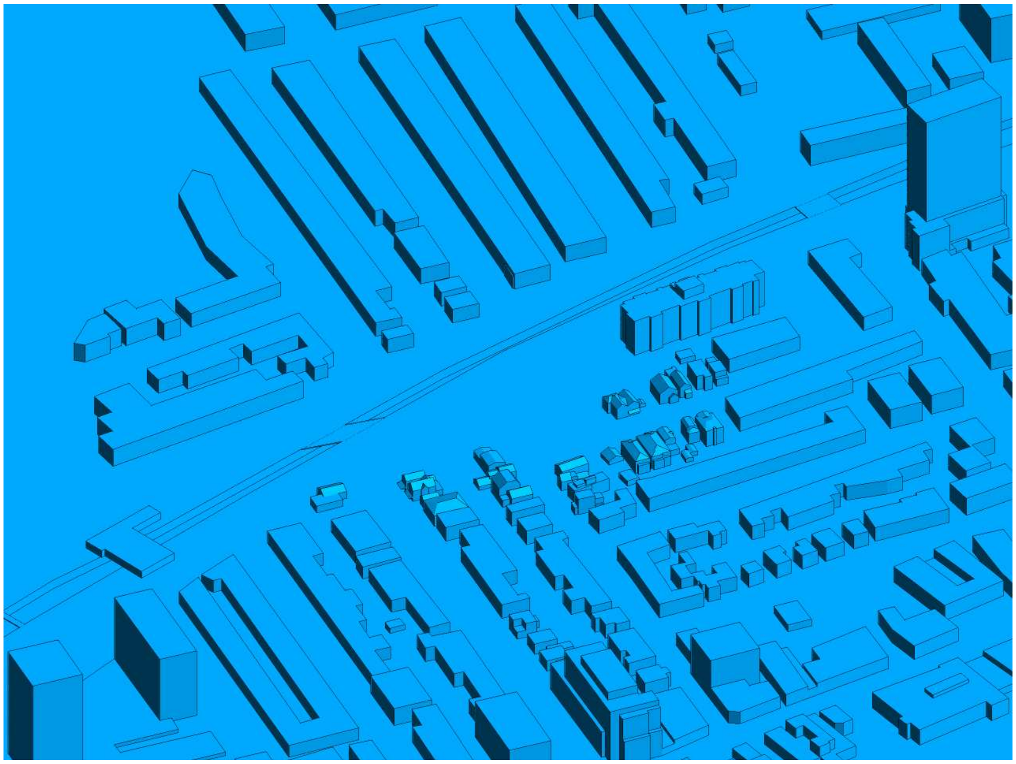


FIGURE 2G: COMPUTATIONAL MODEL, EXISTING MASSING, SOUTH PERSPECTIVE

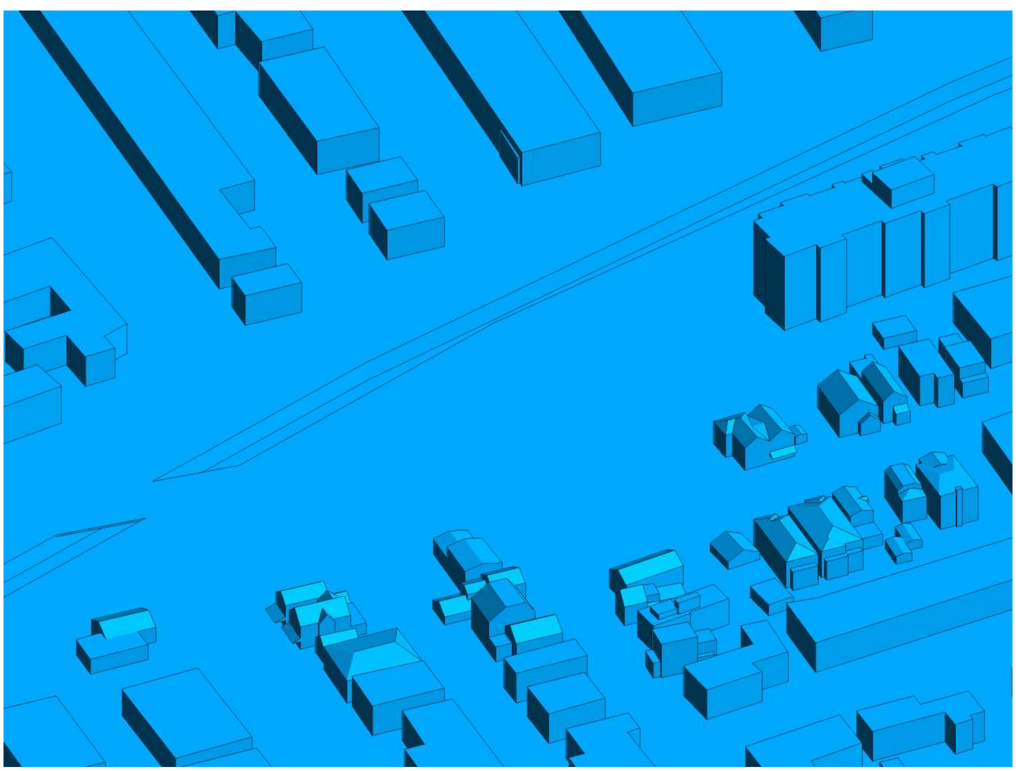


FIGURE 2H: CLOSE UP OF FIGURE 2G

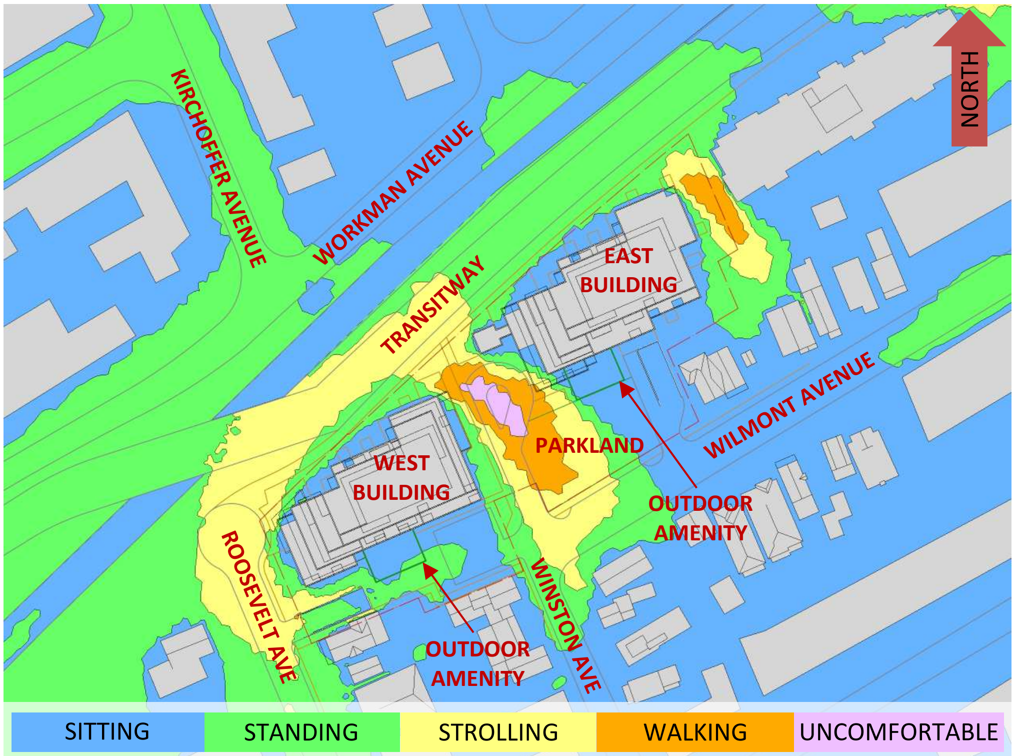


FIGURE 3A: SPRING – WIND COMFORT, GRADE LEVEL – PROPOSED MASSING

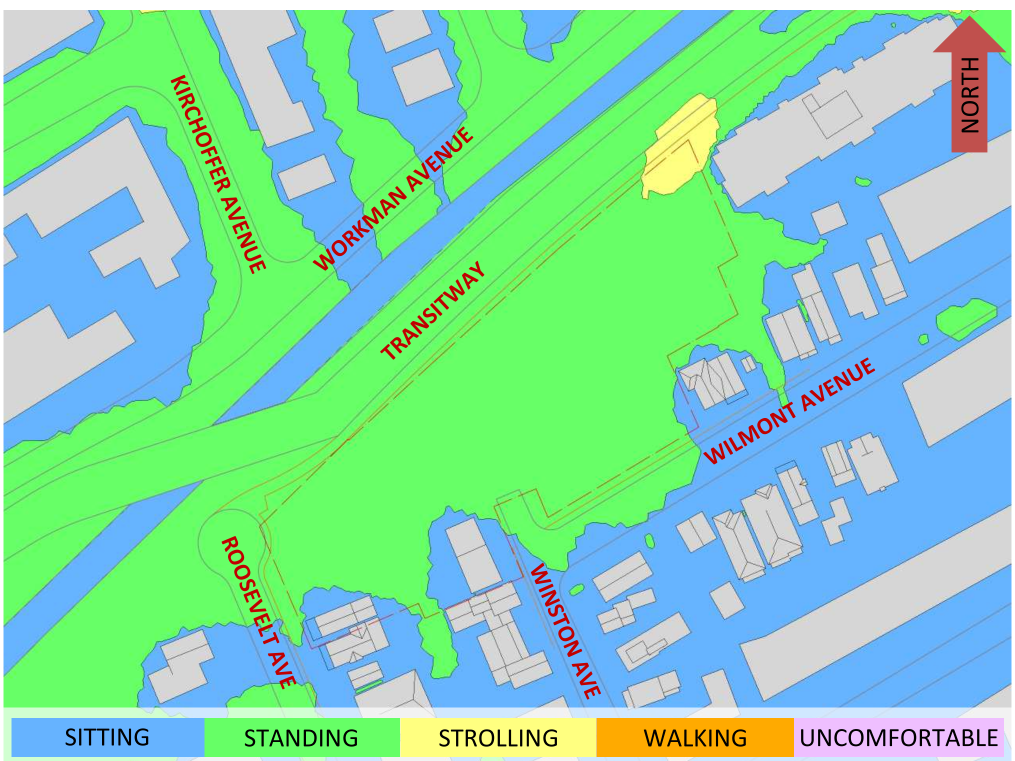


