REPORT

99TH STREET NW MIXED USE

EDMONTON, AB

PEDESTRIAN WIND STUDY

PROJECT #1701011

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SUBMITTED TO

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1. INTRODUCTION

RWDI was retained by One Properties to conduct a pedestrian wind study for the proposed 99th Street NW Mixed Use development in Edmonton, AB (see Image 1).

This assessment was based on the following:

- a review of regional long-term meteorological data for Edmonton City Centre Airport;
- design drawings received from DIALOG on October 18, 2017;
- wind-tunnel studies undertaken by RWDI for similar projects in the Edmonton Area;
- our engineering judgement and knowledge of wind flows around buildings[1-3]; and,
- use of 3D software developed by RWDI (Windestimator[2]) for estimating the potential wind conditions around generalized building forms.

This approach provides a screening-level estimation of potential wind conditions. Conceptual wind control measures to improve wind comfort are recommended, where necessary. To better quantify these wind conditions or refine any conceptual mitigation measures presented herein, physical scale-model tests in a boundary-layer wind tunnel would be required.

Note that other wind issues, such as those related to cladding and structural wind loads, air quality, snow drifting and roof snow loading, etc., were not considered in the scope of this pedestrian wind study.

Image 1 – Rendering of the Proposed Development (View from Southeast)

1. H. Wu and F. Kriksic (2012). "Designing for Pedestrian Comfort in Response to Local Climate", *Journal of Wind Engineering and Industrial Aerodynamics*, vol.104-106, pp.397-407.
2. H. Wu, C.J. Williams, H.A. Baker and W.F. Waechter (2004), "Knowledge-based Desk-Top Analysis of Pedestrian Wind Conditions", *ASCE Structure Congress 2004,* Nashville, Tennessee.
3. C.J. Williams, H. Wu, W.F. Waechter and H.A. Baker (1999), "Experience with Remedial Solutions to Control Pedestrian Wind Problems", *10th International Conference on Wind Engineering*, Copenhagen, Denmark.

2. BUILDING AND SITE INFORMATION

The proposed development is located at the northwest corner of the intersection of 99 Street NW and 89 Avenue NW in Edmonton, Alberta. Currently, the site is occupied by a number of 2-storey buildings and surface parking lots, as shown in Image 1. Existing buildings adjacent to the site are low rise, except a medium-rise building to the northwest of the site. A number of high-rise buildings are further away to the west and northwest of the development, along North Saskatchewan River. Downtown Edmonton is located to the north and northwest.

Image 2 – Aerial View of Existing Site and Surrounding
(Courtesy of Google™ earth)

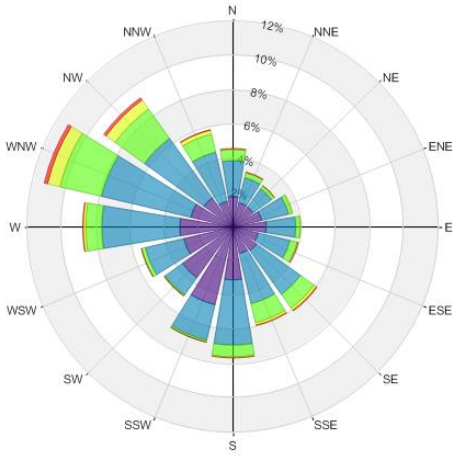
The proposed development will consist of two towers of 15 and 18 storeys, connected with a pedestrian bridge at Level 3 (Images 1 and 3). Pedestrian areas on and around the site include building entrances, a grade level seating area, Level 3 common and private terraces, penthouse/roof decks, and sidewalks.

