REPORT

KING'S WHARF

DARTMOUTH, NS

PEDESTRIAN WIND DESIGN CONSULTATION

PROJECT #1601111

MARCH 27, 2017

SUBMITTED TO

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INTRODUCTION

Rowan Williams Davies & Irwin Inc. (RWDI) was retained by Fares Real Estate Inc. to provide design consultation in regard to the potential pedestrian level wind conditions around the proposed development at King's Wharf in Dartmouth, NS. The objective of this study is to provide design guidance to help shape the future building forms at the site to minimize adverse wind impacts at grade. Our qualitative assessment is based on the following:

- a review of the regional long-term meteorological data from Shearwater Airport;
- 3D e-model of the proposed project received from Fares Real Estate Inc. on March 20, 2017;
- Information on site topography and surroundings obtained from various external sources including Google Earth;
- our past experience with similar projects in the Dartmouth area; and,
- our engineering judgment, experience and expert knowledge of wind flows around buildings[1-3].

Note that our objective is to provide the design team with ideas and design recommendations to consider, from general building massing to smaller architectural and landscaping features, in order to improve the wind conditions and, in particular, to reduce the likelihood of severe wind impacts that would affect pedestrian safety. The effectiveness of any potential wind control measures will be evaluated during wind tunnel testing at an advanced design stage.

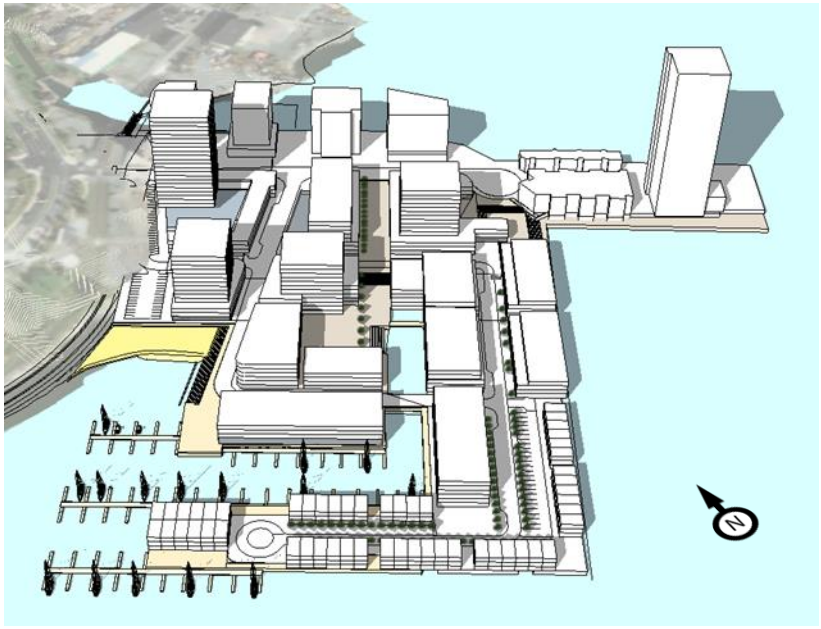


Image 1 – Perspective View of the Proposed Project

1. 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. 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. 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.

SITE & BUILDING INFORMATION

An aerial photo of the King's Wharf project site along with a general concept model of the project are shown in Images 1 and 2. Three of the buildings have been constructed with a fourth currently under construction along the northern edge of the site. The remainder of the site is currently unoccupied. The inland terrain to the west, north and northwest comprise low-rise residential and commercial development. We understand that undesirable pedestrian wind conditions are being experienced around the newly constructed buildings.

