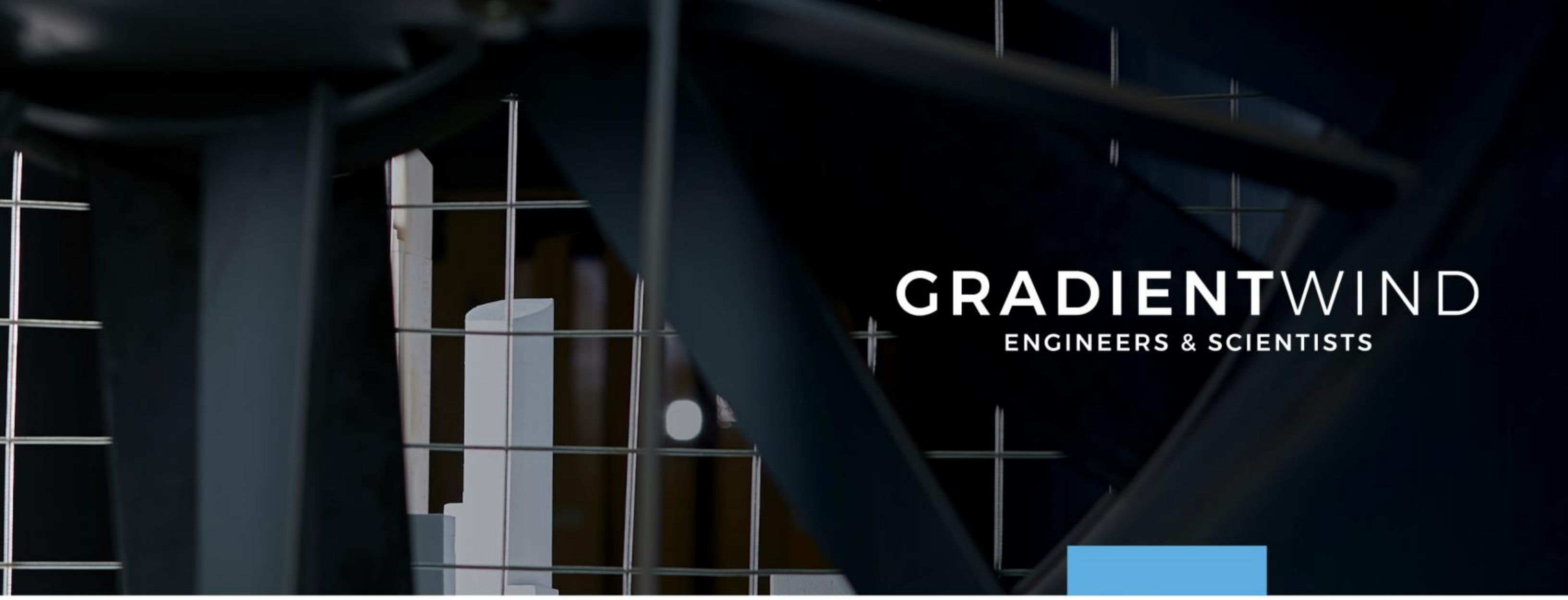
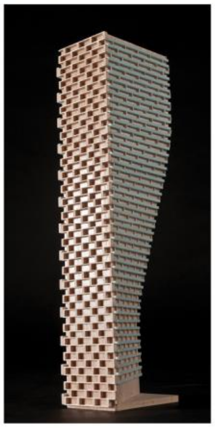
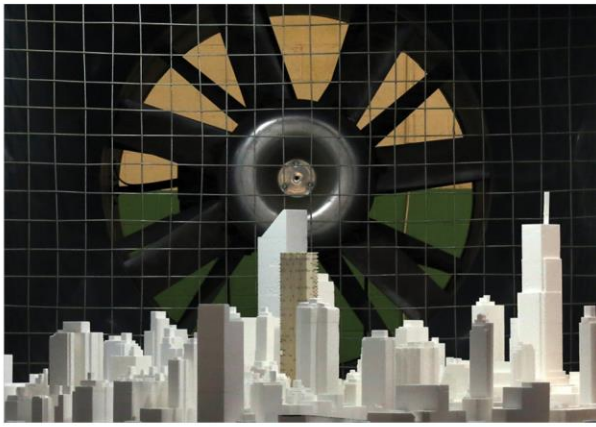


PEDESTRIAN LEVEL WIND STUDY

420-468 South Service Road East
Oakville, Ontario

Report: 24-208-PLW





October 16, 2024

PREPARED FOR
South Service Holding Corp.
156 Duncan Mills Road, Suite 12
Toronto, ON M3B 3N2

PREPARED BY
Sunny Kang, B.A.S., Project Coordinator
Omar Rioseco, B.Eng., Junior Wind Scientist
David Huitema, M.Eng., P.Eng., CFD Lead Engineer

EXECUTIVE SUMMARY

This report describes a pedestrian level wind (PLW) study undertaken to satisfy Official Plan Amendment (OPA) application submission requirements for the multi-building development located at 420-468 South Service Road East in Oakville, Ontario (hereinafter referred to as "subject site"). 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 comfort and safety within and surrounding the subject site. Since the City of Oakville does not specify wind criteria, the City of Toronto wind criteria were used, as they represent the standards applied in a nearby city and are consistent with industry standards. A complete summary of the predicted wind conditions is provided in Section 5 and illustrated in Figures 3A-9, 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 their intended pedestrian uses throughout the year. Specifically, conditions over surrounding sidewalks, neighbouring existing laneways and surface parking lots, in the vicinity of the primary residential building access points, and over most proposed roads, walkways, driveways, and surface parking, are considered acceptable.

2) The windier conditions at grade within Blocks 1 and 2 are primarily attributed to a combination of factors:

    a. The proposed development is exposed to prevailing winds from multiple directions, owing to the surrounding sparse suburban context, and the windy conditions are expected following the introduction of the building development in its surroundings.

b. Salient winds from the southeast and from the southwest clockwise to the north are predicted to downwash over the tower and podia façades and around the exposed corners of the podia serving Towers E, F, G, and H, in combination with prevailing winds accelerating and channelling between Towers and E, Towers D and F, Blocks 1 and 2, Towers G and I, and Towers H and K.

3) Isolated regions of conditions that may occasionally be considered uncomfortable for walking are predicted between Blocks 1 and 2, Towers B and E, Towers D and F, Towers G and I, and Towers H and K.

    a. Mitigation measures that may be considered by the design team as the design of the proposed development progresses may include targeted placement of isolated clusters of vertical wind barriers, in combination with canopies that extend from select building façades above grade to deflect downwash flows.

4) If feasible in the design, it is recommended that entrances to the non-residential frontage serving Blocks 1, 2, and 4 be located away from the central pedestrian walkways between Towers D and F and between Towers H and K and away from the windier areas along the north elevation of Block 4 that are suitable for walking. Alternatively, it is recommended that proposed commercial entrances in these locations be recessed into their respective building façades by at least 2 m.

5) During the typical use period, conditions over the public park within Block 3 are predicted to be suitable for mostly standing, while conditions during the same period over the Block 4 potential park are predicted to be suitable for sitting over a majority of the park with conditions suitable for standing near the southeast corner of Tower P.

    a. If the public park within Block 3 and the southeast corner of the potential park to the east of Block 4 will not accommodate designated seating or more sedentary activities, the wind comfort conditions within these parks may be considered as acceptable.

b. If required by programming, comfort conditions at sensitive-use areas within the parks may be improved by implementing landscaping elements around sensitive areas such as tall 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.

6) The common amenity terraces proposed at Levels 2, 3, and 5 were modelled with 1.8-m-tall wind screens along their full perimeters. Conditions within the common amenity terraces serving Towers A and B at Level 3, Tower E to the west at Level 3, Towers I and J at Level 3, Tower H at Level 3 to the southeast, Block 4 at Level 2, and Towers N and P at Level 5 are predicted to be suitable for mostly sitting during the typical use period, which is considered acceptable without additional mitigation.

    a. Wind comfort conditions during the same period within the remaining amenity terraces are predicted to be mixed between sitting and standing with isolated regions suitable for walking within the terraces fronting South Service Road East.

    b. If seating areas are to be programmed in the windier areas of these terraces, mitigation in the form of targeted elements inboard of the terrace perimeters in combination with canopies extending from select tower façades is recommended, in addition to the 1.8-m-tall perimeter screens.

    c. The extent of mitigation measures is dependent on the programming of the terraces. If required by programming, an appropriate mitigation strategy may be developed in collaboration with the building and landscape architects as the design of the proposed development progresses. This work would be expected to support the future Zoning By-Law Amendment application and Site Plan Control application submissions.

7) The foregoing statements and conclusions apply to common weather systems, during which one region within the vicinity of the subject site may experience wind conditions that approach the wind safety threshold, as defined in Section 4.4. Specifically, the safety criterion may be exceeded on an annual basis within an isolated region between Blocks 1 and 2. It is recommended that an appropriate mitigation strategy to resolve potential wind safety exceedances and to improve pedestrian wind comfort over this area be developed and confirmed as the design of the proposed development progresses. This work would be expected to support the future Zoning By-Law Amendment application and Site Plan Control application submissions.

TABLE OF CONTENTS

1. INTRODUCTION

Gradient Wind Engineering Inc. (Gradient Wind) was retained by South Service Holding Corp. to undertake a pedestrian level wind (PLW) study to satisfy Official Plan Amendment (OPA) application submission requirements for the multi-building development located at 420-468 South Service Road East in Oakville, Ontario (hereinafter referred to as the "subject site" or "proposed development"). Our mandate within the current study is to investigate pedestrian wind conditions within and surrounding the subject site, and to identify areas where wind conditions may interfere with certain pedestrian activities so that mitigation measures may be considered, where required.

The study is based on industry standard computer simulations using the computational fluid dynamics (CFD) technique and data analysis procedures, industry standard wind comfort and safety guidelines, architectural drawings provided by Graziani + Corazza Architects Inc.in September 2024, surrounding street layouts and existing and approved future building massing information obtained from the City of Oakville, and recent site imagery. Since the City of Oakville does not specify wind criteria, the City of Toronto wind criteria were used, as they represent the standards applied in a nearby city and are consistent with industry standards.

2. TERMS OF REFERENCE

The subject site is located at 420-468 South Service Road East in Oakville, situated approximately 250 metres (m) north-northeast of the intersection of South Service Road East and Davis Road on a parcel of land bordered by South Service Road East to the northwest, low-rise commercial buildings to the northeast and southwest, and green space and the Canadian National (CN) railway to the southeast. Throughout this report, South Service Road East is considered as project north.

A north-south arterial road and an east-west collector road divide the proposed development into four blocks – Block 1, Block 2, Block 3, and Block 4 – situated to the northwest, northeast, southwest, and southeast, respectively. Additionally, an east-west arterial road extends along the south site boundary and local roads border the east and west perimeters of the subject site. Blocks 1 and 2 are each served by four underground parking levels while Block 4 is served by three underground parking levels. The subject site comprises a downwards slope towards the south; the ground floor of Block 4 is at the P1 Level of Blocks 1 and 2.

