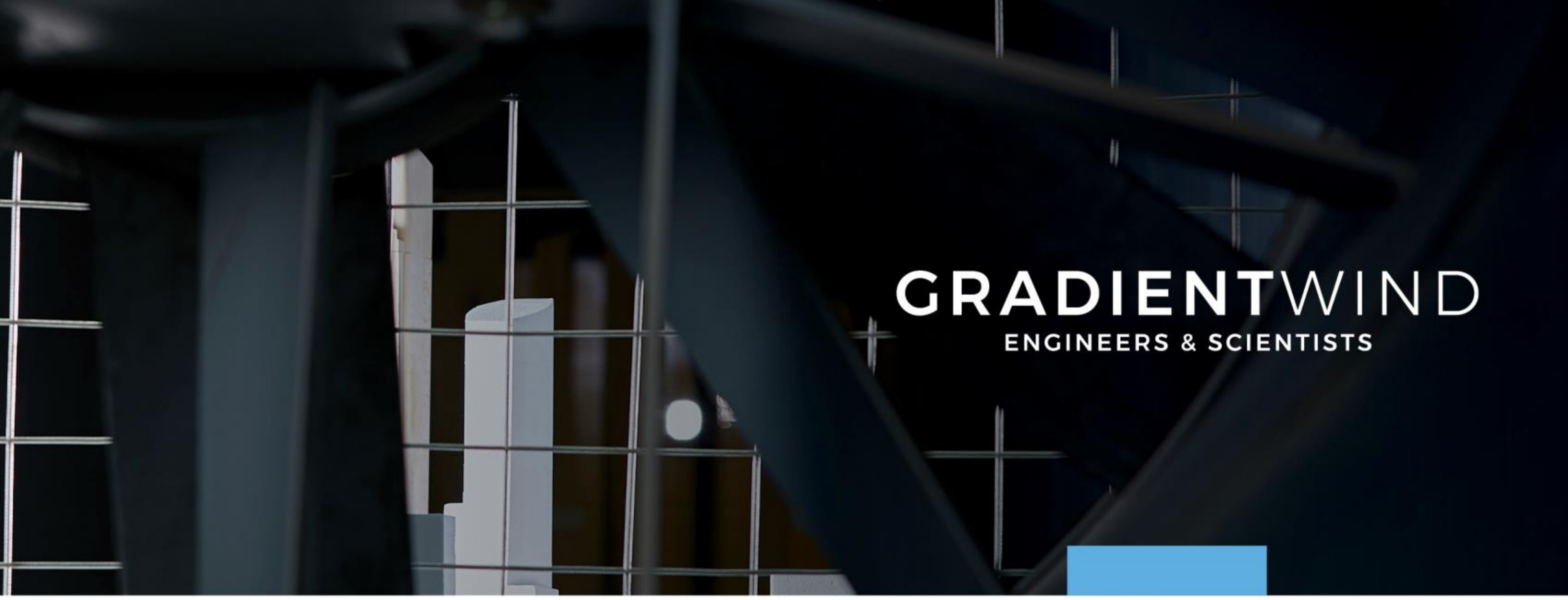
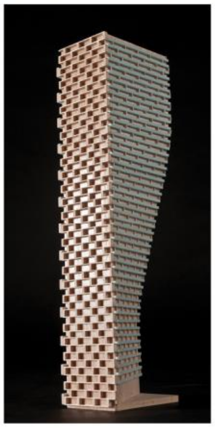


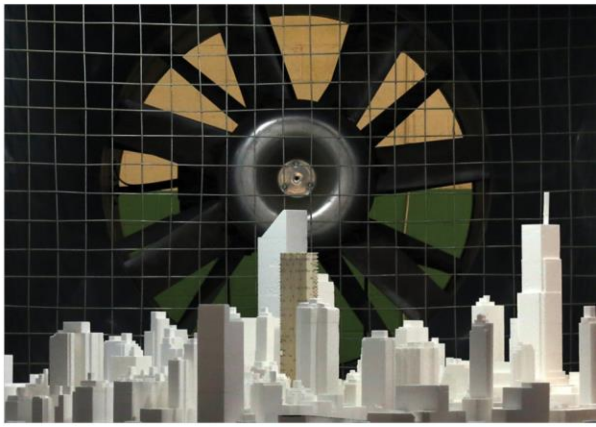
GRADIENTWIND
ENGINEERS & SCIENTISTS

PEDESTRIAN LEVEL WIND STUDY

Petrie's Landing III
8600 Jeanne d'Arc Boulevard North
Ottawa, Ontario

Report: 23-056-PLW





May 25, 2023

PREPARED FOR
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EXECUTIVE SUMMARY

This report describes a pedestrian level wind (PLW) study undertaken to satisfy concurrent Official Plan Amendment (OPA) and Zoning By-law Amendment (ZBLA) application requirements for the proposed multi-building development, referred to as “Petrie’s Landing III”, located at 8600 Jeanne d’Arc Boulevard North 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 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-7, and summarized as follows:

1) Most grade-level areas within and surrounding the subject site are predicted to experience conditions that are considered acceptable for the intended pedestrian uses throughout the year. Specifically, conditions over surrounding sidewalks, transit stops, the existing parking lot, laneways, and walkways to the east, the proposed internal walkways, and public and private roads, the potential P.O.P.S. southwest of buildings A3 and B2, and the building access points serving the proposed development are considered acceptable. Exceptions are described as follows:

    a. Conditions over the future connection are predicted to be suitable mostly for standing during the summer, becoming suitable for a mix of standing, strolling, and walking during the spring and autumn. The windiest conditions are situated in between buildings C2 and D1, where conditions are predicted to be uncomfortable during the winter. Specifically, during the winter season, conditions are predicted to be uncomfortable for at least 24% of the time. While the noted conditions are predicted to occur mostly over the road

surface, conditions are predicted to impact a small section of the walkway along the future connection.

b. Conditions along the east elevation of building B2, the north elevation of building B3, the south elevation of building C2, and the east elevation of building D2 are predicted to be suitable for strolling, or better, throughout the year, with a small, isolated region suitable for walking near the southeast corner of building D2 during the winter.

    - It is recommended that all potential primary building entrances are located away from the noted windier areas.

c. Wind comfort conditions and recommendations regarding mitigation over the park and the remaining potential P.O.P.S. serving the proposed development during the typical use period are described as follows:

    - Conditions within the park are predicted to be suitable for sitting within the majority of the area, with regions suitable for standing to the east and at the southeast corner.

    - Conditions within the potential P.O.P.S. at the northeast corner of building D2 are predicted to be suitable for sitting to the east and west and at the southeast corner, and suitable for standing throughout the remainder of the area.

    - Depending on the programming within the park, the noted conditions may be considered acceptable. Specifically, if the noted windier areas will not accommodate seating or lounging activities, the noted conditions would be considered acceptable.

    - Comfort levels within the potential P.O.P.S. at the northeast corner of building D2 may be improved by implementing landscaping elements around sensitive areas such as tall wind screens and coniferous trees in dense arrangements, in combination with strategically placed seating with high-back benches and other local wind mitigation.

- The extent of mitigation measures is dependent on the programming of the spaces. An appropriate mitigation strategy will be developed in collaboration with the building and landscape architects as the design of the proposed development progresses. This work is expected to support the future Site Plan Control application.

2) Regarding the podia roofs, wind comfort conditions during the typical use period are predicted to be suitable for a mix of sitting and standing over the podia roofs of buildings A1, A2, A3, A4, B1, B2, and C1, suitable mostly for standing over the podium roof of building D2, suitable for strolling, or better, over the podia roofs of buildings B3 and D1, and suitable for a mix of standing and strolling within the podium roof of building C2.

    a. To improve comfort levels within the potential amenity terraces, it is recommended that tall wind screens, in place of standard height guards, be implemented along their full perimeters in combination with mitigation inboard of the terrace perimeters. This inboard mitigation could take the form of wind screens or clusters of coniferous trees located around sensitive areas, and canopies located above designated seating areas.

    b. The extent of the mitigation measures is dependent on the programming of the terraces. An appropriate mitigation strategy will be developed in collaboration with the building and landscape architects as the design of the proposed development progresses. This work is expected to support the future Site Plan Control application.

3) The foregoing statements and conclusions apply to common weather systems, during which no dangerous wind conditions, as defined in Section 4.4, are expected anywhere over the subject site. During extreme weather events, (for example, thunderstorms, tornadoes, and downbursts), pedestrian safety is the main concern. However, these events are generally short-lived and infrequent and there is often sufficient warning for pedestrians to take appropriate cover.

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1. INTRODUCTION

Gradient Wind Engineering Inc. (Gradient Wind) was retained by 11034936 Canada Inc. to undertake a pedestrian level wind (PLW) study to satisfy concurrent Official Plan Amendment (OPA) and Zoning By-law Amendment (ZBLA) application requirements for the proposed multi-building development, referred to as "Petrie's Landing III", located at 8600 Jeanne d'Arc Boulevard North 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 conditions may interfere with certain pedestrian activities so that mitigation measures may be considered, where required.

Our work is based on industry standard computer simulations using the computational fluid dynamics (CFD) technique and data analysis procedures, City of Ottawa wind comfort and safety criteria, architectural drawings prepared by Brigil, in May 2023, surrounding street layouts and existing and approved future building massing information obtained from the City of Ottawa, as well as recent satellite imagery.