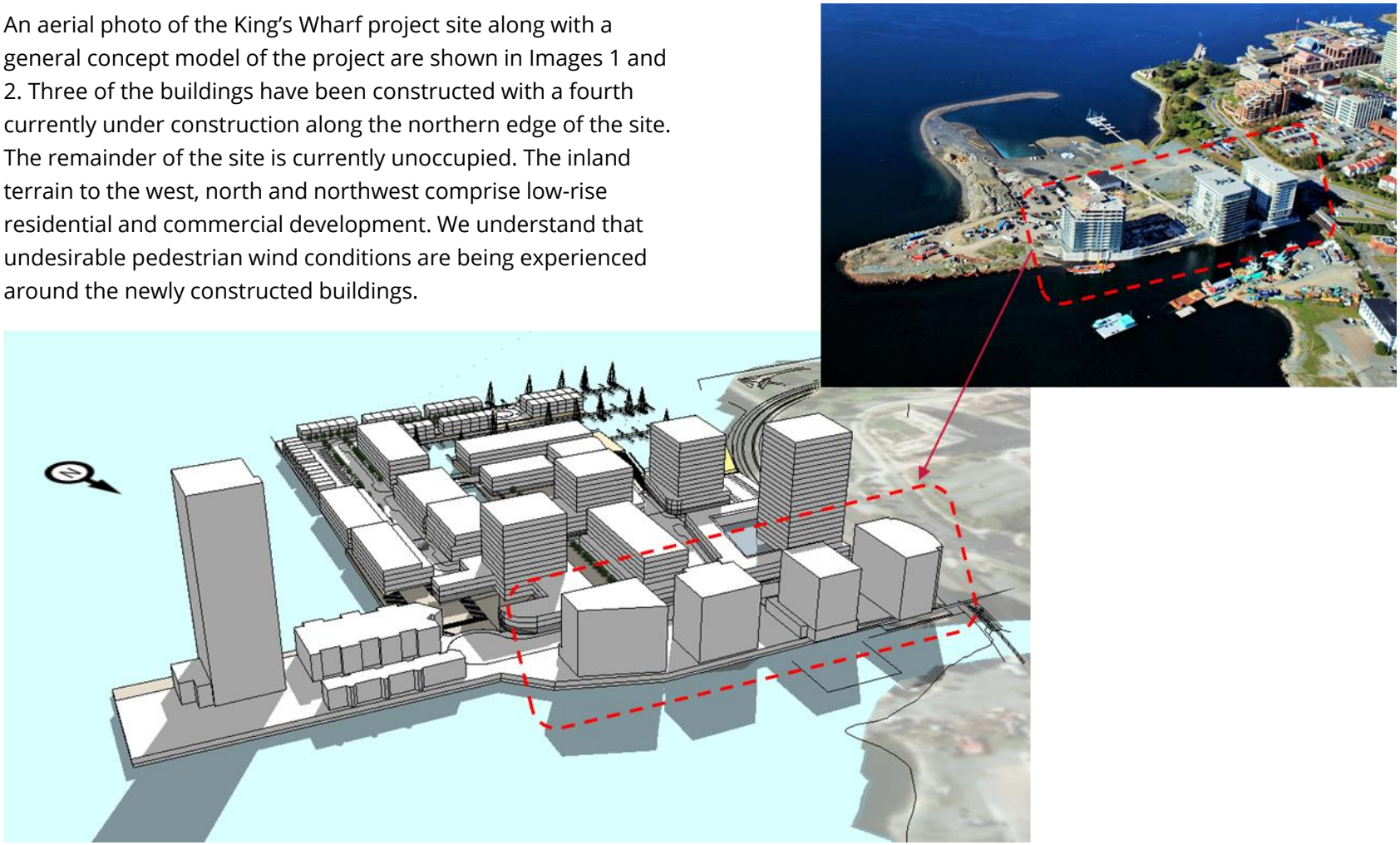
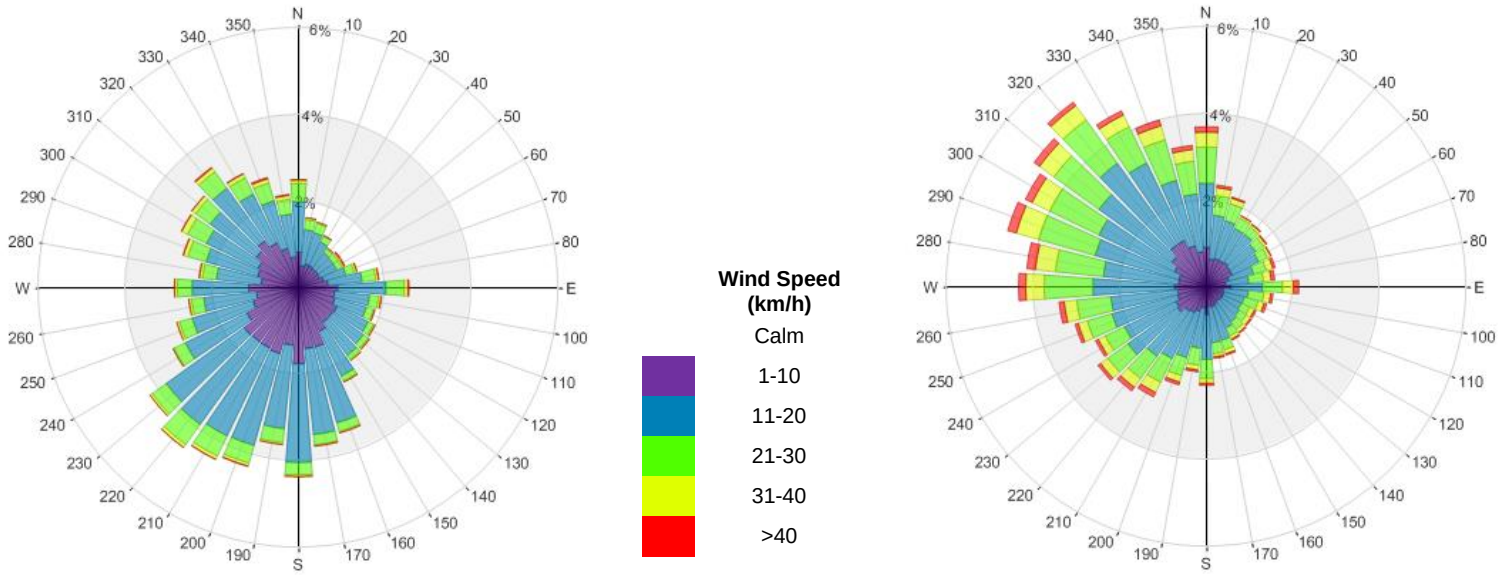


Image 2 – Aerial View of the Site and Surroundings (Credit: Google™ Earth)

METEOROLOGICAL DATA

Meteorological data from Shearwater Airport in Dartmouth, NS for the period from 1985 to 2015 were used as reference for wind conditions in the region. The distributions of wind frequency and directionality for summer (May through October) and winter (November through April) seasons are shown in the wind roses below (Image 3). Winds from the southwest quadrant are predominant in the summer; secondary winds are from the northwest quadrant. During winter, winds approach predominantly from the northwest quadrant.

Strong winds of a mean speed greater than 30 km/h measured at the airport (red and yellow bands) are significantly more frequent in the winter than in the summer. Winds from the east and the northwest quadrant are prevalent throughout the year. Winds from these directions potentially could be the source of uncomfortable or even severe wind conditions, depending upon the site exposure or development design.

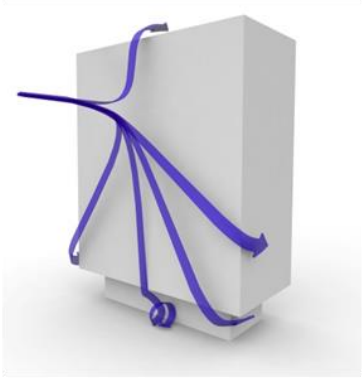


Summer – May through October

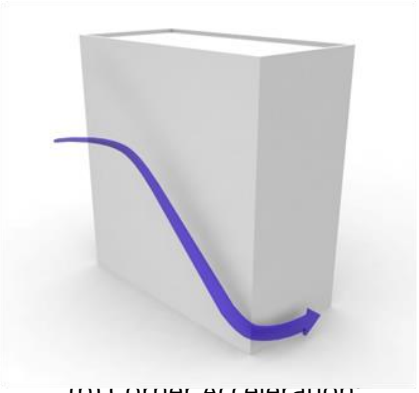
Winter – November through April

Image 3 – Directional Distribution of Winds Approaching Shearwater Airport (1985 – 2015)