Image 3 – South Elevation

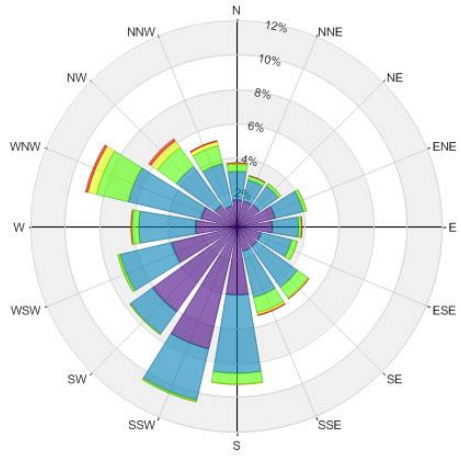
3. METEOROLOGICAL DATA

Meteorological data from Edmonton City Centre Airport, for the period 1985 to 2015, was used as a reference for wind conditions in the area. The distributions of wind frequency and directionality for the summer (May through October) and winter (November through April) seasons are shown in Image 4.

When all winds are considered, wind from southeast through south and west through north-northwest directions are predominant in both summer and winter. Strong winds of a mean speed greater than 30 km/h measured at the airport occur more frequently during the summer then the winter season, and they are typically from the west-northwest and northwest directions.



Summer - May to October



Winter - November to April

Image 4 – Directional Distribution of Winds Approaching Edmonton City Centre Airport (1985 – 2015)

4. PEDESTRIAN WIND CRITERIA

The RWDI pedestrian wind criteria are used in the current study. These criteria have been developed by RWDI through research and consulting practice since 1974. They have also been widely accepted by municipal authorities and by the building design and city planning community including the City of Edmonton. The criteria are as follows:

4.1 Pedestrian Safety

Pedestrian safety is associated with excessive gust wind speeds that can adversely affect a pedestrian's balance and footing. If strong winds that can affect a person's balance (**90 km/h**) occur more than 0.1% of the time or 9 hours per year, the wind conditions are considered severe.

4.2 Pedestrian Comfort

Sitting (≤ 10 km/h): Calm or light breezes desired for outdoor seating areas where one can read a paper without having it blown away.

Standing (≤ 14 km/h): Gentle breezes suitable for main building entrances and bus stops.

Strolling (≤ 17 km/h): Moderate winds that would be appropriate for window shopping and strolling along a downtown street, plaza or park.

Walking (≤ 20 km/h): Relatively high speeds that can be tolerated if one's objective is to walk, run or cycle without lingering.

Uncomfortable: None of the comfort categories are met.

Wind conditions are considered suitable for sitting, standing, strolling or walking if the associate mean wind speeds are expected for at least four out of five days (80% of the time). Wind control measures are typically required at locations where winds are rated as uncomfortable or they exceed the wind safety criterion.

Note that these wind speeds are assessed at the pedestrian height (i.e., 1.5 m above grade or the concerned floor level), typically lower than those recorded in the airport (10 m height and open terrain).

These criteria for wind forces represent average wind tolerance. They are sometimes subjective and regional differences in wind climate and thermal conditions as well as variations in age, health, clothing, etc. can also affect people's perception of the wind climate.

For the current development, wind speeds comfortable for walking or strolling are appropriate for sidewalks and walkways; and lower wind speeds comfortable for standing are required for building entrances where pedestrians may linger. Wind speeds comfortable for sitting are appropriate for outdoor amenity areas during the summer, when these areas will be mainly used.

5. PEDESTRIAN WIND CONDITIONS

5.1 Background

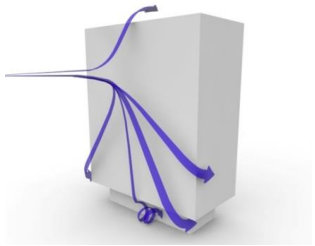
Predicting wind speeds and occurrence frequencies is complicated. It involves building geometry, orientation, position and height of surrounding buildings, upstream terrain and the local wind climate. Over the years, RWDI has conducted thousands of wind-tunnel model studies regarding pedestrian wind conditions around buildings, yielding a broad knowledge base. This knowledge has been incorporated into RWDI's proprietary 3D software that allows, in many situations, for a qualitative, screening-level numerical estimation of pedestrian wind conditions without wind tunnel testing.

