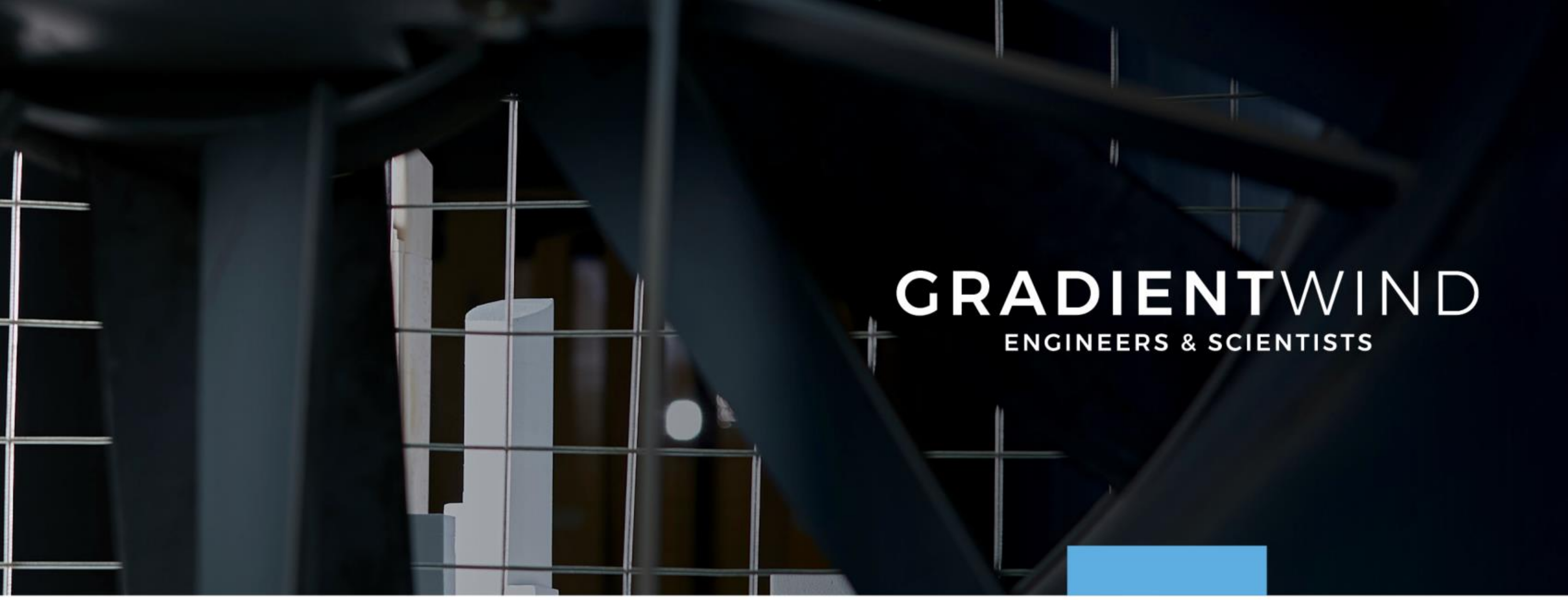
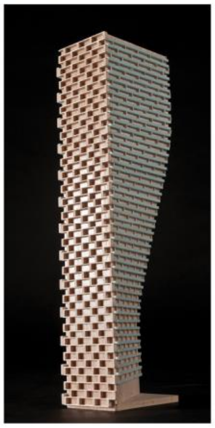
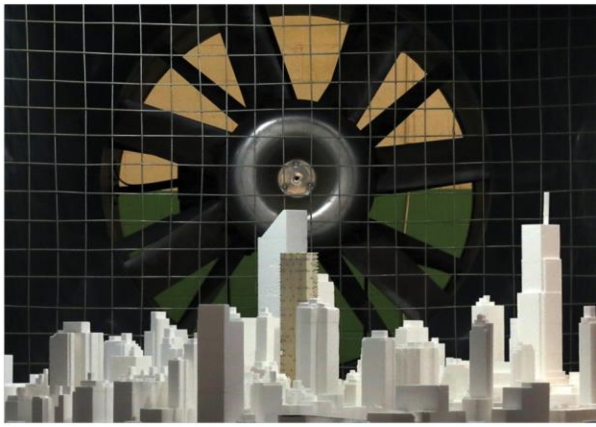


PEDESTRIAN LEVEL WIND STUDY

1015 Tweddle Road
Ottawa, Ontario

Report: 20-087-PLW





April 2, 2025

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EXECUTIVE SUMMARY

This report describes a pedestrian level wind (PLW) study undertaken to satisfy Site Plan Control application submission requirements for the proposed mixed-use residential development located at 1015 Tweddle Road in Ottawa, Ontario (hereinafter referred to as "subject site" or "proposed development"). Our mandate within this study is to investigate pedestrian wind conditions within and surrounding the subject site, and to identify areas where wind conditions may interfere with certain pedestrian activities so that mitigation measures may be considered, where required.

The study involves simulation of wind speeds for selected wind directions in a three-dimensional (3D) computer model using the computational fluid dynamics (CFD) technique, combined with meteorological data integration, to assess pedestrian wind comfort and safety within and surrounding the subject site according to City of Ottawa wind comfort and safety criteria. The results and recommendations derived from these considerations are detailed in the main body of the report (Section 5), illustrated in Figures 3A-9, and summarized as follows:

1) The subject site is located on the banks of the Ottawa River and is exposed to the prevailing winds from the west clockwise to the north-northwest, and the surrounding rural environs comprise sparse massing to the north-northeast and east and in the southwest compass quadrant. Conditions over the area prior to the introduction of the proposed development are predicted to be windy and suitable for mostly strolling during the summer and autumn and walking during the spring and winter seasons.

2) Following the introduction of the proposed development, the prevailing winds are predicted to downwash over the façades of each tower and accelerate around the northeast corners of Towers B1, B3, and B4 and to channel and accelerate between the towers and podia serving the proposed development.

a. A mitigation strategy has been developed in collaboration with the building and landscape architects and is summarized in Sections 2 and 5.1. The mitigation strategy was effective in significantly improving wind conditions within and surrounding the subject site. The mitigation strategy will continue to evolve and progress in collaboration with the building and landscape architects as the design of the proposed development progresses.

b. Regions of conditions that may occasionally be considered uncomfortable for walking are situated between the podia serving Towers B1 and B2, between the podia serving Towers B3 and B4, over the proposed commercial spine and entrance plaza, and over the intersections of Jeanne-d'Arc Boulevard North and Trim and Tweedle Roads.

c. It is recommended that the commercial/secondary access points located along the commercial spine between Towers B1 and B2 and along the pedestrian connection between Towers B3 and B4 serving the Tower B4 podium be recessed into their respective façades by at least 2 m.

d. It is recommended to implement typical transit shelters for the nearby transit stops along Jeanne-d'Arc Boulevard North to provide pedestrians with a means to seek relief from the elements, including during periods of strong wind activity.

e. Within the central pedestrian plaza, particularly to the northwest of Tower B2, it is recommended to implement targeted mitigation adjacent to sensitive-use areas and designated seating areas such as tall wind screens and overhead canopies in combination with strategically placed seating with high-back benches and other local wind mitigation. Additionally, wind conditions over the pedestrian plazas, nature path, and walkways serving the subject site would be expected to improve following the introduction of other mitigation measures to further improve conditions at grade. Vegetation in raised planting beds is proposed throughout the development. This vegetation was omitted from the simulation model, as is industry standard practice, due to the difficulty of providing an accurate seasonal representation of vegetation, as described in Section 4.1.

3) The common amenity terraces serving the proposed development were modelled with 1.8-m-tall wind screens along their full perimeters, which is recommended to provide shielding from direct prevailing winds. During the typical use period (May to October, inclusive), conditions within the terraces are mostly mixed between sitting and standing, with calmer conditions suitable for mostly sitting predicted for the Level 3 terrace serving Tower B1 and the pool terrace serving Towers B2 and B3.

    a. If required by programming, additional mitigation elements may take the form of mitigation inboard of the terrace perimeters and targeted around sensitive areas, in combination with tall perimeter wind screens along the full terrace perimeters and canopies extending from select tower elevations. Inboard mitigation could take the form of wind screens, canopies, or other common landscape elements.

    b. The extent of mitigation is dependent on the programming of the terraces. It is recommended than an appropriate mitigation strategy be further developed in collaboration with the building and landscape architects as the design of the proposed development progresses.

4) The foregoing statements and conclusions apply to common weather systems, during which an isolated pedestrian area at grade to the northwest of Tower B2 may experience wind conditions that approach the wind safety threshold, as defined in Section 4.4.

    a. Additional wind mitigation elements in this area, such as those described in Section 5.1, that further improve upon the pedestrian wind comfort conditions for sensitive pedestrian-uses, such as designated seating in the area, would be expected to also improve upon the potential exceedance of the wind safety threshold.

TABLE OF CONTENTS

1. INTRODUCTION

Gradient Wind Engineering Inc. (Gradient Wind) was retained by Trim Road 1 LP Inc. to undertake a pedestrian level wind (PLW) study to satisfy Site Plan Control application submission requirements for the proposed mixed-use residential development located at 1015 Tweddle Road in Ottawa, Ontario (hereinafter referred to as "subject site" or "proposed development"). Our mandate within the current study is to investigate pedestrian wind conditions within and surrounding the subject site following the introduction of the proposed development, and to identify areas where wind conditions may interfere with certain pedestrian activities so that mitigation measures may be considered, where required. Following results from an initial PLW study conducted in October 2024, a mitigation strategy was developed in collaboration with the building and landscape architects to improve wind comfort conditions at grade. The wind comfort and safety conditions presented in the current study correspond to the January 2025 architectural and landscape designs incorporating these mitigation elements.

Our work is based on industry standard computer simulations using the computational fluid dynamics (CFD) technique and data analysis procedures, City of Ottawa wind comfort and safety criteria, architectural drawings prepared by NEUF architect(e)s in January 2025, surrounding street layouts and existing and approved future building massing information obtained from the City of Ottawa, as well as recent satellite imagery.

2. TERMS OF REFERENCE

The subject site is located at 1015 Tweddle Road in Ottawa, situated to the northeast at the intersection of Jeanne-d'Arc Boulevard North and Tweddle Road. The proposed development comprises four buildings: Tower B1, a 28-storey tower atop a 2-storey podium located at the northwest corner of the subject site fronting Tweddle Road; Tower B2 (32-storeys) and Tower B3 (28-storeys), which share a 2-storey podium centrally located along the south perimeter of the subject site fronting Jeanne-d'Arc Boulevard North; and Tower B4, a 24-storey tower atop a 2-storey podium located at the southeast corner of the subject site fronting Jeanne-d'Arc Boulevard North.

A pedestrian walkway (commercial spine) extends from an entrance plaza located at the southwest corner of the subject site to a central plaza situated to the north of Tower B2. The pedestrian walkway continues east around the shared podium serving Towers B2 and B3, extending between Towers B3 and B4 to reconnect to Jeanne-d'Arc Boulevard North. A nature path extends east from Tweddle Road along the north perimeter of the subject site with a nature park situated along the northern site boundary. The underground parking levels are accessed via parking ramps located at the west elevation of Tower B1 from Tweddle Road and along the south elevation of Tower B4 from Jeanne-d'Arc Boulevard North. Designated loading/drop-off areas and parking areas are located along the north side of Jeanne-d'Arc Boulevard North and the east side of Tweddle Road.

The ground floor of Tower B1 is programmed for mixed-use, comprising commercial space along the south and east elevations and residential amenities to the northwest. A residential lobby is located centrally along the west elevation. The ground floor of the shared podium belonging to Towers B2 and B3 is similarly programmed as mixed-use, comprising commercial space along the south elevation fronting Jeanne-d'Arc Boulevard North and residential amenities along the north elevation. Residential lobbies are located along the south elevation beneath their respective towers. The ground floor of Tower B4 comprises mostly residential units with a lobby along the south elevation. Notably, the primary access points to the residential lobbies serving Towers B2-B4 are outfitted with vestibules and the planforms of Towers B2-B4 overhang their respective primary residential access points while the primary residential access point to Tower B1 includes an overhead canopy.

Notable elements of the grade-level mitigation strategy include large canopies along the perimeters of the podia, extending from the east facade of the podium serving Tower B1, from the west clockwise to the east façade of the podium serving Towers B2 and B3, and from the southwest façade of the podium serving Tower B4. Landscaping elements that have been considered at grade include fixed pergolas with north-facing vertical walls along the north perimeter of the subject site as well as planters and architectural/structural wind barriers located between Towers B1 and B2 and Towers B3 and B4. Seating areas near the entrance plaza include overhead fixed umbrellas, a boulder wall has been implemented along the north perimeter of the main central plaza, and an architectural pavilion connected to the canopy is located to the east of Tower B1. Furthermore, programming has been adjusted at grade to primarily implement seating areas where conditions are calmer, while including more active-use areas, such as play areas or fitness areas where wind conditions are less calm during the typical use period (May to October, inclusive).

Building setbacks accompany amenity terraces serving the proposed development at Level 2. Towers B1-B4 include amenities terraces atop their respective podia at Level 3. A pool deck within the podium serving Towers B2 and B3 is centrally located at Level 2 and is open to the Level 3 amenity terrace above. The four towers are reserved for residential occupancy above their respective ground floors and are each topped with a mechanical penthouse (MPH).