Block 1 comprises six nominally rectangular towers: Tower A (40 storeys) to the northwest, Tower B (45 storeys) to the north, Tower C (35 storeys) to the southwest, Tower D (42 storeys) to the south, Tower E (48 storeys) to the northeast, and Tower F (45 storeys) to the southeast. Towers A and B, Towers C and D, and Towers E and F each share 4-storey podia, respectively. A central driveway that connects to South Service Road East and the above-noted local and collector roads along the west and south elevations of the block divide the three podia and provides access to central lobbies, loading docks, and parking entrances. Notably, Block 1 includes non-residential frontage along the collector road bordering its south elevation, and a pedestrian walkway between Towers D and F provides access to the interior of the block. At Level 3, which comprises a mix of residential units, parking, and indoor amenities, setbacks from the south elevation of the shared podium serving Towers A and B, from the north, east, and west elevations of the podium serving Towers C and D, from all elevations around Tower F, and from the west elevation of the shared podium serving Towers E and F accommodate private terraces and shared exterior outdoor amenity spaces. The podia roofs at Level 5 accommodate outdoor amenities that adjoin indoor amenities at this level.

Block 2 similarly comprises six nominally rectangular towers above 4-storey podia: Tower G (48 storeys) to the northwest and Tower H (45 storeys) to the southwest, rising above a shared podium; Tower I (40 storeys) to the north and Tower J (35 storeys) to the northeast, above a shared podium; and Tower K (42 storeys) to the south and Tower L (35 storeys) to the southeast, above a shared podium. A driveway from South Service Road East and the local road along the east elevation separate the podia and provides access to the interior of the block, the central lobbies, surface parking at grade, parking entrances, and loading docks, alongside a pedestrian walkway located between Towers H and K. At the ground floor, which is mixed between residential units, central lobbies, and parking, non-residential spaces front the collector road along the southern boundary of the block. At Level 3, which is mixed between indoor amenities, residential units, and parking, the podium serving Towers G and H step back from the east and south elevations, the podium serving Towers I and J steps back from its southwest, south, and southeast elevations, and the podium serving Towers K and L steps back from all elevations, accommodating private terraces and common amenity terraces. At Level 5, which is comprised of indoor amenities, outdoor amenity terraces are located at the respective podia roofs.

Block 3 comprises a public park with an area of 18,687 square metres (m^2).

Block 4 comprises four rectangular towers that rise above a common 'U'-shaped 4-storey podium: Tower M (40 storeys) to the northwest, Tower N (35 storeys) to the northeast, Tower O (35 storeys) to the southwest, and Tower P (30 storeys) to the southeast. A potential park is proposed to the east and south of Block 4. A driveway from the local road to the east and the arterial road to the south provides access to the interior of the block and the lobby access points, loading areas, and parking entrances. Non-residential space fronts the collector road along the north elevation of the block. The podium steps back from the east, south, and west elevations at Level 2, accommodating a common amenity terrace between Towers M and N and private terraces elsewhere, adjoining indoor amenities and residential units, respectively. At Level 3, which comprises indoor amenities and residential units, a setback at the north elevation of the podium accommodates a common amenity terrace between Towers M and N, while setbacks from the east and west elevations of Tower N include private terraces. Additional common amenity terraces are located between Towers M and O and Towers N and P at Level 5, which comprises indoor amenities within each tower.

Regarding wind exposures, the near-field surroundings (defined as an area falling within a 200 m radius of the subject site) comprises low-rise commercial buildings with surface parking lots and vacant lots and green spaces in all directions with a mid-rise office building to the south-southwest and Cornwall Road Park to the southeast. Notably, the CN railway extends from the east to the south-southeast. The far-field surroundings (defined as the area beyond the near field and within a 2-kilometre (km) radius) include low-rise massing in all directions with isolated mid-rise buildings to the northeast and isolated clusters of mid- and high-rise buildings from the southeast clockwise to the northwest. Hogs Back Park is located approximately 1.4 km to the southwest and Lake Ontario is located approximately 2 km to the southeast.

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 Greater Toronto Area wind climate, and synthesis of computational data with wind criteria. Since the City of Oakville does not specify wind criteria, the City of Toronto wind criteria[1] were used, as they represent the standards applied in a nearby city and are consistent wind industry standards. 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.

[1] 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

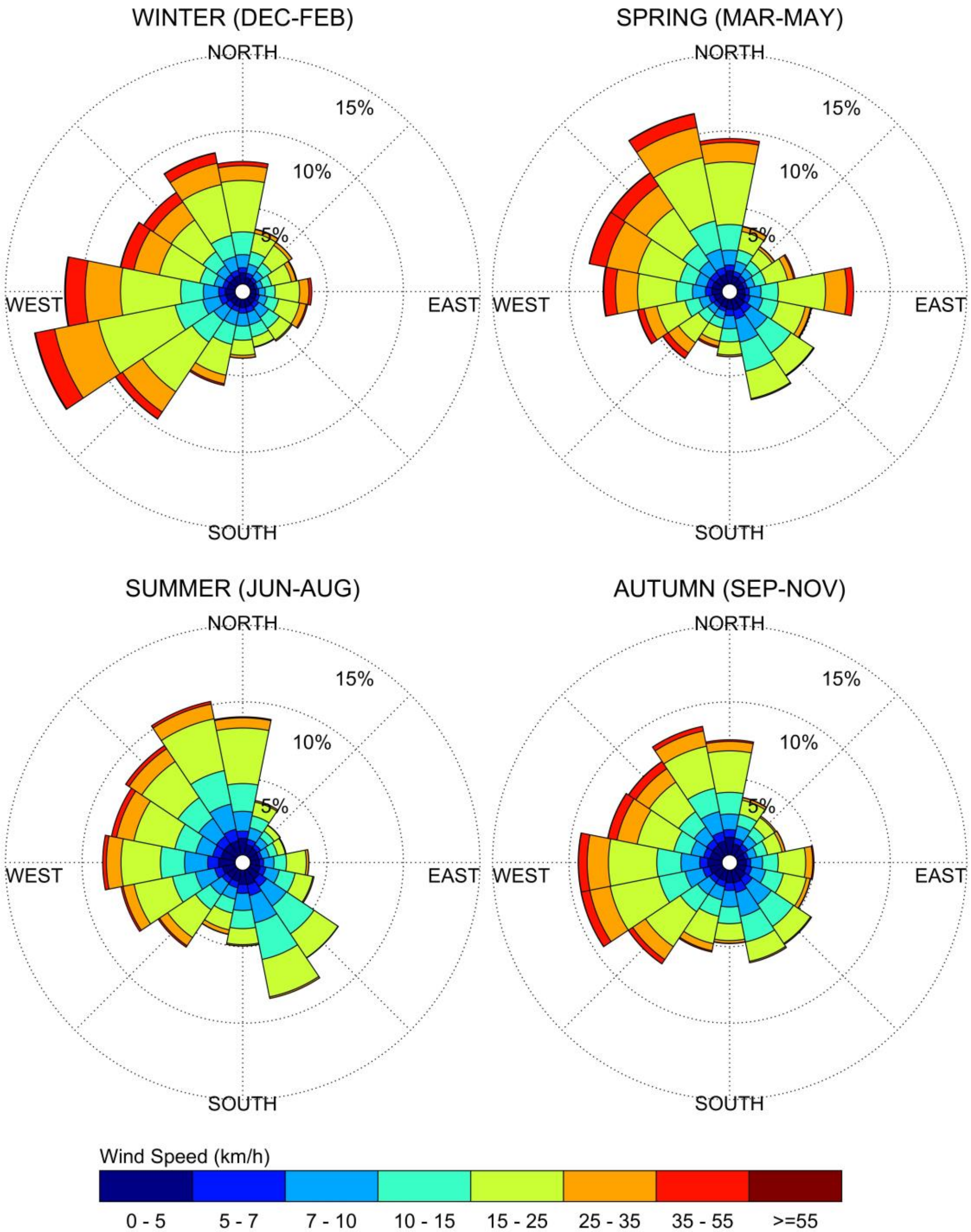
4.2 Wind Speed Measurements

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 630 m. The process was performed for two context massing scenarios, as noted in Section 2. Mean and peak wind speed data obtained over the subject site for each wind direction were interpolated to 36 wind directions at 10° intervals, representing the full compass azimuth. Measured wind speeds approximately 1.5 m above local grade and the 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 Oakville 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. 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 Greater 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 preferred wind speeds and directions can be identified by the longer length of the bars. For the Greater Toronto Area, representative of Oakville, 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 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 Guidelines

Pedestrian wind comfort and safety guidelines are based on the mechanical effects of wind without consideration of other meteorological conditions (that is, temperature and relative humidity). The comfort guidelines 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 guidelines 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. Specifically, the comfort classes, associated wind speed ranges, and limiting targets 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	Target 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-D, which illustrate wind conditions over the common amenity terraces serving Blocks 1 and 2 at Levels 3 and 5 and Block 4 at Levels 2, 3, and 5. Conditions are presented as continuous contours of wind comfort within and surrounding the subject site and correspond to the various comfort classes noted in Section 4.4.

Wind comfort conditions are also reported for the typical use period, which is defined as May to October, inclusive. Figures 7 and 9 illustrate wind comfort conditions at grade level and over the noted common amenity terraces, respectively, during this period, consistent with the comfort classes in Section 4.4.

The details of these conditions are summarized in the following pages for each area of interest.

5.1 Wind Comfort Conditions – Grade Level

Sidewalks along Davis Road: Prior to and following the introduction of the proposed development, wind comfort conditions along Davis Road are predicted to be suitable for standing, or better, during the summer and autumn, becoming suitable for walking, or better, during the spring and winter, which is considered acceptable.

Sidewalks along South Service Road East: Following the introduction of the proposed development, conditions over the nearby public sidewalks along South Service Road East are predicted to be suitable for mostly standing, or better, during the summer and autumn, and suitable for a mix of standing and walking during the spring and winter. The noted conditions are considered acceptable.

Conditions along South Service Road East under the existing massing are predicted to be suitable for standing during the summer and autumn, becoming suitable for mostly walking during the spring and winter. Notably, the introduction of the proposed development is predicted to improve comfort levels along South Service Road East, in comparison to existing conditions, and wind conditions with the proposed development are nevertheless considered acceptable for the noted public sidewalks.

Neighbouring Existing Laneways and Surface Parking Lots: Wind comfort conditions over the nearby existing laneways and surface parking lots in the vicinity of the subject site are predicted to be suitable for standing, or better, during the summer and autumn, becoming suitable for walking, or better, during the spring and winter, prior to and following the introduction of the proposed development. The noted conditions are considered acceptable.

Block 3 Public Park and Block 4 Potential Park: During the typical use period, wind comfort conditions over the public park within Block 3 are predicted to be suitable for standing. Conditions over the potential park to the east and south of Block 4 are predicted to be suitable for sitting over a majority of its area, with conditions suitable for standing near the southeast corner of Tower P.

Depending on programming, the noted conditions may be considered as acceptable. Specifically, if the public park within Block 3 and the southeast corner of the potential park to the east of Block 4 will not accommodate seating or lounging activities, the noted conditions may be considered as acceptable. If required by programming, comfort conditions at sensitive-use areas within these park areas may be improved by implementing targeted landscaping elements adjacent to sensitive-use areas, including elements such as tall 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.

Proposed Roads, Driveways, Surface Parking, and Pedestrian Walkways: Wind conditions over the local roads to the east and west and over the sidewalks and bike lane along the arterial road along the south elevation of the subject site are predicted to be suitable for walking, or better, throughout the year. The driveway serving Block 4 is predicted to be suitable for standing, or better, throughout the year. The noted conditions are considered acceptable.

Wind comfort conditions over most remaining pedestrian areas at grade within the subject site, including over most walkways, most of the exterior surface parking serving Block 2, most of the driveways serving Blocks 1 and 2, and over most of the central arterial road and central collector road are predicted to be suitable for walking, or better, throughout the year.