The proposed development is exposed to the prevailing winds. Tall buildings tend to intercept the stronger winds at higher elevations and redirect them to the ground level. Such a *Downwashing Flow* (see Image 5a) is the main cause for increased wind activity around tall buildings at the grade level. When oblique winds are deflected down by a building, a localized increase in the wind activity or *Corner Acceleration* can be expected around the downwind building corner at pedestrian level (see Image 5b).

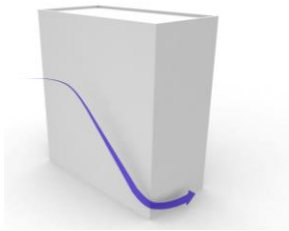
When two buildings are situated side by side, wind flow tends to accelerate through the space between the buildings due to *Channelling Effect* caused by the narrow gap (see Image 5c). If these building/wind combinations occur for prevailing winds, there is a greater potential for increased wind activity.

Building setbacks and podiums will reduce the direct impact of downwashing wind flows at grade (see Image 5d); however, higher wind activities are expected on the podium itself.

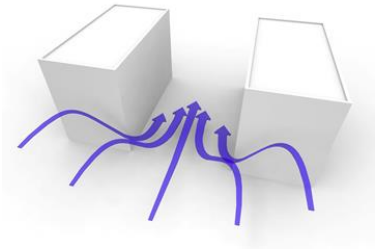
Detailed discussions on the potential wind comfort conditions at key pedestrian areas are provided in the next sections.



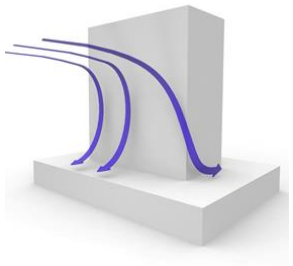
a) Downwashing



b) Corner Acceleration



c) Channeling Effect



d) Podium Reduces Impact of Downwashing

Image 5 – General Wind Flow Patterns

5.2 Entrances

The entrances to the residential lobbies of the west and east towers are located on their east and west sides, respectively (A1 and A2 in Image 6). The retail entrances are located to the west, south and east of the podium of the east tower (A3 through A8 in Image 6). Entrances to the townhouses are located on the south side of the west tower (A9 in Image 6).

The southerly, southeasterly and northwesterly winds are expected to be intercepted by the tower facades and accelerate through the space between the two towers and under the connecting bridge. As a result, wind speeds at A1, A2 and A3 are expected to be higher than desired for main entrances throughout the year. The vestibules at A1 and A2 are positive features which will provide a space for pedestrian to take shelter on windy days. In order to improve the conditions at these entrances, we recommend to recess them from the main façade or install wind screens or tall planters on both sides of them. Examples of these wind control features are shown in Image 7.

The large podium of the east tower will help redirect winds away from the ground and the retail entrances on the south and east sides of the podium. Similarly, the podium at the southwest corner of the west tower will help to keep winds away from the townhouse entrances. Also, the proposed landscaping at the townhouse courtyards and along 89 Ave NW and 99 St NW are expected to further improve the wind conditions. Further, entrances A4 through A8 are recessed from the main façade, which are positive design features in providing local wind protection. Appropriate wind conditions are expected at these entrances (A4 through A9) throughout the year.