FIGURE 3B: SPRING – WIND COMFORT, GRADE LEVEL– EXISTING MASSING

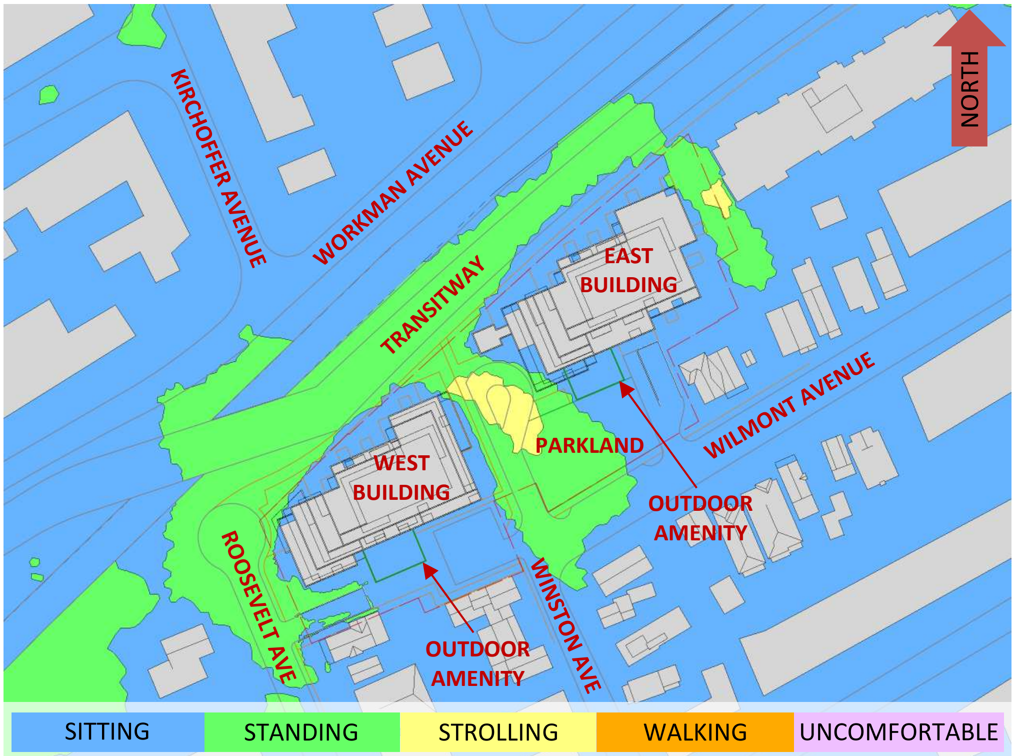


FIGURE 4A: SUMMER – WIND COMFORT, GRADE LEVEL – PROPOSED MASSING

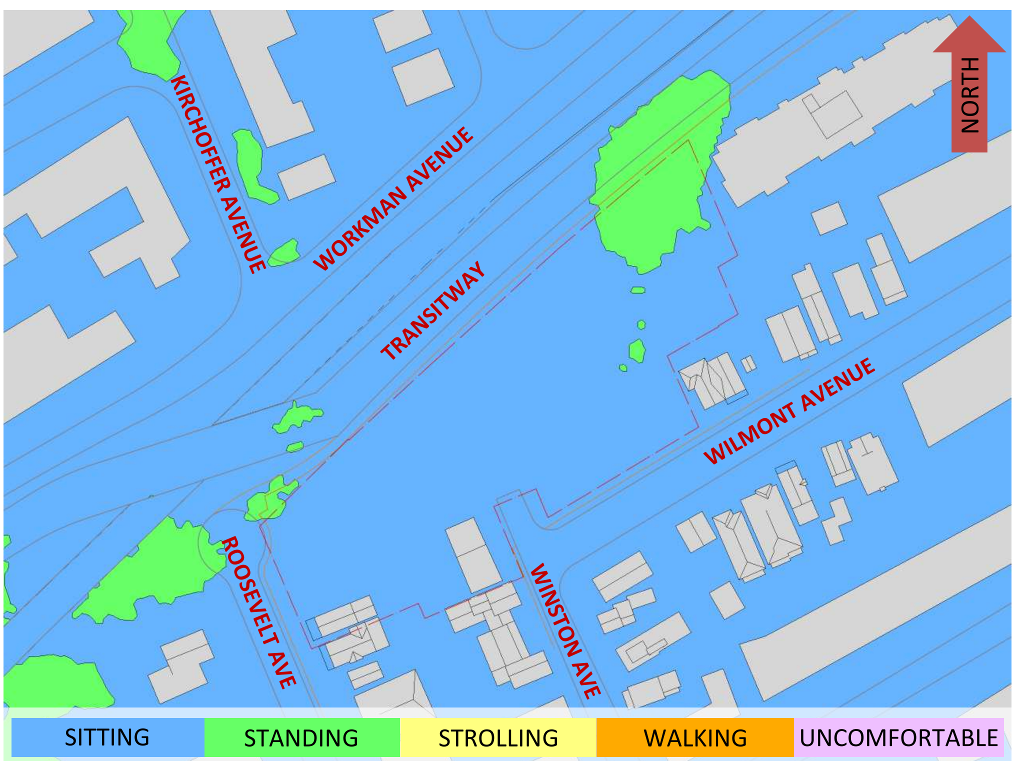


FIGURE 4B: SUMMER – WIND COMFORT, GRADE LEVEL– EXISTING MASSING

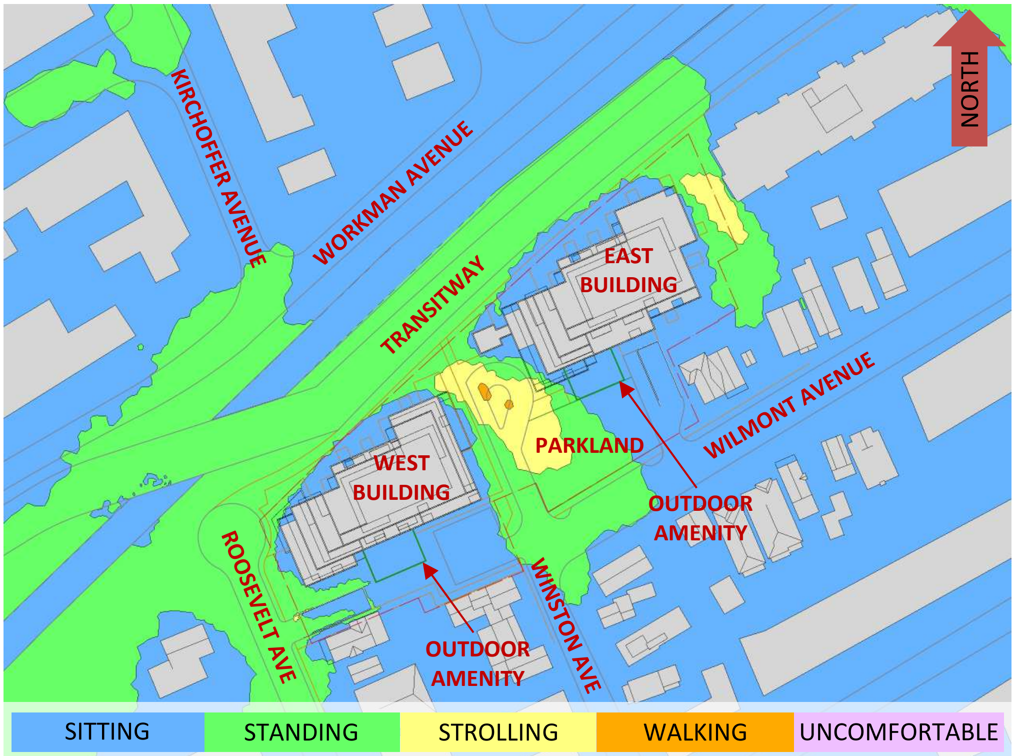