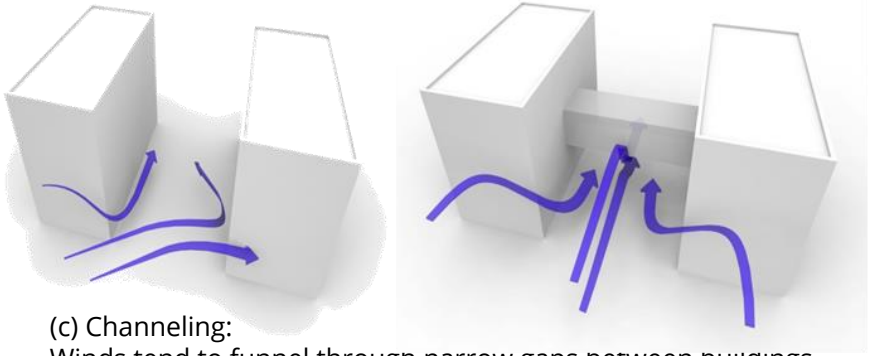
GENERIC WIND FLOW PHENOMENA



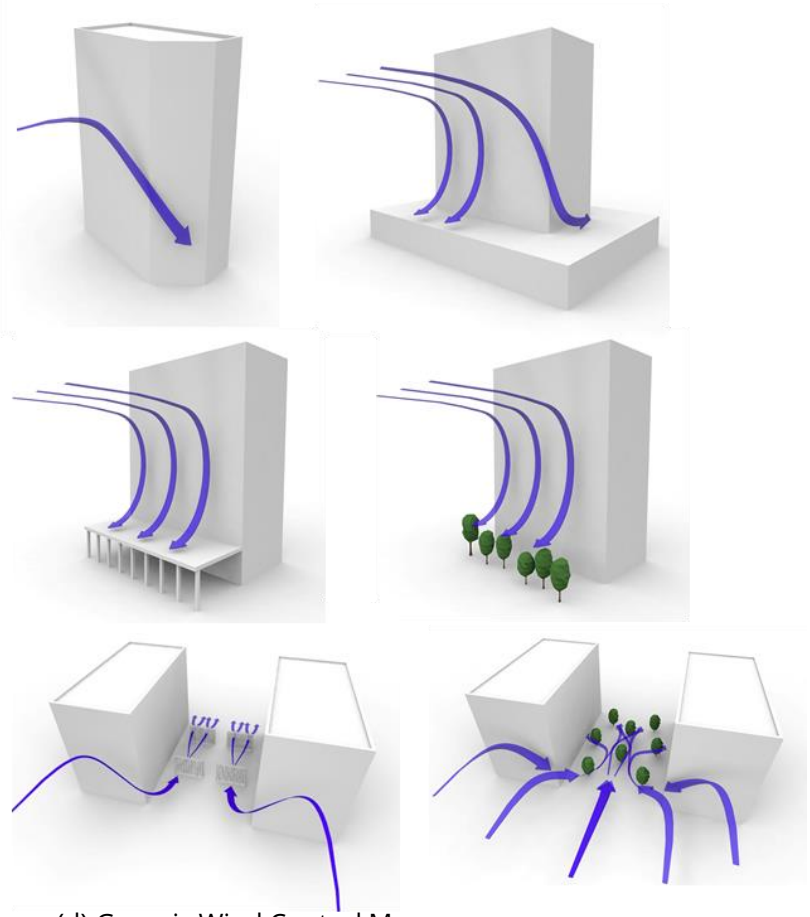
(a) Downwashing:
Tall buildings intercept strong winds at higher elevations and direct them down to grade.



(b) Corner Acceleration:
At lower elevations, winds tend to accelerate at building corners and creating a high wind zone at the corner



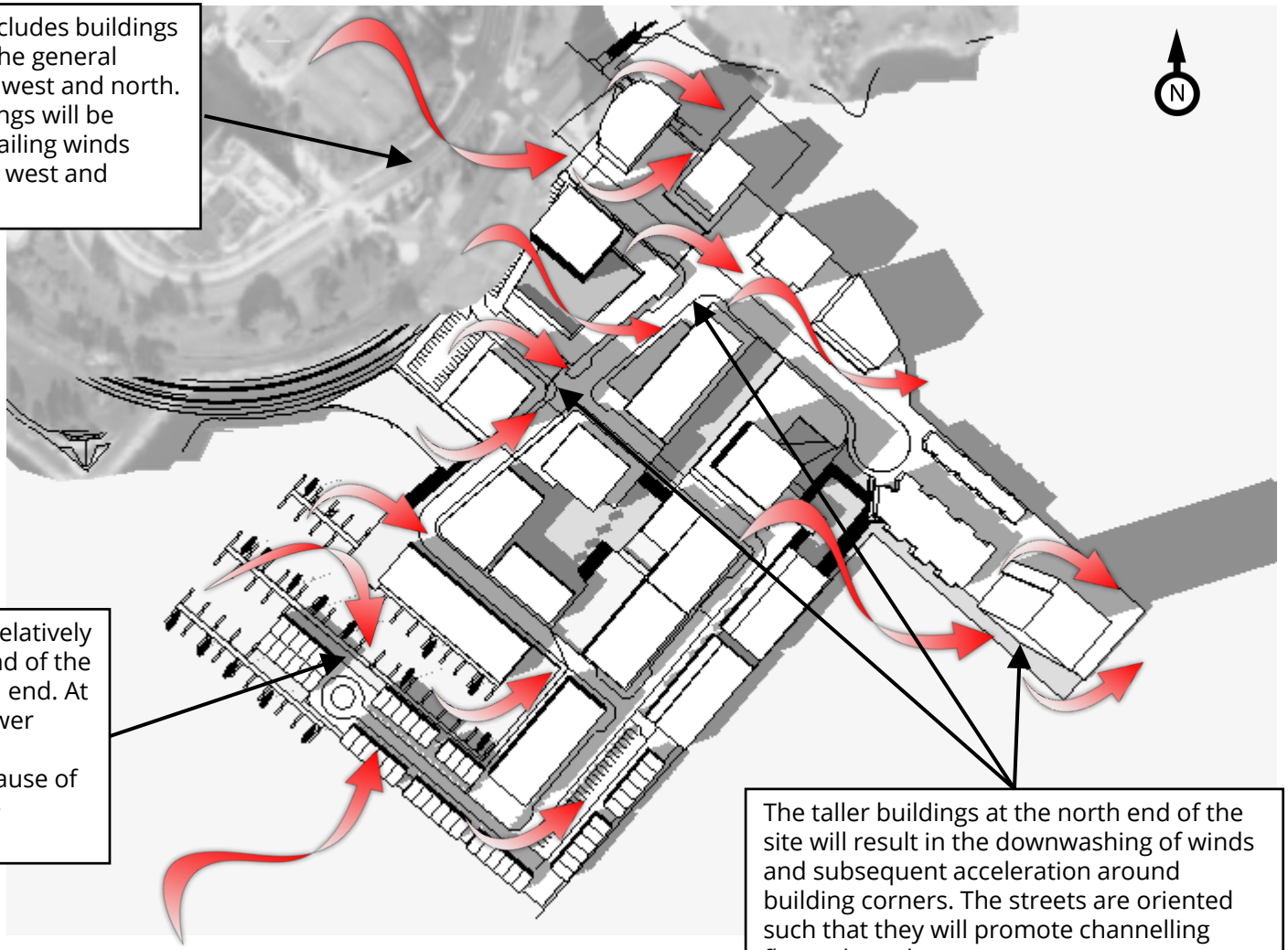
(c) Channeling:
Winds tend to funnel through narrow gaps between buildings when the passages are oriented along a predominant wind direction. The acceleration is accentuated when winds pass under bridges or tunnels



