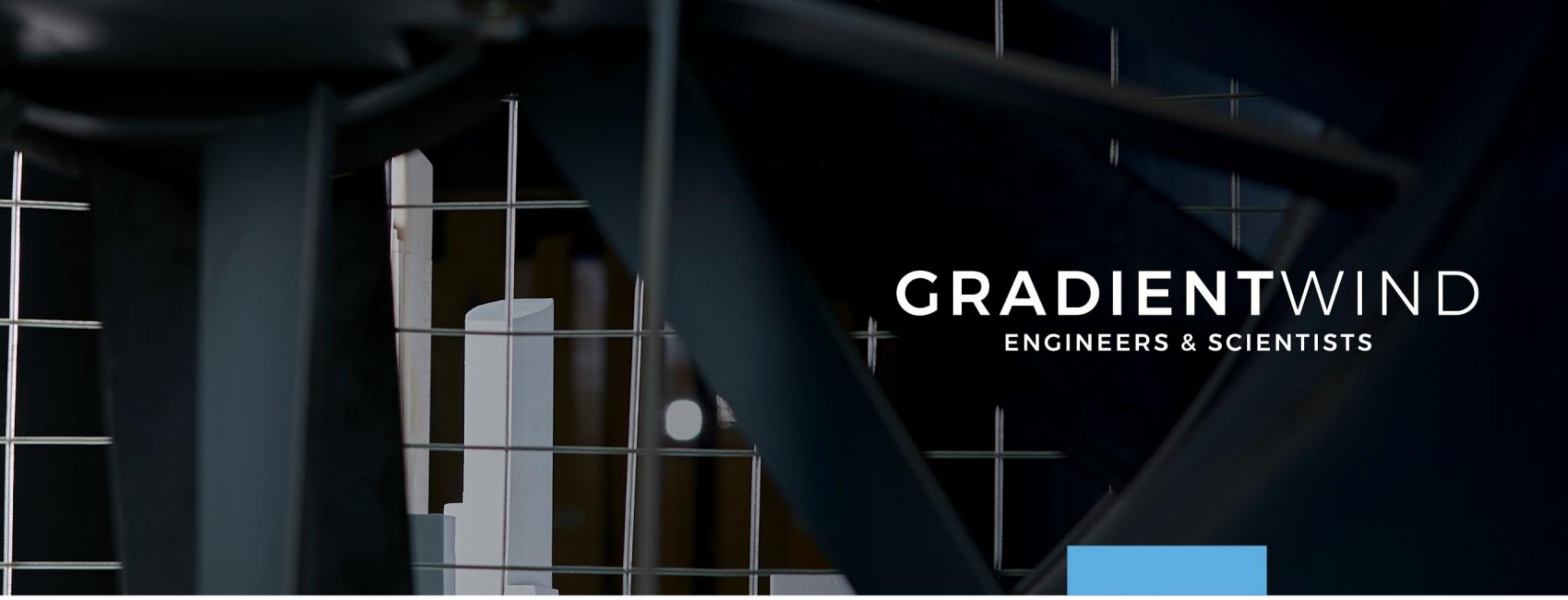
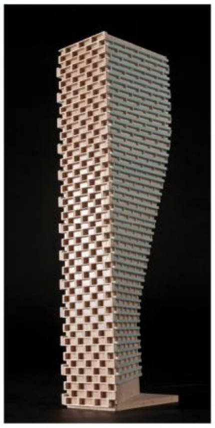


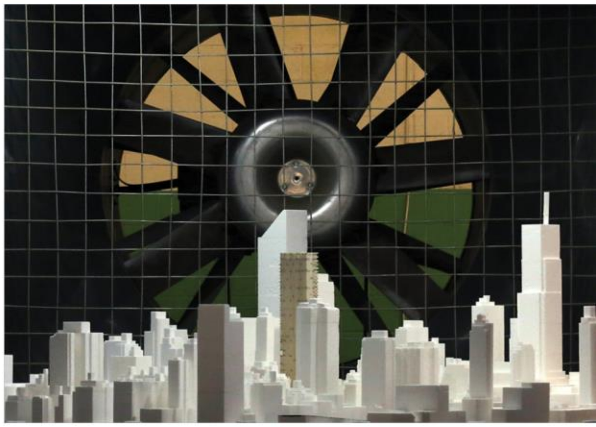
GRADIENTWIND
ENGINEERS & SCIENTISTS

PEDESTRIAN LEVEL WIND STUDY

780 Baseline Road
Ottawa, Ontario

Report: 22-062-PLW-2023





June 1, 2023

PREPARED FOR
780 Baseline Inc.
1600 Laperriere Avenue
Ottawa, ON K1Z 8P5

PREPARED BY
David Huitema, M.Eng., Wind Scientist
Justin Ferraro, P.Eng., Principal

EXECUTIVE SUMMARY

This report describes a pedestrian level wind (PLW) study undertaken to satisfy Site Plan Control application requirements for Phase 1 of the proposed mixed-use development at 780 Baseline Road 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) 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, walkways, transit stops, surface parking, and in the vicinity of building access points, are considered acceptable. A sole exception is as follows:

    a. Conditions over the proposed park at the southwest corner of the subject site are predicted to be suitable for a mix of sitting and standing during the typical use period. Depending on programming, the noted conditions may be considered acceptable. Specifically, if the windier areas of the proposed park will not accommodate seating or lounging activities, the noted conditions would be considered acceptable.

    b. If required by programming, comfort levels may be improved with targeted wind barriers installed to the north and east of sensitive areas. Wind barriers could take the form of wind screens, clusters of coniferous trees in dense arrangements, or a combination of both options, in combination with other local wind mitigation.

2) Regarding the balconies adjoining the office space at Level 2, conditions during the typical use period are calm and are considered acceptable. Conditions within the MPH Level terrace are suitable for sitting over most the terrace during the same period, with limited standing conditions primarily along the north elevation of the MPH, where they are also suitable for sitting for at least 78% of the typical use period, where the target is 80% to achieve the sitting comfort class. These conditions may be considered acceptable. Notably, the MPH terrace was modelled with a 1.8-m-tall wind screen around the full perimeter of the terrace.

3) Regarding the common amenity terrace serving the proposed development atop the podium at Level 5, wind comfort conditions during the typical use period are predicted to be suitable for mostly sitting, with limited areas of conditions suitable for standing at the east end of the terrace. Where conditions are suitable for standing, they are also suitable for sitting for at least 76% of the time during the same period, where the target is 80% to achieve the sitting comfort class. Notably, the Level 5 terrace was modelled with a 1.8-m-tall wind screen around its full perimeter.

    a. Depending on programming, the noted conditions may be considered acceptable. Specifically, if the east end of the terrace will not accommodate seating or more sedentary activities, the noted conditions may be considered acceptable.

    b. If required by programming, conditions suitable for sitting may be extended over the full terrace area by implementing targeted mitigation inboard of the perimeter of the terrace, which may take the form of tall wind screens around sensitive areas, rising to at least 1.8 m above the local walking surface, in combination with clusters of plantings in dense arrangements and canopies located above designated seating areas.

    c. The extent of mitigation is dependant on the programming of the terrace. If necessary, an appropriate mitigation strategy will be developed in collaboration with the building and landscape architects as the design of the development progresses.

4) 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 780 Baseline Inc. to undertake a pedestrian level wind (PLW) study to satisfy Site Plan Control application requirements for Phase 1 of the proposed mixed-use development at 780 Baseline Road in Ottawa, Ontario (hereinafter referred to as "subject site" or "proposed development"). A PLW study was previously conducted in May 2022 to satisfy Zoning By-Law Amendment application requirements for the proposed development[1]. 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.

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 RLA Architecture in May 2023, 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 780 Baseline Road in Ottawa, situated on a parcel of land at the southwest intersection of Baseline Road and Fisher Avenue. The proposed development comprises the first phase of a three-phase development. To the southeast, Phase 1 comprises "Tower A" rising to 24-storeys above a 'U'-shaped four-storey podium and proposed park at the southwest corner that fronts Hillard Avenue. Phase 2 includes a 'C'-shaped 24-storey "Tower B" situated to the northwest, and Phase 3 includes an 'L'-shaped 32-storey "Tower C" to the northeast of the subject site. Tower A is topped with a mechanical penthouse (MPH) and is served by two below-grade parking levels.

The ground floor of Tower A is divided into eastern and western wings, divided by a single-storey central north-south passageway. The first floor of the western wing is comprised of residential units, with a garbage space and a rental office at the northeast corner, and a ramp to the underground parking along the east elevation, accessed via a laneway from Fisher Avenue. The ground floor of the east wing

[1] Gradient Wind Engineering Inc., '*780 Baseline Road – Pedestrian Level Wind Study*', [May 9, 2022]

comprises retail fronting Fisher Avenue to the east, a garbage room to the southwest, a central office, and the building lobby to the northwest. Level 2 is comprised of an office space along the west elevation of the east wing with adjoining balconies to the east and southwest, while the remainder of the level is comprised of residential units. Levels 3-4 and 6-24 are reserved for residential use. At Level 5, which is comprised of an indoor amenity to the west and residential units throughout the remainder of the level, the building steps back to the east to accommodate an outdoor amenity terrace. The building steps back from the west and east elevations at Levels 4 and 5, respectively, to accommodate private terraces. At Levels 21 and 23, the building steps back from the southeast, south, and southwest elevations and from the northeast and northwest corners, respectively, to accommodate private terraces. The MPH level includes an indoor amenity to the north adjoining a common amenity terrace along the northeast, north, and northwest elevations of the level.

The near-field surroundings (defined as an area within 200 m of the subject site) include low-rise residential buildings from the northeast clockwise to the west, the existing strip mall followed by the open fields of the Central Experimental Farm from the west clockwise to the northeast. 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 massing from the northeast clockwise to the west-southwest, the open fields of the Central Experimental farm followed by low-rise massing from the west clockwise to the north-northwest, and the open fields of the Central Experimental Farm from the north clockwise to the northeast, with isolated mid- and high-rise buildings to the north, east, south, and from the southwest clockwise to the northwest.

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 changes 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 study 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 study site on the surrounding model, and to create suitable atmospheric wind profiles at the model boundary. The wind profiles are designed to have similar mean and turbulent wind properties consistent with actual site exposures.