The near-field surroundings (defined as an area within 200 metres (m) of the subject site) comprise green space marshlands from the southwest clockwise to the east and sparse, low-rise commercial massing to the southeast. The far-field surroundings (defined as an area beyond the near-field but within a 2-kilometre (km) radius of the subject site) are characterized by marshlands, Petrie Island, and the Ottawa River from the west-southwest clockwise to the north-northeast, four high-rise residential towers to the east-northeast (Petrie's Landing) followed by green space, and a mix of low-rise buildings and green spaces in the remaining directions.

Site plans for the proposed and existing massing scenarios are illustrated in Figures 1A and 1B, while Figures 2A-2H illustrate the computational models used to conduct the study. The existing massing scenario includes the existing massing and any developments that have been approved by the City of Ottawa.

3. OBJECTIVES

The principal objectives of this study are to (i) determine pedestrian level wind conditions at key areas within and surrounding the development site; (ii) identify areas where wind conditions may interfere with the intended uses of outdoor spaces; and (iii) recommend suitable mitigation measures, where required.

4. METHODOLOGY

The approach followed to quantify pedestrian wind conditions over the site is based on CFD simulations of wind speeds across the subject site within a virtual environment, meteorological analysis of the Ottawa area wind climate, and synthesis of computational data with City of Ottawa wind comfort and safety criteria[1]. The following sections describe the analysis procedures, including a discussion of the noted pedestrian wind criteria.

4.1 Computer-Based Context Modelling

A computer based PLW study was performed to determine the influence of the wind environment on pedestrian comfort over the proposed development site. Pedestrian comfort predictions, based on the mechanical effects of wind, were determined by combining measured wind speed data from CFD simulations with statistical weather data obtained from Ottawa Macdonald-Cartier International Airport. The general concept and approach to CFD modelling is to represent building and topographic details in the immediate vicinity of the subject site on the surrounding model, and to create suitable atmospheric wind profiles at the model boundary. The wind profiles are designed to have similar mean and turbulent wind properties consistent with actual site exposures.

An industry standard practice is to omit trees, vegetation, and other existing and planned landscape elements from the model due to the difficulty of providing accurate seasonal representation of vegetation. The omission of trees and other landscaping elements produces slightly stronger wind speeds.

4.2 Wind Speed Measurements

The PLW analysis was performed by simulating wind flows and gathering velocity data over a CFD model of the site for 16 wind directions. The CFD simulation model was centered on the proposed development, complete with surrounding massing within a radius of approximately 515 m. The process was performed for two context massing scenarios, as noted in Section 2.

[1] City of Ottawa Terms of References: Wind Analysis
https://documents.ottawa.ca/sites/documents/files/wind_analysis_tor_en.pdf

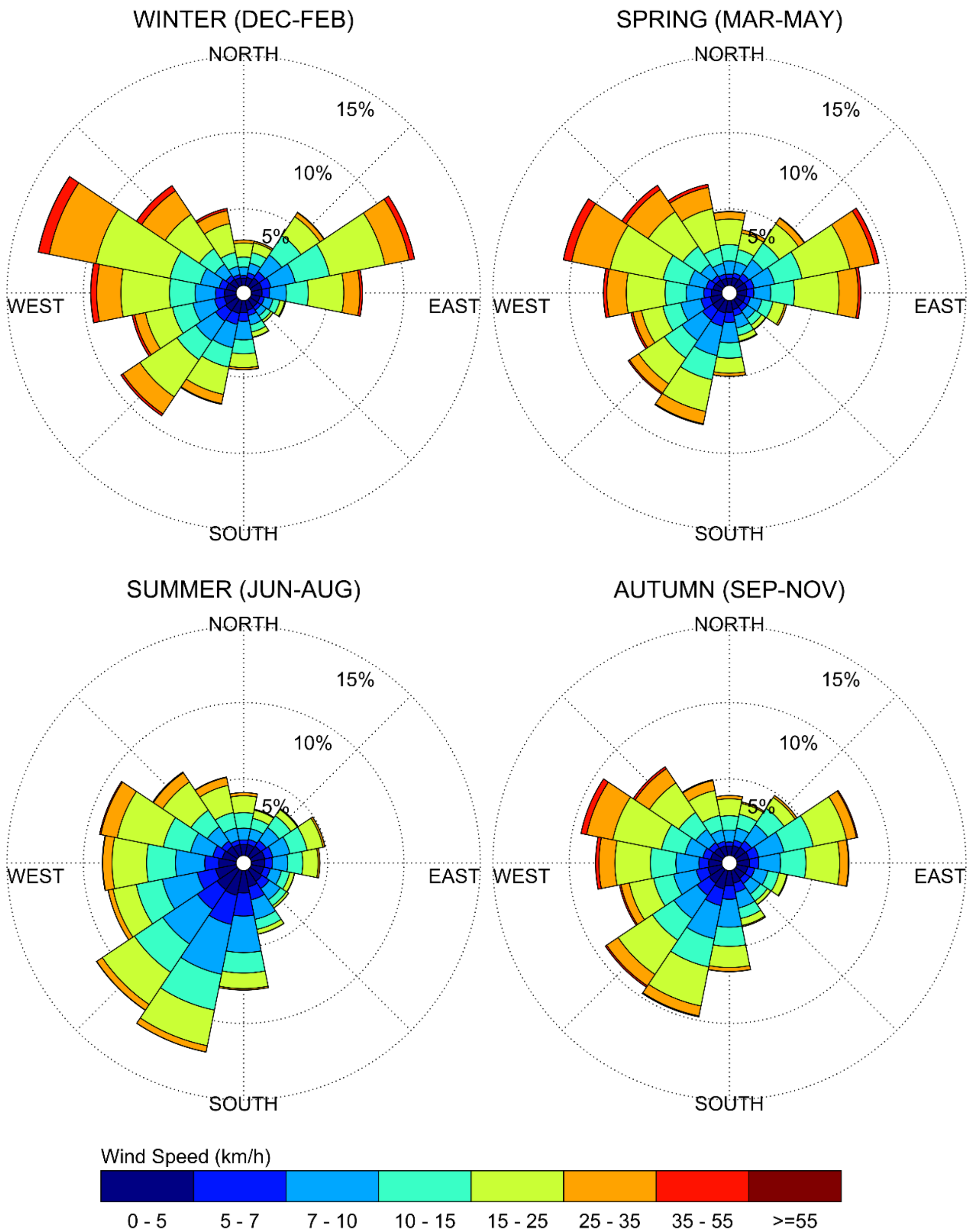
Mean and peak wind speed data obtained over the subject site for each wind direction were interpolated to 36 wind directions at 10° intervals, representing the full compass azimuth. Measured wind speeds approximately 1.5 m above local grade and above the common amenity terraces serving the proposed development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

4.3 Historical Wind Speed and Direction Data

A statistical model for winds in Ottawa was developed from approximately 40 years of hourly meteorological wind data recorded at Ottawa Macdonald-Cartier International Airport and obtained from Environment and Climate Change Canada. Wind speed and direction data were analyzed during the appropriate hours of pedestrian usage (that is, between 06:00 and 23:00) and divided into four distinct seasons, as stipulated in the wind criteria. Specifically, the spring season is defined as March through May, the summer season is defined as June through August, the autumn season is defined as September through November, and the winter season is defined as December through February, inclusive.

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

SEASONAL DISTRIBUTION OF WIND
OTTAWA MACDONALD-CARTIER INTERNATIONAL AIRPORT



Notes:

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

4.4 Pedestrian Wind Comfort and Safety Criteria – City of Ottawa

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

PEDESTRIAN WIND COMFORT CLASS DEFINITIONS

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

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

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

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

TARGET PEDESTRIAN WIND COMFORT CLASSES FOR VARIOUS LOCATION TYPES

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

5. RESULTS AND DISCUSSION

The following discussion of the predicted pedestrian wind conditions for the subject site is accompanied by Figures 3A-6B, which illustrate wind conditions at grade level for the proposed and existing massing scenarios, and by Figures 8A-D, which illustrate conditions over the common amenity terraces serving the proposed development. Conditions are presented as continuous contours of wind comfort throughout the subject site and correspond to the comfort classes presented in Section 4.4.

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

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

5.1 Wind Comfort Conditions – Grade Level

The mostly rural environs and the limited built-up massing in the vicinity of the proposed development exposes the subject site to prevailing winds from multiple directions. Of particular note, the subject site is located on the banks of the Ottawa River and is exposed to the prevailing unmitigated winds from the west clockwise to the north-northwest, and the sparse surroundings to the north-northeast and east and in the southwest compass quadrant offer limited shielding to salient winds from these directions.

Under the existing massing, which is comprised of a vacant lot, wind comfort conditions over the subject site are predicted to be windy and suitable for mostly strolling during the summer and autumn and walking during the spring and winter seasons. Notably, prevailing winds from the river valley are predicted to accelerate up the embankment located along the north site boundary that slopes towards the marshlands to the north and the Ottawa River and Petrie Island.

These existing winds conditions are then predicted to combine and interact with the proposed development, with the prevailing winds predicted to downwash over the facades of each tower and accelerate around the northeast corners of Towers B1, B3, and B4 and to channel and accelerate between the towers and podia serving the proposed development.

In coordination with the building and landscape architects, several mitigation measures have been incorporated into the current architectural and landscape design, comprising cantilevered canopies extending from the podia façades to deflect downwash from prevailing winds, and landscaping elements including free-standing canopies, pergolas with vertical trellis-like panels, architectural/structural wind barriers, an architectural pavilion, raised planting beds, and a boulder wall to reduce the channelling and acceleration of winds between the podia. Furthermore, the towers have been rotated and the shape of the podiums serving Towers B2 and B3 has been revised to further reduce the channelling of winds between the podia. Under the revised massing, as compared to the October 2024 design, and the incorporation of the above-noted mitigative elements, while isolated regions of conditions that may occasionally be considered uncomfortable for walking are situated between the podia serving Towers B1 and B2, between the podia serving Towers B3 and B4, over the proposed central and entrance plazas, and over the intersection of Jeanne-d'Arc Boulevard North and Trim Road, wind comfort conditions at grade are predicted to significantly improve over the subject site throughout the year following the introduction of these mitigation measures.

Specifically, conditions over Tweedle Road and Jeanne-d'Arc Boulevard North are now predicted to be suitable for mostly walking, or better, throughout the year, with the uncomfortable wind conditions predicted to the southwest and southeast of the subject site significantly reduced in extent and magnitude, and now limited to the colder months during spring and winter. Over the public sidewalks along Tweedle Road and Jeanne-d'Arc Boulevard North, conditions are predicted to be suitable for walking at least 76% of the time during the spring and winter seasons, representing a marginal 4% exceedance of the walking comfort threshold.

Within the subject site, conditions have similarly significantly improved, with wind conditions along the pathway through the nature park now predicted to be suitable for walking, or better, throughout the year, which is considered acceptable. Conditions during the typical use period (May to October, inclusive) over most areas within the subject site are predicted to be suitable for sitting, standing, or strolling, with isolated areas that are windier along the commercial spine and to the northeast of Tower B3, which includes an active-use area. During the typical use period, wind comfort conditions over the seating areas along the north perimeter of the central plaza and central gardens as well as those to the south of Tower B1 are predicted to be suitable for mostly sitting.

Notably, trees, vegetation, and other planned landscaping elements were omitted from the simulation model, as is industry standard practice, due to the difficulty of providing an accurate seasonal representation of vegetation, as described in Section 4.1. Vegetation including trees and other plantings are proposed throughout the development, which are expected to further improve upon the pedestrian wind conditions throughout the subject site.

Further mitigation that may be considered by the design team include additional canopies that extend from select podia facades, as well as additional wind screening at grade to further diffuse accelerating winds around building corners and between the podia. Mitigation is recommended to be targeted primarily around sensitive-use and designated seating areas, including those to the northwest of Tower B2. The mitigation strategy will continue to be developed and evolve to further improve wind conditions at grade over pedestrian-sensitive areas as the design of the proposed development progresses.

Sidewalks and Multi-Use Paths along Jeanne-d'Arc Boulevard North and Tweedle Road: Conditions over the existing sidewalks and multi-use paths along Jeanne-d'Arc Boulevard North under the existing massing are predicted to be suitable for mostly strolling during the summer and autumn, becoming suitable for a mix of strolling and walking during the spring and winter. With the exception of the above-noted isolated windier areas, wind comfort conditions following the introduction of the proposed development over the sidewalks and multi-use paths along Jeanne-d'Arc Boulevard North are predicted to be suitable for a mix of standing, strolling, and walking throughout the year.

Conditions over the proposed sidewalks along Tweedle Road are predicted to be suitable for mostly walking, or better, throughout the year, with the exception of the above-noted isolated windier area to the south of Tower B1 at the intersection of Tweedle Road and Jeanne–d'Arc Boulevard North.

Nearby Transit Stops along Jeanne-d'Arc Boulevard North: Following the introduction of the proposed development, wind comfort conditions in the vicinity of the nearby westbound transit stop along Jeanne-d'Arc Boulevard North are predicted to be suitable for a mix of standing and strolling during the summer and strolling during autumn. Conditions during the spring and winter over the area are predicted to be suitable for walking. Conditions in the vicinity of the nearby eastbound transit stop are predicted to be suitable for standing during the summer, strolling during the spring and autumn, and a mix of strolling and walking during the winter season. It is recommended to implement typical transit shelters for these transit stops that provide pedestrians with a means to seek relief from the elements, including during periods of strong wind activity.