(d) Generic Wind Control Measures:
Reshaping of the building for a streamlined flow and large podiums to capture downwashing are larger scale modifications that would lower the potential for severe wind impact at grade. Smaller more area focused measures include the use of canopies, covered walkways, strategic placement of landscaping, dense trees and wind screens.

PREDICTED WIND FLOW PATTERNS
WESTERLIES

The development includes buildings that are taller than the general surroundings to the west and north. Therefore the buildings will be exposed to the prevailing winds from the southwest, west and northwest.



Wind impact will be relatively lower at the south end of the site than at the north end. At the south end the lower buildings will still be impacted simply because of their exposure to the approaching winds.

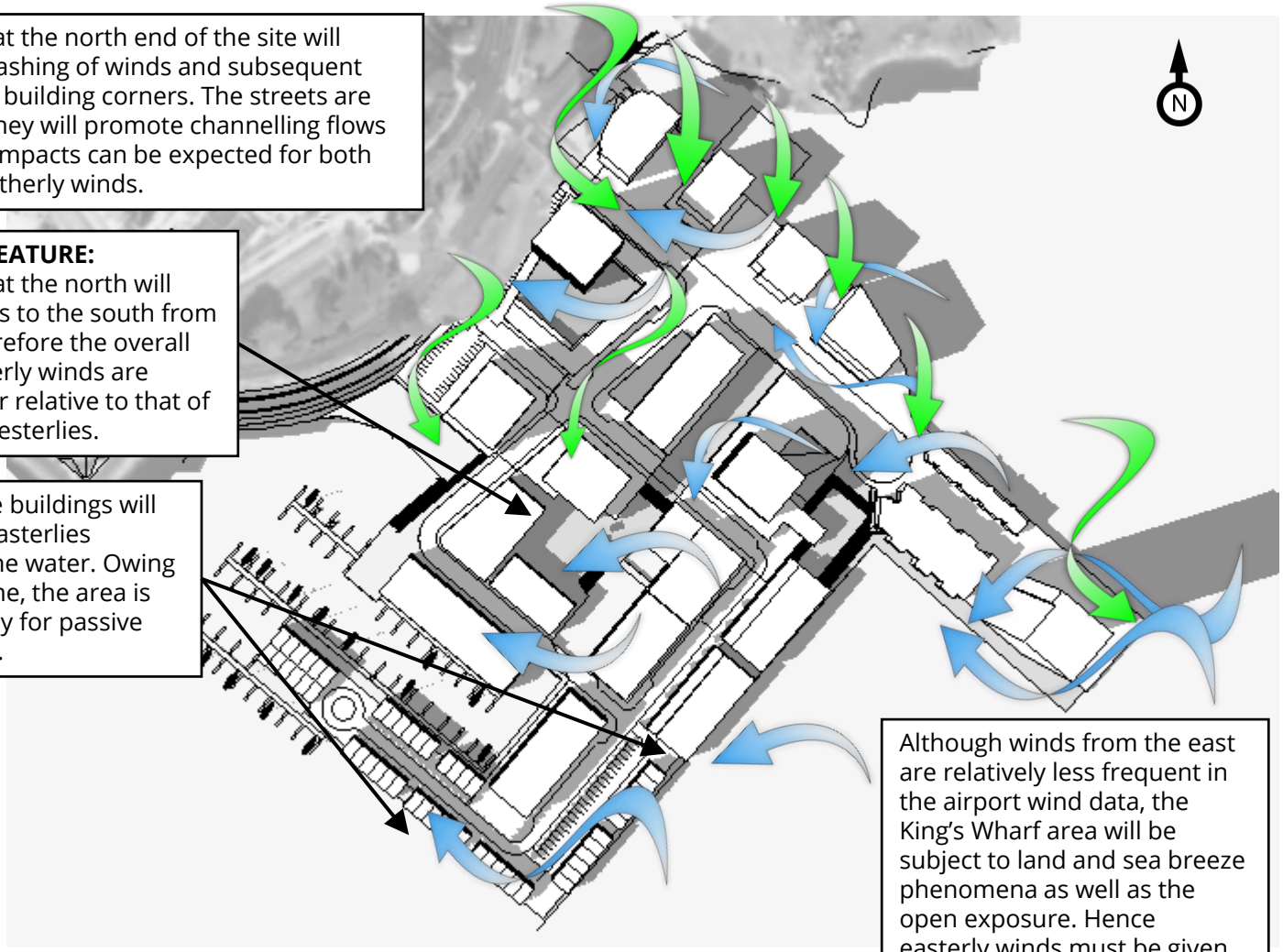
The taller buildings at the north end of the site will result in the downwashing of winds and subsequent acceleration around building corners. The streets are oriented such that they will promote channelling flows along them.

