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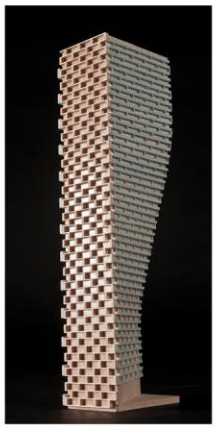
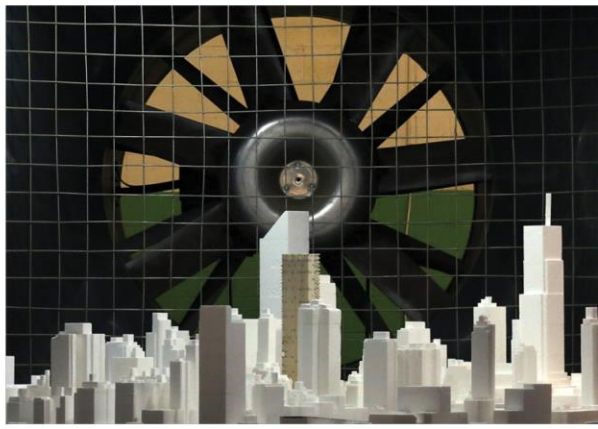
PEDESTRIAN LEVEL WIND STUDY

780 Baseline Road
Ottawa, Ontario

Report: 22-062-PLW-2023





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EXECUTIVE SUMMARY

This report describes a pedestrian level wind (PLW) study to satisfy Zoning By-Law Amendment (ZBLA) application requirements for the planned buildout of the proposed multi-building development located 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-6, 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, transit stops, drive aisles, surface parking, walkways, the proposed parkland, and in the vicinity of building access points, are considered acceptable. The areas that are predicted to experience windy conditions are described as follows:

    a. **Amenity Courtyard Serving Tower B & Commercial Patios Serving Towers B and C**. During the typical use period, conditions within the amenity courtyard to the east of Tower B are predicted to be suitable for mostly sitting with a limited region of standing conditions to the east, while conditions within the commercial patios at the northeast corner of Tower B and at the northwest and northeast corners of Tower C are predicted to be suitable for mostly standing.

- Depending on the programming of the amenity courtyard, the noted wind comfort conditions may be considered acceptable. Specifically, if the windier area to the east will not accommodate seating or lounging activities, the noted conditions would be considered acceptable.

- Comfort levels within the noted commercial patios, and to the east within the amenity courtyard if required by programming, may be improved by implementing landscaping elements around sensitive areas such as wind screens and coniferous plantings in dense arrangements, in combination with strategically placed seating with high-back benches and other local wind mitigation.

- The extent of the mitigation measures is dependent on the programming of the noted spaces. If required by programming, an appropriate mitigation strategy will be developed in collaboration with the building and landscape architects for the future Site Plan Control application.

b. **Northeast Building Access Points Serving Towers B and C & West Building Access Point Serving Tower C**. Wind conditions in the vicinity of the commercial entrance at the northeast corner of Tower B are predicted to be suitable for strolling, or better, during the spring and winter, while conditions in the vicinity of the commercial entrance at the northeast corner of Tower C and the primary residential entrance along the west elevation of Tower C are predicted to be suitable for strolling, or better, during the spring and autumn, and walking, or better, during the winter. It is recommended that the noted entrances be recessed into the building façade by at least 2 m.

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

a. **Tower A, Level 5 Amenity Terrace**: Conditions are predicted to be suitable for sitting over the majority of the terrace with regions suitable for standing to the north of the terrace.

b. **Tower A, MPH Level Amenity Terrace**: Conditions are predicted to be suitable for mostly sitting with regions suitable for standing at the four corners of the terrace.

c. **Tower B, Level 5 Amenity Terrace:** Conditions are predicted to be suitable for mostly standing, with conditions suitable for sitting close to the south and southeast of the terrace, and an isolated region suitable for strolling near at the northwest corner of the tower.

d. **Tower C, West Level 5 Amenity Terrace**: Conditions are predicted to be suitable for mostly standing, with conditions suitable for sitting close to the tower façade and to the west of the terrace, and an isolated region suitable for strolling near at the northwest corner of the tower.

e. **Tower C, South Level 5 Amenity Terrace**: Conditions are predicted to be suitable for mostly standing, with conditions suitable for sitting to the north and south of the terrace.

f. Depending on programming, the predicted wind conditions within the amenity terraces serving Tower A may be considered acceptable. Specifically, if the noted windier areas of the terraces will not include seating or lounging activities, the noted conditions may be considered acceptable.

g. To improve comfort levels within the amenity terraces serving Towers B and C, and the amenity terraces serving Tower A if required by programming, mitigation inboard of the terrace perimeter and targeted around sensitive areas is recommended, in combination with taller perimeter wind screens (that is, greater than 1.8 m, measured from the walking surface). Inboard mitigation could take the form of wind screens or other common landscape elements. Canopies may also be required above sensitive areas.

h. The extent of the mitigation measures is dependent on the programming of the amenity 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 submission.

3) Within the context of typical weather patterns, which exclude anomalous localized storm events such as tornadoes and downbursts, one area within the amenity terrace serving Tower C to the west at Level 5 may be expected to experience conditions that could be considered dangerous, as defined in Section 4.4. The one area is the northwest corner of Tower C at Level 5, which is predicted to exceed the safety criterion on an annual basis. Additional wind testing will be required to develop an appropriate strategy to improve wind comfort conditions within the terrace and to resolve the wind safety exceedance.

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1. INTRODUCTION

Gradient Wind Engineering Inc. (Gradient Wind) was retained by 780 Baseline Inc. to satisfy Zoning By-Law Amendment (ZBLA) application requirements for the planned buildout of the proposed multi-building development located at 780 Baseline Road in Ottawa, Ontario (hereinafter referred to as "subject site" or "proposed development"). A PLW study was conducted in June 2023[1] for a previous architectural design of the future planned buildout of the proposed development. The noted study includes detailed descriptions of the predicted wind conditions under the existing massing conditions. Our mandate within this study is to investigate pedestrian wind conditions within and surrounding the subject site, and to identify areas where conditions may interfere with certain pedestrian activities so that mitigation measures may be considered, where required.

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 September 2023, surrounding street layouts and existing and approved future building massing information obtained from the City of Ottawa, recent satellite imagery, and experience with numerous similar developments.

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 three phases: Phase 1, Phase 2, and Phase 3 situated to the south, at the northwest corner, and at the northeast corner of the subject site, respectively. Phase 1 comprises "Tower A" rising to 24-storeys above a 'U'-shaped four-storey podium and a proposed parkland at the southwest corner that fronts Hillard Avenue. Phase 2 comprises "Tower B" rising to 24-storeys above a 'C'-shaped four-storey podium. Phase 3 comprises "Tower C" rising to 32-storeys above an 'L'-shaped four-storey podium. All towers are topped with a mechanical penthouse (MPH) and share 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 ground floor of the western wing includes a loading area to the north, a

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

garbage space and an admin office near the northeast corner, and a ramp to the underground parking along the east elevation, accessed via a drive aisle from Fisher Avenue. The ground floor of the east wing includes a residential lobby at the northwest corner. At Level 5, the building steps back from the west elevation to accommodate an amenity terrace. Private terraces are located along the east and south elevations at Level 5 and at the southeast and southwest corners at Level 21. The building steps back from all elevations at the MPH Level to accommodate an amenity terrace.

The ground floor of Tower B includes commercial entrances along the north elevation, a residential lobby to the northeast, and a loading area and a ramp to the underground parking to the southeast, accessed via a drive aisle from Baseline Road. A commercial patio is provided at the northeast corner and an amenity courtyard is situated within the inset of the 'C'-shaped planform. The building steps back from the inner east elevation at Level 2. Setbacks to the south and west at Level 5 accommodate an amenity terrace.

The ground floor of Tower C is divided into northern and southern wings, divided by a single-storey central east-west carriageway. A residential lobby is located to the west of the northern wing. Commercial patios are provided at the northwest and northeast corners of the building, and the building steps back from all elevations at Level 5 to accommodate amenity terraces. Private terraces are located within a setback to the west at Level 27.

Regarding wind exposures, the near-field surroundings (defined as an area falling within a 200-metre (m) radius of the subject site) include low-rise residential buildings from the northeast clockwise to the west with the open fields of the Central Experimental Farm from the west clockwise to the northeast. The far-field surroundings (defined as the area beyond the near field and within a 2-kilometre (km) radius) 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.

A site plan for the proposed massing scenario is illustrated in Figure 1, while Figures 2A-2D illustrate the computational model used to conduct the study.

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 12 wind directions. The CFD simulation model was centered on the proposed development, complete with surrounding massing within a radius of 580 m. The process was performed for the proposed massing scenario, as noted in Section 2.