2. TERMS OF REFERENCE

The subject site is located at 8600 Jeanne d'Arc Boulevard North in Ottawa, situated at the east intersection of Jeanne d'Arc Boulevard North and Parkrose Private, on a parcel of land bounded by Jeanne d'Arc Boulevard North to the north, Centre des métiers Minto educational institution to the east, Ottawa Regional Road 174 (hereinafter referred to as "Highway 174") to the south, and Taylor Creek and low-rise residential dwellings to the west. Internal public and private roads extending from Jeanne d'Arc Boulevard North and a future connection extending from the existing laneway situated to the east of the subject site divides the subject site into four blocks (identified as 'A', 'B', 'C', and 'D'). The proposed development comprises 11 buildings with a mixture of residential units and retail spaces. A park is situated to the west of the subject site. Of note, the present study considers all podia roofs as potential common amenity terraces.

Block A is situated at the northwest corner of the subject site and includes buildings A1, A2, A3, and A4. Buildings A1, A2, and A4 comprise nominally rectangular planforms and building A3 comprises a nominally 'L'-shaped planform with its long axis-oriented along Jeanne d'Arc Boulevard North. Building A1 rises to four storeys while buildings A2, A3, and A4 rise to six storeys. A potential privately-owned publicly accessible space (P.O.P.S.) is provided at the southwest corner of building A3.

Block B is situated central to the subject site and includes buildings B1, B2, and B3. Buildings B1 and B2 both rise to nine storeys. Building B1 comprises a nominally 'U'-shaped planform and building B2 comprises a nominally 'L'-shaped planform, with their long and short axis-oriented along Jeanne d'Arc Boulevard North, respectively. Building B3 comprises a nominally rectangular 40-storey tower inclusive of a nominally trapezoidal six-storey podium. A potential P.O.P.S. is located at the southwest corner of building B2.

Block C is situated at the northeast corner of the subject site and includes buildings C1 and C2. Buildings C1 and C2 both comprise nominally rectangular planforms. Building C1 rises to nine storeys while building C2 comprises a 30-storey tower inclusive of a six-storey podium.

Block D is situated to the south of the subject site and includes buildings D1 and D2. Building D1 comprises two 30-storey towers above a common six-storey podium, while building D2 comprises a 30-storey tower above a nominally trapezoidal six-storey podium. A potential P.O.P.S. is provided at the northeast corner of building D2.

The near-field surroundings, defined as an area within 200-metres (m) of the subject site, comprise green spaces in all compass directions with Highway 174 to the southeast, low-rise residential dwellings to the southwest, and Taylor Creek to the west. 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 primarily by low-rise massing from the southeast clockwise to the west, and primarily open exposure from the west clockwise to the southeast, with an isolated high-rise building to the northeast and isolated mid-rise buildings to the southwest. The Ottawa River flows from the west-northwest to the northeast approximately 600 m to the north.

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 future developments approved by the City of Ottawa.

3. OBJECTIVES

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

4. METHODOLOGY

The approach followed to quantify pedestrian wind conditions over the site is based on CFD simulations of wind speeds across the study site within a virtual environment, meteorological analysis of the Ottawa area wind climate, and synthesis of computational data with City of Ottawa wind comfort and safety criteria[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 study site on the surrounding model, and to create suitable atmospheric wind profiles at the model boundary. The wind profiles are designed to have similar mean and turbulent wind properties consistent with actual site exposures.

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

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

4.2 Wind Speed Measurements

The PLW analysis was performed by simulating wind flows and gathering velocity data over a CFD model of the site for 12 wind directions. The CFD simulation model was centered on the study building, complete with surrounding massing within a radius of 617 m. The process was performed for two context massing scenarios, as noted in Section 2.

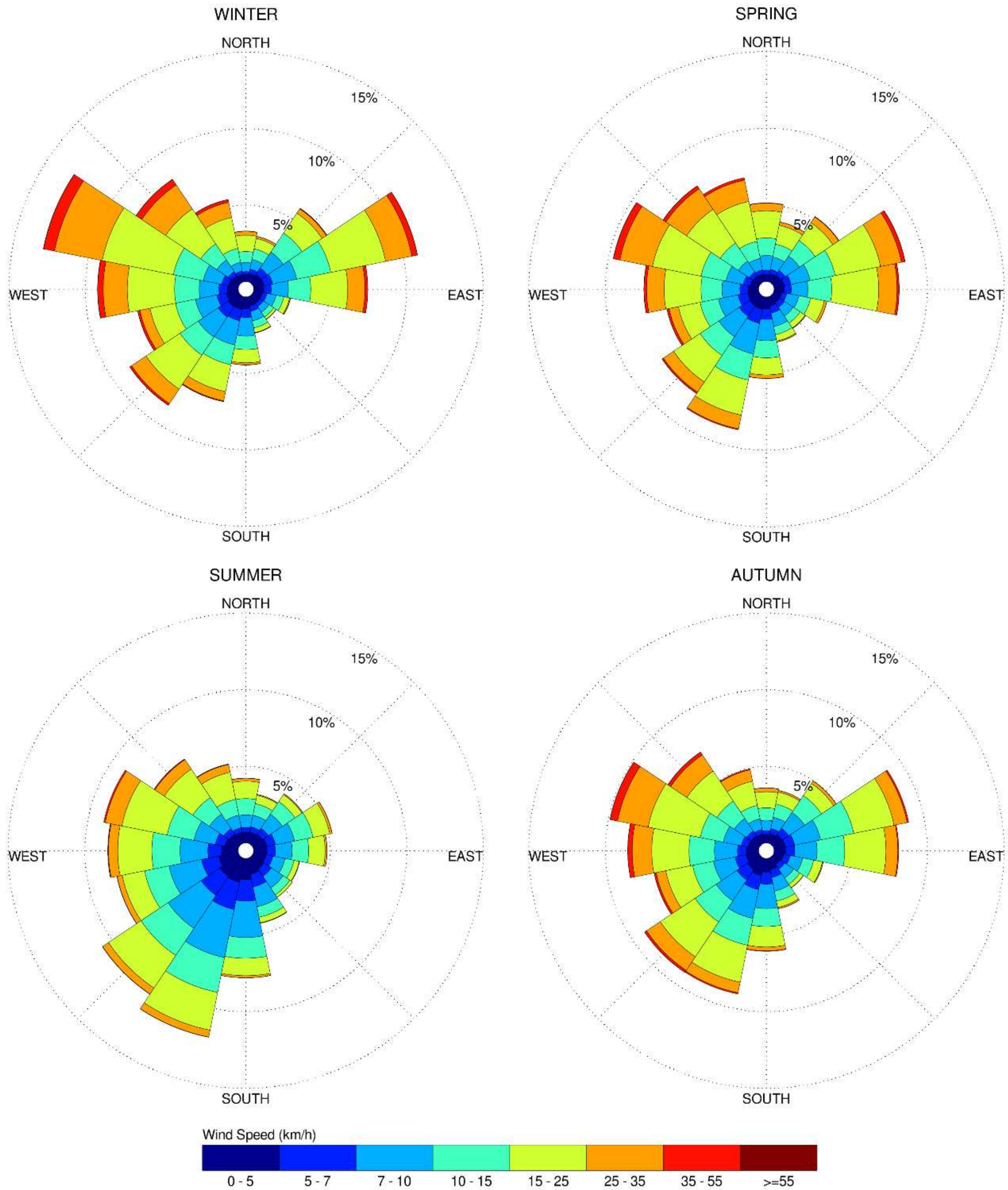
Mean and peak wind speed data obtained over the study site for each wind direction were interpolated to 36 wind directions at 10° intervals, representing the full compass azimuth. Measured wind speeds approximately 1.5 m above local grade and over the potential common amenity terraces serving the proposed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

4.3 Historical Wind Speed and Direction Data

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

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

SEASONAL DISTRIBUTION OF WIND
OTTAWA MACDONALD-CARTIER INTERNATIONAL AIRPORT



Notes:

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

4.4 Pedestrian Wind Comfort and Safety Criteria – City of Ottawa

Pedestrian comfort and safety criteria are based on the mechanical effects of wind without consideration of other meteorological conditions (that is, temperature, relative humidity). The comfort criteria assume that pedestrians are appropriately dressed for a specified outdoor activity during any given season. Five pedestrian comfort classes are based on 20% non-exceedance mean wind speed ranges, which include (1) Sitting; (2) Standing; (3) Strolling; (4) Walking; and (5) Uncomfortable. More specifically, the comfort classes and associated mean wind speed ranges are summarized as follows:

1) **Sitting:** Mean wind speeds no greater than 10 km/h occurring at least 80% of the time. The equivalent gust wind speed is approximately 16 km/h.

2) **Standing:** Mean wind speeds no greater than 14 km/h occurring at least 80% of the time. The equivalent gust wind speed is approximately 22 km/h.

3) **Strolling:** Mean wind speeds no greater than 17 km/h occurring at least 80% of the time. The equivalent gust wind speed is approximately 27 km/h.

4) **Walking:** Mean wind speeds no greater than 20 km/h occurring at least 80% of the time. The equivalent gust wind speed is approximately 32 km/h.

5) **Uncomfortable:** Uncomfortable conditions are characterized by predicted values that fall below the 80% target for walking. Brisk walking and exercise, such as jogging, would be acceptable for moderate excesses of this criterion.