PREDICTED WIND FLOW PATTERNS NORTHERLIES & EASTERLIES

The taller buildings at the north end of the site will result in the downwashing of winds and subsequent acceleration around building corners. The streets are oriented such that they will promote channelling flows along them. These impacts can be expected for both the easterly and northerly winds.

POSITIVE DESIGN FEATURE:
The taller buildings at the north will also shelter buildings to the south from the northerlies. Therefore the overall impact of the northerly winds are expected to be lower relative to that of the easterlies and westerlies.

At the south end the buildings will be exposed to the easterlies approaching from the water. Owing to the exposure alone, the area is expected to be windy for passive pedestrian activities.



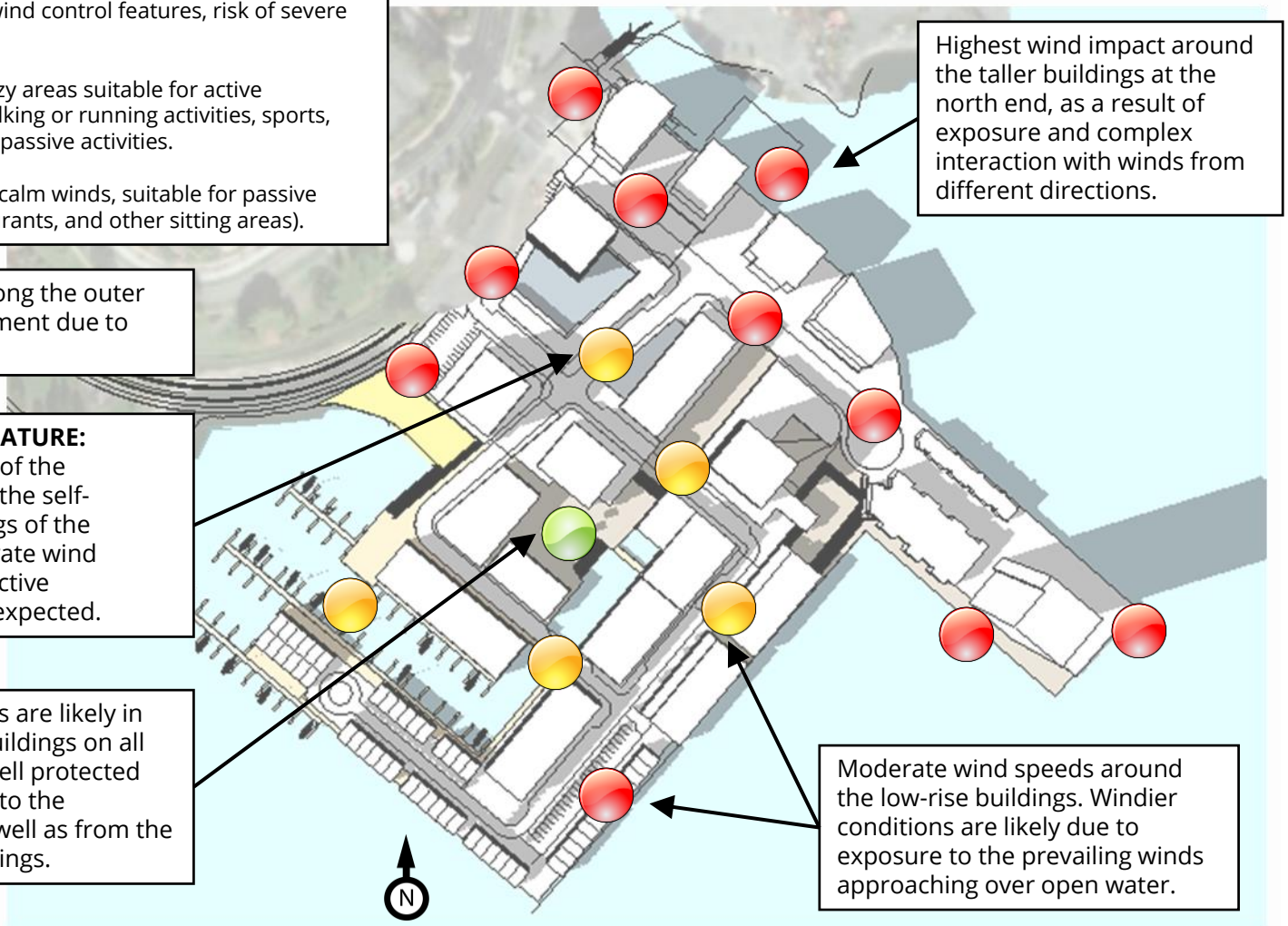
Although winds from the east are relatively less frequent in the airport wind data, the King's Wharf area will be subject to land and sea breeze phenomena as well as the open exposure. Hence easterly winds must be given due consideration.

PREDICTED WIND CONDITIONS

Uncomfortable: Potentially too windy for pedestrian usage without wind control features, risk of severe winds.

Moderate: Breezy areas suitable for active pedestrians (walking or running activities, sports, etc.) but not for passive activities.

Low: Relatively calm winds, suitable for passive activities (restaurants, and other sitting areas).



Highest wind impact around the taller buildings at the north end, as a result of exposure and complex interaction with winds from different directions.

High wind speeds along the outer edge of the development due to exposure.

