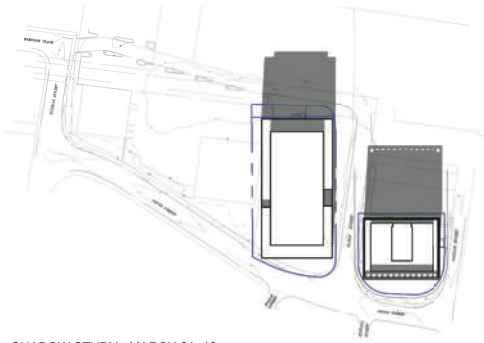
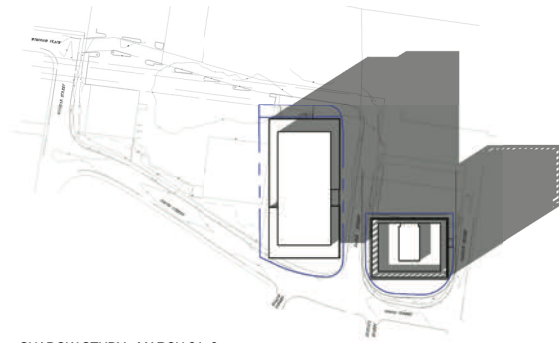


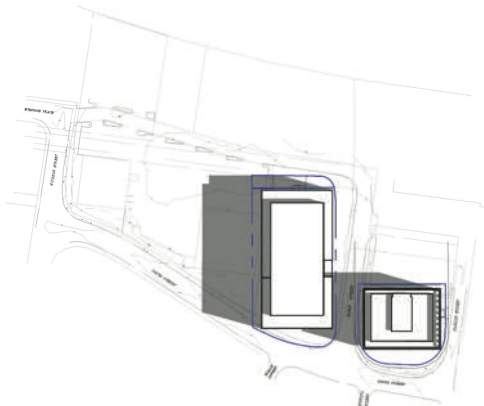
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1" = 160'-0"



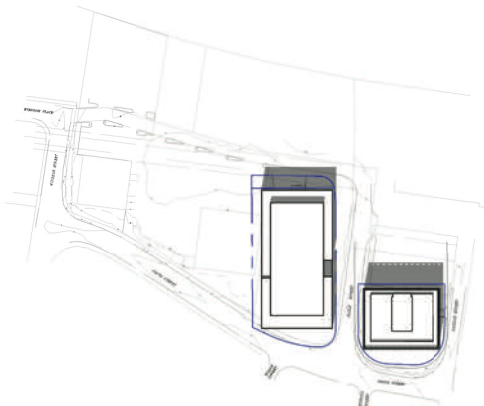
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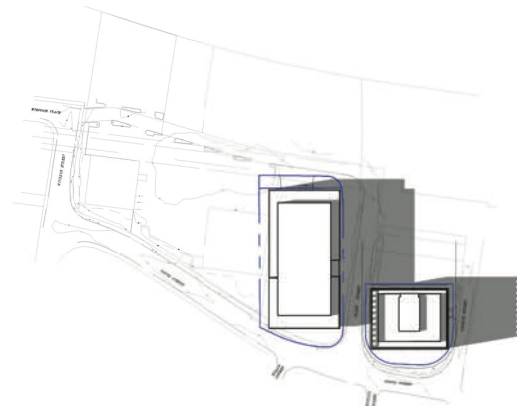
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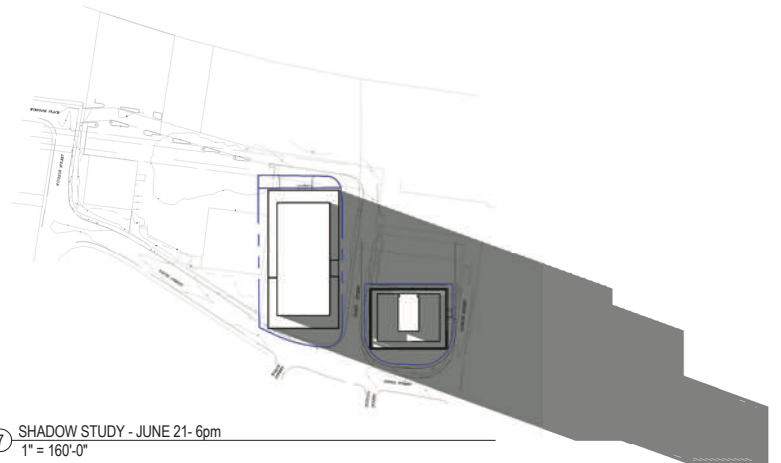
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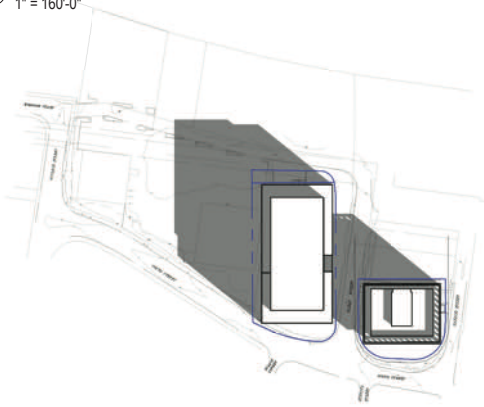
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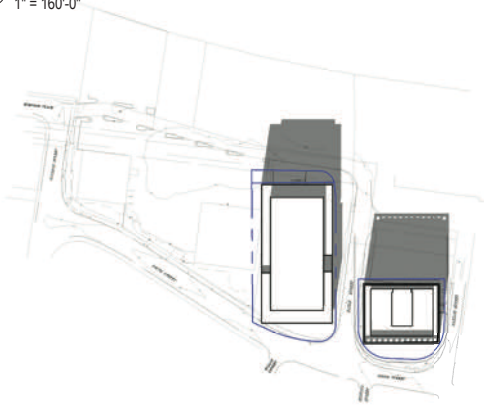
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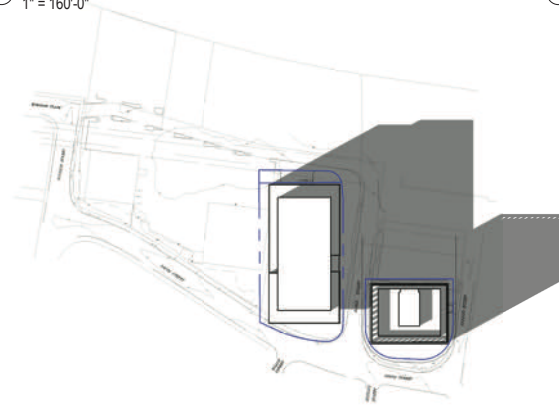
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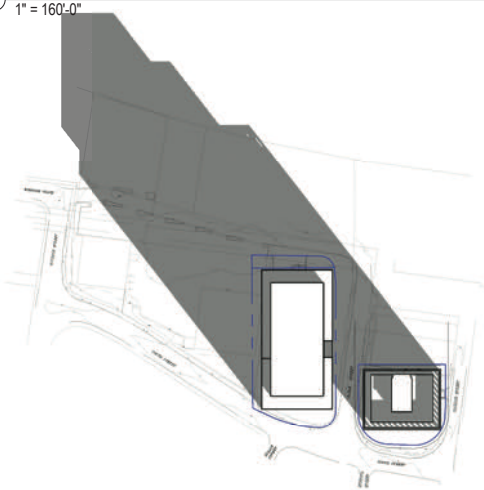
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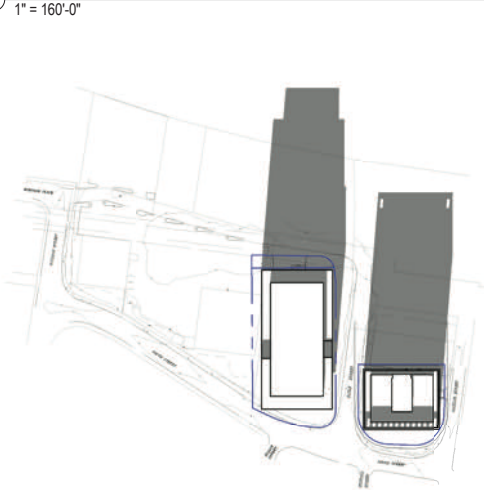
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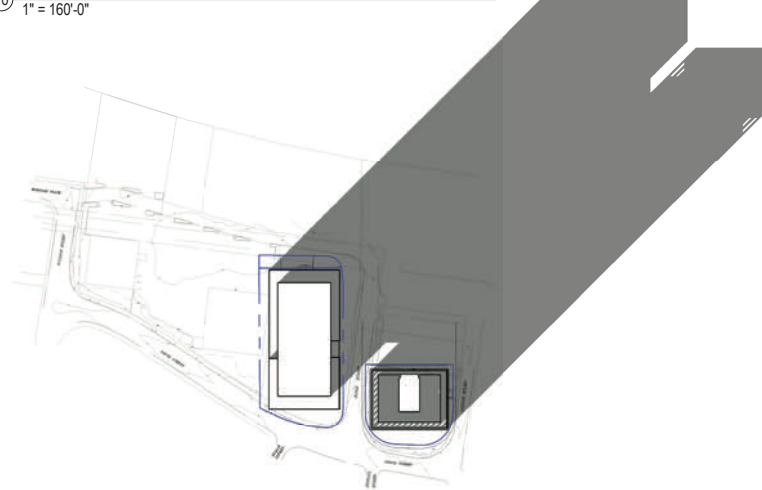
⑩ SHADOW STUDY - SEPT 21- 3pm
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⑪ SHADOW STUDY - DEC 21- 9am
1" = 160'-0"



⑫ SHADOW STUDY - DEC 21- 12pm
1" = 160'-0"



⑬ SHADOW STUDY - DEC 21- 3pm
1" = 160'-0"

***PEDESTRIAN WIND STUDY FOR BOYNTON
YARDS***

SOMERVILLE, MASSACHUSETTS

February 2018

**PEDESTRIAN WIND STUDY
FOR BOYNTON YARDS
SOMERVILLE, MASSACHUSETTS**

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1.0 SUMMARY

Tech Environmental (Tech) was retained by DLJ Real Estate Capital Partners, LLC (DLJ) to perform a pedestrian wind study for the proposed Boynton Yards project. The project consists of two buildings located on Harding Street (Building 1), and west of Earle Street (Building 2), in Somerville, Massachusetts. The project area is surrounded by multi-family residences to the south, a Target store and moving company to the north, a few residences and small businesses to the east, and parking lots and office buildings to the west.

This study included determining potential changes in wind speeds at pedestrian height caused by the size, location and orientation of the proposed buildings. If desired, a subsequent phase can be considered that would be more focused on specific uses once designs are more developed and the anticipated pedestrian activities nearby have been determined. For this study, the acceptable level for pedestrian winds is an Effective Gust Velocity of 31 miles per hour (mph), not to be exceeded more than 1% of the time.

The study employs a state-of-the-art computational fluid dynamics model (CFD), customized to the project site, to examine both increases and decreases in wind caused by the wind channeling over and around these proposed buildings and other buildings nearby. Two scenarios were examined, the “No Build case” and the “Build case”. The No Build case assumes that the project does not move forward and therefore examines the current condition of three open lots, while the Build case inserts the two new buildings into the wind field. In addition to the formal comparison of No Build and Build, we also look at a comparison of “normal” wind conditions and the Build for perspective.

The study results show there will be areas, in the proximity to the corners of the new buildings, where wind speeds will increase. This phenomenon is greatest in one particular direction, when the wind is from the west (W).

As the design progresses, the project team may want to revisit this modeling as landscaping plans are developed for the future building lot, or if any changes are made to the design, or if areas designed for sitting are identified, especially anywhere near the peak wind speed locations.

The comfort criteria used in this study mimic the gust analysis at the higher speeds. The “normal” wind direction that most often occurred on an annual basis was wind from the west-northwest. This occurred over 80% of the time during the fall, winter and spring seasons. In the summer, the predominant wind direction is from the south-southwest. For the No Build case, because of the shielding from the Target box store, almost all wind conditions are ≤ 12 mph. The 12 mph cutoff is based on a threshold where it is comfortable for sitting. The “normal” conditions (i.e. the normal wind without any buildings present) would have about 60% calm conditions. The Build case will actually have more calm conditions, around 65% because the new buildings will provide further shielding in many wind directions.

The wind speeds where it is comfortable for sitting, walking or standing remain about the same between the “normal” wind condition and the Build scenario. There is an increase in the percentage of time where it is uncomfortable when the Build is compared to the normal conditions. The

percentages increases from about 6% for the normal baseline condition to about 9% for the Build scenario. This increase is not uncommon in an urban area and is not considered problematic.

Lastly, there are many areas that will be conducive to sitting in all wind directions. The exact locations can be identified in more detail, if the project proponents desire outdoor activities such as plazas or outdoor cafes.

The results indicate that there will be minimal changes to other commercial and residential areas outside of the project footprint.

2.0 INTRODUCTION

A pedestrian level wind study was performed for the proposed Boynton Yards project in Somerville, Massachusetts. The goal of the study is to perform a wind analysis to assess the potential pedestrian level winds for the adjacent areas to ensure that the size, location and orientation of the proposed buildings will not create dangerous or uncomfortable wind conditions for pedestrians, and to examine potential winds that may alter pedestrian comfort during walking, standing, or sitting.

This study includes the creation of a computational fluid dynamics (CFD) model, customized to the project site, to assess pedestrian wind speeds in the project area for both the before-construction-scenario “No Build case” and the after-construction-scenario “Build case”. Currently, there are two lots that encompass the project site.

This study estimates changes in the wind conditions, using historical meteorological data, to evaluate the potential for dangerous wind gusts. It is important to note that the statistical procedure for predicting wind gusts does not account for extreme weather events, such as major nor’easters or tropical storms, in which dangerous wind gusts may occur regardless of terrain or any building construction. For this study, the acceptable level for pedestrian winds is an Effective Gust Velocity of 31 mph not to be exceeded more than 1% of the time.

In addition to examining wind gusts, this study considers the wind speed with respect to ranges associated with wind-related comfort criteria. Although wind-related comfort is highly subjective and factors such as age, individual health, clothing type, and other individual factors can greatly affect perceived comfort, it is useful for determining locations that are most suitable for leisure activities, and to determine whether existing pedestrian activities could be adversely impacted from an increase in pedestrian level winds.

The next section, Section 3.0 presents the methodology used to perform this study, Section 4.0 presents the criteria used to determine the level at which a wind gust is “dangerous”, uncomfortable, or comfortable; Section 5.0 presents the study results.

3.0 METHODOLOGY

Wind is the perceptible natural movement of the air. Wind is typically described using wind speed and wind direction. Wind speed is often discussed in miles per hour (mph) and wind direction describes the pathway of air blowing from a particular direction. While there are times of still wind conditions, with the spin of the earth and the heating and cooling of land and water masses, there is naturally some movement of air. Wind can be as comforting and refreshing as a summer breeze, annoying if the speed is too high or if it is cold outside, or unsafe if it is too strong. A pedestrian wind study focuses on safety first, and also the comfort of pedestrians.

“Normal” background wind is continually measured at both lower and upper levels in the atmosphere. Wind is typically measured at National Weather Service (NWS) meteorological (met) stations. These met stations are often located at or near airports, since local wind conditions are very important to air traffic control patterns, especially for takeoff and landing directions. The data can be used to explore the potential impact of wind on pedestrians in an area nearby the met stations.

Upper air wind is examined because there is often a macro-trend that determines the overall wind dynamics, while localized conditions can cause micro-trends near the surface to behave somewhat differently. When one explores meteorological conditions with respect to wind, one or both of these trends are important. When exploring wind near the ground level, where pedestrians walk, the lower level data is most important.

Although there may be local phenomenon that slightly alter the met conditions on any given hour or day, the data from a NWS met station is completely applicable on a long-term basis. Any slight hourly or daily variations average out over time, so a site “across town” or in some cases even “across the state” sees very similar wind conditions in the aggregate. Therefore, any wind study should include an analysis of macro wind trends prior to exploring the micro-concerns of a particular project. To demonstrate the results of this wind data analysis, met conditions are typically expressed in a “wind rose”. A wind rose shows the wind direction and speed over a period of time. The period of time is typically at least a season, but could also be a year, or five years, or even 30 years. For wind studies, we typically look at a minimum of 5 years, and preferably longer to cover long-term weather variations.

Once the “normal” wind data is known, then the changes that occur when wind reaches an obstacle, such as a building, and is channeled in another direction, can be explored. In urban areas where many buildings are clustered together, wind is channeled in many different directions. Wind flow follows the path of least resistance. The challenge is to determine the path of least resistance. As air flows by any object a pressure gradient is formed. The pressure gradient creates localized areas of high pressure and low pressure, the wind is then “channeled” through areas of low pressure and “bent” around areas of high pressure. At any single location, this is all simple physics. In a situation such as an urban environment, these simple physics calculations are combined together as a chain. The problem is that for every low/high pressure change, air is moved in multiple directions. Then those different pathways meet the next obstacle and they split again, or recombine with another pathway. When the wind pattern changes over and over again, the number of calculations required to determine the overall wind speed through a set of buildings increases exponentially. Fortunately,

today's supercomputers can complete about 34,000,000,000,000,000 calculations a second! What used to take weeks or months (if one even could get it to run because of the sheer size of the calculations) is now done in hours. This improved computational capacity now allows for algorithms and calculations to expand exponentially and properly predict increases and decreases in wind speed as wind travels around buildings and through neighborhoods.

