March 1, 2016

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Mr. Moore:

Re: Qualitative Pedestrian Wind Assessment
900 Albert Street, Ottawa, Ontario
GWE File: 16-018 DTPLW

1. INTRODUCTION

Gradient Wind Engineering Inc. (GWE) was retained by Trinity Development Group to undertake a qualitative pedestrian wind study for a proposed mixed-use multi-building development located at 900 Albert Street, Ottawa, Ontario. The current study is based on architectural drawings provided by B+H Architects in February 2016, a review of existing site massing, statistical knowledge of the Ottawa wind climate, and experience with similar past projects in Ottawa.

Qualitative assessments, as compared to detailed wind tunnel or computational studies, serve to determine the general suitability of anticipated wind conditions over sensitive pedestrian areas early in the design process, and to introduce initial recommendations for mitigation as required.

2. TERMS OF REFERENCE

The focus of this qualitative pedestrian level wind assessment is a proposed mixed-use multi-tower development located at 900 Albert Street, in Ottawa, adjacent to the Bayview Station of the O-Train Light Rail Transit (LRT) system. The development is divided into two phases, Phases 1A and 1B. Phase 1A is located on a triangular parcel of land bounded by the O-Train corridor on the west, Albert Street on the north and an adjacent property to the south. Phase 1A would contain three 55-storey towers rising above grade including a continuous six-storey podium. The placement of the three towers would have one tower at the northwest corner of the site overlooking Albert Street and two towers overlooking the south boundary of the site. The east end of the podium is reserved for a restaurant at the second level, which steps back to accommodate a rooftop outdoor patio. Phase 1B could see expansion of the development to a west parcel, including construction over the O-Train corridor. In this phase, the proposed massing would include extension of the six-storey podium, a 15-storey office building above the train corridor, and an additional 55-storey residential tower on the west end of the podium. At this stage of development, the massing of the towers includes simple square plan forms which could be modified and refined, as required, to help mitigate any wind issues that arise.

Whereas the towers are slated for residential use, the low-rise portions would be used for retail and commercial, above grade parking and office uses in Phase 1B.

The site surroundings comprise low-rise commercial, light industrial and office in proximity, followed by single family residences for all directions from northeast clockwise to west. Open field, arterial roadways and the Ottawa River define the exposures for the remaining wind directions. The abutting property on the south side contains a low-rise linear building connected to an eight-storey office building at its north end. Phase 1A development provides a pedestrian link on the south side of the site between Albert Street and the existing path along the O-Train corridor.

Key areas under consideration include perimeter sidewalks, pedestrian pathways, interior walkways, building access points and grade level patios or terraces. Although podium roof terraces will likely be included in the final massing, none are discussed at this early assessment as these details may change during design development.