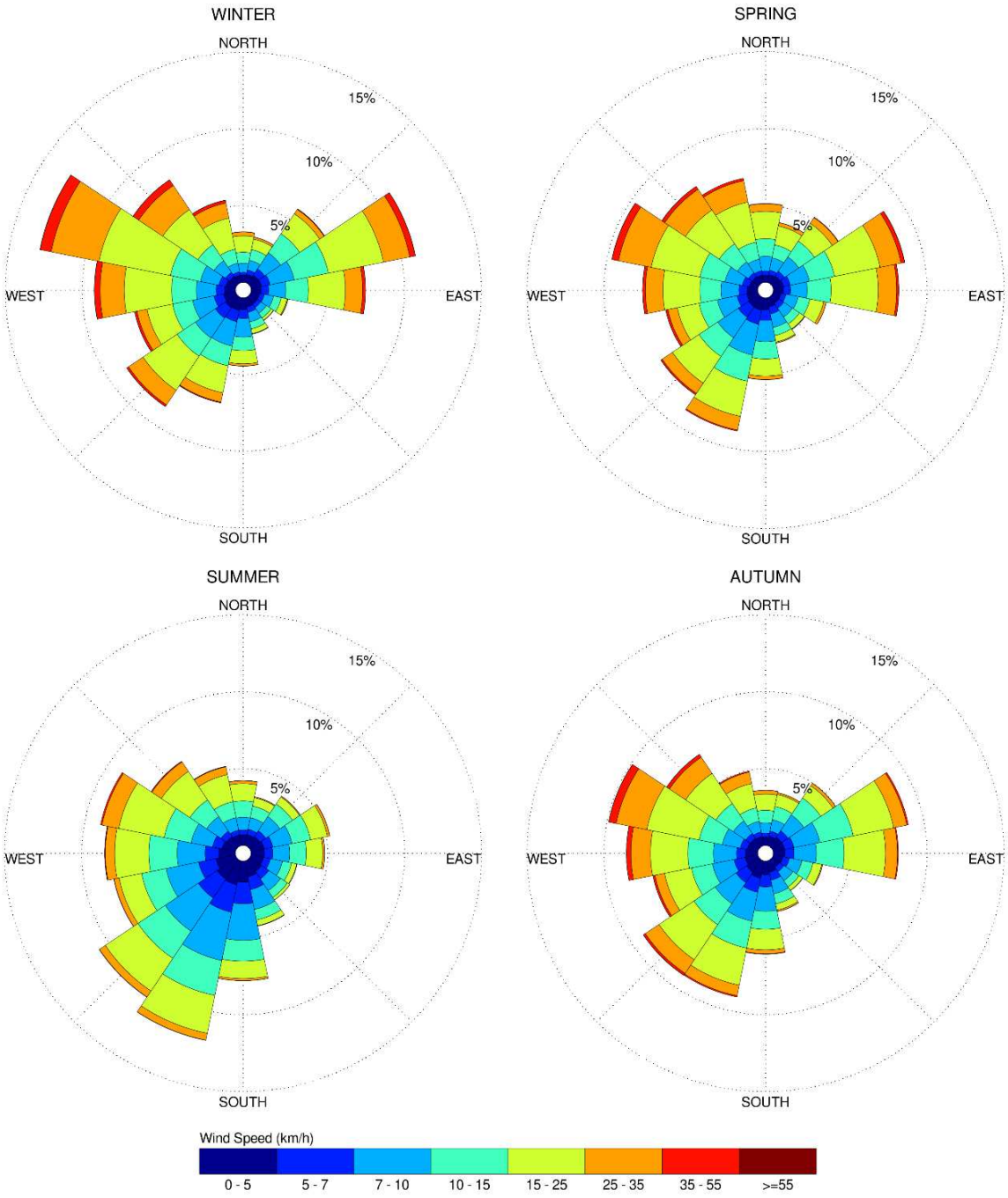
Mean and peak wind speed data obtained over the subject site for each wind direction were interpolated to 36 wind directions at 10° intervals, representing the full compass azimuth. Measured wind speeds approximately 1.5 m above local grade and the common amenity terraces serving the proposed development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

4.3 Historical Wind Speed and Direction Data

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

The statistical model of the Ottawa area wind climate, which indicates the directional character of local winds on a seasonal basis, is illustrated on the following page. The plots illustrate seasonal distribution of measured wind speeds and directions in kilometers per hour (km/h). Probabilities of occurrence of different wind speeds are represented as stacked polar bars in sixteen azimuth divisions. The radial direction represents the percentage of time for various wind speed ranges per wind direction during the measurement period. The prominent wind speeds and directions can be identified by the longer length of the bars. For Ottawa, the most common winds occur for westerly wind directions, followed by those from the east, while the most common wind speeds are below 36 km/h. The directional prominence and relative magnitude of wind speed changes somewhat from season to season.

SEASONAL DISTRIBUTION OF WIND
OTTAWA MACDONALD-CARTIER INTERNATIONAL AIRPORT



Notes:

1. Radial distances indicate percentage of time of wind events.
2. Wind speeds are mean hourly in km/h, measured at 10 m above the ground.

4.4 Pedestrian Wind Comfort and Safety Criteria – City of Ottawa

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

PEDESTRIAN WIND COMFORT CLASS DEFINITIONS

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

Regarding wind safety, the pedestrian safety wind speed criterion is based on the approximate threshold that would cause a vulnerable member of the population to fall. A 0.1% exceedance gust wind speed of 90 km/h is classified as dangerous. From calculations of stability, it can be shown that gust wind speeds of 90 km/h would be the approximate threshold wind speed that would cause an average elderly person in good health to fall. Notably, pedestrians tend to be more sensitive to wind gusts than to steady winds for lower wind speed ranges. For strong winds approaching dangerous levels, this effect is less important because the mean wind can also create problems for pedestrians.

Experience and research on people's perception of mechanical wind effects has shown that if the wind speed levels are exceeded for more than 20% of the time, the activity level would be judged to be uncomfortable by most people. For instance, if a mean wind speed of 10 km/h (equivalent gust wind speed of approximately 16 km/h) were exceeded for more than 20% of the time most pedestrians would judge that location to be too windy for sitting. Similarly, if mean wind speed of 20 km/h (equivalent gust wind speed of approximately 32 km/h) at a location were exceeded for more than 20% of the time, walking or less vigorous activities would be considered uncomfortable. As these criteria are based on subjective reactions of a population to wind forces, their application is partly based on experience and judgment.

Once the pedestrian wind speed predictions have been established throughout the subject site, the assessment of pedestrian comfort involves determining the suitability of the predicted wind conditions for discrete regions within and surrounding the subject site. This step involves comparing the predicted comfort classes to the target comfort classes, which are dictated by the location type for each region (that is, a sidewalk, building entrance, amenity space, or other). An overview of common pedestrian location types and their typical windiest target comfort classes are summarized on the following page. Depending on the programming of a space, the desired comfort class may differ from this table.

TARGET PEDESTRIAN WIND COMFORT CLASSES FOR VARIOUS LOCATION TYPES

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

5. RESULTS AND DISCUSSION

The following discussion of the predicted pedestrian wind conditions for the subject site is accompanied by Figures 3A-3D, which illustrate conditions at grade level for the proposed massing scenario, and by Figures 5A-5D, which illustrate conditions over the common amenity terraces serving Towers A, B, and C at Level 5 and Tower A at the MPH Level. Conditions are presented as continuous contours of wind comfort within and surrounding the subject site and correspond to the various comfort classes noted in Section 4.4.

Wind comfort conditions are also reported for the typical use period, which is defined as May to October, inclusive. Figures 4 and 6 illustrate wind comfort conditions at grade level and over the common amenity terraces serving the proposed development, respectively, consistent with the comfort classes in Section 4.4. The details of these conditions are summarized in the following pages for each area of interest.

5.1 Wind Comfort Conditions – Grade Level

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

While the introduction of the proposed development produces windier conditions over Sunnycrest Drive and Hillard Avenue in comparison to existing conditions (refer to Section 5 of the noted previous PLW report mentioned in Section 1 for a detailed description of the predicted wind comfort conditions for the existing massing scenario), 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, wind conditions over the nearby sidewalks along Baseline Road are predicted to be suitable for standing, or better, during the summer, becoming suitable for strolling, or better, during the autumn, and suitable for a mix of standing and strolling with isolated regions suitable for walking near the intersection of Baseline Road and Fisher Avenue during the winter and spring. Conditions in the vicinity of the nearby transit stop to the north of Baseline Road, which is served by a typical shelter, are predicted to be suitable for standing during the summer and autumn, becoming suitable for a mix of standing and strolling during the spring, and suitable for strolling during the winter. Conditions in the vicinity of the nearby transit stop to the south of Baseline Road, which is served by a typical shelter, are predicted to be suitable for standing during the spring, summer, and autumn, becoming suitable for strolling during the winter. The noted conditions are considered acceptable.