Now that wind movement can be calculated three-dimensionally via a state-of-the-art computational fluid dynamics (CFD) model, the possible locations for results can be increased dramatically. Thus, where previous physical models examined 100 locations, a CFD model can calculate the wind field at millions of locations. Traditionally rectangular or polar grids were "placed" over a site in two-dimensions to determine what the potential impact would be at ground level. With the three dimensional model, the model calculates a "mesh" to create receptor points. The mesh is chosen based upon the degree of accuracy desired. The larger the mesh, the faster the model runs; and the smaller the mesh, the slower it runs. At first glance, it would appear that a more detailed mesh would be better, but the size of the mesh is not directly related to accuracy of the model. However, if the mesh is too broad, one may not fully define hot spots of concern. Typically, a rough mesh can be placed along with a more refined mesh at or near areas of concern to balance the receptor locations.

Since wind dynamics are local, the acceptable level is often based on the absolute magnitude, but also the potential change. In some cases, such as near the ocean or mountains, the wind may already at times gust at levels that are not desirable, say during a nor'easter or a tropical storm, so these studies often look at changes in trends between "normal" unobstructed weather conditions, the No Build scenario, and/or the Build scenario. The No Build wind analysis includes the project area in its current state, and the Build condition wind analysis includes the proposed project buildings, the existing buildings, and any proposed new structures of significance.

The CFD modeling starts with a reference wind speed that can be related to the NWS met data. Using a predetermined reference wind speed to represent wind blowing over the project area, the corresponding project area wind speeds are sorted into the 16 primary wind directions. The 16 wind directions encompass all 360 degrees of wind exposure. By analyzing all 360 degrees of wind angles in 22.5 degree increments, the directional trends can be explored, since wind bends around structures differently depending on the angle it approaches a structure.

Once the model calculations are complete, a ratio of the results to the reference wind speeds is made. The analysis can be done on a monthly, seasonal, annual, or longer term basis. Since a year is a typical timeframe that includes a complete set of seasons, it is often explored for overall safety concerns. In addition, it is often desirable to examine the results on a seasonal basis when one considers comfort. For example, in northern climates, the potential for windy conditions considered too high for sitting is probably not a major concern in the colder months, where people are typically only walking or standing outdoors for short periods of time. Unless noted otherwise, the study explores the results on a seasonal and annual basis.

The criteria used to determine whether changes in wind patterns caused by a new development will have adverse effect on pedestrians is typically broken into two parts: the safety component and the comfort component.

The safety concern is quick and simple. Is it possible that the development will create a location where individuals could be blown over if their footing is not secure, e.g. standing on an icy sidewalk? Previous wind studies in the greater Boston areas have established a conservative criteria for wind gusts. Essentially it is dangerous if the wind speed regularly exceeds 31 mph effective gust velocity. (The Effective Gust Velocity is defined as the hourly mean wind speed plus 1.5 times the root-mean-square about the average). Some gusts can exceed this during both winter and summer storms, as mentioned earlier. Historically, in the Boston area the 31 mph should not be exceeded more than one half to one percent of the time in “normal” conditions. Therefore a threshold of one percent is typically used in pedestrian wind studies.

Like with many air modeling studies, it is more conservative to initially explore a sum of the maximums in any wind direction, regardless of whether the impacts occur at the same location. Then, if necessary, one can drill down into a more special analyses, if warranted. This modeling study explores the maximum potential increase (or the smallest decrease) in wind speed regardless of the location. This is very conservative since typically maximum wind speed directions are also at, or near, minimums at 90 degrees on both sides, and can also be less than the maximum wind speed in the exact opposite (180 degree) direction.

Pedestrian wind comfort criteria is a little more complicated and less absolute when establishing the future impact of wind from a new project at the pedestrian level. The standard of many pedestrian wind criteria across the world are the criteria set forth by Melbourne (1977). Those findings were based on three levels of wind speed, a speed strong enough to knock people off of their feet at a moment’s notice, and a wind speed that was accepted by people in a main public area in both the short-term and the long-term.

Unless otherwise discussed in the results, the following criteria are from Melbourne (1977) and are summarized below:

- Potentially Dangerous > 27 mph
- Uncomfortable for Walking ≤ 27 mph
- Comfortable for Walking ≤ 19 mph
- Comfortable for Standing ≤ 15 mph
- Comfortable for Sitting < 12 mph

And lastly, one of the primary benefits of completing one of these studies early in the design process is to identify potential problem areas that could be mitigated. At the conceptual level, mitigation can be as simple as proposing a change to the angle around buildings, general landscaping recommendations, or steering site designers away from areas of concern for outdoor activities. At the final design level, mitigation can be as localized, for example, recommending discrete wind screens made of specific plantings, changes to retaining walls, etc.

The “acceptable” level is not solely dependent on the speed, but also the use. Use can be simply broken down into the length of exposure and the type of activity. Limited exposure activities typically correspond to a higher tolerance than an activity that may last for an hour or more.

4.0 RESULTS

The pedestrian wind study was performed with state-of-the-art computational fluid dynamics (CFD) software to assess pedestrian wind speeds in the project area for the No Build and Build cases. The No Build wind analysis included the project area in its current state. The Build condition wind analysis included the proposed project buildings, the existing buildings, and any proposed new structures of significance. To our knowledge there are no in-process projects of relevant size within the project area.

The No Build scenario can be considered one of two ways. The first is simply the current conditions at the site with no changes from the proposed project. This scenario is very important in complex city environments where there may be existing elevated levels of concern from adjacent buildings, or buildings currently located on the site, which is not the case for this project. For this project, the lots are open, so there are no existing elevated wind patterns. The large open lot is actually shielded on most sides by Target, the large “box store” to the north and smaller buildings from the east and west. Although there are some tractor trailers located on-site, which could increase wind speed, those are ignored in the No Build assessment since they are mobile units. Therefore, if minimizing the impact on pedestrians were the only concern, then nothing should ever be built on the property. Obviously, that is not the goal. A more realistic baseline in this case is therefore the normal wind conditions for the greater Boston area with no obstructions.

Currently, there are three lots that encompass the site. The first is roughly 22,500 ft² where the proposed office building (Building 1) would be located on the corner of Earle Street and South Street. Directly to the east of this intersection and proposed Building 1, there is a larger dirt lot that is roughly 55,400 ft², where the proposed lab building (Building 2) would be located. The proposed office building will be 104' x 134' in footprint and 149' in height. The proposed lab building will be 125' x 246' in footprint and 159' tall. These buildings are shown in Figure 1. Figure 2, shown the buildings again along with some of the adjacent neighborhood for perspective. The third lot will house part of the new driveway and is reserved for future development. No landscaping or building design for the third lot has been developed at this time.

The study included surrounding buildings within a known radius of the project site. As shown in Figure 3, a rotating base containing the proposed buildings (inner cylinder) and surrounding structures (outer cylinder) was enclosed within a rectangular flow volume.

The meshing that established the receptors for this project can be seen in three levels of detail. The highest receptor resolution is located directly within the project area. This is shown in Figure 4 in the inner cylinder in and around the two proposed buildings. The cylindrical shape for the meshing was selected so that the cylinder could be “rotated” to represent the different wind directions, similar to the way a pedestrian wind analysis is done in a wind tunnel. Please note that the meshing is not uniformly spaced. The program calculates the meshing needs based upon how things change. The meshing is generated with higher resolutions on the areas of concern, therefore if there are more areas of interest the meshing can be refined in that zone. The next level of resolution includes the buildings in the neighborhood directly adjacent to the project site. This meshing structure is also a cylinder and the area uses slightly lower resolution (i.e. slightly larger spacing with a less dense

distribution) in the surrounding area. This second, outer, cylinder is shown in Figure 5. As one can clearly see from this figure, the inner cylinder receptor meshing is denser in comparison to outer cylinder.

The last level of meshing is shown in the overall receptor box, Figure 6. This box is rectangular so that the wind can uniformly enter the outer cylinder. Figure 6 shows the two inner cylinders and the outer receptor box. As one can clearly see from this figure, the interior is very dense when compared to exterior box. This figure best illustrates that there are millions upon millions of receptor locations that are included in the calculations deep inside the cylinders.

In addition to meshing, a surface roughness factor of the 3-dimensional buildings that represents the aerodynamic drag and corresponding turbulence caused by the building materials and ground features was included. By assigning a roughness factor, the model considers influences from the atmospheric boundary layer. The boundary layer is the layer of the atmosphere in which the dynamics are directly influenced by its contact with the ground surface and features.

There is a long-term intention to develop the third lot. Once it is developed, the new building, other structures and landscaping will lessen the wind speed at the corners of Building 2. In the interim it will remain as an open lot. An eight-foot high L-shaped stockade fence, or equal mitigation, will be installed along the driveway to the northwest of Building 2 with a gate located at the sidewalk for access. Any type of non-porous fence or wall will do. A similar fence will be added to the southwest corner of the building with a gate for access at the sidewalk around Building 2. These walls will be added to show that temporary measures can provide sufficient wind speed mitigation in the interim, prior to a design of Building 3. These walls are by no means the only option, and if other options are proposed as the design progresses, this report can be revised to demonstrate that the wind gust criteria can be met.

In each modeling scenario and wind direction, the location and magnitude of the worst-case wind at 5 feet above ground within the entire study area was found and used to determine the ratio of the mean and gust speeds to the reference wind speed. This ratio, otherwise known as the wind amplification factor, is then applied to NWS met data collected at Boston's Logan International Airport to predict full-scale wind conditions.

Figures 7 and 8 display the met data as wind roses. These wind roses summarize the annual and seasonal wind climates in the Boston area, as collected by the National Weather Service (NWS) meteorological station at Logan Airport. Figure 7 shows the wind roses for spring and summer and Figure 8 shows the winter and fall. The annual wind rose is included on both figures for an easy seasonal-to-annual comparison.

The wind roses include all of the analyzed hourly meteorological data for the given season. The seasons are as follows: Spring includes March, April and May; summer includes June, July and August; fall includes September, October and November; and winter includes December, January and February.

There is seasonal variation. The winds in the spring blow predominantly from the west-northwest

and south-southwest. Winds during the summer however, typically blow from the south-southwest, and at a lesser magnitude. Winds during the fall blow from the west-northwest and south-southwest similarly to the spring wind conditions. Winds during the winter blow predominately from the west and west-northwest and do not have nearly as many calm conditions as the other seasons.

Individual Wind Direction Results

Although each of 16 wind directions were studied with the CFD model, results for the four basic directions, north, south, east, and west, are emphasized in the attached figures along with a select few other directions for discussion. Figures 9, 10, 11, and 12 show the potential change from the project for the north, east, south and west wind directions, respectively. Each of these figure includes the two scenarios. The left figure, labelled (A), represents results from the No Build scenario. The right figure, labelled (B), represents results from the Build scenario. The location of the proposed buildings is outlined in both figures for perspective.

The colored section of the figures represents the relative wind speed profile. The color gradient goes from deep blue which represents little to no wind speed to deep red, which represents the maximum wind speed. Please note that in some directions, the maximum wind speed may actually be less than the reference wind speed. In most cases the maximum is an elevated wind speed.

As one can see from these four figures, the No Build wind speed is much higher in the easterly and westerly directions, again, because of the large box store to the north. Another basic trend is that in the Build scenarios there is elevated wind speed at or near the corners of the buildings. Although these figures clearly show an increase in wind speed, the areas of concern where wind speed is maximized are very isolated.

In addition to these primary directions, Figures 13, 14 and 15 were included to show the change in wind from the angles between north and west. This wind direction quadrant has the highest potential for wind increases. These angles funnel around the box store at approximately 22, 45 and 67 degrees which creates wind shear and channeling, as well as being the dominant wind direction quadrant. (See the wind rose figures for more information.) The channeling is clear from these figures.

Figures 16-22 are close ups of the Build wind directions depicted in Figures 9-15, respectively. These figures do not include areas of low wind speed to better visualize potential areas of concern. The scale shown here starts at about one half of the reference speed up to and through elevated speeds. Essentially anything shown in blue through green is at the reference wind speed or less and anything yellow to red has an elevated wind speed.

Figures 23 and 24 are included to demonstrate that although the pedestrian concern is evaluated at 5 feet above ground level, the model is considering everything in three dimensions. Figures 23 and 24 show the vertical profile at 90-degrees of offset from each other about the calculated maximum from the model.

As mentioned previously, although only a select number of figures are included in the report, all directions were analyzed to determine the potential gust and comfort pedestrian wind impacts. Figure

25 shows the location of the maximum wind speed in each direction spatially.

Table 1 includes the annual and seasonal exceedances of the wind gust speed of 31 mph. As discussed earlier, there will be some natural exceedances of this wind speed because of storm conditions, however, the goal is to minimize other occurrences to insignificant levels overall. A threshold of 1% of the year is used in this study. The total of all directions may exceed 1% of the time, as long as the results occur at different locations. Therefore, the primary goal is that the project not show exceedances of 1% for each specific wind direction.

Although each of the wind directions do not exceed 1%, there is one small location where the wind speed could exceed 1% when accounting for overlapping peaks from other wind directions. We do not expect this to be problematic, because the location where the peaks overlap is primarily in the road and the existing trees and/or future landscaping will reduce the gusts. The multiple wind direction peak locations are shown in Figure 25.

Table 2 shows the normal wind distribution that is depicted in the wind roses. The “normal” wind conditions were obtained for the Boston area from meteorological data collected at a National Weather Service-sanctioned Automated Surface Observing System (ASOS) meteorological station at Logan Airport. Although this is not the No-Build scenario, it is the normal wind conditions. West-northwest occurred most often for each wind speed, with an exception to when the wind speed is greater than 27 mph, in which case north-northeast occurred most often. The “normal” wind direction that most often occurred on an annual basis was from the west-northwest. In fact, it was the predominant direction for the winter, spring and fall. In the summer the predominant wind direction was from the south-southwest.

Tables 3 to 5 summarize the results of the wind comfort comparison. Table 3 shows the normal wind directions and the distribution of occurrence for each comfort wind category. Tables 4 and 5 were created by incorporating the CFD modeling results from the No- Build and Build scenarios, respectively. For No Build a wind speed of less than 12 mph occurs 99+% of the time, because of the shielding from the box store, with the maximum wind direction occurrence being WNW at approximately 11%.

The 12 mph cutoff is based on a threshold where it is comfortable for sitting. The “normal” conditions (i.e. the normal wind without any buildings present) would have about 66% calm conditions. The build would have about 64% calm conditions, only a minor decrease.

The wind speeds where it is comfortable for sitting, walking or standing remain about the same between the “normal” wind condition and the Build scenario. There is an increase in the percentage of time where it is uncomfortable when the Build is compared to the normal conditions. The percentages increases from about 6% for the normal baseline condition to about 9% for the Build scenario. This increase is not uncommon in an urban area and is not considered problematic.

Lastly, there clearly are areas that would be conducive to sitting in all wind directions. The exact locations could be explored in more detail, if the project proponents desire outdoor activities such as plazas or outdoor cafes.