3. METHODOLOGY

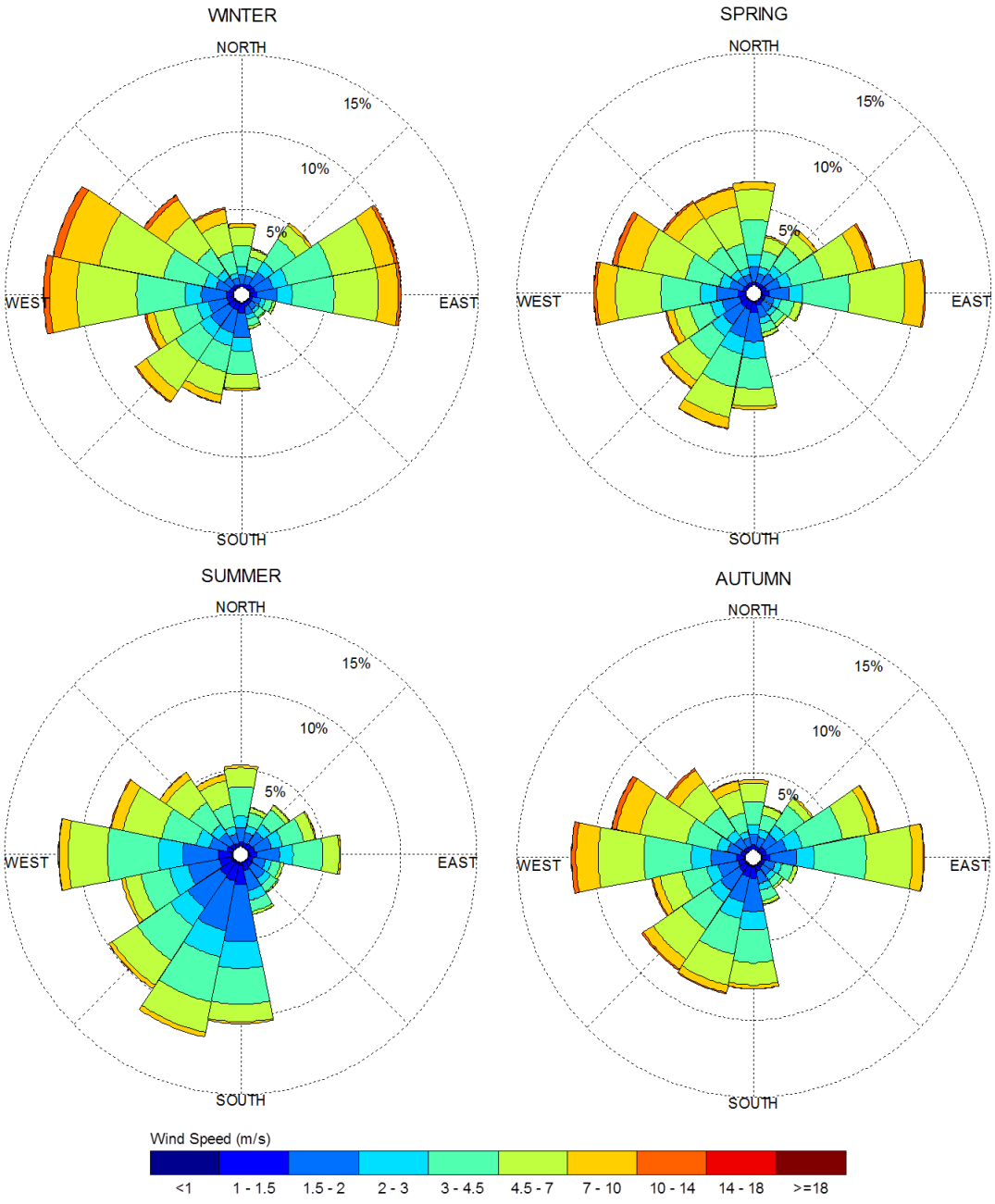
The following section describes the analysis process, including a background discussion of pedestrian comfort. The essential aspects of a qualitative pedestrian wind analysis include: (i) consideration of the statistical properties of the local wind climate; (ii) consideration of the massing of the site (i.e., the shape, height and orientation of the buildings); and (iii) evaluation of anticipated pedestrian comfort measured against industry standard guidelines based on in-house experience.

3.1 Ottawa Wind Climate

The statistical model of the Ottawa 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 meters per second. 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 a 40-year measurement period. The preferred 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 10 meters per second (m/s).

The directional preference and relative magnitude of wind speed changes somewhat from season to season. Also, by convention in microclimate studies, wind direction refers to the wind origin (e.g., a north wind blows from north to south).

SEASONAL DISTRIBUTION OF WINDS FOR VARIOUS PROBABILITIES
OTTAWA INTERNATIONAL AIRPORT



NOTES:

1. Radial distances indicate percentage of time of wind events.
2. Wind speeds represent mean hourly wind speeds measured at 10 meters above the ground.

3.2 Pedestrian Wind Comfort Guidelines

The pedestrian comfort guidelines used by GWE, which are consistent with the Terms of Reference for the City of Ottawa, are based on the correlation between a variety of pedestrian activity types, and acceptable wind speed ranges for those activities. More specifically:

(i) Wind conditions are considered to be comfortable for ***sitting*** when gust wind speeds less than or equal to 14 kilometers per hour (km/h) occur at least 80% of the time. The corresponding mean wind speed is approximately 10 km/h.

(ii) Wind conditions are considered to be comfortable for ***standing*** when gust wind speeds less than or equal to 20 km/h occur at least 80% of the time. The corresponding mean wind speed is approximately 14 km/h.

(iii) Wind conditions are considered to be comfortable for ***strolling*** when gust wind speeds less than or equal to 25 km/h occur at least 80% of the time. The corresponding mean wind speed is approximately 17 km/h, respectively.

