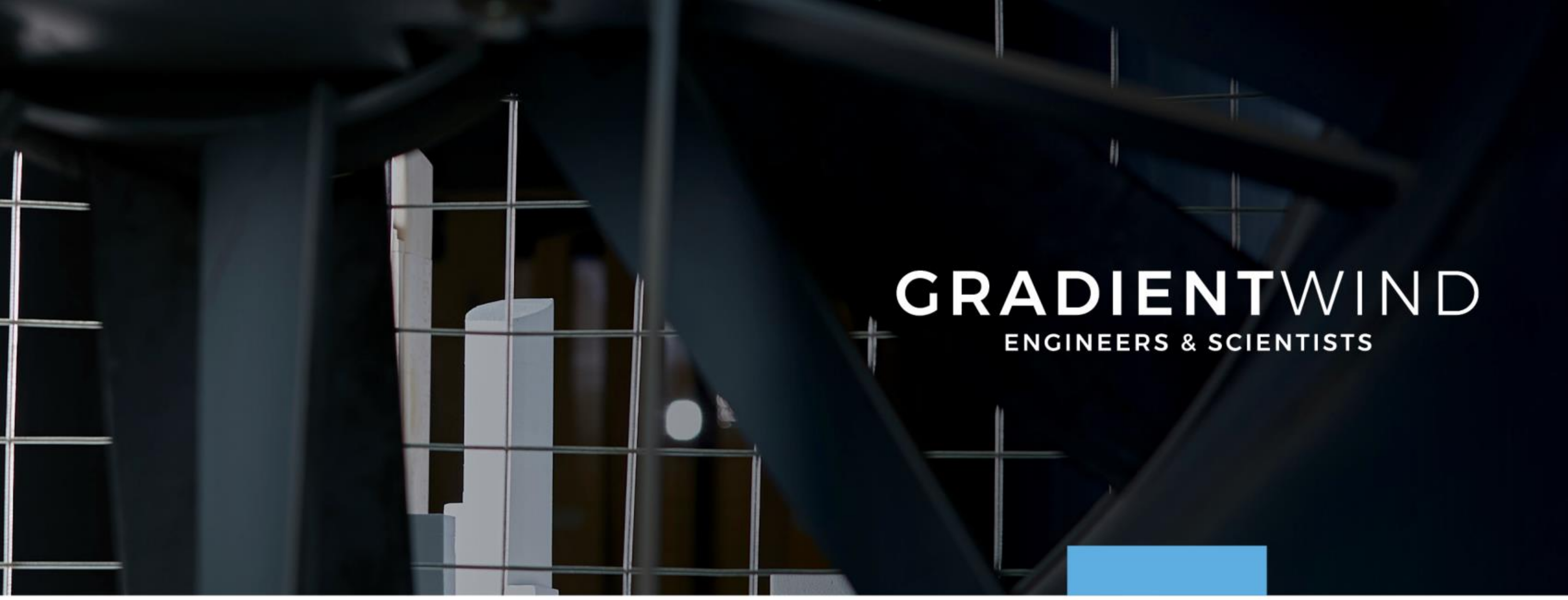
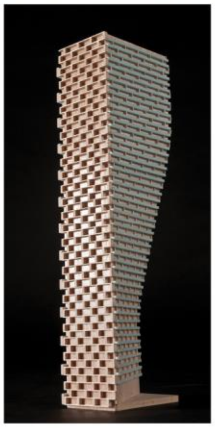


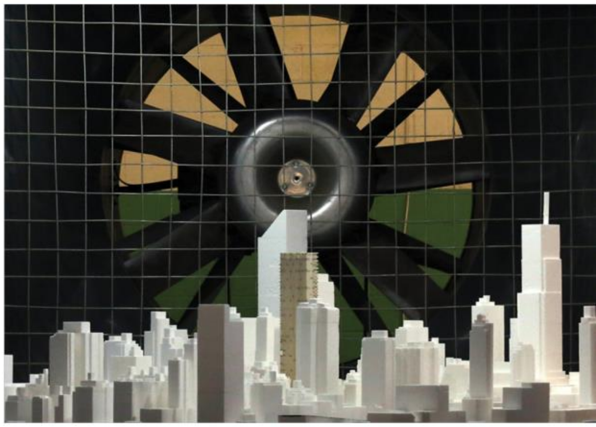
GRADIENTWIND
ENGINEERS & SCIENTISTS

PEDESTRIAN LEVEL WIND STUDY

33 Davisville Avenue & 60 Balliol Street
Toronto, Ontario

Report: 22-107-PLW-2023





October 12, 2023

PREPARED FOR
Osmington Gerofsky Development Corporation
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EXECUTIVE SUMMARY

This report describes a pedestrian level wind (PLW) study to satisfy Zoning By-law Amendment (ZBLA) application submission requirements for the proposed residential development located at 33 Davisville Avenue & 60 Balliol Street in Toronto, Ontario (hereinafter referred to as the "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 sixteen (16) 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 conditions within and surrounding the subject site according to City of Toronto wind comfort and safety criteria. A complete summary of the predicted wind conditions is provided in Section 5 and illustrated in Figures 3A-11, and is 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, nearby existing walkways, nearby existing laneway, the parkland dedication serving 95 Balliol Street, the outdoor amenity and parkland dedication serving 45 Balliol Street, the seating areas serving 77 Davisville Avenue, laneway, walkways, pet relief area, and in the vicinity of building access points, are considered acceptable. The three areas of interest are described as follows:

    a. **Outdoor Amenities and Parkland Dedication.** The outdoor amenities near the northwest and northeast corners of the proposed development and the parkland dedication to the east are predicted to be suitable for a mix of sitting and standing during the typical use period (that is, May to October, inclusive).

        i. Depending on the programming of the outdoor amenities and the parkland dedication, the noted conditions may be considered acceptable. Specifically, if the windier areas of these spaces will not accommodate seating or lounging activities, the noted conditions would be considered acceptable.

ii. If required by programming, comfort levels within the noted spaces may be improved by implementing landscaping elements around sensitive areas such as tall wind screens and coniferous trees in dense arrangements, in combination with strategically placed seating with high-back benches and other local wind mitigation.

2) The proposed development is served by common amenity terraces at Level 6 and at the MPH Level. Per the mitigation recommendations in the previous wind tunnel study, the noted common amenity terraces were modelled with 2-m-tall wind screens along their full perimeters. Of note, per the landscape drawings distributed to the consultant team following the completion of the present analysis, the perimeter wind screens of the terraces are planned to be raised to a height of 2.4 m above the local walking surface of the terraces. Additionally, trellises are proposed along the north elevation of the Level 6 terrace. Wind comfort conditions during the typical use period within the noted common amenity terraces are provided as follows:

   a. **Level 6 Amenity Terrace**: With the 2-m-tall wind screens around the full perimeter of the terrace considered in the present study, wind comfort conditions are predicted to be suitable for sitting with regions suitable for standing near the northeast corner of the tower and to the north and west of the terrace. With the mitigation strategies adopted by the landscape architects and the design team, the noted conditions are expected to improve, and the sitting conditions are expected to extend within the windiest areas.

   b. **MPH Level Amenity Terrace**: With the 2-m-tall wind screens around the full perimeter of the terrace considered in the present study, wind comfort conditions are predicted to be suitable for sitting with regions suitable for standing near the northeast, southeast, and southwest corners of the terrace. Since the terrace is programmed to be active, the noted conditions are considered acceptable. Furthermore, with the mitigation strategies adopted by the landscape architects and the design team, the wind comfort conditions are expected to improve, and the sitting conditions are expected to extend within the windiest areas.

3) Wind comfort conditions during the typical use period over the amenity terraces serving the neighbouring developments at 45 and 22 Balliol Street are predicted to remain unchanged following the introduction of the proposed development.

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.

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1. INTRODUCTION

Gradient Wind Engineering Inc. (Gradient Wind) was retained by Osmington Gerofsky Development Corporation to undertake a pedestrian level wind (PLW) study to satisfy Zoning By-law Amendment (ZBLA) application submission requirements for the proposed residential development located at 33 Davisville Avenue & 60 Balliol Street in Toronto, Ontario (hereinafter referred to as the "subject site" or "proposed development"). A PLW wind tunnel study was conducted in May 2022[1] for the previous design of the 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 is based on industry standard computer simulations using the computational fluid dynamics (CFD) technique and data analysis procedures, City of Toronto wind and safety criteria, architectural drawings provided by Wallman Architects in September 2023, surrounding street layouts and existing and approved future building massing information obtained from the City of Toronto, and recent site imagery.

2. TERMS OF REFERENCE

The subject site is located at 33 Davisville Avenue & 60 Balliol Street in Toronto, situated on the south side of a parcel of land bounded by Davisville Avenue to the north, Pailton Crescent to the east, Balliol Street to the south, and Yonge Street to the west. An existing 21-storey residential building resides to the north of the subject site at the civic address of 33 Davisville Avenue. The proposed development is located to the south of the subject site and comprises nearly rectangular 40-storey residential building, topped with a mechanical penthouse (MPH). The proposed development includes three below-grade parking levels that are connected to the three existing parking levels underneath the existing northern building. Access to the underground parking levels is provided by the existing ramp located at the northwest corner of the noted existing building from Davisville Avenue.

The ground floor includes an indoor amenity to the east, a lobby to the south with entrances to the south and at the southwest corner, a garbage storage to the west, a loading area at the northwest corner, a central elevator core, and shared building support spaces throughout the remainder of the level. A pet

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[1] Gradient Wind Engineering Inc., '*33 Davisville Avenue – Pedestrian Level Wind Study*', [May 19, 2022]

relief area is located near the southwest corner of the noted existing building, outdoor amenities are near the northwest and northeast corners of the proposed development, and a parkland dedication is to the east. Level 2 is open to below at the northwest corner and includes an indoor amenity to the west and residential units throughout the remainder of the level. Levels 3-5 are reserved for residential occupancy. The building steps back from the south elevation at Level 5 to accommodate private terraces. Level 6 is reserved for indoor amenities and includes setbacks from the west, north, and east elevations to accommodate an amenity terrace. The building extends from the noted elevations at Level 7. Levels 7-40 rise with a typical residential planform. The MPH Level includes an indoor amenity at the southeast corner and mechanical space throughout the remainder of the level. The building steps back from the east and south elevations at this level to accommodate an amenity terrace.

Regarding wind exposures, the near-field surroundings of the development (defined as an area falling within a 200 m radius of the subject site) comprise a mix of mid- and high-rise buildings in all compass directions with low-rise massing from the west clockwise to the northeast. Notably, a 37-storey residential building is approved at 95 Balliol Street, approximately 100 m to the southeast. In addition, two 40-storey residential buildings are approved at 45 Balliol Street, to the immediate south, and at 22 Balliol Street, approximately 70 m to the west, respectively.

The far-field surroundings (defined as the area beyond the near field and within a two-kilometre (km) radius) comprise low-rise suburban massing in all compass directions with isolated mid- and high-rise buildings from the south clockwise to the northeast and clusters of high-rise buildings to the north, east, and south. Mount Pleasant Cemetery extends from the east to the west - southwest.

A site plan for the proposed massing scenario is illustrated in Figure 1A, while the existing scenario is illustrated in Figure 1B. Figures 2A-2H illustrate the computational models 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 subject 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 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 Toronto area wind climate, and synthesis of computational data with City of Toronto wind 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 subject 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 Lester B. Pearson International Airport in Mississauga, Ontario. 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 proposed 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 stronger wind speed values.

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[2] Toronto, *Pedestrian Level Wind Study Terms of Reference Guide*, 2022
https://www.toronto.ca/wp-content/uploads/2022/03/8f9c-CityPlanning-ToR-Wind-Guide.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 subject site for 16 wind directions. The CFD simulation model was centered on the proposed development, complete with surrounding massing within a radius of approximately 480 m. The process was performed for two context massing scenarios, as noted in Section 2.