Appendix A:

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Figure 1
Proposed Project Site
Boynton Yards Project, Somerville, MA



Figure 2
Proposed Project Site and Surrounding Buildings
Boynton Yards Project, Somerville, MA

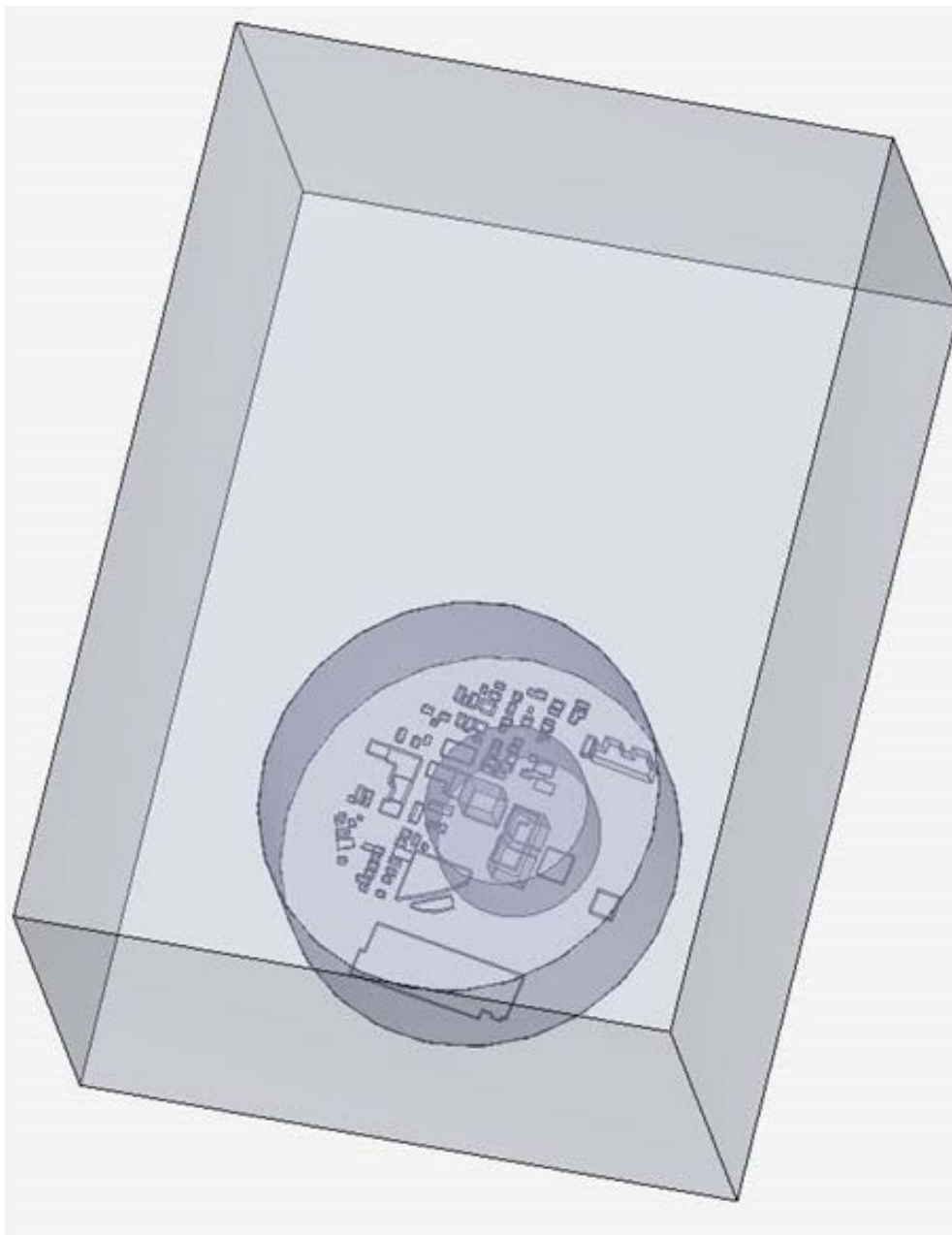


Figure 3
Rotating Base
Boynton Yards Project, Somerville, MA

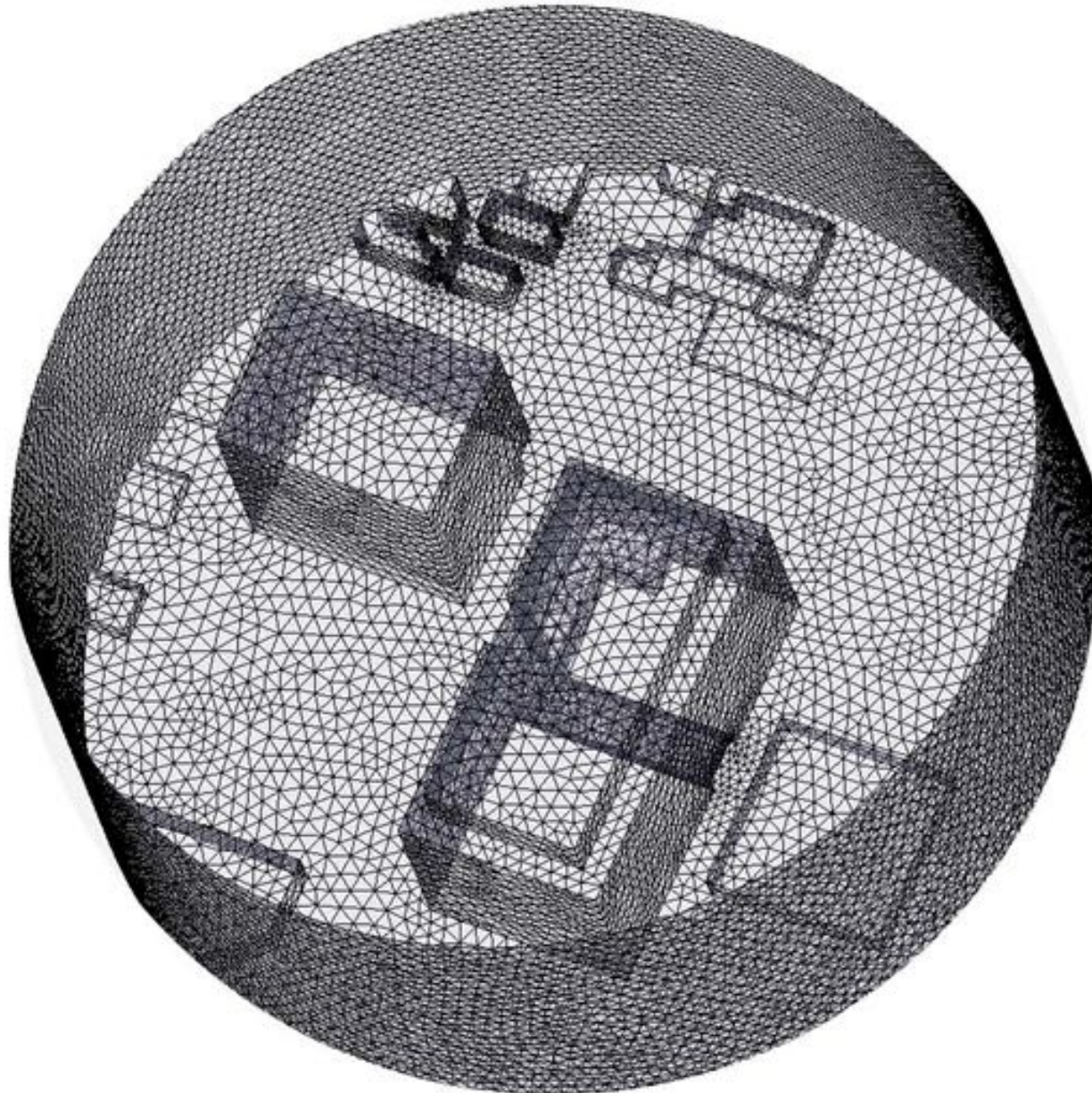


Figure 4
Meshing Within the Immediate Project Area
Boynton Yards Project, Somerville, MA

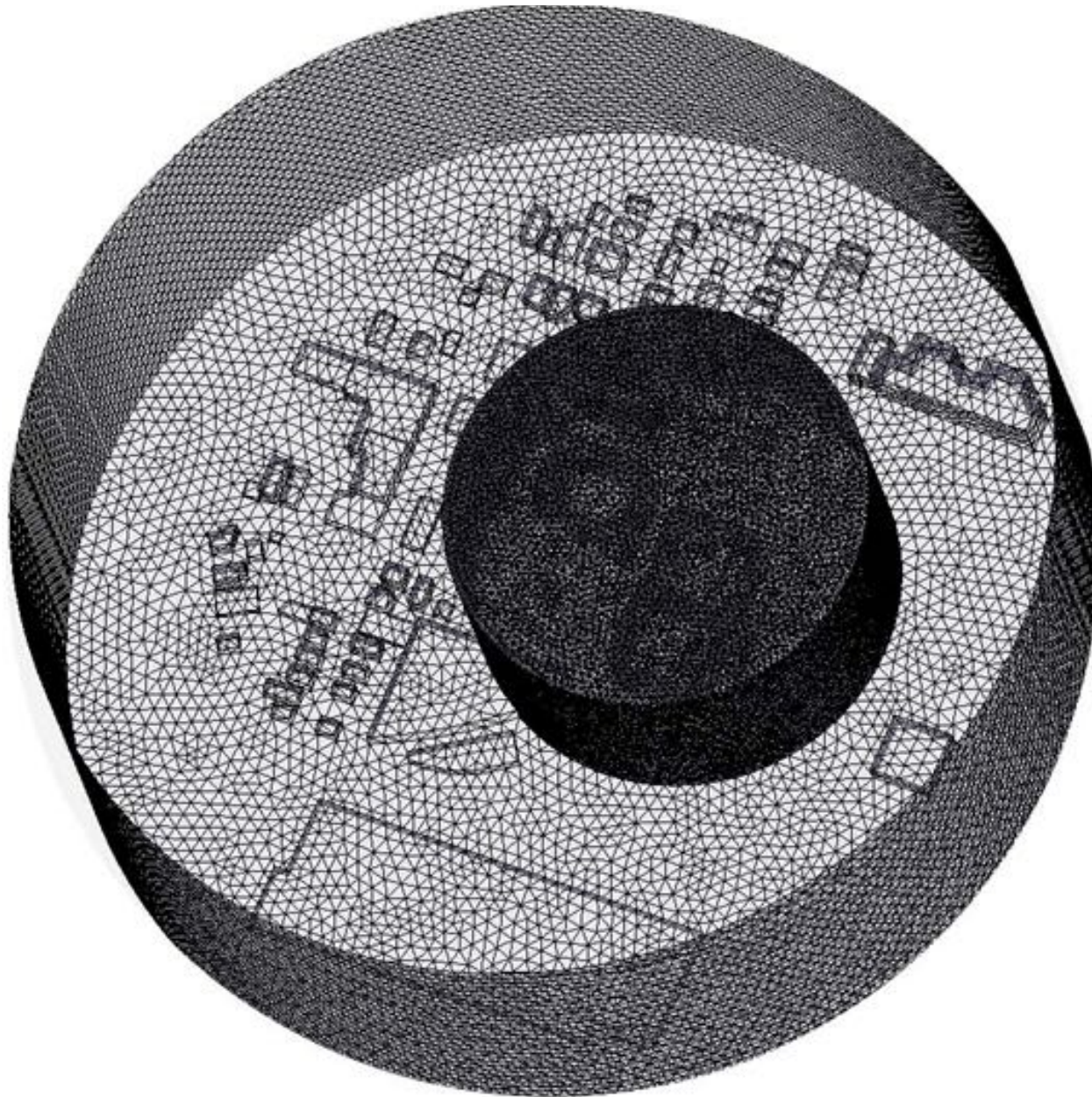


Figure 5
Meshing Within the Surrounding Project Area
Boynton Yards Project, Somerville, MA

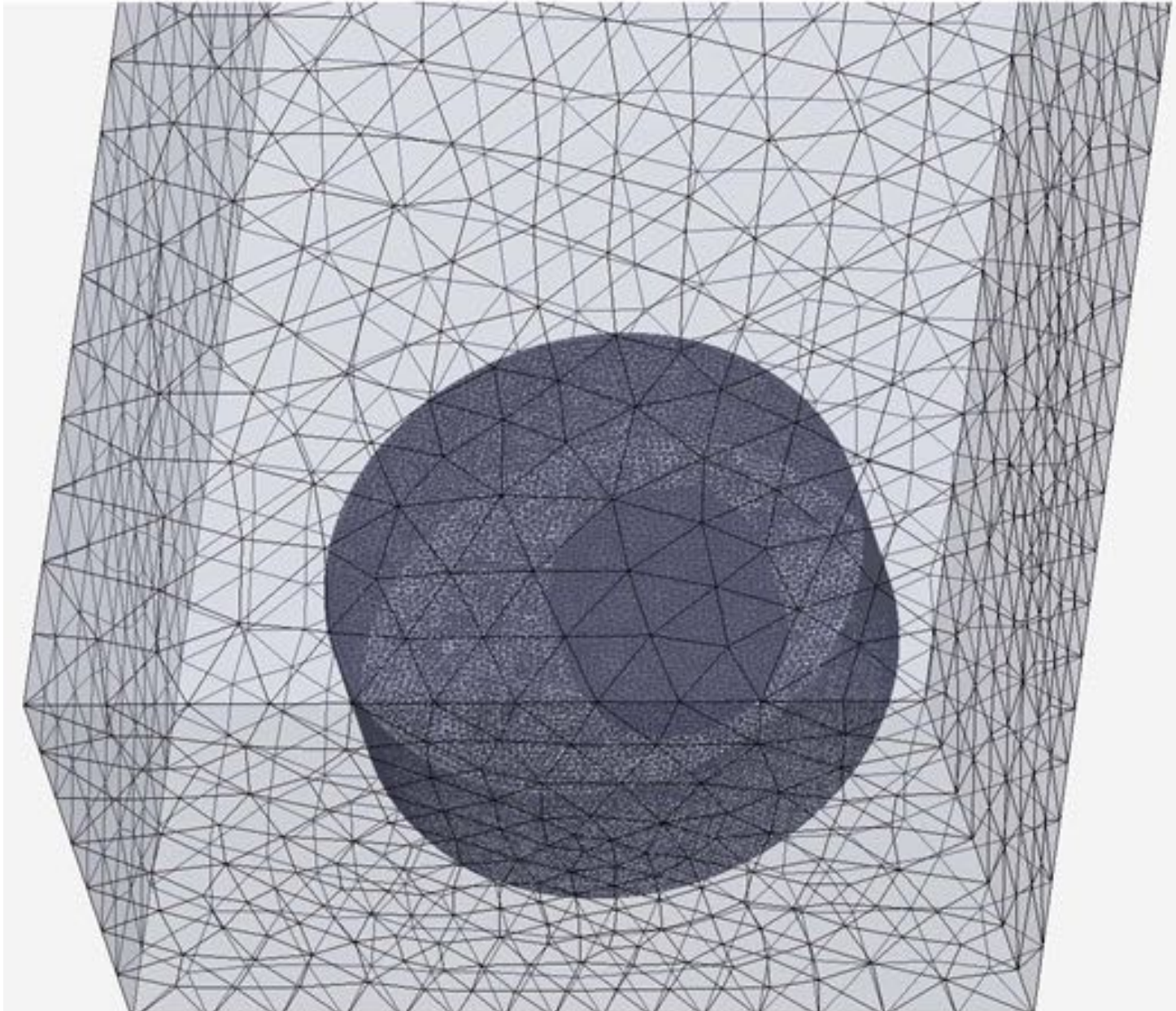
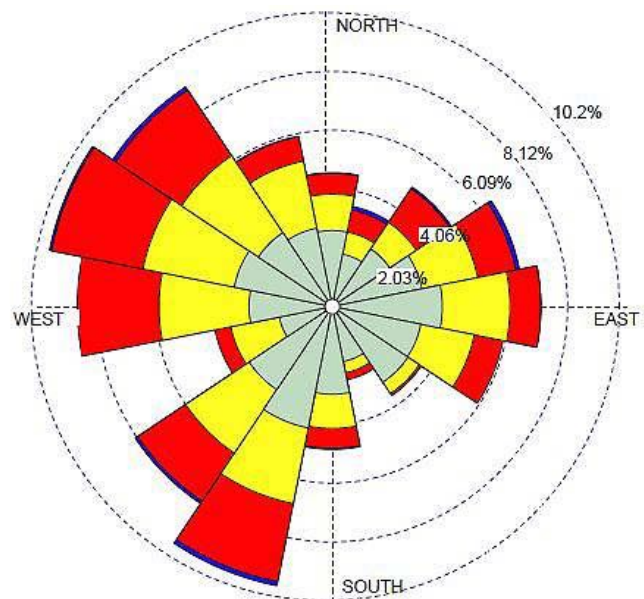
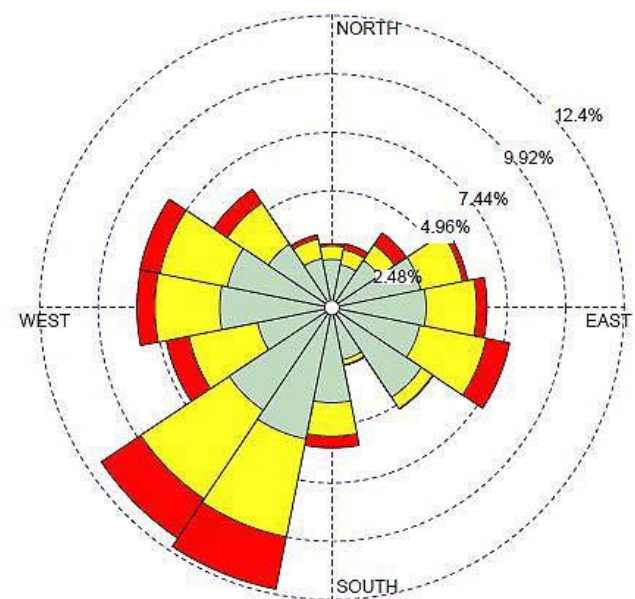


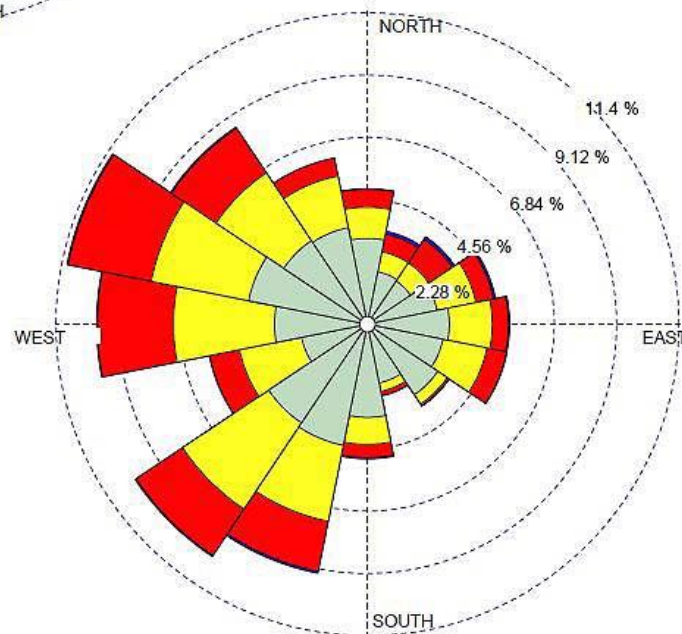
Figure 6
Meshing Within the Volumetric Flow
Boynton Yards Project, Somerville, MA