(iv) Wind conditions are considered to be comfortable for ***walking*** when gust wind speeds less than or equal to 30 km/h occur at least 80% of the time. The corresponding mean wind speed is approximately 20 km/h.

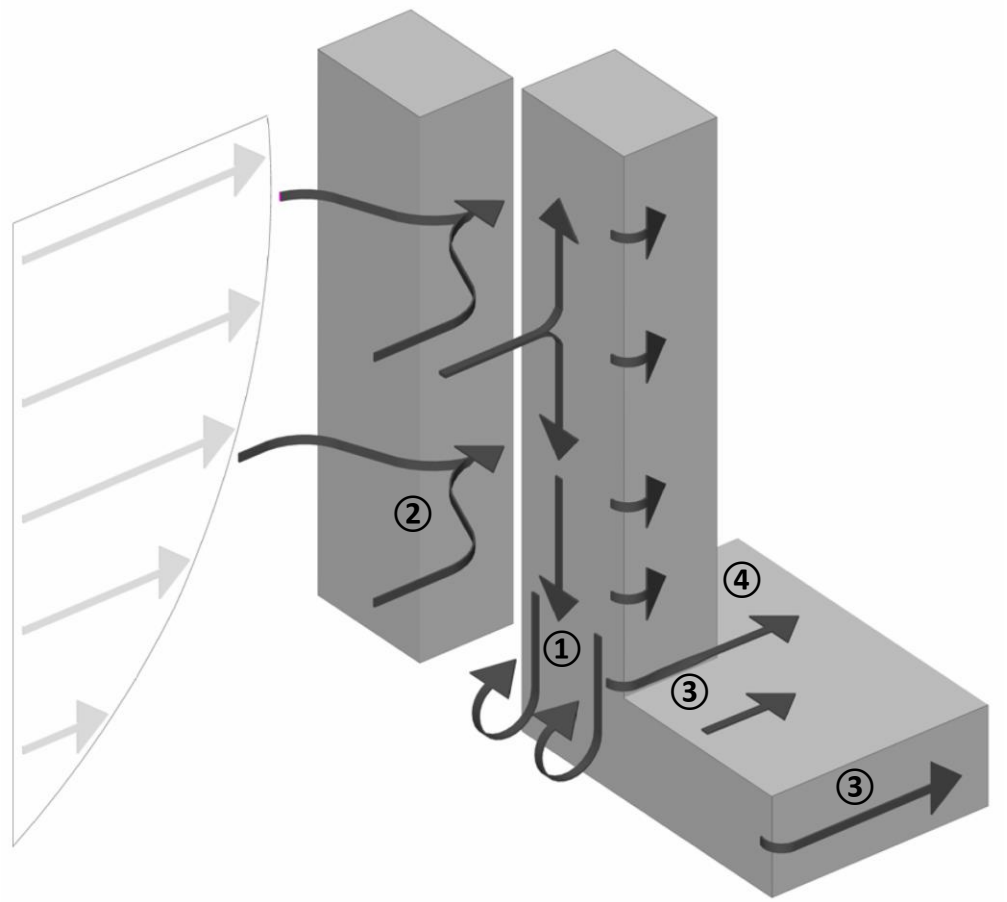
(v) Dangerous wind conditions which affects pedestrian's ability to be stand or walk in a stable manner are defined to exist when a gust wind speed greater than or equal to 90 km/h exists for more than 0.1% of the time (i.e., approximately 9 hours per year).

GWE's guidelines are based on gust wind speeds, since people are most sensitive to wind gusts rather than to constant wind speeds, and are applied according to the intended use of the outdoor area. For example, a building entrance not served by a revolving door should be suitable for standing but need not be suitable for sitting, while a public sidewalk need only be suitable for walking in most circumstances.

3.3 Consideration of Massing and Climate

The physical features of a development site that are most influential to the local wind conditions include the massing of surrounding buildings, the geometry and orientation of the study site, and the alignment of the study buildings relative to prominent wind directions.