The mostly suburban environs of the subject site and the limited built-up massing in the vicinity of the proposed development exposes the subject site to prevailing winds from multiple directions. Salient winds from the southeast and from the southwest clockwise to the north are predicted to downwash over the tower and podia façades and around the exposed corners of the podia serving Towers E, F, G, and H. Most notably, these prevailing winds are predicted to accelerate and be channelled between Towers and E, Towers D and F, Blocks 1 and 2, Towers G and I, and Towers H and K. The noted conditions are predicted to impact sections of the pedestrian walkways between Towers D and F and Towers H and K, the central arterial road, the driveways within Blocks 1 and 2, and the surface parking to the southeast of Tower G.

Specifically, during the spring season, isolated regions of conditions that may be considered as occasionally uncomfortable for walking are predicted between Blocks 1 and 2, Towers B and E, Towers D and F, and Towers H and K. During the winter, regions of uncomfortable conditions are predicted at these locations as well as between Towers G and I.

During the spring season, conditions between Towers D and F are predicted to be suitable for walking approximately 76% of the time, representing a 4% exceedance of the walking comfort criterion, while conditions between Blocks 1 and 2, Towers B and E, and Towers H and K are predicted to be suitable for walking for approximately 75% of the time, representing 5% exceedances of the walking threshold. During the winter months, conditions between Towers H and K are predicted to be suitable for walking approximately 78% of the time, representing a 2% exceedance of the walking comfort criterion, conditions between Towers D and F and Towers G and I are predicted to be suitable for walking approximately 77% of the time, representing 3% exceedances of the walking comfort criterion, and conditions between Towers B and E and Blocks 1 and 2 are predicted to be suitable for walking approximately 75% and 72% of the time, respectively, representing 5% and 8% exceedances of the walking threshold.

Mitigation measures that may be considered by the design team as the design of the proposed development progresses may include targeted placement of isolated clusters of vertical wind barriers, in combination with canopies that extend from select building façades above grade to deflect downwash flows.

Building Access Points: Wind conditions along the pedestrian walkways between Towers D and F and Towers H and K are predicted to be windier throughout the year, as well as along some areas along the non-residential frontage in Block 4 along the central collector road during the spring and winter. If entrances to the non-residential frontage are located along the windier areas suitable for walking, it is recommended that they be either relocated to less windier areas that are suitable for standing, or better, throughout the year, or be recessed into their respective façades by at least 2 m.

Conditions in the vicinity of the primary residential 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

Blocks 1 and 2 are served by common amenity terraces at Levels 3 and 5, while Block 4 is served by common amenity terraces at Levels 2, 3, and 5. The terraces were modelled with 1.8-m-tall wind screens along their full perimeters, which is recommended to provide shielding from the direct exposure to prevailing winds. Wind conditions within the terraces and additional recommendations regarding mitigation, where required, are described as follows.

During the typical use period, as illustrated in Figure 9, conditions within the common amenity terraces serving Towers A and B at Level 3, Tower E to the west at Level 3, Towers I and J at Level 3, Tower H at Level 3 to the southeast, Block 4 at Level 2, and Towers N and P at Level 5 are predicted to be suitable for mostly sitting, which is considered acceptable without additional mitigation.

Conditions within the remaining amenity terraces that are proposed at Levels 3 and 5 are predicted to be mostly mixed between sitting and standing during the typical use period, with isolated areas of walking conditions within select terrace areas, particularly for the most exposed terraces along South Service Road East. The extent of mitigation measures is dependent on the programming of the terraces.

If seating areas are to be programmed in the windier areas of these terraces, mitigation in the form of targeted mitigation inboard of the terrace perimeters in combination with canopies extending from select tower façades and the tall perimeter wind screens as noted above, is expected to be required to achieve suitable wind conditions at sensitive-use areas within the windier areas of the terraces. This inboard mitigation could take the form of tall wind screens or clusters of coniferous plantings located around sensitive areas, and canopies located above designated seating areas.

If required by programming, an appropriate mitigation strategy may be developed in collaboration with the building and landscape architects as the design of the proposed development progresses. This work would be expected to support the future Zoning By-Law Amendment application and Site Plan Control application submissions.

5.3 Wind Safety

Within the context of typical weather patterns, which exclude anomalous localized storm events such as tornadoes and downbursts, one pedestrian areas within the subject site may experience wind conditions that approach the wind safety threshold, as defined in Section 4.4. Specifically, the wind safety threshold may be exceeded on an annual basis within an isolated region between Blocks 1 and 2 at grade. It is recommended that an appropriate mitigation strategy to resolve potential wind safety exceedances and to improve pedestrian wind comfort over this area be developed and confirmed as the design of the proposed development progresses. This work would be expected to support the future Zoning By-Law Amendment application and Site Plan Control application submissions.

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-9. 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 their intended pedestrian uses throughout the year. Specifically, conditions over surrounding sidewalks, neighbouring existing laneways and surface parking lots, in the vicinity of the primary residential building access points, and over most proposed roads, walkways, driveways, and surface parking, are considered acceptable.

2) The windier conditions at grade within Blocks 1 and 2 are primarily attributed to a combination of factors:

    a. The proposed development is exposed to prevailing winds from multiple directions, owing to the surrounding sparse suburban context, and the windy conditions are expected following the introduction of the building development in its surroundings.

    b. Salient winds from the southeast and from the southwest clockwise to the north are predicted to downwash over the tower and podia façades and around the exposed corners of the podia serving Towers E, F, G, and H, in combination with prevailing winds accelerating and channelling between Towers and E, Towers D and F, Blocks 1 and 2, Towers G and I, and Towers H and K.

3) Isolated regions of conditions that may occasionally be considered uncomfortable for walking are predicted between Blocks 1 and 2, Towers B and E, Towers D and F, Towers G and I, and Towers H and K.

    a. Mitigation measures that may be considered by the design team as the design of the proposed development progresses may include targeted placement of isolated clusters of vertical wind barriers, in combination with canopies that extend from select building façades above grade to deflect downwash flows.

4) If feasible in the design, it is recommended that entrances to the non-residential frontage serving Blocks 1, 2, and 4 be located away from the central pedestrian walkways between Towers D and F and between Towers H and K and away from the windier areas along the north elevation of Block 4 that are suitable for walking. Alternatively, it is recommended that proposed commercial entrances in these locations be recessed into their respective building façades by at least 2 m.

5) During the typical use period, conditions over the public park within Block 3 are predicted to be suitable for mostly standing, while conditions during the same period over the Block 4 potential park are predicted to be suitable for sitting over a majority of the park with conditions suitable for standing near the southeast corner of Tower P.

   a. If the public park within Block 3 and the southeast corner of the potential park to the east of Block 4 will not accommodate designated seating or more sedentary activities, the wind comfort conditions within these parks may be considered as acceptable.

   b. If required by programming, comfort conditions at sensitive-use areas within the parks may be improved by implementing landscaping elements around sensitive areas such as tall 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.

6) The common amenity terraces proposed at Levels 2, 3, and 5 were modelled with 1.8-m-tall wind screens along their full perimeters. Conditions within the common amenity terraces serving Towers A and B at Level 3, Tower E to the west at Level 3, Towers I and J at Level 3, Tower H at Level 3 to the southeast, Block 4 at Level 2, and Towers N and P at Level 5 are predicted to be suitable for mostly sitting during the typical use period, which is considered acceptable without additional mitigation.

   a. Wind comfort conditions during the same period within the remaining amenity terraces are predicted to be mixed between sitting and standing with isolated regions suitable for walking within the terraces fronting South Service Road East.

b. If seating areas are to be programmed in the windier areas of these terraces, mitigation in the form of targeted elements inboard of the terrace perimeters in combination with canopies extending from select tower façades is recommended, in addition to the 1.8-m-tall perimeter screens.

c. The extent of mitigation measures is dependent on the programming of the terraces. If required by programming, an appropriate mitigation strategy may be developed in collaboration with the building and landscape architects as the design of the proposed development progresses. This work would be expected to support the future Zoning By-Law Amendment application and Site Plan Control application submissions.

7) The foregoing statements and conclusions apply to common weather systems, during which one region within the vicinity of the subject site may experience wind conditions that approach the wind safety threshold, as defined in Section 4.4. Specifically, the safety criterion may be exceeded on an annual basis within an isolated region between Blocks 1 and 2. It is recommended that an appropriate mitigation strategy to resolve potential wind safety exceedances and to improve pedestrian wind comfort over this area be developed and confirmed as the design of the proposed development progresses. This work would be expected to support the future Zoning By-Law Amendment application and Site Plan Control application submissions.

Sincerely,

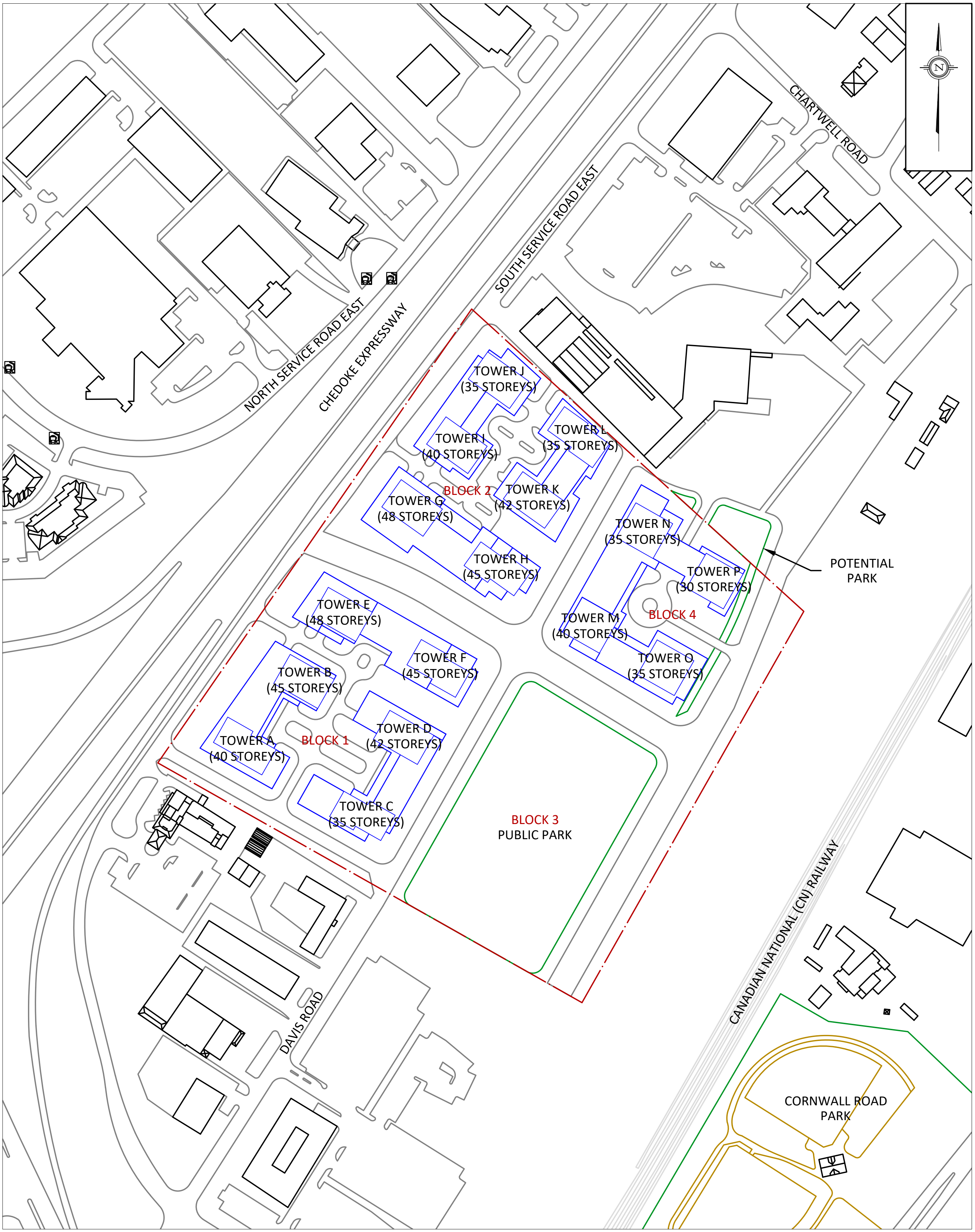
Gradient Wind Engineering Inc.