Spring



Summer



Annual

WIND SPEED (m/s)

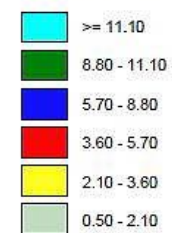


Figure 7
Wind Roses: Spring, Summer, Annual
Boynton Yards Project, Somerville, MA

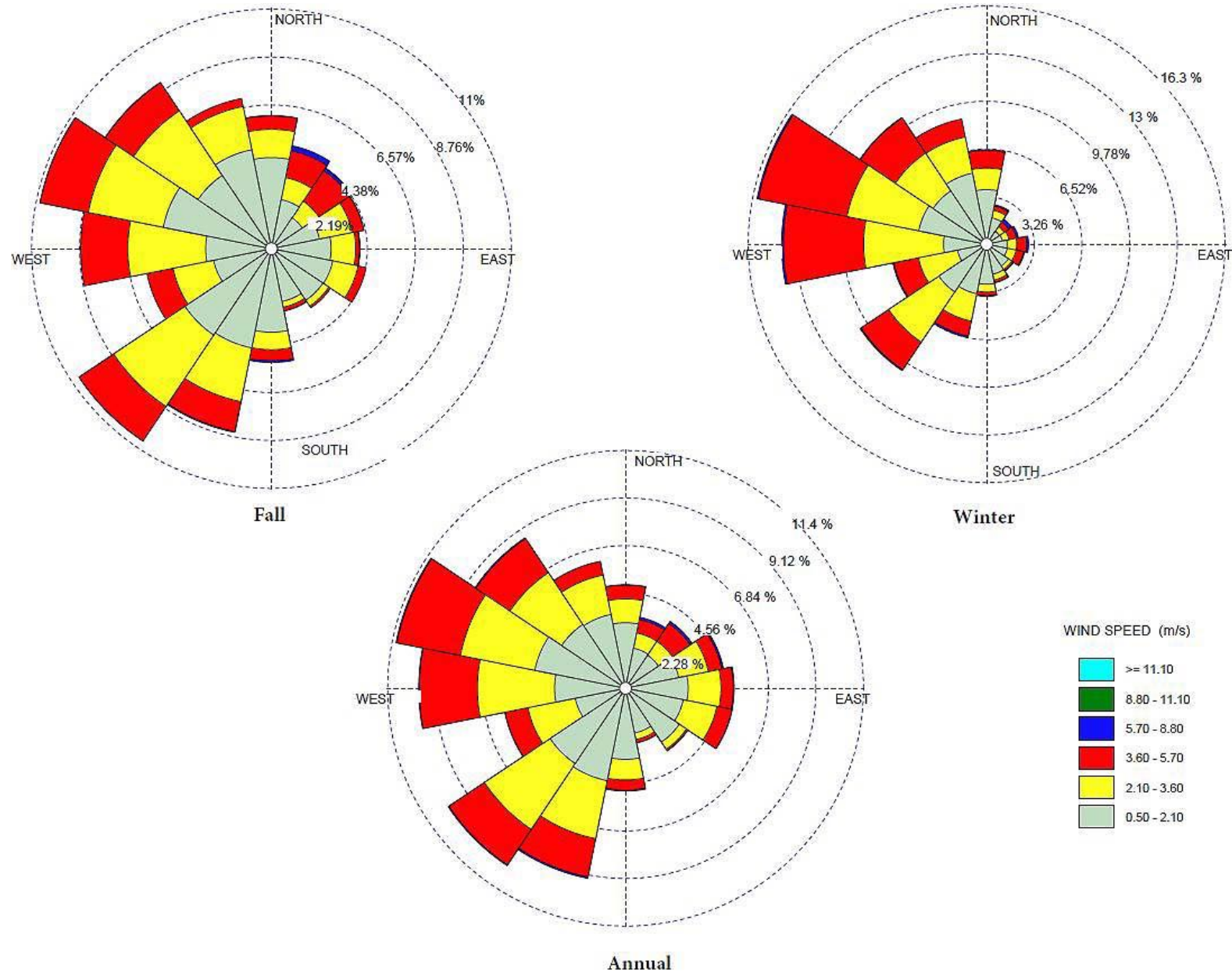
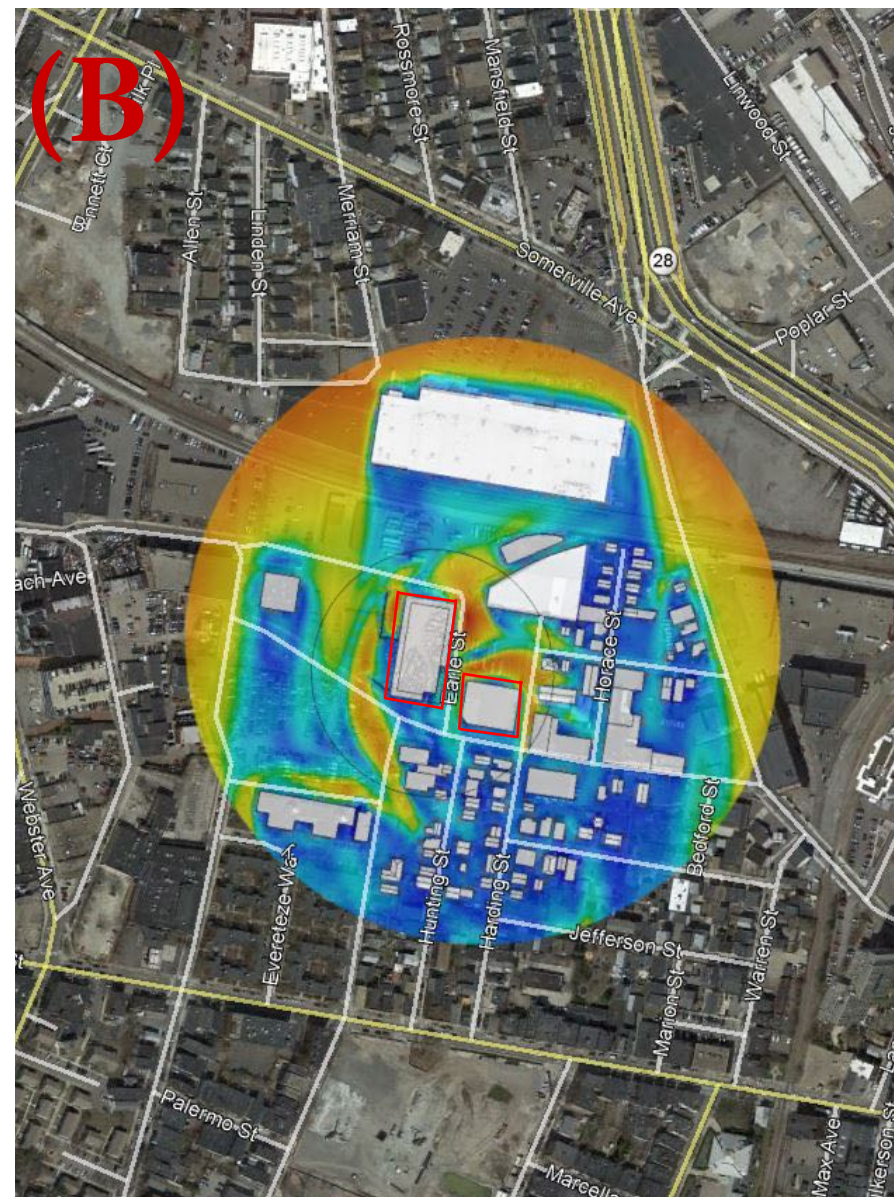
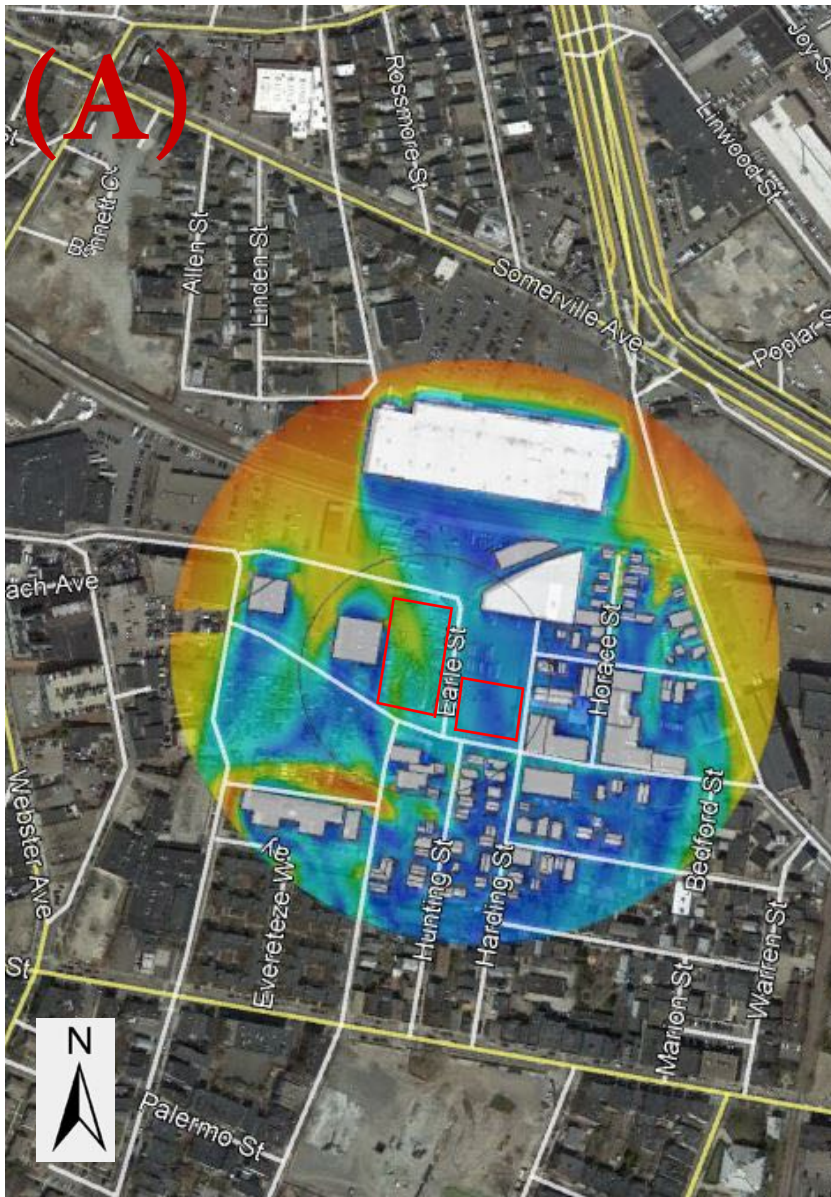
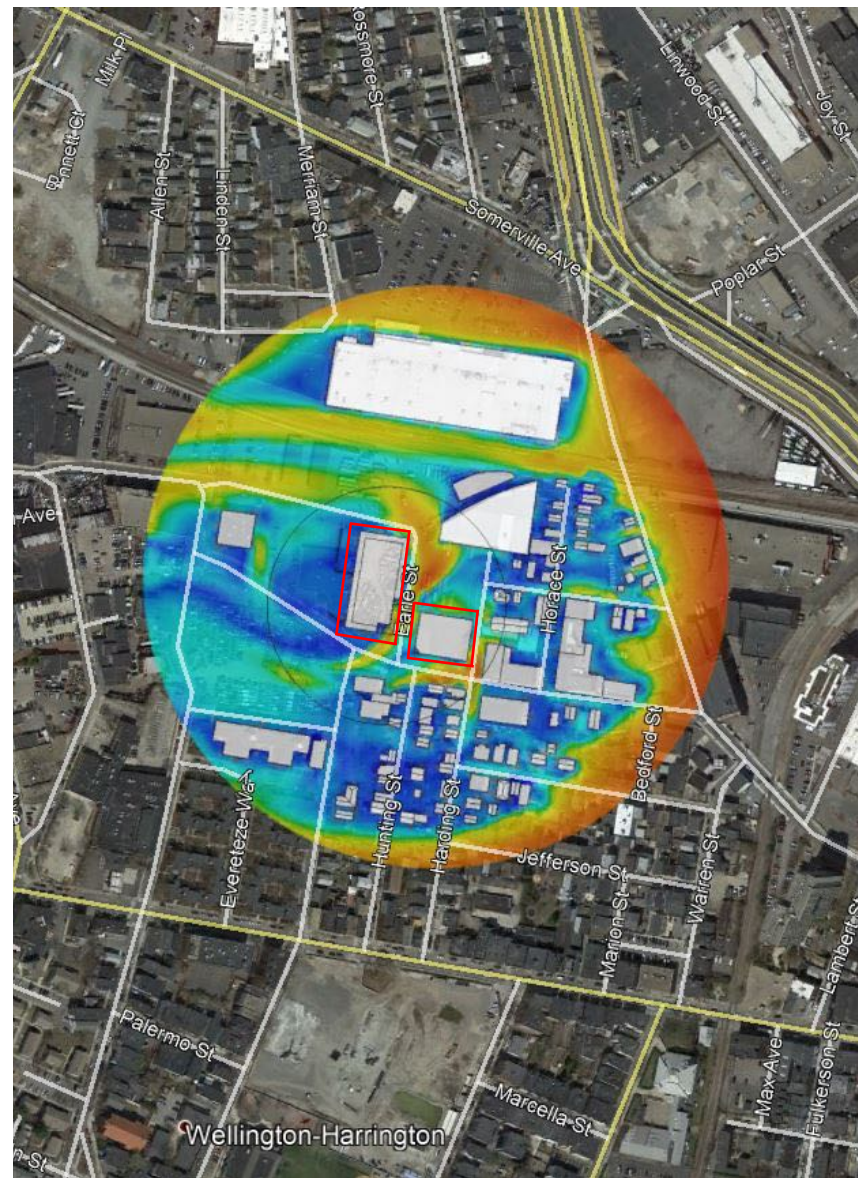
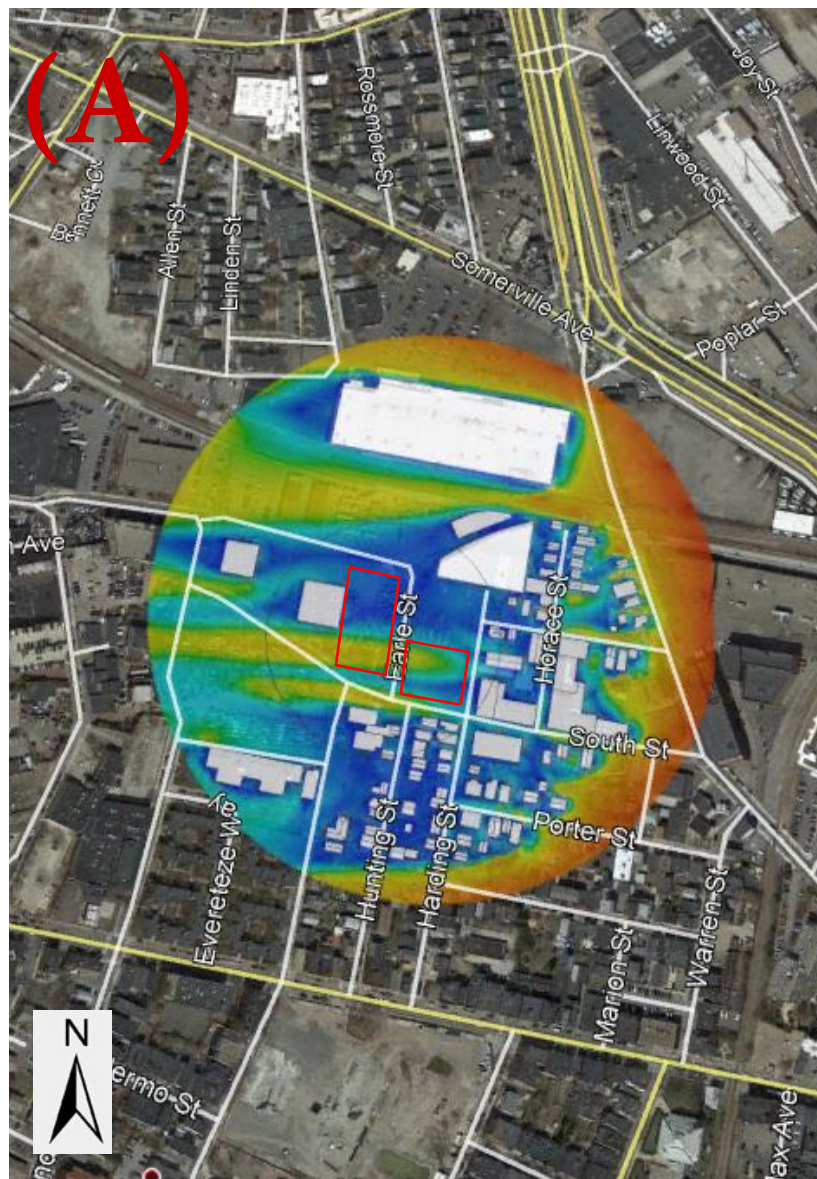


