PRELIMINARY RESULTS

EMERYVILLE PUBLIC MARKET – PARCEL B

EMERYVILLE, CA

PEDESTRIAN WIND STUDY
RWDI # 1902969
May 13, 2019

SUBMITTED TO

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EXECUTIVE SUMMARY

The following document provides the preliminary results for the Pedestrian Wind Study conducted for the proposed Emeryville Public Market – Parcel B (Project) located in Emeryville, CA. The project site, photographs of the wind tunnel study model and the wind statistics recorded at a nearby airport with long-term, reliable meteorological data are shown in Images 1, 2A through 2C and 3, respectively. Since Emeryville does not have an adopted wind significance threshold, the City of Oakland planning code requirement which deals with pedestrian hazard as related to wind force was used. This criterion is also described to assist with the interpretation of the results presented. For information purposes, we also provide an assessment against applicable pedestrian wind comfort criteria.

The predicted wind hazard and comfort conditions pertaining to the three site and surrounding configurations assessed are graphically depicted on site plans in Figures 1A through 2C. These conditions and the associated wind speeds are presented in Tables 1 and 2. These results are presented in the attached results package and can be summarized as follows:

Wind Hazard Conditions:

- For the existing configuration (without the project), wind speeds at all locations are anticipated to comply with the wind hazard criterion except for a location on the east side of the railroad tracks near the pedestrian bridge tower.
- With the addition of the proposed building to the site (existing + project configuration), wind speeds at all locations are expected to meet the wind hazard criterion including the location on the east side of the railroad tracks near the pedestrian bridge tower.
- The wind hazard criterion is predicted to be met after adding the future buildings (5850 Shellmound Way and Parcel F) to the southwest of the project (project + cumulative configuration).

Wind Comfort Conditions:

- Wind speeds at 24 locations in the existing configuration (without the project) are expected to exceed the comfort criterion. Most of these locations are to the west of the project site and around the building east of Overland Avenue.
- With the addition of the proposed building to the site (existing + project configuration), wind conditions are expected to be moderated and the number of locations where wind speeds exceed the comfort criterion are predicted to be 15. In general, the addition of the proposed building has a positive effect on the wind conditions.
- For the project + cumulative configuration, wind comfort conditions are expected to be similar to those for the existing + project configuration, with 18 locations exceeding the comfort criterion.

Image 1: Aerial View of Site and Surroundings (Photo Courtesy of Google™ Earth)