LICENSED PROFESSIONAL ENGINEER
D. T. HUITEMA
100561777
October 16, 2024
PROVINCE OF ONTARIO

Omar Rioseco, B.Eng.
Junior Wind Scientist

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

Sunny Kang, B.A.S.
Project Coordinator

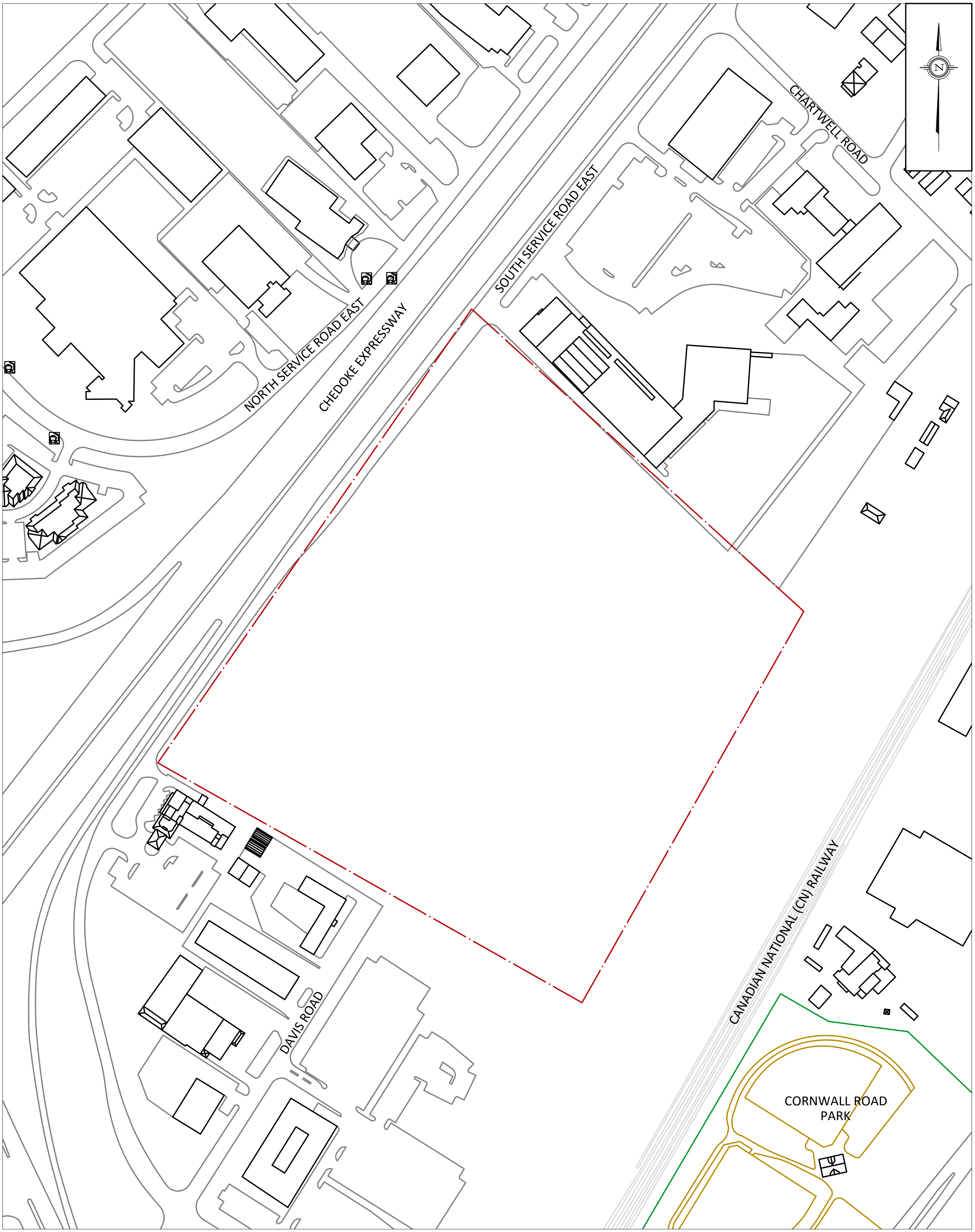


GRADIENTWIND
ENGINEERS & SCIENTISTS
127 WALGREEN ROAD, OTTAWA, ON
613 836 0934 • GRADIENTWIND.COM

PROJECT	420-468 SOUTH SERVICE ROAD EAST, OAKVILLE PEDESTRIAN LEVEL WIND STUDY		
SCALE	1:3500	DRAWING NO.	24-208-PLW-1A
DATE	OCTOBER 16, 2024	DRAWN BY	S.K.

DESCRIPTION

FIGURE 1A:
PROPOSED SITE PLAN AND SURROUNDING CONTEXT



GRADIENTWIND
ENGINEERS & SCIENTISTS

127 WALGREEN ROAD, OTTAWA, ON
613 836 0934 • GRADIENTWIND.COM

PROJECT	420-468 SOUTH SERVICE ROAD EAST, OAKVILLE PEDESTRIAN LEVEL WIND STUDY
SCALE	1:3500
DRAWING NO.	24-208-PLW-1B
DATE	OCTOBER 16, 2024
DRAWN BY	S.K.
DESCRIPTION	FIGURE 1B: EXISTING SITE PLAN AND SURROUNDING CONTEXT