Under the existing massing, condition over the nearby westbound and eastbound transit stops are predicted to be suitable for walking, or better, throughout the year. Notably, the introduction of the proposed development is expected to improve wind conditions in the vicinity of the nearby eastbound transit stop. Nevertheless, transit stop shelters are recommended at both westbound and eastbound transit stops to improve comfort conditions.

Plazas, and Walkways within the Subject Site: Conditions over the entrance plaza at the southwest corner of the subject site are predicted to be suitable for mostly a mix of sitting and standing during the typical use period, with conditions suitable for sitting over the western areas of the designated seating located to the south of Tower B1.

Conditions over the central plaza and gardens during the same period are predicted to be suitable for a mix of mostly strolling and walking during the same period with standing conditions to the north of the podium serving Towers B2 and B3. Designated seating and lounging areas beneath the pergolas and free-standing canopies serving the north perimeter of the subject site fronting the nature park and pathway are predicted to be suitable for mostly sitting during the typical use period, which is considered acceptable.

As noted above, conditions over the nature path along the north perimeter of the subject site are predicted to be mostly suitable for walking, or better, throughout the year, being suitable for a mix of mostly sitting and standing during the summer and autumn, and a mix of standing, strolling, and walking during the spring and winter, which is considered acceptable.

Wind conditions over the remaining pedestrian walkways at grade within the subject site are predicted to be mostly suitable for a mix of mostly standing and strolling during the summer and mostly walking, or better, during the autumn. As noted above, an isolated region of windier conditions considered occasionally uncomfortable for walking is predicted between the podia serving Towers B1 and B2, and an isolated region considered occassionally uncomfortable for walking during the spring, autumn, and winter months is predicted between the podia serving Towers B3 and B4. Calmer conditions that are suitable for strolling, or better, throughout the year are predicted to the north and west of Tower B1 and to the south of Towers B2 and B3.

If the pedestrian plazas will include additional designated seating or lounging areas, it is recommended to implement targeted mitigation around these areas, such as tall wind screens and overhead umbrellas or canopies in combination with strategically placed seating with high-back benches and other local wind mitigation. The extent of mitigation measures is dependent on the programming of these spaces. The mitigation strategy may be further developed in collaboration with the building and landscape architects as the design of the proposed development progresses.

Loading/Drop-off Areas Serving the Subject Site: The loading/drop-off area serving Tower B1 along Tweddle Road is predicted to be suitable for standing during the summer and autumn and a mix of standing and strolling during the spring and winter, which is considered acceptable.

Wind conditions over the loading/drop-off areas serving the proposed development along Jeanne-d'Arc Boulevard North are predicted to be suitable for walking, or better, throughout the year, with an isolated region of conditions considered uncomfortable for walking over the eastern-most loading/drop-off area.

Building Access Points: Owing to the protection of building façades, conditions in the vicinity of the primary residential access points serving Towers B1-B3 and the commercial access points along the south elevation of Towers B2 and B3 are predicted to be suitable for standing, or better, throughout the year, which is considered acceptable. Conditions in the vicinity of the secondary access points along the west elevation of Tower B1, the north elevation of the shared podium serving Towers B2 and B3, and the east elevation of Tower B4 are predicted to be suitable for strolling, or better, throughout the year, which is considered acceptable.

Owing to a recessed entrance, wind comfort conditions in the vicinity of the primary residential access point serving Tower B4 are predicted to be suitable for standing, or better, throughout the year and are considered acceptable.

Wind conditions in the vicinity of the commercial/secondary access points located between the podia serving Towers B1 and B2 and Towers B3 and B4 are mostly suitable for walking with isolated regions considered occasionally uncomfortable for walking, primarily during the spring and winter. It is recommended that all commercial/secondary access points located along the commercial spine between Towers B1 and B2 and serving Tower B4 along the pedestrian connection between Towers B3 and B4 be recessed into their respective façades by at least 2 m.

5.2 Wind Comfort Conditions – Common Amenity Terraces

The common amenity terraces serving Towers B1-B4 of the proposed development atop their podia were modelled using 1.8-m-tall wind screens around the full terrace perimeters. Wind conditions within these terraces during the typical use period, and recommendations regarding mitigation, where required, are described as follows:

Tower B1, Level 2 and Towers B2 and B3, Level 2: Wind comfort conditions over the central pool deck serving the shared podium for Towers B2 and B3 at Level 2 are predicted to be suitable for sitting, which is considered acceptable.

Wind conditions within the remaining amenity terraces serving the proposed development at Level 2 are predicted to be suitable for mostly standing, with isolated areas suitable for strolling. Notably, a large region is suitable for sitting at the eastern end of the Level 2 terrace serving Towers B2 and B3.

Tower B1, Level 3: Wind comfort conditions within the common amenity terrace serving Tower B1 at Level 3 are predicted to be suitable for sitting over most of the terrace, with standing conditions predicted along the east perimeter. If the programming along the east perimeter of the terrace will not include seating or lounging activities, the noted conditions within this terrace may be considered acceptable without additional mitigation.

Towers B2 and B3, Level 3: Conditions within the terrace serving Towers B2 and B3 at Level 3 are predicted to be suitable for sitting to the east of Tower B3 and a mix of sitting and standing over the remainder of the terrace, with conditions suitable for sitting along the façades of the towers.

Tower B4, Level 3: Conditions within the amenity terrace serving Building 4 at Level 3 are predicted to be suitable for a mix of sitting and standing along west and north elevations and sitting along the east elevation.

Depending on programming, conditions may be considered acceptable. Specifically, if seating or lounging activities are not programmed in the windier areas of these terraces, the noted conditions may be considered acceptable without additional mitigation. If required by programming, additional mitigation elements may include a combination of taller wind screens along the perimeters of the noted amenity terraces, and mitigation inboard of the terrace perimeters and targeted around sensitive areas. Inboard mitigation could take the form of wind screens, canopies, or other common landscape elements. Canopies extending from select tower elevations above the terraces may also be beneficial to deflect downwash incident on the terraces.

The extent of mitigation measures is dependent on the programming of the terraces. It is recommended than an appropriate mitigation strategy be further developed in collaboration with the building and landscape architects as the design of the proposed development progresses.

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 target may be exceeded on an annual basis near the northwest corner of Tower B2 at grade between Towers B1 and B2. Additional wind mitigation elements in this area, such as those described in Section 5.1, that further improve upon the pedestrian wind comfort conditions for sensitive pedestrian-uses, such as designated seating in the area, would be expected to also improve upon the potential exceedance of the wind safety threshold.

5.4 Applicability of Results

Pedestrian wind comfort and safety have been quantified for the specific configuration of existing and foreseeable construction around the subject site. Future changes (that is, construction or demolition) of these surroundings may cause changes to the wind effects in two ways, namely: (i) changes beyond the immediate vicinity of the subject site would alter the wind profile approaching the subject site; and (ii) development in proximity to the subject site would cause changes to local flow patterns.

6. CONCLUSIONS AND RECOMMENDATIONS

A complete summary of the predicted wind conditions is provided in Section 5 and illustrated in Figures 3A-9. Based on computer simulations using the CFD technique, meteorological data analysis of the Ottawa wind climate, City of Ottawa wind comfort and safety criteria, and experience with numerous similar developments, the study concludes the following:

1) The subject site is located on the banks of the Ottawa River and is exposed to the prevailing winds from the west clockwise to the north-northwest, and the surrounding rural environs comprise sparse massing to the north-northeast and east and in the southwest compass quadrant. Conditions over the area prior to the introduction of the proposed development are predicted to be windy and suitable for mostly strolling during the summer and autumn and walking during the spring and winter seasons.

2) Following the introduction of the proposed development, the prevailing winds are predicted to downwash over the façades of each tower and accelerate around the northeast corners of Towers B1, B3, and B4 and to channel and accelerate between the towers and podia serving the proposed development.

    a. A mitigation strategy has been developed in collaboration with the building and landscape architects and is summarized in Sections 2 and 5.1. The mitigation strategy was effective in significantly improving wind conditions within and surrounding the subject site. The mitigation strategy will continue to evolve and progress in collaboration with the building and landscape architects as the design of the proposed development progresses.

    b. Regions of conditions that may occasionally be considered uncomfortable for walking are situated between the podia serving Towers B1 and B2, between the podia serving Towers B3 and B4, over the proposed commercial spine and entrance plaza, and over the intersections of Jeanne-d'Arc Boulevard North and Trim and Tweedle Roads.

c. It is recommended that the commercial/secondary access points located along the commercial spine between Towers B1 and B2 and along the pedestrian connection between Towers B3 and B4 serving the Tower B4 podium be recessed into their respective façades by at least 2 m.

d. It is recommended to implement typical transit shelters for the nearby transit stops along Jeanne-d'Arc Boulevard North to provide pedestrians with a means to seek relief from the elements, including during periods of strong wind activity.

e. Within the central pedestrian plaza, particularly to the northwest of Tower B2, it is recommended to implement targeted mitigation adjacent to sensitive-use areas and designated seating areas such as tall wind screens and overhead canopies in combination with strategically placed seating with high-back benches and other local wind mitigation. Additionally, wind conditions over the pedestrian plazas, nature path, and walkways serving the subject site would be expected to improve following the introduction of other mitigation measures to further improve conditions at grade. Vegetation in raised planting beds is proposed throughout the development. This vegetation was omitted from the simulation model, as is industry standard practice, due to the difficulty of providing an accurate seasonal representation of vegetation, as described in Section 4.1.

3) The common amenity terraces serving the proposed development were modelled with 1.8-m-tall wind screens along their full perimeters, which is recommended to provide shielding from direct prevailing winds. During the typical use period (May to October, inclusive), conditions within the terraces are mostly mixed between sitting and standing, with calmer conditions suitable for mostly sitting predicted for the Level 3 terrace serving Tower B1 and the pool terrace serving Towers B2 and B3.

a. If required by programming, additional mitigation elements may take the form of mitigation inboard of the terrace perimeters and targeted around sensitive areas, in combination with tall perimeter wind screens along the full terrace perimeters and canopies extending from select tower elevations. Inboard mitigation could take the form of wind screens, canopies, or other common landscape elements.

b. The extent of mitigation is dependent on the programming of the terraces. It is recommended than an appropriate mitigation strategy be further developed in collaboration with the building and landscape architects as the design of the proposed development progresses.

4) The foregoing statements and conclusions apply to common weather systems, during which an isolated pedestrian area at grade to the northwest of Tower B2 may experience wind conditions that approach the wind safety threshold, as defined in Section 4.4.

a. Additional wind mitigation elements in this area, such as those described in Section 5.1, that further improve upon the pedestrian wind comfort conditions for sensitive pedestrian-uses, such as designated seating in the area, would be expected to also improve upon the potential exceedance of the wind safety threshold.

Sincerely,

Gradient Wind Engineering Inc.