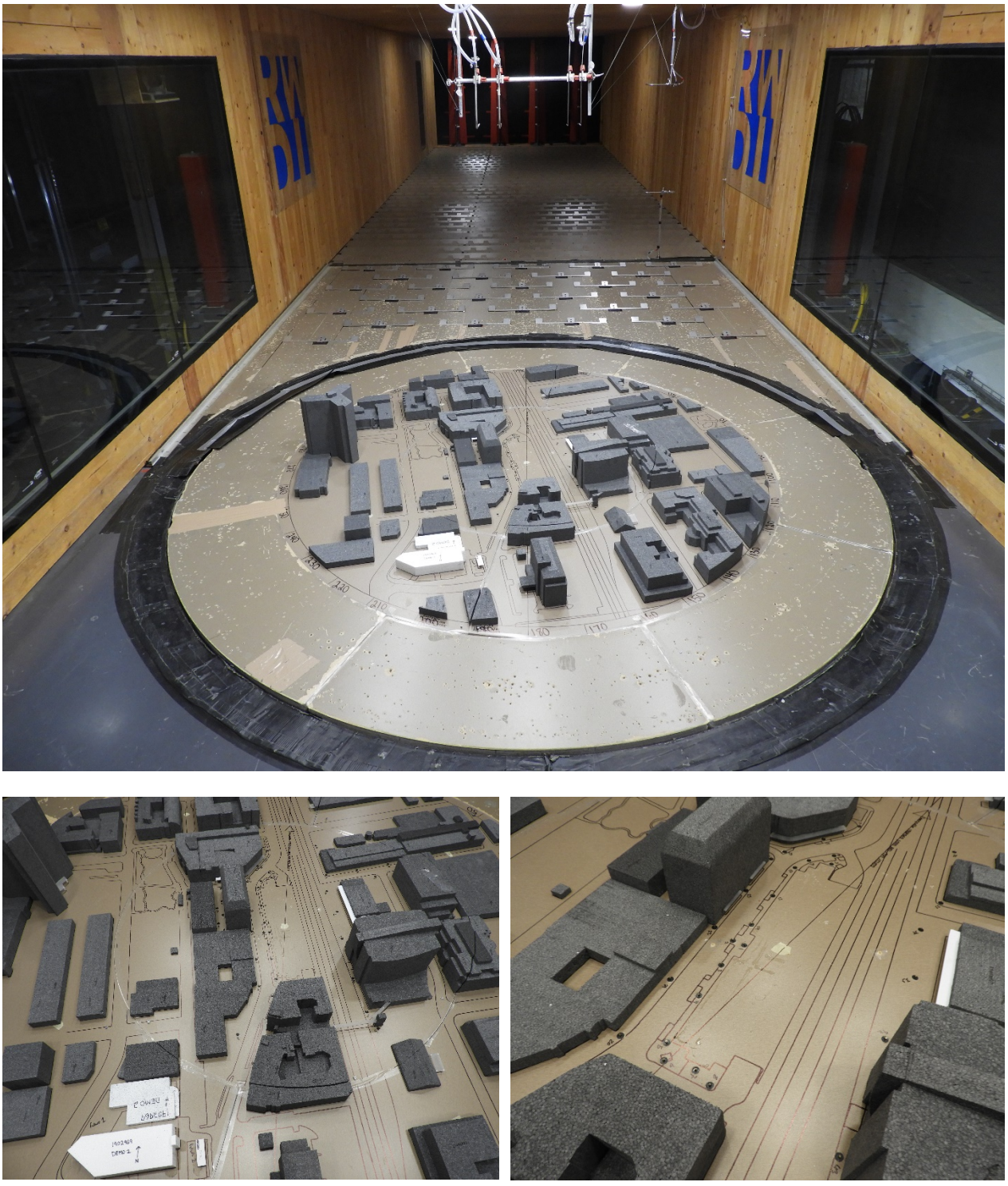


Image 2A: Wind Tunnel Study Model – Existing Configuration

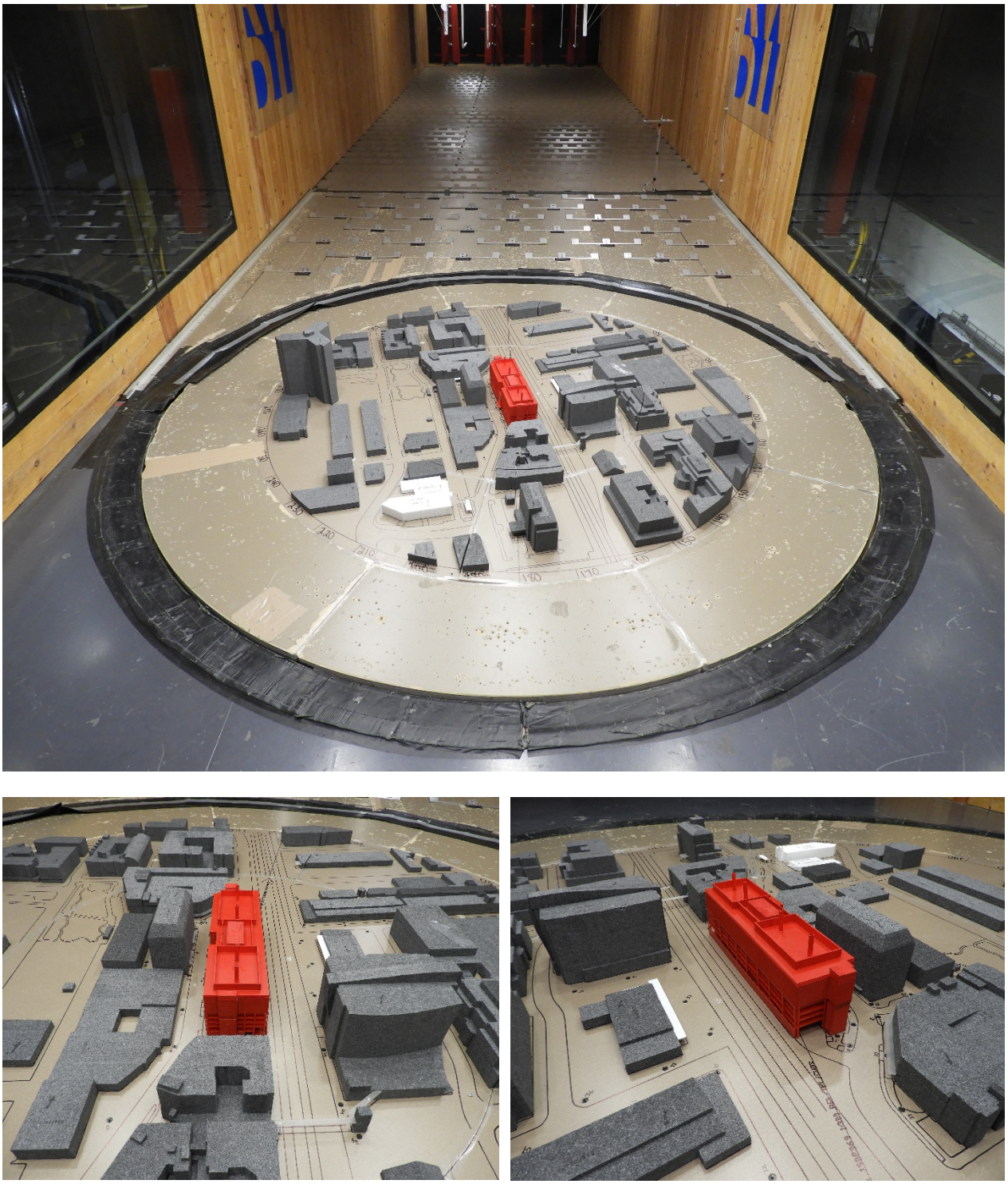