The pedestrian safety wind speed criterion is based on the approximate threshold that would cause a vulnerable member of the population to fall. A 0.1% exceedance gust wind speed of 90 km/h is classified as dangerous. The gust speeds, and equivalent mean speeds, are selected based on 'The Beaufort Scale', presented on the following page, which describes the effects of forces produced by varying wind speed levels on objects. Gust speeds are included because pedestrians tend to be more sensitive to wind gusts than to steady winds for lower wind speed ranges. For strong winds approaching dangerous levels, this effect is less important because the mean wind can also create problems for pedestrians.

THE BEAUFORT SCALE

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

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

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

DESIRED PEDESTRIAN COMFORT CLASSES FOR VARIOUS LOCATION TYPES

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

5. RESULTS AND DISCUSSION

The following discussion of the predicted pedestrian wind conditions for the subject site is accompanied by Figures 3A-6B, illustrating wind conditions at grade level for the proposed and existing massing scenarios. Conditions are presented as continuous contours of wind comfort throughout the subject site and correspond to the comfort classes presented in Section 4.4. Conditions suitable for sitting are represented by the colour blue, standing by green, strolling by yellow, and walking by orange; uncomfortable conditions are represented by the colour magenta.

Wind comfort conditions at grade level are also reported for the typical use period, which is defined as May to October, inclusive. Figure 7 illustrates comfort conditions 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 and Transit Stops along Jeanne d'Arc Boulevard North: Following the introduction of the proposed development, wind comfort conditions over the public sidewalks along Jeanne d'Arc Boulevard North are predicted to be suitable for a mix of sitting and standing during the summer, becoming suitable for strolling, or better, during the autumn, a mix of standing and strolling during the spring, and a mix of standing, strolling, and walking during the winter. Conditions in the vicinity of the nearby transit stop to the north of Jeanne d'Arc Boulevard North are predicted to be suitable for standing during the summer, becoming suitable for strolling throughout the remainder of the year. Conditions in the vicinity of the nearby transit stop to the south of Jeanne d'Arc Boulevard North are predicted to be suitable for standing during the summer and autumn, becoming suitable for strolling during the winter and spring. The noted conditions are considered acceptable.

Wind conditions over the sidewalks along Jeanne d'Arc Boulevard North with the existing massing are predicted to be suitable for standing during the summer, becoming suitable for strolling during the autumn, and suitable for a mix of strolling and walking during the winter and spring. Conditions in the vicinity of the nearby transit stop to the north of Jeanne d'Arc Boulevard North are predicted to be suitable for standing during the summer, becoming suitable for strolling during the autumn, and suitable for walking during the winter and spring. Conditions in the vicinity of the nearby transit stop to the south of Jeanne d'Arc Boulevard North are predicted to be suitable for standing during the summer, becoming suitable for strolling during the spring and autumn, and suitable for walking during the winter. Notably, the introduction of the proposed development is predicted to improve comfort levels along Jeanne d'Arc Boulevard North, in comparison to existing conditions.

Existing Parking Lot, Laneways, and Walkways East of Subject Site: Following the introduction of the proposed development, wind comfort conditions over the existing parking lot, laneways, and walkways serving Centre des métiers Minto educational institution situated to the east of the subject site are predicted to be suitable for a mix of sitting and standing during the summer and autumn, becoming suitable for standing, or better, during the spring and winter, with regions predicted to be suitable for strolling during the winter. The noted conditions are considered acceptable.

Wind conditions over the noted areas with the existing massing are predicted to be suitable for standing, or better, during the summer, becoming suitable for strolling, or better, throughout the remainder of the year. Notably, the introduction of the proposed development is predicted to improve comfort levels over the noted areas, in comparison to existing conditions.

Highway 174 South of Subject Site: Following the introduction of the proposed development, wind comfort conditions over Highway 174, situated to the south of the subject site, are predicted to be suitable for a mix of sitting and standing during the summer, becoming suitable for a mix of standing and strolling throughout the remainder of the year, with a region predicted to be suitable for walking during the winter. The noted conditions are considered acceptable.

Wind conditions over Highway 174 with the existing massing are predicted to be suitable for standing during the summer, becoming suitable for strolling during the spring and autumn, and suitable for a mix of strolling and walking during the winter. Notably, the introduction of the proposed development is predicted to improve comfort levels over Highway 174, in comparison to existing conditions.

Internal Walkways, Public and Private Roads, and Future Connection: Wind comfort conditions over the internal walkways along the internal private road are predicted to be mostly suitable for sitting during the summer, becoming suitable for standing, or better, throughout the remainder of the year, with isolated regions predicted to be suitable for strolling during the winter and spring. Wind comfort conditions over the internal walkways along the internal public road are predicted to be suitable for a mix of sitting and standing during the summer, becoming suitable for strolling, or better, throughout the remainder of the year, with regions predicted to be suitable for walking during the winter and spring to the south of building B3. The noted conditions are considered acceptable.

Wind comfort conditions over internal walkways along the future connection are predicted to be suitable mostly for standing during the summer, becoming suitable for a mix of standing, strolling, and walking during the spring and autumn. The windiest conditions are situated between buildings C2 and D1, where conditions are predicted to be uncomfortable during the winter. Specifically, during the winter season, conditions are predicted to be suitable for walking for at least 76% of the time, representing a 4% exceedance of the uncomfortable comfort class. The noted conditions are predicted to occur mostly over the road surface, while impacting a small section of the walkway along the future connection.

Park and Potential P.O.P.S.: Wind comfort conditions and recommendations regarding mitigation over the park situated to the west of the subject site and the potential P.O.P.S. situated at the southwest corners of buildings A3 and B2 and at the northeast corner of building D2 during the typical use period are described as follows:

- Conditions within the potential P.O.P.S. at the southwest corners of buildings A3 and B2 are predicted to be suitable for sitting, which is considered acceptable.

- Conditions within the park are predicted to be suitable for sitting within the majority of the area, with regions suitable for standing to the east and at the southeast corner. The areas that are predicted to be suitable for standing are also predicted to be suitable for sitting for at least 74% of the time during the same period, where the target is 80% to achieve the sitting comfort class.

- Conditions within the potential P.O.P.S. at the northeast corner of building D2 are predicted to be suitable for sitting to the east and west and at the southeast corner, and suitable for standing throughout the remainder of the area.

- Depending on the programming of the park, the noted wind comfort conditions may be considered acceptable. Specifically, if the noted windier areas will not accommodate seating or lounging activities, the noted conditions would be considered acceptable.

- Comfort levels within the potential P.O.P.S. at the northeast corner of building D2 may be improved by implementing landscaping elements around sensitive areas such as tall wind screens and coniferous trees in dense arrangements, in combination with strategically placed seating with high-back benches and other local wind mitigation.

- The extent of mitigation measures is dependent on the programming of the spaces. An appropriate mitigation strategy will be developed in collaboration with the building and landscape architects as the design of the proposed development progresses. This work is expected to support the future Site Plan Control application.

Building Access Points: Conditions along the east elevation of building B2 are predicted to be suitable mostly for sitting during the summer, becoming suitable for standing during the spring and autumn, and suitable for a mix of standing and strolling during the winter. Conditions along the north elevation of building B3 and along the south elevation of building C2 are predicted to be suitable for a mix of sitting and standing during the summer, becoming suitable for standing during the autumn, and suitable for a mix of standing and strolling during the winter and spring. Conditions along the east elevation of building D2 are predicted to be suitable for a mix of sitting and standing during the summer, becoming suitable for a mix of standing and strolling throughout the remainder of the year, with a small, isolated region precited to be suitable for walking near the southeast corner during the winter. It is recommended that all potential primary building entrances serving buildings B2, B3, C2, and D2 are located away from the noted windier areas. Additionally, it is recommended that potential secondary building entrances along the noted areas be recessed into the building façade by at least 2 m.

Conditions in the vicinity of the remaining potential 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 – Potential Common Amenity Terraces

All podia roofs serving the proposed development were considered as potential amenity terraces. Figures illustrating the wind conditions within the potential elevated common amenity terraces were not included in the report since their locations are undefined and their predicted wind comfort conditions are preliminary. Wind comfort conditions during the typical use period within the potential common amenity terraces, and recommendations regarding mitigation, where required, are provided as follows:

Wind comfort conditions are predicted to be suitable for a mix of sitting and standing over the podia roofs of buildings A1, A2, A3, A4, B1, B2, and C1, suitable mostly for standing over the podium roof of building D2, suitable for strolling, or better, over the podia roofs of buildings B3 and D1, and suitable for a mix of standing and strolling within the podium roof of building C2.

To improve comfort levels within the potential amenity terraces, it is recommended that tall wind screens, in place of standard height guards, be implemented along their full perimeters in combination with mitigation inboard of the terrace perimeters. This inboard mitigation could take the form of wind screens or clusters of coniferous trees located around sensitive areas, and canopies located above designated seating areas.

The extent of the mitigation measures is dependent on the programming of the terraces. An appropriate mitigation strategy will be developed in collaboration with the building and landscape architects as the design of the proposed development progresses. This work is expected to support the future Site Plan Control application.

5.3 Wind Safety

Within the context of typical weather patterns, which exclude anomalous localized storm events such as tornadoes and downbursts, no pedestrian areas within or surrounding the subject are expected to experience conditions that could be considered dangerous, as defined in Section 4.4.