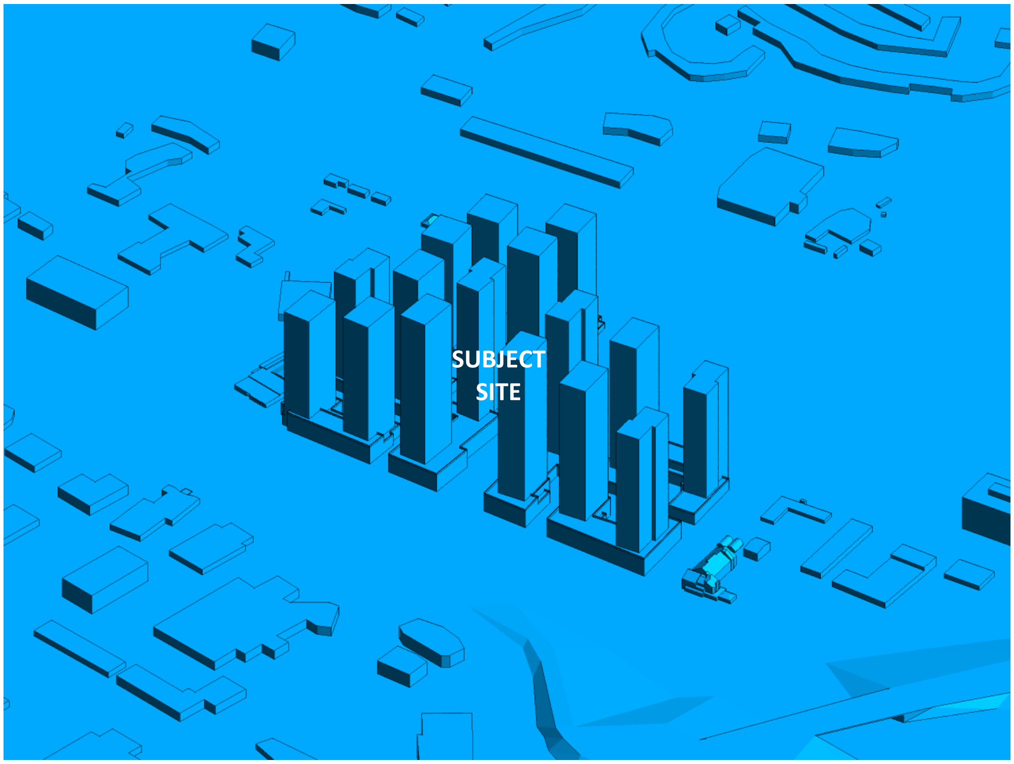


FIGURE 2A: COMPUTATIONAL MODEL, PROPOSED MASSING, WEST PERSPECTIVE

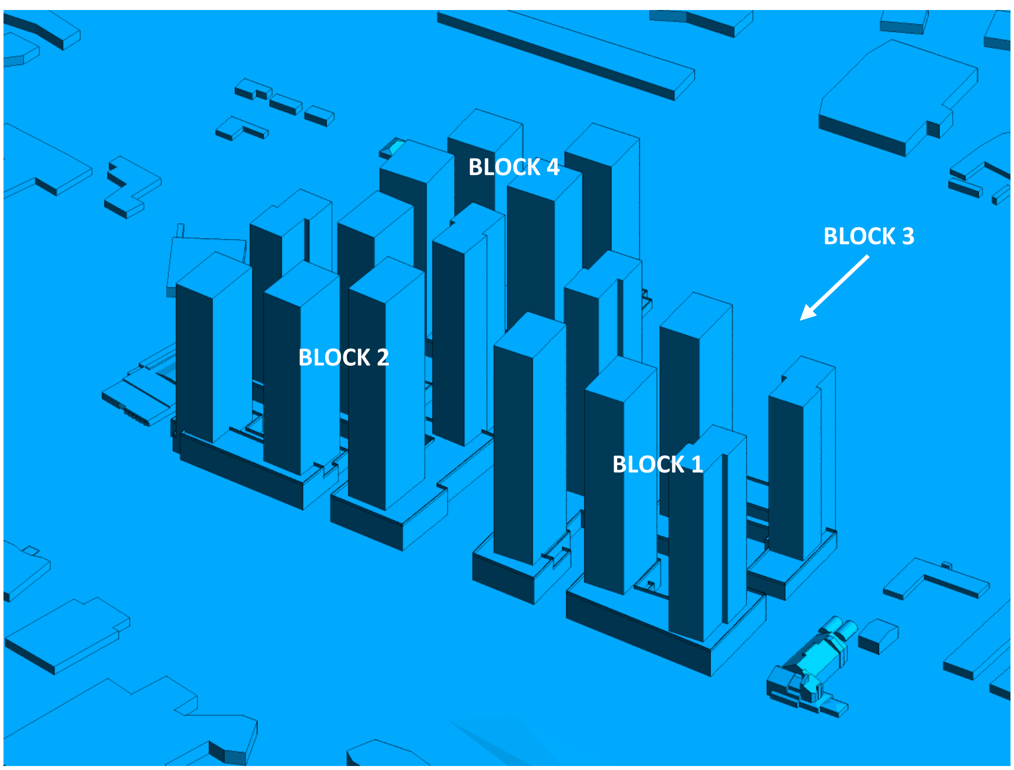


FIGURE 2B: CLOSE-UP VIEW OF FIGURE 2A

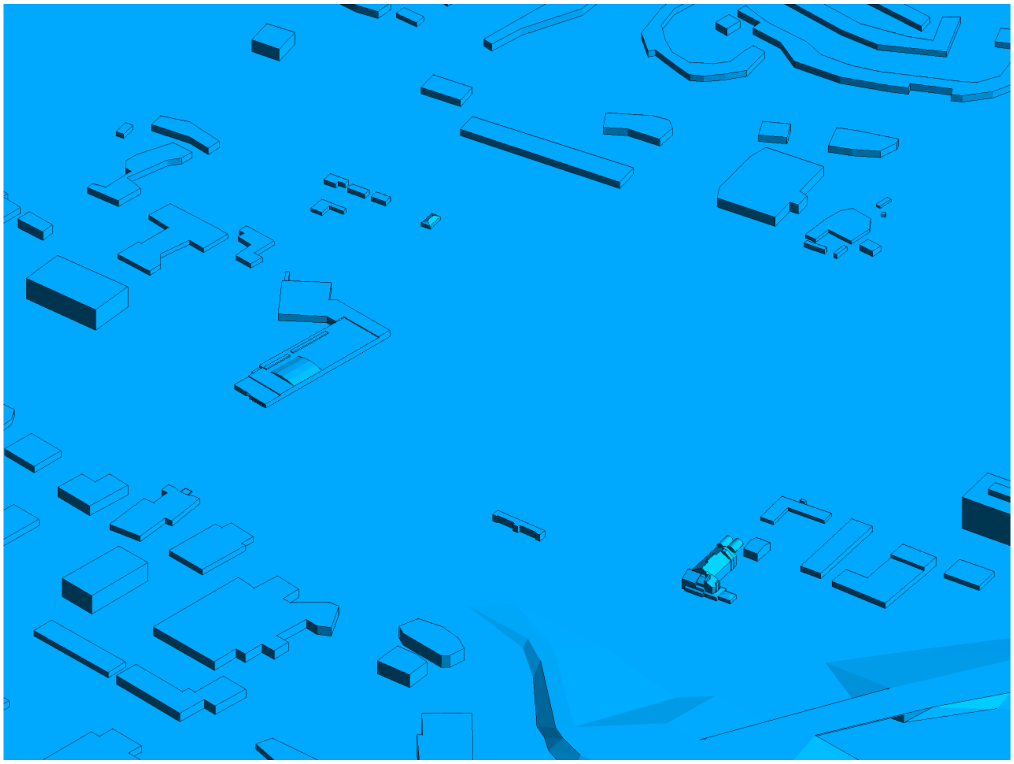


FIGURE 2C: COMPUTATIONAL MODEL, EXISTING MASSING, WEST PERSPECTIVE

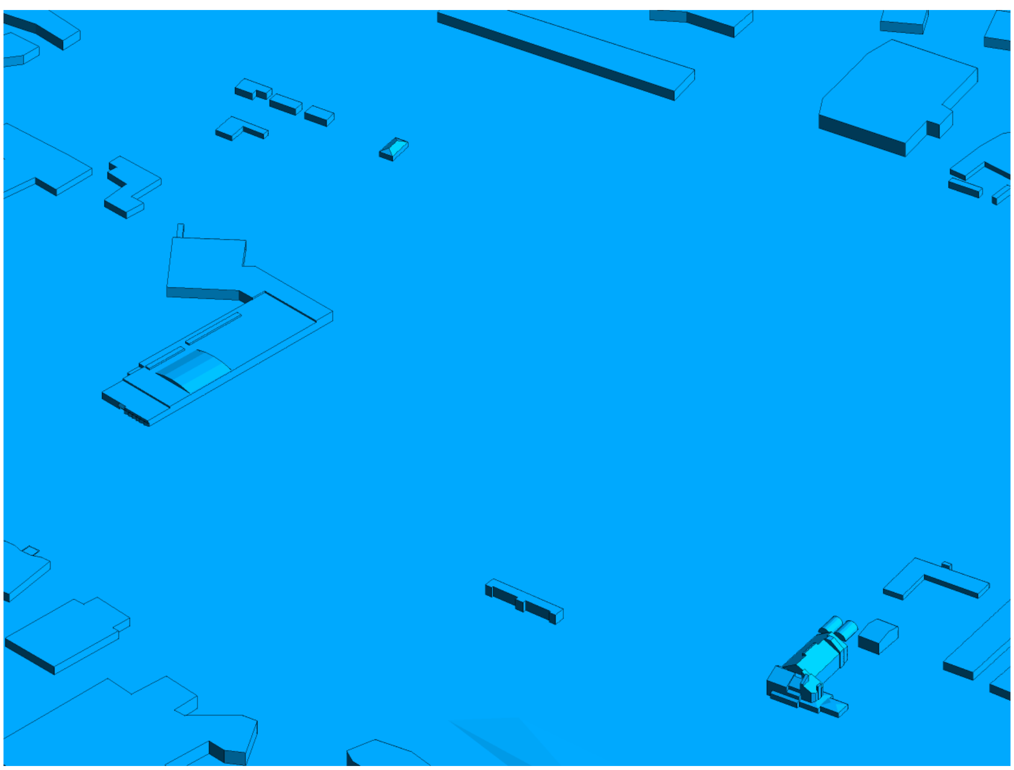


FIGURE 2D: CLOSE-UP VIEW OF FIGURE 2C

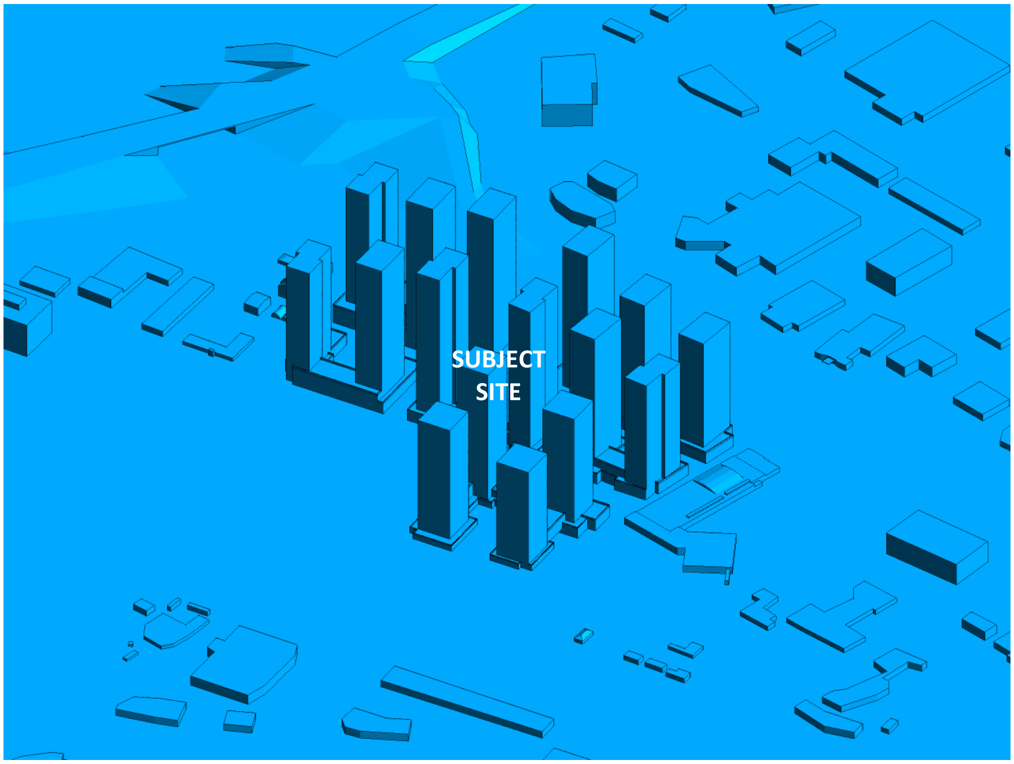


FIGURE 2E: COMPUTATIONAL MODEL, PROPOSED MASSING, EAST PERSPECTIVE

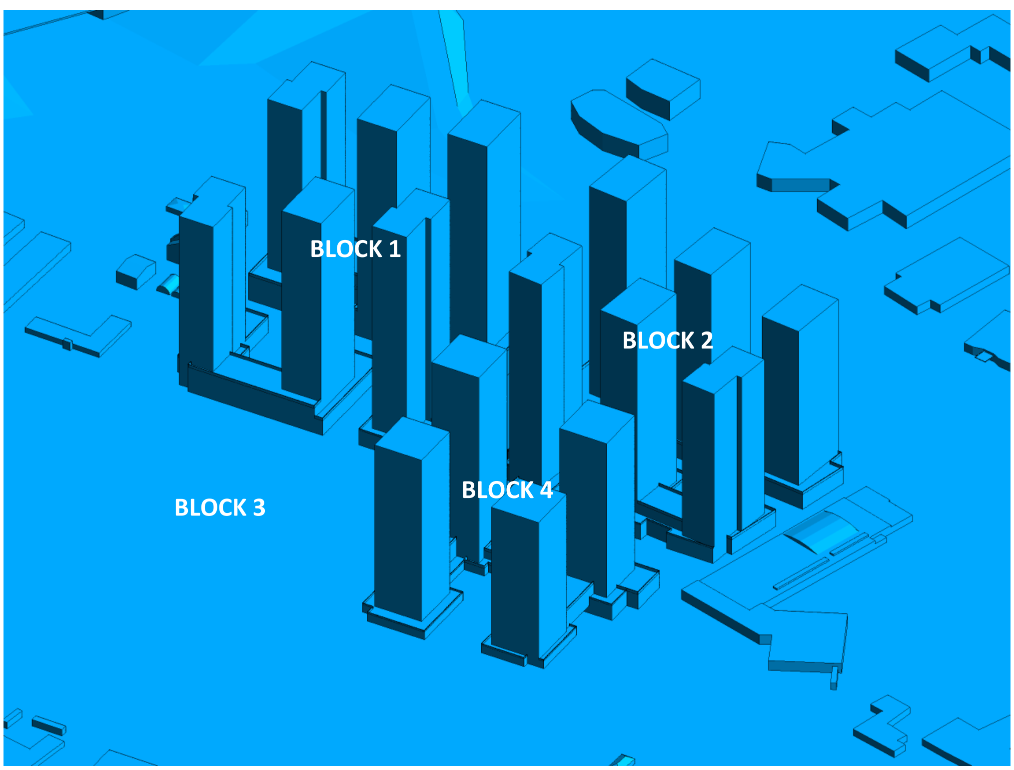


FIGURE 2F: CLOSE-UP VIEW OF FIGURE 2E

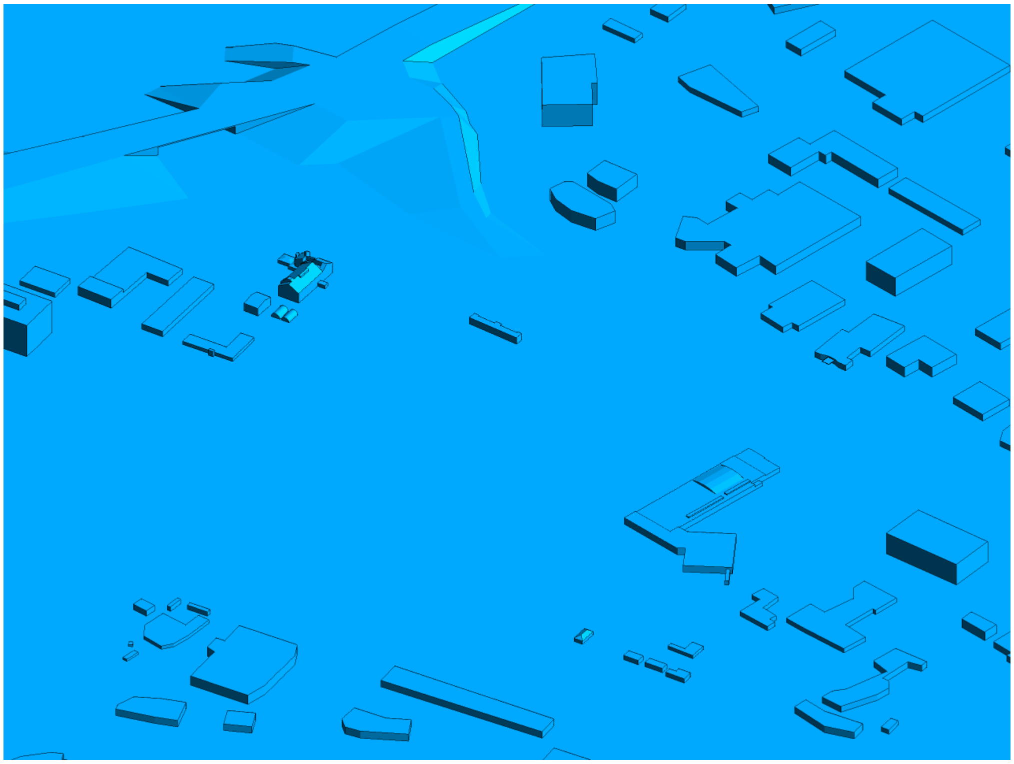


FIGURE 2G: COMPUTATIONAL MODEL, EXISTING MASSING, EAST PERSPECTIVE

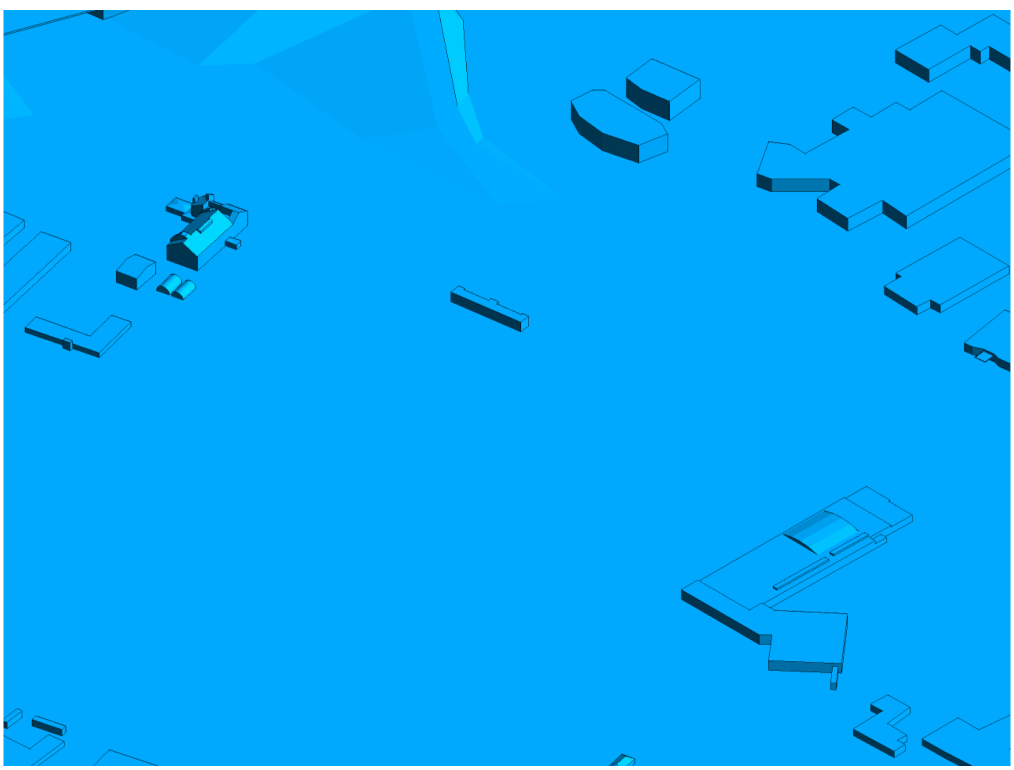