FIGURE 5A: AUTUMN – WIND COMFORT, GRADE LEVEL – PROPOSED MASSING

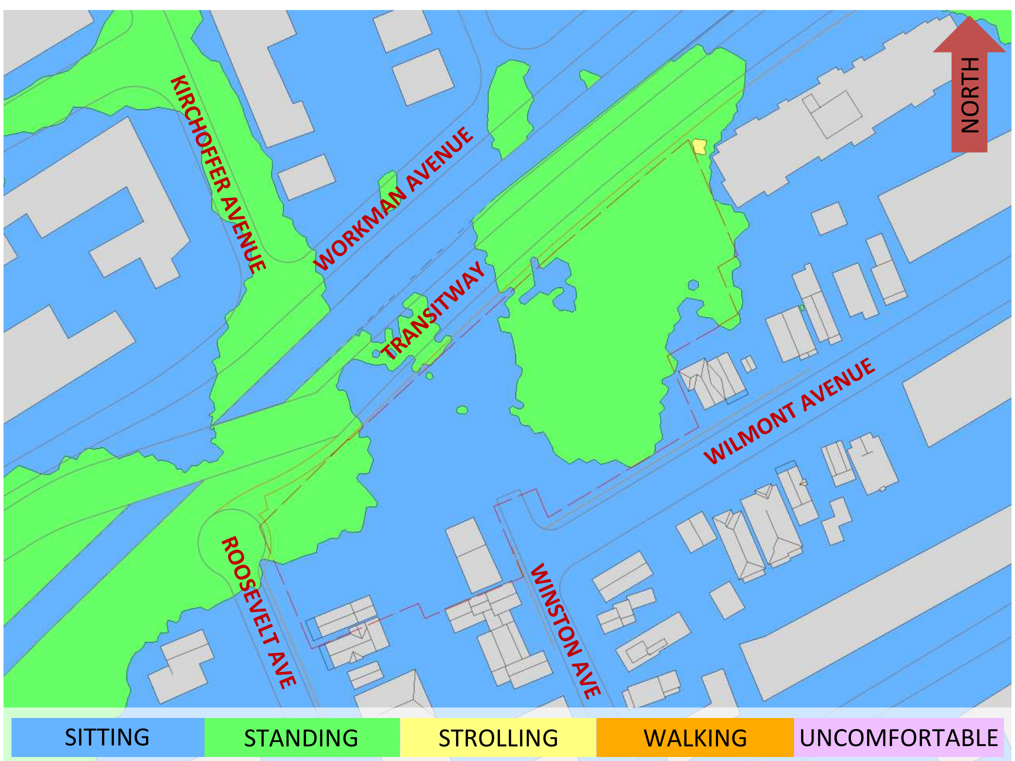


FIGURE 5B: AUTUMN – WIND COMFORT, GRADE LEVEL– EXISTING MASSING

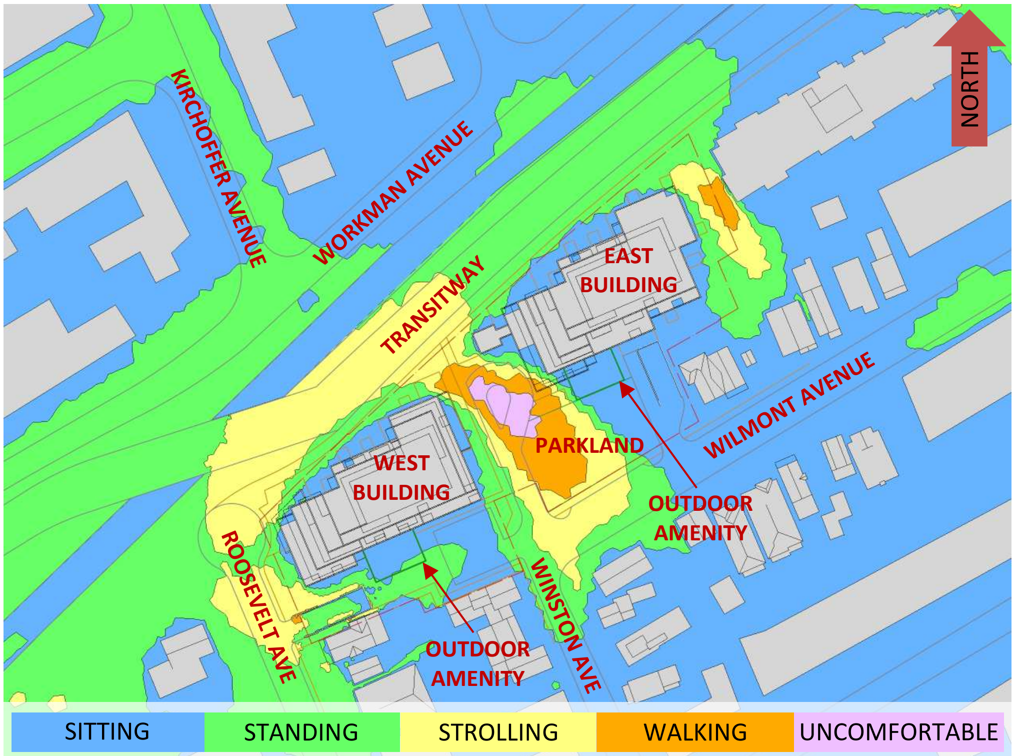


FIGURE 6A: WINTER – WIND COMFORT, GRADE LEVEL – PROPOSED MASSING

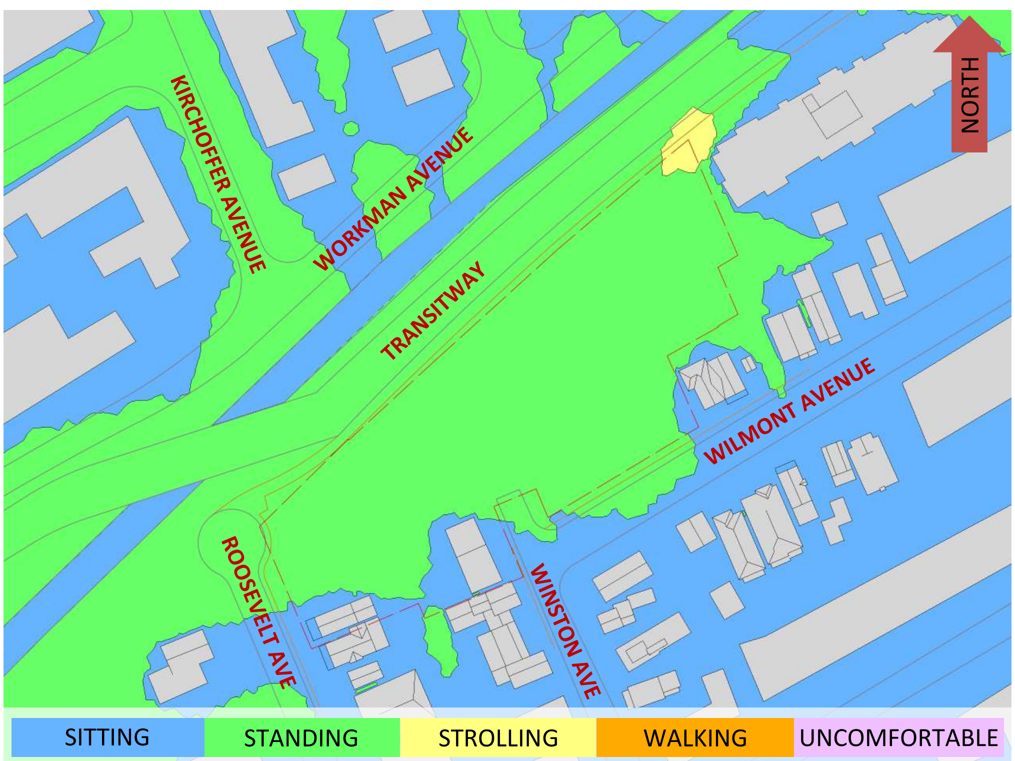