5.4 Applicability of Results

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

6. CONCLUSIONS AND RECOMMENDATIONS

A complete summary of the predicted wind conditions is provided in Section 5 and illustrated in Figures 3A-7. 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) Most grade-level areas within and surrounding the subject site are predicted to experience conditions that are considered acceptable for the intended pedestrian uses throughout the year. Specifically, conditions over surrounding sidewalks, transit stops, the existing parking lot, laneways, and walkways to the east, the proposed internal walkways, and public and private roads, the potential P.O.P.S. southwest of buildings A3 and B2, and the building access points serving the proposed development are considered acceptable. Exceptions are described as follows:

    a. Conditions over the future connection are predicted to be suitable mostly for standing during the summer, becoming suitable for a mix of standing, strolling, and walking during the spring and autumn. The windiest conditions are situated in between buildings C2 and D1, where conditions are predicted to be uncomfortable during the winter. Specifically, during the winter season, conditions are predicted to be uncomfortable for at least 24% of the time. While the noted conditions are predicted to occur mostly over the road surface, conditions are predicted to impact a small section of the walkway along the future connection.

    b. Conditions along the east elevation of building B2, the north elevation of building B3, the south elevation of building C2, and the east elevation of building D2 are predicted to be suitable for strolling, or better, throughout the year, with a small, isolated region suitable for walking near the southeast corner of building D2 during the winter.

        - It is recommended that all potential primary building entrances are located away from the noted windier areas. Additionally, it is recommended that potential secondary building entrances along the noted areas be recessed into the building façade by at least 2 m.

c. Wind comfort conditions and recommendations regarding mitigation over the park and the remaining potential P.O.P.S. serving the proposed development during the typical use period are described as follows:

- Conditions within the park are predicted to be suitable for sitting within the majority of the area, with regions suitable for standing to the east and at the southeast corner.
- Conditions within the potential P.O.P.S. at the northeast corner of building D2 are predicted to be suitable for sitting to the east and west and at the southeast corner, and suitable for standing throughout the remainder of the area.
- Depending on the programming within the park, the noted conditions may be considered acceptable. Specifically, if the noted windier areas will not accommodate seating or lounging activities, the noted conditions would be considered acceptable.
- Comfort levels within the potential P.O.P.S. at the northeast corner of building D2 may be improved by implementing landscaping elements around sensitive areas such as tall wind screens and coniferous trees in dense arrangements, in combination with strategically placed seating with high-back benches and other local wind mitigation.
- The extent of mitigation measures is dependent on the programming of the spaces. An appropriate mitigation strategy will be developed in collaboration with the building and landscape architects as the design of the proposed development progresses. This work is expected to support the future Site Plan Control application.

2) Regarding the podia roofs, wind comfort conditions during the typical use period are predicted to be suitable for a mix of sitting and standing over the podia roofs of buildings A1, A2, A3, A4, B1, B2, and C1, suitable mostly for standing over the podium roof of building D2, suitable for strolling,

or better, over the podia roofs of buildings B3 and D1, and suitable for a mix of standing and strolling within the podium roof of building C2.

a. To improve comfort levels within the potential amenity terraces, it is recommended that tall wind screens, in place of standard height guards, be implemented along their full perimeters in combination with mitigation inboard of the terrace perimeters. This inboard mitigation could take the form of wind screens or clusters of coniferous trees located around sensitive areas, and canopies located above designated seating areas.

b. The extent of the mitigation measures is dependent on the programming of the terraces. An appropriate mitigation strategy will be developed in collaboration with the building and landscape architects as the design of the proposed development progresses. This work is expected to support the future Site Plan Control application.

3) The foregoing statements and conclusions apply to common weather systems, during which no dangerous wind conditions, as defined in Section 4.4, are expected anywhere over the subject site. During extreme weather events, (for example, thunderstorms, tornadoes, and downbursts), pedestrian safety is the main concern. However, these events are generally short-lived and infrequent and there is often sufficient warning for pedestrians to take appropriate cover.

Sincerely,

Gradient Wind Engineering Inc.

Omar Rioseco, B.Eng.
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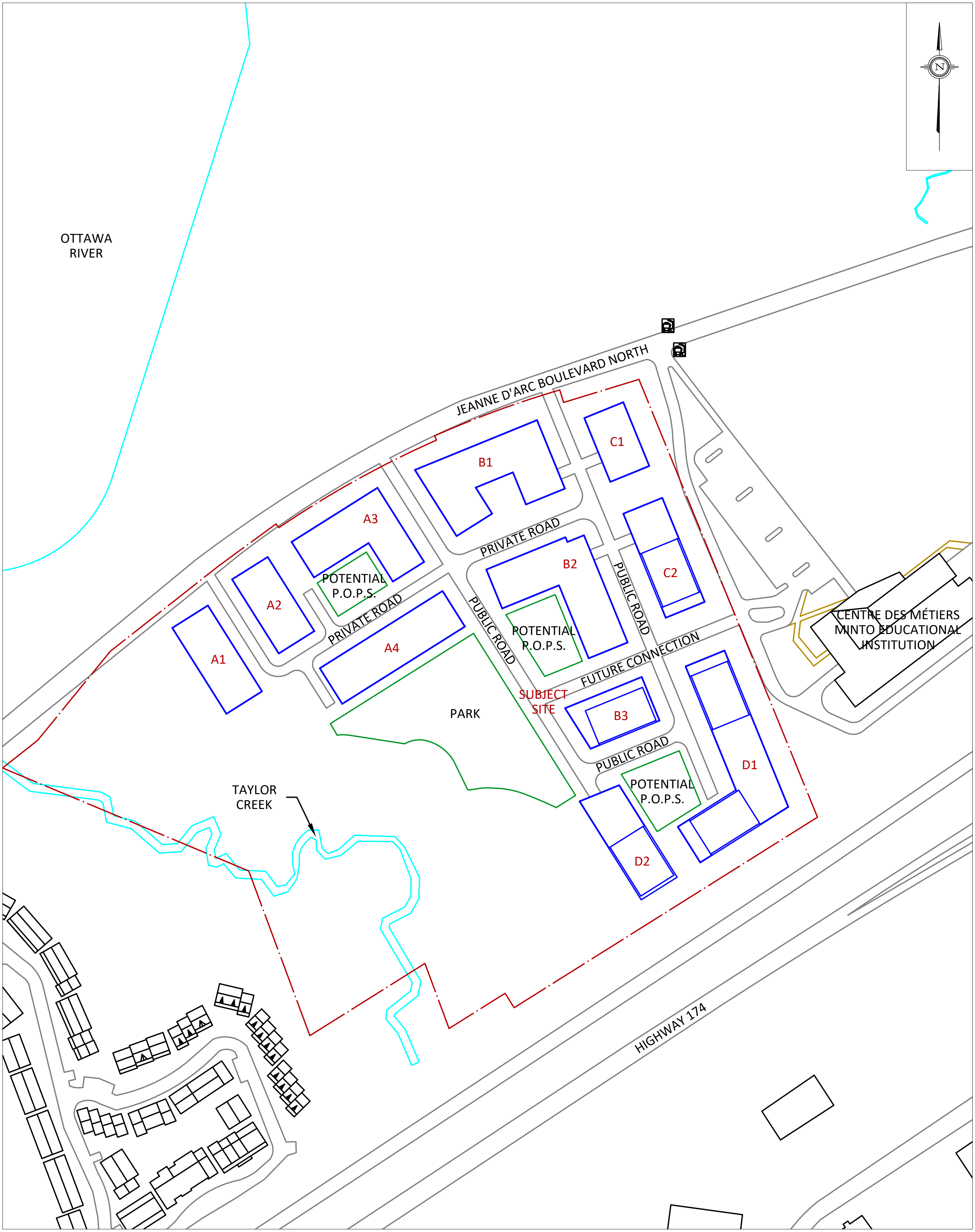
Project Coordinator