FIGURE 2H: CLOSE-UP VIEW OF FIGURE 2G

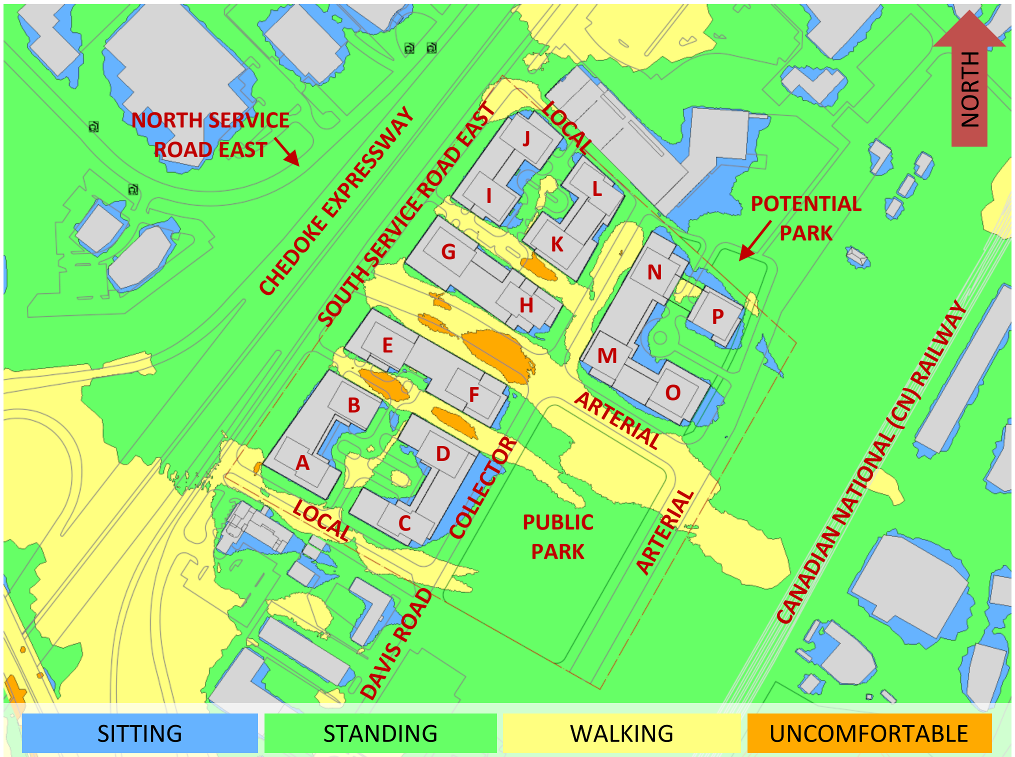


FIGURE 3A: SPRING – WIND COMFORT, GRADE LEVEL – PROPOSED MASSING

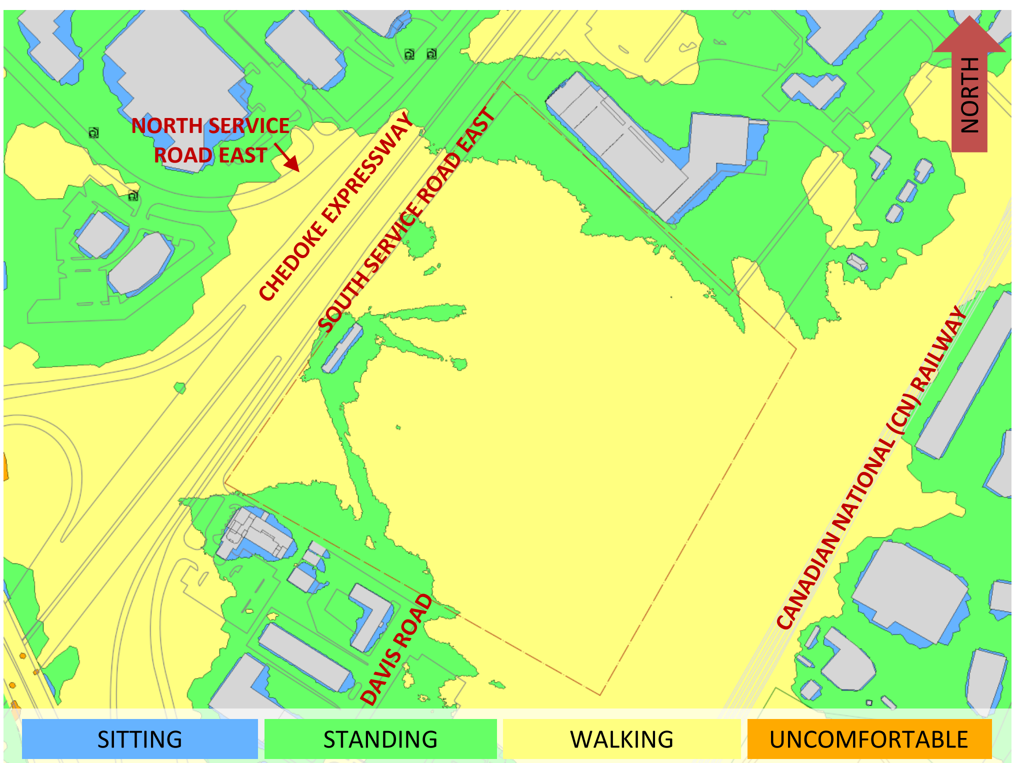


FIGURE 3B: SPRING – WIND COMFORT, GRADE LEVEL – EXISTING MASSING

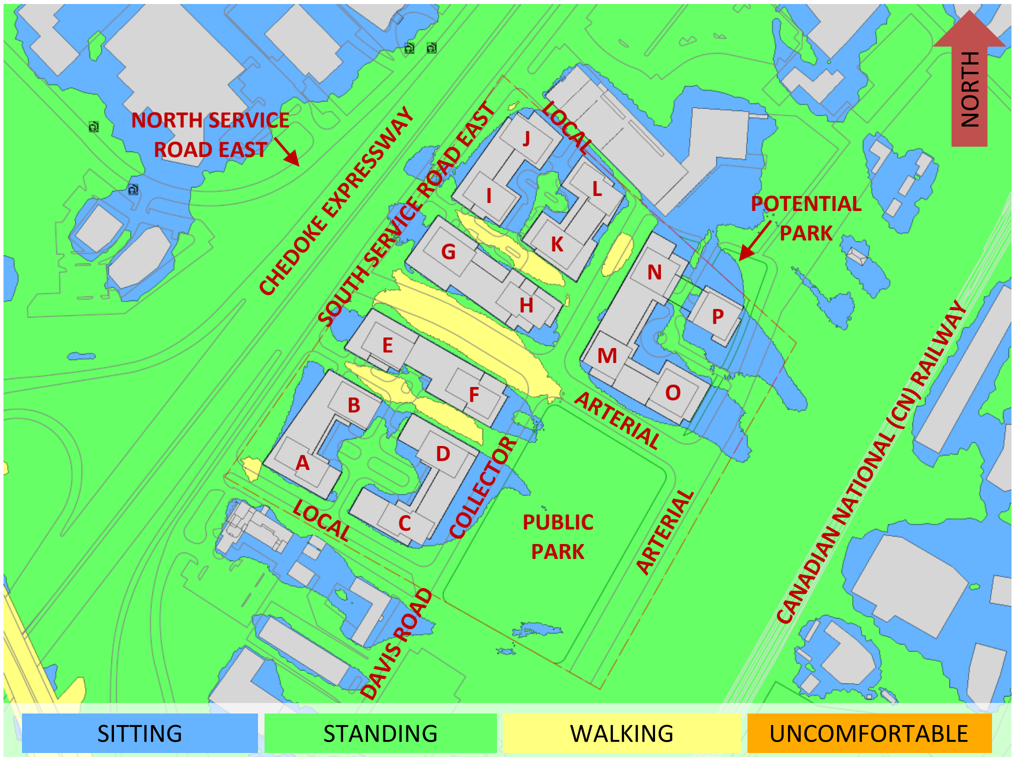


FIGURE 4A: SUMMER – WIND COMFORT, GRADE LEVEL – PROPOSED MASSING

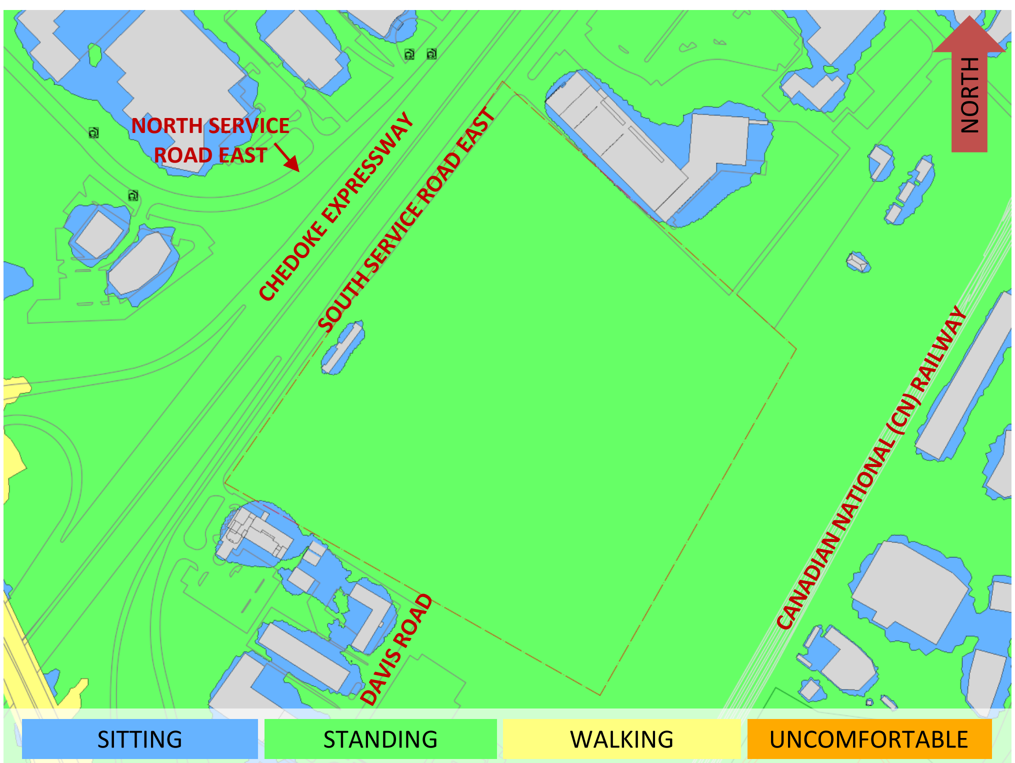


FIGURE 4B: SUMMER – WIND COMFORT, GRADE LEVEL – EXISTING MASSING

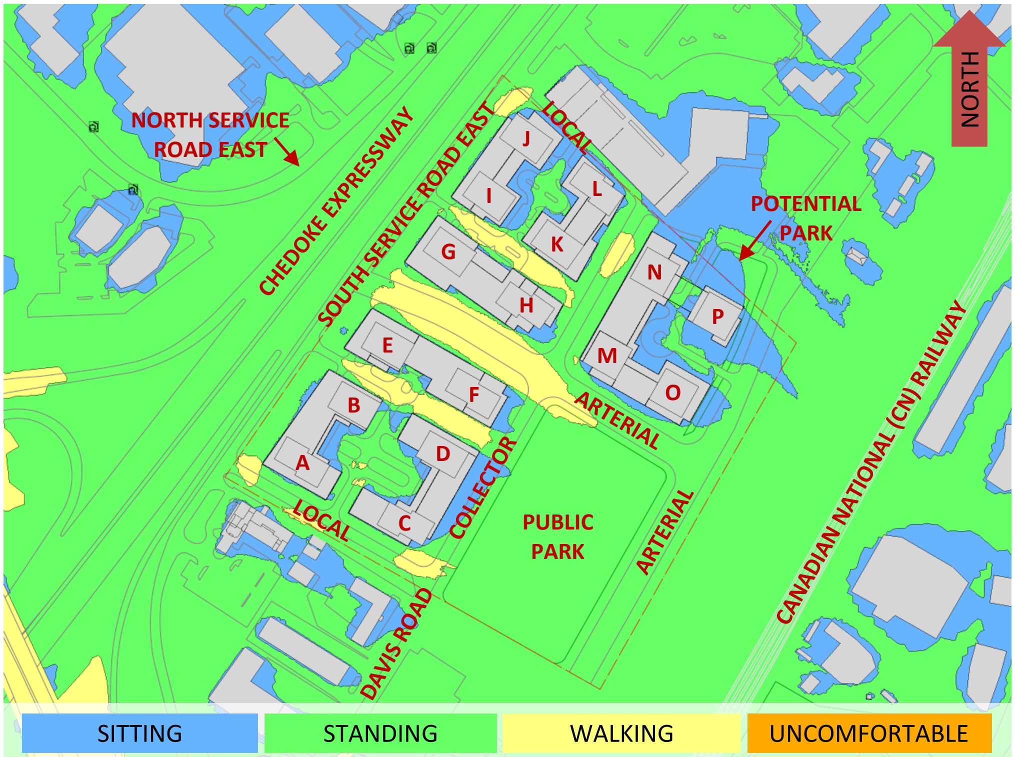


FIGURE 5A: AUTUMN – WIND COMFORT, GRADE LEVEL – PROPOSED MASSING

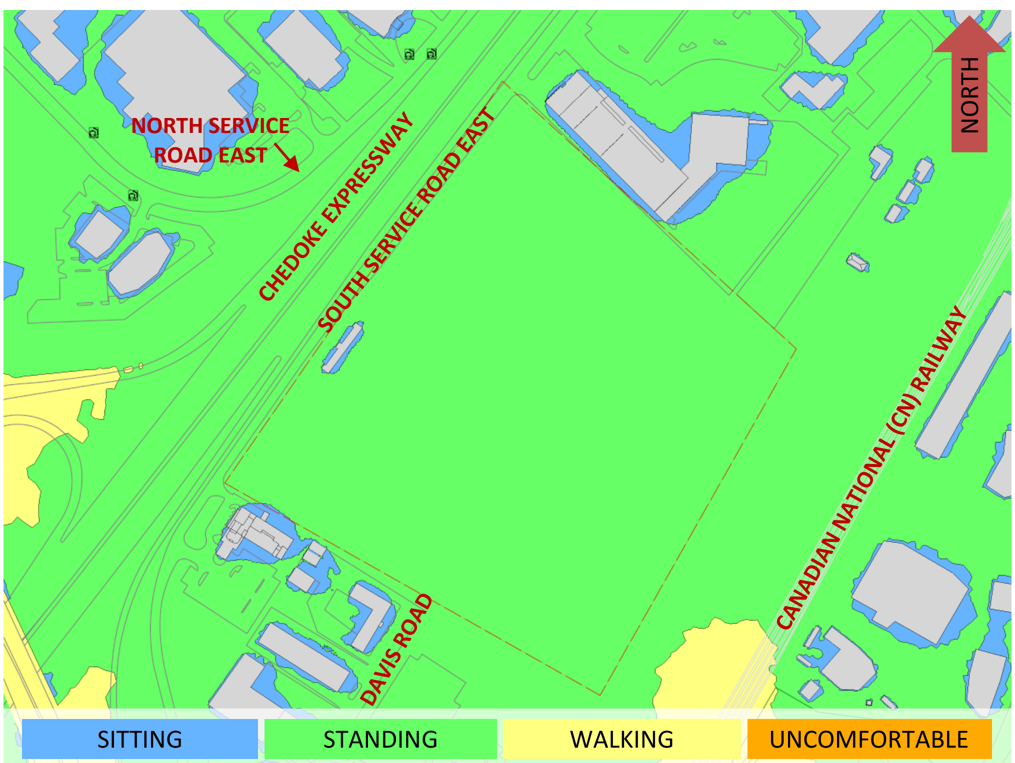


FIGURE 5B: AUTUMN – WIND COMFORT, GRADE LEVEL – EXISTING MASSING