Figure 8
Wind Roses: Fall, Winter, Annual
Boynton Yards Project, Somerville, MA



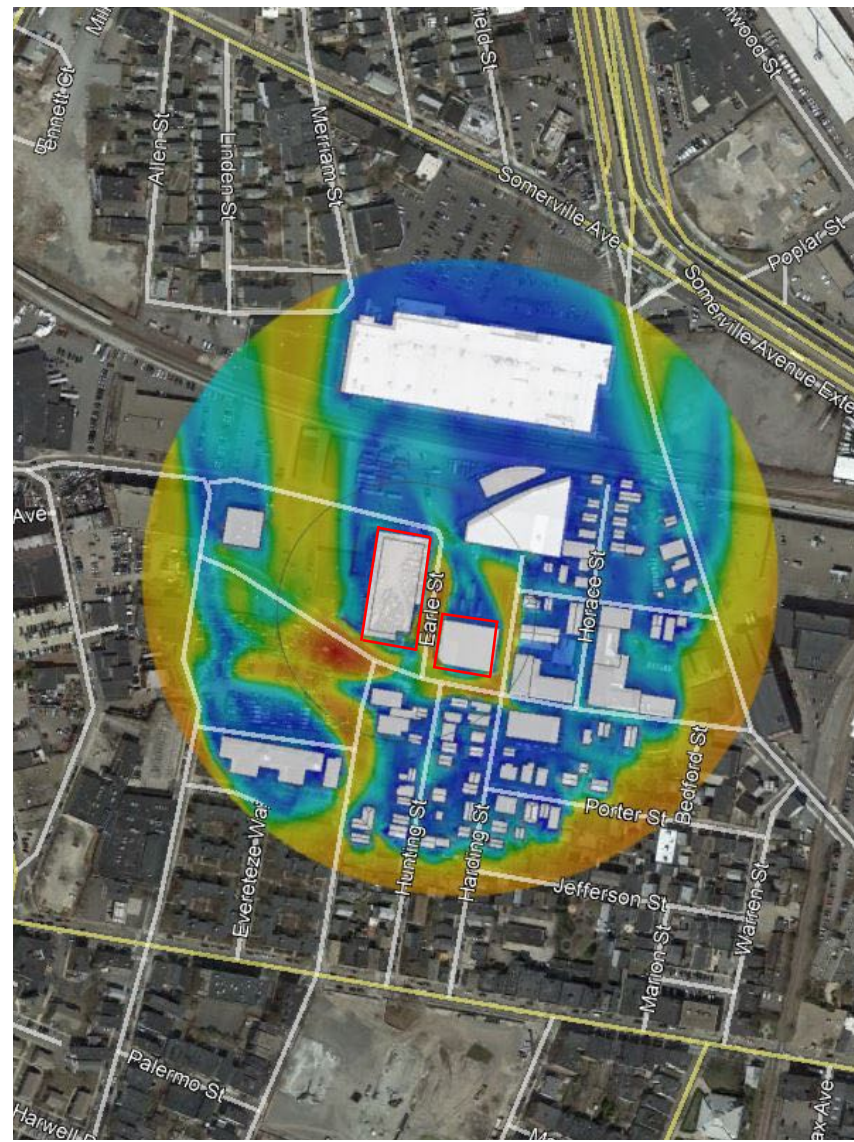
(Wind speed profile where dark blue trends to 0 mph, and dark red is the maximum elevated wind speed.)

Figure 9
Wind out of North: (A) No-Build (B) Build
Wind Speed at 5' of Height Above Ground
Boynton Yards Project, Somerville, MA



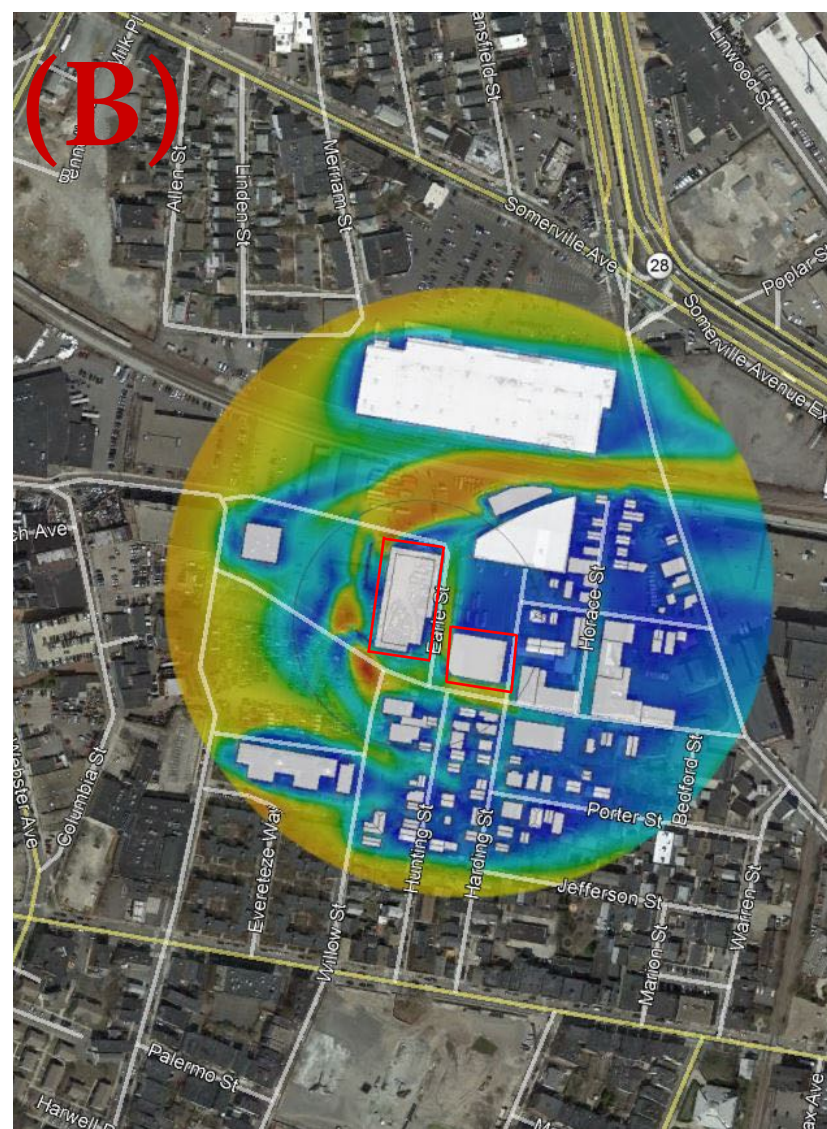
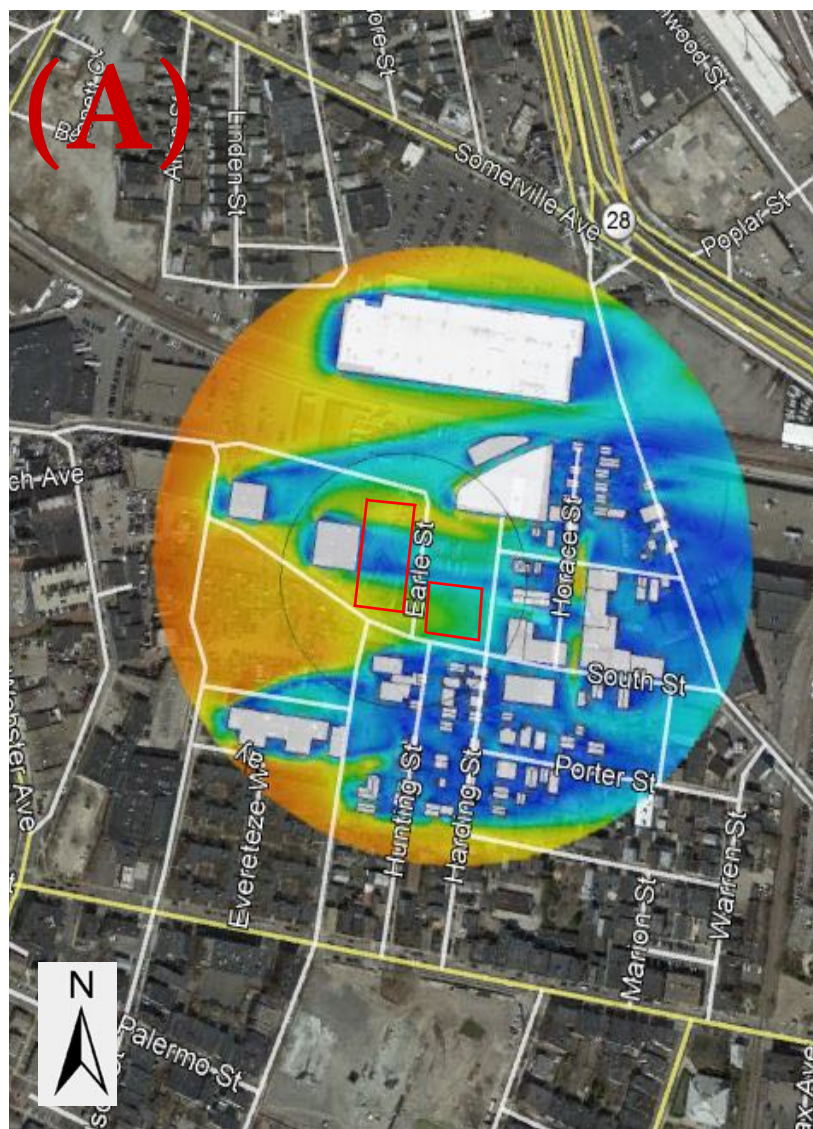
(Wind speed profile where dark blue trends to 0 mph, and dark red is the maximum elevated wind speed.)

Figure 10
Wind out of East: (A) No-Build (B) Build
Wind Speed at 5' of Height Above Ground
Boynton Yards Project, Somerville, MA



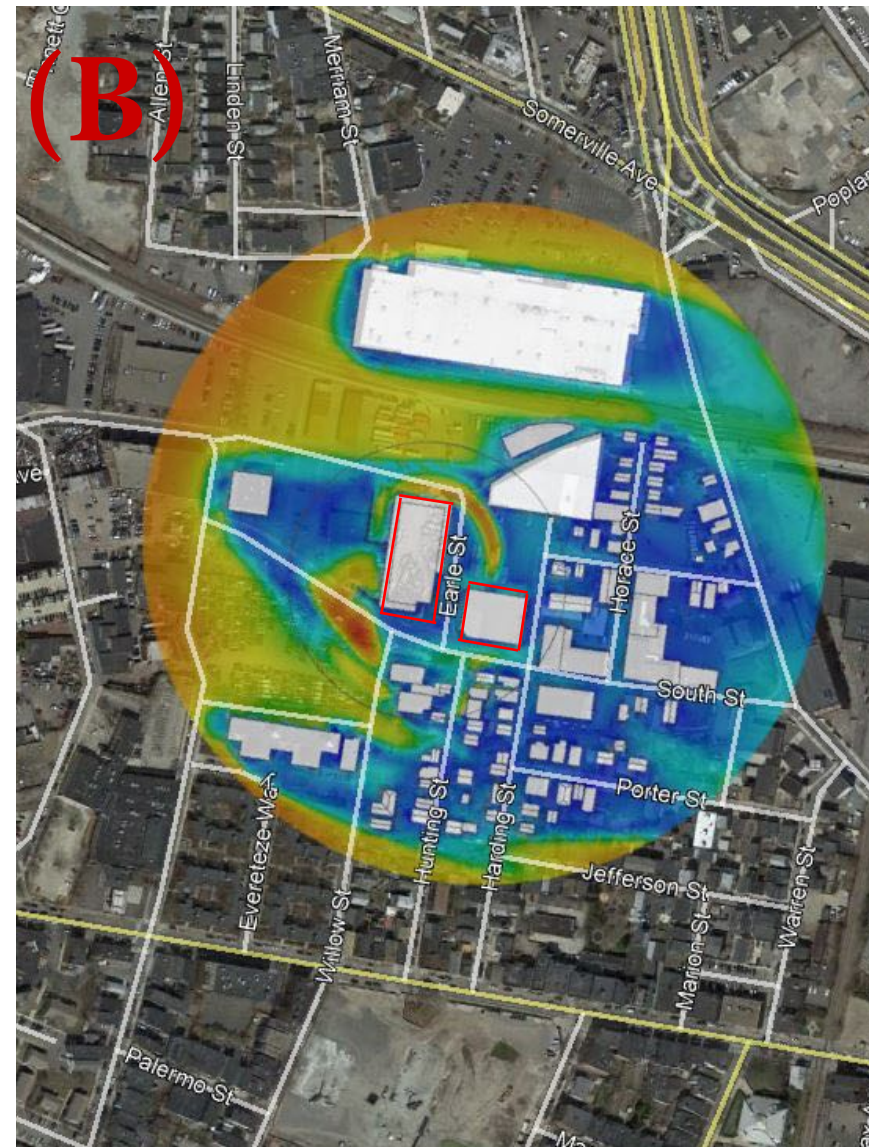
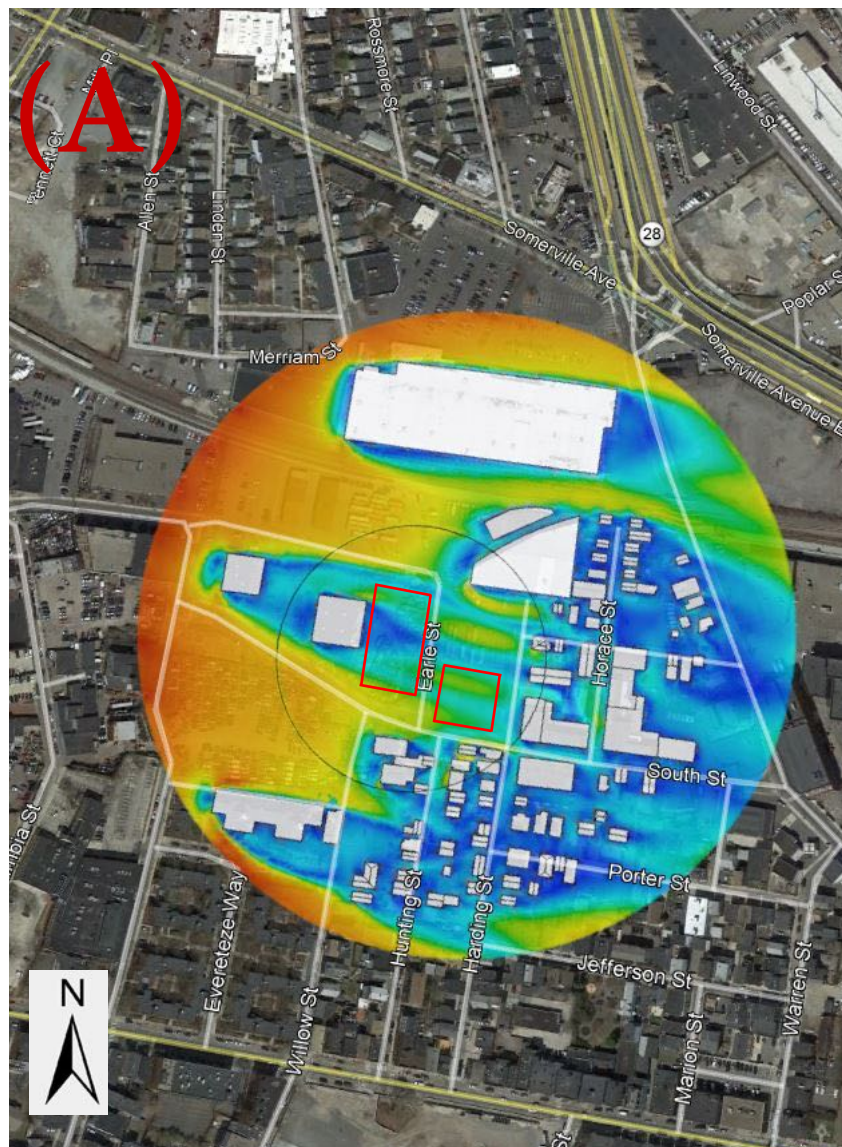
(Wind speed profile where dark blue trends to 0 mph, and dark red is the maximum elevated wind speed.)