An industry standard practice is to omit trees, vegetation, and other existing and planned landscape elements from the model due to the difficulty of providing accurate seasonal representation of vegetation. The omission of trees and other landscaping elements produces slightly 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 12 wind directions. The CFD simulation model was centered on the study building, complete with surrounding massing within a radius of 480 m. The process was performed for two context massing scenarios, as noted in Section 2.

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

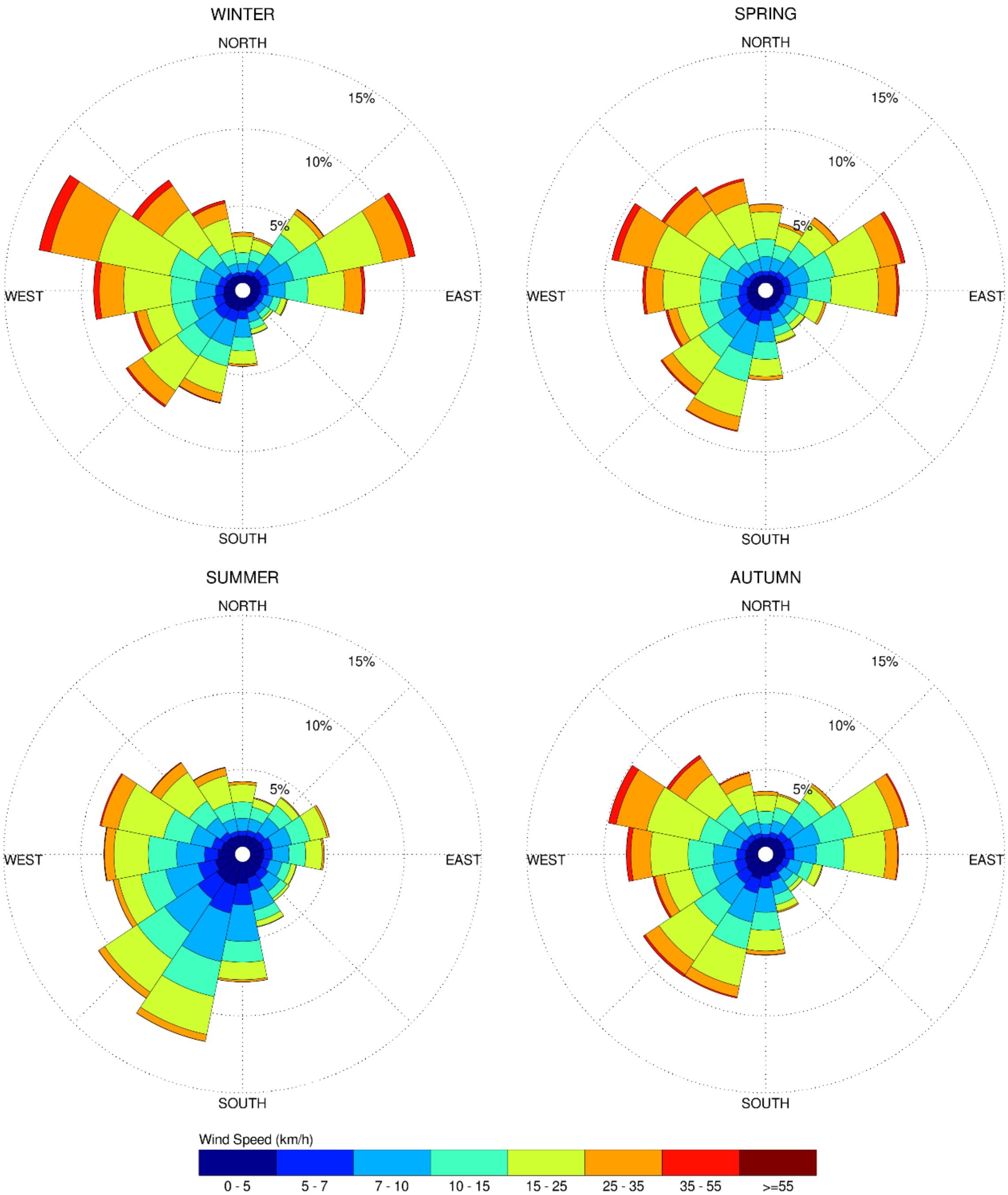
Mean and peak wind speed data obtained over the study site for each wind direction were interpolated to 36 wind directions at 10° intervals, representing the full compass azimuth. Measured wind speeds approximately 1.5 m above local grade and the common amenity terraces serving the proposed development 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 comfort and safety criteria are based on the mechanical effects of wind without consideration of other meteorological conditions (that is, temperature, relative humidity). The comfort criteria assume that pedestrians are appropriately dressed for a specified outdoor activity during any given season. Five pedestrian comfort classes are based on 20% non-exceedance mean wind speed ranges, which include (1) Sitting; (2) Standing; (3) Strolling; (4) Walking; and (5) Uncomfortable. More specifically, the comfort classes and associated mean wind speed ranges are summarized as follows:

1) **Sitting:** 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.

2) **Standing:** 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.

3) **Strolling:** 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.

4) **Walking:** 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.

5) **Uncomfortable:** 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.

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. The gust speeds, and equivalent mean speeds, are selected based on 'The Beaufort Scale', presented on the following page, which describes the effects of forces produced by varying wind speed levels on objects. Gust speeds are included because 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.

THE BEAUFORT SCALE

Number	Description	Gust Wind Speed (km/h)	Description
2	Light Breeze	9-17	Wind felt on faces
3	Gentle Breeze	18-29	Leaves and small twigs in constant motion; wind extends light flags
4	Moderate Breeze	30-42	Wind raises dust and loose paper; small branches are moved
5	Fresh Breeze	43-57	Small trees in leaf begin to sway
6	Strong Breeze	58-74	Large branches in motion; Whistling heard in electrical wires; umbrellas used with difficulty
7	Moderate Gale	75-92	Whole trees in motion; inconvenient walking against wind
8	Gale	93-111	Breaks twigs off trees; generally impedes progress

Experience and research on people's perception of mechanical wind effects has shown that if the wind speed levels are exceeded for more than 20% of the time, the activity level would be judged to be uncomfortable by most people. For instance, if 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 site, the assessment of pedestrian comfort involves determining the suitability of the predicted wind conditions for discrete regions within and surrounding the subject site. This step involves comparing the predicted comfort classes to the desired comfort classes, which are dictated by the location type for each region (that is, a sidewalk, building entrance, amenity space, or other). An overview of common pedestrian location types and their typical windiest desired comfort classes are summarized on the following page. Depending on the programming of a space, the desired comfort class may differ from this table.

DESIRED PEDESTRIAN COMFORT CLASSES FOR VARIOUS LOCATION TYPES

Location Types	Desired 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, illustrating wind conditions over the common amenity terraces serving the proposed development at Levels 2 and 5 and at the MPH Level. Conditions are presented as continuous contours of wind comfort throughout the subject site and correspond to the comfort classes presented in Section 4.4. 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.

Wind comfort conditions at grade level and over the noted common amenity terraces 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 common amenity terraces, 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

Sidewalks along Sunnycrest Drive, Hillard Avenue, and Kesler Avenue: Following the introduction of the proposed development, the nearby public sidewalks along Sunnycrest Drive, Hillard Avenue, and Keslar Avenue are predicted to be suitable for standing, or better, during the summer and autumn, becoming suitable for strolling, or better, during the winter and spring. The noted conditions are considered acceptable according to the City of Ottawa Terms of Reference.

Wind conditions over the noted sidewalks with the existing massing 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. While the introduction of the proposed development produces windier conditions over the noted sidewalks in comparison to existing conditions, wind comfort conditions with the proposed development are nevertheless considered acceptable.

Existing Surface Parking North of the Subject Site: Following the introduction of the proposed development, wind conditions during the summer over the existing parking lot serving the strip mall to the north of the proposed development are predicted to be suitable for sitting to the south and east of the mall and suitable for a mix of sitting and standing elsewhere. During the spring, autumn, and winter, conditions within the parking lot are predicted to be suitable for a mix of sitting and standing, with some areas suitable for strolling. The noted conditions are considered acceptable according to the City of Ottawa Terms of Reference.

Wind conditions over the noted surface parking lot with the existing massing are predicted to be suitable for a mix of sitting and standing during the summer and autumn, becoming suitable for a mix of sitting, standing, and strolling throughout the remainder of the year. While the introduction of the proposed development produces windier conditions over the noted surface parking lot in comparison to existing conditions, wind comfort conditions with the proposed development are nevertheless considered acceptable.

Sidewalks and Transit Stops along Baseline Road: Following the introduction of the proposed development, the nearby public sidewalks along Baseline Road are predicted to be suitable for a mix of sitting and standing during the summer, becoming suitable for strolling, or better, during the autumn, and suitable for a mix of standing and strolling during the winter and spring with walking conditions at the northeast corner of Tower A during the spring and at the northeast and southeast corners of Tower A and along the east elevation of Baseline Road during the winter. Conditions over the nearby transit stops along Baseline Road are predicted to be suitable for standing, or better, throughout the year. The noted conditions are considered acceptable according to the City of Ottawa Terms of Reference.

Wind conditions over the nearby sidewalks along Baseline Road with the existing massing are predicted to be suitable for sitting during the summer, becoming suitable for a mix of sitting and standing during the spring, autumn, and winter. Conditions over the nearby transit stops along Baseline Road are predicted to be mostly suitable for sitting during the summer and autumn, and suitable for standing, or better, during the spring and winter. While the introduction of the proposed development produces windier conditions over the noted areas in comparison to existing conditions, wind comfort conditions with the proposed development are nevertheless considered acceptable.

Walkways and Surface Parking within Subject Site: Wind conditions over the walkways throughout the subject site are predicted to be suitable for standing, or better, during the summer, becoming suitable for strolling, or better, throughout the remainder of the year, with conditions suitable for walking over the proposed laneway beneath the single-storey overhang at the southeast corner of Tower A. Conditions over the surface parking between the east and west wings at grade are predicted to be suitable for a mix of sitting and standing during the summer, becoming suitable for standing during the autumn, and suitable for a mix of standing and strolling during the spring and winter. The noted conditions are considered acceptable according to the City of Ottawa Terms of Reference.

Proposed Park: Wind conditions over the proposed park are predicted to be suitable for a mix of sitting and standing during the typical use period. Where conditions are predicted to be suitable for standing, they are also predicted to be suitable for sitting for at least 73% of the time during the same period, where the target is 80% to achieve the sitting comfort class.