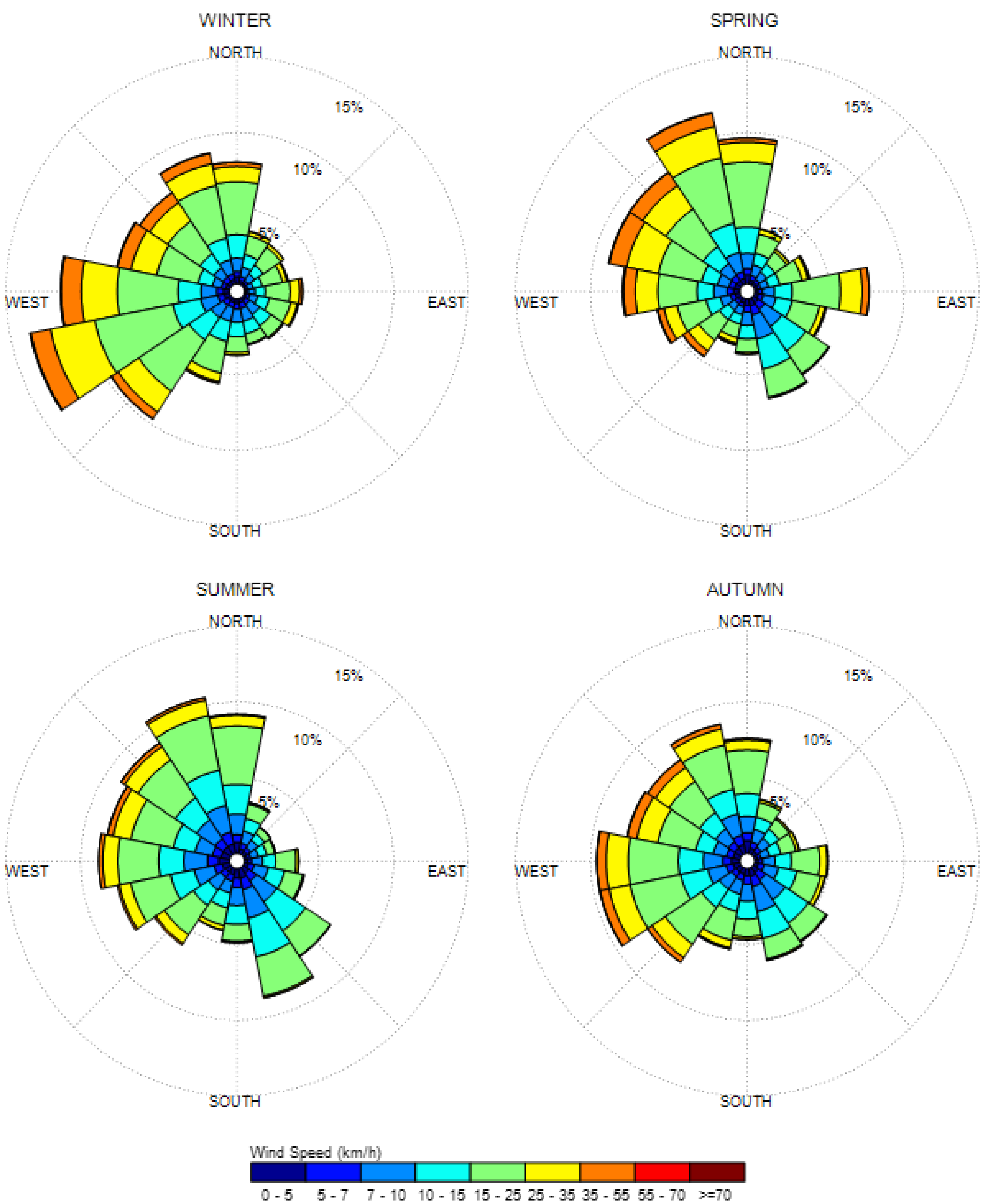
Mean and peak wind speed data obtained over the subject site for each wind direction were interpolated to 36 wind directions at 10° intervals, representing the full compass azimuth. Measured wind speeds approximately 1.5 m above local grade, the common amenity terraces serving the proposed development, and the common amenity terraces serving the neighbouring developments at 45 Balliol Street and 22 Balliol Street 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 Toronto was developed from approximately 40 years of hourly meteorological wind data recorded at Lester B. Pearson International Airport and obtained from Environment and Climate Change Canada. Wind speed and direction data were analyzed during the appropriate hours of pedestrian usage (that is, between 06:00 and 23:00) and divided into four distinct seasons, as stipulated in the wind criteria. Specifically, spring is defined as March through May, summer is defined as June through August, autumn is defined as September through November, and winter is defined as December through February, inclusive.

The statistical model of the Toronto 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 Toronto, the most common winds occur for southwesterly clockwise to north wind directions, followed by those from the east, while the most common wind speeds are below 36 km/h. The directional preference and relative magnitude of wind speed changes somewhat from season to season.

SEASONAL DISTRIBUTION OF WIND
LESTER B. PEARSON INTERNATIONAL AIRPORT, MISSISSAUGA, ONTARIO



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 Toronto

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. Since both mean and gust wind speeds affect pedestrian comfort, their combined effect is defined in the City of Toronto Pedestrian Level Wind Study Terms of Reference Guide. Specifically, the criteria are defined as a Gust Equivalent Mean (GEM) wind speed, which is the greater of the mean wind speed or the gust wind speed divided by 1.85.

The wind speed ranges are based on the Beaufort scale, which describes the effects of forces produced by varying wind speed levels on objects. Four pedestrian comfort classes and corresponding gust wind speed ranges are used to assess pedestrian comfort: (1) Sitting; (2) Standing; (3) Walking; and (4) Uncomfortable. Wind conditions suitable for sitting are represented by the colour blue, standing by green, and walking by yellow; uncomfortable conditions are represented by the colour orange, consistent with the City of Toronto Terms of Reference. 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	GEM wind speeds no greater than 10 km/h occurring at least 80% of the time are considered acceptable for sedentary activities, including sitting.
STANDING	≤ 15	GEM wind speeds no greater than 15 km/h occurring at least 80% of the time are considered acceptable for activities such as standing, strolling, or more vigorous activities.
WALKING	≤ 20	GEM wind speeds no greater than 20 km/h occurring at least 80% of the time are considered acceptable for walking or more vigorous activities.
UNCOMFORTABLE	> 20	Uncomfortable conditions are characterized by predicted values that fall below the 80% target for walking. Brisk walking and exercise, such as jogging, are considered acceptable for moderate excesses of this criterion.

Regarding wind safety, gust wind speeds greater than 90 km/h, occurring more than 0.1% of the time on an annual basis (based on wind events recorded for 24 hours a day), are 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.

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 GEM wind speeds of 10 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 GEM wind speeds of 20 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 below. 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
Café / Patio / Bench / Garden	Sitting / Standing
Transit/Bus Stop (Without Shelter)	Standing
Transit/Bus Stop (With Shelter)	Walking
Public Park / Plaza / Amenity Space	Sitting / Standing
Garage / Service Entrance / Parking Lot	Walking

5. RESULTS AND DISCUSSION

The following discussion of the predicted pedestrian wind conditions for the subject site is accompanied by Figures 3A-6B, which illustrate wind conditions at grade level for the proposed and existing massing scenarios, and by Figures 8A-8D and 10A-10D, which illustrate wind conditions over the common amenity terraces serving the proposed development at Level 6 and at the MPH Level, respectively. 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 7A-7B illustrate wind comfort conditions at grade level and Figures 9 and 11 illustrate wind comfort conditions over Level 6 and MPH Level 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.

5.1 Wind Comfort Conditions – Grade Level

Sidewalks along Balliol Street: Prior to the introduction of the proposed development, wind comfort conditions over the public sidewalks along Balliol Street are predicted to be suitable for standing, or better, during the summer and autumn, becoming suitable for a mix of standing and walking during the winter and spring. The noted conditions are predicted to remain practically unchanged following the introduction of the proposed development. As such, wind conditions with the proposed development are considered acceptable.

Existing Walkways North of Subject Site: Following the introduction of the proposed development, wind comfort conditions over the existing walkways to the north of the subject site are predicted to be suitable for sitting during the summer, becoming suitable for a mix of sitting and standing during the spring and autumn, and suitable for standing, or better, during the winter. The noted conditions are considered acceptable.

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

Existing Laneway Northeast of Subject Site: Following the introduction of the proposed development, wind comfort conditions over the existing laneway to the northeast of the subject site are predicted to be suitable for a mix of sitting and standing during the summer, becoming suitable for standing, or better, during the spring and autumn, and suitable for standing during the winter. The noted conditions are considered acceptable.

Conditions over the noted laneway with the existing massing are predicted to be suitable for standing, or better, during the summer and autumn, becoming suitable for standing during the winter and spring with small, isolated regions predicted to be suitable for walking during the winter. Notably, the introduction of the proposed development is predicted to improve comfort levels over the laneway to the northeast, in comparison to existing conditions, and wind conditions with the proposed development are considered acceptable.

Seating Areas Serving 77 Davisville Avenue: Following the introduction of the proposed development, wind conditions over the seating areas serving the existing building at 77 Davisville Avenue to the immediate east of the proposed development are predicted to be suitable for sitting to the west and northeast, and suitable for standing throughout the remainder of the area during the typical use period.

Conditions over the seating areas serving the noted building with the existing massing are predicted to be suitable for sitting to the northwest, northeast, and southwest, and suitable for standing throughout the remainder of the area during the typical use period. Notably, the introduction of the proposed development is predicted to slightly improve comfort levels within the seating areas, and wind comfort conditions with the proposed development are considered acceptable.

Proposed Laneway and Walkways Within Subject Site: Wind comfort conditions over the laneway along the west and north elevations of the proposed development and the walkways to the north, east, and south are predicted to be suitable for standing, or better, throughout the year, with a small, isolated region suitable for walking to the north of the proposed development during the winter. The noted conditions are considered acceptable.

Pet Relief Area, Outdoor Amenities, and Parkland Dedication: Wind comfort conditions over the pet relief area near the southwest corner of the existing building to the north of the subject site, outdoor amenities near the northwest and northeast corners of the proposed development, and the parkland dedication to the east are described as follows:

- Conditions within the pet relief area are predicted to be suitable for sitting during the summer and autumn, becoming suitable for standing, or better, during the spring and winter. The noted conditions are considered acceptable.

- During the typical use period, conditions within the northwest outdoor amenity are predicted to be suitable for sitting to the north and west, and suitable for standing throughout the remainder of the area.

- During the typical use period, conditions within the northeast outdoor amenity are predicted to be suitable for sitting near the northeast corner of the proposed development, and suitable for standing throughout the remainder of the area.

- During the typical use period, conditions within the parkland dedication are predicted to be suitable for sitting to the west, and suitable for standing throughout the remainder of the area.

- Depending on the programming of the outdoor amenities and the parkland dedication, the noted conditions may be considered acceptable. Specifically, if the noted windier areas will not accommodate seating or lounging activities, the noted conditions would be considered acceptable.

- If required by programming, comfort levels within the noted spaces may be improved by implementing landscaping elements around sensitive areas such as tall wind screens and coniferous trees in dense arrangements, in combination with strategically placed seating with high-back benches and other local wind mitigation.

Parkland Dedication Serving 95 Balliol Street: Prior to the introduction of the proposed development, wind comfort conditions over the parkland dedication serving the approved development at 95 Balliol Street situated to the southeast of the subject site are predicted to be suitable for mostly standing during the typical use period. The noted conditions are predicted to remain unchanged following the introduction of the proposed development. As such, wind conditions with the proposed development are considered acceptable.

Outdoor Amenity and Parkland Dedication Serving 45 Balliol Street: Prior to the introduction of the proposed development, wind comfort conditions over the outdoor amenity serving the approved development at 45 Balliol Street situated to the south of the subject site are predicted to be suitable for sitting during the typical use period. Conditions over the existing parkland dedication serving the noted development are predicted to be suitable for standing, or better, during the typical use period. The noted conditions are predicted to remain practically unchanged following the introduction of the proposed development. As such, wind conditions with the proposed development are considered acceptable.

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

5.2 Wind Comfort Conditions – Common Amenity Terraces

The proposed development is served by common amenity terraces at Level 6 and at the MPH Level. Per the mitigation recommendations in the previous wind tunnel study, the noted common amenity terraces were modelled with 2-m-tall wind screens along their full perimeters. Of note, per the landscape drawings[3] distributed to the consultant team following the completion of the present analysis, the perimeter wind screens of the terraces are planned to be raised to a height of 2.4 m above the local walking surface of the terraces. Additionally, trellises are proposed along the north elevation of the Level 6 terrace. Wind comfort conditions during the typical use period within the noted common amenity terraces are provided as follows:

[3] Wallman Architects, '33 Davisville Ave – Wind Study Diagram', [Oct 4, 2023]

Level 6 Amenity Terrace: With the 2-m-tall wind screens around the full perimeter of the terrace considered in the present study, wind comfort conditions within the common amenity terrace serving the proposed development at Level 6 are predicted to be suitable for sitting with regions suitable for standing near the northeast corner of the tower and to the north and west of the terrace, as illustrated in Figure 9. The areas that are predicted to be suitable for standing are also predicted to be suitable for sitting for at least 73% of the time during the typical use period, where the target is 80% to achieve the sitting comfort criterion. With the mitigation strategies adopted by the landscape architects and the design team, that is, 2.4-m-tall wind screens along the full perimeter of the terrace and trellises along the north elevation of the terrace, the wind comfort conditions are expected to improve, and the sitting conditions are expected to extend within the windiest areas.

MPH Level Amenity Terrace: With the 2-m-tall wind screens around the full perimeter of the terrace considered in the present study, wind comfort conditions within the common amenity terrace serving the proposed development at the MPH Level are predicted to be suitable for sitting with regions suitable for standing near the northeast, southeast, and southwest corners of the terrace, as illustrated in Figure 11. The areas that are predicted to be suitable for standing are also predicted to be suitable for sitting for at least 70% of the time during the typical use period, where the target is 80% to achieve the sitting comfort criterion. Per the landscape drawings, the MPH Level common amenity terrace is programmed to be active. Specifically, the southern and eastern portions of the terrace are programmed to be an outdoor gym, and the northern portion of the terrace is programmed to be a yoga deck. As such, the noted conditions are considered acceptable for the intended pedestrian uses within the terrace. Furthermore, with the mitigation strategies adopted by the landscape architects and the design team, that is, 2.4-m-tall wind screens along the full perimeter of the terrace, the wind comfort conditions are expected to improve, and the sitting conditions are expected to extend within the windiest areas.

Common Amenity Terraces Serving 45 Balliol Street: Prior to the introduction of the proposed development, conditions over the common amenity terraces serving the neighbouring development located at 45 Balliol Street, are predicted to be suitable for a mix of sitting and standing, with an isolated region suitable for walking near the southwest corner of the tower within the Level 11 amenity terrace during the typical use period. Conditions are predicted to remain practically unchanged following the introduction of the proposed development.

Common Amenity Terraces Serving 22 Balliol Street: Prior to the introduction of the proposed development, conditions over the podium level common amenity terrace serving the neighbouring development located at 22 Balliol Street, are predicted to be suitable for a mix of sitting and standing with an isolated region suitable for walking near the northwest corner of the tower during the typical use period, while conditions over the MPH Level amenity terrace are predicted to be suitable for sitting throughout the year. Conditions are predicted to remain practically unchanged following the introduction of the proposed development.

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 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. SUMMARY AND RECOMMENDATIONS

A complete summary of the predicted wind conditions is provided in Section 5 of this report and illustrated in Figures 3A-11. 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, nearby existing walkways, nearby existing laneway, the parkland dedication serving 95 Balliol Street, the outdoor amenity and parkland dedication serving 45 Balliol Street, the seating areas serving 77 Davisville Avenue, laneway,

walkways, pet relief area, and in the vicinity of building access points, are considered acceptable. The three areas of interest are described as follows:

a. **Outdoor Amenities and Parkland Dedication.** The outdoor amenities near the northwest and northeast corners of the proposed development and the parkland dedication to the east are predicted to be suitable for a mix of sitting and standing during the typical use period (that is, May to October, inclusive).

   i. Depending on the programming of the outdoor amenities and the parkland dedication, the noted conditions may be considered acceptable. Specifically, if the windier areas of these spaces will not accommodate seating or lounging activities, the noted conditions would be considered acceptable.

   ii. If required by programming, comfort levels within the noted spaces may be improved by implementing landscaping elements around sensitive areas such as tall wind screens and coniferous trees in dense arrangements, in combination with strategically placed seating with high-back benches and other local wind mitigation.