Image 2B: Wind Tunnel Study Model – Existing + Project Configuration

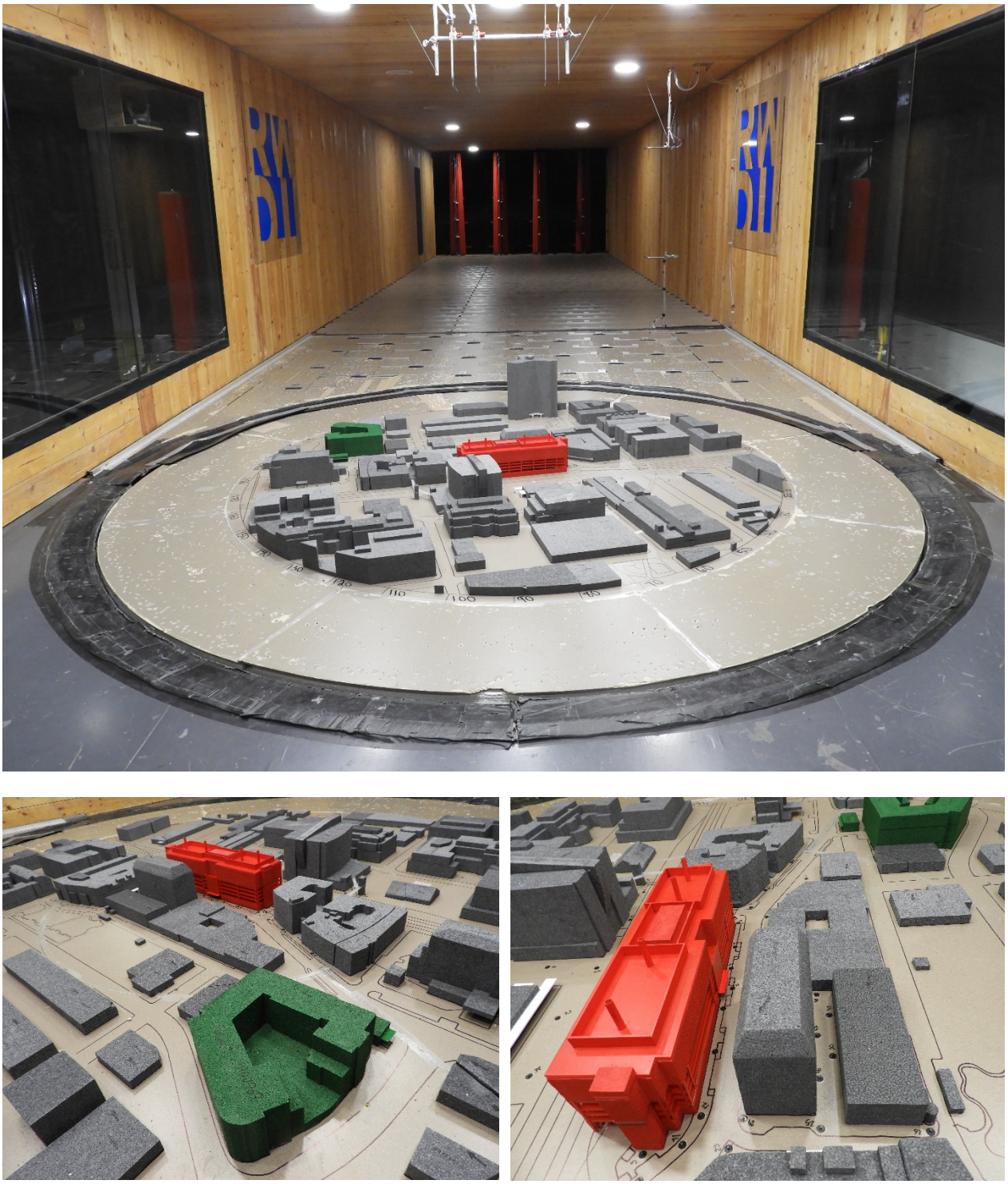


Image 2C: Wind Tunnel Study Model – Project + Cumulative Configuration