Depending on programming, the noted conditions may be considered acceptable. Specifically, if the windier areas will not accommodate seating or lounging activities, the noted conditions would be considered acceptable. If required by programming, comfort levels may be improved with targeted wind barriers installed to the north and east of sensitive areas. Wind barriers could take the form of wind screens, clusters of coniferous trees in dense arrangements, or a combination of both options, in combination with other local wind mitigation.

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. The sole exception is the entrance to the garbage room at the northeast corner of the west wing, where conditions in the vicinity of the entrance are predicted to be suitable for standing during the summer and suitable for strolling, or better, throughout the remainder of the year. The noted conditions are considered acceptable according to the City of Ottawa Terms of Reference.

5.2 Wind Comfort Conditions – Common Amenity Terraces

The proposed development is served by common amenity terraces atop the podium at Level 5 and at the MPH Level, as well as two balconies adjoining the office space on Level 2. The Level 5 and MPH Level amenity terraces were modelled with 1.8-m-tall wind screens along their full perimeters.

Level 2 Office Balconies: As illustrated in Figure 9, wind comfort conditions within the Level 2 office balconies during the typical use period are predicted to be suitable for sitting, which is considered acceptable according to the City of Ottawa Terms of Reference.

Level 5 Common Amenity Terrace: With the perimeter wind screen wind mitigation described in the introductory paragraph, wind conditions over the common amenity terrace serving the proposed development at Level 5 are predicted to be suitable for mostly sitting, with limited areas of conditions suitable for standing to the east of the terrace. Where conditions are suitable for standing, they are also suitable for sitting for at least 76% of the time during the same period, where the target is 80% to achieve the sitting comfort class.

Depending on programming, 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. If required by programming, sitting conditions may be extended around sensitive areas with targeted mitigation inboard of the terrace perimeters. This inboard mitigation could take the form of tall wind screens, rising to at least 1.8 m above the local walking surface, or clusters of coniferous plantings in dense arrangements located around sensitive areas, and canopies located above designated seating areas.

The extent of mitigation is dependant on the programming of the terrace. If necessary, an appropriate mitigation strategy will be developed in collaboration with the building and landscape architects as the design of the development progresses.

MPH Level Terrace: With the perimeter wind screen wind mitigation described in the introductory paragraph, wind conditions within the amenity terrace at the MPH Level are predicted to be suitable for mostly sitting during the typical use period, with limited regions of standing conditions along the north façade of the MPH and a small, isolated region at the southwest corner of the terrace. Where conditions are suitable for standing, they are also suitable for sitting for at least 78% of the time during the same period, where the target is 80% to achieve the sitting comfort class. As conditions are suitable for sitting over most of the terrace and the exceedance of the sitting comfort class is considered minor, conditions within the terrace may be considered acceptable.

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, walkways, transit stops, surface parking, and in the vicinity of building access points, are considered acceptable. A sole exception is as follows:

    a. Conditions over the proposed park at the southwest corner of the subject site are predicted to be suitable for a mix of sitting and standing during the typical use period. Depending on programming, the noted conditions may be considered acceptable. Specifically, if the windier areas of the proposed park will not accommodate seating or lounging activities, the noted conditions would be considered acceptable.

    b. If required by programming, comfort levels may be improved with targeted wind barriers installed to the north and east of sensitive areas. Wind barriers could take the form of wind screens, clusters of coniferous trees in dense arrangements, or a combination of both options, in combination with other local wind mitigation.

2) Regarding the balconies adjoining the office space at Level 2, conditions during the typical use period are calm and are considered acceptable. Conditions within the MPH Level terrace are suitable for sitting over most the terrace during the same period, with limited standing conditions primarily along the north elevation of the MPH, where they are also suitable for sitting for at least 78% of the typical use period, where the target is 80% to achieve the sitting comfort class. These conditions may be considered acceptable. Notably, the MPH terrace was modelled with a 1.8-m-tall wind screen around the full perimeter of the terrace.

3) Regarding the common amenity terrace serving the proposed development atop the podium at Level 5, wind comfort conditions during the typical use period are predicted to be suitable for mostly sitting, with limited areas of conditions suitable for standing at the east end of the terrace.

Where conditions are suitable for standing, they are also suitable for sitting for at least 76% of the time during the same period, where the target is 80% to achieve the sitting comfort class. Notably, the Level 5 terrace was modelled with a 1.8-m-tall wind screen around its full perimeter.

a. Depending on programming, the noted conditions may be considered acceptable. Specifically, if the east end of the terrace will not accommodate seating or more sedentary activities, the noted conditions may be considered acceptable.

b. If required by programming, conditions suitable for sitting may be extended over the full terrace area by implementing targeted mitigation inboard of the perimeter of the terrace, which may take the form of tall wind screens around sensitive areas, rising to at least 1.8 m above the local walking surface, in combination with clusters of plantings in dense arrangements and canopies located above designated seating areas.

c. The extent of mitigation is dependant on the programming of the terrace. If necessary, an appropriate mitigation strategy will be developed in collaboration with the building and landscape architects as the design of the development progresses.

4) 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.

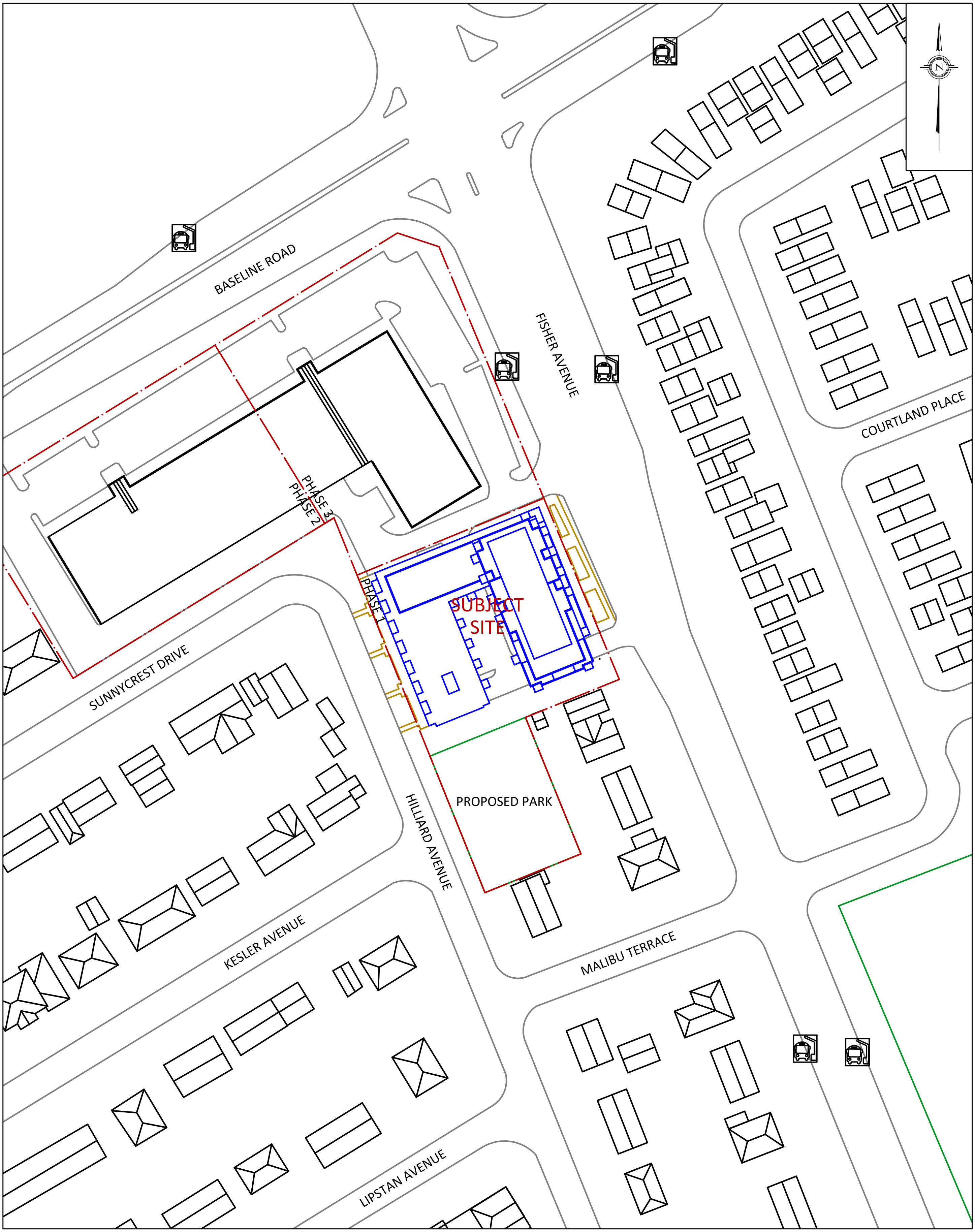
Sincerely,

Gradient Wind Engineering Inc.