2) The proposed development is served by common amenity terraces at Level 6 and at the MPH Level. Per the mitigation recommendations in the previous wind tunnel study, the noted common amenity terraces were modelled with 2-m-tall wind screens along their full perimeters. Of note, per the landscape drawings distributed to the consultant team following the completion of the present analysis, the perimeter wind screens of the terraces are planned to be raised to a height of 2.4 m above the local walking surface of the terraces. Additionally, trellises are proposed along the north elevation of the Level 6 terrace. Wind comfort conditions during the typical use period within the noted common amenity terraces are provided as follows:

   a. **Level 6 Amenity Terrace**: With the 2-m-tall wind screens around the full perimeter of the terrace considered in the present study, wind comfort conditions are predicted to be suitable for sitting with regions suitable for standing near the northeast corner of the tower and to the north and west of the terrace. With the mitigation strategies adopted by the landscape architects and the design team, the noted conditions are expected to improve, and the sitting conditions are expected to extend within the windiest areas.

b. **MPH Level Amenity Terrace**: With the 2-m-tall wind screens around the full perimeter of the terrace considered in the present study, wind comfort conditions are predicted to be suitable for sitting with regions suitable for standing near the northeast, southeast, and southwest corners of the terrace. Since the terrace is programmed to be active, the noted conditions are considered acceptable. Furthermore, with the mitigation strategies adopted by the landscape architects and the design team, the wind comfort conditions are expected to improve, and the sitting conditions are expected to extend within the windiest areas.

3) Wind comfort conditions during the typical use period over the amenity terraces serving the neighbouring developments at 45 and 22 Balliol Street are predicted to remain unchanged following the introduction of the proposed development.

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
Oct 12, 2023
PROVINCE OF ONTARIO

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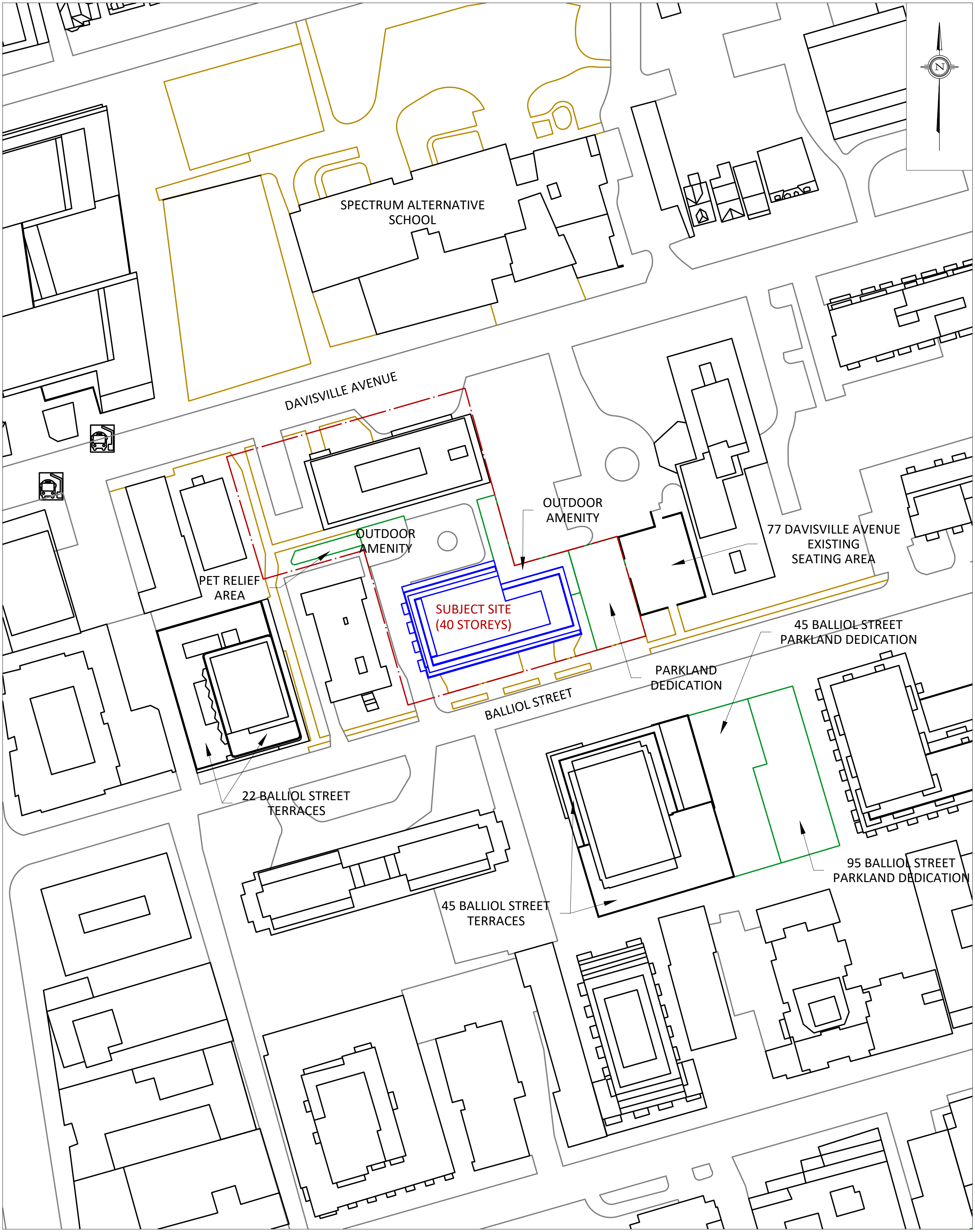

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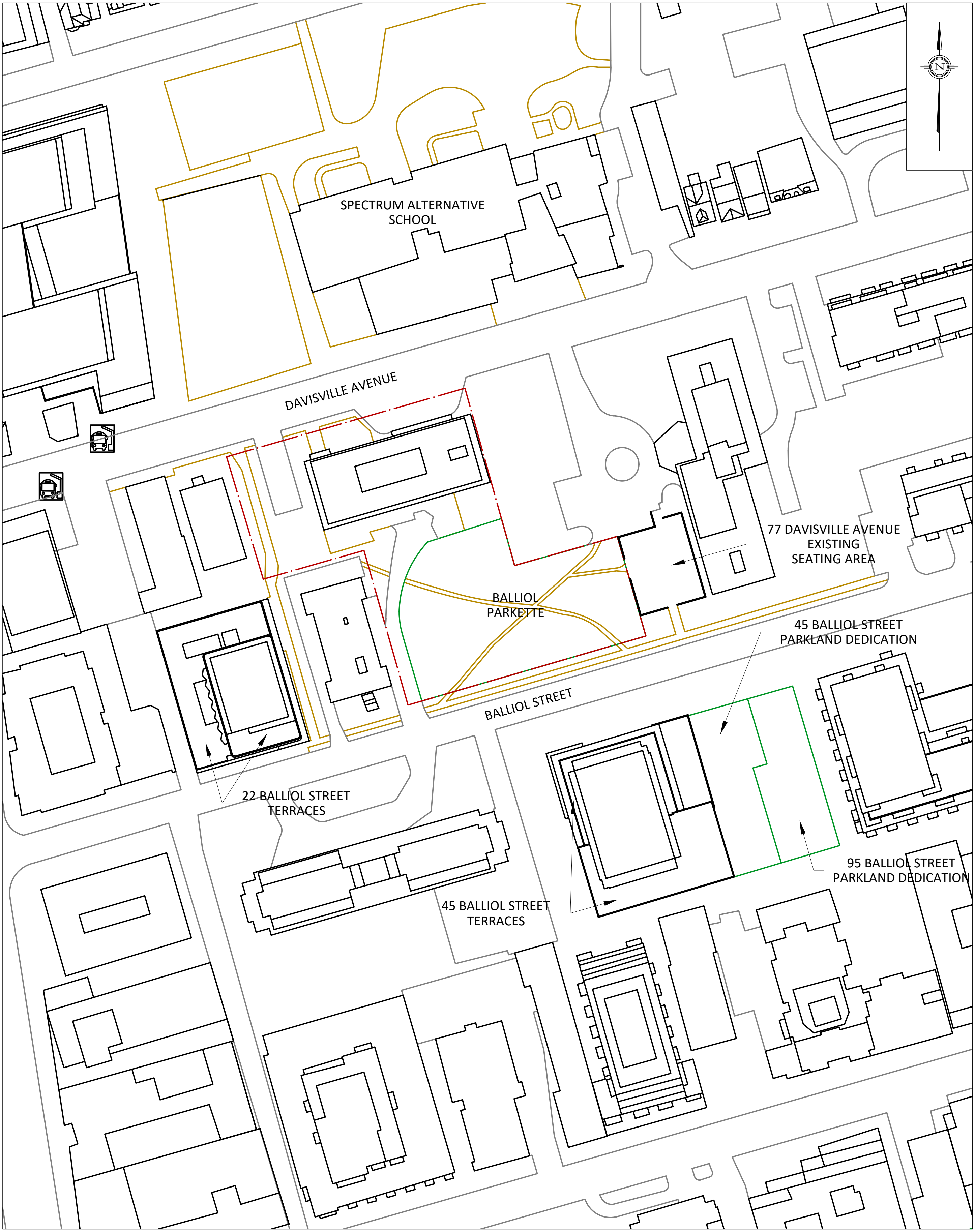
PROJECT	33 DAVISVILLE AVENUE & 60 BALLIOL STREET, TORONTO PEDESTRIAN LEVEL WIND STUDY
SCALE	1:1500
DRAWING NO.	22-107-PLW-2023-1A
DATE	SEPTEMBER 27, 2023
DRAWN BY	N.M.P.
DESCRIPTION	FIGURE 1A: PROPOSED SITE PLAN AND SURROUNDING CONTEXT



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PROJECT	33 DAVISVILLE AVENUE & 60 BALLIOL STREET, TORONTO PEDESTRIAN LEVEL WIND STUDY
SCALE	1:1500
DRAWING NO.	22-107-PLW-2023-1B
DATE	SEPTEMBER 27, 2023
DRAWN BY	N.M.P.
DESCRIPTION	FIGURE 1B: EXISTING SITE PLAN AND SURROUNDING CONTEXT