Figure 11
Wind out of South: (A) No-Build (B) Build
Wind Speed at 5' of Height Above Ground
Boynton Yards Project, Somerville, MA



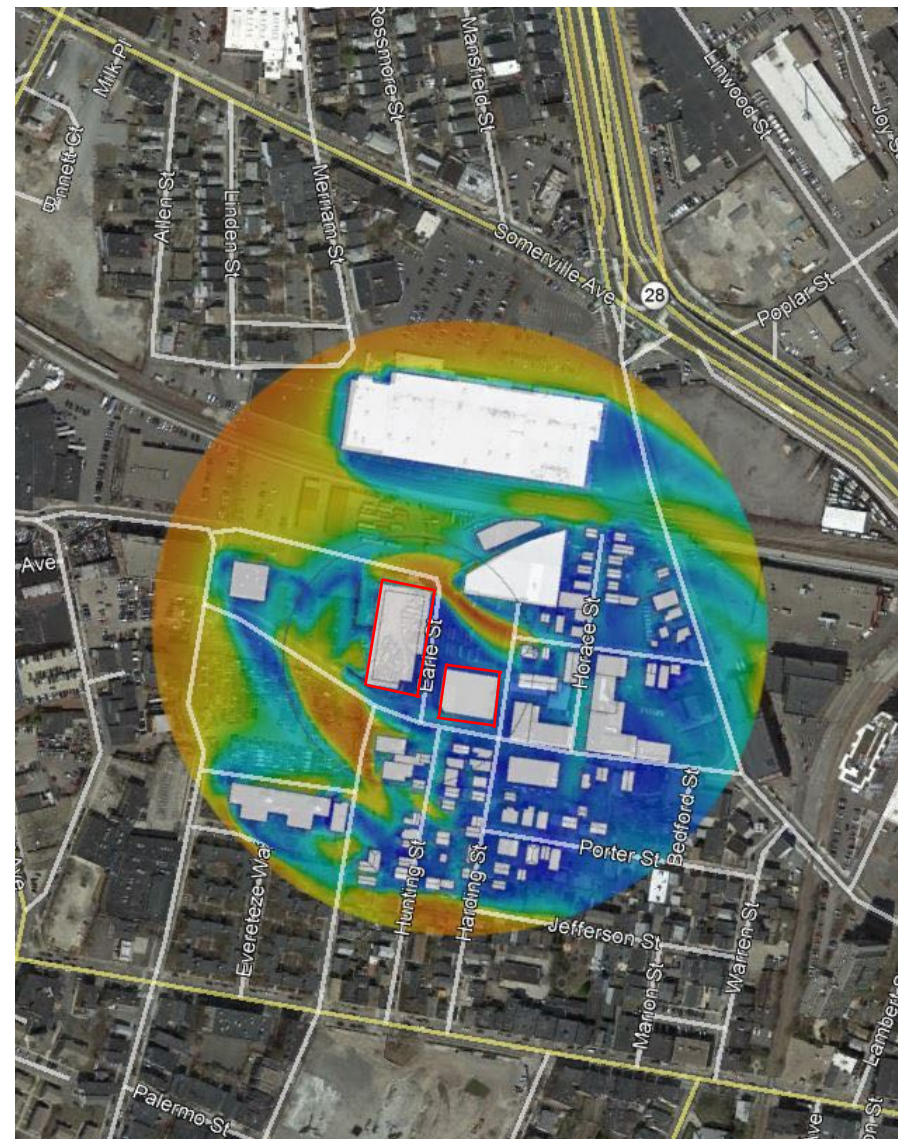
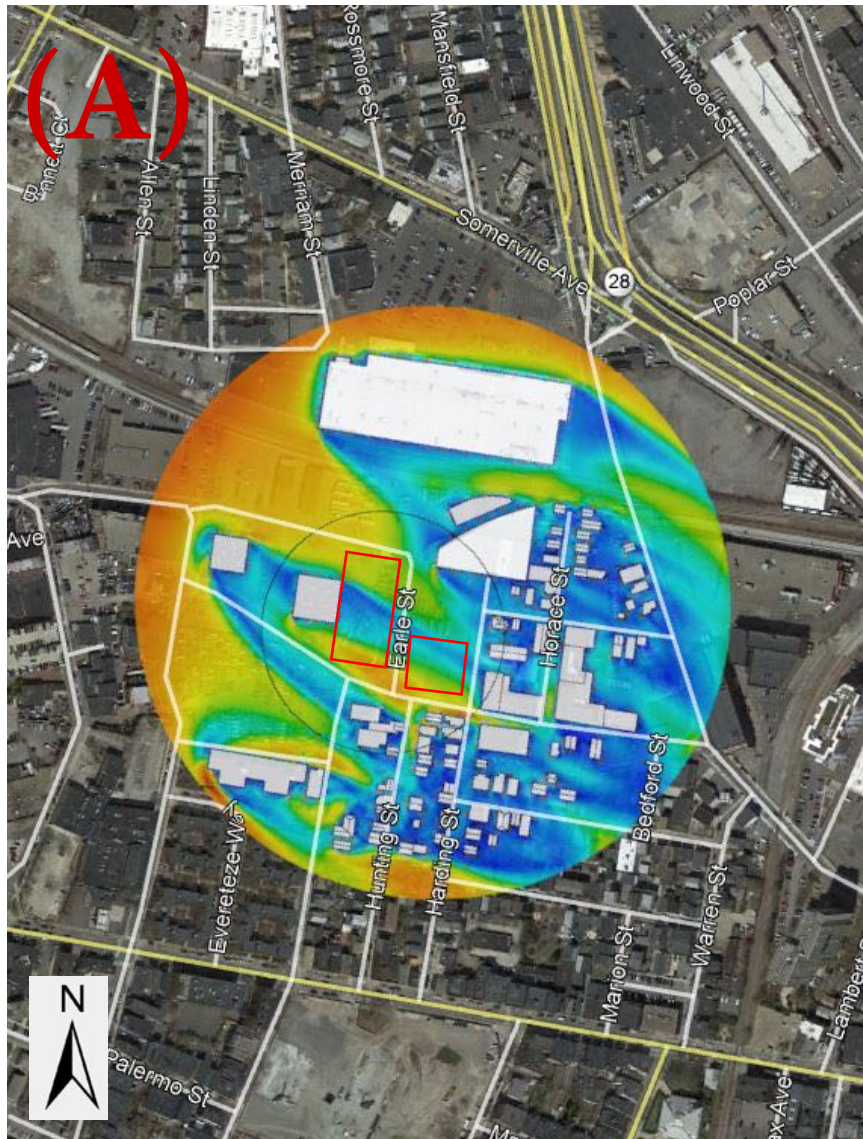
(Wind speed profile where dark blue trends to 0 mph, and dark red is the maximum elevated wind speed.)

Figure 12
Wind out of West: (A) No-Build (B) Build
Wind Speed at 5' of Height Above Ground
Boynton Yards Project, Somerville, MA



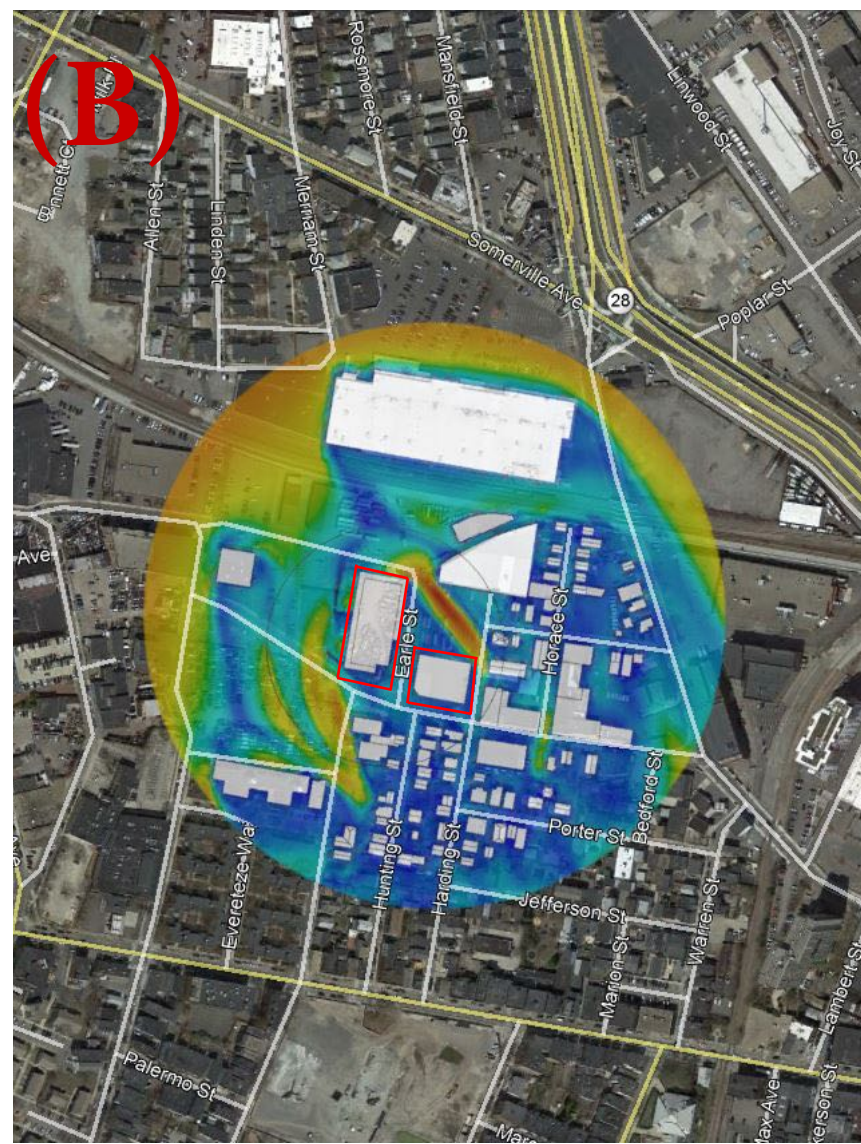
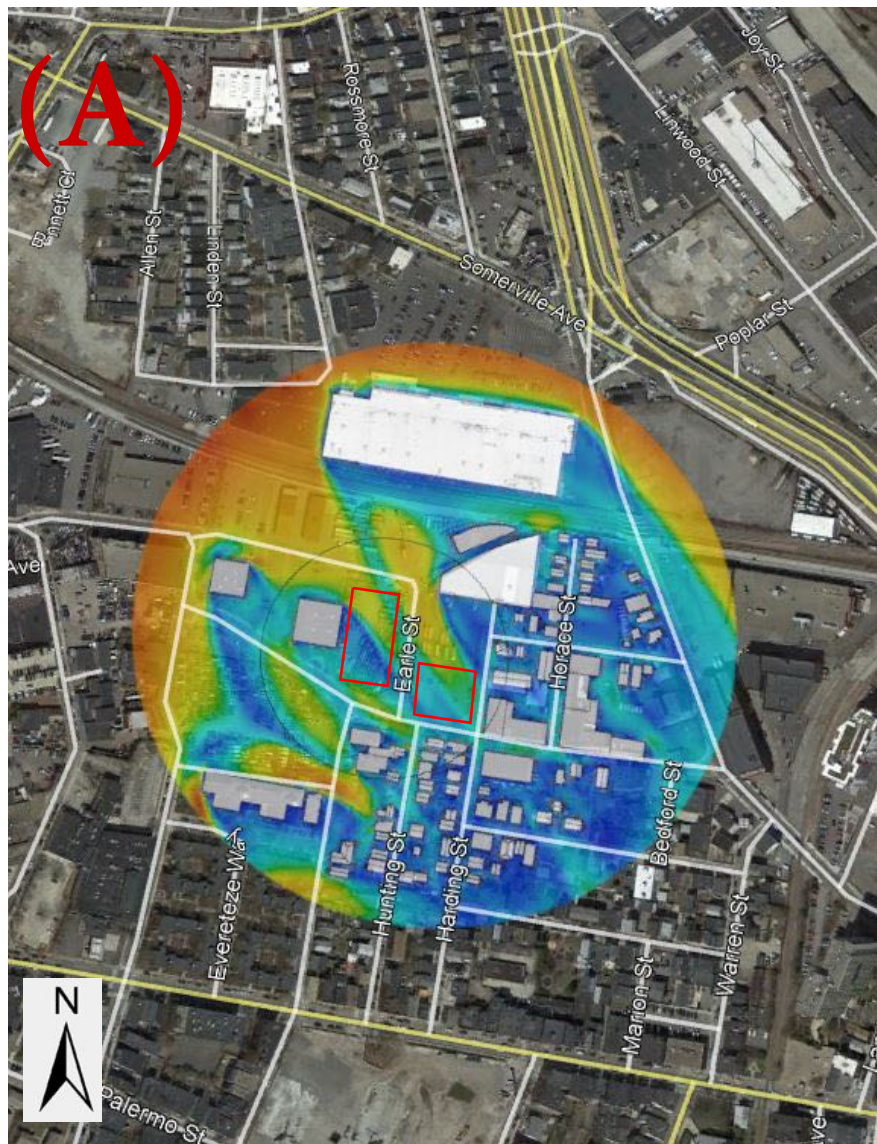
(Wind speed profile where dark blue trends to 0 mph, and dark red is the maximum elevated wind speed.)

Figure 13
Wind out of WNW: (A) No-Build (B) Build
Wind Speed at 5' of Height Above Ground
Boynton Yards Project, Somerville, MA



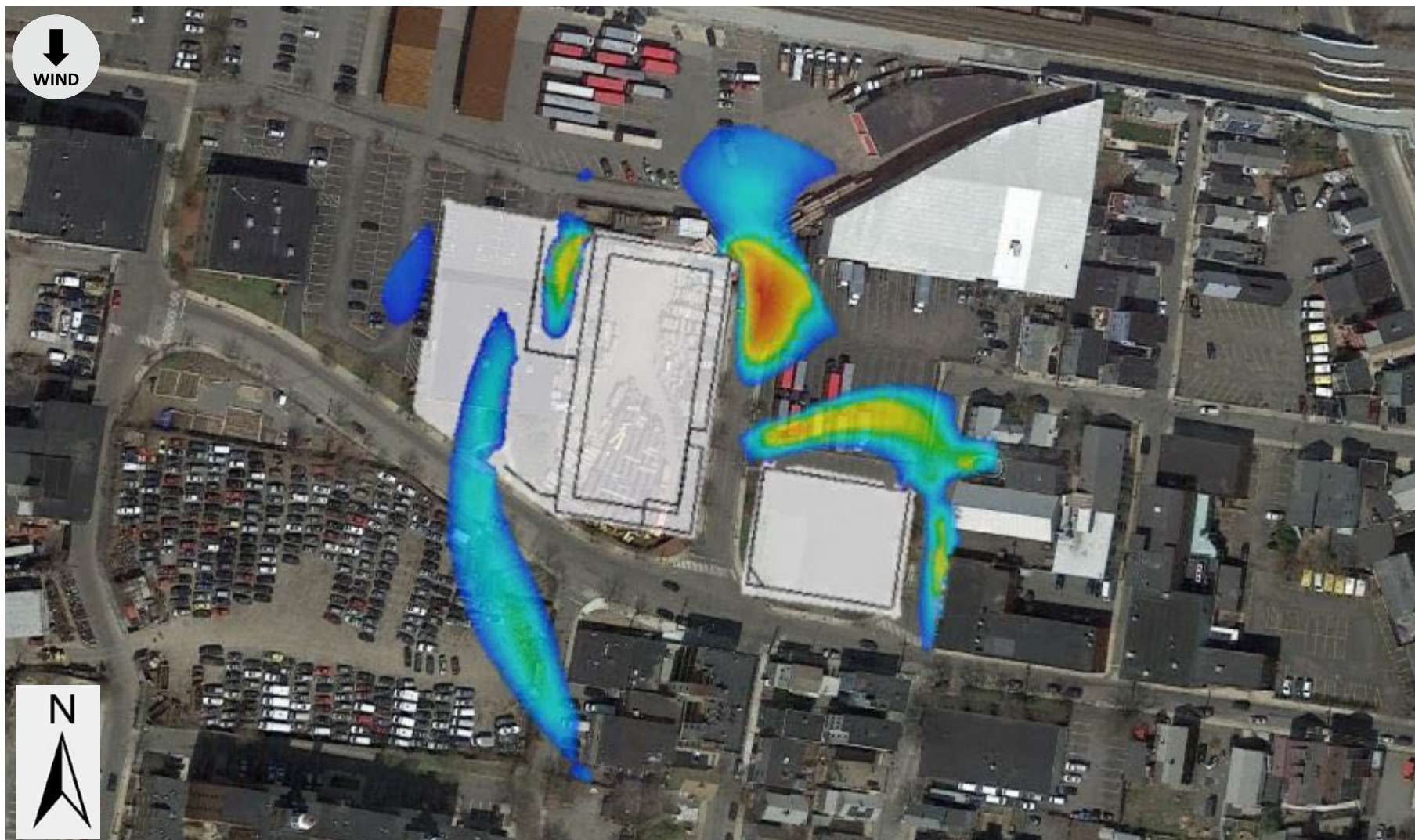
(Wind speed profile where dark blue trends to 0 mph, and dark red is the maximum elevated wind speed.)