While the introduction of the proposed development produces windier conditions over Baseline Road in comparison to existing conditions (refer to Section 5 of the noted previous PLW report mentioned in Section 1 for a detailed description of the predicted conditions for the existing massing scenario), conditions are nevertheless considered acceptable.

Sidewalks and Transit Stops along Fisher Avenue: Following the introduction of the proposed development, conditions over the nearby sidewalks along Fisher Avenue 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 an isolated region suitable for walking near the intersection of Baseline Road and Fisher Avenue during the winter. Conditions in the vicinity of the nearby transit stop to the east of Fisher Avenue are predicted to be suitable for sitting during the summer, becoming suitable for standing throughout the remainder of the year, while conditions in the vicinity of the nearby transit stop to the west of Fisher Avenue are predicted to be suitable for sitting during the summer, becoming suitable for a mix of sitting and standing throughout the remainder of the year. The noted conditions are considered acceptable.

While the introduction of the proposed development produces windier conditions over Fisher Avenue in comparison to existing conditions (refer to Section 5 of the noted previous PLW report mentioned in Section 1 for a detailed description of the predicted conditions for the existing massing scenario), wind conditions are nevertheless considered acceptable.

Proposed Parkland, Amenity Courtyard, and Commercial Patios: Wind comfort conditions and recommendations regarding mitigation, where required, over the proposed parkland to the southwest of Tower A, the amenity courtyard to the east of Tower B, and the commercial patios at the northeast corner of Tower B and near the northwest and northeast corners of Tower C during the typical use period are described as follows:

- Conditions within the proposed parkland to the southwest of Tower A are predicted to be suitable for sitting, which is considered acceptable.
- Conditions within the amenity courtyard to the east of Tower B are predicted to be suitable for mostly sitting with limited regions suitable for standing to the east.
- Conditions within the commercial patio near the northeast corner of Tower B are predicted to be suitable for mostly standing with regions suitable for sitting to the west.
- Conditions within the commercial patio near the northwest corner of Tower C are predicted to be suitable for mostly standing with sitting conditions to the east.

- Conditions within the commercial patio near the northeast corner of Tower C are predicted to be suitable for sitting to the south and suitable for standing to the north.

- Depending on the programming of the amenity courtyard, the noted wind comfort conditions may be considered acceptable. Specifically, if the windier area to the east will not accommodate seating or lounging activities, the noted conditions would be considered acceptable.

- Comfort levels within the commercial patios, and to the east within the amenity courtyard if required by programming, may be improved by implementing landscaping elements around sensitive areas such as wind screens and coniferous plantings in dense arrangements, in combination with strategically placed seating with high-back benches and other local wind mitigation.

- The extent of the mitigation measures is dependent on the programming of the noted spaces. If required by programming, an appropriate mitigation strategy will be developed in collaboration with the building and landscape architects for the future Site Plan Control application.

Drive aisles, Surface Parking, and Walkways within Subject Site: Conditions over the drive aisles within the subject site are predicted to be suitable for standing, or better, during the summer, becoming suitable for walking, or better, throughout the remainder of the year. Conditions over the surface parking located within the subject site are predicted to be suitable for mostly sitting during the summer, becoming suitable for mostly strolling, or better, throughout the remainder of the year. Conditions over the walkways within the subject site are predicted to be suitable for standing, or better, during the summer, becoming suitable for strolling, or better, during the spring and autumn with isolated regions suitable for walking between Towers A and C, and suitable for walking, or better, during the winter. The noted conditions are considered acceptable.

Building Access Points: Conditions in the vicinity of the commercial entrance near the northeast corner of Tower B are predicted to be suitable for sitting during the summer, becoming suitable for standing, or better, during the spring and autumn, and suitable for strolling, or better, during the winter. Conditions in the vicinity of the commercial entrance near the northeast corner of Tower C are predicted to be suitable for standing, or better, during the summer, becoming suitable for strolling, or better, during the spring and autumn, and suitable for walking, or better, during the winter. Conditions in the vicinity of the primary building access point along the west elevation of Tower C are predicted to be suitable for standing during the summer, becoming suitable for strolling during the spring and autumn, and suitable for a mix of strolling and walking during the winter. It is recommended that the noted building entrances be recessed into the building façade by at least 2 m.

Conditions in the vicinity of the remaining building access points serving the proposed development are predicted to be suitable for standing, or better, throughout the year. The noted conditions considered acceptable.

5.2 Wind Comfort Conditions – Common Amenity Terraces

Wind comfort conditions during the typical use period within the common amenity terraces serving the proposed development, which were modelled with 1.8-m-tall wind screens along their full perimeters, and recommendations regarding mitigation are provided as follows:

Tower A, Level 5 Amenity Terrace: Conditions over the common amenity terrace serving Tower A at Level 5 are predicted to be suitable for sitting over the majority of the terrace with regions suitable for standing to the north of the terrace.

Tower A, MPH Level Amenity Terrace: Conditions over the common amenity terrace serving Tower A at the MPH Level are predicted to be suitable mostly for sitting with regions suitable for standing at the four corners of the terrace.

Tower B, Level 5 Amenity Terrace: Conditions over the common amenity terrace serving Tower B at Level 5 are predicted to be suitable mostly for standing, with conditions suitable for sitting to the south and southeast of the terrace, and an isolated region suitable for strolling near at the northwest corner of the tower.

Tower C, West Level 5 Amenity Terrace: Conditions over the common amenity terrace serving Tower C at Level 5 to the west are predicted to be suitable mostly for standing, with conditions suitable for sitting close to the tower façade and to the west of the terrace, and an isolated region suitable for strolling near the northwest corner of the tower.

Tower C, South Level 5 Amenity Terrace: Conditions over the common amenity terrace serving Tower C at Level 5 to the south are predicted to be suitable mostly for standing, with conditions suitable for sitting to the north and south of the terrace.

Depending on programming, the predicted wind conditions within the amenity terraces serving Tower A may be considered acceptable. Specifically, if the noted windier areas of the terraces will not include seating or lounging activities, the noted conditions may be considered acceptable.

To improve comfort levels within the remaining amenity terraces, and the amenity terraces serving Tower A if required by programming, mitigation inboard of the terrace perimeter and targeted around sensitive areas is recommended, in combination with taller perimeter wind screens (that is, greater than 1.8 m, measured from the walking surface). 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 the mitigation measures is dependent on the programming of the amenity 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 submission.

5.3 Wind Safety

Within the context of typical weather patterns, which exclude anomalous localized storm events such as tornadoes and downbursts, one area within the amenity terrace serving Tower C to the west at Level 5 may experience conditions that could be considered dangerous, as defined in Section 4.4. The noted area is at the northwest corner of Tower C at Level 5, which is predicted to exceed the safety criterion on an annual basis. Additional wind testing will be required to develop an appropriate strategy to improve wind comfort conditions within the terrace and to resolve the wind safety exceedance.

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 of this report and illustrated in Figures 3A-6. Based on computer simulations using the CFD technique, meteorological data analysis, 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, transit stops, drive aisles, surface parking, walkways, the proposed parkland, and in the vicinity of building access points, are considered acceptable. The areas that are predicted to experience windy conditions are described as follows:

    a. **Amenity Courtyard Serving Tower B & Commercial Patios Serving Towers B and C**. During the typical use period, conditions within the amenity courtyard to the east of Tower B are predicted to be suitable for mostly sitting with a limited region of standing conditions to the east, while conditions within the commercial patios at the northeast

corner of Tower B and at the northwest and northeast corners of Tower C are predicted to be suitable for mostly standing.

- Depending on the programming of the amenity courtyard, the noted wind comfort conditions may be considered acceptable. Specifically, if the windier area to the east will not accommodate seating or lounging activities, the noted conditions would be considered acceptable.

- Comfort levels within the noted commercial patios, and to the east within the amenity courtyard if required by programming, may be improved by implementing landscaping elements around sensitive areas such as wind screens and coniferous plantings in dense arrangements, in combination with strategically placed seating with high-back benches and other local wind mitigation.

- The extent of the mitigation measures is dependent on the programming of the noted spaces. If required by programming, an appropriate mitigation strategy will be developed in collaboration with the building and landscape architects for the future Site Plan Control application.

b. **Northeast Building Access Points Serving Towers B and C & West Building Access Point Serving Tower C**. Wind conditions in the vicinity of the commercial entrance at the northeast corner of Tower B are predicted to be suitable for strolling, or better, during the spring and winter, while conditions in the vicinity of the commercial entrance at the northeast corner of Tower C and the primary residential entrance along the west elevation of Tower C are predicted to be suitable for strolling, or better, during the spring and autumn, and walking, or better, during the winter. It is recommended that the noted entrances be recessed into the building façade by at least 2 m.