LICENSED PROFESSIONAL ENGINEER
J. D. FERRARO
100158495
June 1, 2023
PROVINCE OF ONTARIO

David Huitema, M.Eng.
Wind Scientist

Justin Ferraro, P.Eng.
Principal



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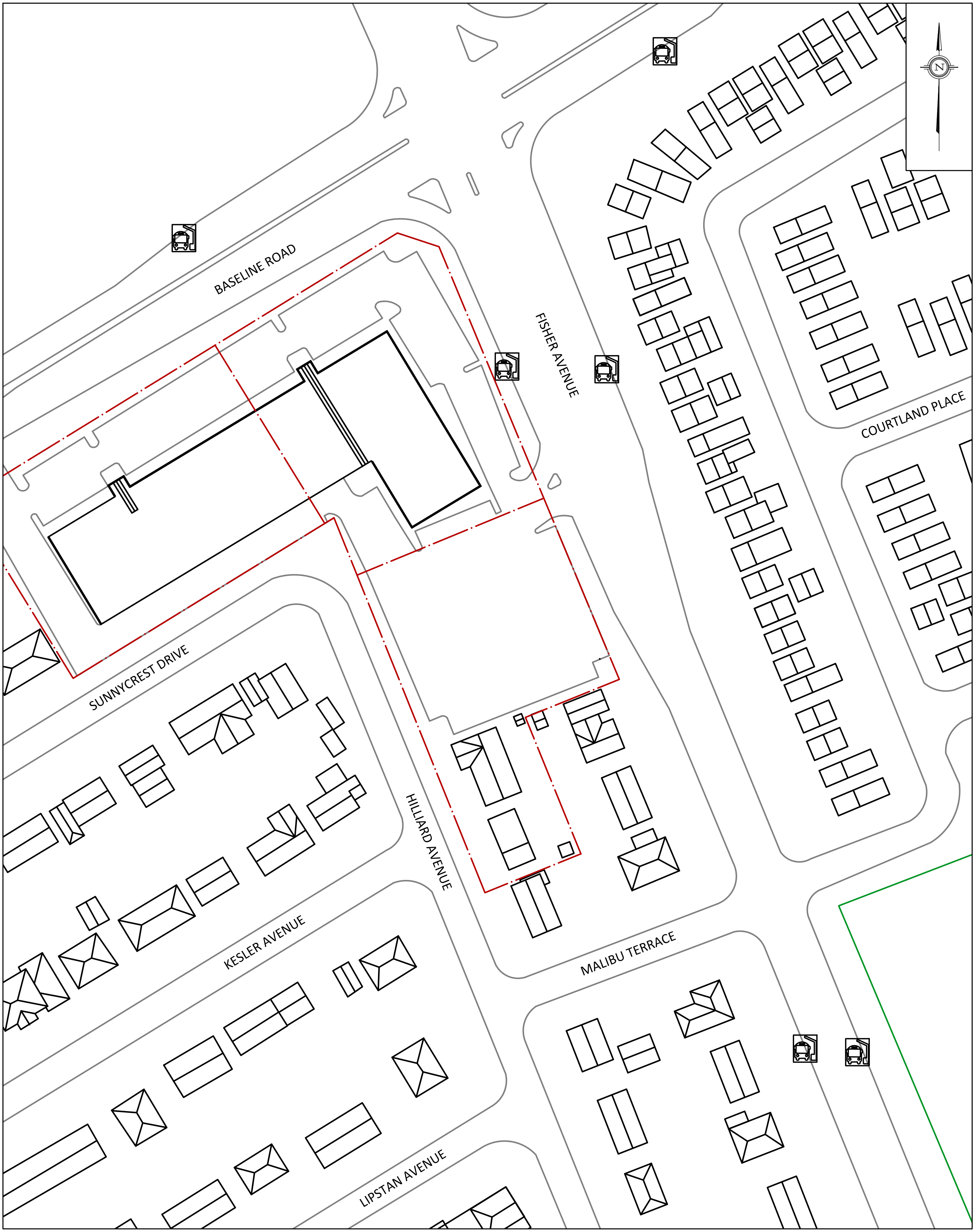
PROJECT: 780 BASELINE ROAD, OTTAWA PEDESTRIAN LEVEL WIND STUDY		DESCRIPTION: FIGURE 1A: PROPOSED SITE PLAN AND SURROUNDING CONTEXT
SCALE: 1:1500	DRAWING NO.: 22-062-PLW-2023-1A	
DATE: JUNE 1, 2023	DRAWN BY: T.K.	



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PROJECT: 780 BASELINE ROAD, OTTAWA PEDESTRIAN LEVEL WIND STUDY		DESCRIPTION: FIGURE 1B: EXISTING SITE PLAN AND SURROUNDING CONTEXT
SCALE: 1:1500	DRAWING NO.: 22-062-PLW-2023-1B	
DATE: JUNE 1, 2023	DRAWN BY: T.K.	