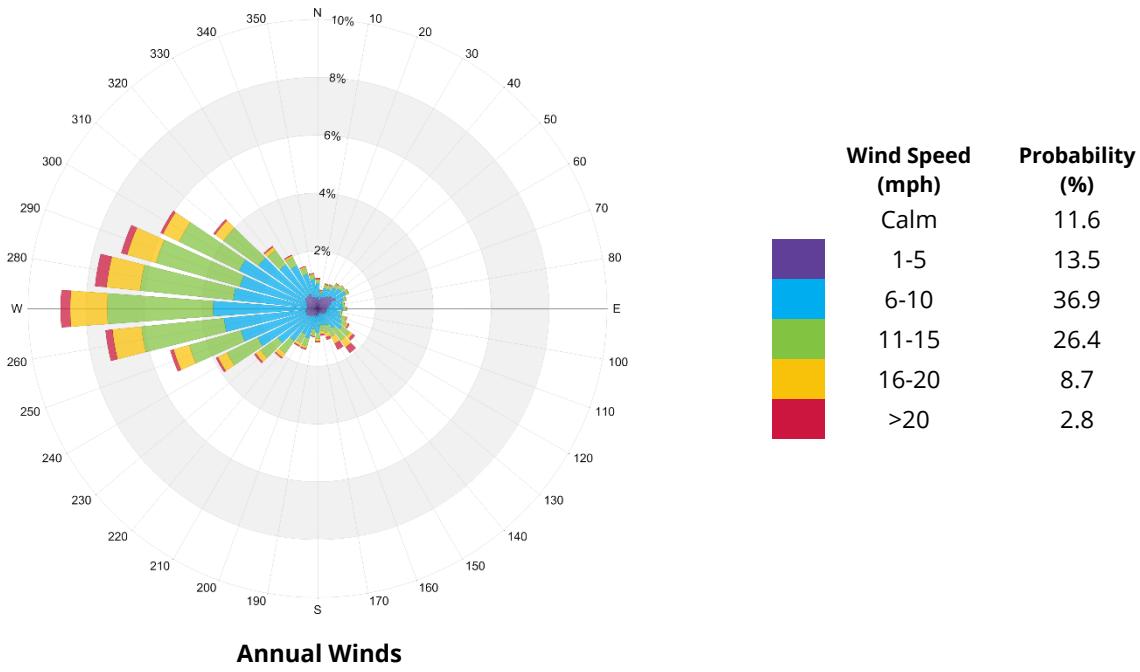


Image 3: Directional distribution of winds approaching Metropolitan Oakland International Airport from 1987 to 2017