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

a. **Tower A, Level 5 Amenity Terrace**: Conditions are predicted to be suitable for sitting over the majority of the terrace with regions suitable for standing to the north of the terrace.

b. **Tower A, MPH Level Amenity Terrace**: Conditions are predicted to be suitable for mostly sitting with regions suitable for standing at the four corners of the terrace.

c. **Tower B, Level 5 Amenity Terrace:** Conditions are predicted to be suitable for mostly standing, with conditions suitable for sitting close to the south and southeast of the terrace, and an isolated region suitable for strolling near at the northwest corner of the tower.

d. **Tower C, West Level 5 Amenity Terrace**: Conditions are predicted to be suitable for mostly standing, with conditions suitable for sitting close to the tower façade and to the west of the terrace, and an isolated region suitable for strolling near at the northwest corner of the tower.

e. **Tower C, South Level 5 Amenity Terrace**: Conditions are predicted to be suitable for mostly standing, with conditions suitable for sitting to the north and south of the terrace.

f. Depending on programming, the predicted wind conditions within the amenity terraces serving Tower A may be considered acceptable. Specifically, if the noted windier areas of the terraces will not include seating or lounging activities, the noted conditions may be considered acceptable.

g. To improve comfort levels within the amenity terraces serving Towers B and C, and the amenity terraces serving Tower A if required by programming, mitigation inboard of the terrace perimeter and targeted around sensitive areas is recommended, in combination with taller perimeter wind screens (that is, greater than 1.8 m, measured from the walking surface). Inboard mitigation could take the form of wind screens or other common landscape elements. Canopies may also be required above sensitive areas.

h. The extent of the mitigation measures is dependent on the programming of the amenity 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 submission.

3) Within the context of typical weather patterns, which exclude anomalous localized storm events such as tornadoes and downbursts, one area within the amenity terrace serving Tower C to the west at Level 5 may be expected to experience conditions that could be considered dangerous, as defined in Section 4.4. The one area is the northwest corner of Tower C at Level 5, which is predicted to exceed the safety criterion on an annual basis. Additional wind testing will be required to develop an appropriate strategy to improve wind comfort conditions within the terrace and to resolve the wind safety exceedance.

Sincerely,

Gradient Wind Engineering Inc.

Omar Rioseco, B.Eng.
Junior Wind Scientist

Justin Ferraro, P.Eng.
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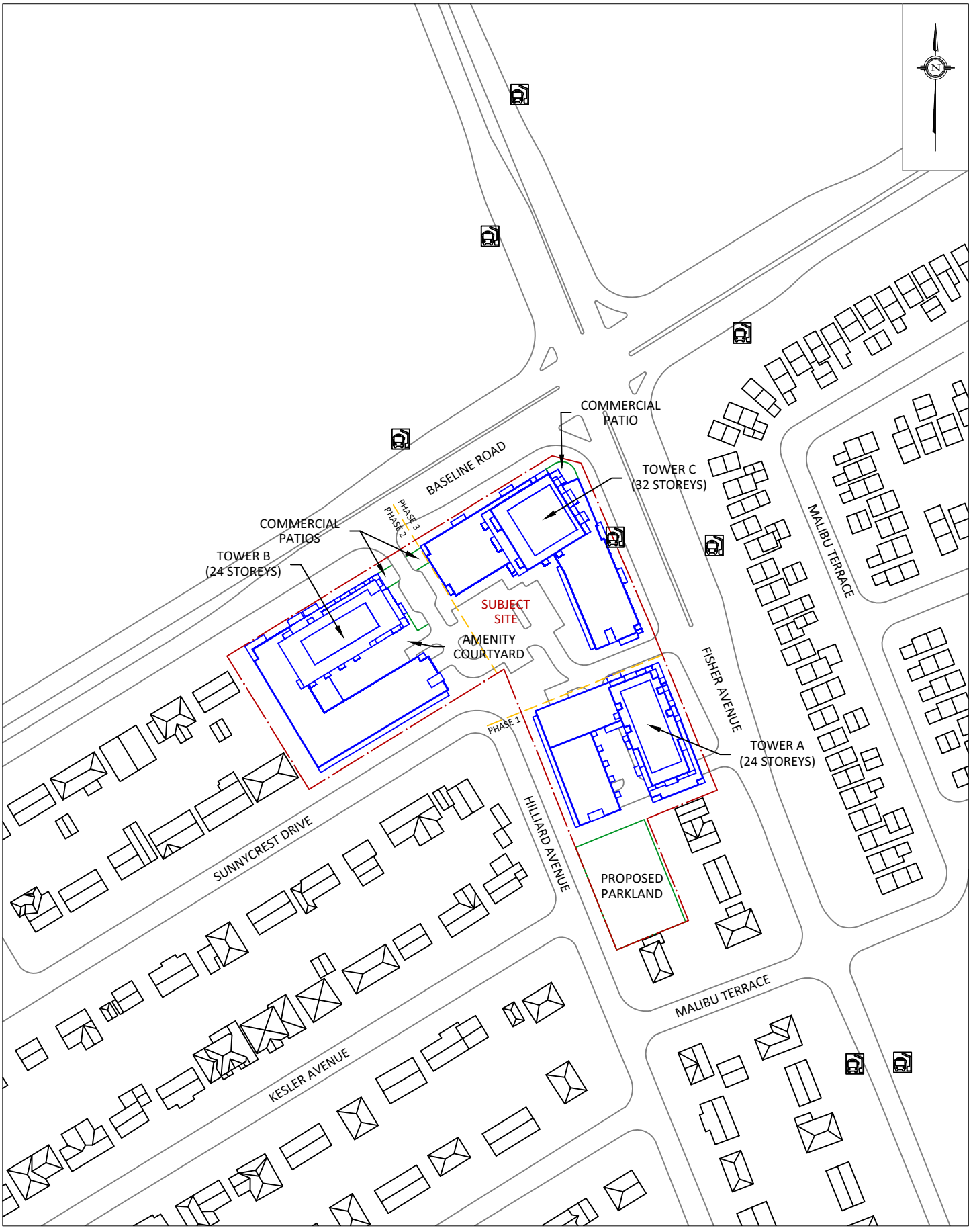
Project Coordinator



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PROJECT	780 BASELINE ROAD, OTTAWA PEDESTRIAN LEVEL WIND STUDY
SCALE	1:2000
DRAWING NO.	22-062-PLW-2023-1
DATE	OCTOBER 18, 2023
DRAWN BY	S.K.