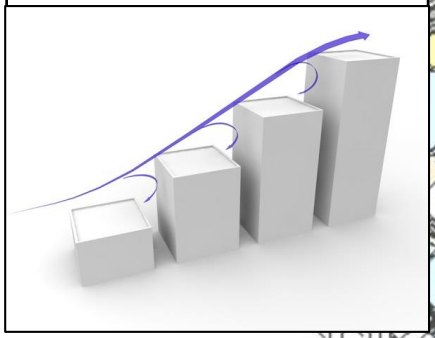
POSITIVE DESIGN FEATURE: Towards the interior of the development, owing the self-sheltering by buildings of the development, moderate wind speeds suitable for active pedestrians may be expected.

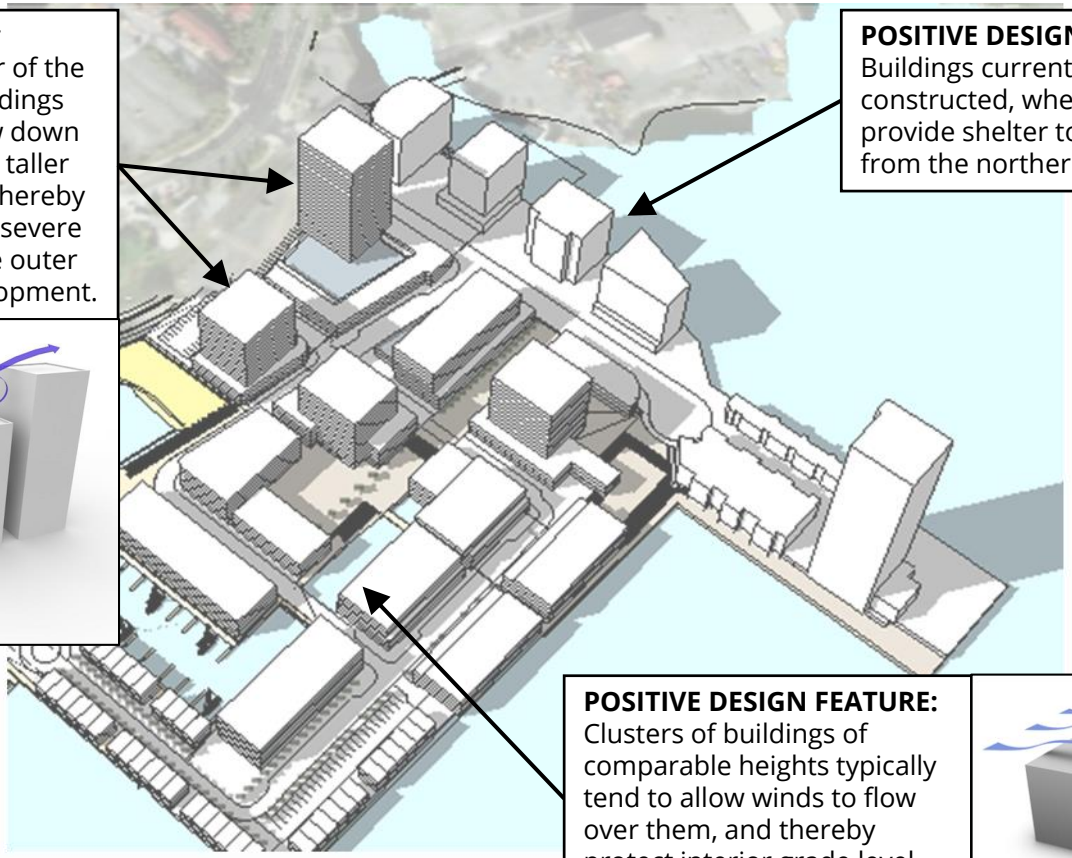
Very low wind speeds are likely in areas enclosed by buildings on all sides, and thereby well protected from both exposure to the prevailing winds, as well as from the impact of taller buildings.

Moderate wind speeds around the low-rise buildings. Windier conditions are likely due to exposure to the prevailing winds approaching over open water.

DESIGN STRATEGIES FOR WIND CONTROL
OVERALL LAYOUT

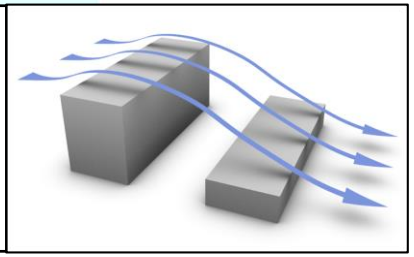
Consider locating taller buildings in the interior of the development. Low buildings surrounding it will slow down winds approaching the taller interior buildings and thereby lower the potential for severe wind impacts along the outer perimeter of the development.





POSITIVE DESIGN FEATURE:
Buildings currently completed or being constructed, when complete, will provide shelter to areas to their south from the northerlies.

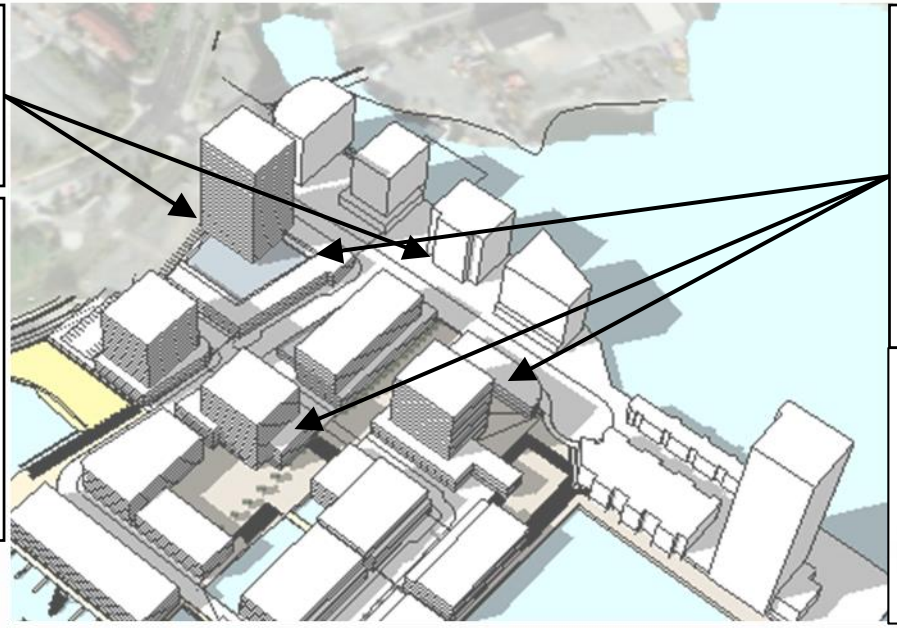
POSITIVE DESIGN FEATURE:
Clusters of buildings of comparable heights typically tend to allow winds to flow over them, and thereby protect interior grade level areas between them.