LICENSED PROFESSIONAL ENGINEER
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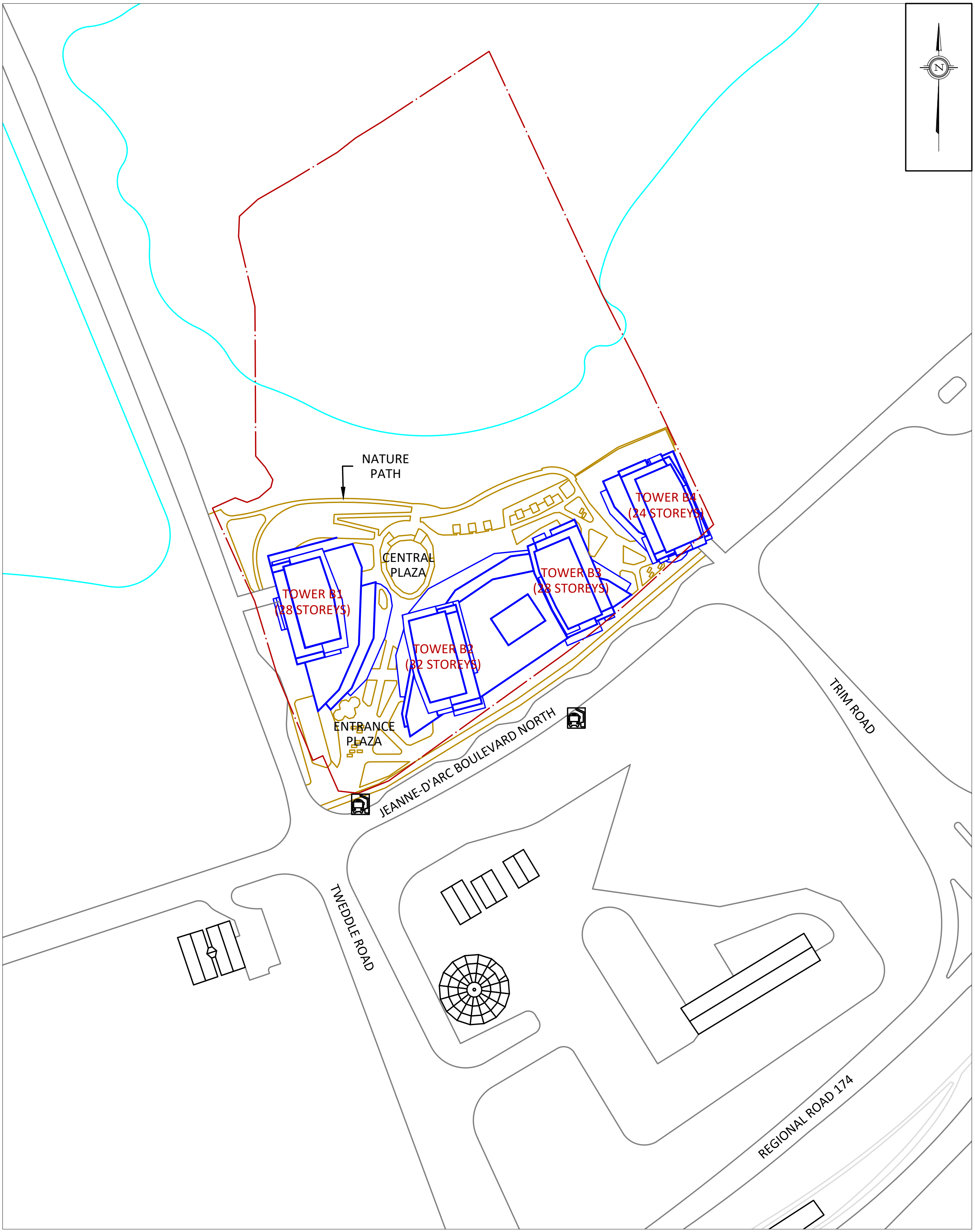
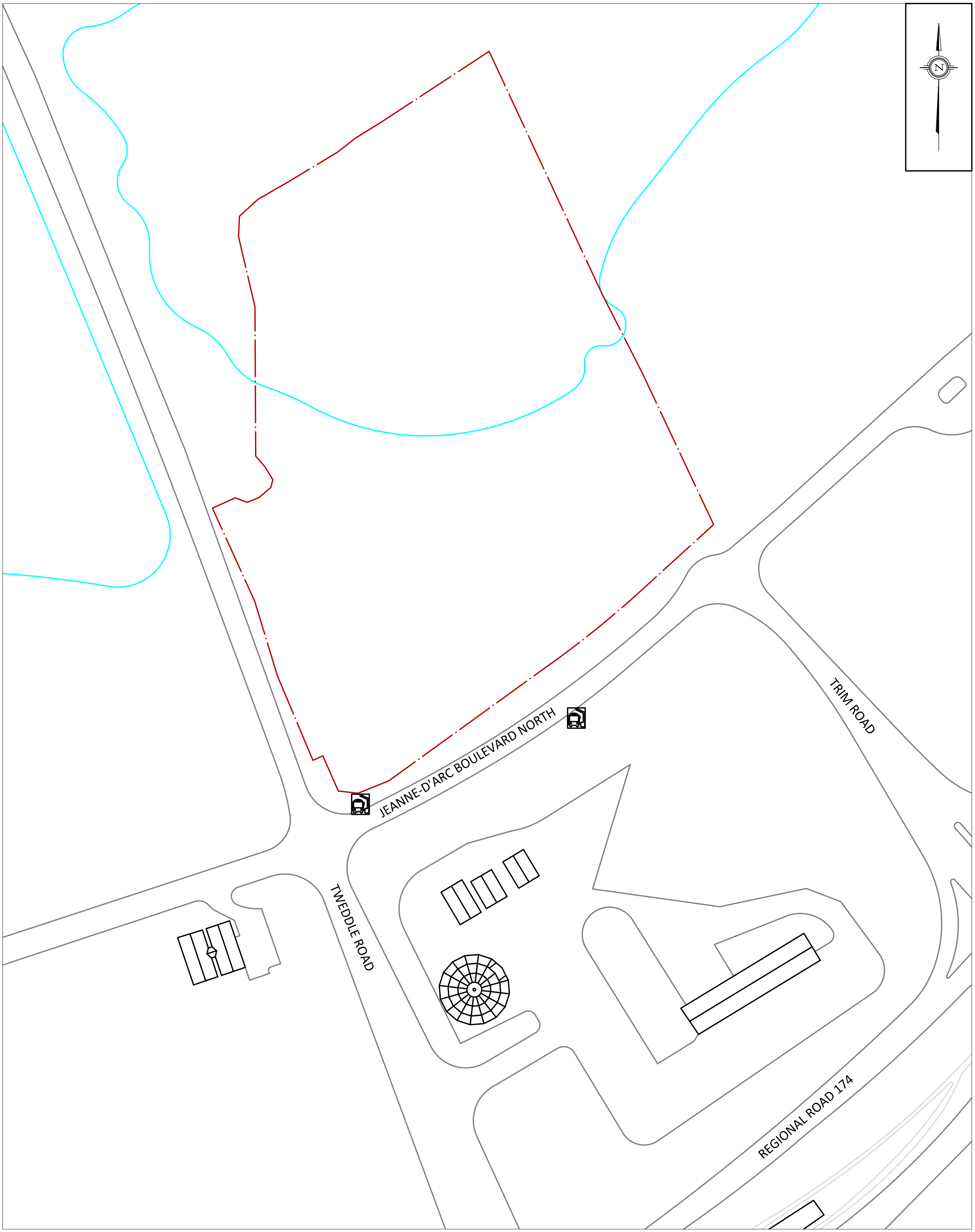


GRADIENTWIND ENGINEERS & SCIENTISTS 127 WALGREEN ROAD, OTTAWA, ON 613 836 0934 • GRADIENTWIND.COM	PROJECT 1015 TWEDDLE ROAD, OTTAWA PEDESTRIAN LEVEL WIND STUDY		DESCRIPTION FIGURE 1A: PROPOSED SITE PLAN AND SURROUNDING CONTEXT
	SCALE 1:2000	DRAWING NO. 20-087-PLW-1A	
	DATE FEBRUARY 13, 2025	DRAWN BY S.K.	



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PROJECT		DESCRIPTION
1015 TWEDDLE ROAD, OTTAWA PEDESTRIAN LEVEL WIND STUDY		FIGURE 1B: EXISTING SITE PLAN AND SURROUNDING CONTEXT
SCALE: 1:2000	DRAWING NO.: 20-087-PLW-1B	
DATE: FEBRUARY 13, 2025	DRAWN BY: S.K.	