DESCRIPTION

FIGURE 1:
PROPOSED SITE PLAN AND SURROUNDING CONTEXT

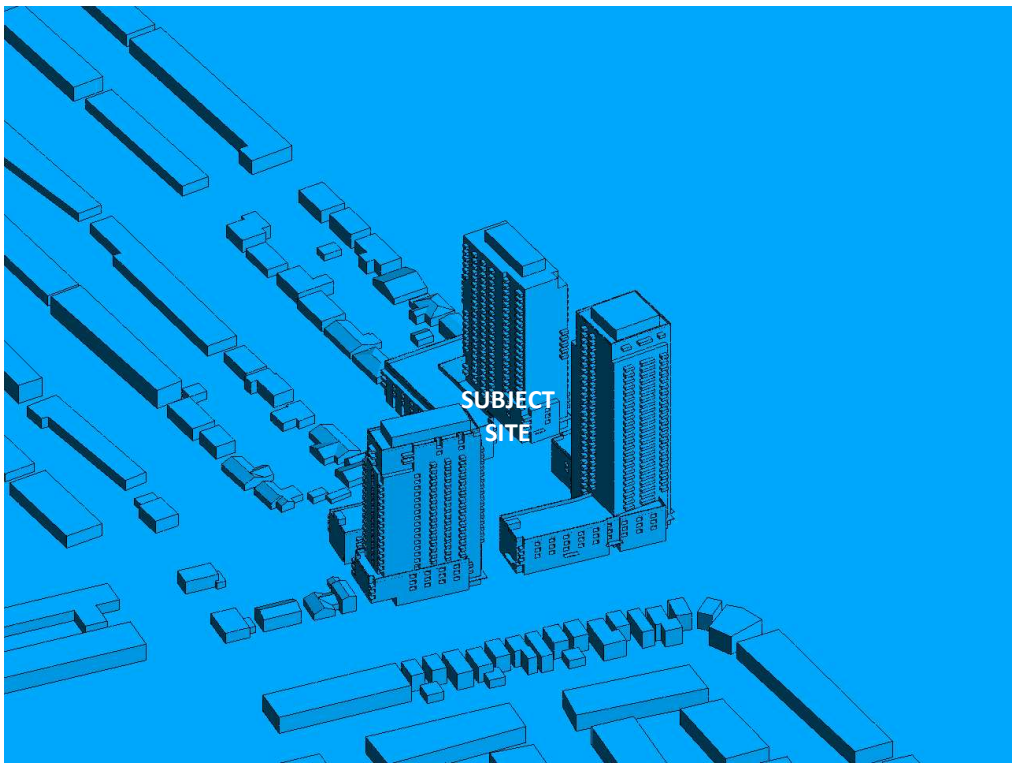

FIGURE 2A: COMPUTATIONAL MODEL, PROPOSED MASSING, EAST PERSPECTIVE

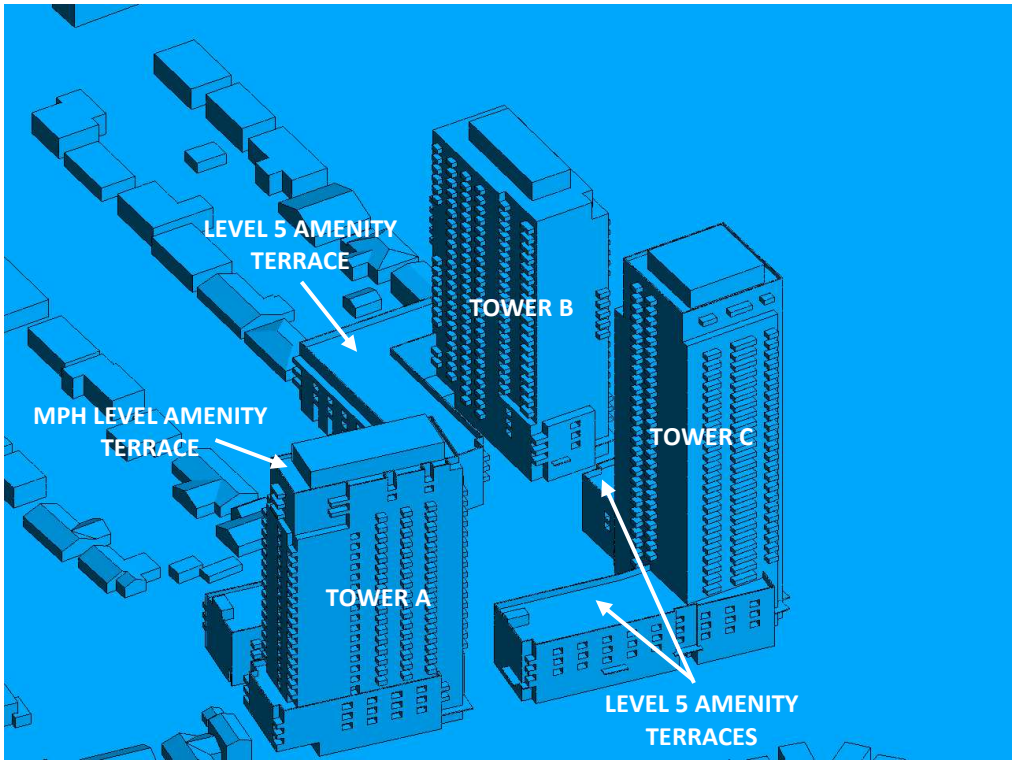

FIGURE 2B: CLOSE-UP VIEW OF FIGURE 2A

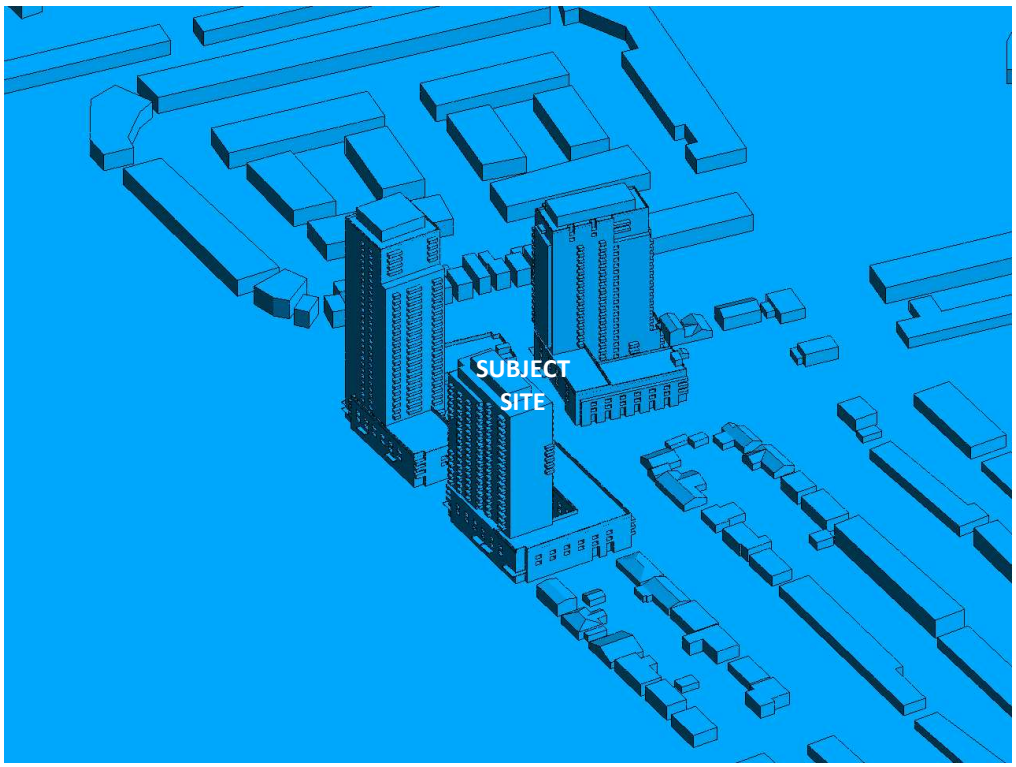

FIGURE 2C: COMPUTATIONAL MODEL, PROPOSED MASSING, WEST PERSPECTIVE

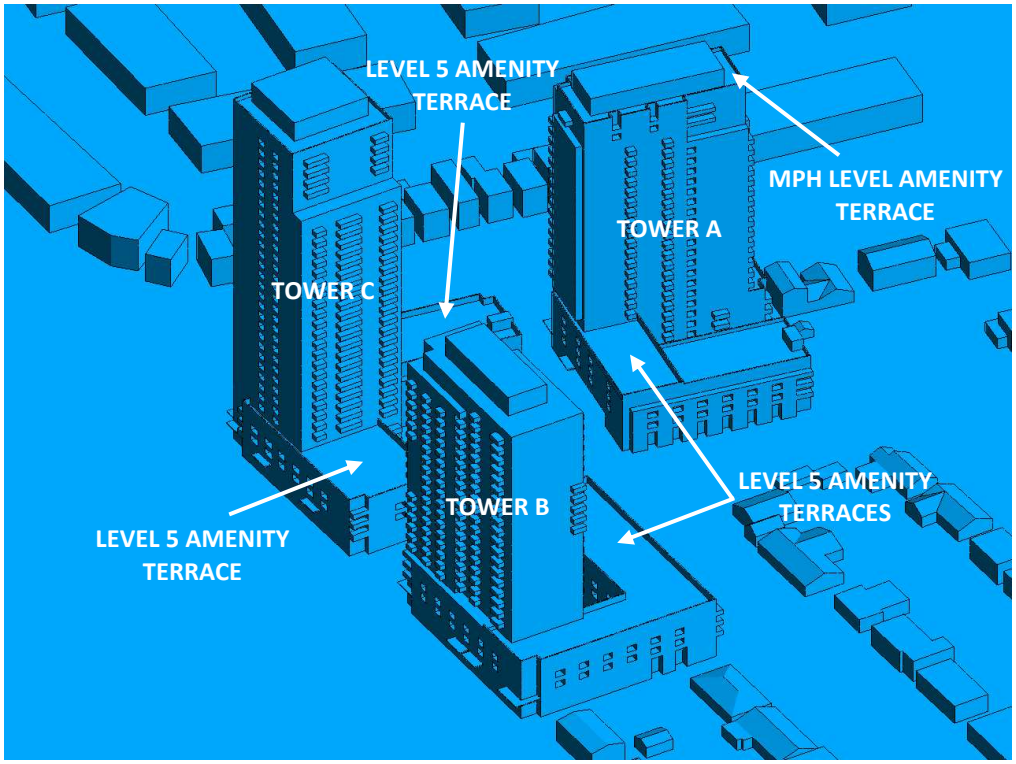

FIGURE 2D: CLOSE-UP VIEW OF FIGURE 2C

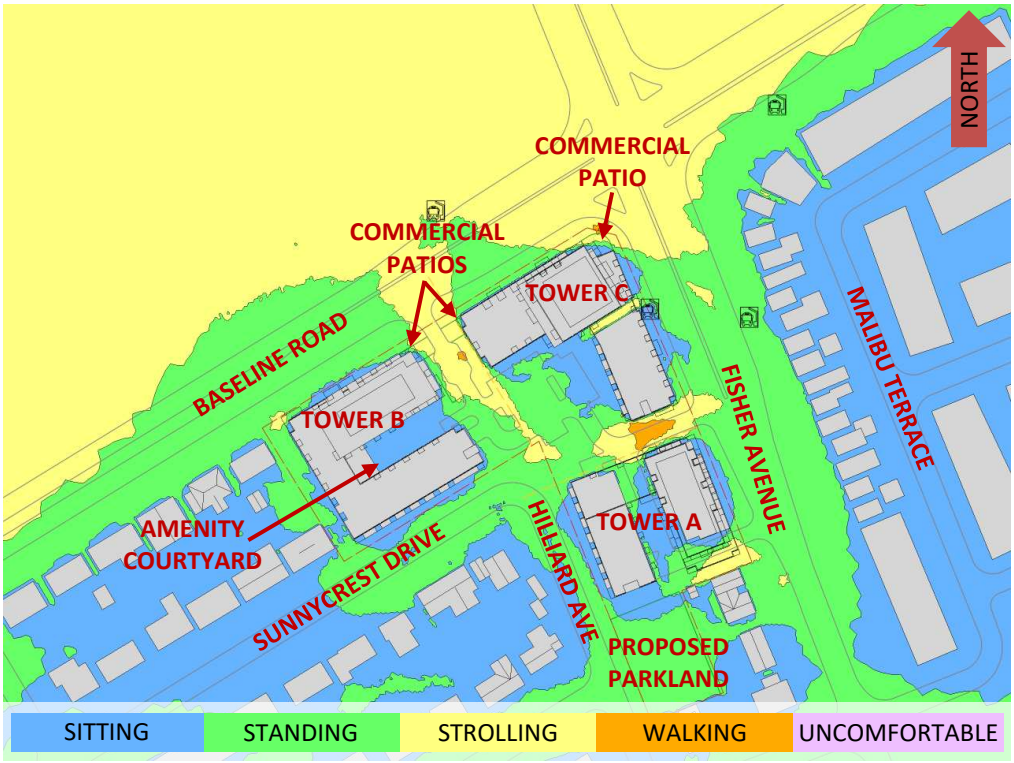