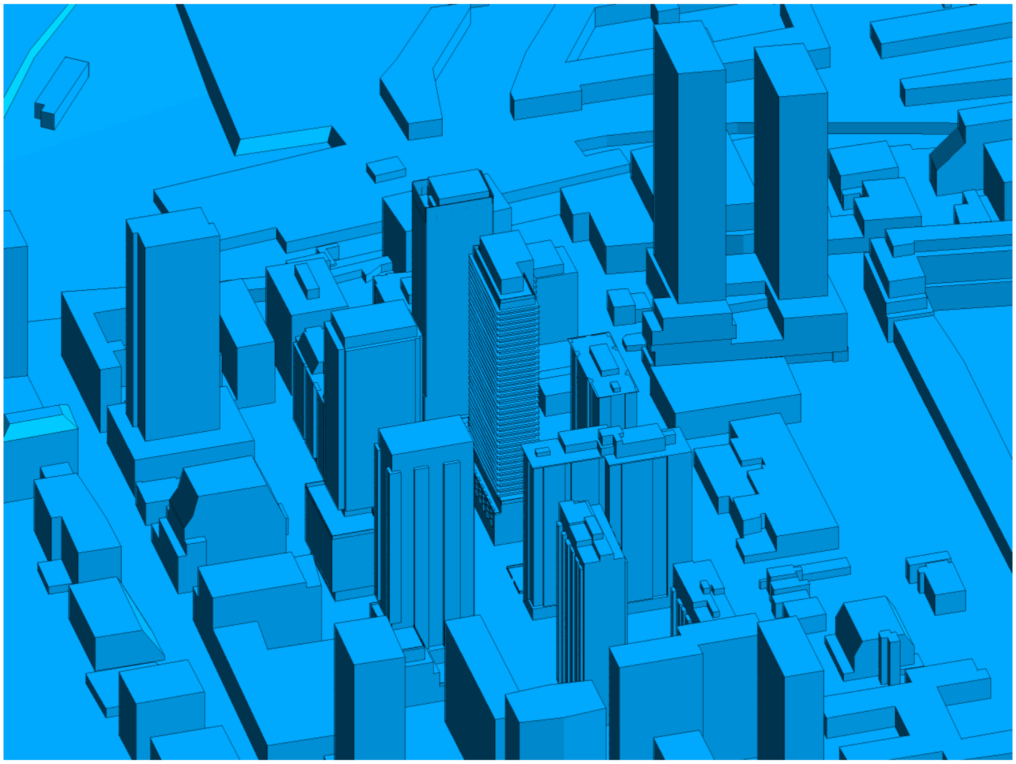


FIGURE 2A: COMPUTATIONAL MODEL, PROPOSED MASSING, EAST PERSPECTIVE

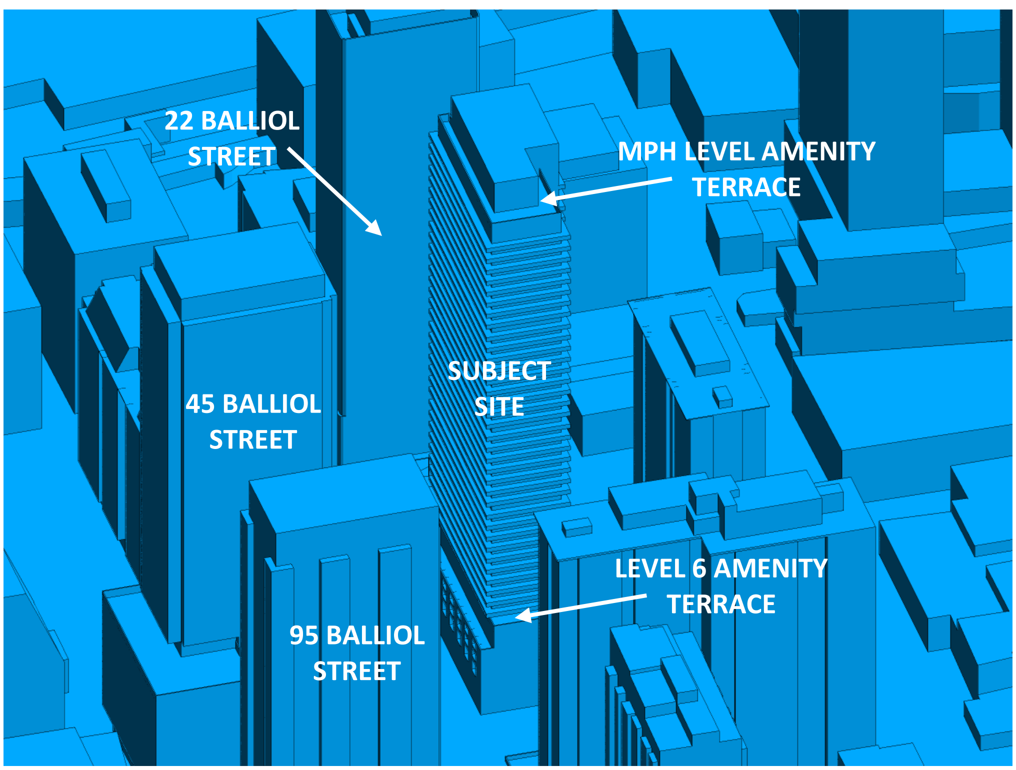


FIGURE 2B: CLOSE-UP VIEW OF FIGURE 2A

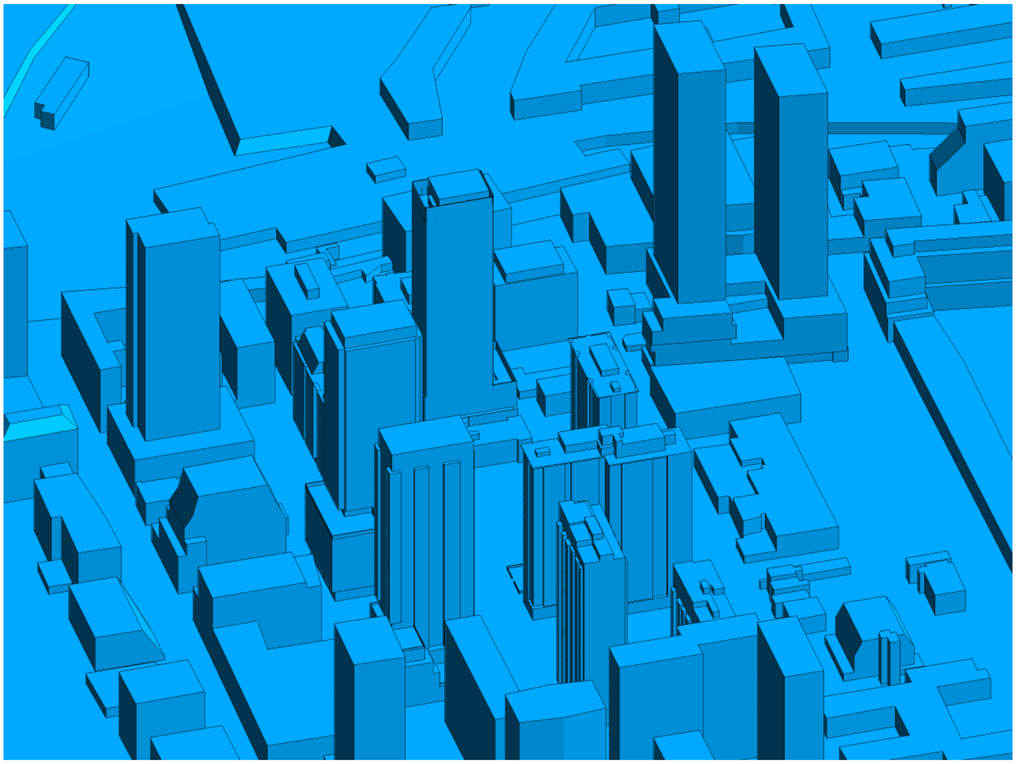


FIGURE 2C: COMPUTATIONAL MODEL, EXISTING MASSING, EAST PERSPECTIVE

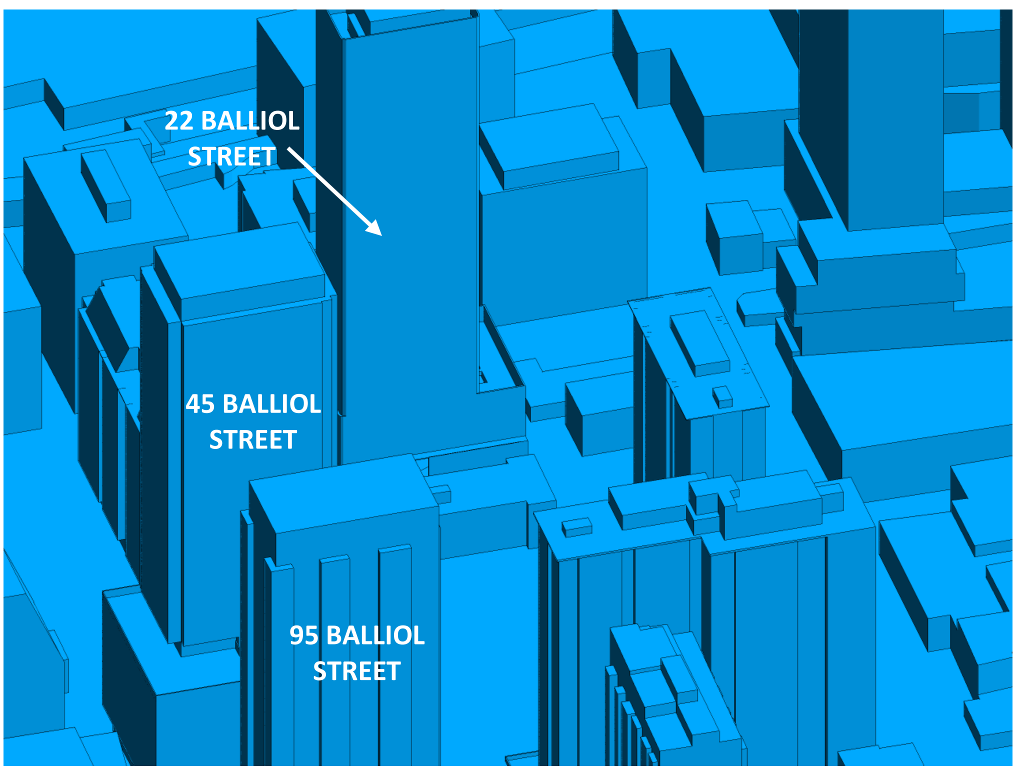


FIGURE 2D: CLOSE-UP VIEW OF FIGURE 2C

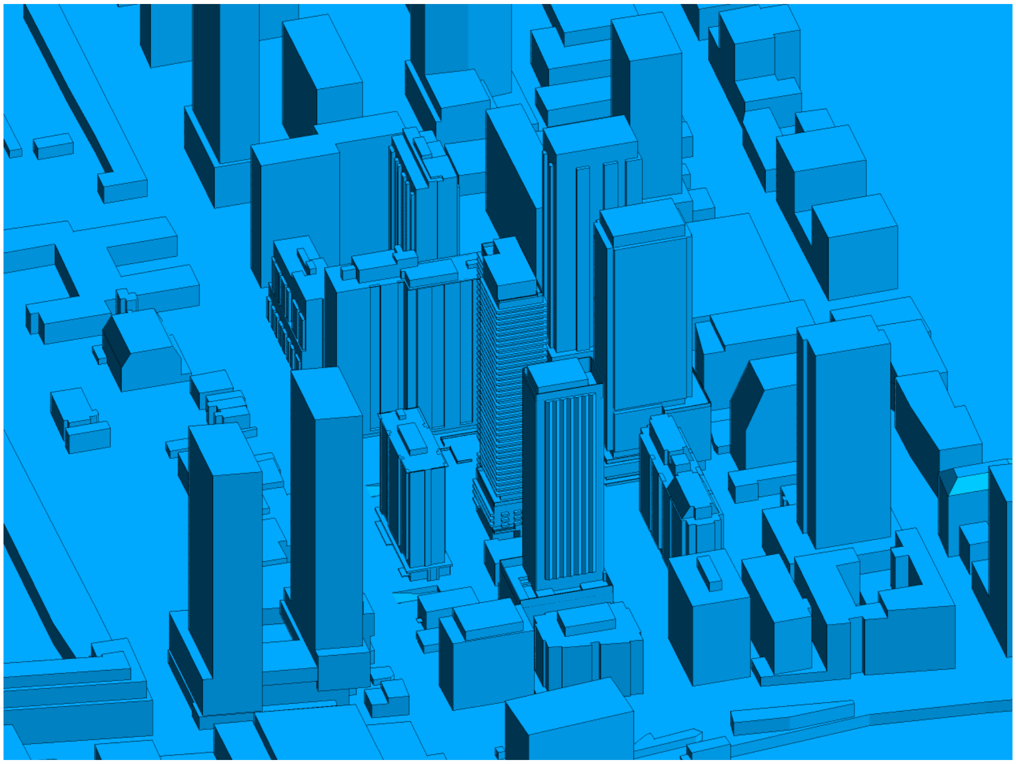


FIGURE 2E: COMPUTATIONAL MODEL, PROPOSED MASSING, WEST PERSPECTIVE

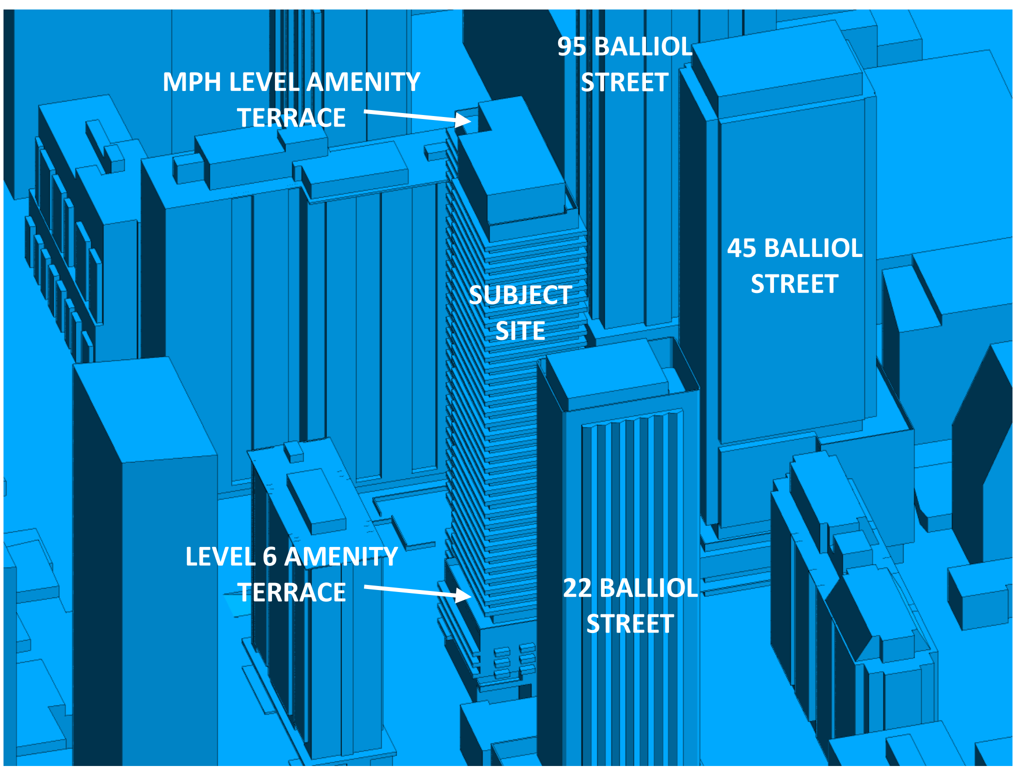


FIGURE 2F: CLOSE-UP VIEW OF FIGURE 2E

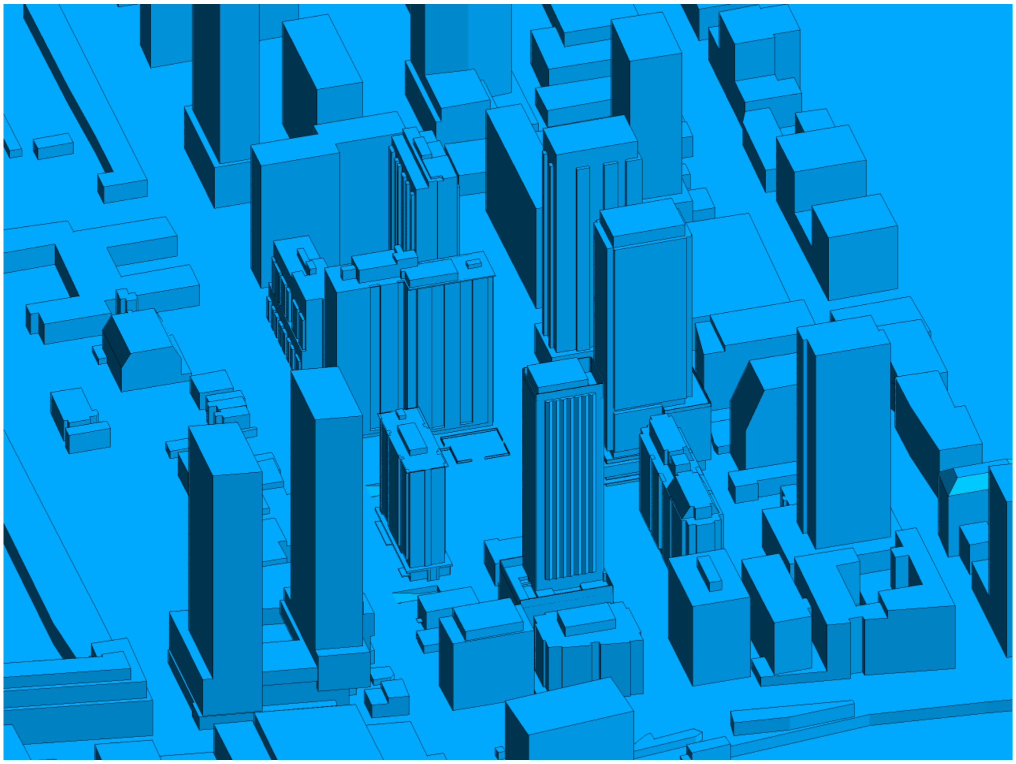


FIGURE 2G: COMPUTATIONAL MODEL, EXISTING MASSING, WEST PERSPECTIVE

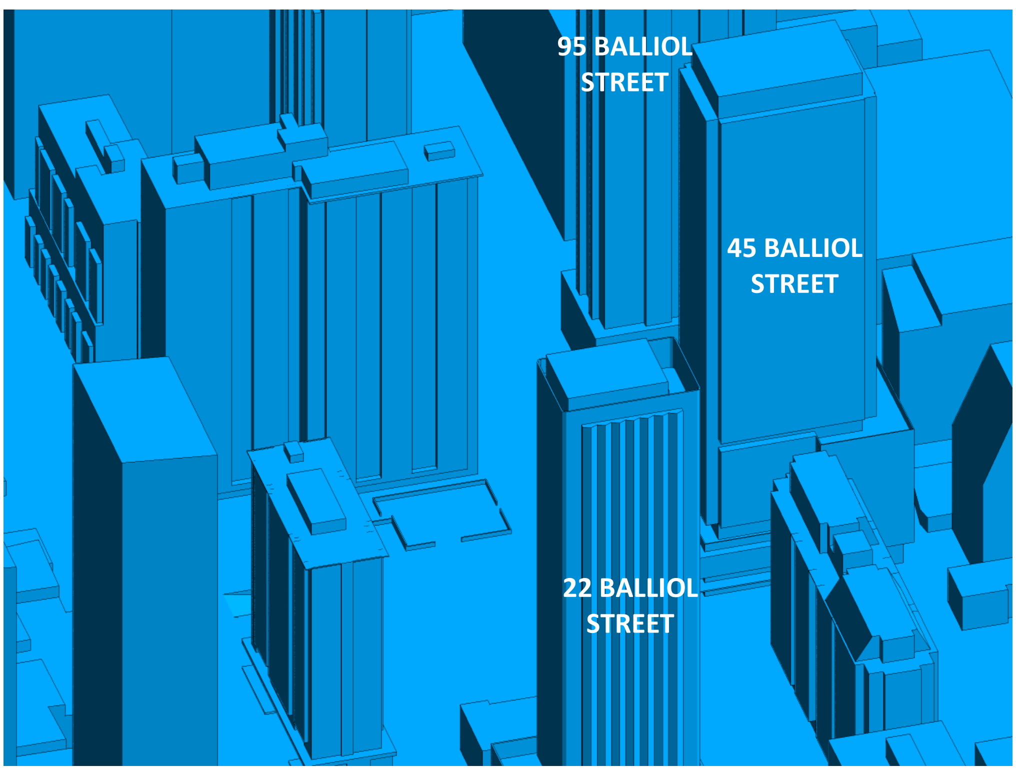


FIGURE 2H: CLOSE-UP VIEW OF FIGURE 2G

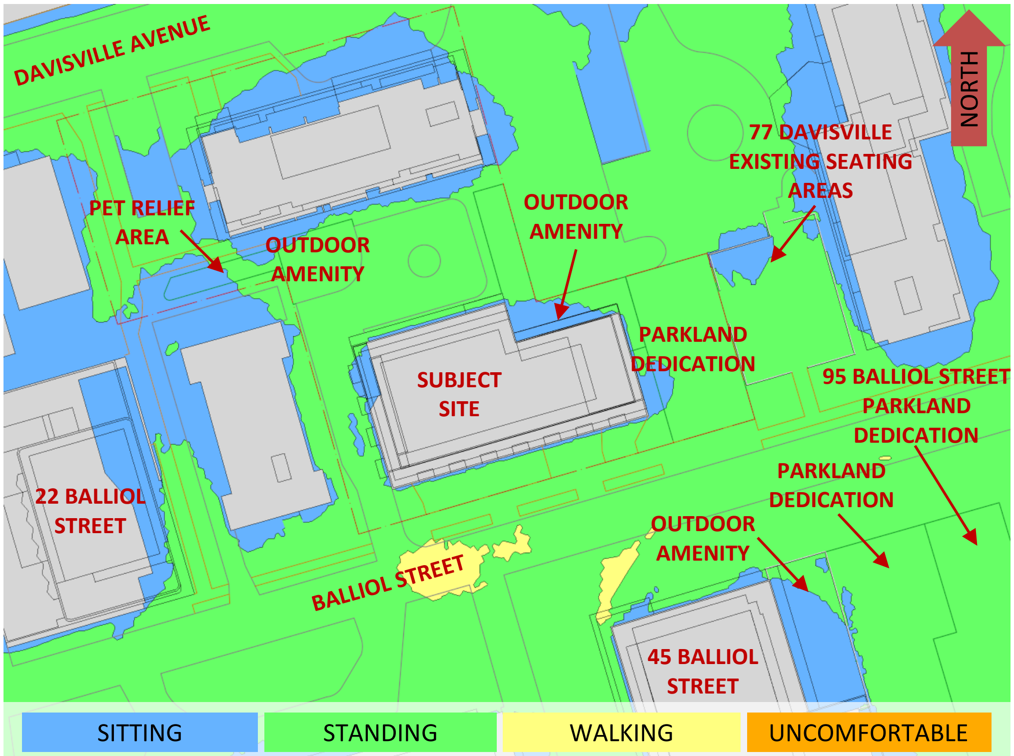


FIGURE 3A: SPRING – PROPOSED MASSING – WIND COMFORT, GRADE LEVEL

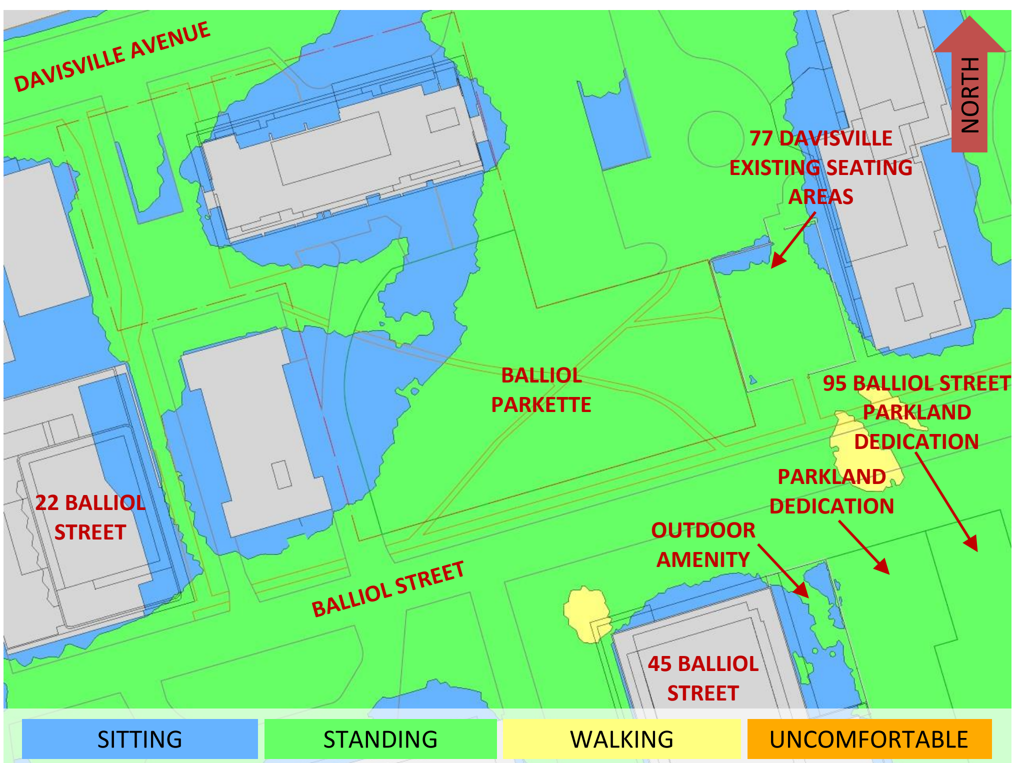


FIGURE 3B: SPRING – EXISTING MASSING – WIND COMFORT, GRADE LEVEL