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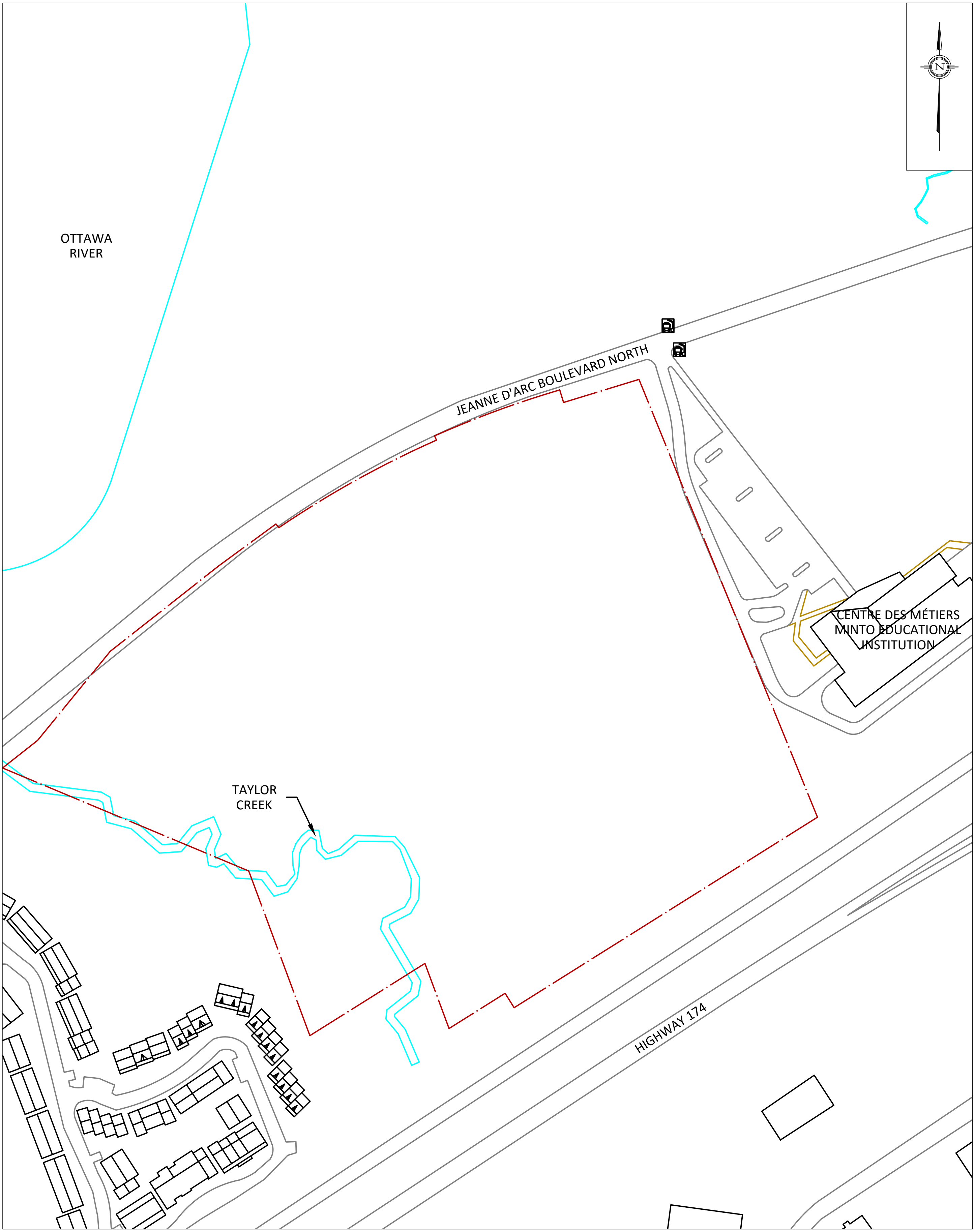
PROJECT	PETRIE'S LANDING III - 8600 JEANNE D'ARC BLVD N, OTTAWA PEDESTRIAN LEVEL WIND STUDY
SCALE	1:3000
DRAWING NO.	23-056-PLW-1A
DATE	MAY 25, 2023
DRAWN BY	S.K.
DESCRIPTION	FIGURE 1A: PROPOSED SITE PLAN AND SURROUNDING CONTEXT



GRADIENTWIND ENGINEERS & SCIENTISTS 127 WALGREEN ROAD, OTTAWA, ON 613 836 0934 • GRADIENTWIND.COM	PROJECT PETRIE'S LANDING III - 8600 JEANNE D'ARC BLVD N, OTTAWA PEDESTRIAN LEVEL WIND STUDY		DESCRIPTION FIGURE 1B: EXISTING SITE PLAN AND SURROUNDING CONTEXT
	SCALE 1:3000	DRAWING NO. 23-056-PLW-1B	
	DATE MAY 25, 2023	DRAWN BY S.K.	