FIGURE 6B: WINTER – WIND COMFORT, GRADE LEVEL– EXISTING MASSING

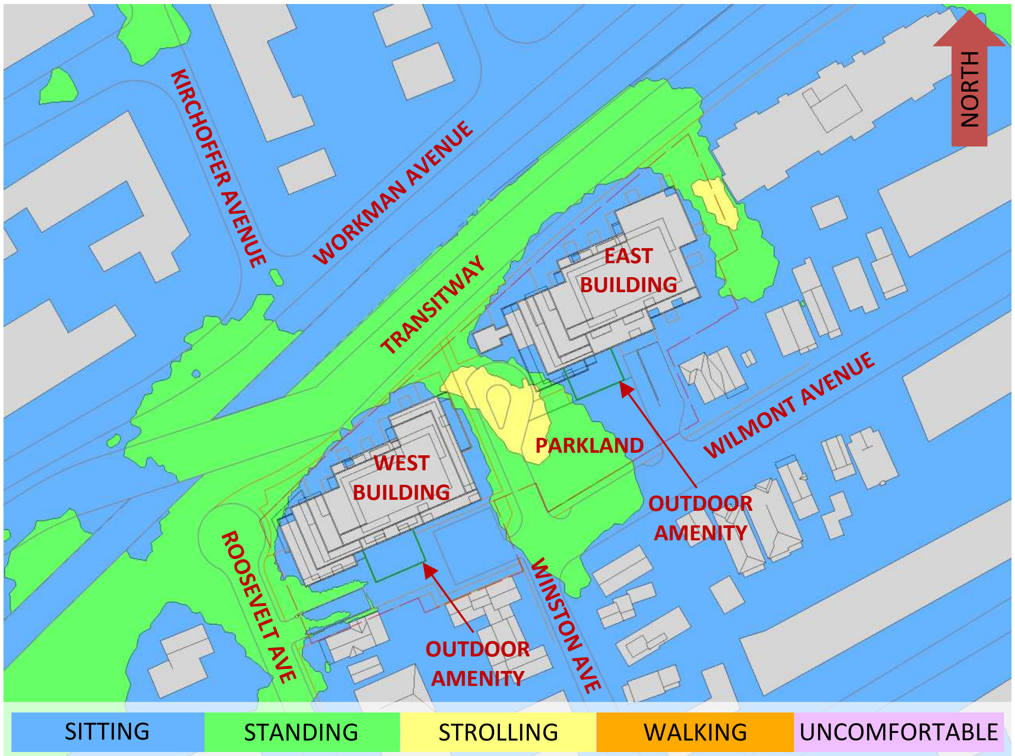


FIGURE 7: TYPICAL USE PERIOD – WIND COMFORT, GRADE LEVEL – PROPOSED MASSING

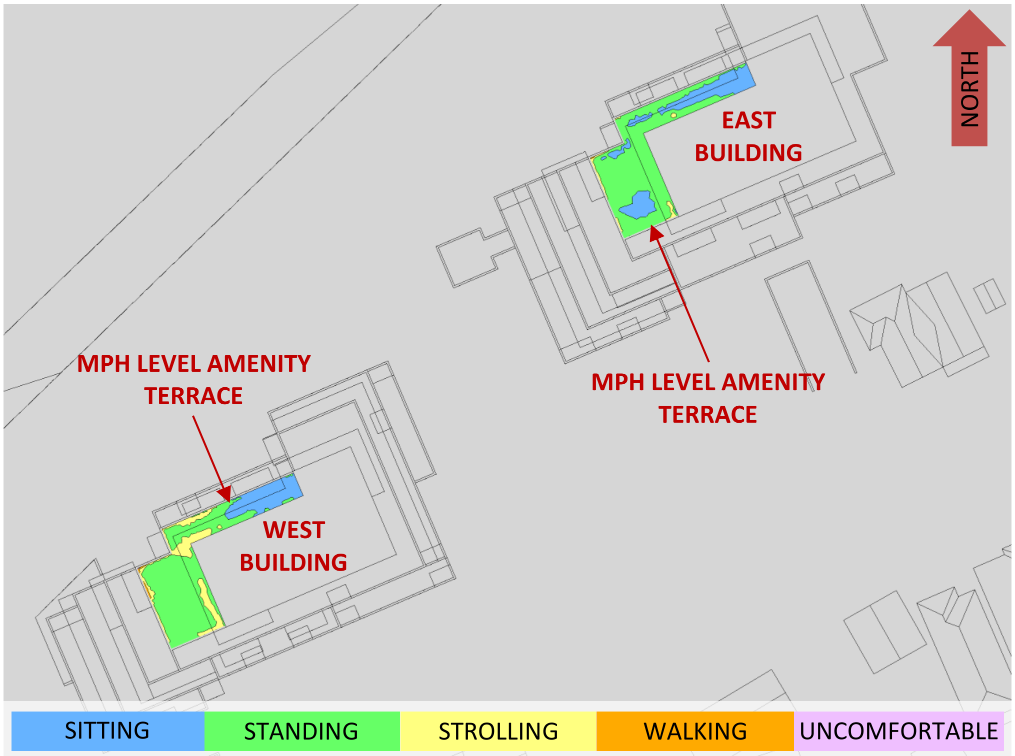


FIGURE 8A: SPRING – WIND COMFORT, MPH LEVEL COMMON AMENITY TERRACES

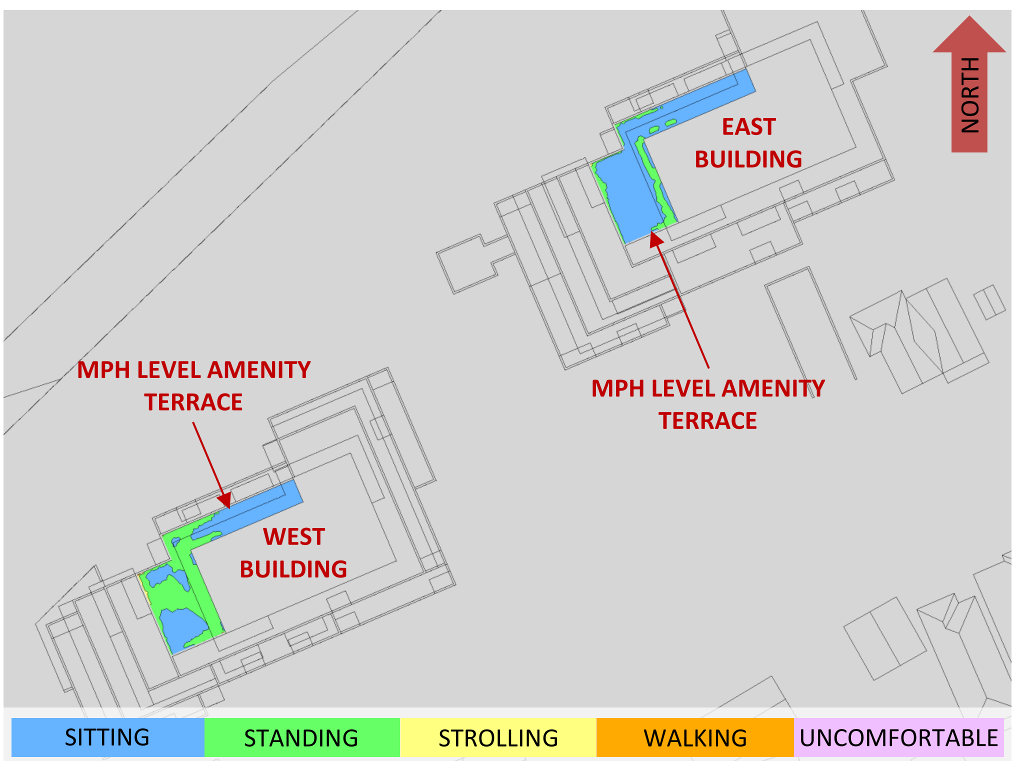