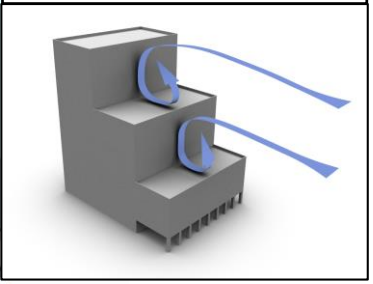
DESIGN STRATEGIES FOR WIND CONTROL
BUILDING MASSING

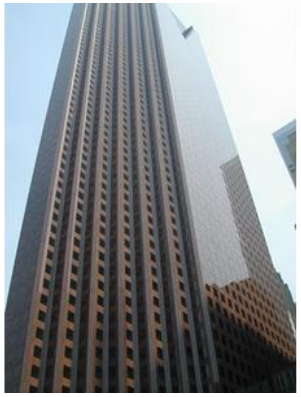
Tall towers with sharp corners create higher wind accelerations than buildings with modified corners (re-entrant, chamfered, etc.)

Consider reshaping towers to allow wind flow around it to be either more streamlined (chamfered or rounded corners), or diffused at the corners (stepped or re-entrant corners). Low buildings may also be designed with a stepped form to achieve a similar wind speed reduction.

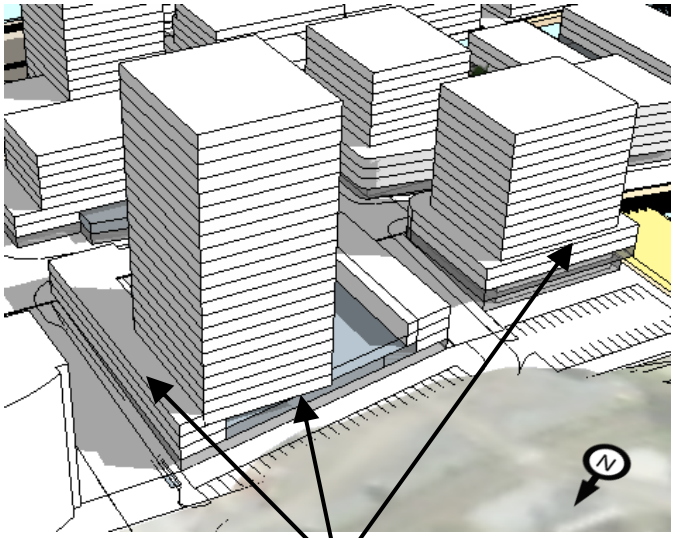


POSITIVE DESIGN FEATURE:
Low podiums and large tower setbacks on the facades facing prevailing winds are positive for wind control. They capture downwashing flows and reduce wind impact at grade level.

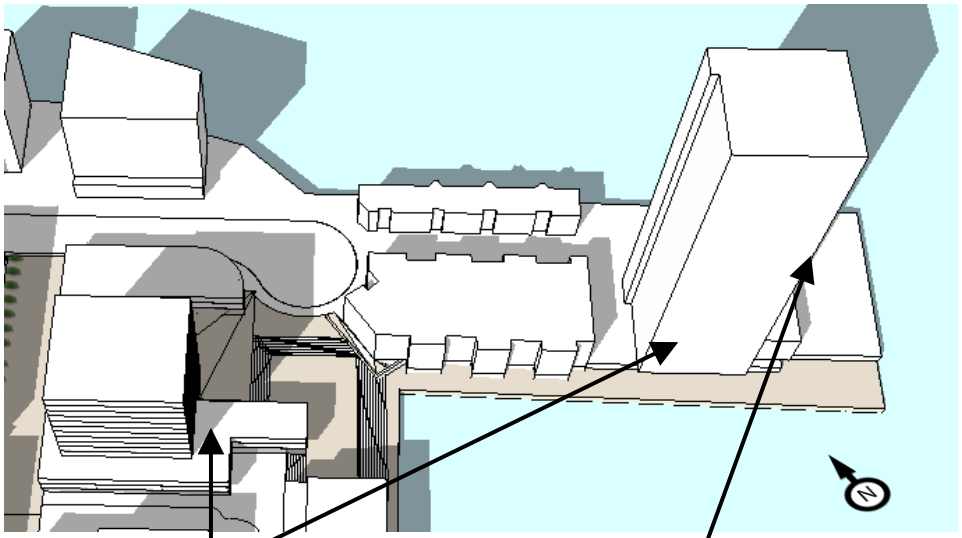




DESIGN STRATEGIES FOR WIND CONTROL
BUILDING MASSING



Consider repositioning towers on their podiums such that there are large setbacks on the sides of the tower exposed to the prevailing winds - southwest, west, northwest and north in particular.



POSITIVE DESIGN FEATURE: Wide podiums and tower setbacks are more important when the tower is exposed to the approaching winds.

Consider reshaping to allow wind flow around the tower to be either more streamlined (chamfered or rounded corners), or diffused at the corners (stepped or re-entrant corners).

DESIGN STRATEGIES FOR WIND CONTROL LOCALIZED FEATURES

Large scale building modifications help reduce the overall interaction of buildings in a development with winds. Smaller features such as landscaping, wind screens, canopies, and other localized architectural features may be considered at a later design stage for area-specific wind speed reductions.

Wind screens may be placed on both sides of entrances, on sidewalks and in parks and other open spaces to create localized low wind areas. It is recommended that wind screens be at least 2 m tall and approximately 30% open/porous for high wind control efficacy.