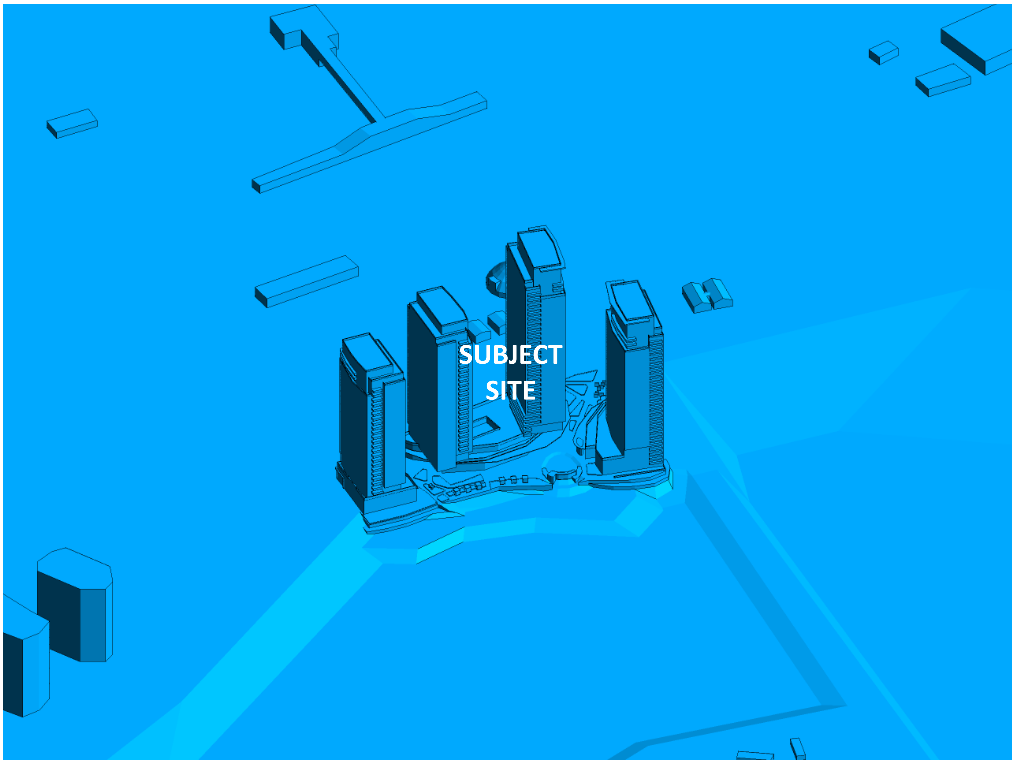


FIGURE 2A: COMPUTATIONAL MODEL, PROPOSED MASSING, NORTH PERSPECTIVE

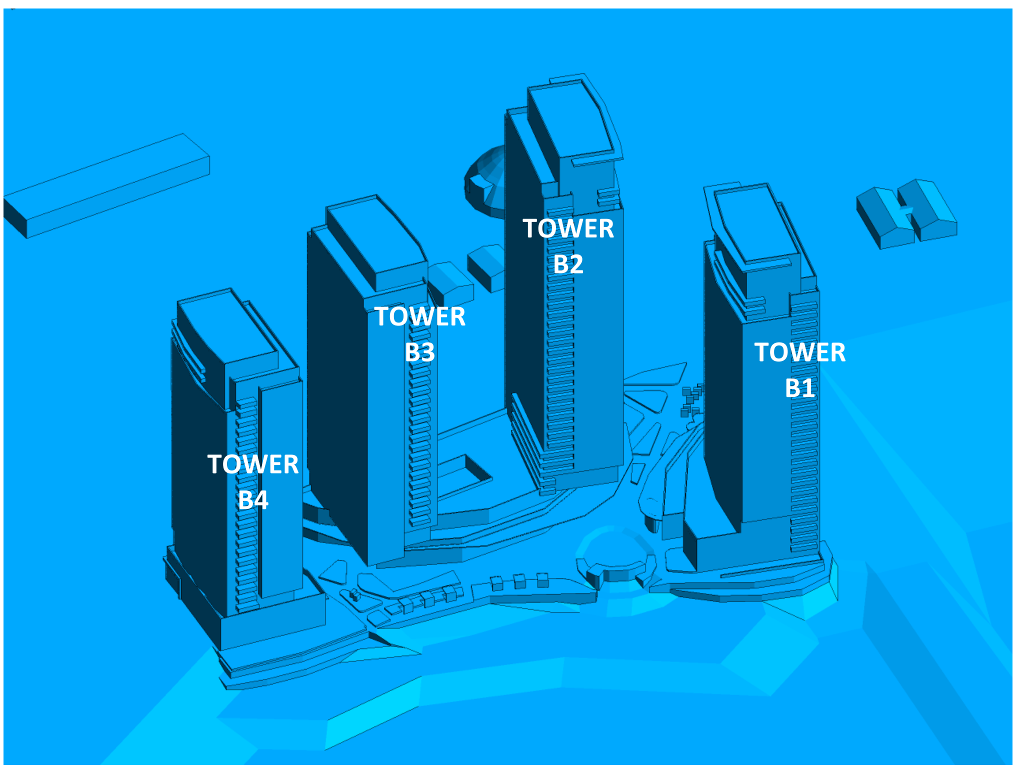


FIGURE 2B: CLOSE UP OF FIGURE 2A

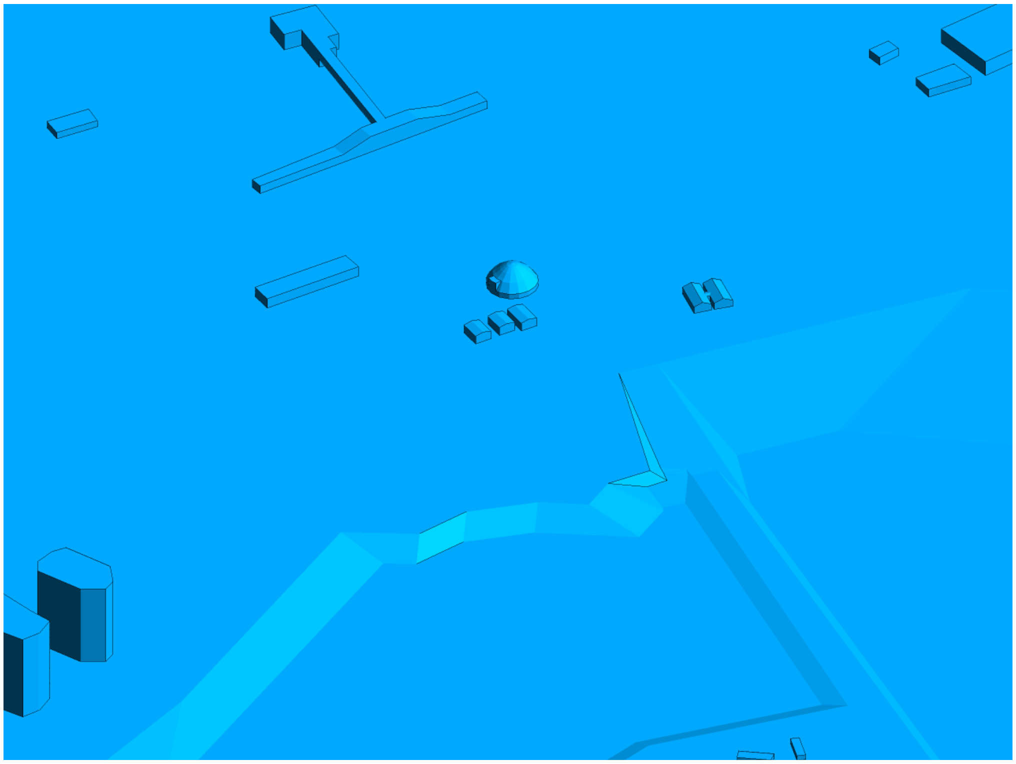


FIGURE 2C: COMPUTATIONAL MODEL, EXISTING MASSING, NORTH PERSPECTIVE

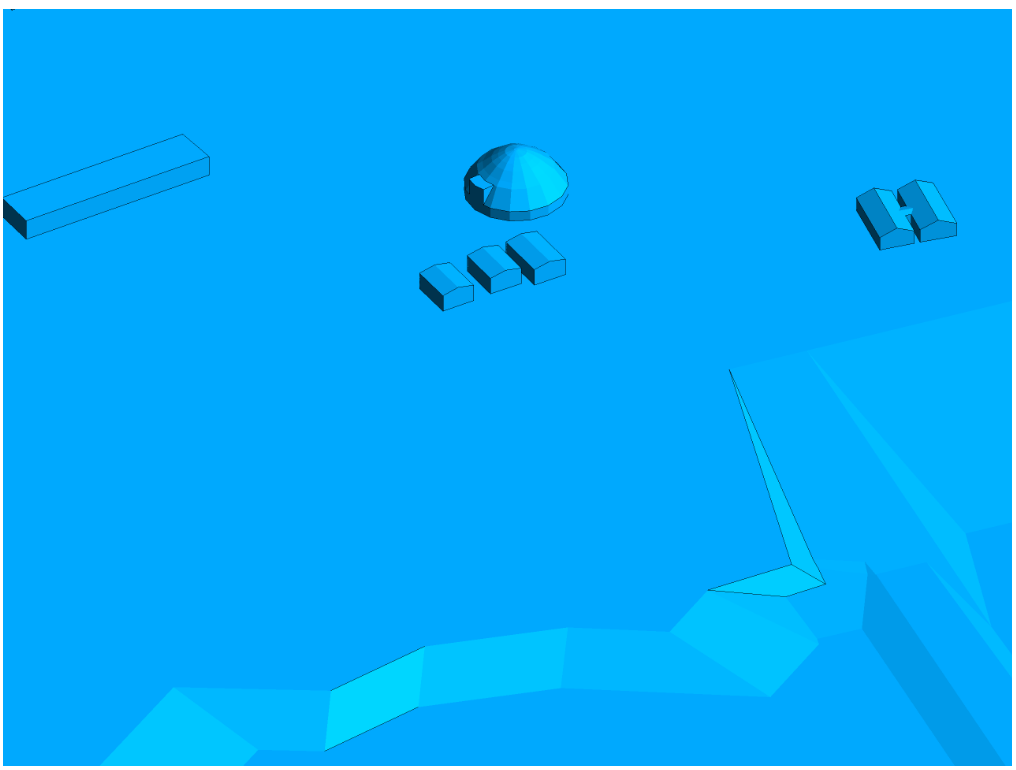


FIGURE 2D: CLOSE UP OF FIGURE 2C

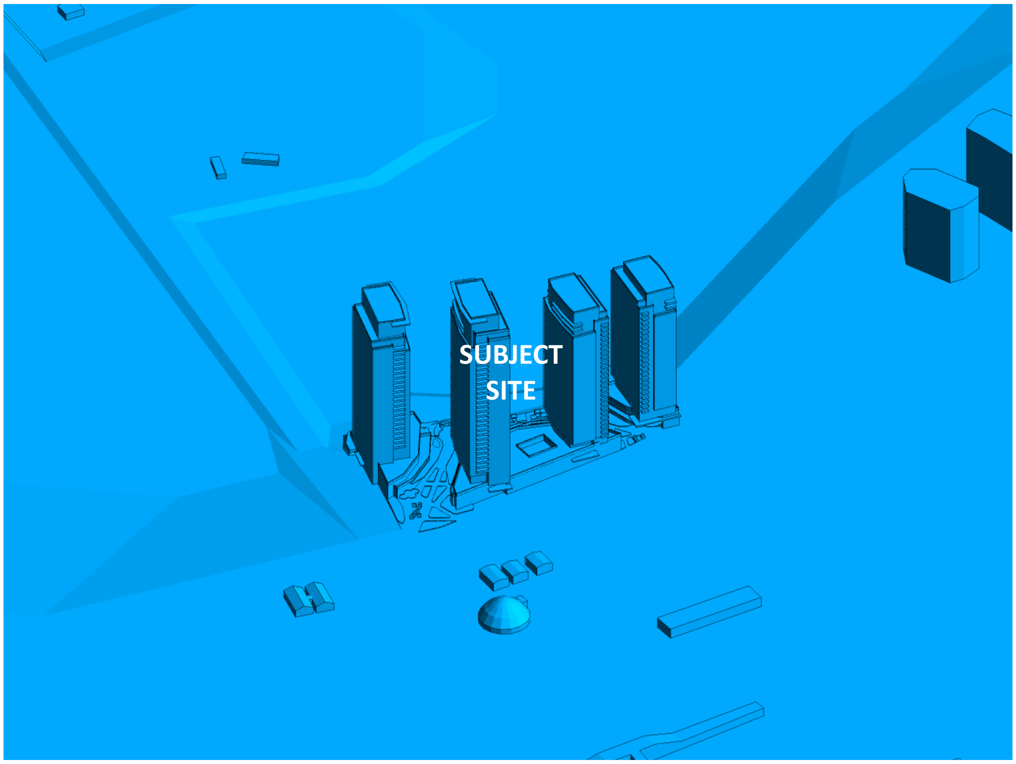


FIGURE 2E: COMPUTATIONAL MODEL, PROPOSED MASSING, SOUTH PERSPECTIVE

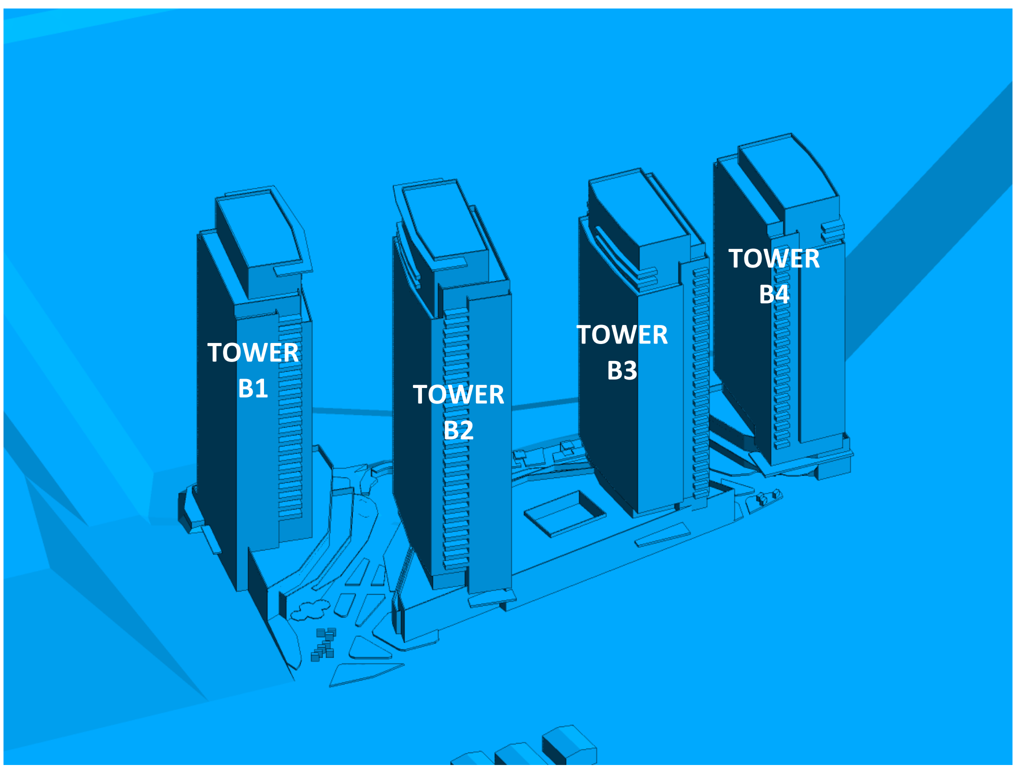


FIGURE 2F: CLOSE UP OF FIGURE 2E

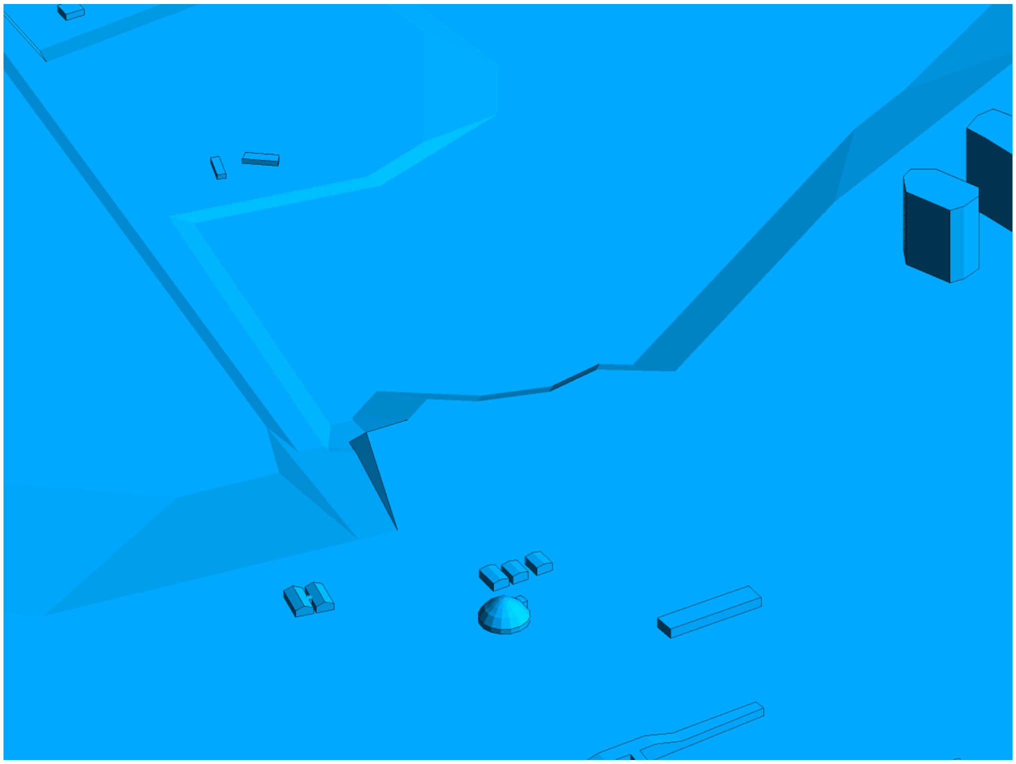


FIGURE 2G: COMPUTATIONAL MODEL, EXISTING MASSING, SOUTH PERSPECTIVE

FIGURE 2H: CLOSE UP OF FIGURE 2G

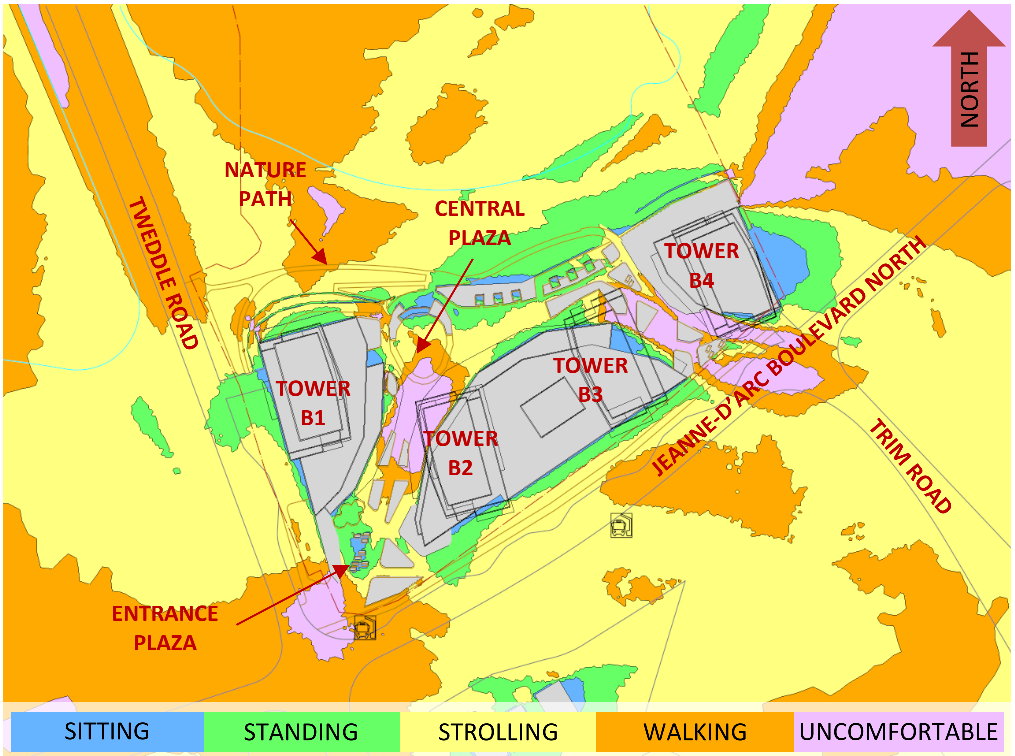


FIGURE 3A: SPRING – WIND COMFORT, GRADE LEVEL – PROPOSED MASSING

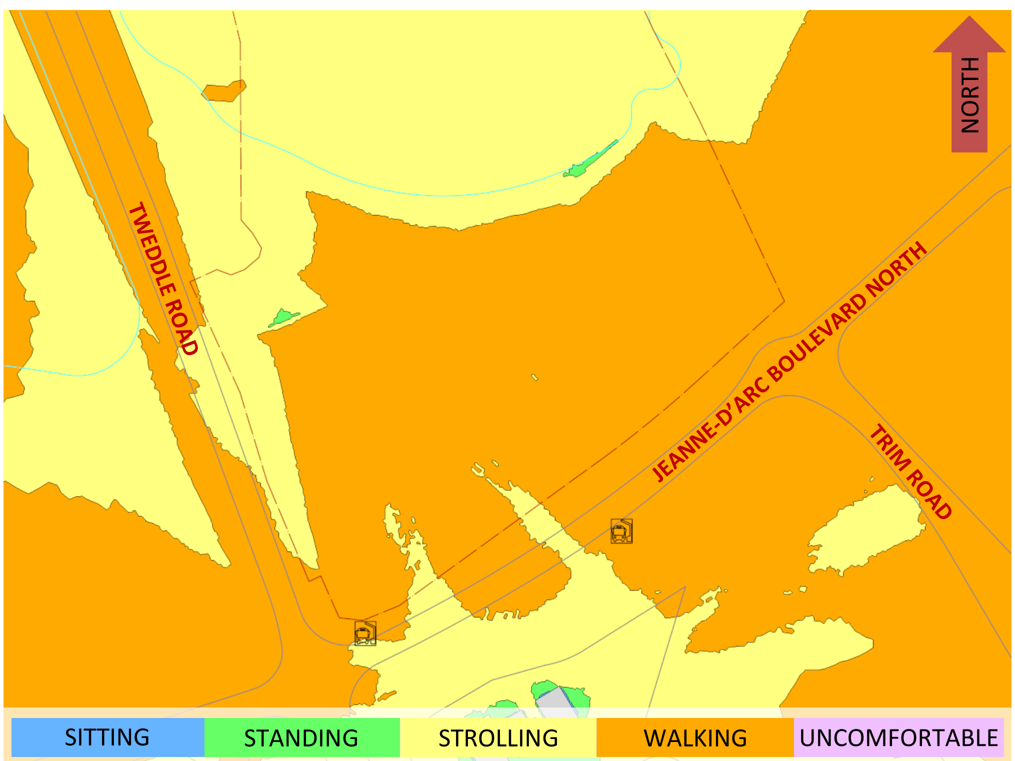