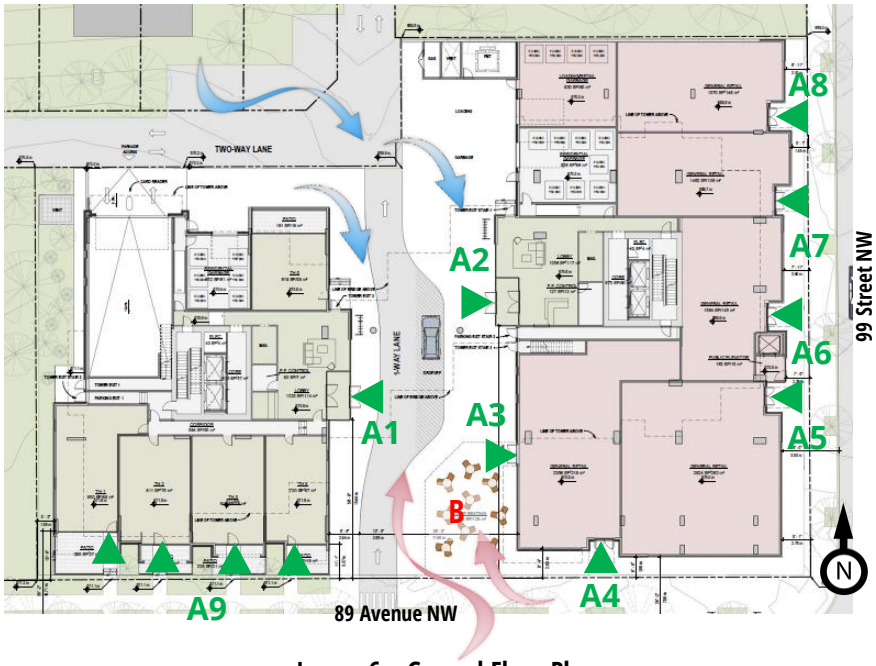


Image 6 – Ground Floor Plan

Image 7 – Examples of Wind Mitigation Features at Entrances

5.3 Grade-Level Outdoor Seating Area

The outdoor seating area at the grade level at the southwest corner of the east tower (Location B in Image 6) are exposed to the southeasterly, southerly and northwesterly winds. As a result, wind speeds are expected to be higher than desired for seating activities. The proposed landscaping along 89 Ave NW are expected to help to improve the conditions; however, additional wind control features might be required. These wind control features can be in form of wind screens or tall planters around the perimeter of the seating area and umbrellas or trellises in this area. Examples are shown in Image 8.

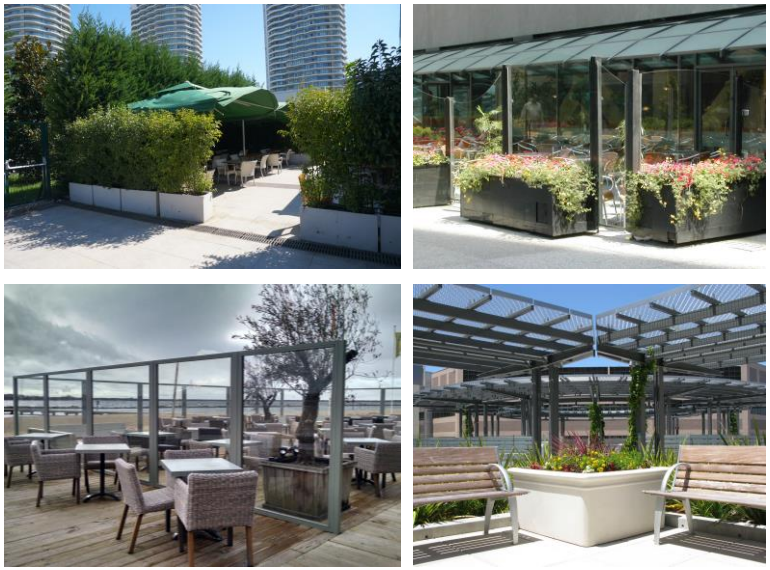


Image 8 – Examples of Wind Mitigation Features at the Seating Area

5.4 Sidewalks

The two-storey podiums on the north, south and east of the east tower, and on the south side of the west tower will help to keep winds accelerating down the towers, away from the grade. As a result, wind conditions along the sidewalks of 89 Ave NW and 99 St NW are expected to be comfortable for the intended use throughout the year.

5.5 Level 3 Common and Private Terraces

The common and private terraces at Level 3 on the south side of the podium of the east tower (C1 and C2, respectively, in Image 9) are protected from the northwesterly winds by the bridge connecting the two towers; however, they are exposed to the southeasterly and southerly winds. The private terraces on the north and west sides of the east tower and to the northeast, southeast and southwest of the west tower (C3 through C7, respectively, in Image 9) are exposed to all prevailing winds. These terraces are exposed to the prevailing winds both directly, and after they are redirected down the tower facades. As a result, wind speeds at C1 through C6 are expected to be higher than desired for passive pedestrian activities during the summer. We recommend to install min 2m tall guardrails/parapets (ideally 20-30% porous if possible) around the perimeter of these terraces if frequent use is anticipated. Additionally, landscaping, wind screens and trellises (in particular close to the building façades) will further help to improve the conditions. Examples of these mitigation features are shown in Image 10.