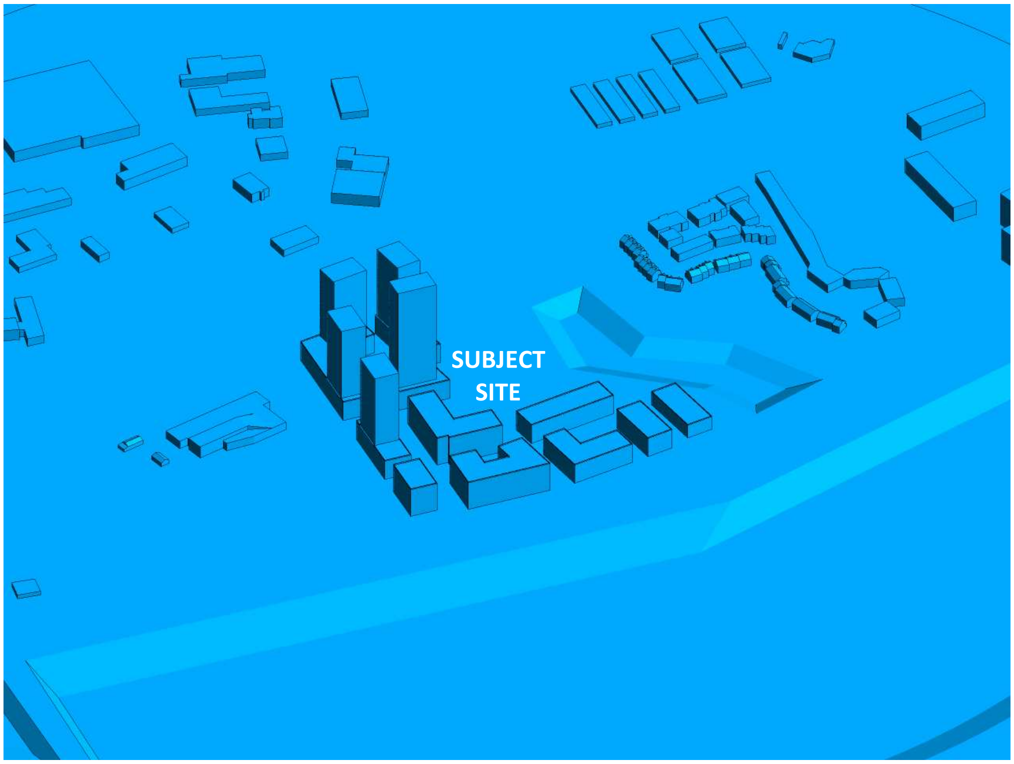


FIGURE 2A: COMPUTATIONAL MODEL, PROPOSED MASSING, NORTH PERSPECTIVE

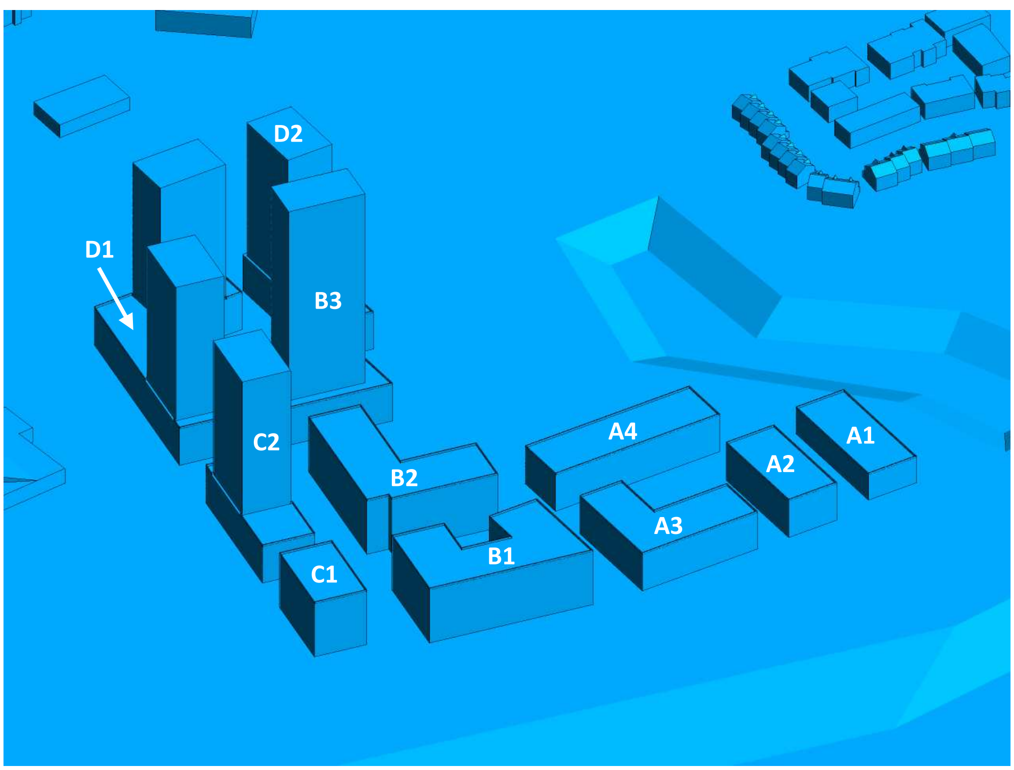


FIGURE 2B: CLOSE UP OF FIGURE 2A

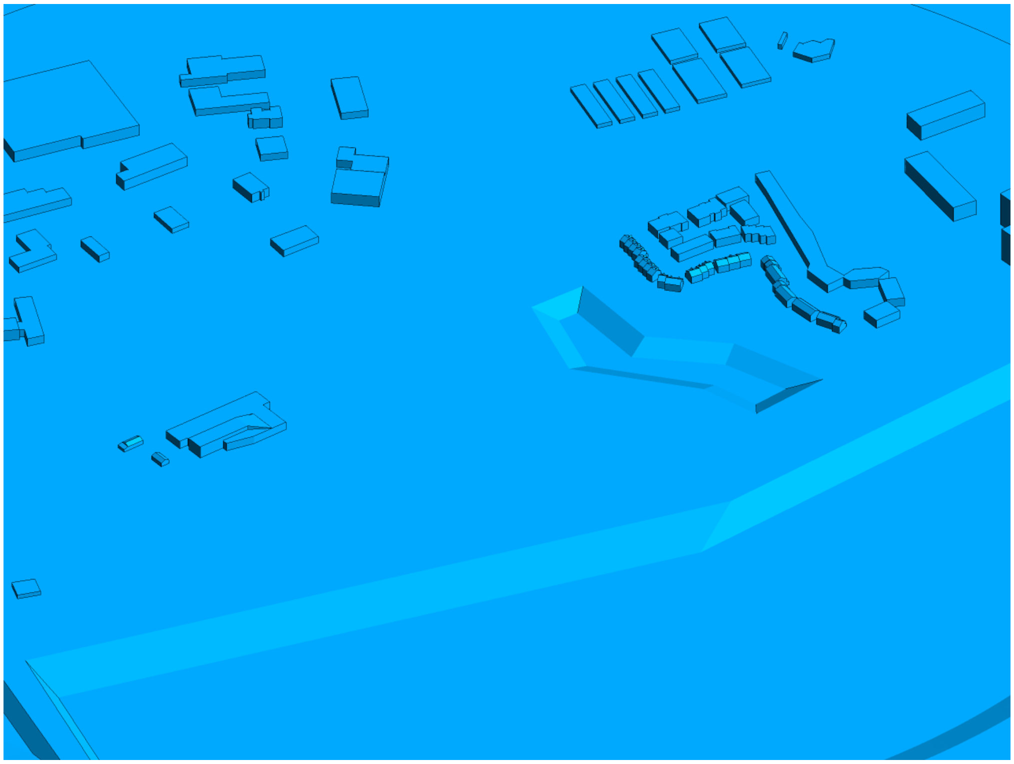


FIGURE 2C: COMPUTATIONAL MODEL, EXISTING MASSING, NORTH PERSPECTIVE

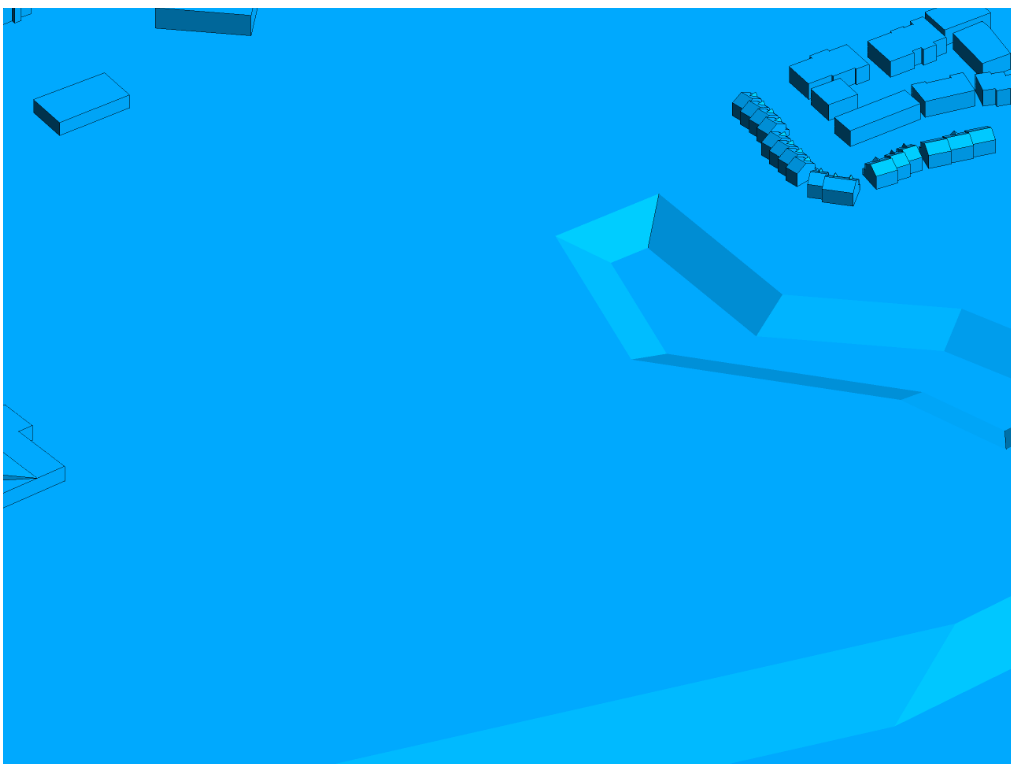


FIGURE 2D: CLOSE UP OF FIGURE 2C

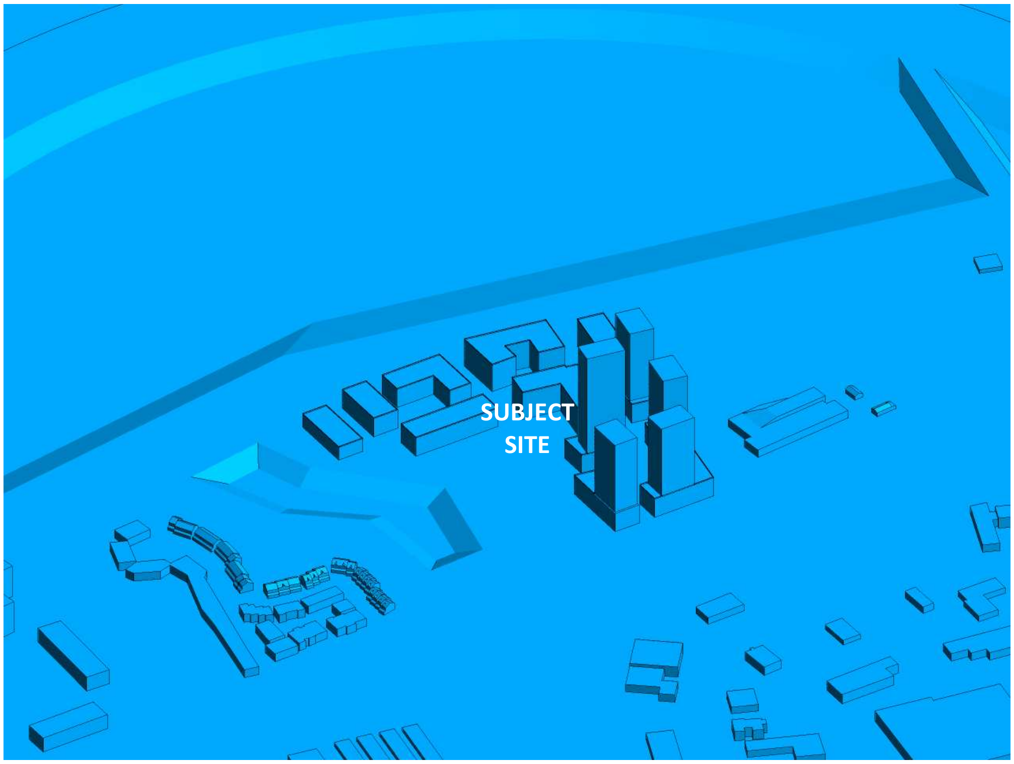


FIGURE 2E: COMPUTATIONAL MODEL, PROPOSED MASSING, SOUTH PERSPECTIVE

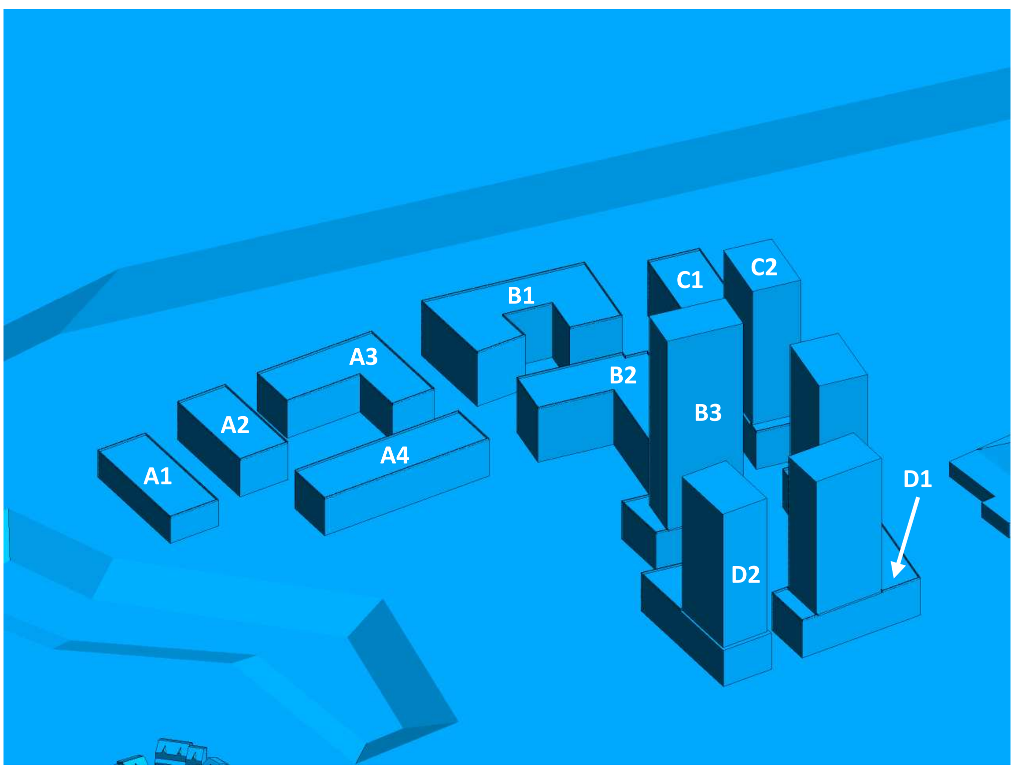


FIGURE 2F: CLOSE UP OF FIGURE 2E

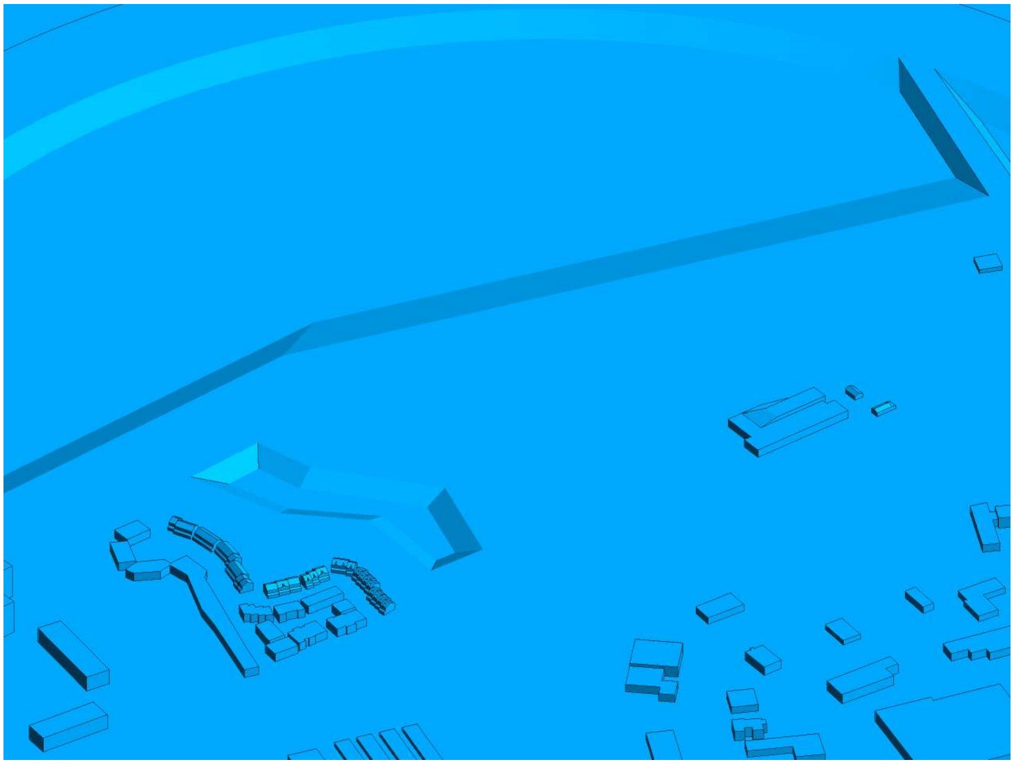


FIGURE 2G: COMPUTATIONAL MODEL, EXISTING MASSING, SOUTH PERSPECTIVE

FIGURE 2H: CLOSE UP OF FIGURE 2G

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

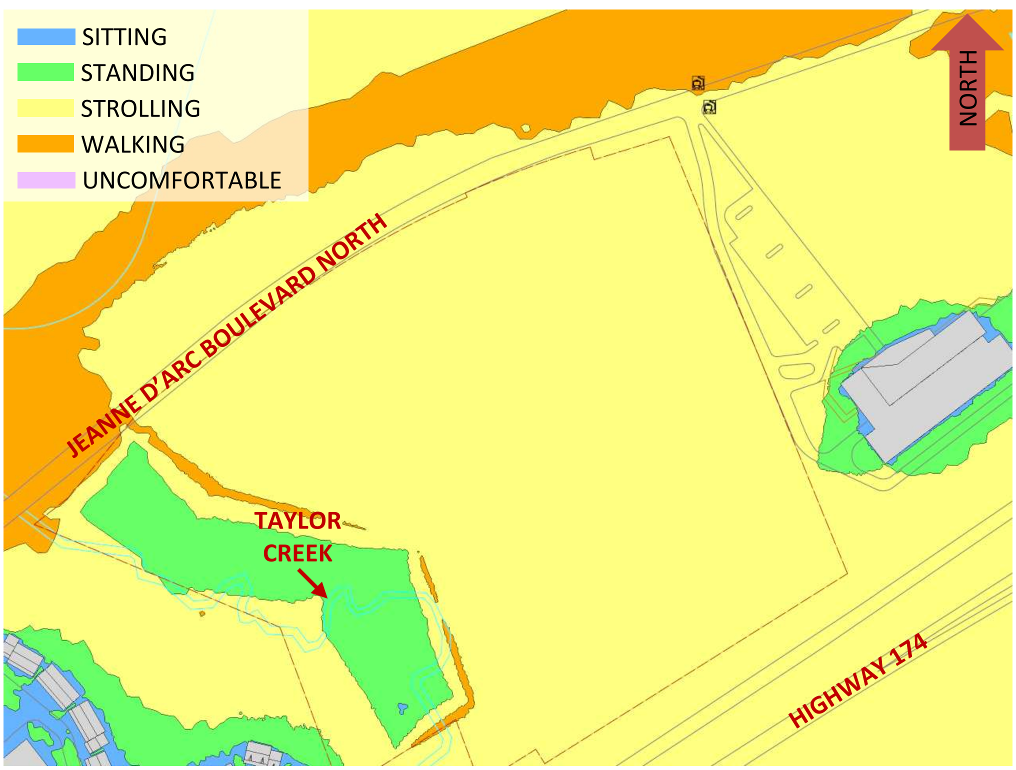