Planning Code Requirements

Since the City of Emeryville does not have a wind significance threshold, the City of Oakland's requirements were considered. In Oakland, a wind analysis needs to be done if the height of the project is 100 feet or greater (measured to the roof) and one of the following conditions exists: (a) the project is located adjacent to a substantial water body (i.e. Oakland Estuary, Lake Merritt or San Francisco Bay); or (b) the project is located in the downtown. Since the proposed project (approximately 113 feet tall) exceeds 100 feet height and is adjacent to San Francisco Bay, it is subject to the thresholds of significance.

For the purposes of this study, the City of Oakland considers a significant wind impact to occur if a project were to "Create winds exceeding 36 mph for more than one hour during daylight hours of the year". The Planning Code defines these wind speeds in terms of equivalent wind speeds, and average wind speed (mean velocity), adjusted to include the level of gustiness and turbulence. Equivalent wind speeds were calculated according to the specifications in the City of Oakland Significant Wind Impact Criterion, whereby the mean hourly wind speed is increased when the turbulence intensity is greater than 15% according to the following formula:

$$\boldsymbol{EWS} = \boldsymbol{V_m} \times (\mathbf{2} \times \boldsymbol{TI} + \mathbf{0.7})$$

where $\boldsymbol{EWS}$ = equivalent wind speed

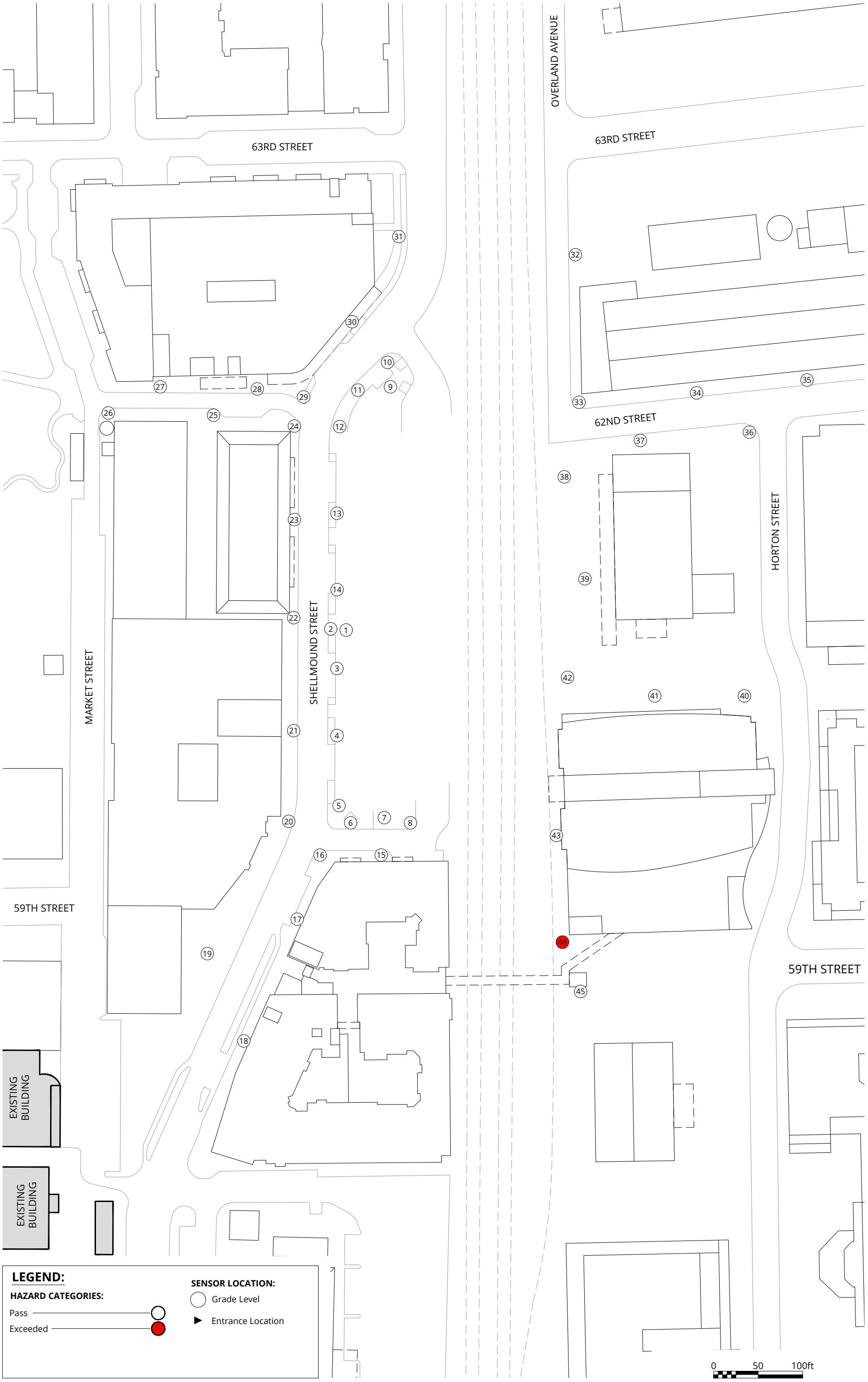
$\boldsymbol{V_m}$ = mean pedestrian-level wind speed