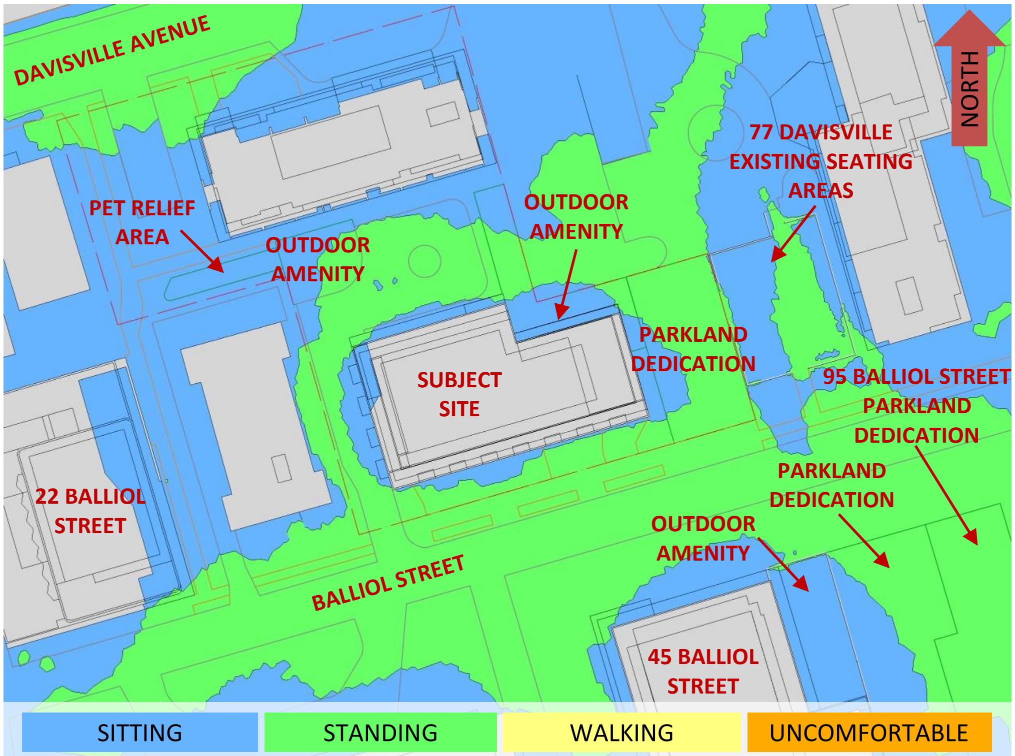


FIGURE 4A: SUMMER – PROPOSED MASSING – WIND COMFORT, GRADE LEVEL

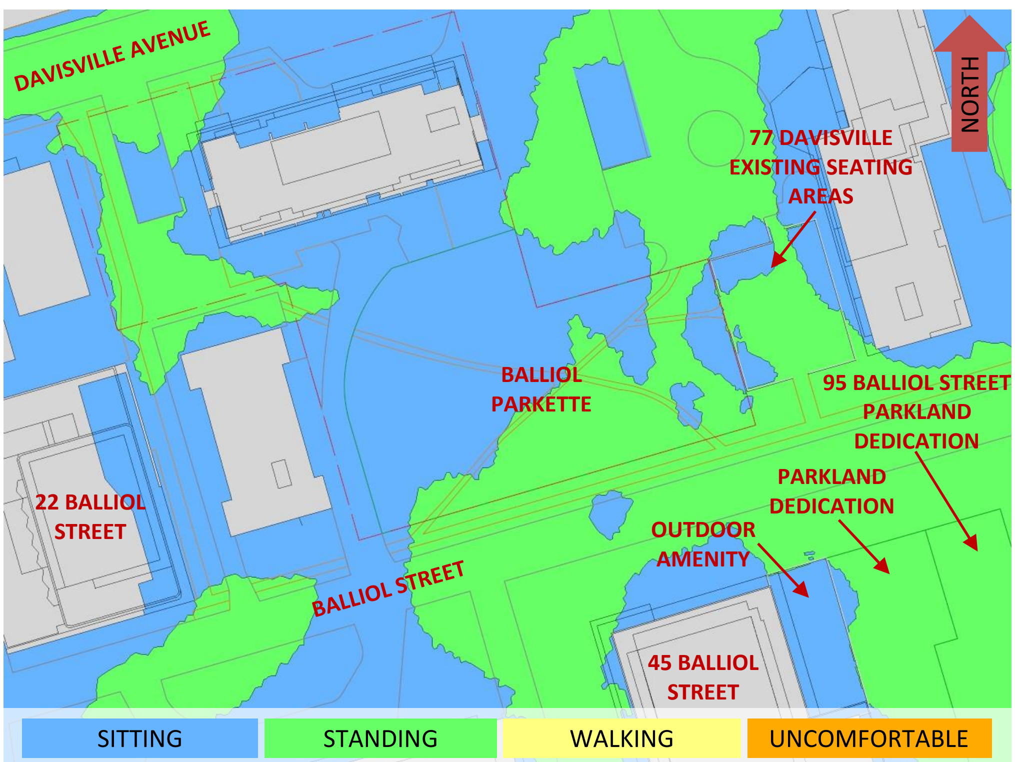


FIGURE 4B: SUMMER – EXISTING MASSING – WIND COMFORT, GRADE LEVEL

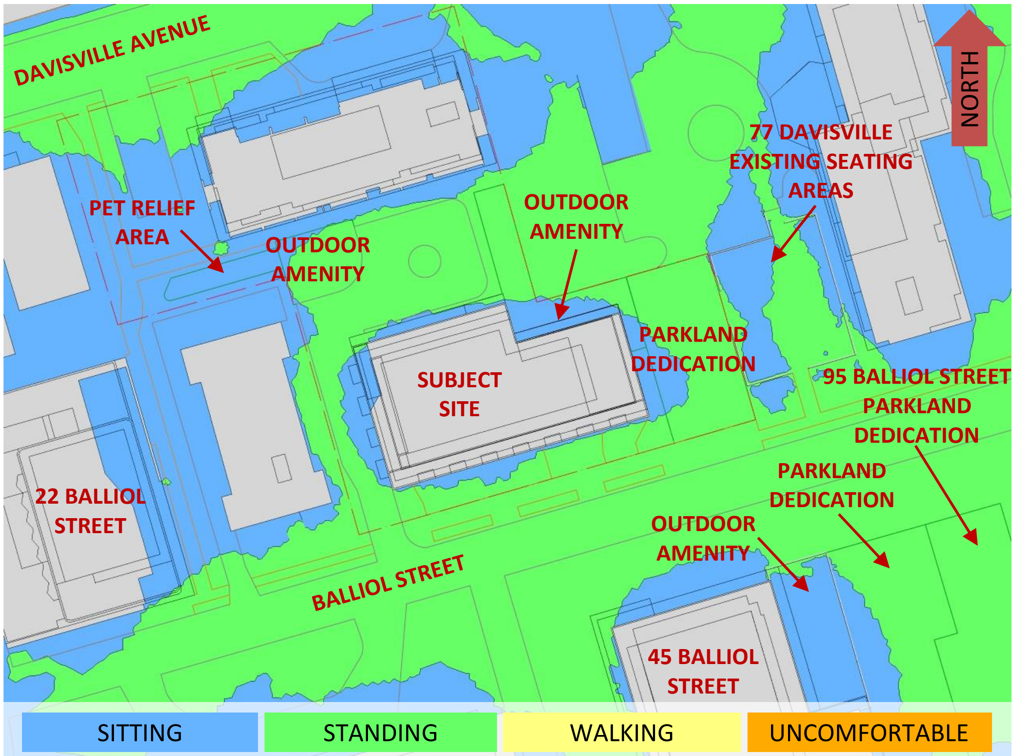


FIGURE 5A: AUTUMN – PROPOSED MASSING – WIND COMFORT, GRADE LEVEL

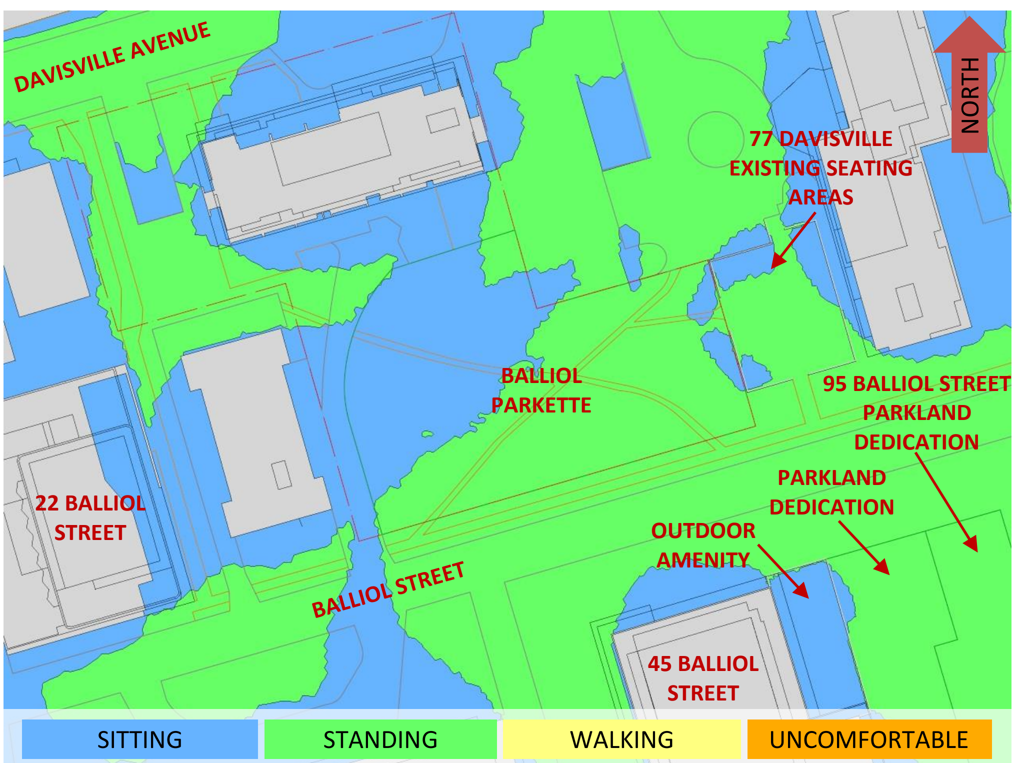


FIGURE 5B: AUTUMN – EXISTING MASSING – WIND COMFORT, GRADE LEVEL

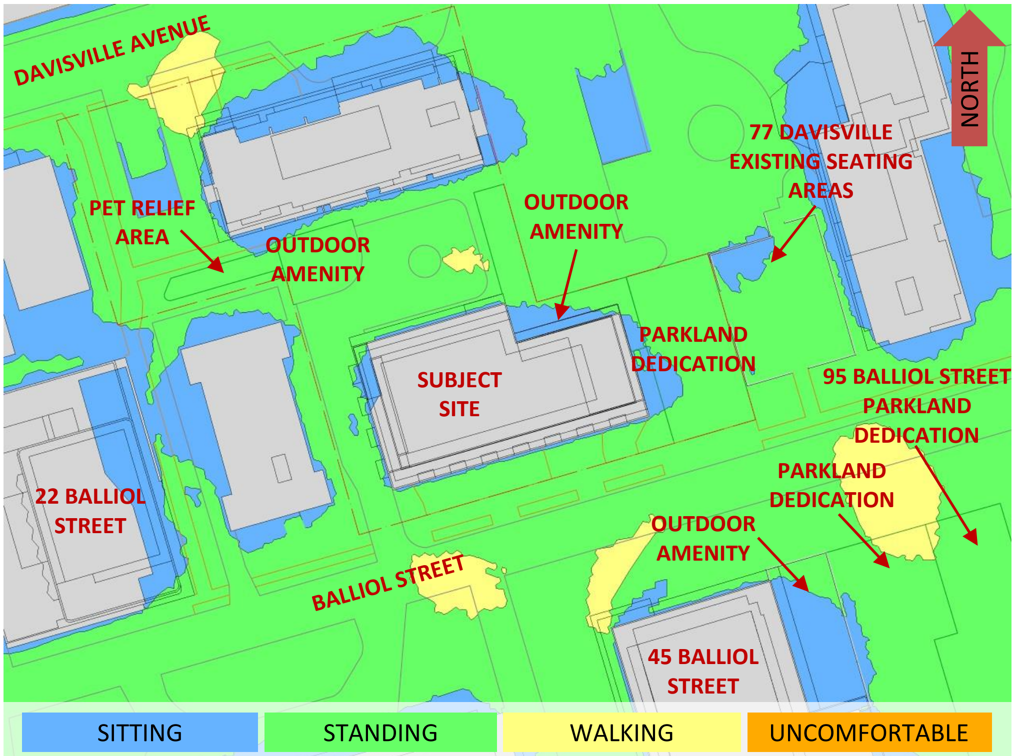


FIGURE 6A: WINTER – PROPOSED MASSING – WIND COMFORT, GRADE LEVEL

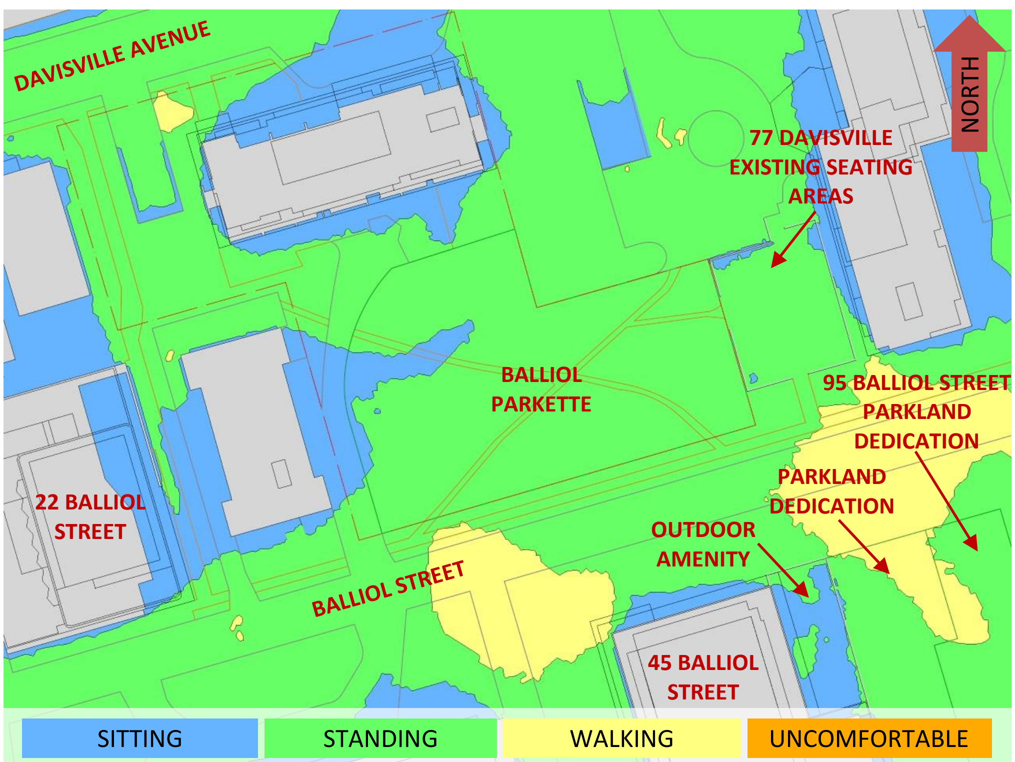


FIGURE 6B: WINTER – EXISTING MASSING – WIND COMFORT, GRADE LEVEL

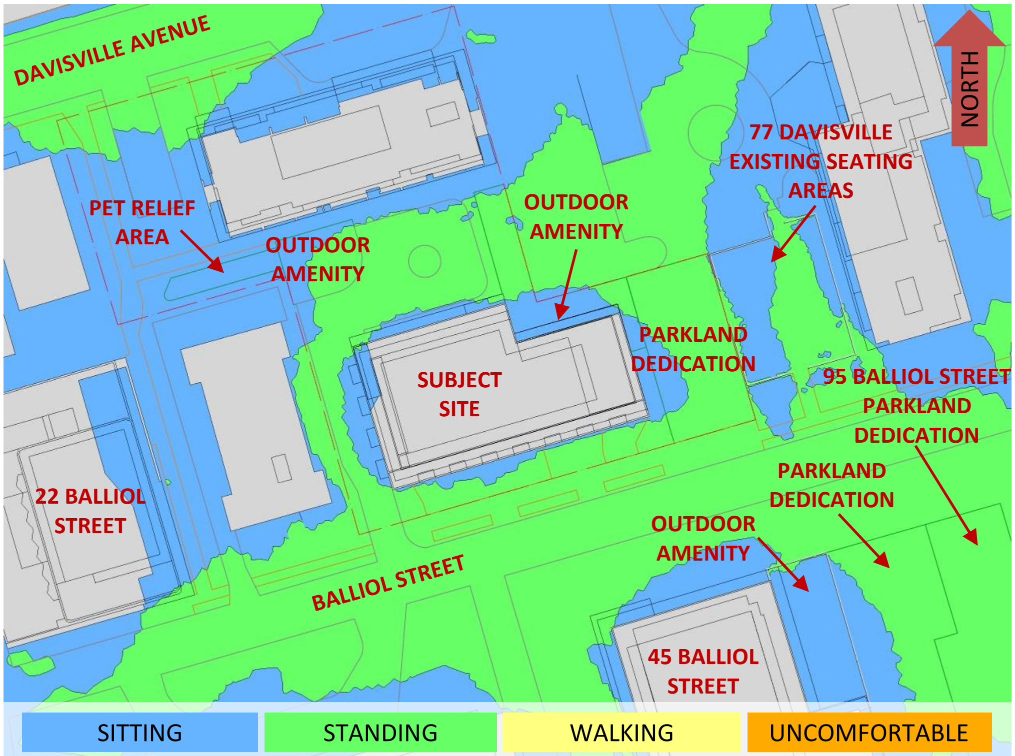


FIGURE 7A: TYPICAL USE PERIOD – PROPOSED MASSING – WIND COMFORT, GRADE LEVEL

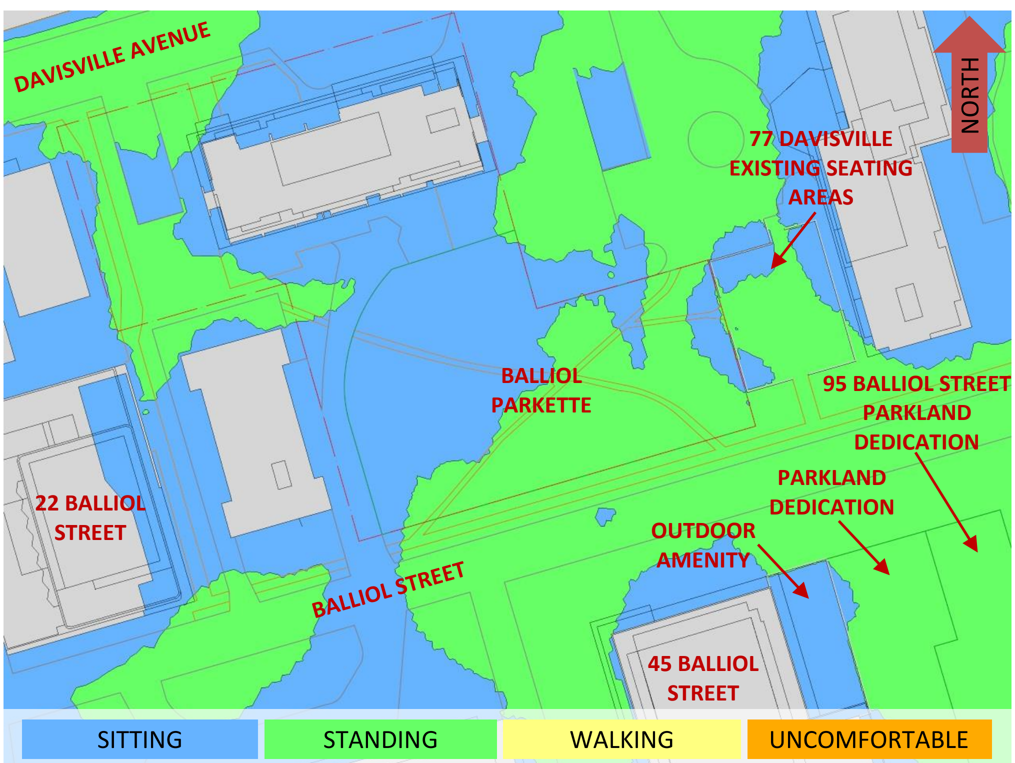


FIGURE 7B: TYPICAL USE PERIOD – EXISTING MASSING – WIND COMFORT, GRADE LEVEL

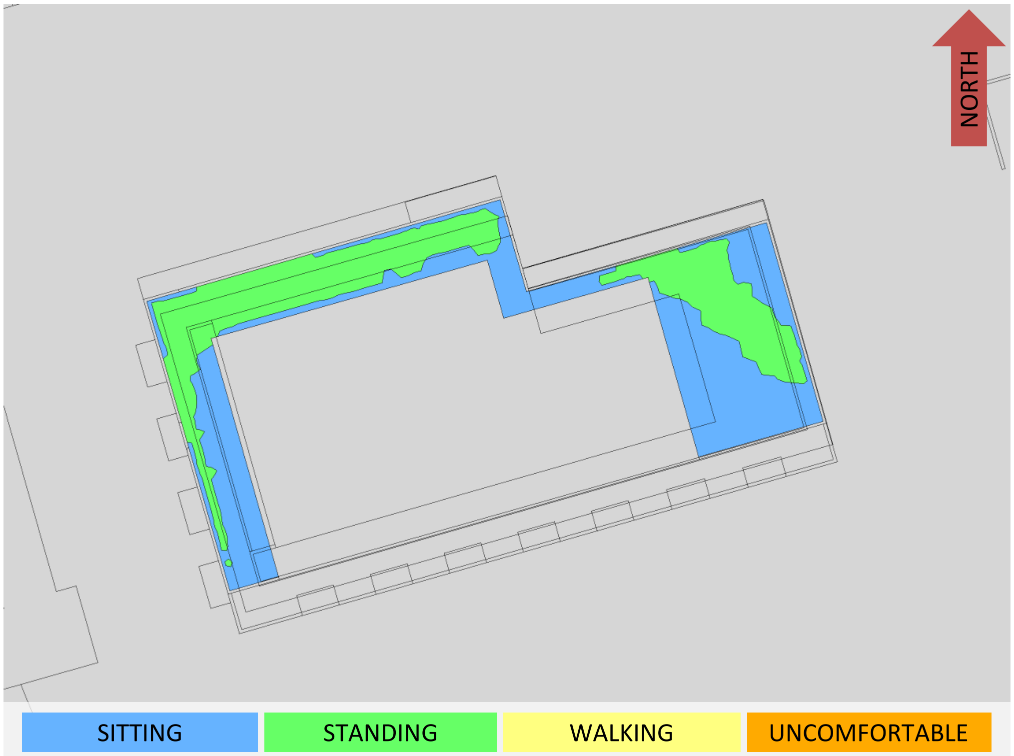


FIGURE 8A: SPRING – WIND COMFORT, LEVEL 6 AMENITY TERRACE