Wind flow characteristics which combine to determine how conditions will develop include phenomena known as downwash, channelling coupled with acceleration, and shielding, as illustrated in the image below. Downwash ① relates to the effect of winds against a tall building, whereby much of the impinging flow on the windward side of the building, nominally below two-thirds of the total height, is directed to lower levels. Taller buildings with smooth façades and no podiums produce the strongest downwash effects at grade, while the presence of protruding balconies and a tower setback from the podium edge mitigates downwash effects at the ground level. Channelling ② refers to acceleration of wind through gaps, while acceleration of wind ③ occurs around building corners. Shielding ④ relates to calm zones on the leeward side of buildings, protected from prevailing winds.



4. ANTICIPATED PEDESTRIAN COMFORT

Based on the massing of the study site, surrounding building massing and the orientation relative to the local wind climate, the following statements summarize anticipated wind comfort around the site.

North Elevation Along Albert Street (Figure 1, Tags A): The north sidewalk along Albert Street at the base of the tower (Tags A) will experience frequent northwest winds which create direct impacts and indirect impacts in the form of downwash along the face of the tower resulting in windy conditions at grade. The preferred solution to mitigate these effects, as illustrated in Figure 1, is to introduce a tower setback from the edge of the podium, the depth of which would be confirmed by detailed wind tunnel testing to be conducted for site plan application. With this improvement, pedestrian comfort at the base of the tower will be suitable for walking or better during the winter, and spring, and suitable for standing during the summer and autumn. The main entrance would also be provided with a vestibule and revolving doors to promote easy access and favourable wind comfort.

North Elevation Access To Underground Retail & Parking (Figure 1, Tags B & C): The sidewalks on both sides of the vehicle access to retail and parking from Albert Street are exposed to direct northerly winds but no other focusing wind effects. Set backs of higher podium floors on the north elevation will also help to create acceptable wind comfort at grade. As a result, the sidewalk areas along the north elevation are expected to experience wind comfort suitable for standing during the three warmer seasons, and suitable for walking during the winter, conditions which are acceptable for the intended uses. With little wind flow into the covered drop-off lane, the covered sidewalks beneath the podium will experience calm conditions.

The sidewalk east of Albert Street (Figure 1, Tags C) will experience similar conditions to the corner areas which will provide acceptable wind comfort for the intended uses.

East End Plaza Area (Figure 1, Tag D): The open plaza at the east end of the site is expected to experience moderately windy conditions due to its exposure to a range of wind directions from northwest to south. Wind conditions are expected to be suitable for standing during the summer and autumn, and suitable for walking during the spring and winter. Hence, if sedentary uses are intended for this area, mitigation will need to be considered in the form of greater landscaping, or architectural

wind screening. This area forms part of the pedestrian path that links Albert Street through the property to the O-Train pathway and the existing community on the south side.

South Elevation Base of Towers & Nearby Areas (Figure 1, Tags E & F): The base of both towers, represented with Tags E, will be exposed to west and southwest winds sweeping across the area, combined with indirect effects of downwash along the face of the towers creating windy conditions at grade. As a result, wind comfort around the base of the two towers will be suitable only for walking and occasionally more vigorous activity. However, since these areas are not intended for regular pedestrian use, windy conditions would be acceptable without the need for mitigation.

Wind conditions away from the tower bases, along the pedestrian path identify in Figure 1, Tags F, will experience calmer conditions as the downwash effect dissipates. The east side of this south elevation provided with seating will experience relatively calm winds suitable for sitting during the summer and autumn and suitable for standing during the spring and winter. These conditions will be confirmed by detailed wind tunnel tests and mitigation recommended, if required, as part of site plan application.

Large Plaza Overlooking O-Train Corridor (Figure 1: Tags G): For Phase 1A, the west elevation of the site would be exposed to westerly winds encountering the six-storey podium without significant influence of the nearby towers. Pedestrian comfort at grade over much of this plaza is expected to be suitable for sitting during the summer and standing during the remaining seasons without the need for mitigation. Installation of landscaping will improve conditions when plants are with foliage.

East End 2nd Level Patio (Figure 1: Tag H): For Phase 1A, the east end of the podium is cut back at the 2nd level to accommodate a rooftop patio. The location of the patio exposes it to a wide range of common wind directions from the northwest clockwise to the southeast, with little shielding from surrounding buildings. As such, direct wind from a multitude of directions is likely to create frequent moderate winds, which would not suit the sitting and dining experience required for a restaurant patio. In order to provide appropriate conditions suitable for sitting and eating, it will likely be necessary to erect transparent wind barriers of at least 1.6 m above the walking surface.