Figure 14
Wind out of NW: (A) No-Build (B) Build
Wind Speed at 5' of Height Above Ground
Boynton Yards Project, Somerville, MA



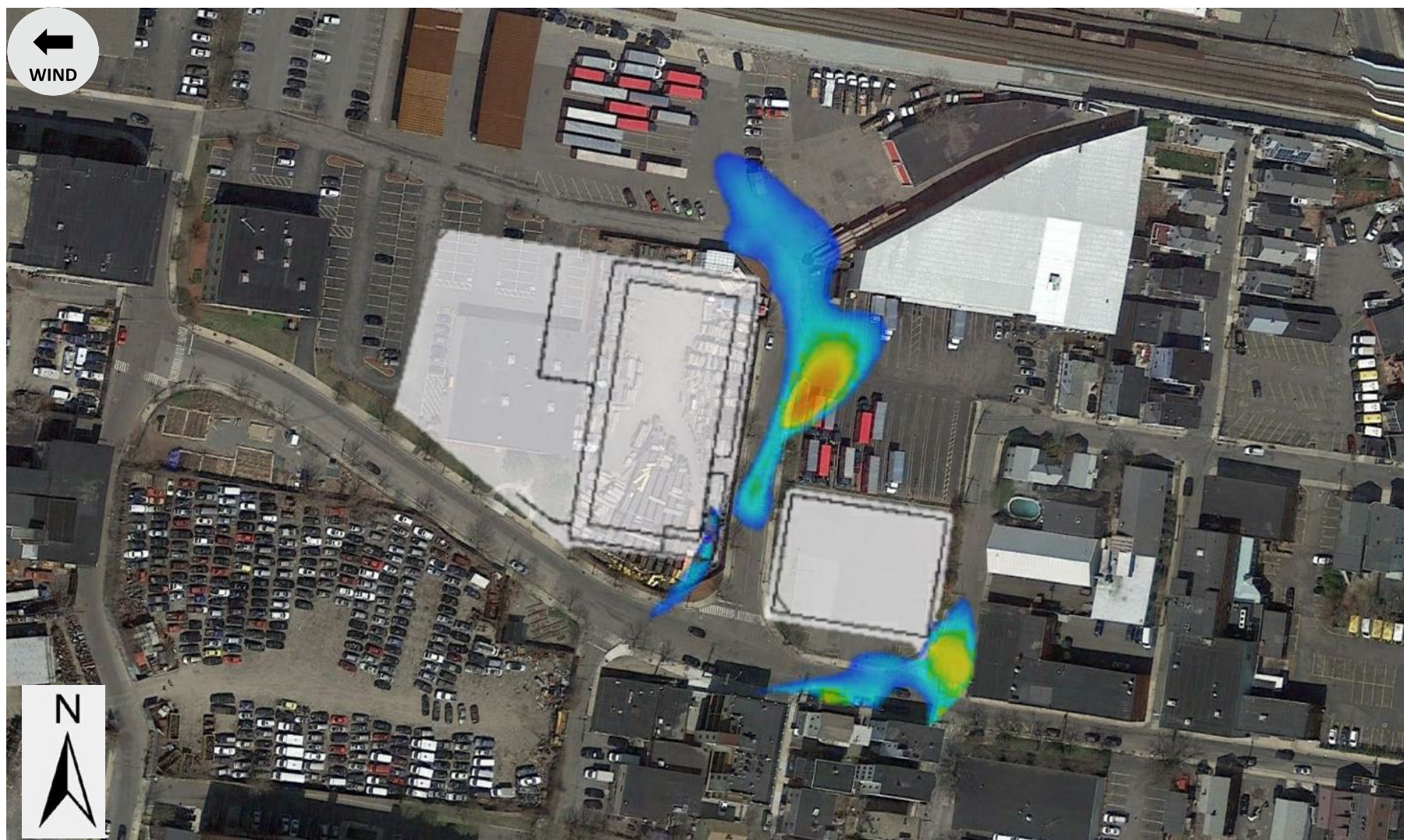
(Wind speed profile where dark blue trends to 0 mph, and dark red is the maximum elevated wind speed.)

Figure 15
Wind out of NNW: (A) No-Build (B) Build
Wind Speed at 5' of Height Above Ground
Boynton Yards Project, Somerville, MA



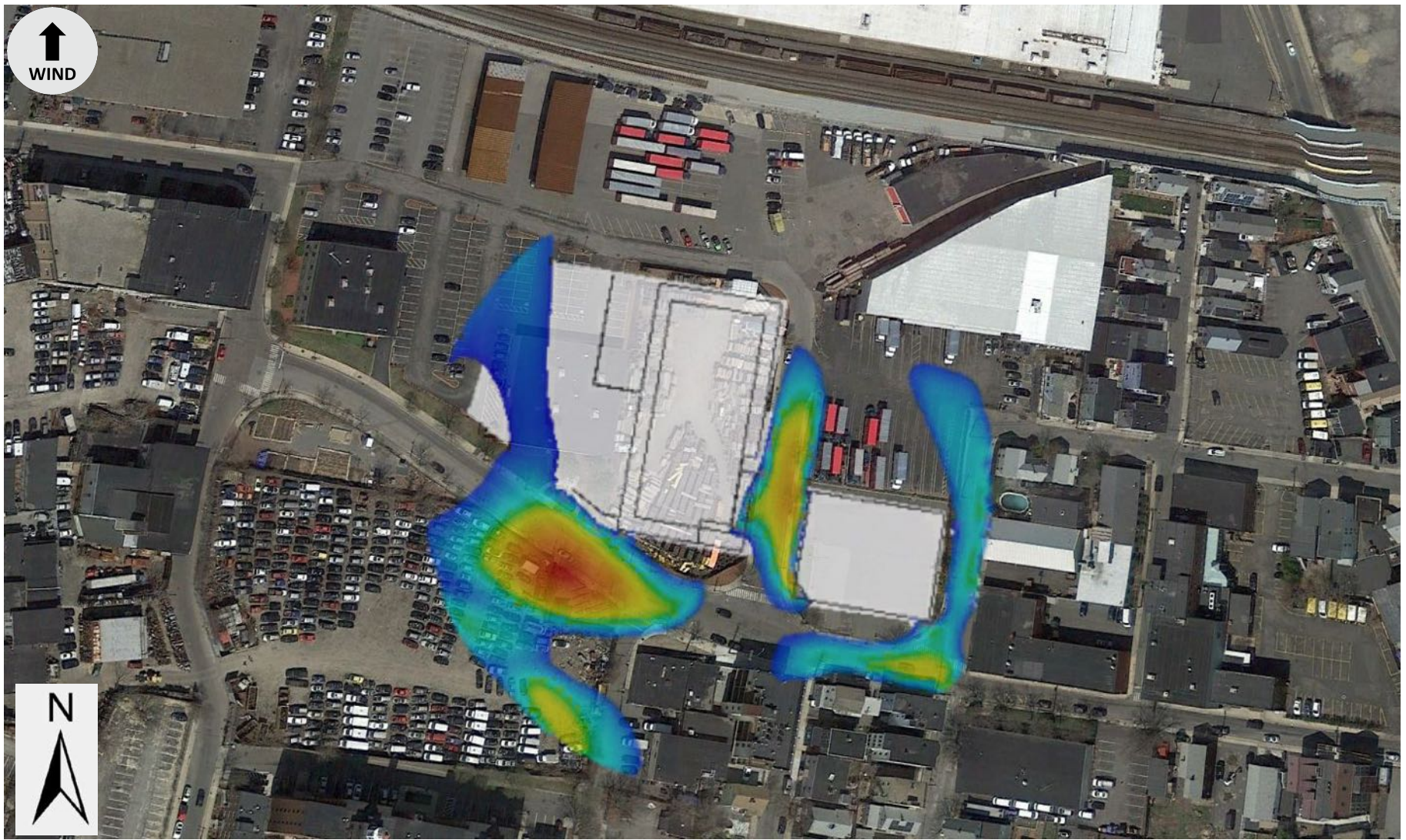
(Peak wind speeds are shown above normal meterological conditions from yellow to red. Colors green to blue depict speed less than the normal wind speeds.)

Figure 16
Wind out of North
Peak Wind Disturbances Around the Proposed Buildings
Boynton Yards Project, Somerville, MA



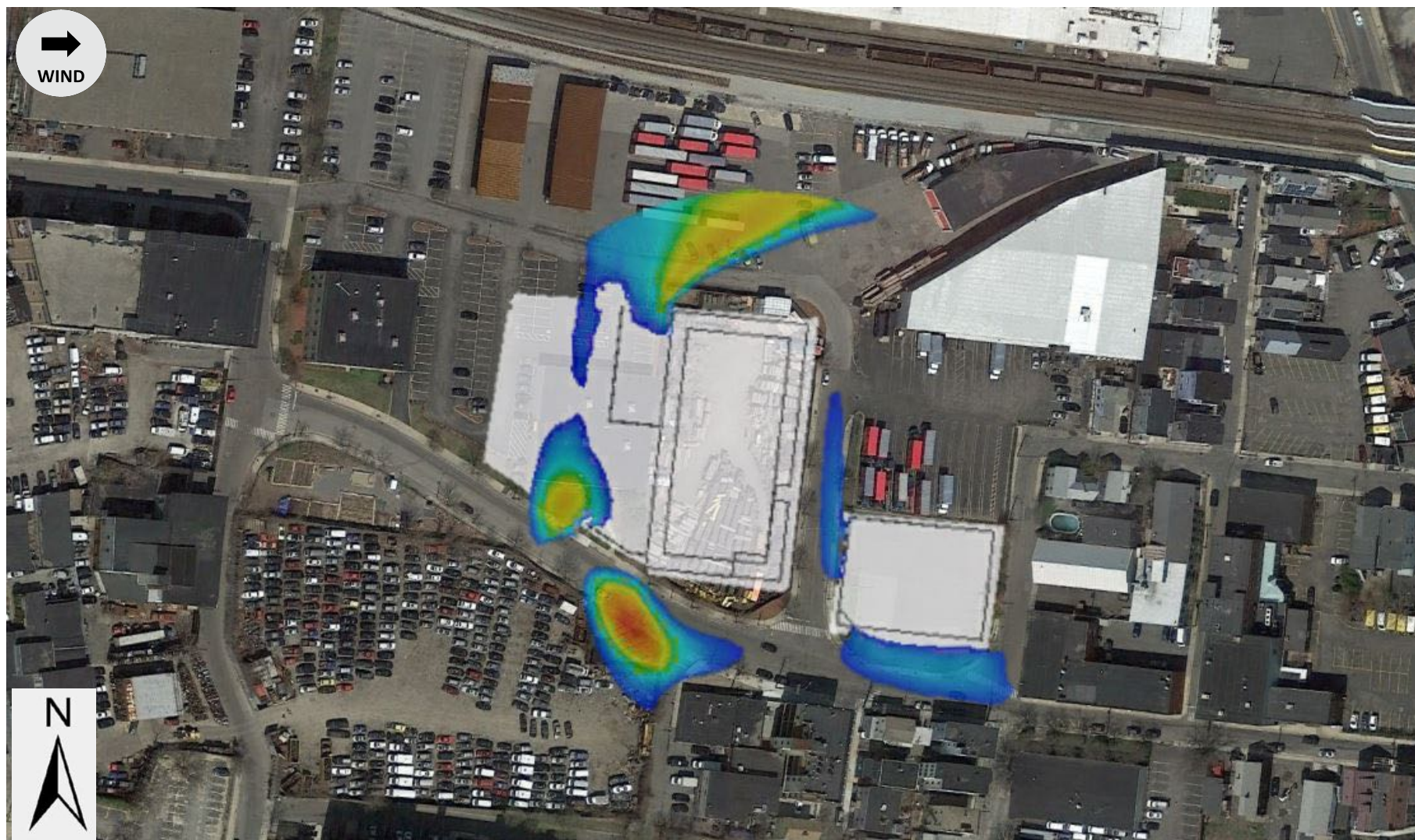
(Peak wind speeds are shown above normal meterological conditions from yellow to red. Colors green to blue depict speed less than the normal wind speeds.)

Figure 17
Wind out of East
Peak Wind Disturbances Around the Proposed Buildings
Boynton Yards Project, Somerville, MA



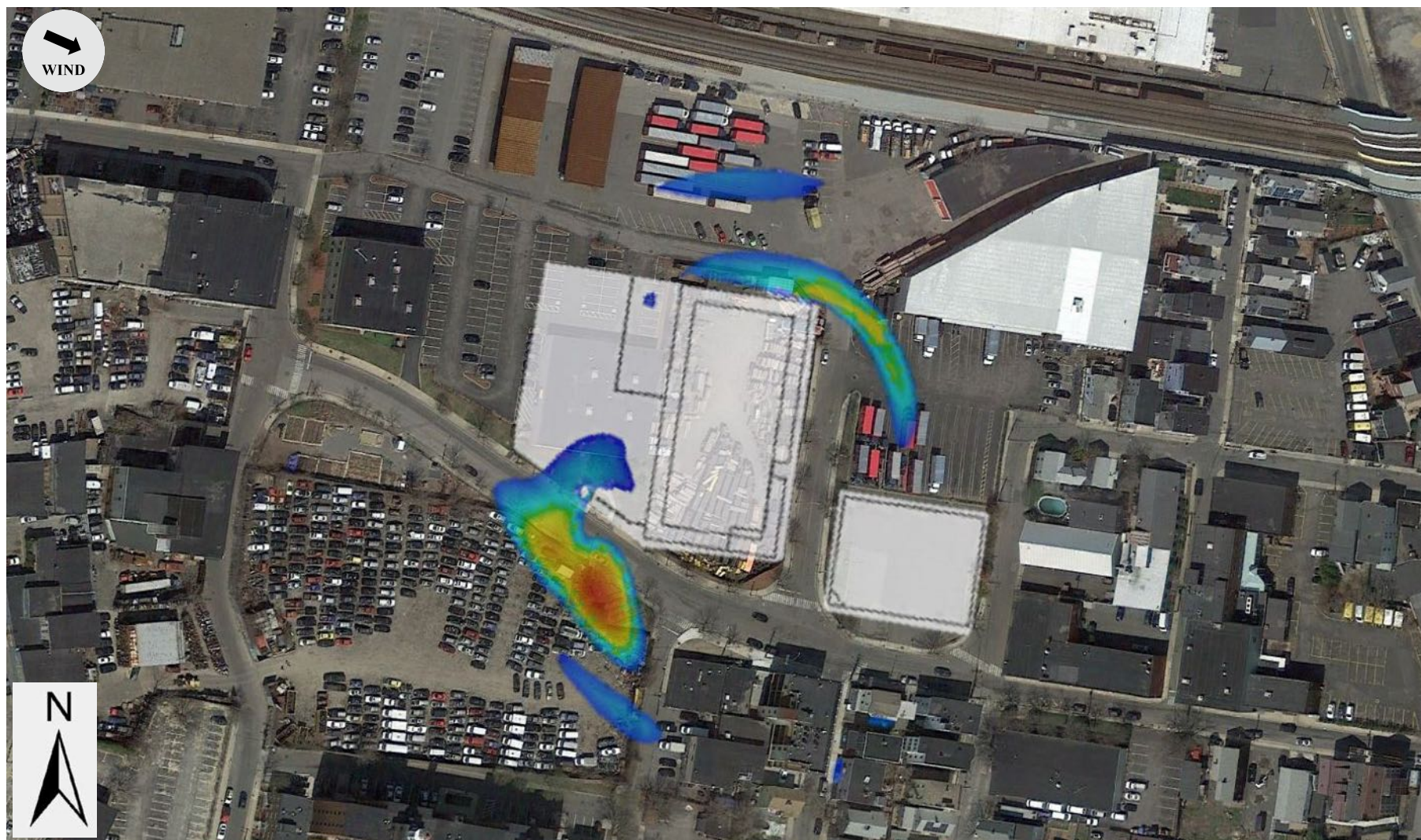
(Peak wind speeds are shown above normal meterological conditions from yellow to red. Colors green to blue depict speed less than the normal wind speeds.)

Figure 18
Wind out of South
Peak Wind Disturbances Around the Proposed Buildings
Boynton Yards Project, Somerville, MA



(Peak wind speeds are shown above normal meteorological conditions from yellow to red. Colors green to blue depict speed less than the normal wind speeds.)