FIGURE 3B: SPRING – WIND COMFORT, GRADE LEVEL– EXISTING MASSING

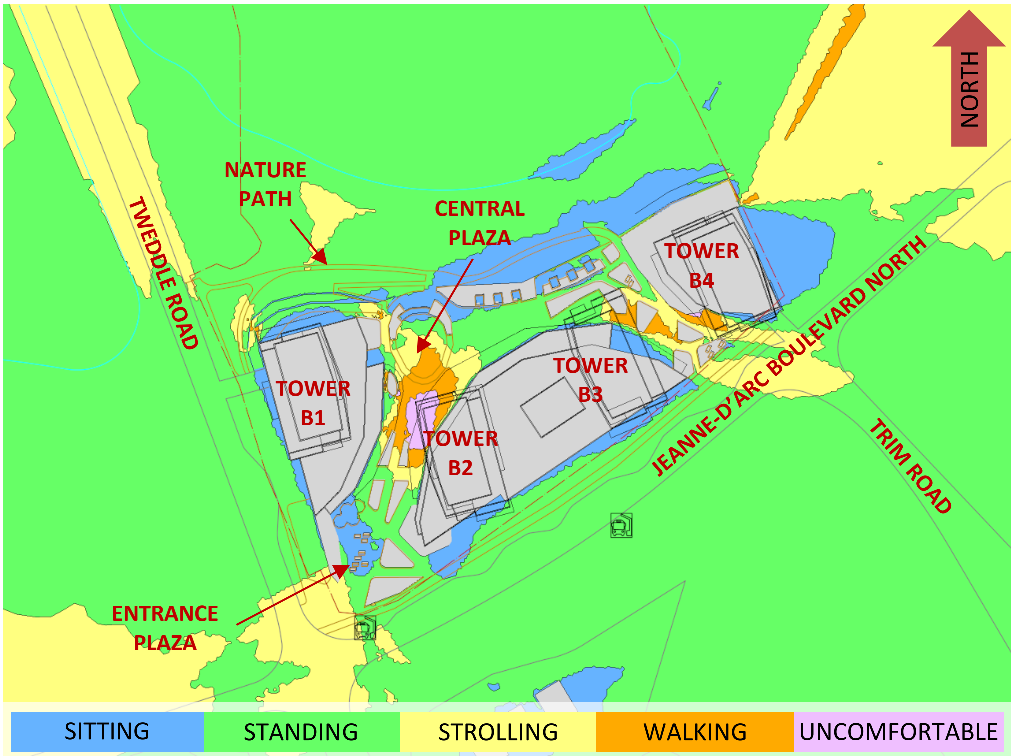


FIGURE 4A: SUMMER – WIND COMFORT, GRADE LEVEL – PROPOSED MASSING

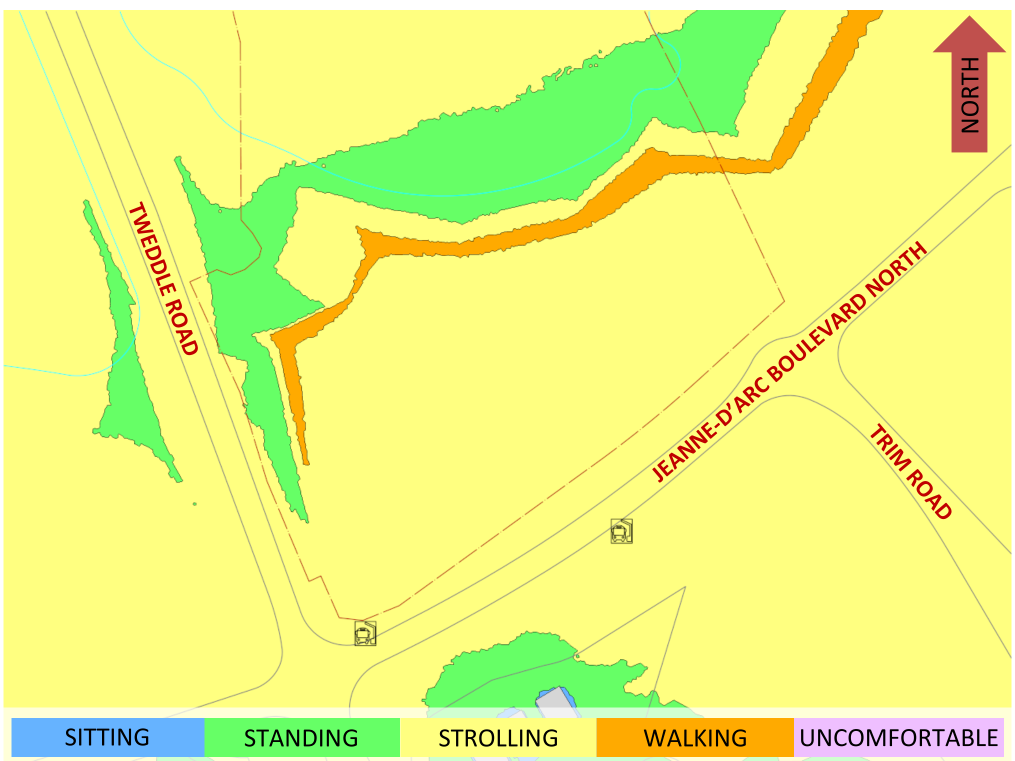


FIGURE 4B: SUMMER – WIND COMFORT, GRADE LEVEL– EXISTING MASSING

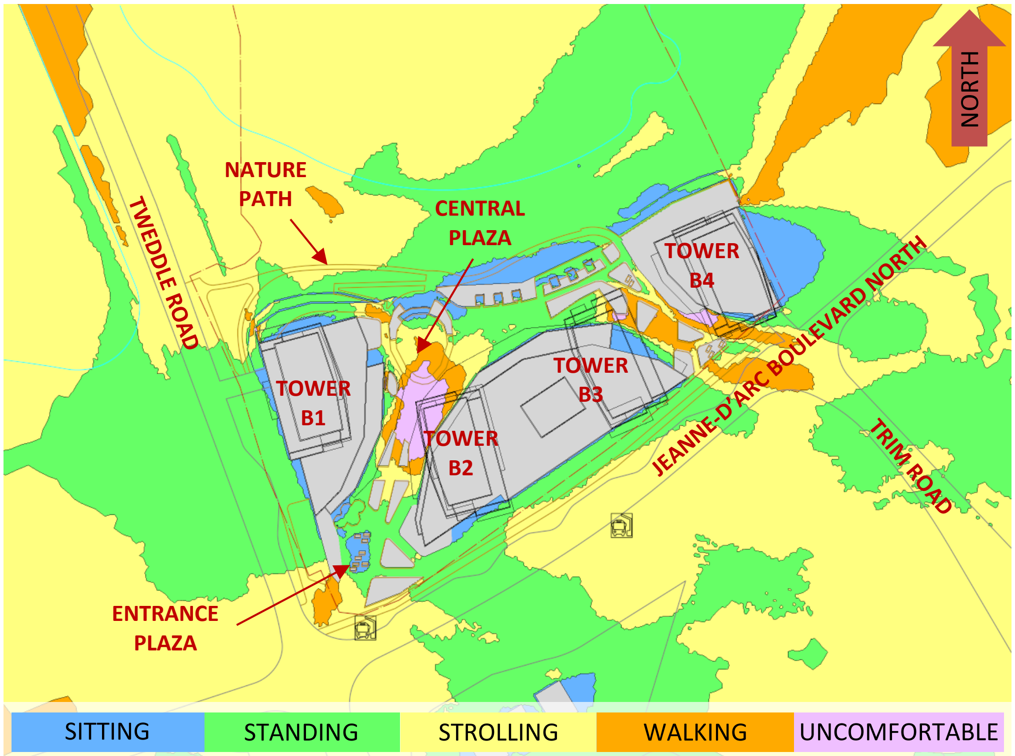


FIGURE 5A: AUTUMN – WIND COMFORT, GRADE LEVEL – PROPOSED MASSING

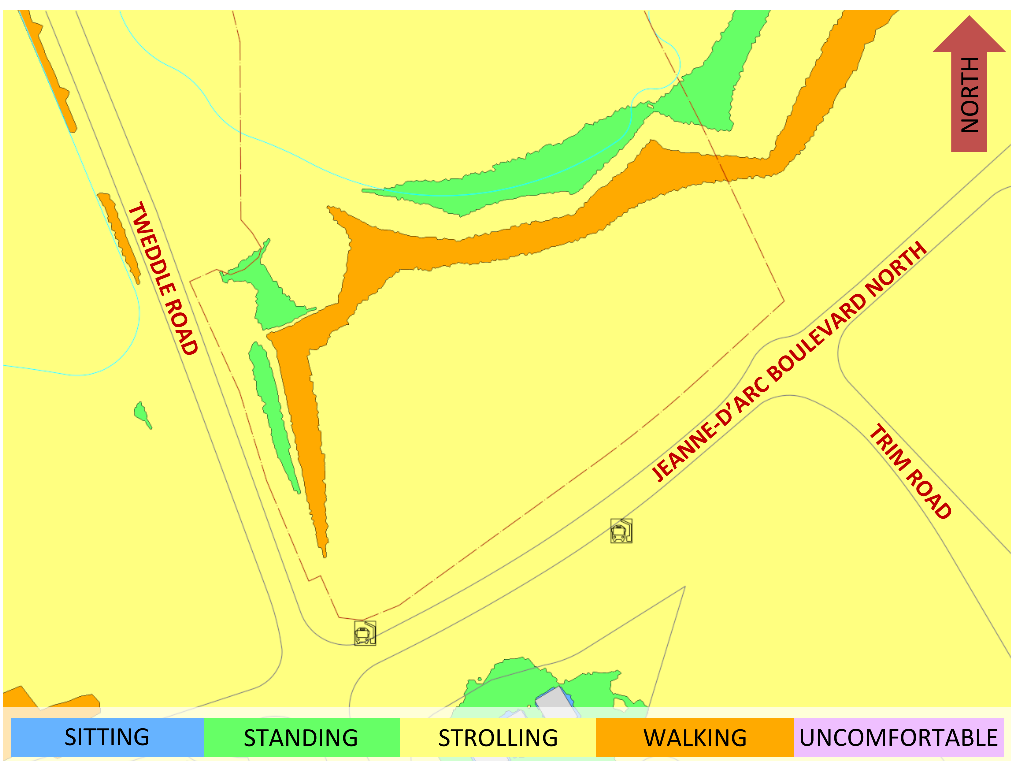


FIGURE 5B: AUTUMN – WIND COMFORT, GRADE LEVEL– EXISTING MASSING

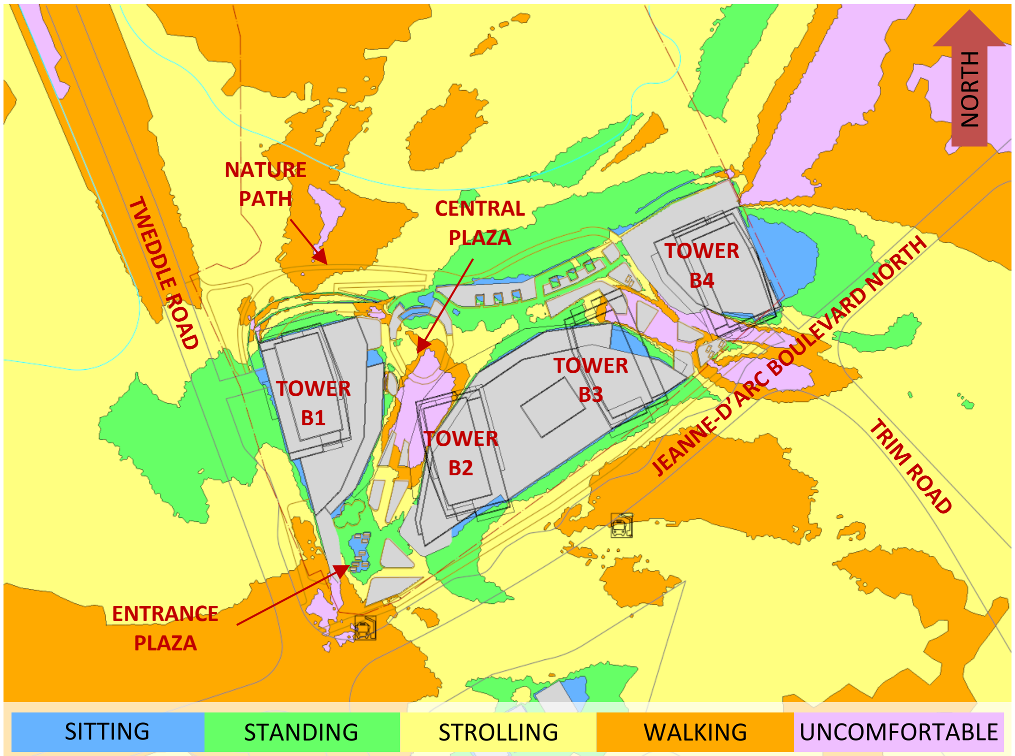


FIGURE 6A: WINTER – WIND COMFORT, GRADE LEVEL – PROPOSED MASSING

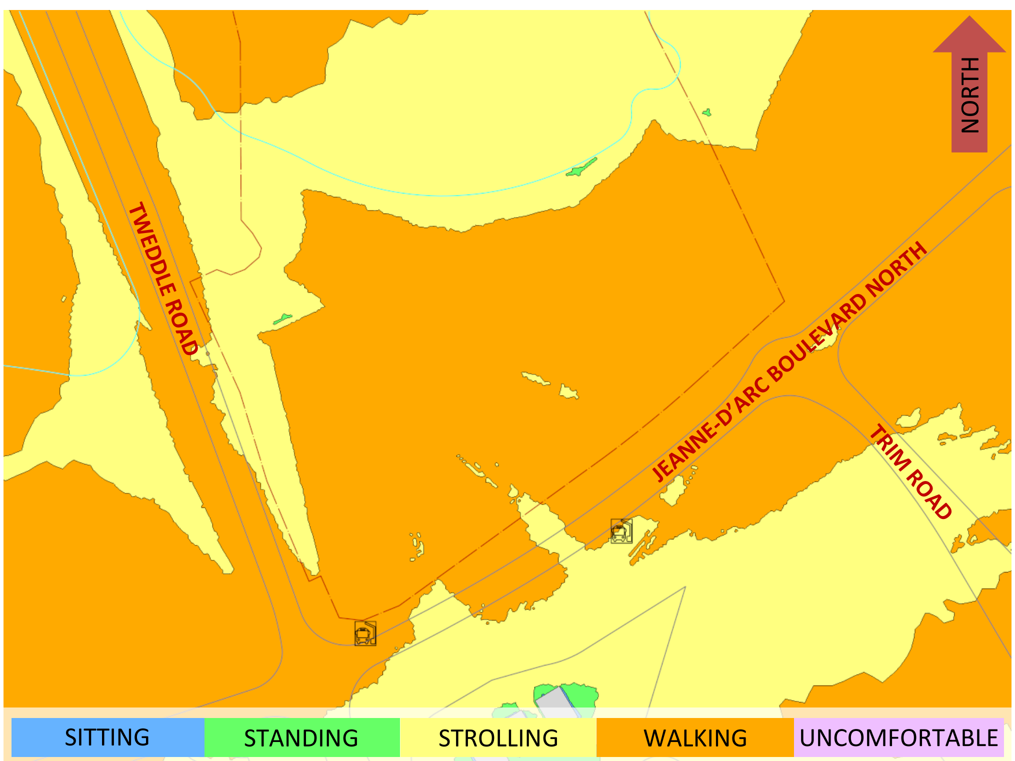


FIGURE 6B: WINTER – WIND COMFORT, GRADE LEVEL– EXISTING MASSING

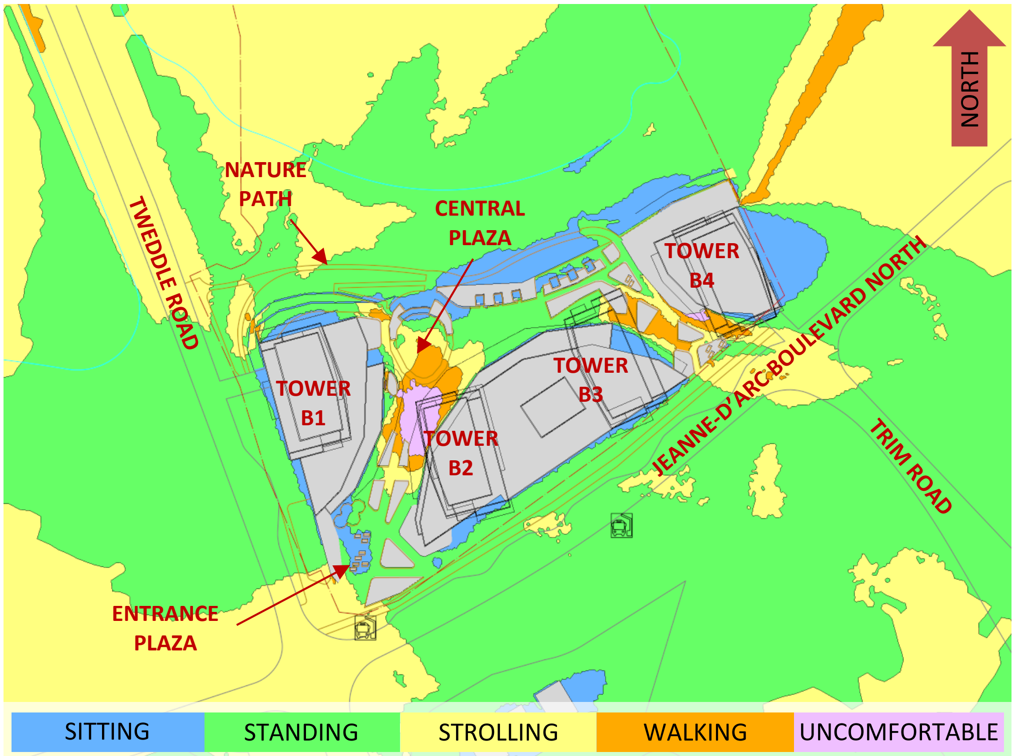


FIGURE 7: TYPICAL USE PERIOD – WIND COMFORT, GRADE LEVEL – PROPOSED MASSING

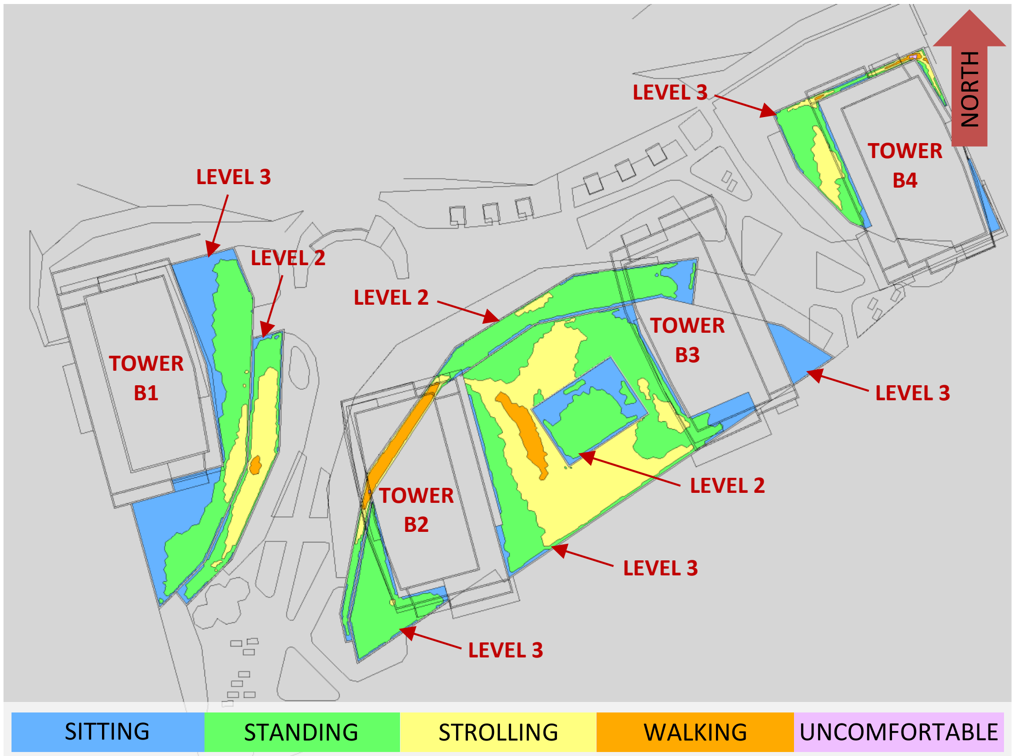


FIGURE 8A: SPRING – WIND COMFORT, COMMON AMENITY TERRACES