$\boldsymbol{TI}$ = turbulence intensity

Pedestrian Comfort

Although not applicable towards Significant Wind Impacts as defined by the City of Oakland, wind comfort speeds have been calculated for informational purposes. The comfort criteria are that wind speeds do not exceed 11 mph for more than 10% of the time during the year, when calculated for daylight hours, in substantial pedestrian use areas. A lower wind speed threshold of 7 mph may be considered for public seating areas where calmer wind conditions are ideal.

FIGURES



Pedestrian Wind Hazard Conditions
Existing
Annual

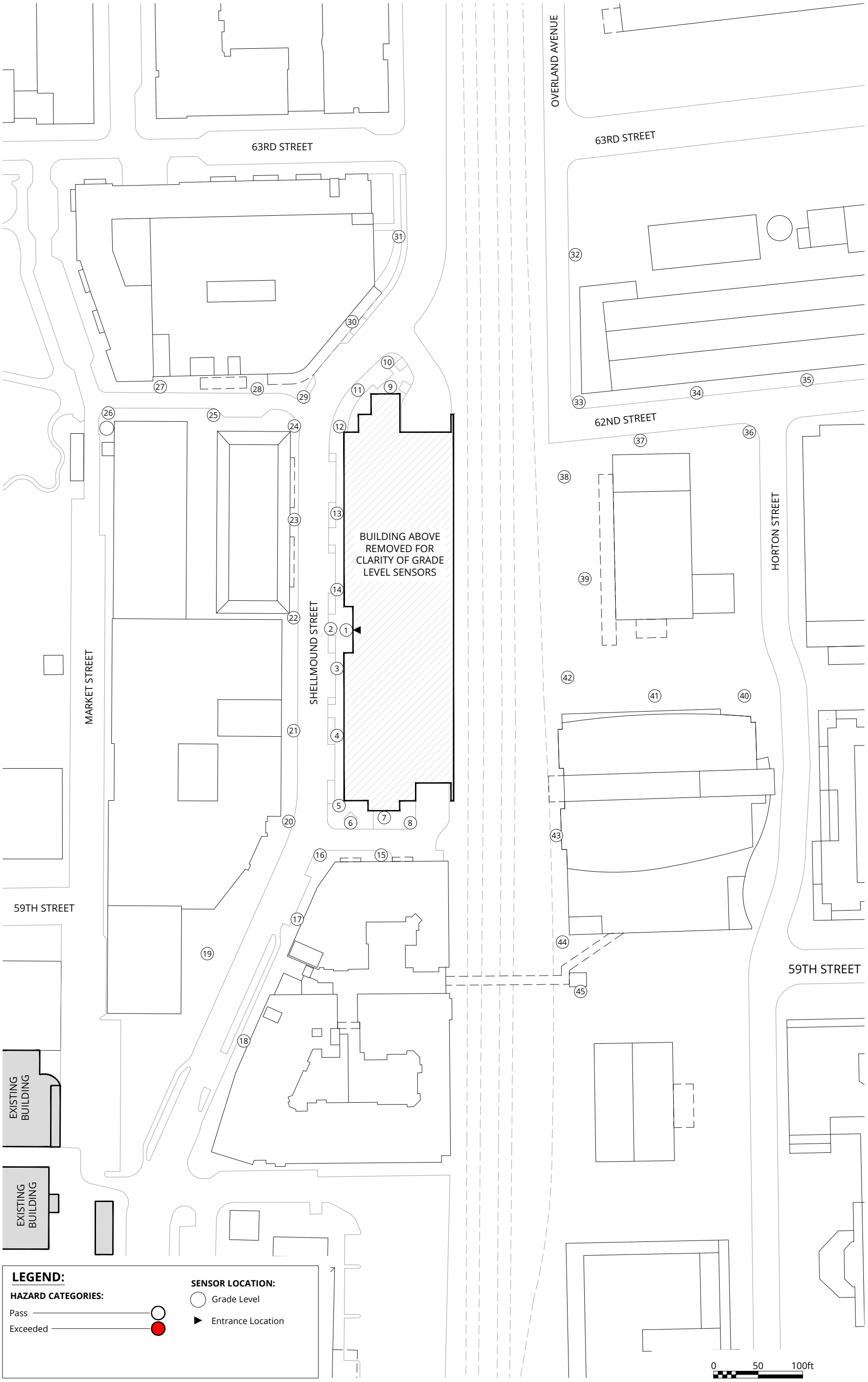
Emeryville Public Market - Parcel B - Emeryville, CA