FIGURE 8B: SUMMER – WIND COMFORT, MPH LEVEL COMMON AMENITY TERRACES

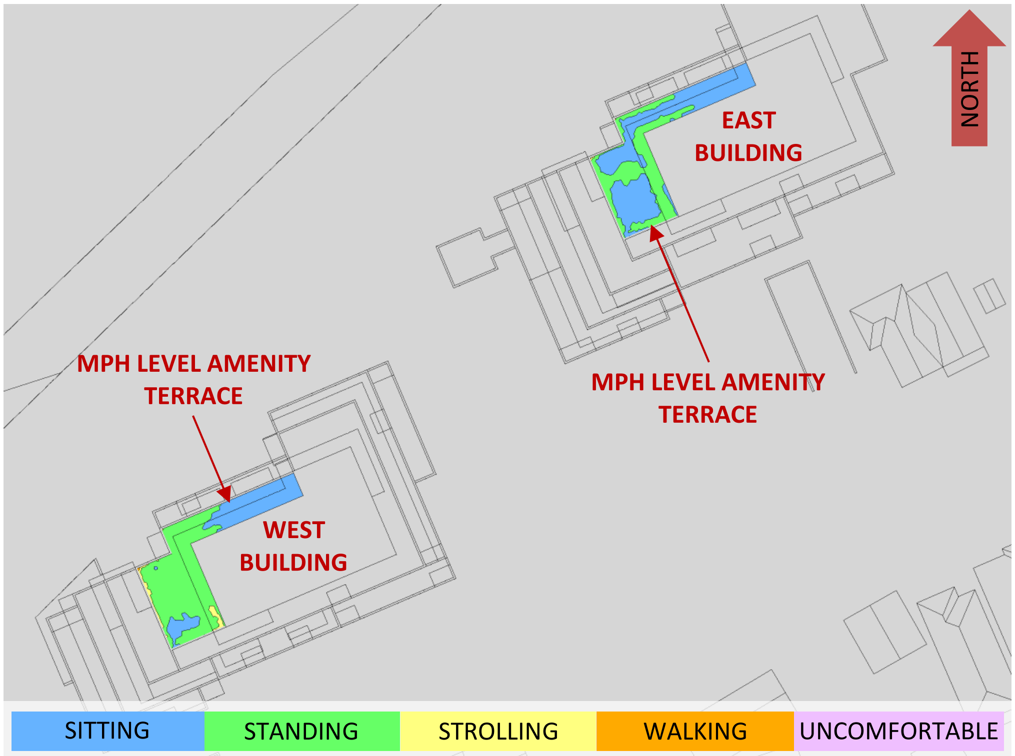


FIGURE 8C: AUTUMN – WIND COMFORT, MPH LEVEL COMMON AMENITY TERRACES

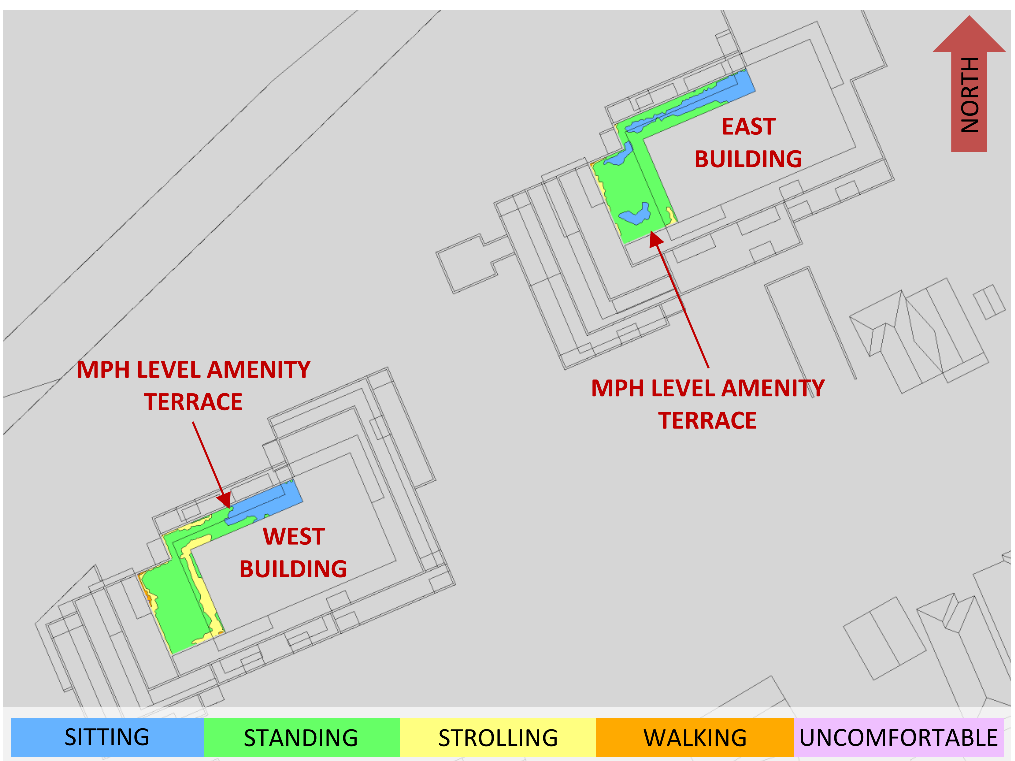


FIGURE 8D: WINTER – WIND COMFORT, MPH LEVEL COMMON AMENITY TERRACES