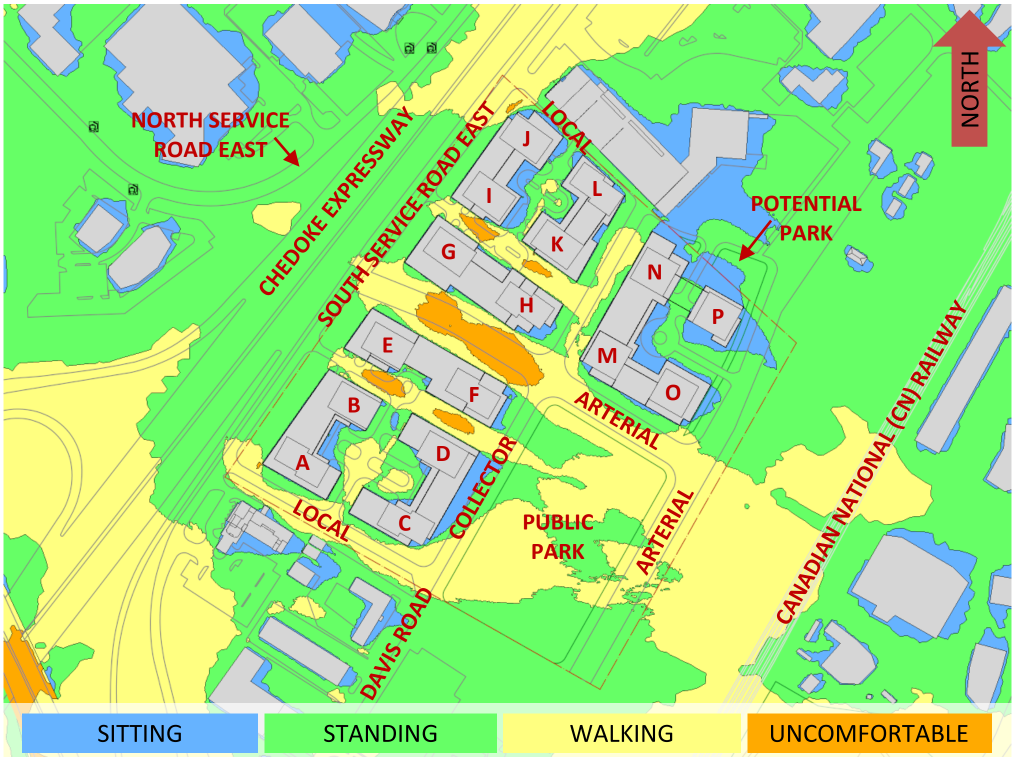


FIGURE 6A: WINTER – WIND COMFORT, GRADE LEVEL – PROPOSED MASSING

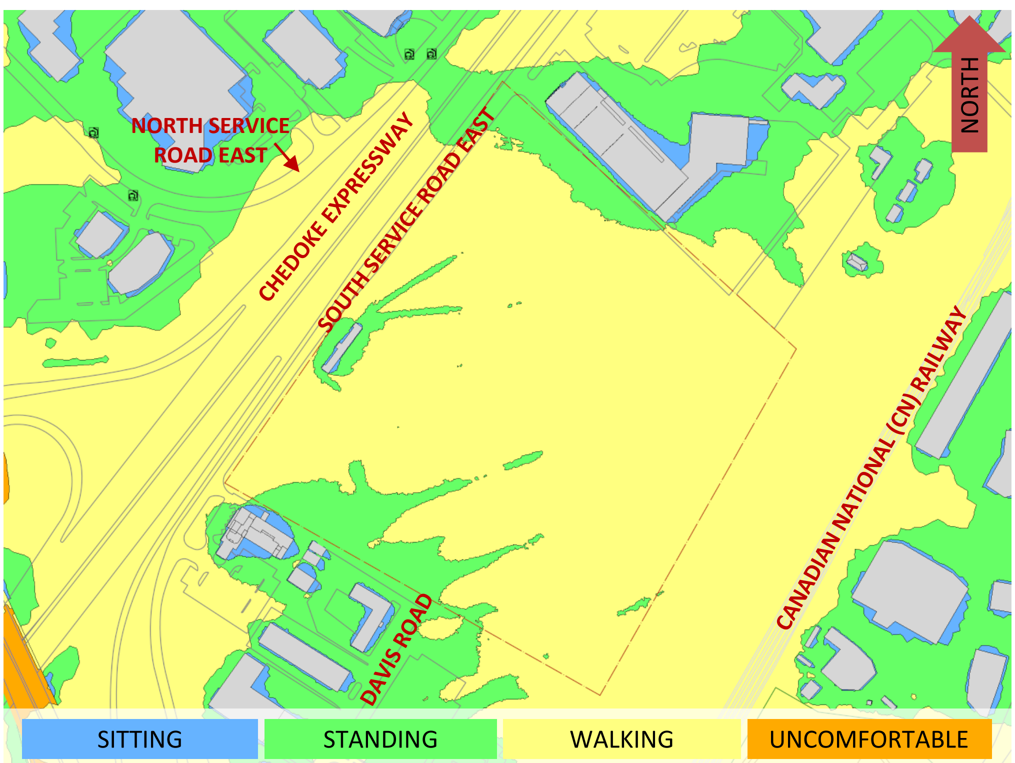


FIGURE 6B: WINTER – WIND COMFORT, GRADE LEVEL – EXISTING MASSING

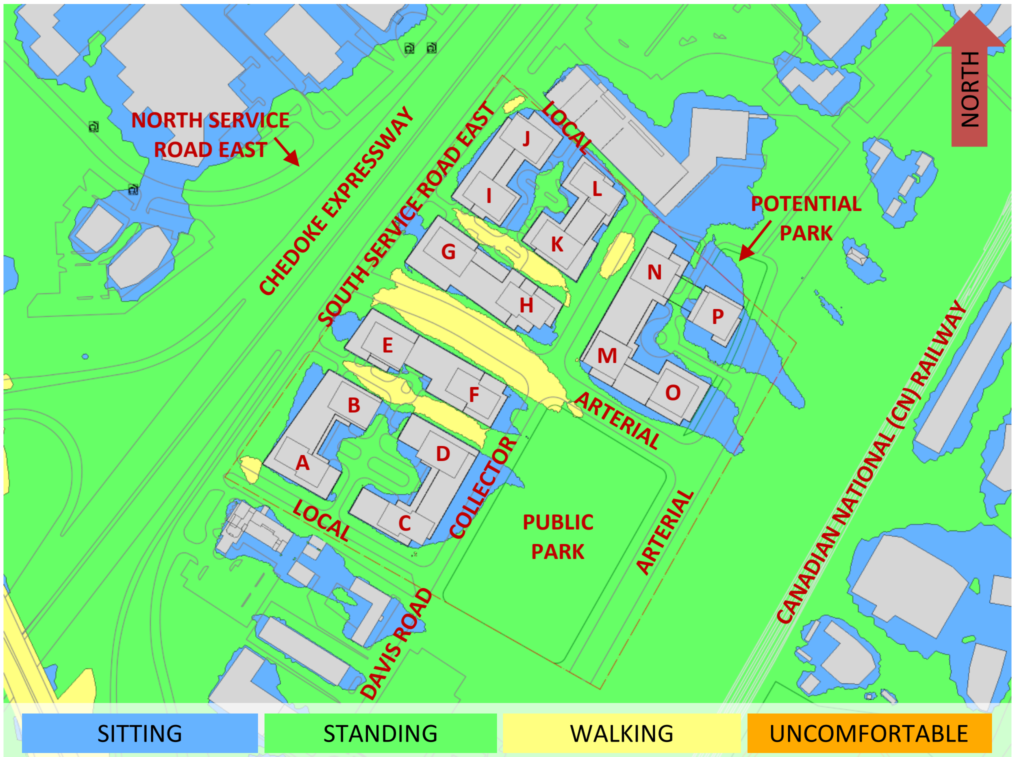


FIGURE 7: TYPICAL USE PERIOD – WIND COMFORT, GRADE LEVEL – PROPOSED MASSING

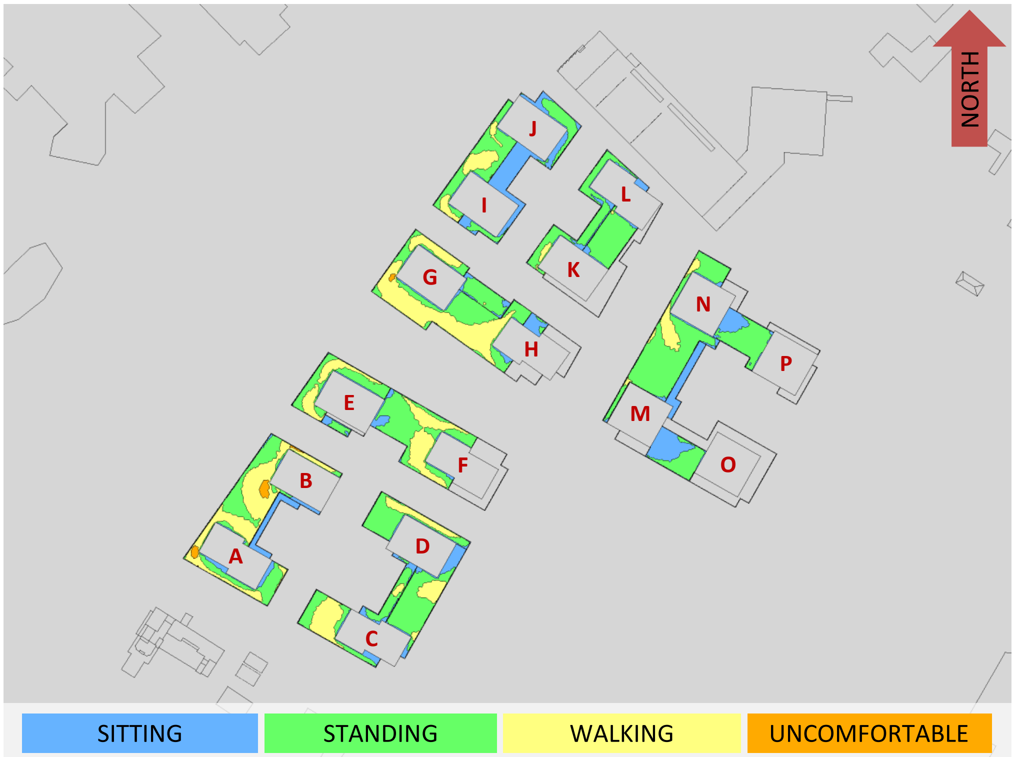


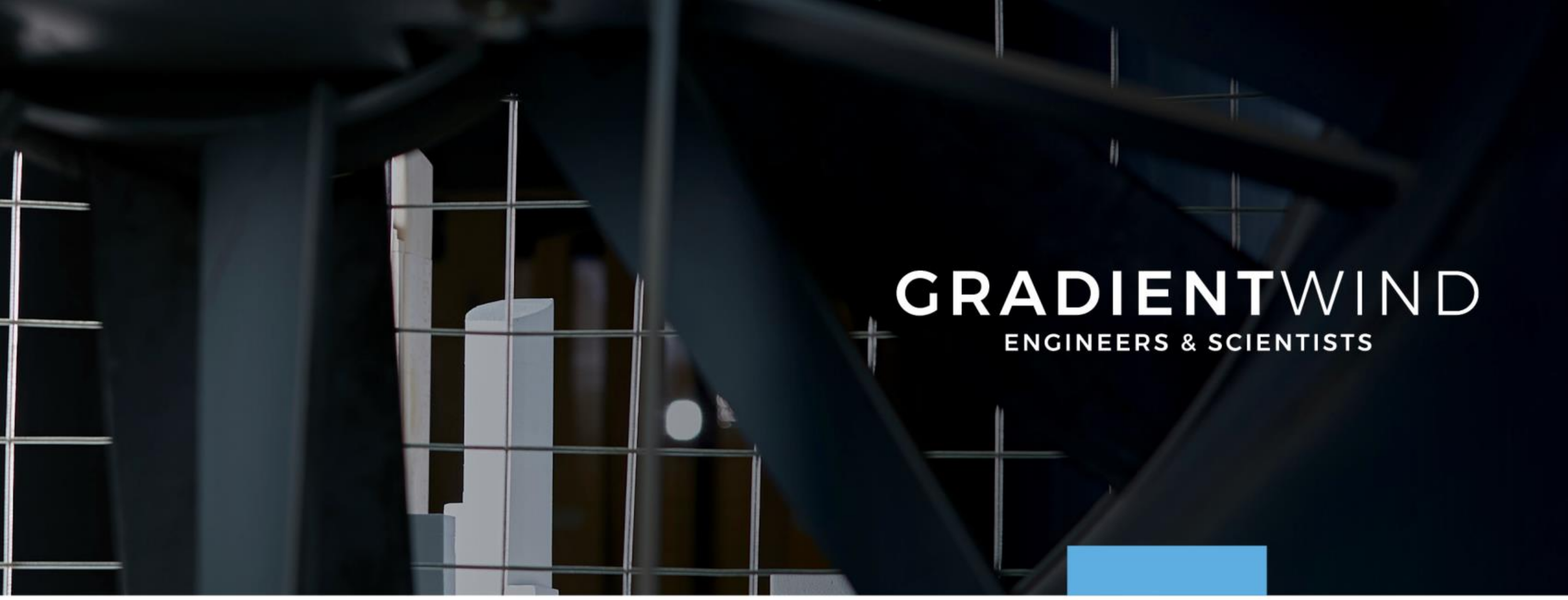
FIGURE 8A: SPRING – WIND COMFORT, COMMON AMENITY TERRACES

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

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

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

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



APPENDIX A

SIMULATION OF THE ATMOSPHERIC BOUNDARY LAYER

127 WALGREEN ROAD, OTTAWA, ON, CANADA K0A 1L0 | 613 836 0934
GRADIENTWIND.COM

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

TABLE 2: DEFINITION OF UPSTREAM EXPOSURE (ALPHA VALUE)

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

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

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

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

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

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

REFERENCES

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

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

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