FIGURE 3A: SPRING – WIND COMFORT, GRADE LEVEL – PROPOSED MASSING

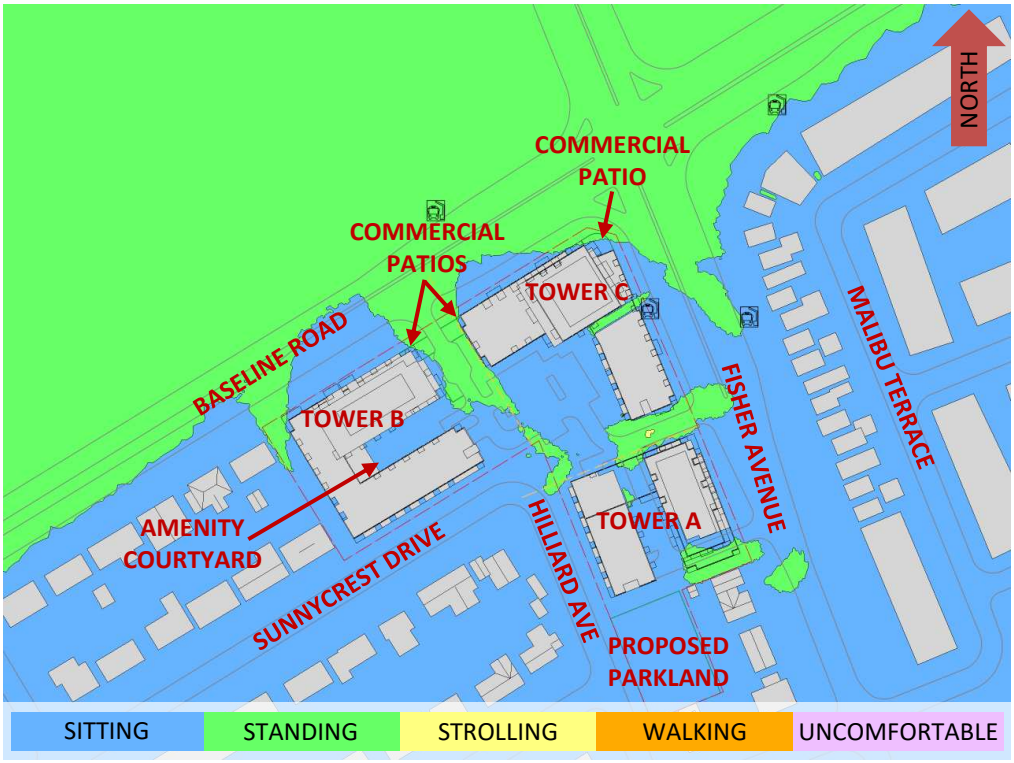

FIGURE 3B: SUMMER – WIND COMFORT, GRADE LEVEL – PROPOSED MASSING

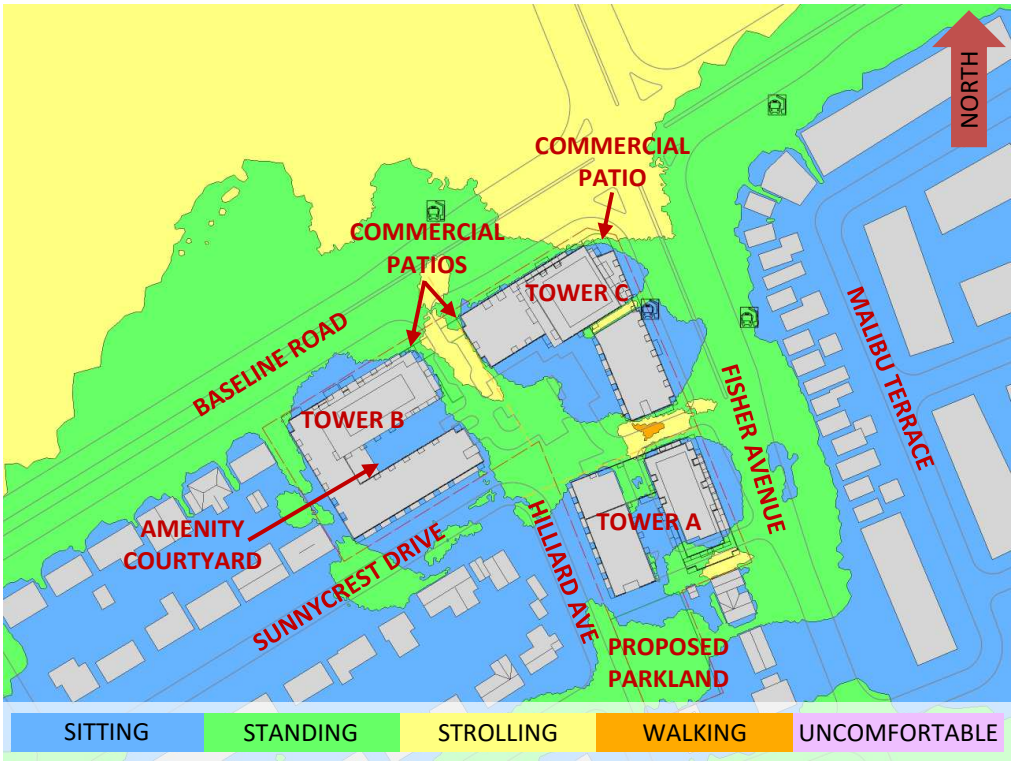

FIGURE 3C: AUTUMN – WIND COMFORT, GRADE LEVEL – PROPOSED MASSING

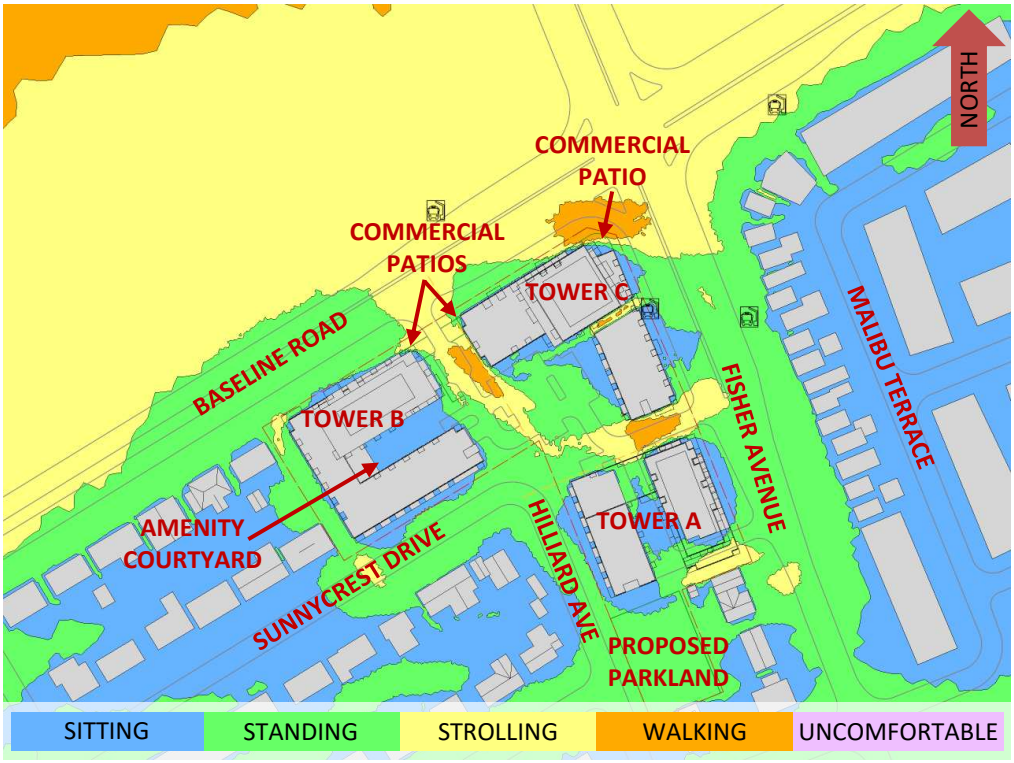

FIGURE 3D: WINTER – WIND COMFORT, GRADE LEVEL – PROPOSED MASSING

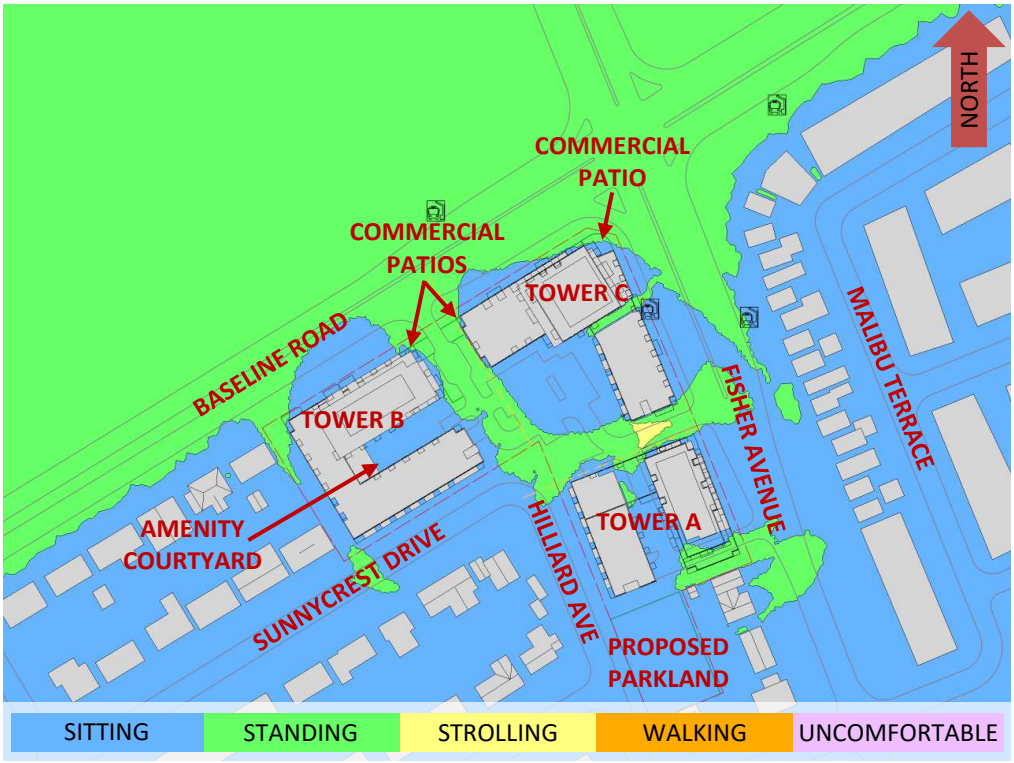

FIGURE 4: TYPICAL USE PERIOD – WIND COMFORT, GRADE LEVEL – PROPOSED MASSING

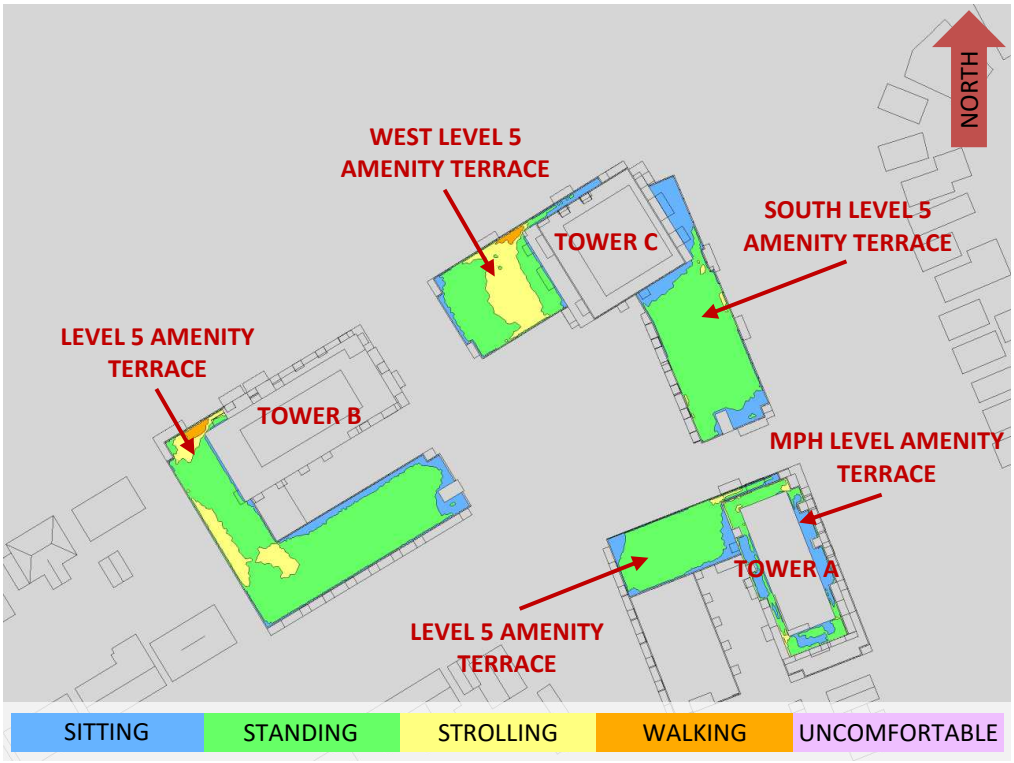