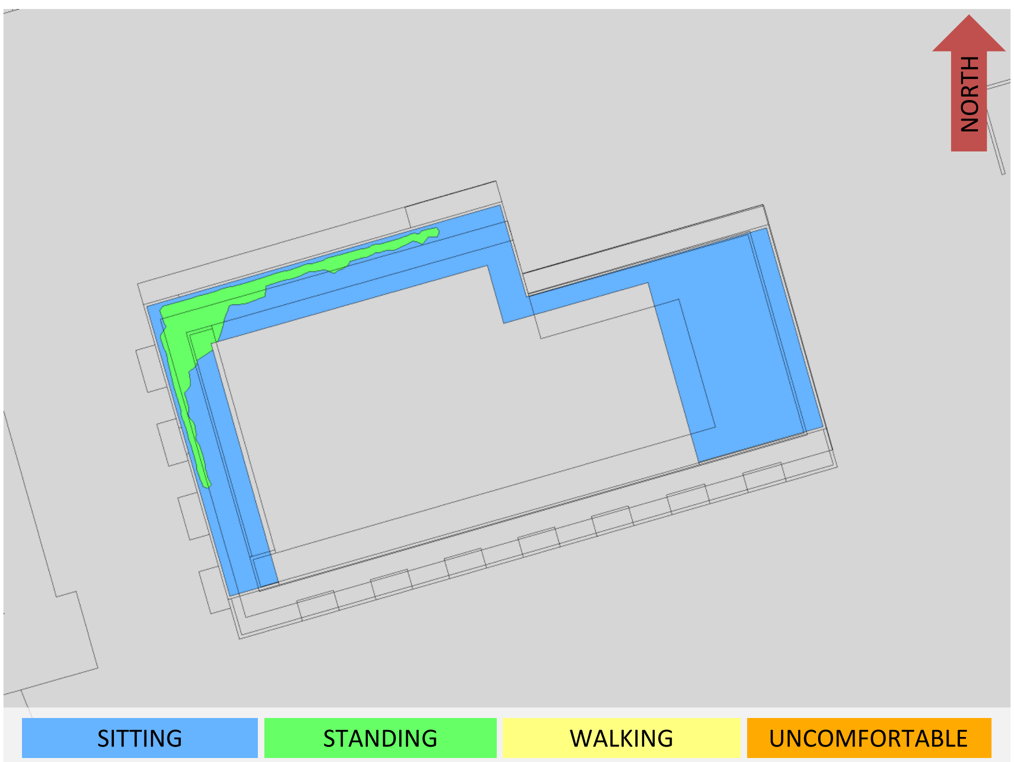


FIGURE 8B: SUMMER – WIND COMFORT, LEVEL 6 AMENITY TERRACE

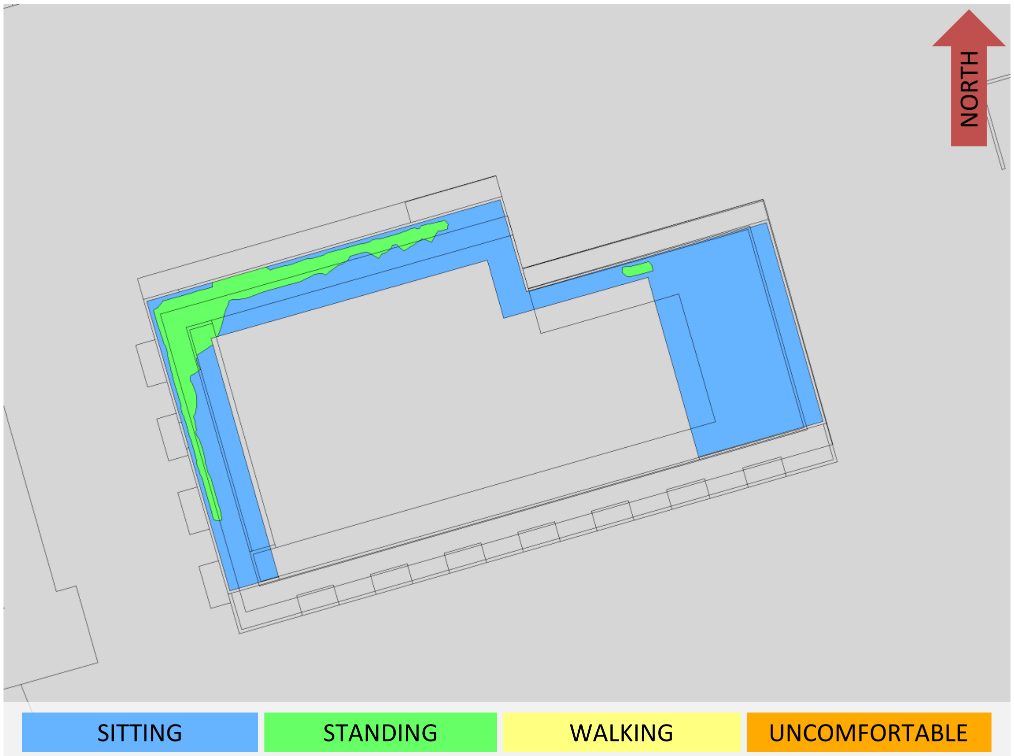


FIGURE 8C: AUTUMN – WIND COMFORT, LEVEL 6 AMENITY TERRACE

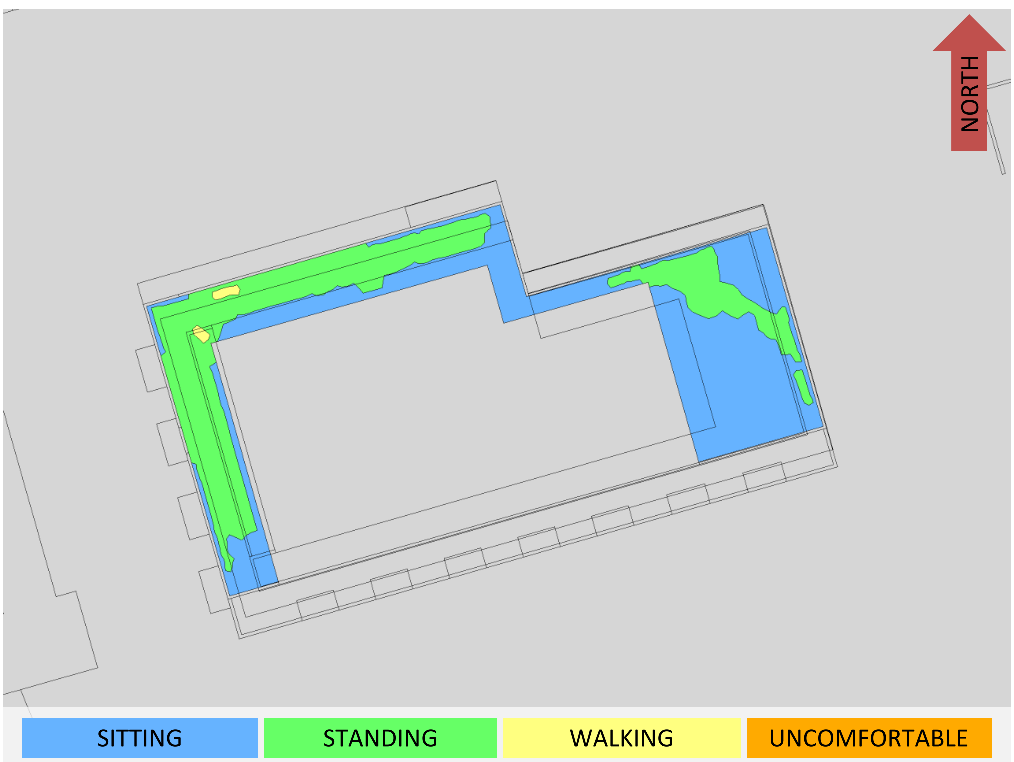


FIGURE 8D: WINTER – WIND COMFORT, LEVEL 6 AMENITY TERRACE

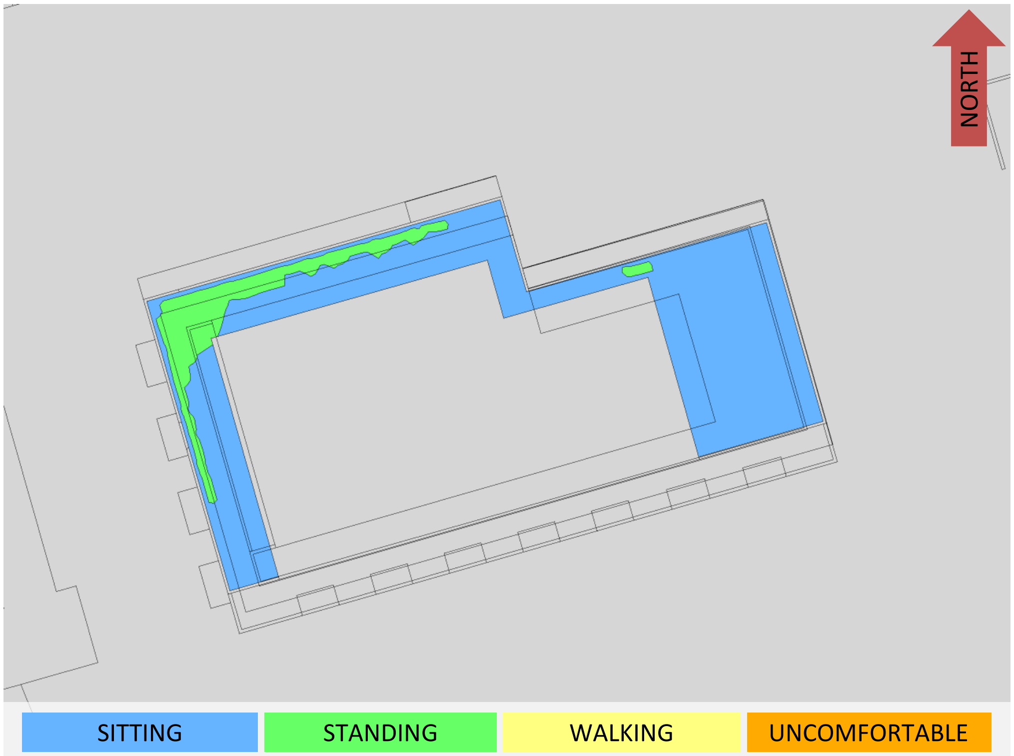


FIGURE 9: TYPICAL USE PERIOD – WIND COMFORT, LEVEL 6 AMENITY TERRACE

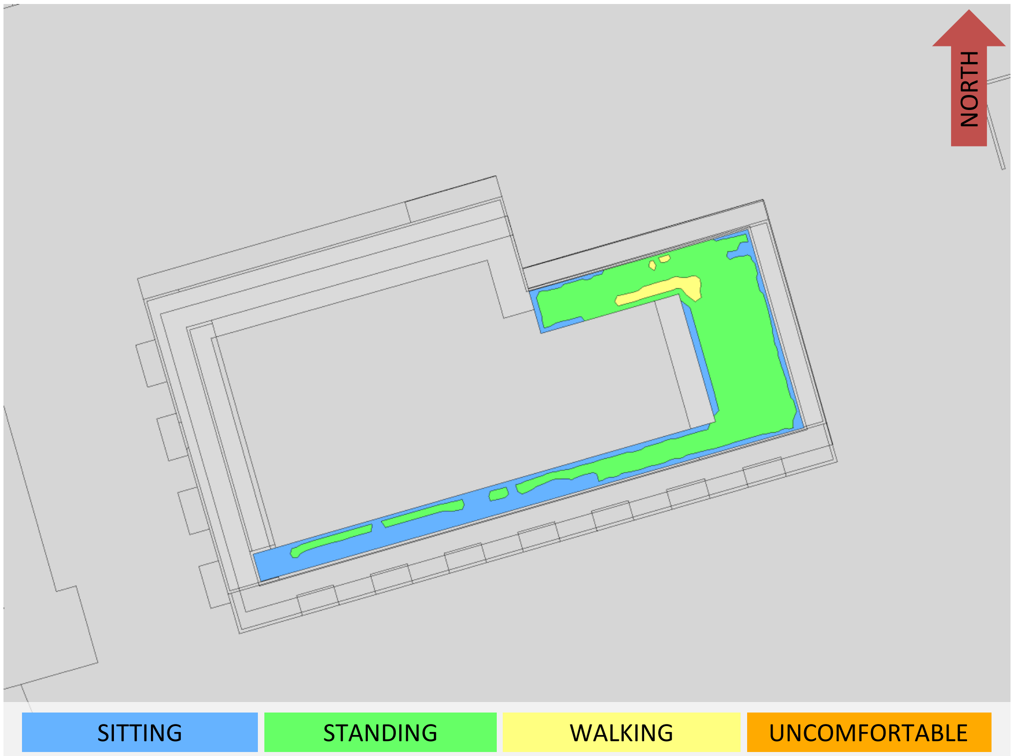


FIGURE 10A: SPRING – WIND COMFORT, MPH LEVEL AMENITY TERRACE

FIGURE 10B: SUMMER – WIND COMFORT, MPH LEVEL AMENITY TERRACE

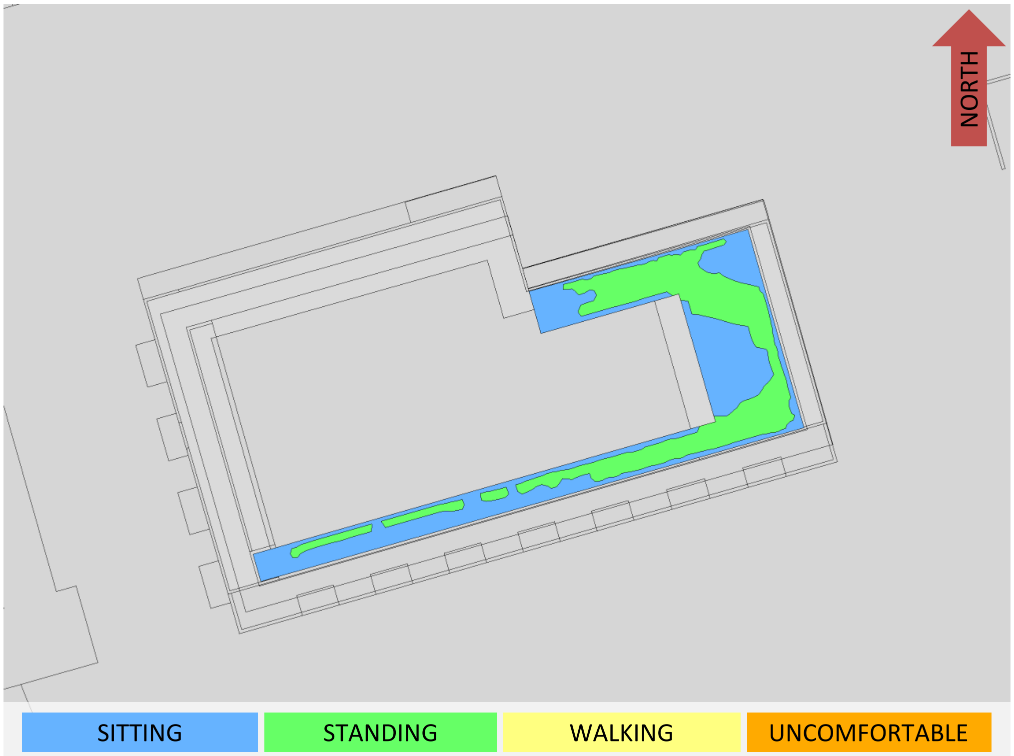


FIGURE 10C: AUTUMN – WIND COMFORT, MPH LEVEL AMENITY TERRACE

FIGURE 10D: WINTER – WIND COMFORT, MPH LEVEL AMENITY TERRACE

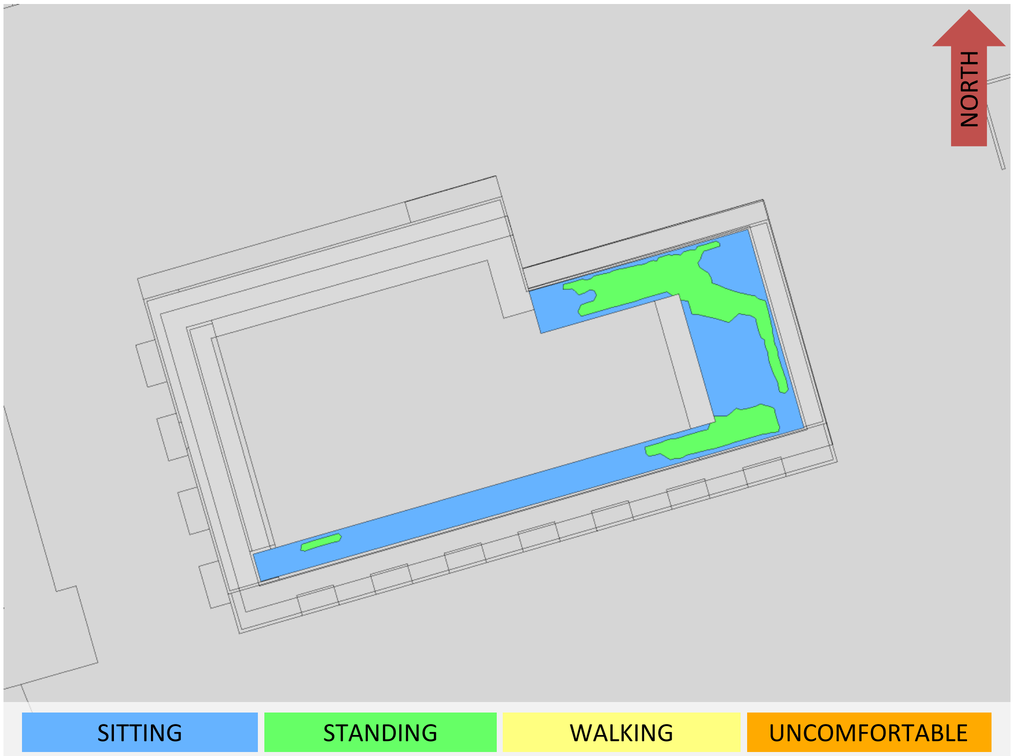
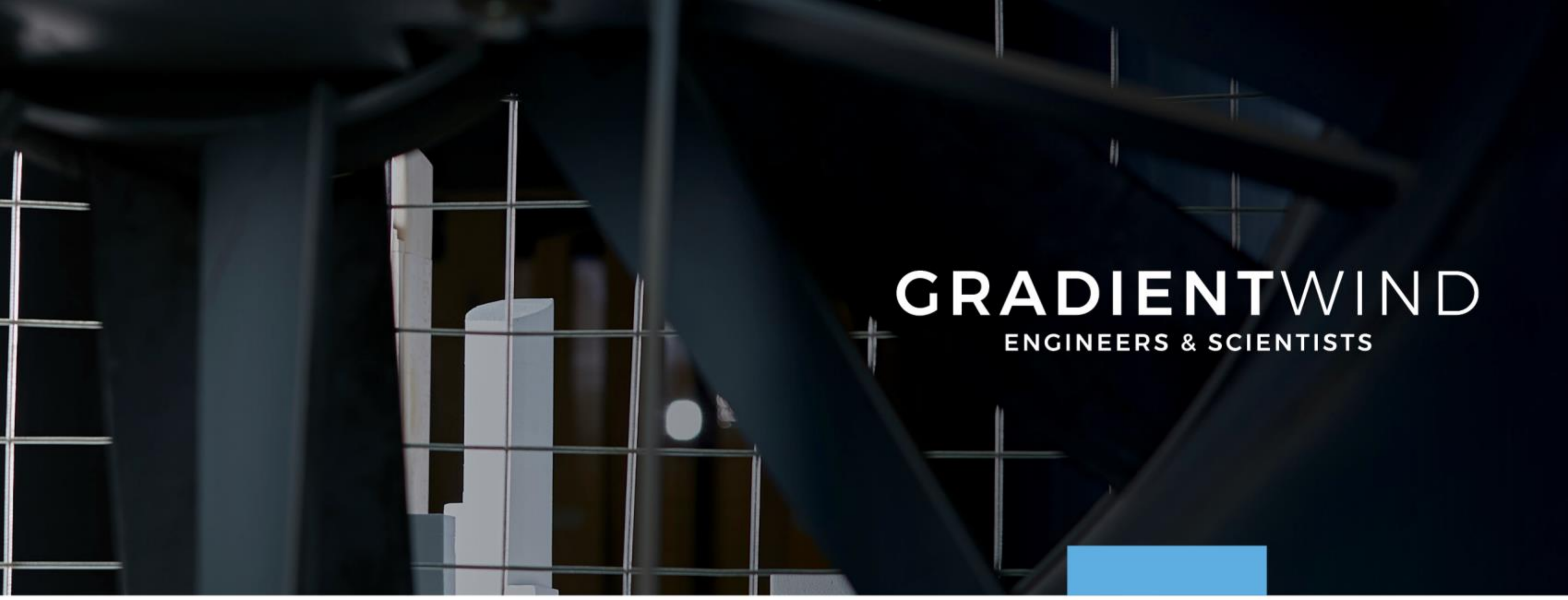
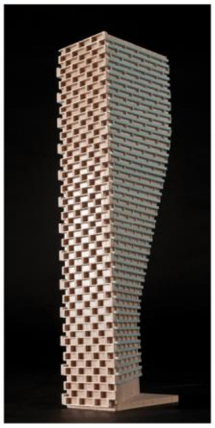
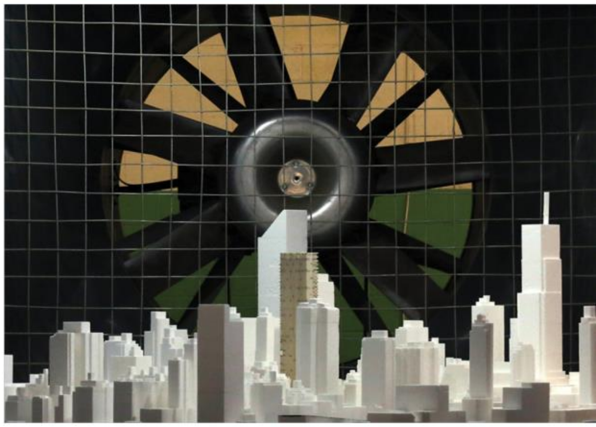


FIGURE 11: TYPICAL USE PERIOD – WIND COMFORT, MPH LEVEL AMENITY TERRACE







APPENDIX A