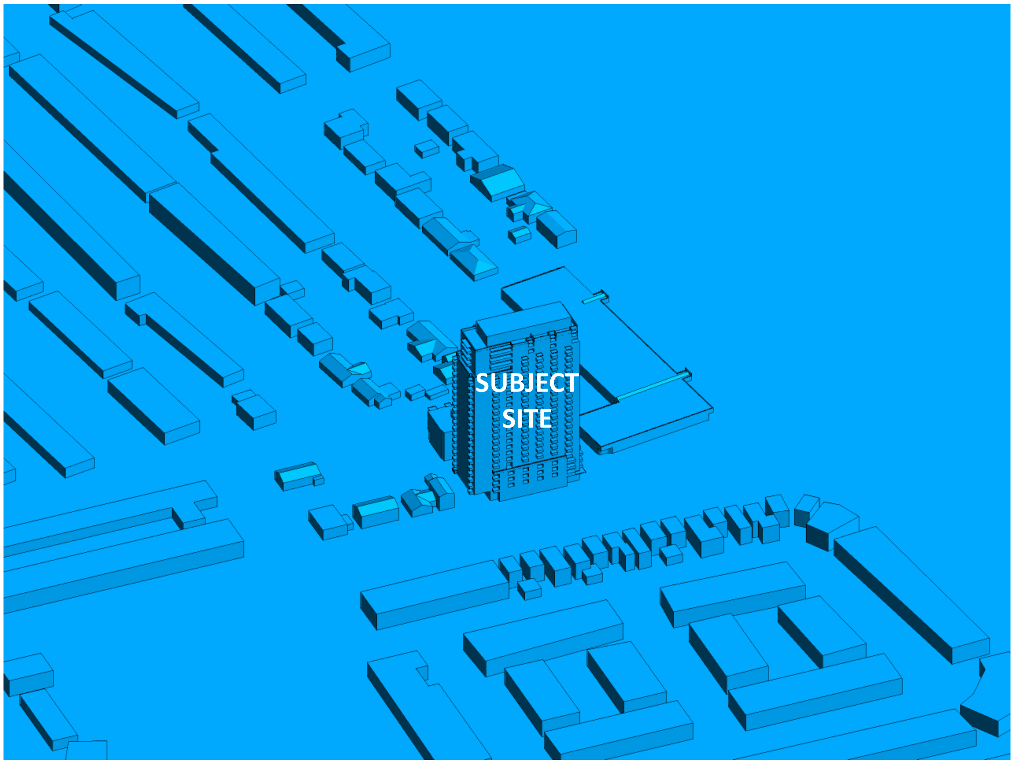

FIGURE 2A: COMPUTATIONAL MODEL, PROPOSED MASSING, EAST PERSPECTIVE

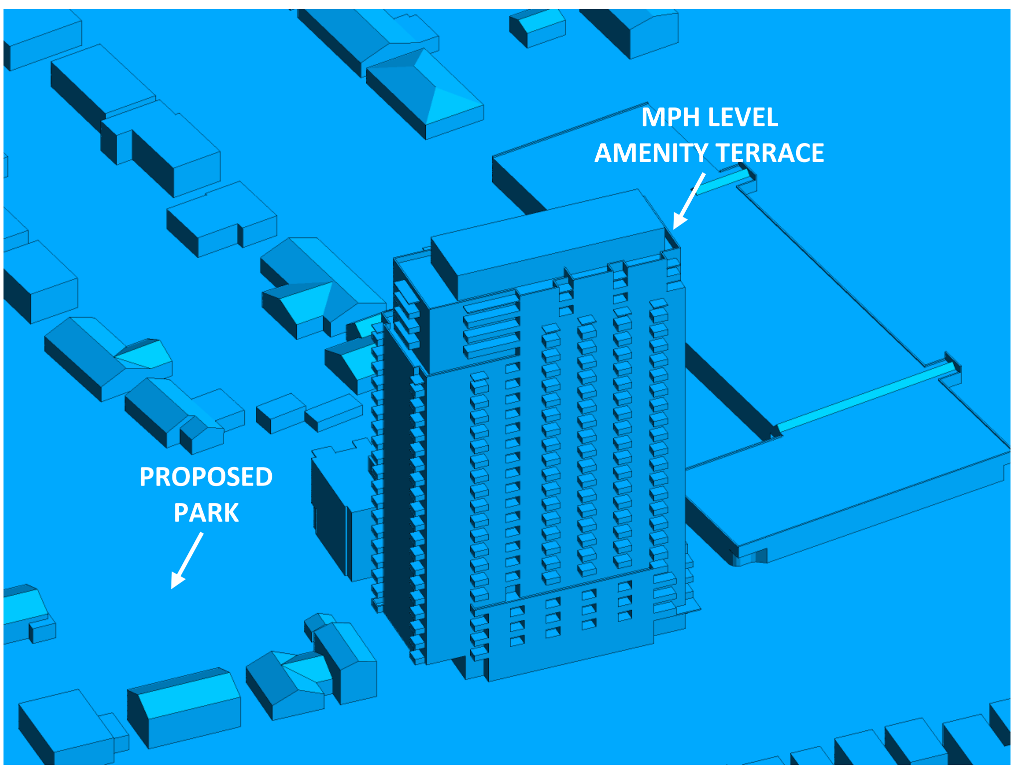

FIGURE 2B: CLOSE UP OF FIGURE 2A

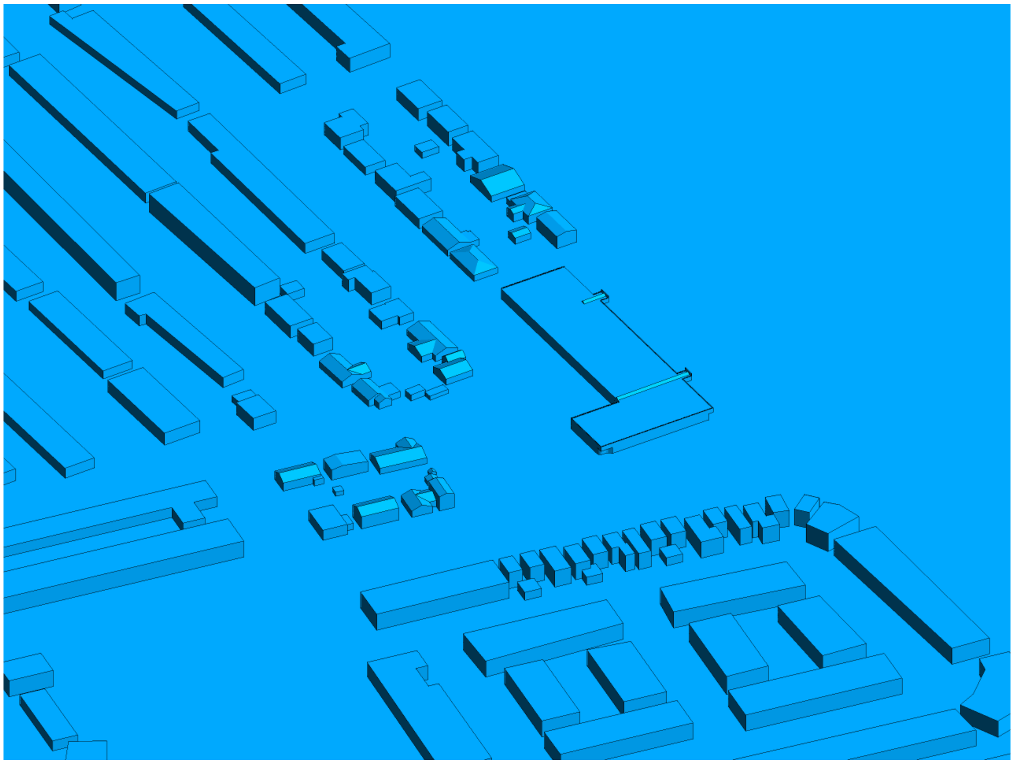

FIGURE 2C: COMPUTATIONAL MODEL, EXISTING MASSING, EAST PERSPECTIVE

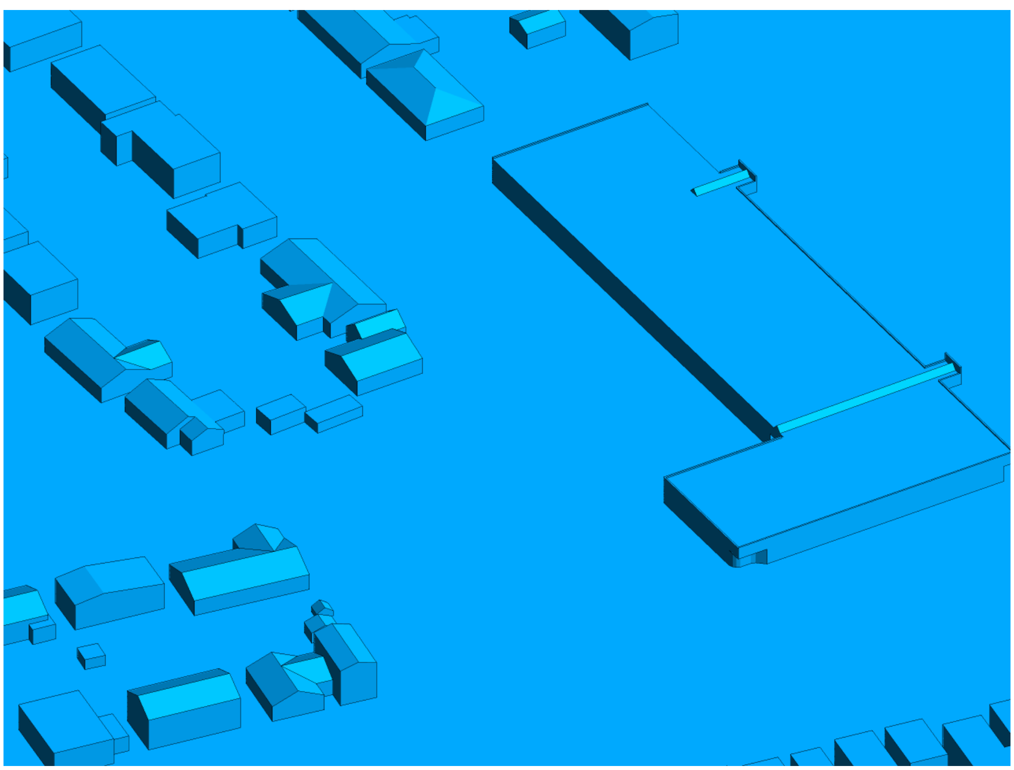

FIGURE 2D: CLOSE UP OF FIGURE 2C

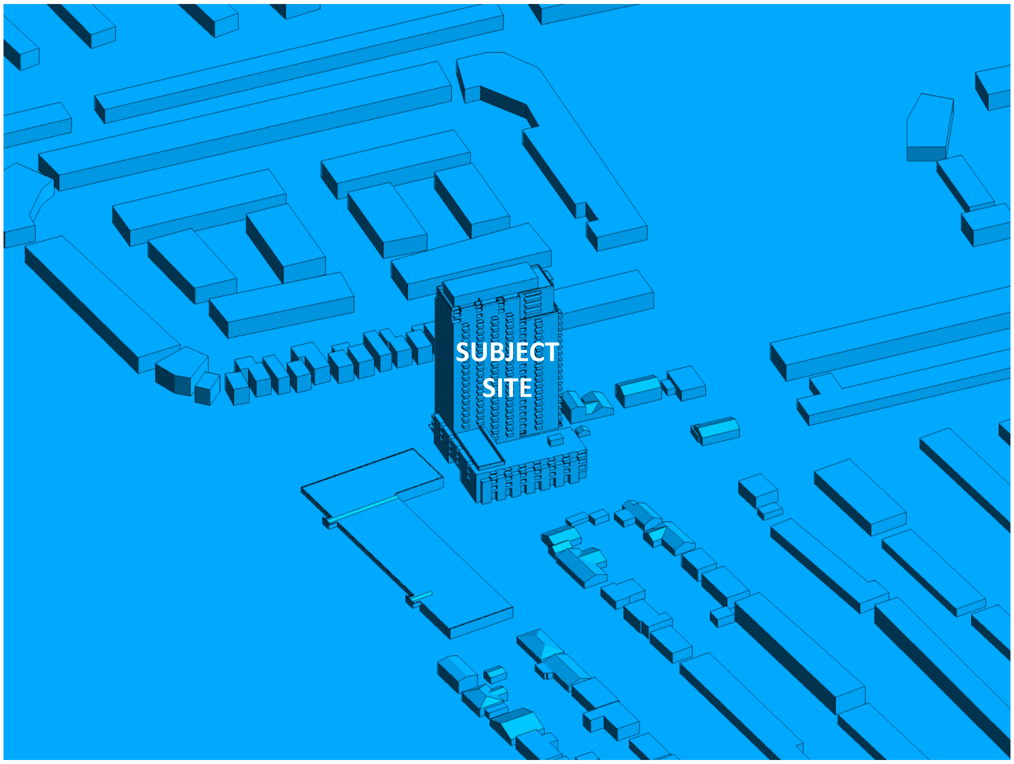

FIGURE 2E: COMPUTATIONAL MODEL, PROPOSED MASSING, WEST PERSPECTIVE

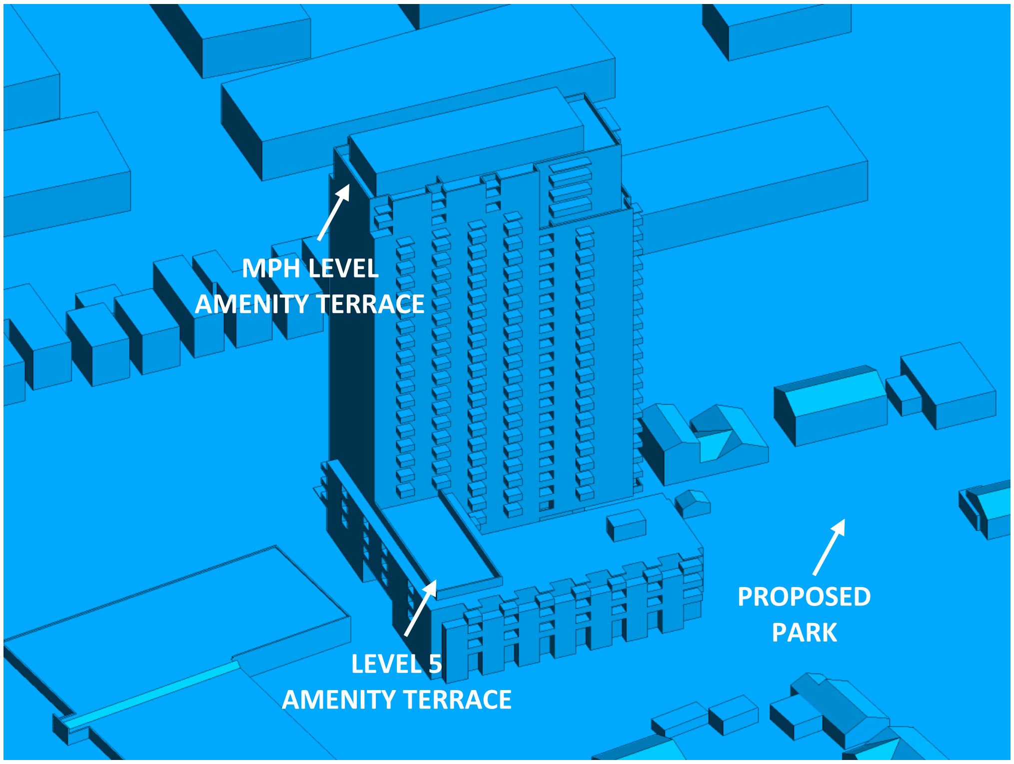

FIGURE 2F: CLOSE UP OF FIGURE 2E

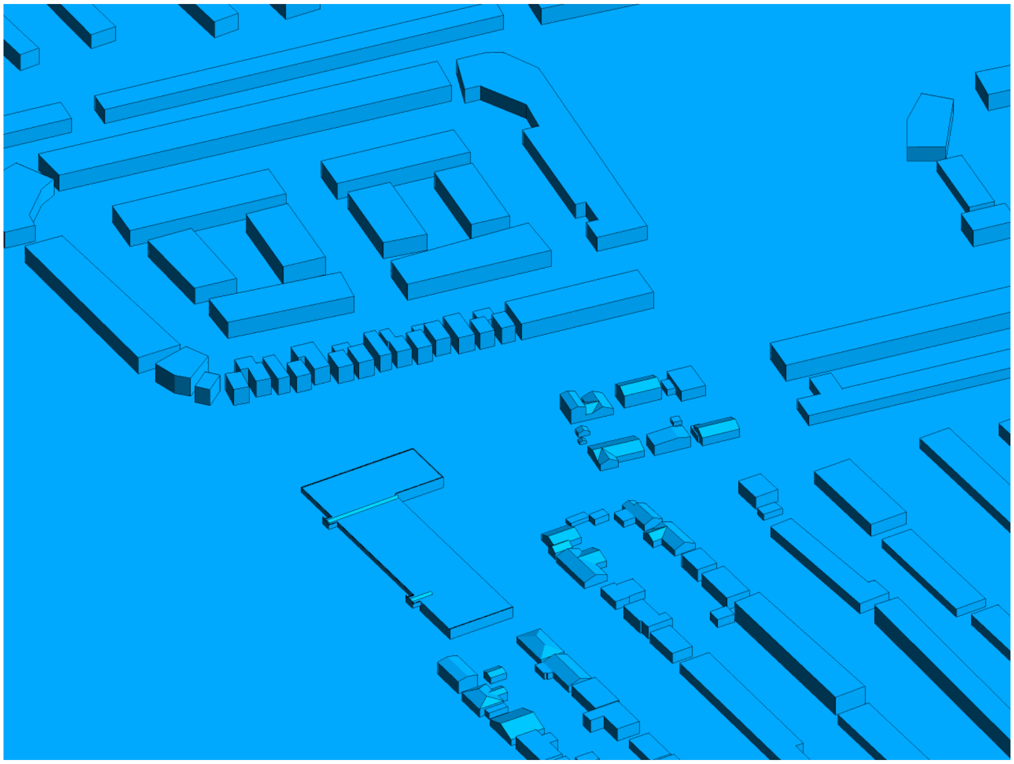

FIGURE 2G: COMPUTATIONAL MODEL, EXISTING MASSING, WEST PERSPECTIVE

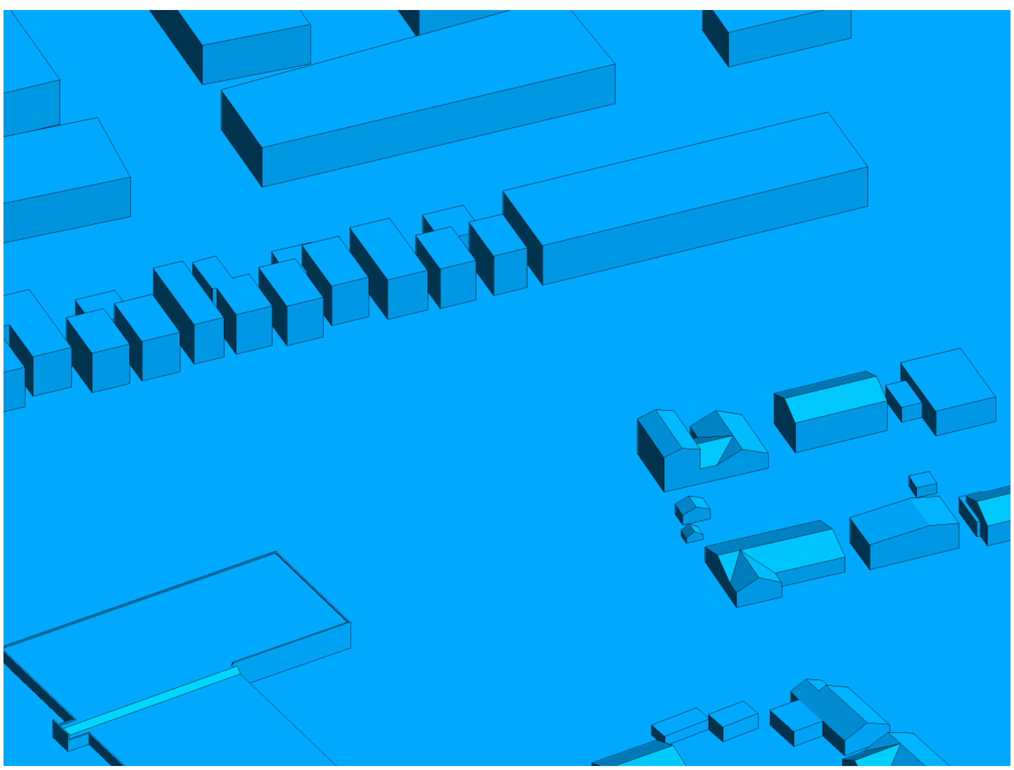

FIGURE 2H: CLOSE UP OF FIGURE 2G