FIGURE 5A: SPRING – WIND COMFORT, COMMON AMENITY TERRACES

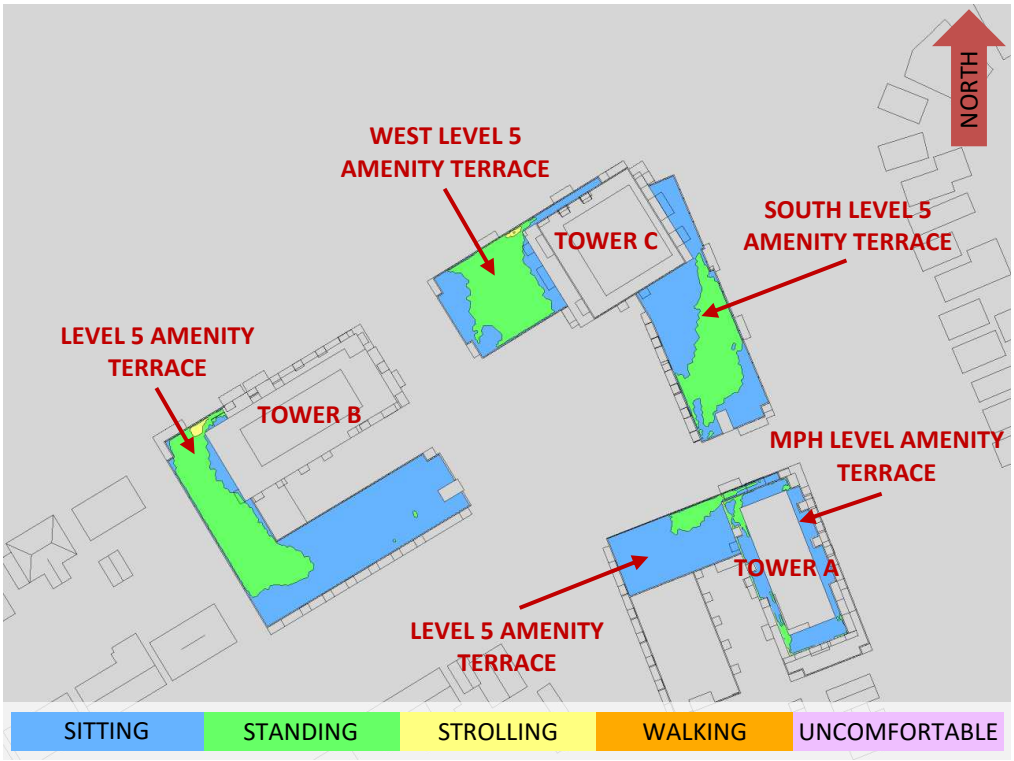

FIGURE 5B: SUMMER – WIND COMFORT, COMMON AMENITY TERRACES

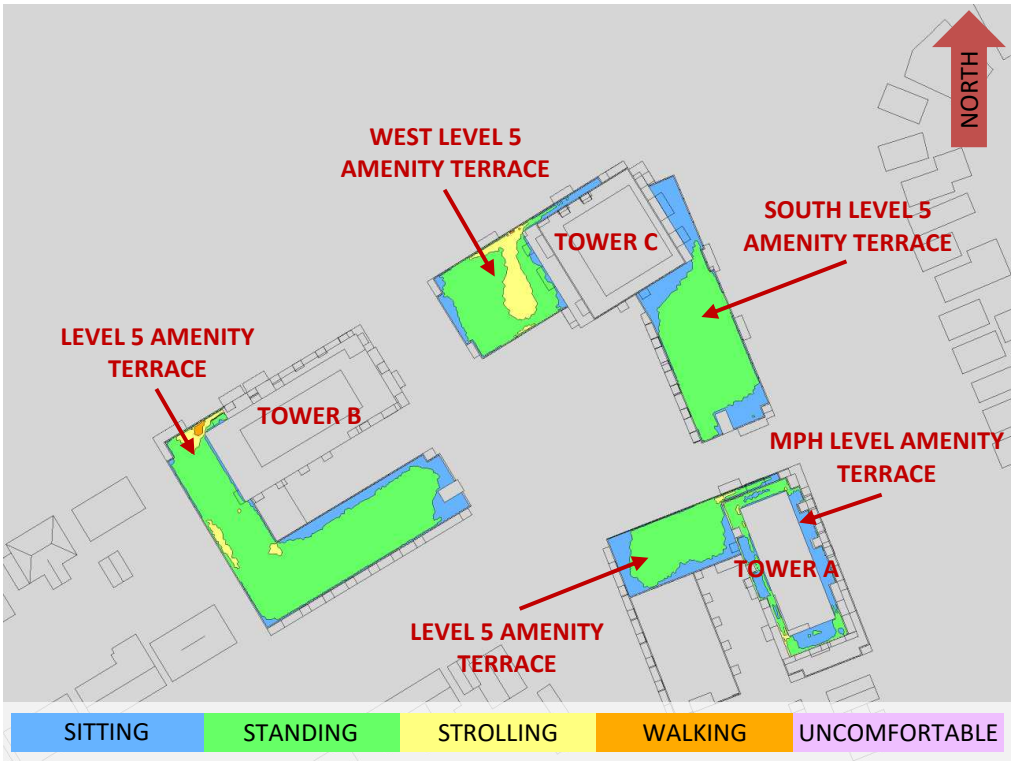

FIGURE 5C: AUTUMN – WIND COMFORT, COMMON AMENITY TERRACES

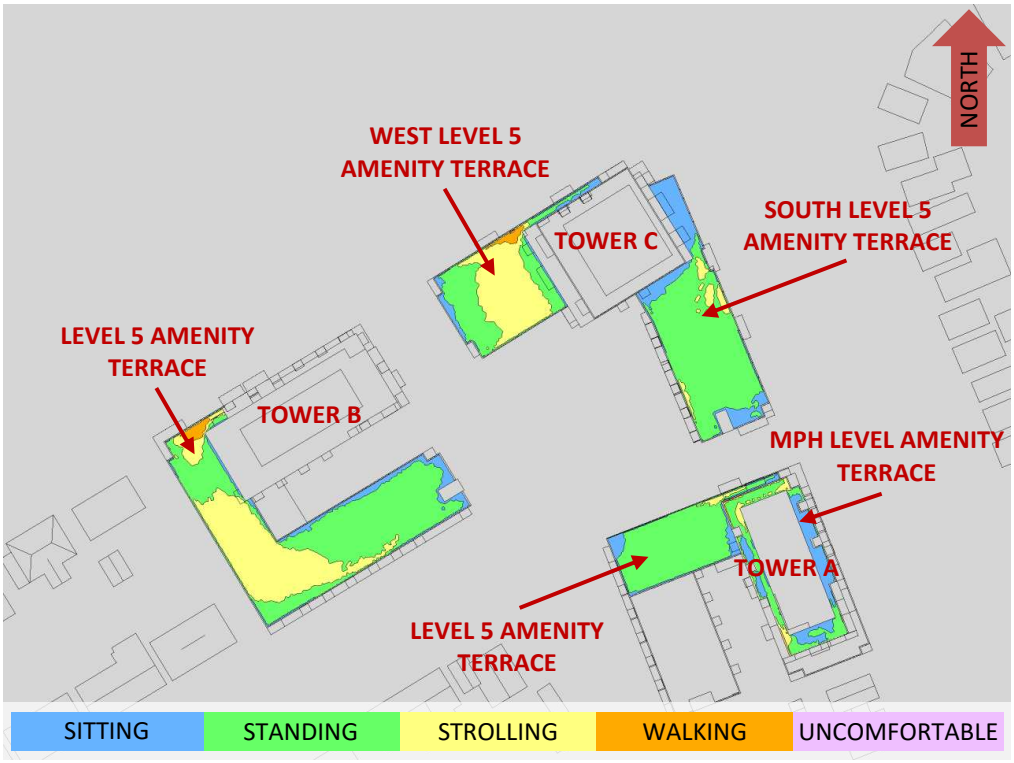

FIGURE 5D: WINTER – WIND COMFORT, COMMON AMENITY TERRACES

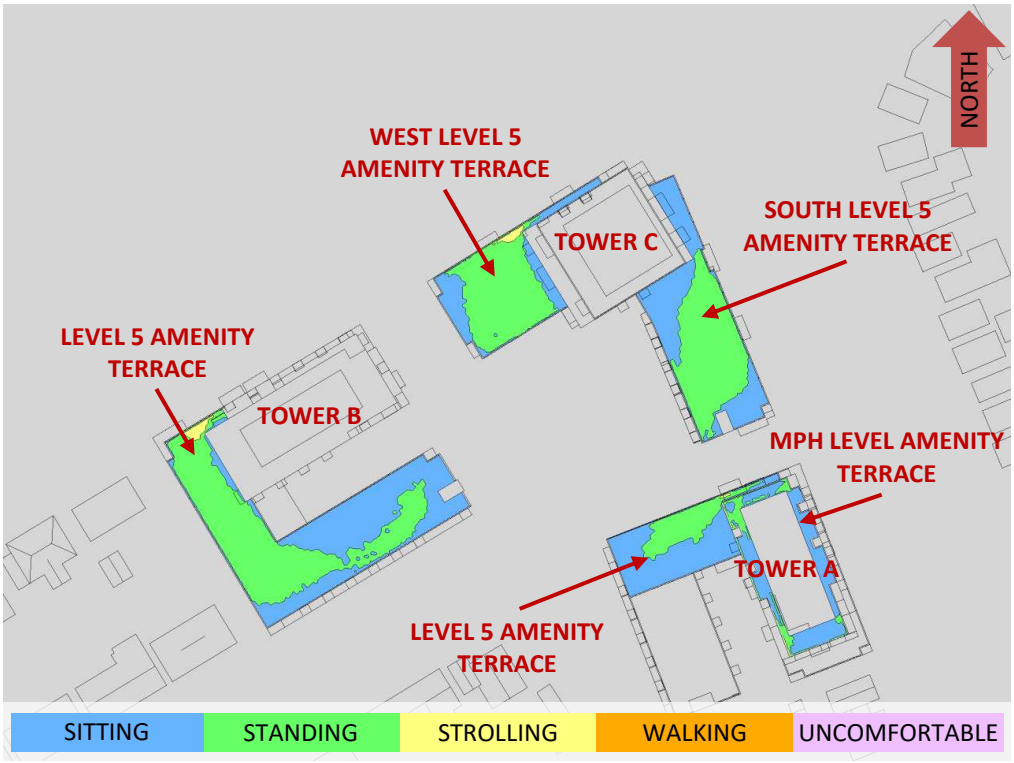

FIGURE 6: TYPICAL USE PERIOD – WIND COMFORT, COMMON AMENITY TERRACES

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 (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
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).

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

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

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

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

REFERENCES

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

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

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