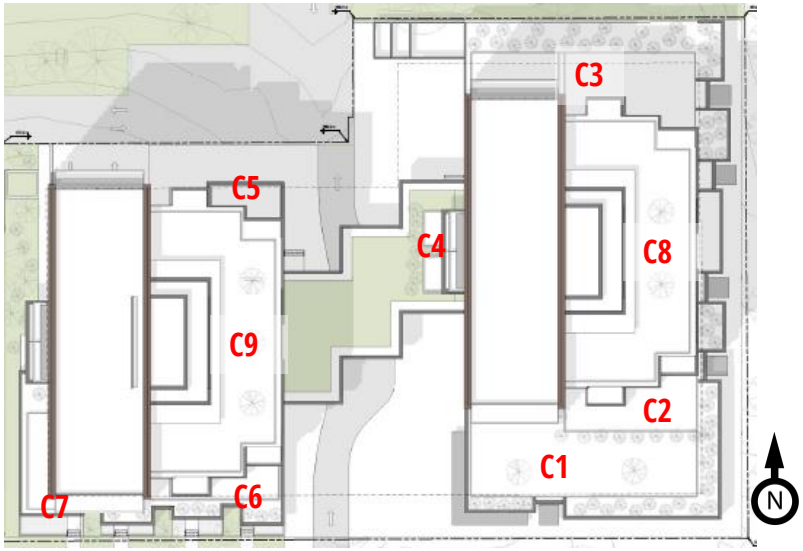


Image 9 – Roof Plan

Image 10 – Examples of Mitigation Features for Podium Amenity Spaces

5.6 Penthouse and Roof Top Amenity Decks

The penthouse deck at Level 15 of the east tower and the roof top amenity deck at Level 18 of the west tower (C7 and C8, respectively, in Image 9) are exposed to the southeasterly and southerly winds, as well as northwesterly winds accelerating around the northeast corner of the penthouse levels. Wind speeds at these areas will be higher than desired for passive pedestrian activities during the summer. Vertical wind control features suggested for Level 3 terraces (e.g., tall parapets or guardrails) can help to improve the conditions in these areas. Examples of these mitigation features are shown in Image 10.

6. SUMMARY

Wind conditions on and around the proposed 99th Street NW Mixed Use development in Edmonton, AB are discussed in this report, based on the local wind climate, surrounding buildings our past experience with wind tunnel testing of similar buildings, and screening-level wind flow modelling.

The proposed development has a number of positive design features such as vestibules at the main entrances, podiums, tower setbacks and landscaping. Appropriate wind conditions are expected at the sidewalks of 99th St NW and 89 Ave NW, retail entrances to the south and east of the podium of the east tower and townhouse entrances south of the west tower.

Higher-than-desired wind speeds are expected at the main lobby entrances of both towers and the retail entrances to the west of the east tower throughout the year, and at outdoor seating area at the grade level, Level 3 common and private terraces, penthouse deck and roof top amenity deck during the summer, when these areas will be frequently used. Wind control features have been recommended to improve the wind conditions in the areas.

The findings of the wind study are quite commonly encountered with podium and tower designs. It should be possible to mitigate the impacts through appropriate design feature, as indicated in this report.

7. APPLICABILITY OF RESULTS

The assessment presented in this report are for proposed 99th Street NW Mixed Use development in Edmonton, AB based on the design drawings and documents received from DIALOG on October 18, 2017.

In the event of any significant changes to the design, construction or operation of the building or addition of surroundings in the future, RWDI could provide an assessment of their impact on the pedestrian wind conditions discussed in this report. It is the responsibility of others to contact RWDI to initiate this process.