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

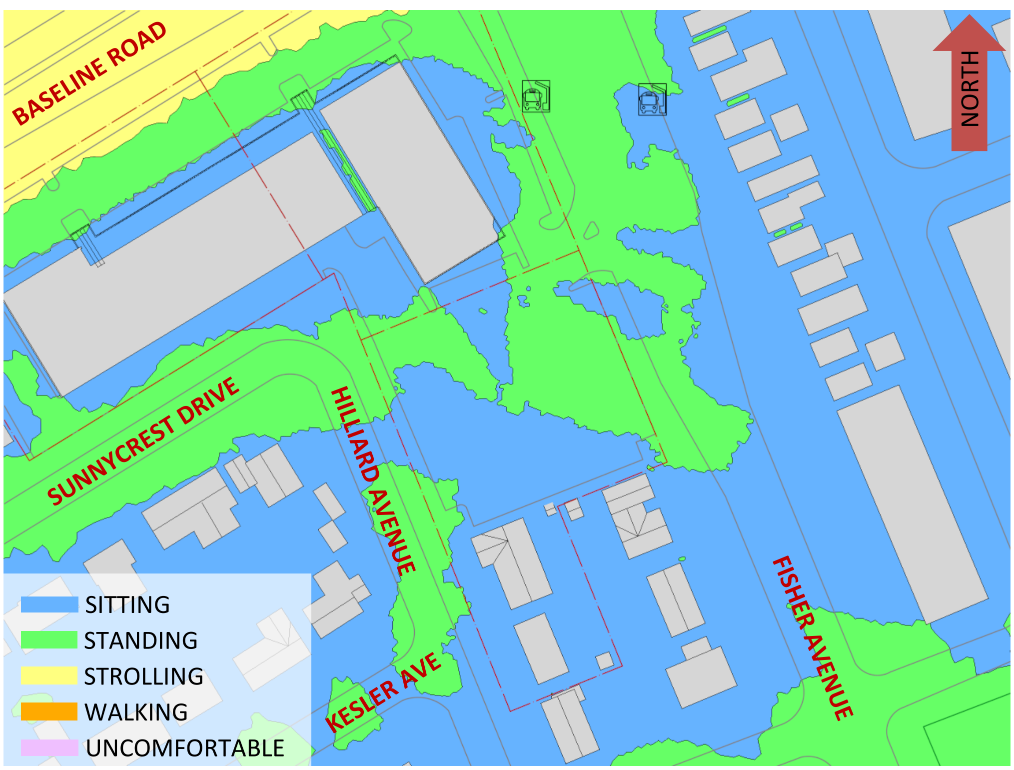

FIGURE 3B: SPRING – WIND COMFORT, GRADE LEVEL – EXISTING MASSING

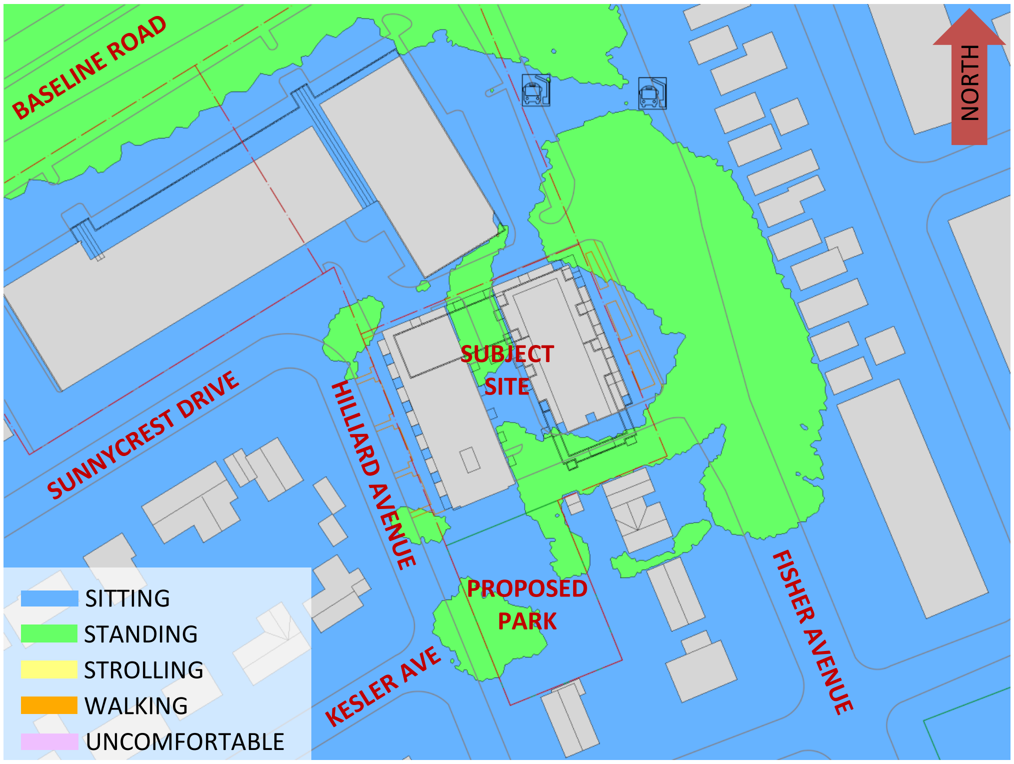

FIGURE 4A: SUMMER – WIND COMFORT, GRADE LEVEL – PROPOSED MASSING

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

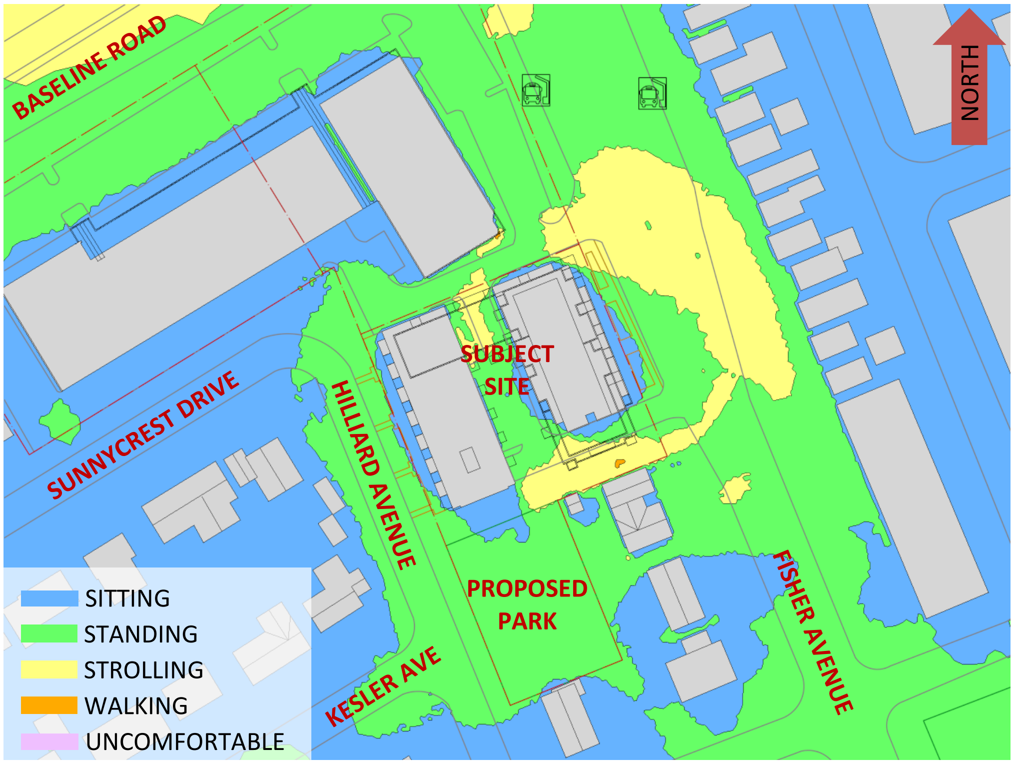

FIGURE 5A: AUTUMN – WIND COMFORT, GRADE LEVEL – PROPOSED MASSING

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

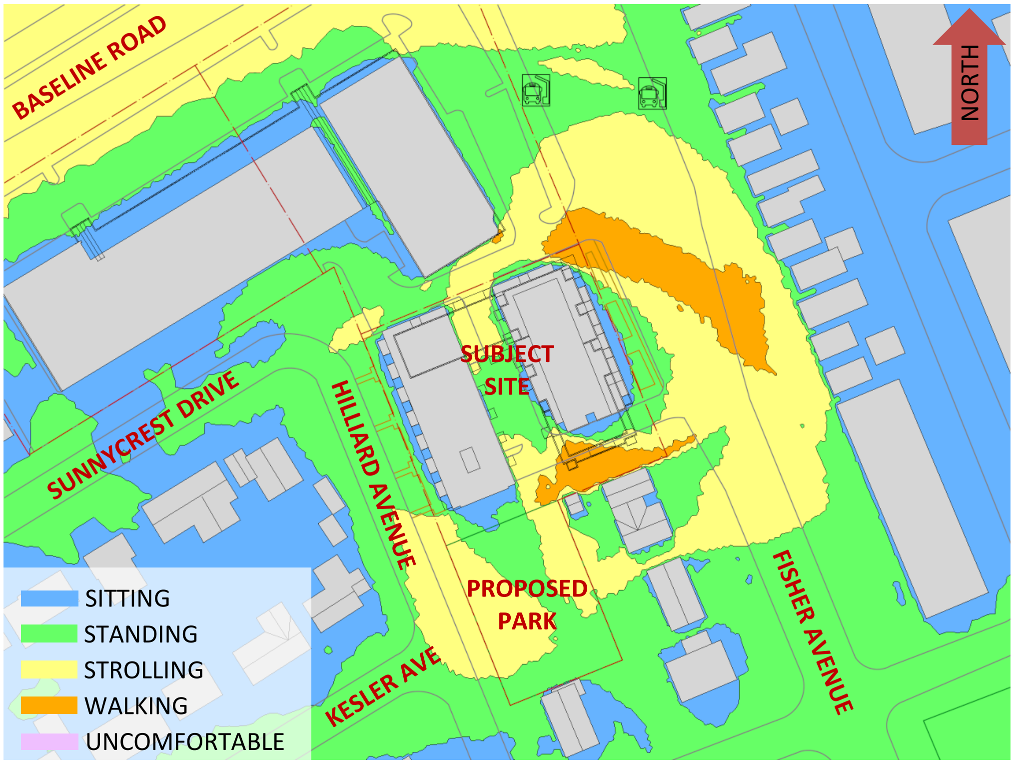

FIGURE 6A: WINTER – WIND COMFORT, GRADE LEVEL – PROPOSED MASSING

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

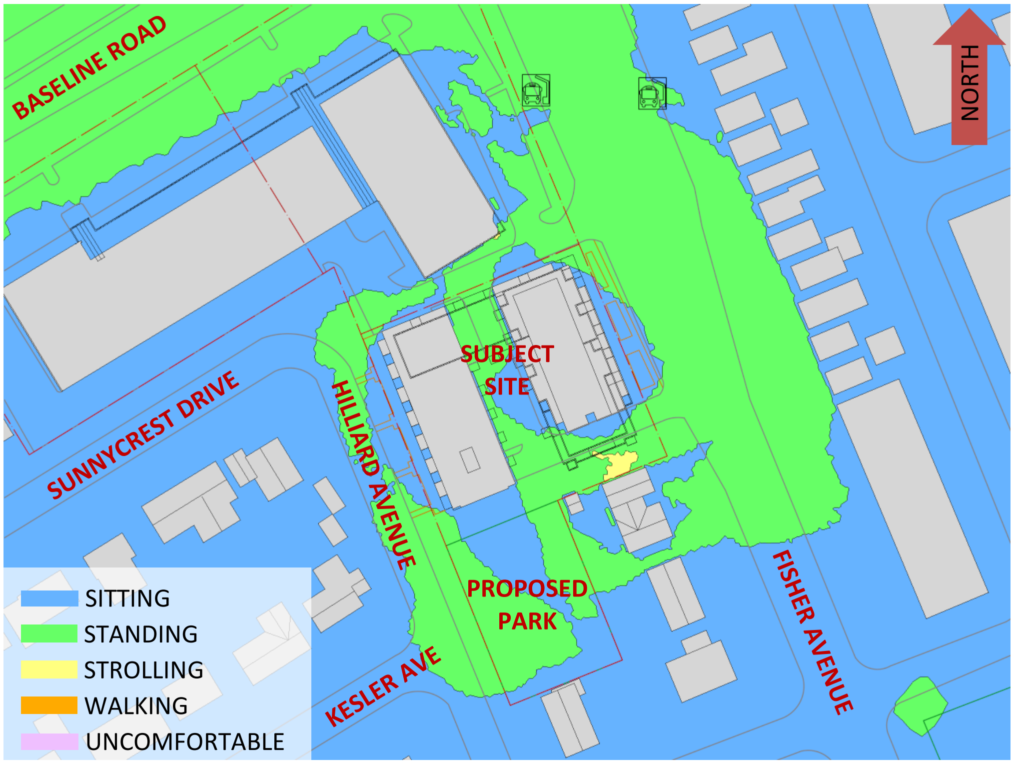

FIGURE 7: TYPICAL USE PERIOD – WIND COMFORT, GRADE LEVEL – PROPOSED MASSING

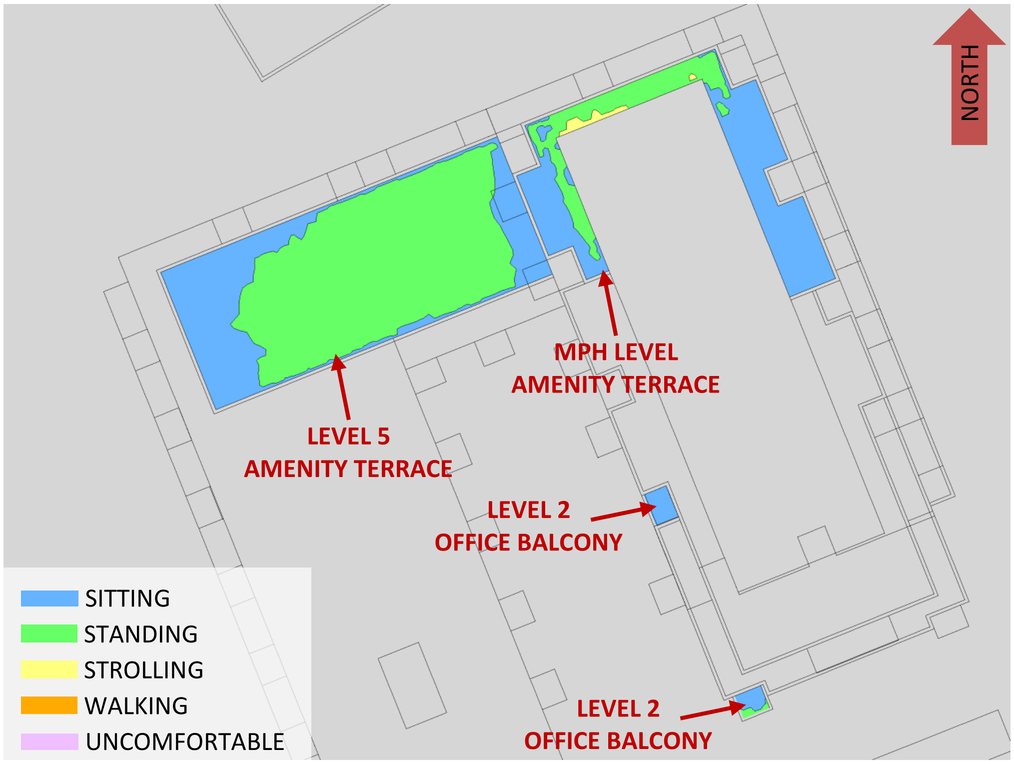