SIMULATION OF THE ATMOSPHERIC BOUNDARY LAYER

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SIMULATION OF THE ATMOSPHERIC BOUNDARY LAYER

The atmospheric boundary layer (ABL) is defined by the velocity and turbulence profiles according to industry standard practices. The mean wind profile can be represented, to a good approximation, by a power law relation, Equation (1), giving height above ground versus wind speed [1], [2].

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

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 50% mean wind speed for Toronto based on historical climate data and statistical analyses. When the results are normalized by this velocity, they are relatively insensitive to the selection of gradient wind speed.

Z_g is set to 540 m. The selection of gradient height is relatively unimportant, so long as it exceeds the building heights surrounding the subject site. The value has been selected to correspond to our physical wind tunnel reference value.

α is determined based on the upstream exposure of the far-field surroundings (that is, the area that is not captured within the simulation model).

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

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

Wind Direction (Degrees True)	Alpha Value (α)
0	0.29
22.5	0.27
45	0.25
67.5	0.25
90	0.24
112.5	0.23
135	0.23
157.5	0.24
180	0.27
202.5	0.26
225	0.26
247.5	0.25
270	0.25
292.5	0.25
315	0.25
337.5	0.28

TABLE 2: DEFINITION OF UPSTREAM EXPOSURE (ALPHA VALUE)

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

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

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

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

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

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

REFERENCES

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

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

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