True North

Project #1902969

Drawn by: GRE	Figure: 1A
Approx. Scale:	1"=100'
Date Revised:	May 13, 2019

AR2083



Pedestrian Wind Hazard Conditions
Existing + Project
Annual

Emeryville Public Market - Parcel B - Emeryville, CA

True North

Project #1902969

Drawn by: GRE	Figure: 1B
Approx. Scale:	1"=100'
Date Revised:	May 13, 2019

AR2084

63RD STREET

OVERLAND AVENUE

63RD STREET

62ND STREET

HORTON STREET

BUILDING ABOVE REMOVED FOR CLARITY OF GRADE LEVEL SENSORS

SHELLMOUND STREET

MARKET STREET

59TH STREET

59TH STREET

FUTURE BUILDING

FUTURE BUILDING

LEGEND:

HAZARD CATEGORIES:

Pass

Exceeded

SENSOR LOCATION:

Grade Level

Entrance Location

0 50 100ft

Pedestrian Wind Hazard Conditions
Project + Cumulative
Annual

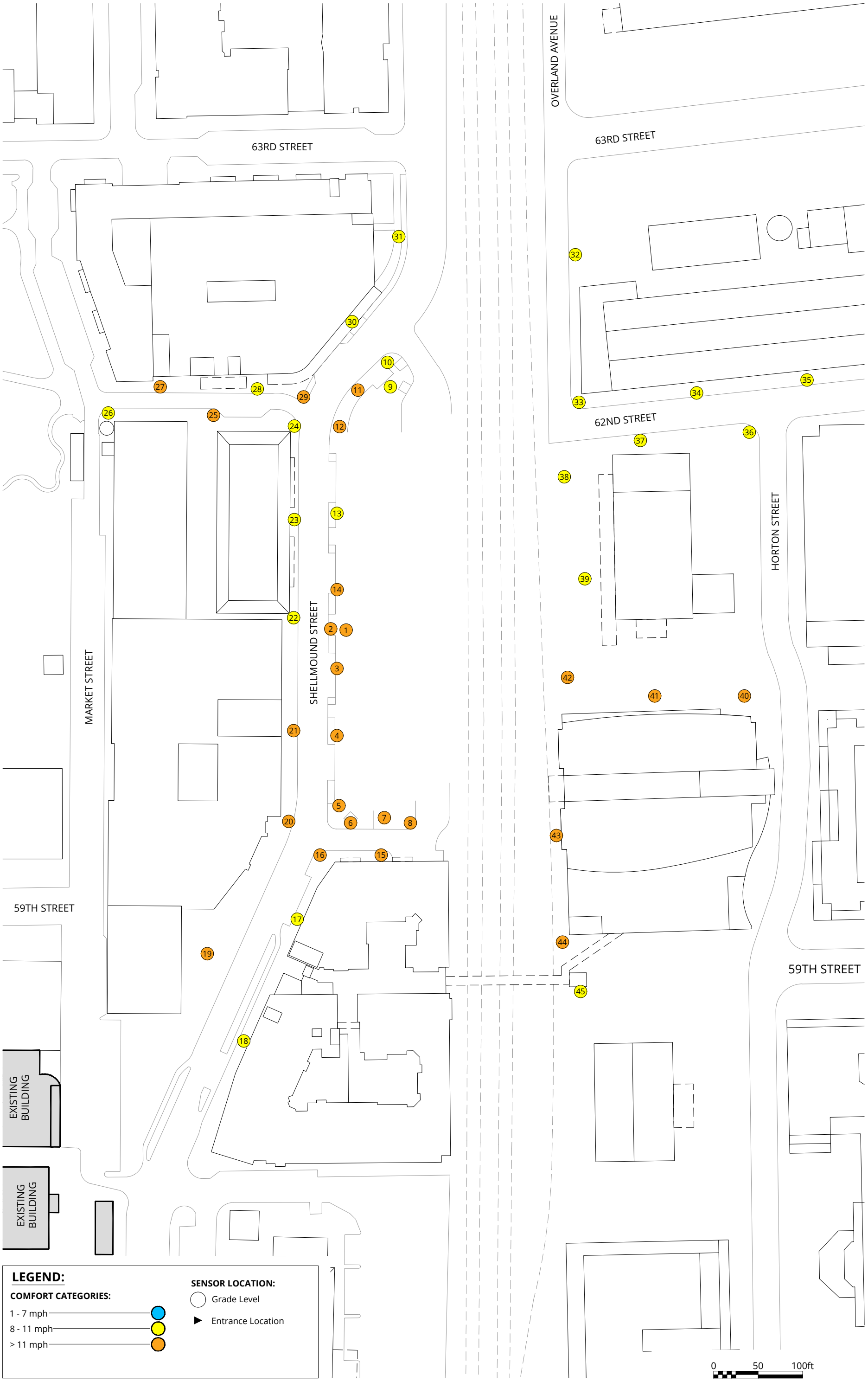
Emeryville Public Market - Parcel B - Emeryville, CA

True North

Project #1902969

Drawn by:	GRE	Figure:	1C
Approx. Scale:	1"=100'		
Date Revised:	May 13, 2019		

AR2085



Pedestrian Wind Comfort Conditions
Existing
Annual