Street Trees aid in reducing wind speeds in areas immediately around them. They are most effective in their fully leafed out phase. In order for effective wind control in the winter, coniferous, wind-tolerant trees must be considered.

Recessed Walls create areas that will be protected from ambient wind activity. If entrances are located in such recessed areas, it also creates a waiting area for patrons using the entrance, as well as a transition zone for patrons exiting to get acclimatized to the ambient conditions.

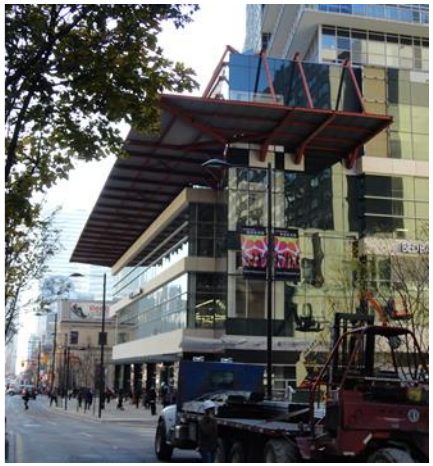
DESIGN STRATEGIES FOR WIND CONTROL LOCALIZED FEATURES - EXAMPLES

Examples of Wind Gates

Building Façade Set Back Using Colonnade

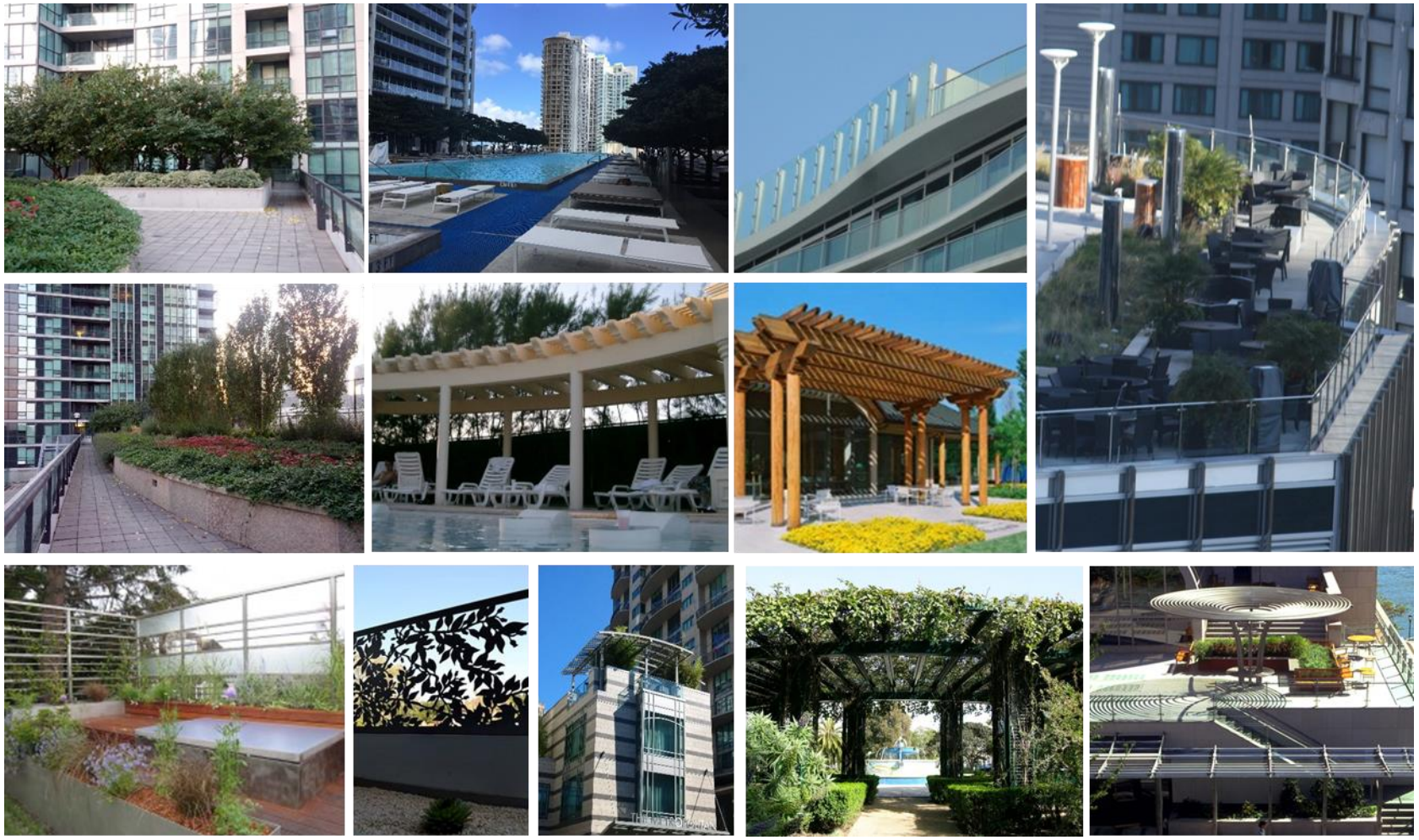
Walkway Covered using Vegetated Trellis

Building Facade Set Back Using a Step at Level 3



Examples of Large Canopies/Arcades

DESIGN STRATEGIES FOR WIND CONTROL
LOCALIZED FEATURES – TERRACES – EXAMPLES



CONCLUDING REMARKS

RWDI was retained to provide pedestrian level wind consultation for the proposed development at King's Wharf in Dartmouth, NS. The objective was to provide design guidance so as to reduce potential wind impacts at outdoor pedestrian areas on and around the proposed development.

This report provides general illustrations and comments on the proposed design of the development, guidelines to make the buildings more wind-responsive and strategies to reduce potential wind impacts.

RWDI can provide advice over a conference call by going over the discussion presented in this report and answering any questions in order to help achieve a better design in terms of pedestrian level wind conditions.

It is advised that wind tunnel tests be conducted at a later design stage in order to quantify wind effects and refine wind control measures where necessary.