Phase 1B Expansion, South Elevation (Figure 2, Tags G, & H): In this phase of development, pedestrian pathways adjacent to the building outside the influence of the towers will experience wind comfort comparable to the east side of the same elevation at locations marked F in Figure 1. As such, conditions over this area will be suitable for sitting during the summer and standing for the remainder of the year, which is acceptable for the intended use.

Phase 1B Expansion, West Elevation (Figure 2, Tags I): The base of the west tower (Tags I) will experience windy conditions due primarily to the effect of downwash along the face of the tower created by prominent west winds. Unlike the south towers in Phase 1A, the area around the base of the Phase 1B tower provides pedestrian access to the building, which therefore must be mitigated to create conditions suitable for walking or better. Adequate mitigation can be achieved by various means which include shaping and orienting the west building façade, among others. Actual wind conditions over the site of Phase 1B expansion will be confirmed, along with appropriate mitigation if required, by detailed wind tunnel testing prior to site plan application.

Wind conditions along the north half of the west elevation for Phase 1B (Tags J) will be relatively calm and suitable for walking, or better, year round without the need for mitigation.

Phase 1B Expansion, North Elevation (Figure 2, Tags K): The north elevation of Phase 1B is removed from the immediate influence of the north tower and the associated effect of downwash. As such, conditions are expected to be suitable for standing during the three warmer seasons and for walking during the winter, which are acceptable for sidewalk areas.

Existing vs Future Wind Conditions: The proposed development is not expected to adversely influence existing neighbouring buildings. For the Phase 1A development, the project massing will not significantly affect the wind environment over the O-Train corridor or platform, due to the large separation of the podium by the plaza. Site massing also provides sufficient separation to the building on the south to avoid significant influence. For Phase 1B, the impacts on the O-Train corridor and platform may be more significant, but are not expected to create uncomfortable conditions overall. Hence, in general terms, pedestrian comfort over areas outside the immediate influence of the study site is expected to remain similar to existing conditions.

Additionally, within the context of typical weather patterns, excluding anomalous local storm events, such as thunderstorms, tornadoes and downbursts, no dangerous or consistently strong wind conditions are expected anywhere over the subject site on an annual basis. No areas over the study site are likely to experience conditions that would be considered unsafe, or troublesome for elderly persons.

5. SUMMARY AND RECOMMENDATIONS

Based on the qualitative analysis of concept plans, site massing, and wind statistics for Ottawa, grade level wind conditions over the proposed development at 900 Albert Street, are generally expected to be suitable for the intended uses with few exceptions, described as follows:

(i) The base of the two south towers in Phase 1A are expected to be windy due to wind washing down the face of the towers to grade levels. However, given that the areas will not be used regularly by pedestrians, no mitigation will be necessary;

(ii) The pedestrian pathway along the south side of the property, connecting Albert Street to the existing pathway along the O-Train corridor, will experience moderately calm conditions suitable for standing or sitting in places. These conditions will be confirmed by detailed wind tunnel testing and mitigation provided in the form of additional landscaping if required;

(iii) The base of the west tower in Phase 1B is expected to experience windy conditions. Pedestrian comfort will be confirmed by detailed wind tunnel testing and mitigation provided if necessary. The form of mitigation may include shaping the west façade and refining the tower massing, among other possible measures.

(iv) The restaurant roof top patio at the east end of the podium in Phase 1A will also require mitigation in the form of perimeter wind screens.

(v) Wind conditions will be confirmed over the site by detailed wind tunnel testing and mitigation options provided, where required, as part of site plan application.

Neither the Phase 1A nor the 1B development are expected to have measureable wind impacts on the O-Train operation. However, as for other areas of the site, detailed conditions will be determined and remedied if required during SPA submission.

The foregoing analysis and statements are based on experience and knowledge of wind flow patterns in urban settings. Hence, this assessment is intended to assure adequate pedestrian safety relating to wind, while providing general guidance relating to pedestrian comfort around the subject site.

This concludes our pedestrian level wind assessment and report.

Sincerely,

Gradient Wind Engineering Inc.