Figure 19
Wind out of West
Peak Wind Disturbances Around the Proposed Buildings
Boynton Yards Project, Somerville, MA



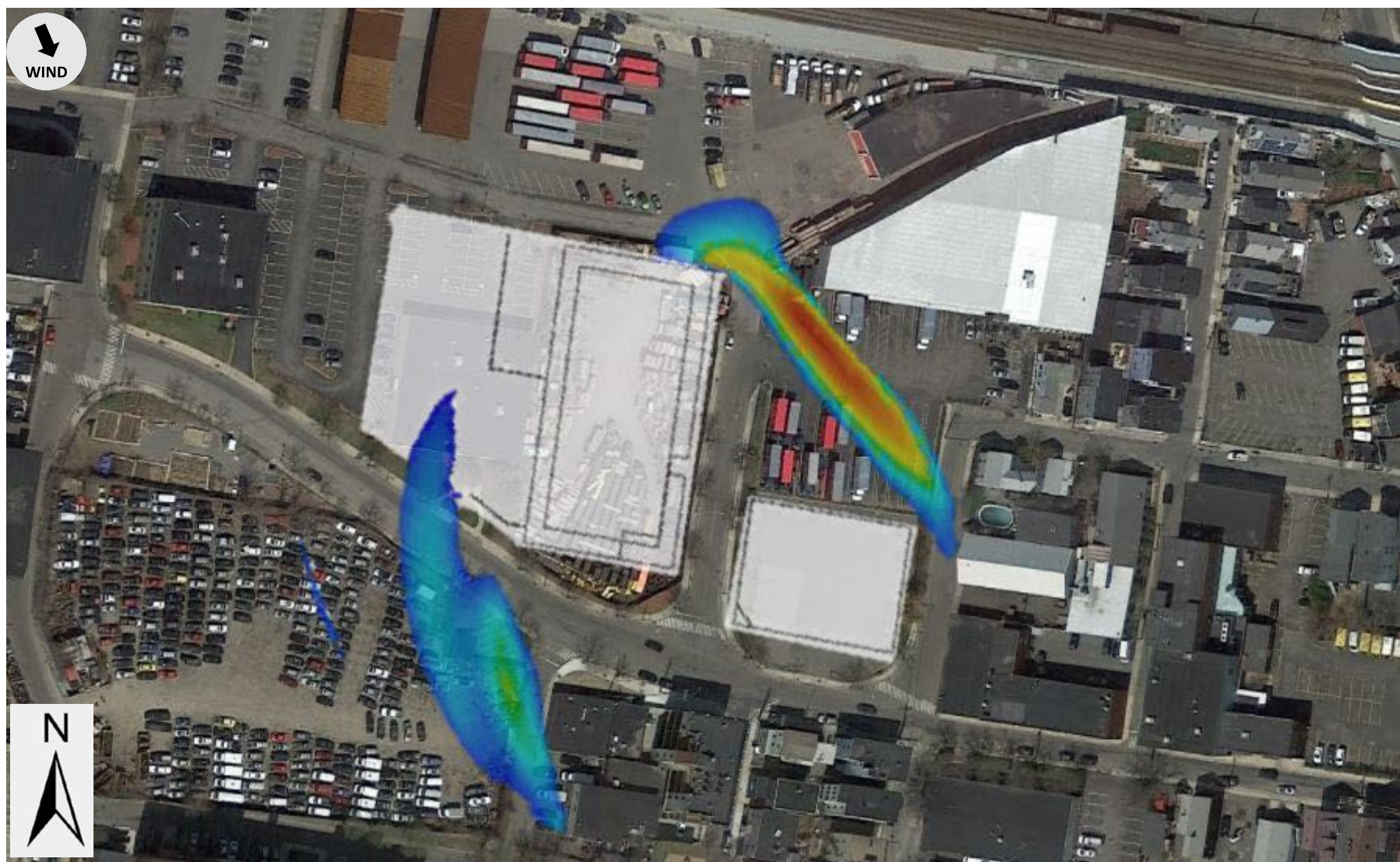
(Peak wind speeds are shown above normal meterological conditions from yellow to red. Colors green to blue depict speed less than the normal wind speeds.)

Figure 20
Wind out of WNW
Peak Wind Disturbances Around the Proposed Buildings
Boynton Yards Project, Somerville, MA



(Peak wind speeds are shown above normal meteorological conditions from yellow to red. Colors green to blue depict speed less than the normal wind speeds.)

Figure 21
Wind out of NW
Peak Wind Disturbances Around the Proposed Buildings
Boynton Yards Project, Somerville, MA



(Peak wind speeds are shown above normal meterological conditions from yellow to red. Colors green to blue depict speed less than the normal wind speeds.)

Figure 22
Wind out of NNW
Peak Wind Disturbances Around the Proposed Buildings
Boynton Yards Project, Somerville, MA

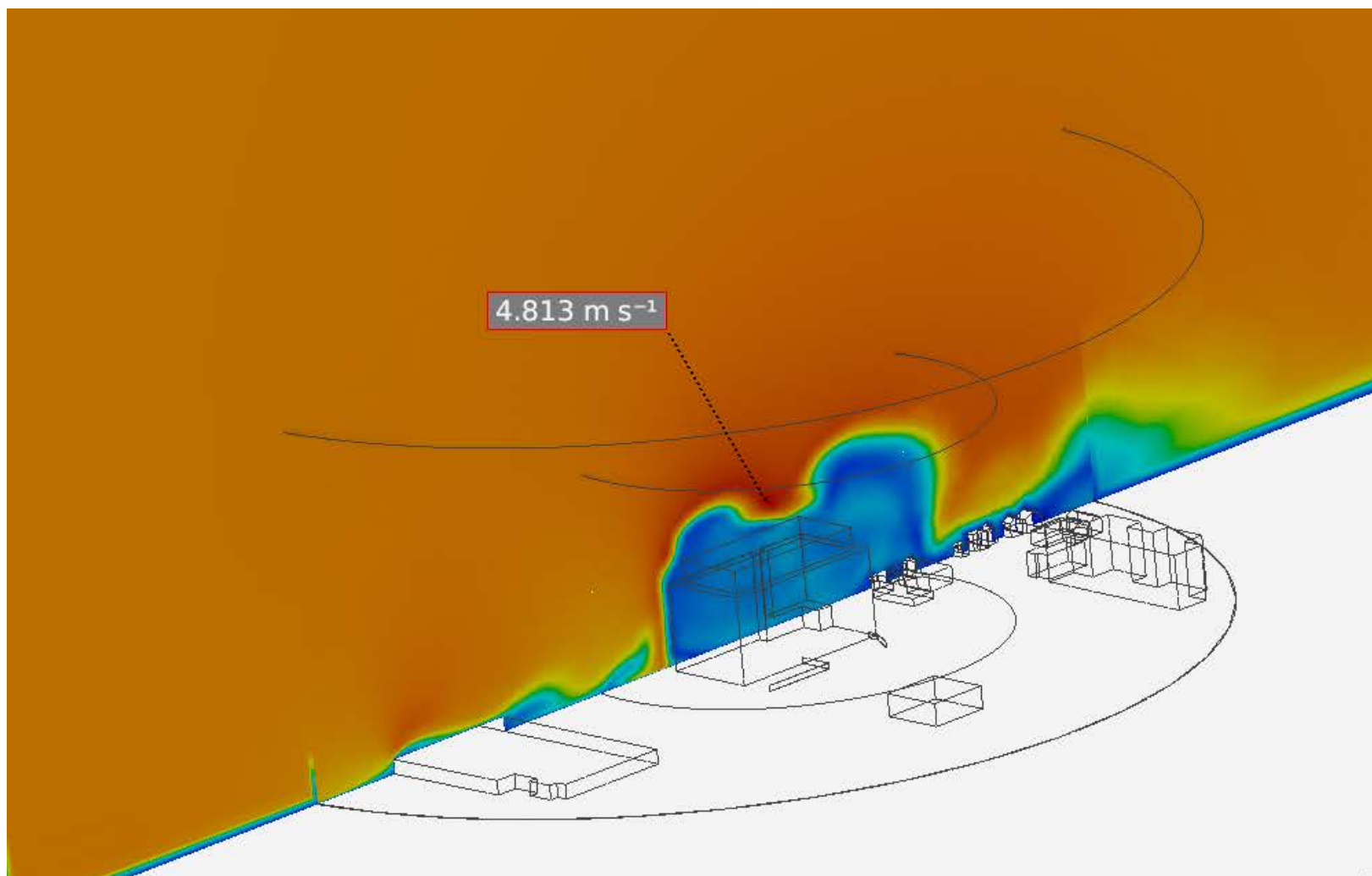


Figure 23
Wind out of NNW
Vertical Wind Speed Profile Flow Between the Buildings
Boynton Yards Project, Somerville, MA

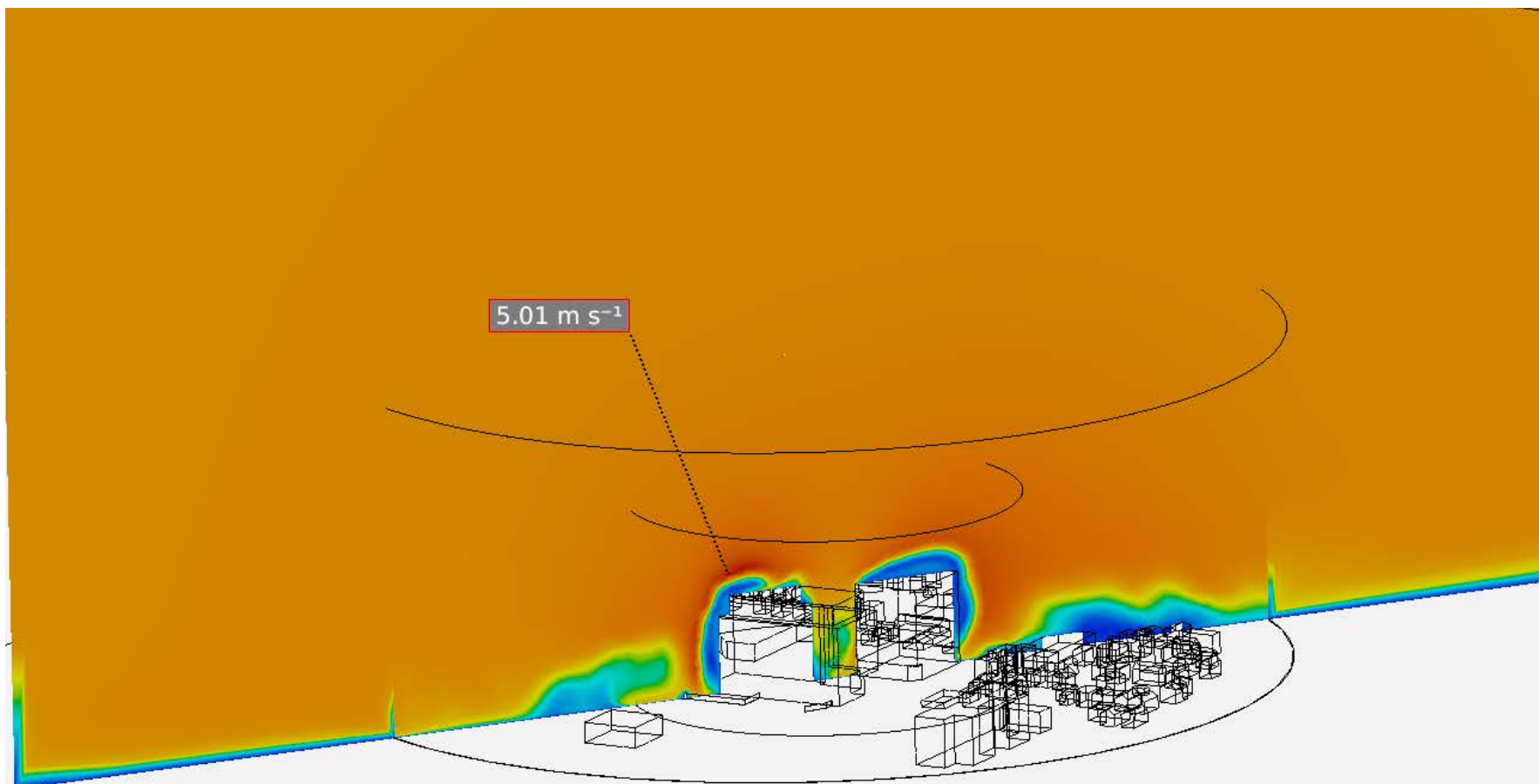


Figure 24
Wind out of NNE
Vertical Wind Speed Profile Flow Across the Buildings
Boynton Yards Project, Somerville, MA



Figure 25
Maximum Wind Speed Locations
Boynton Yards Project, Somerville, MA

Appendix B:

Tables

- Table 1: Effective Gusts in Exceedance of 31 mph by Direction
- Table 2: Normal Wind Direction Occurrence
- Table 3: Normal Wind Speed Occurrence by Direction
- Table 4: No-Build Amplified Wind Speed Occurrence by Direction
- Table 5: Build Amplified Wind Speed Occurrence by Direction

**Table 1: Effective Gusts in Exceedance of
31 mph by Direction**

Wind Direction	Season (%)				
	Spring	Summer	Fall	Winter	Total
N	0.0	0.0	0.0	0.0	0.1
NNE	0.1	0.0	0.1	0.0	0.2
NE	0.0	0.0	0.1	0.1	0.2
ENE	0.0	0.0	0.0	0.0	0.1
E	0.0	0.0	0.0	0.1	0.0
ESE*	0.0	0.0	0.0	0.0	0.0
SE*	0.0	0.0	0.0	0.0	0.0
SSE*	0.0	0.0	0.0	0.0	0.0
S	0.0	0.0	0.0	0.0	0.1
SSW	0.1	0.0	0.0	0.1	0.3
SW*	0.0	0.0	0.0	0.0	0.0
WSW	0.0	0.0	0.1	0.1	0.2
W	0.3	0.0	0.1	0.5	0.9
WNW	0.1	0.0	0.0	0.2	0.3
NW	0.1	0.0	0.0	0.1	0.2
NNW	0.0	0.0	0.0	0.0	0.1
Total	0.8	0.1	0.6	1.2	2.7

* This wind direction was not rerun because the final changes would have little effect.

Table 2: Normal Wind Direction Occurrence

Wind Direction	Season (%)				Annual
	Spring	Summer	Fall	Winter	
N	1.1	0.7	1.5	1.5	4.8
NNE	0.9	0.7	1.3	0.7	3.6
NE	1.2	0.9	1.1	0.5	3.7
ENE	1.7	1.5	1.1	0.6	4.9
E	1.8	1.6	1.0	0.7	5.0
ESE	1.6	2.0	1.2	0.7	5.4
SE	0.9	1.3	0.8	0.5	3.5
SSE	0.7	0.7	0.8	0.7	2.8
S	1.1	1.4	1.2	0.8	4.6
SSW	2.6	3.2	2.2	1.6	9.6
SW	2.0	2.8	2.6	2.4	9.8
WSW	1.1	1.9	1.6	1.7	6.3
W	2.1	2.0	2.1	3.2	9.4
WNW	2.6	2.2	2.8	4.0	11.7
NW	2.2	1.5	2.2	2.4	8.3
NNW	1.6	0.8	1.9	2.2	6.5

Table 3: Normal Wind Speed Occurrence by Direction

Wind Direction	Frequency (%)				
	<=12 mph	>12 <=15 mph	>15 <=19 mph	>19 <=27 mph	>27 mph
N	3.6	0.5	0.4	0.2	0.0
NNE	2.5	0.5	0.4	0.3	0.1
NE	2.2	0.5	0.6	0.4	0.1
ENE	3.4	0.9	0.4	0.2	0.0
E	3.7	0.8	0.3	0.1	0.0
ESE	3.8	1.0	0.5	0.2	0.0
SE	3.3	0.1	0.1	0.0	0.0
SSE	2.5	0.2	0.1	0.0	0.0
S	3.7	0.5	0.2	0.1	0.0
SSW	6.2	1.6	1.2	0.5	0.1
SW	6.0	2.1	1.2	0.5	0.0
WSW	3.8	1.5	0.8	0.2	0.0
W	4.9	2.1	1.6	0.8	0.0
WNW	6.5	2.2	2.0	1.0	0.0
NW	5.0	1.7	1.1	0.5	0.0
NNW	4.8	1.1	0.5	0.3	0.0
Total	65.9	17.1	11.3	5.3	0.47

Table 4: No-Build Amplified Wind Speed Occurrence by Direction

Wind Direction	Frequency (%)				
	<=12 mph	>12 <=15 mph	>15 <=19 mph	>19 <=27 mph	>27 mph
N	4.80	0.00	0.00	0.00	0.00
NNE	3.64	0.00	0.00	0.00	0.00
NE	3.62	0.05	0.01	0.00	0.00
ENE	4.94	0.00	0.00	0.00	0.00
E	4.98	0.00	0.00	0.00	0.00
ESE	5.43	0.00	0.00	0.00	0.00
SE	3.52	0.00	0.00	0.00	0.00
SSE	2.78	0.00	0.00	0.00	0.00
S	4.56	0.00	0.00	0.00	0.00
SSW	9.64	0.00	0.00	0.00	0.00
SW	9.84	0.00	0.00	0.00	0.00
WSW	6.26	0.00	0.00	0.00	0.00
W	9.40	0.00	0.00	0.00	0.00
WNW	10.93	0.68	0.08	0.00	0.00
NW	8.33	0.00	0.00	0.00	0.00
NNW	6.51	0.00	0.00	0.00	0.00
Total	99.2	0.7	0.1	0.0	0.00

Table 5: Build Amplified Wind Speed Occurrence by Direction

Wind Direction	Frequency (%)				
	<=12 mph	>12 <=15 mph	>15 <=19 mph	>19 <=27 mph	>27 mph
N	3.6	0.6	0.4	0.3	0.0
NNE	2.4	0.5	0.4	0.3	0.1
NE	2.1	0.5	0.6	0.4	0.1
ENE	3.8	0.7	0.3	0.2	0.0
E	3.8	0.7	0.3	0.1	0.0
ESE*	4.1	0.8	0.4	0.1	0.0
SE*	3.2	0.2	0.1	0.0	0.0
SSE*	2.4	0.2	0.1	0.1	0.0
S	3.5	0.6	0.3	0.2	0.0
SSW	5.7	1.7	1.5	0.7	0.1
SW*	8.1	1.2	0.5	0.1	0.0
WSW	2.9	1.6	1.2	0.6	0.0
W	3.3	2.2	2.1	1.7	0.2
WNW	6.1	2.2	2.1	1.2	0.0
NW	4.7	1.7	1.3	0.6	0.0
NNW	4.2	1.3	0.7	0.3	0.0
Total	63.5	16.6	12.3	6.9	0.74

* This wind direction was not rerun because the final changes would have little effect.