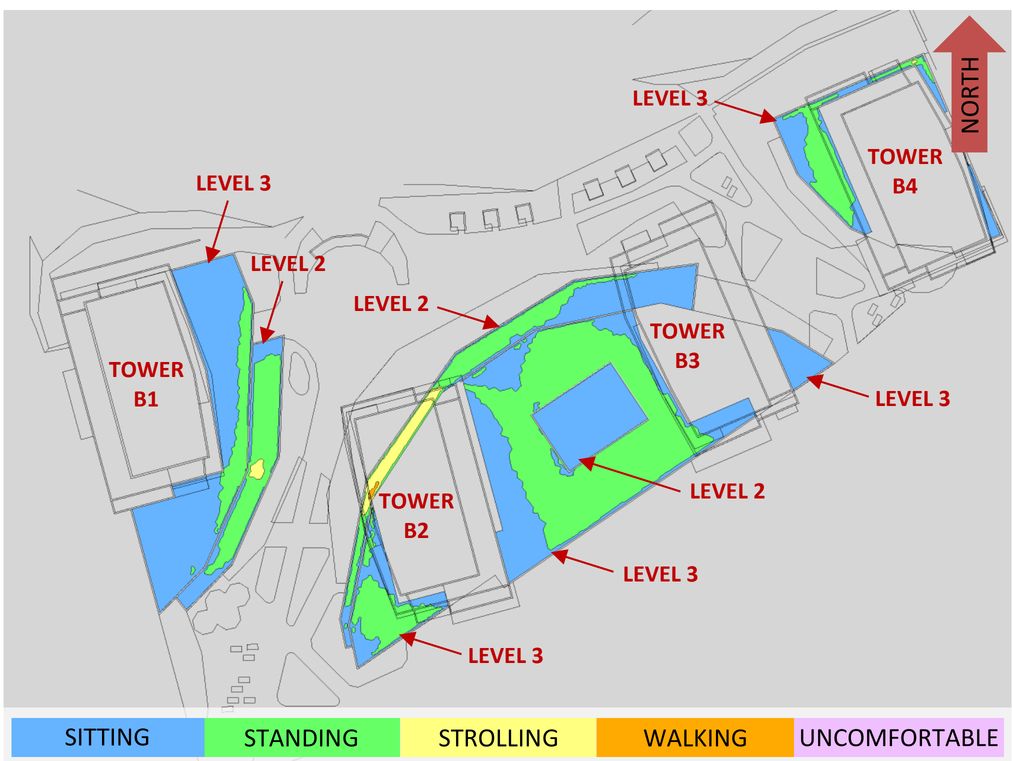


FIGURE 8B: SUMMER – WIND COMFORT, COMMON AMENITY TERRACES

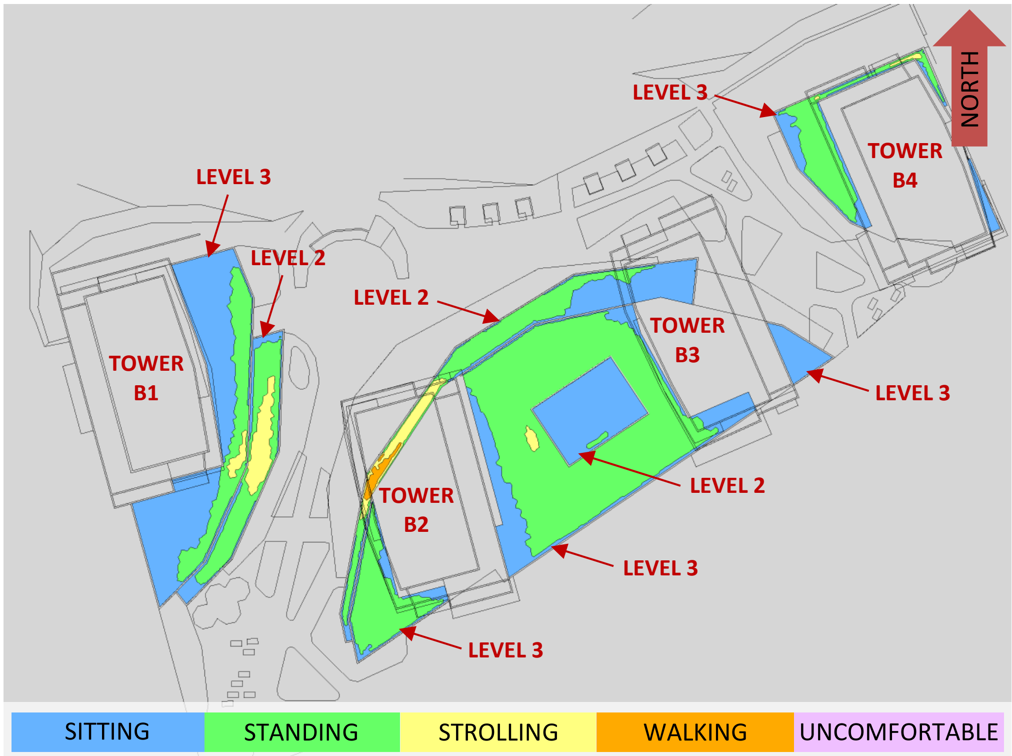


FIGURE 8C: AUTUMN – WIND COMFORT, COMMON AMENITY TERRACES

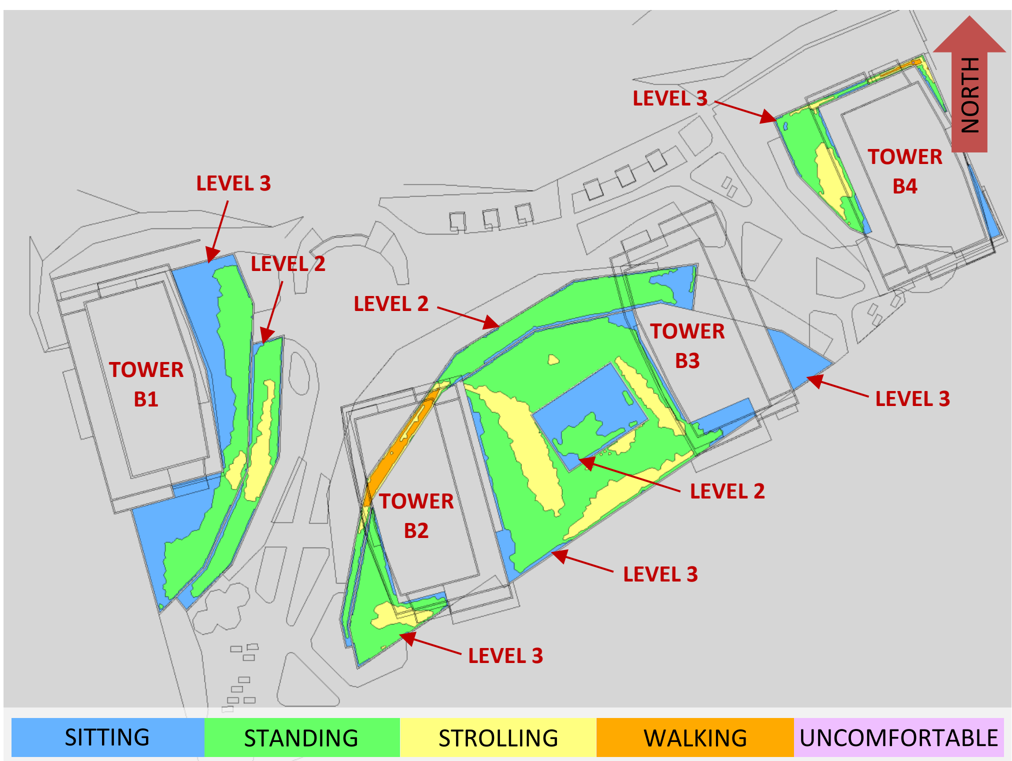


FIGURE 8D: WINTER – WIND COMFORT, COMMON AMENITY TERRACES

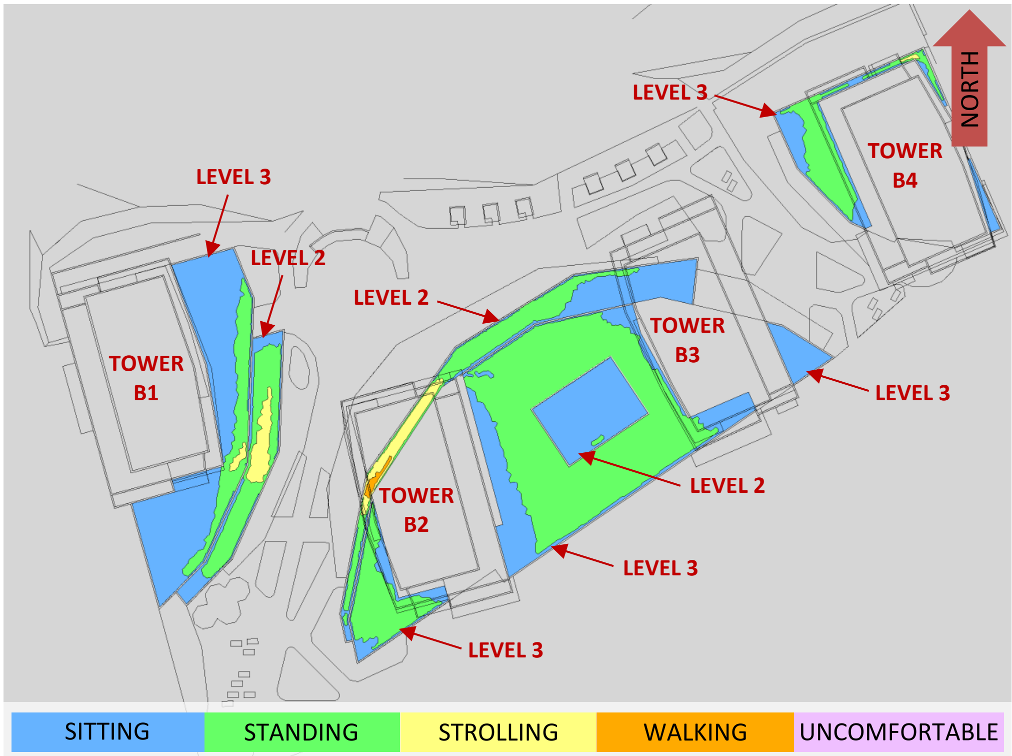
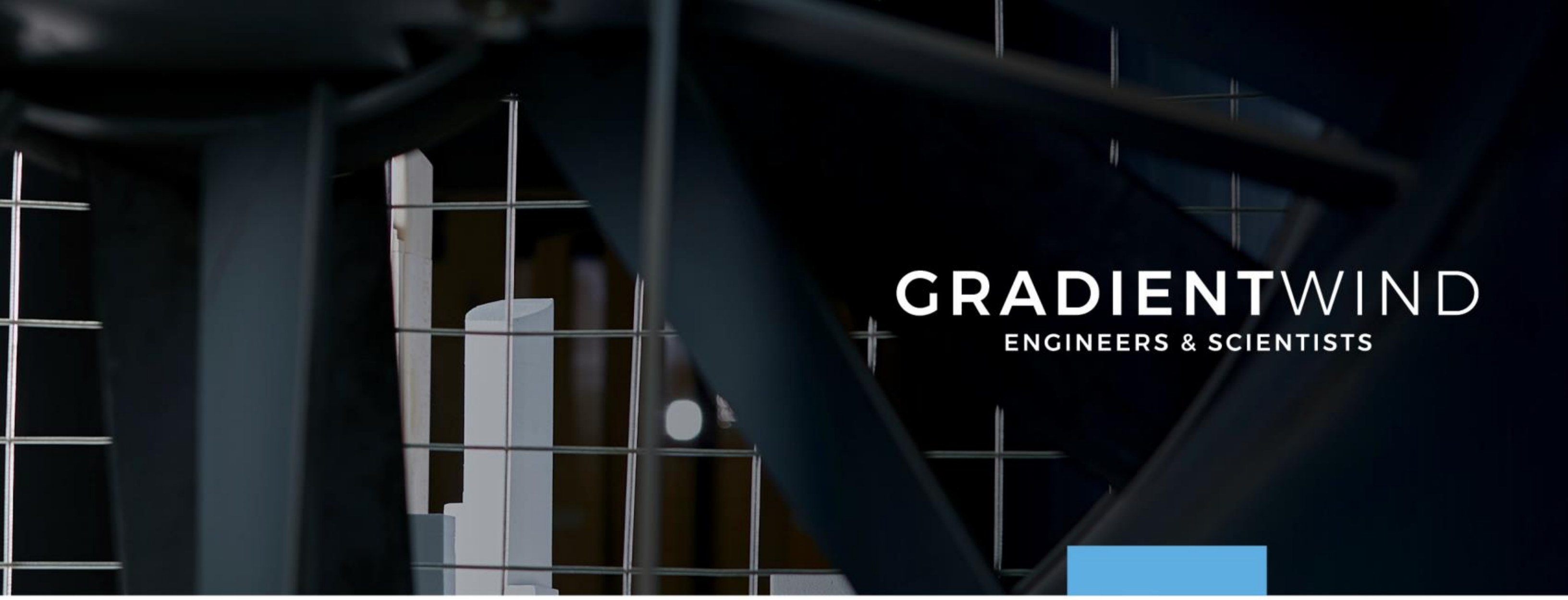
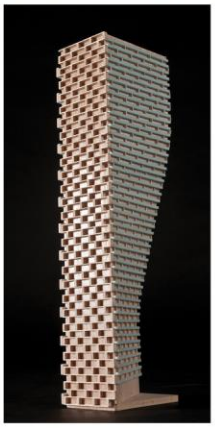
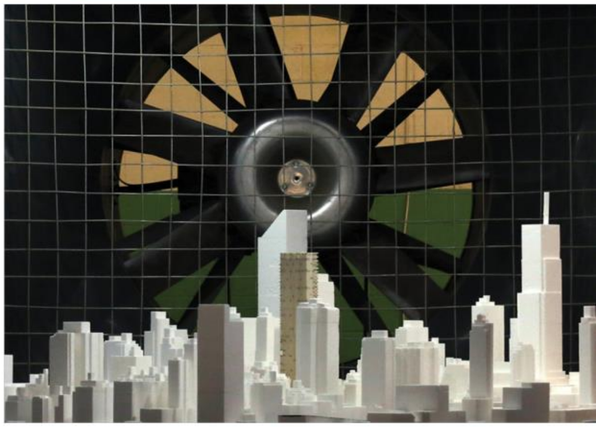


FIGURE 9: TYPICAL USE PERIOD – COMMON AMENITY TERRACES







APPENDIX A

SIMULATION OF THE ATMOSPHERIC BOUNDARY LAYER

SIMULATION OF THE ATMOSPHERIC BOUNDARY LAYER

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

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

where, $\boldsymbol{U}$ = mean wind speed, $\boldsymbol{U_g}$ = gradient wind speed, $\boldsymbol{Z}$ = height above ground, $\boldsymbol{Z_g}$ = depth of the boundary layer (gradient height), and α is the power law exponent.

For the model, U_g is set to 6.5 metres per second (m/s), which approximately corresponds to the 60% mean wind speed for Ottawa based on historical climate data and statistical analyses. When the results are normalized by this velocity, they are relatively insensitive to the selection of gradient wind speed.

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

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

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

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

Wind Direction (Degrees True)	Alpha Value (α)
0	0.18
22.5	0.16
45	0.16
67.5	0.20
90	0.22
112.5	0.21
135	0.21
157.5	0.23
180	0.24
202.5	0.23
225	0.23
247.5	0.20
270	0.17
292.5	0.17
315	0.19
337.5	0.19

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.