LICENCED PROFESSIONAL ENGINEER
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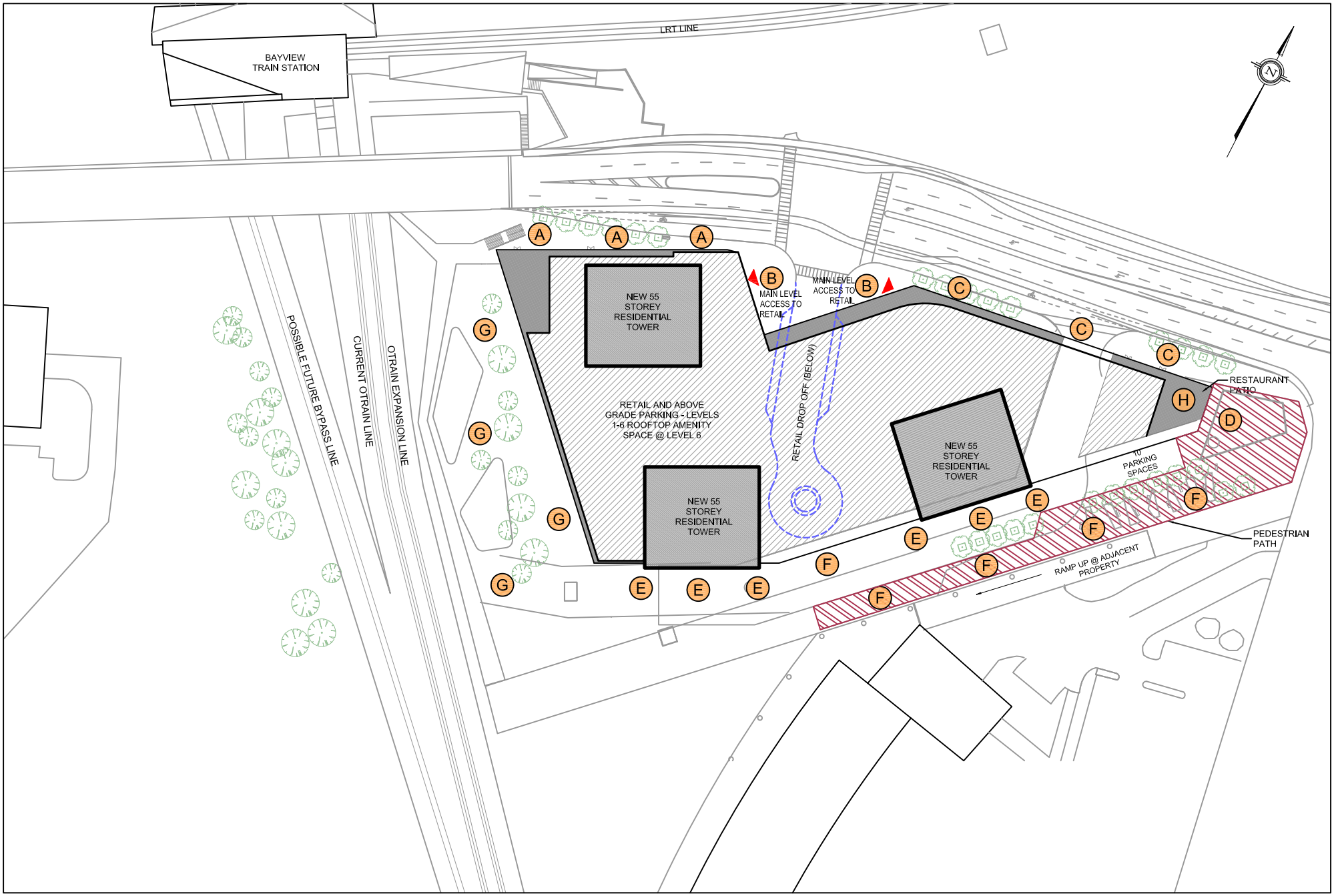
GWE16-018 DTPLW