FIGURE 8A: SPRING – WIND COMFORT, COMMON AMENITY TERRACES

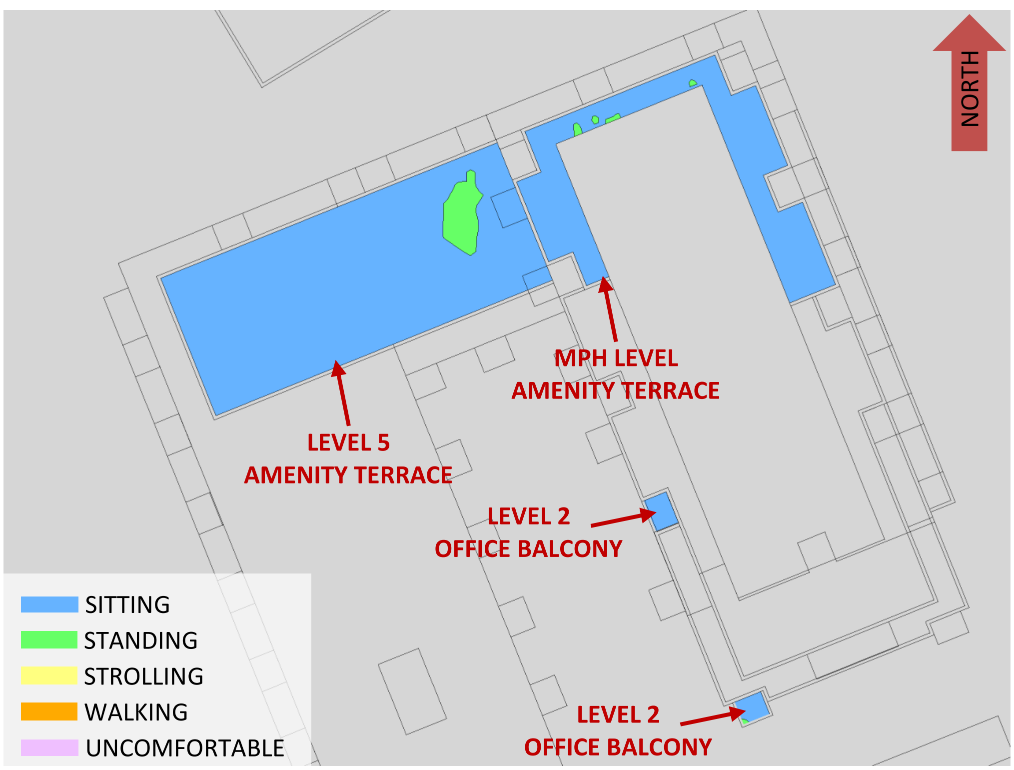

FIGURE 8B: SUMMER – WIND COMFORT, COMMON AMENITY TERRACES

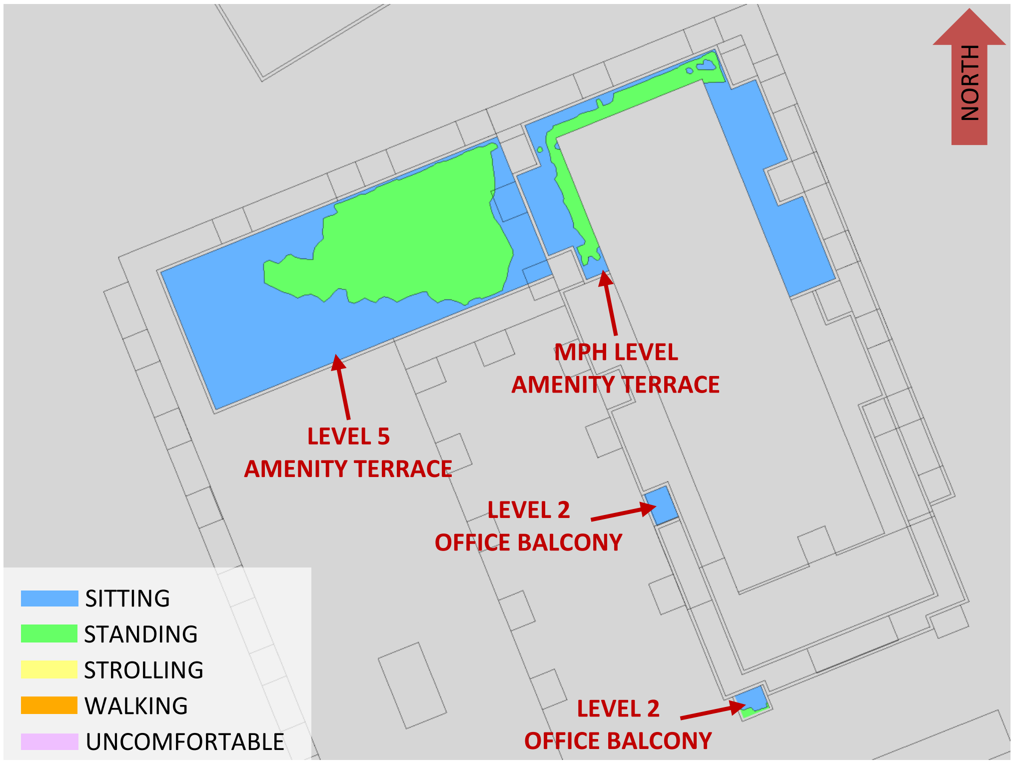

FIGURE 8C: AUTUMN – WIND COMFORT, COMMON AMENITY TERRACES

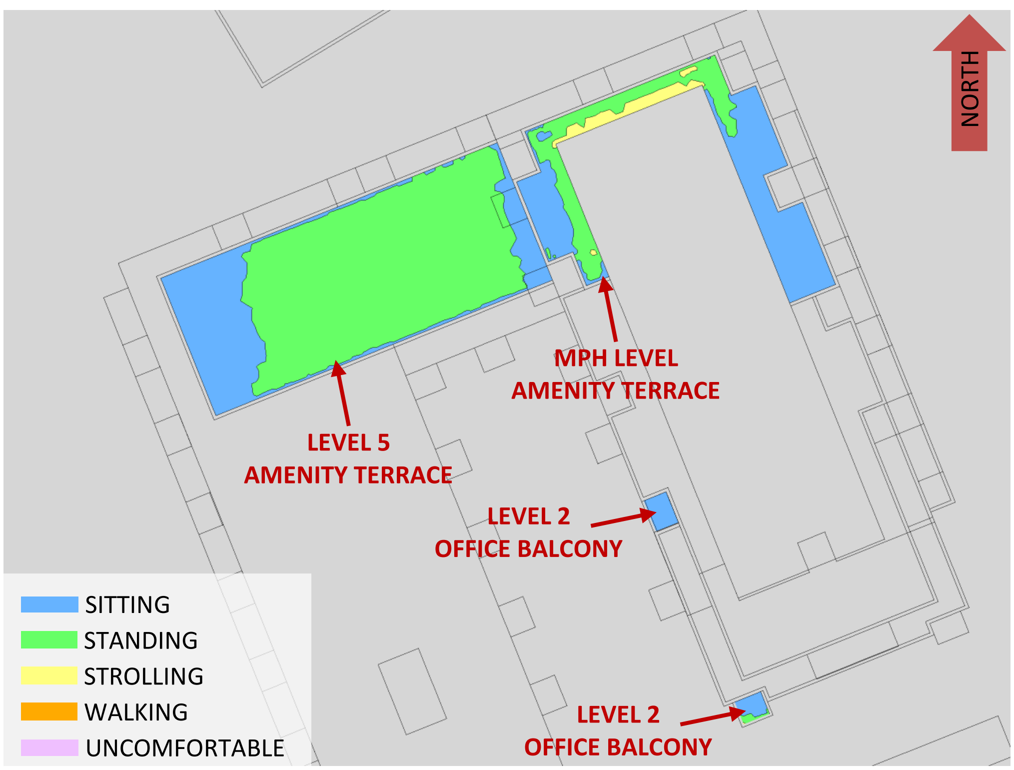

FIGURE 8D: WINTER – WIND COMFORT, COMMON AMENITY TERRACES

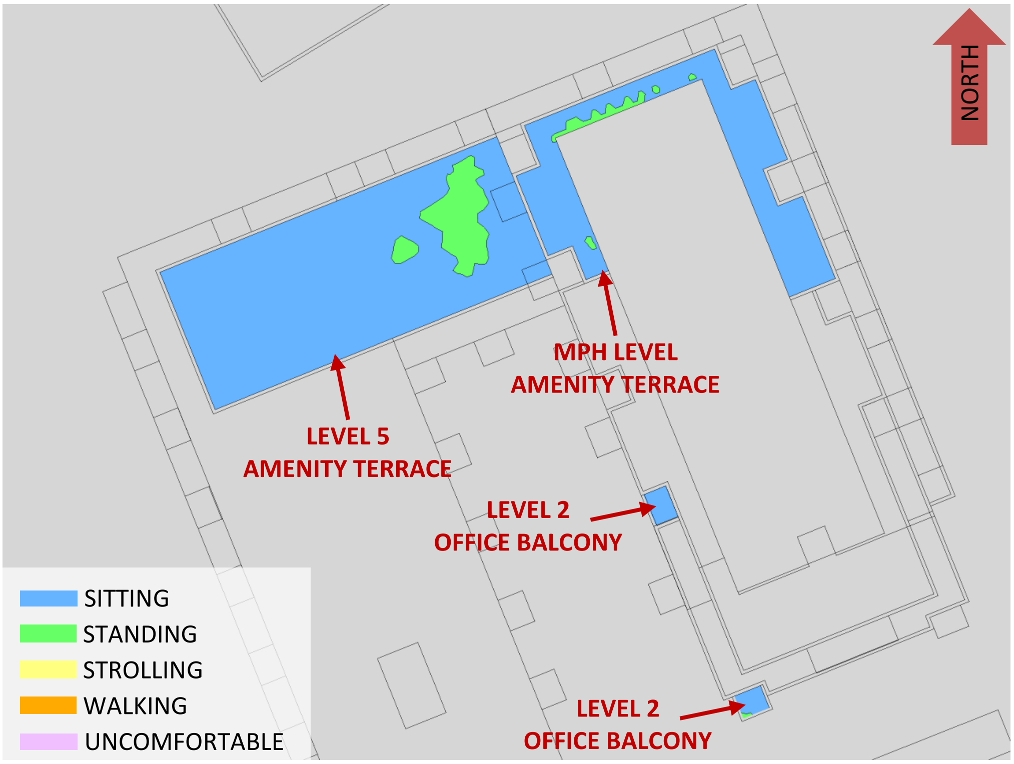

FIGURE 9: TYPICAL USE PERIOD – WIND COMFORT, COMMON AMENITY TERRACES

APPENDIX A

SIMULATION OF THE ATMOSPHERIC BOUNDARY LAYER

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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 (i.e., the area that it not captured within the simulation model).

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

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

Wind Direction (Degrees True)	Alpha Value (α)
0	0.20
49	0.21
74	0.24
103	0.24
167	0.24
197	0.24
217	0.24
237	0.22
262	0.21
282	0.21
301	0.21
324	0.22

TABLE 2: DEFINITION OF UPSTREAM EXPOSURE (ALPHA VALUE)

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

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

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

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

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

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

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

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

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