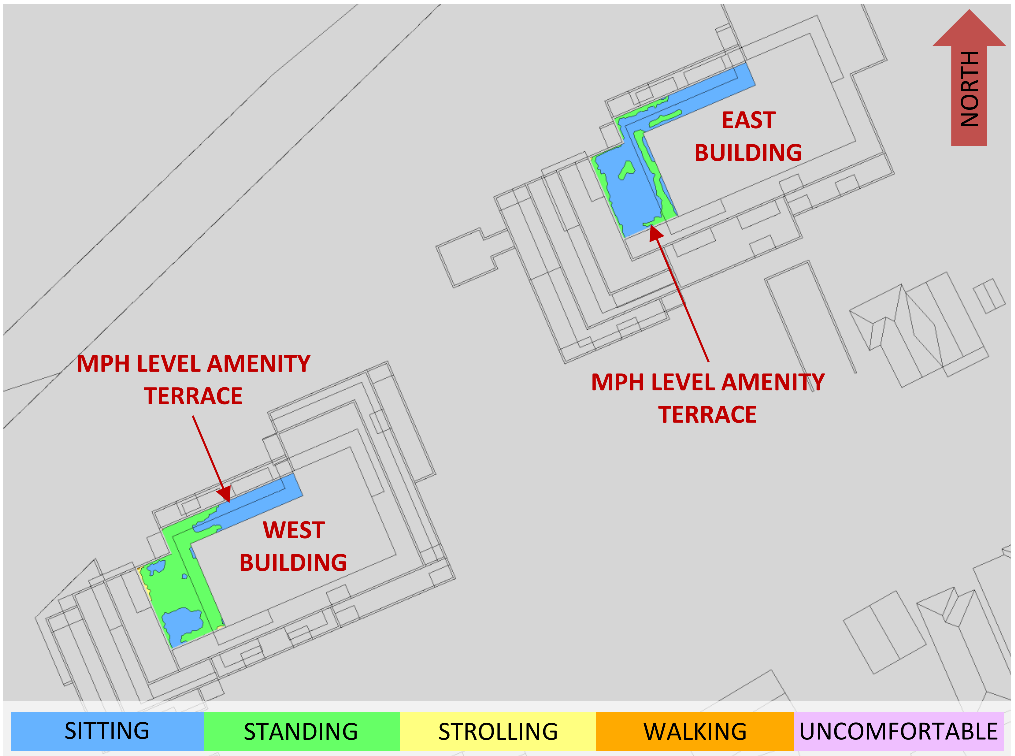
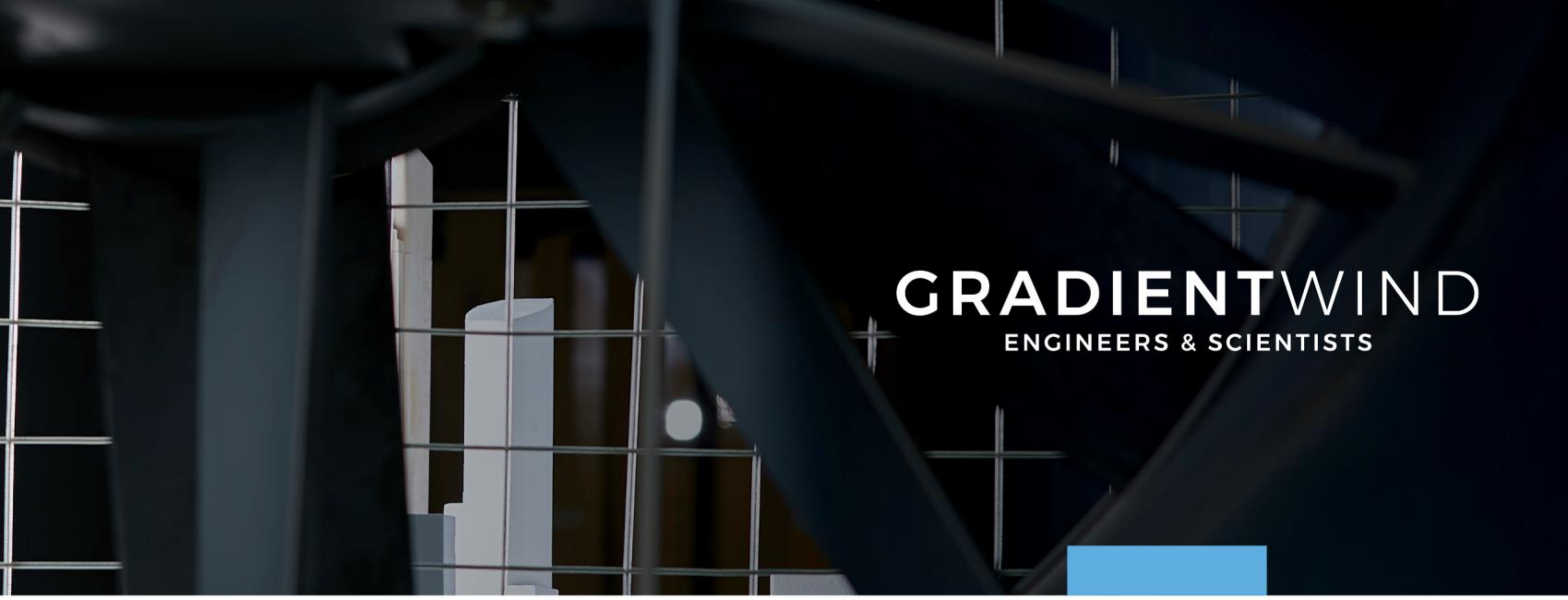
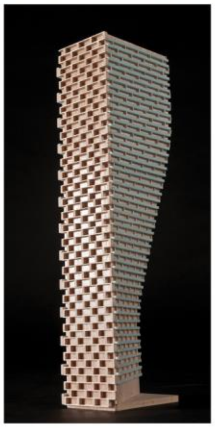
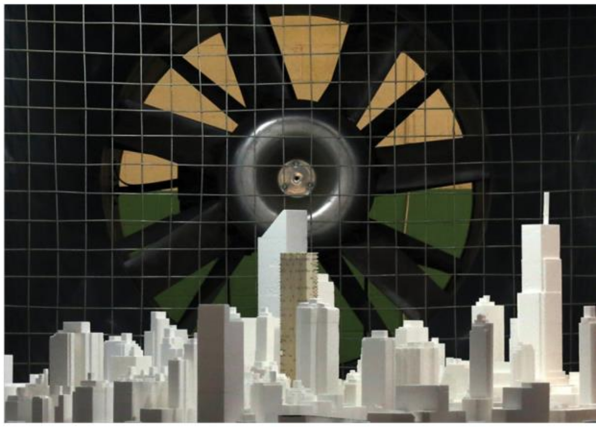


FIGURE 9: TYPICAL USE PERIOD – MPH LEVEL COMMON AMENITY TERRACES







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).

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

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 (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 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	0.20
22.5	0.22
45	0.24
67.5	0.26
90	0.25
112.5	0.25
135	0.25
157.5	0.25
180	0.25
202.5	0.24
225	0.21
247.5	0.15
270	0.18
292.5	0.18
315	0.18
337.5	0.20

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).

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

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

where, $\boldsymbol{I}$ = turbulence intensity, $\boldsymbol{L_t}$ = turbulence length scale, $\boldsymbol{Z}$ = 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.