FIGURE 3B: SPRING – WIND COMFORT, GRADE LEVEL – EXISTING MASSING

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

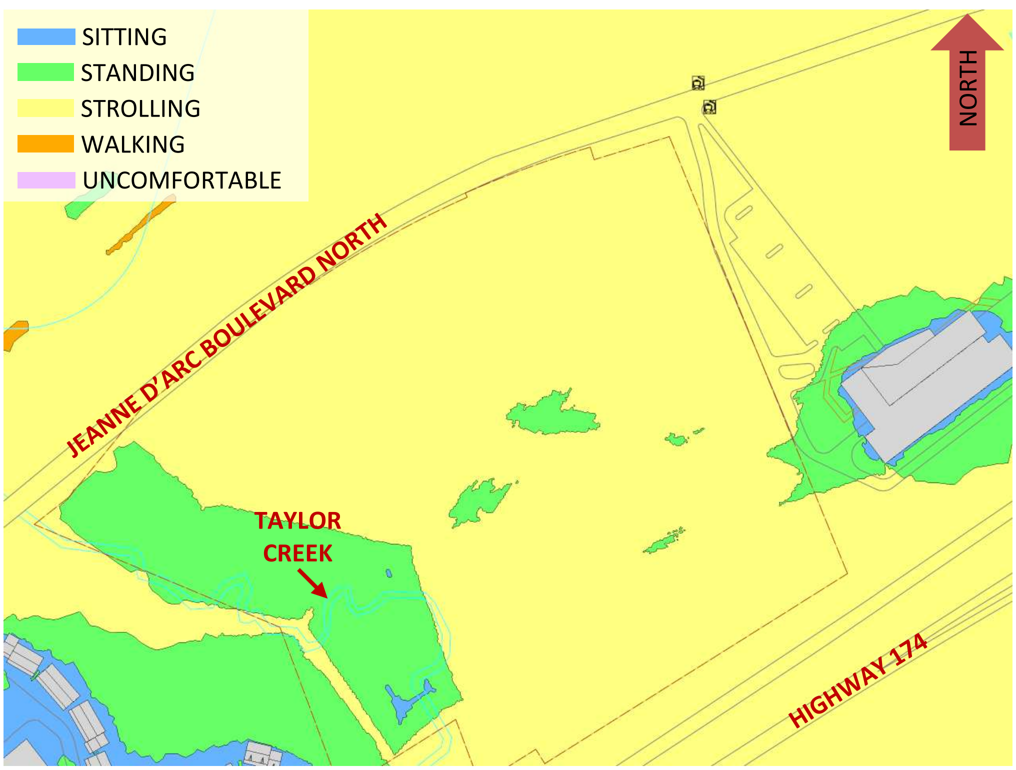


FIGURE 5B: AUTUMN – WIND COMFORT, GRADE LEVEL – EXISTING MASSING

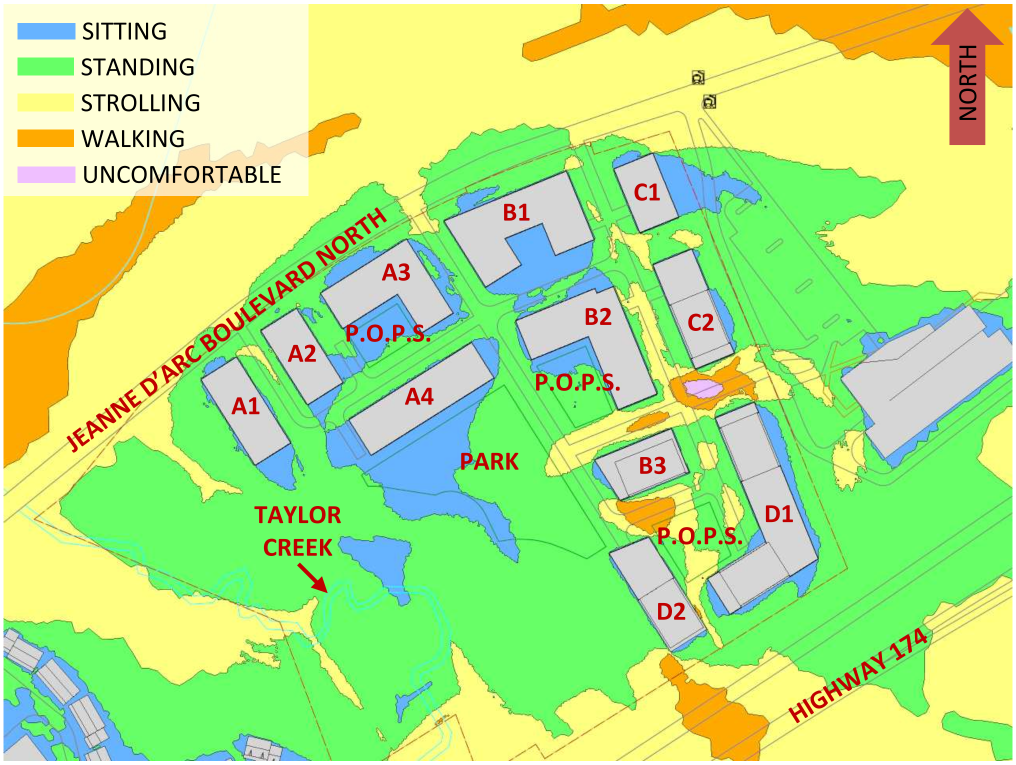


FIGURE 6A: WINTER – WIND COMFORT, GRADE LEVEL – PROPOSED MASSING

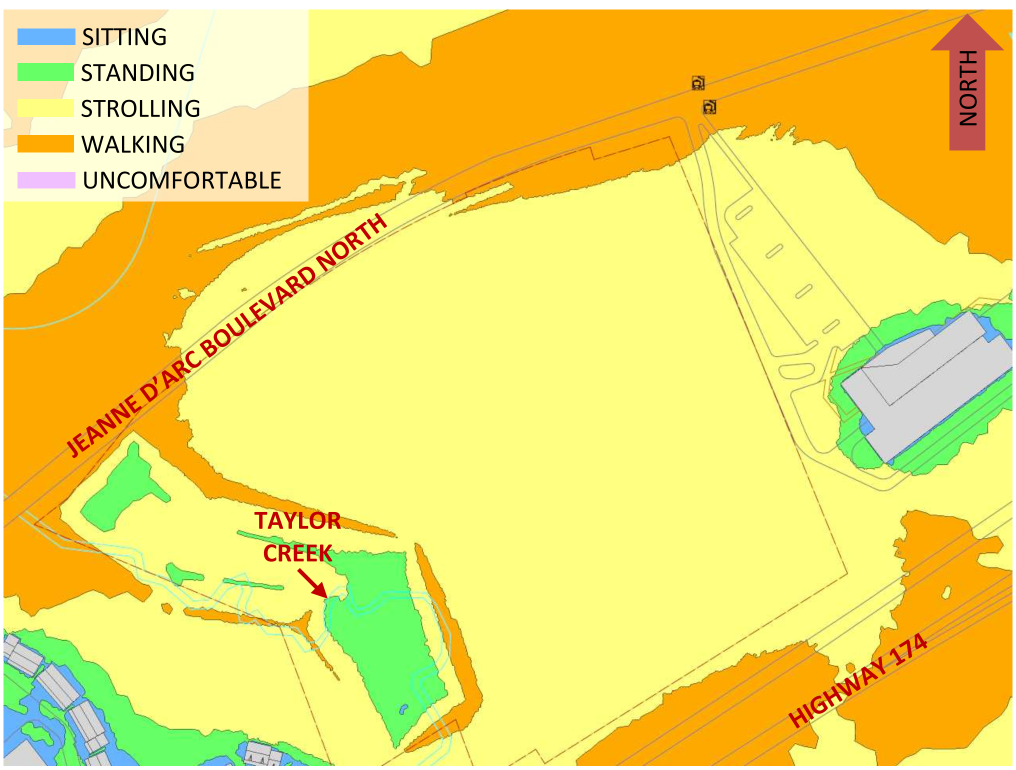
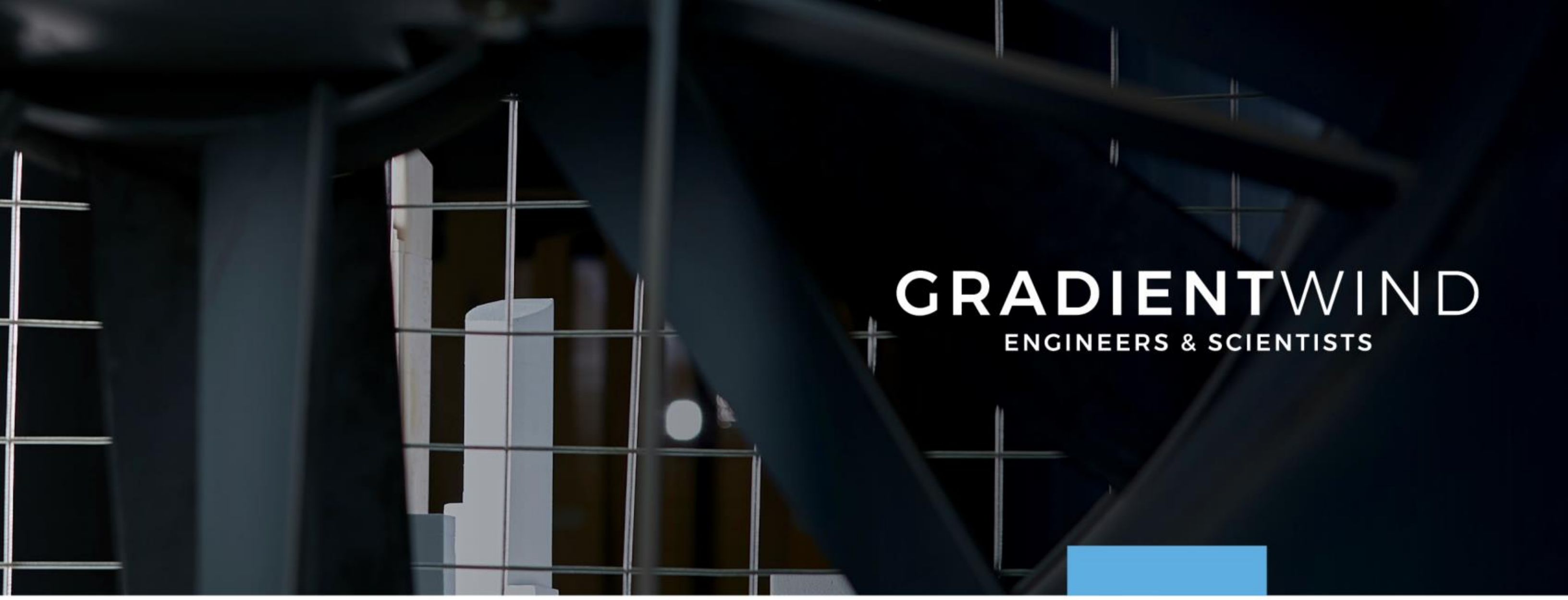
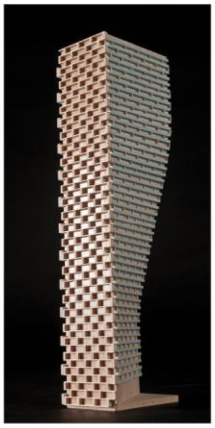
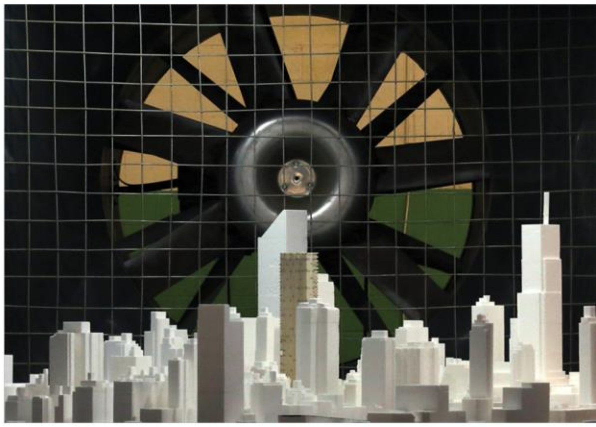


FIGURE 6B: WINTER – WIND COMFORT, GRADE LEVEL – EXISTING MASSING

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







APPENDIX A

SIMULATION OF THE ATMOSPHERIC BOUNDARY LAYER

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SIMULATION OF THE ATMOSPHERIC BOUNDARY LAYER

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

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

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

For the model, U_g is set to 6.5 metres per second, 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	0.19
49	0.19
74	0.20
103	0.20
167	0.24
197	0.24
217	0.24
237	0.24
262	0.21
282	0.18
301	0.17
324	0.17

TABLE 2: DEFINITION OF UPSTREAM EXPOSURE (ALPHA VALUE)

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

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

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

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

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

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

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

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

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