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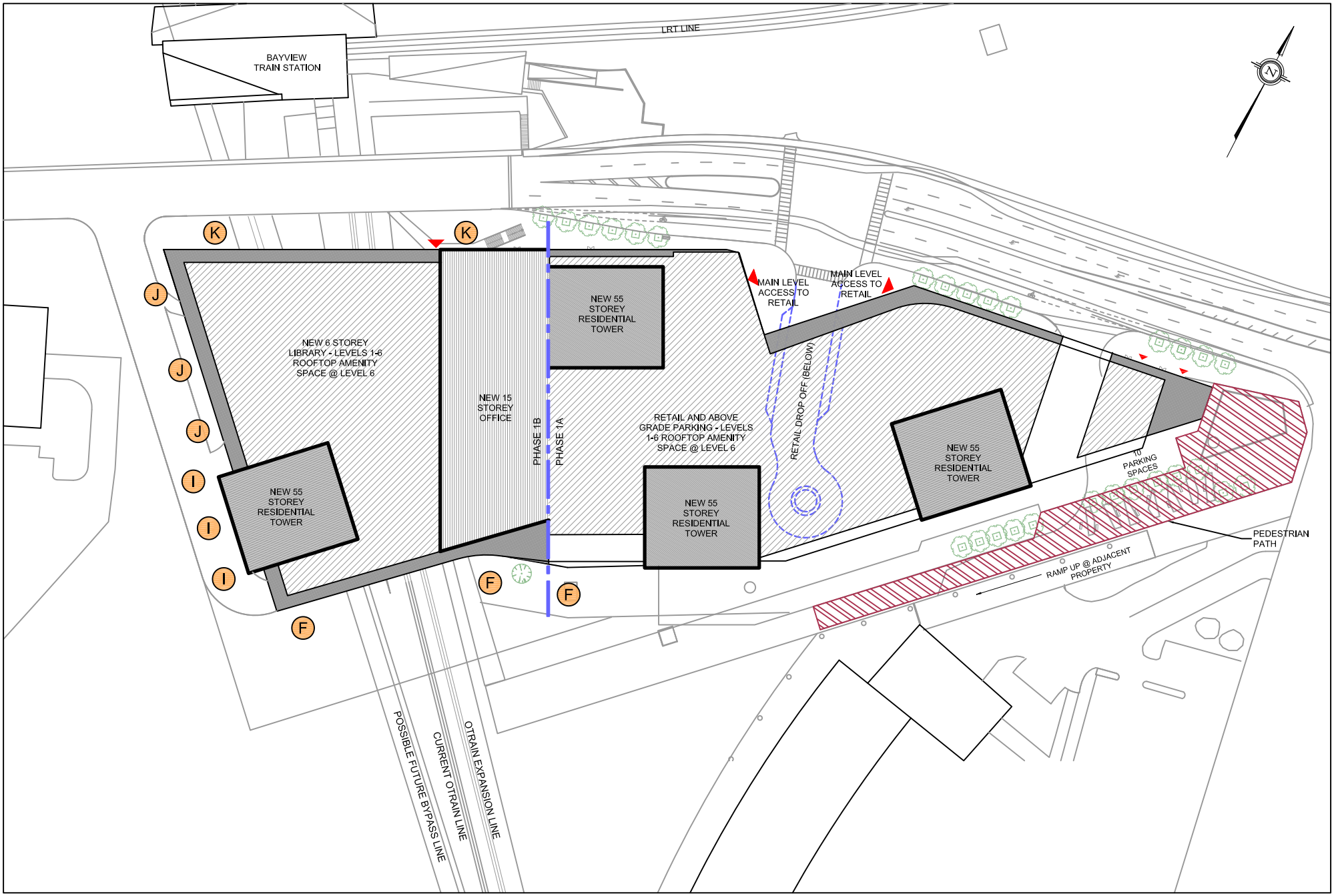
GRADIENT WIND
ENGINEERING INC

PROJECT	900 ALBERT STREET, OTTAWA QUALITATIVE PEDESTRIAN LEVEL WIND ASSESSMENT
SCALE	1:1400 (APPROX.)
DRAWING NO.	GWE16-018-DTPLW-1
DATE	MARCH 1, 2016
DRAWN BY	K.A.

DESCRIPTION

FIGURE 1: PHASE 1A
SITE PLAN WITH REFERENCE MARKERS



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SCALE	1:1400 (APPROX.)
DRAWING NO.	GWE16-018-DTPLW-2
DATE	MARCH 1, 2016
DRAWN BY	K.A.

DESCRIPTION

FIGURE 2: PHASE 1B
SITE PLAN WITH REFERENCE MARKERS