Emeryville Public Market - Parcel B - Emeryville, CA

True North

Project #1902969

Drawn by: GRE	Figure: 2A
Approx. Scale:	1"=100'
Date Revised:	May 13, 2019

AR2086

63RD STREET

OVERLAND AVENUE

63RD STREET

62ND STREET

HORTON STREET

59TH STREET

MARKET STREET

SHELLMOUND STREET

BUILDING ABOVE REMOVED FOR CLARITY OF GRADE LEVEL SENSORS

EXISTING BUILDING

EXISTING BUILDING

LEGEND:

COMFORT CATEGORIES:

1 - 7 mph

8 - 11 mph

> 11 mph

SENSOR LOCATION:

Grade Level

Entrance Location

0 50 100ft

Pedestrian Wind Comfort Conditions

Existing + Project

Annual

Emeryville Public Market - Parcel B - Emeryville, CA

True North

Project #1902969

Drawn by: GRE	Figure: 2B
Approx. Scale:	1"=100'
Date Revised:	May 13, 2019

AR2087

63RD STREET

OVERLAND AVENUE

63RD STREET

62ND STREET

HORTON STREET

BUILDING ABOVE REMOVED FOR CLARITY OF GRADE LEVEL SENSORS

SHELLMOUND STREET

MARKET STREET

59TH STREET

59TH STREET

FUTURE BUILDING

FUTURE BUILDING

LEGEND:

COMFORT CATEGORIES:

1 - 7 mph

8 - 11 mph

> 11 mph

SENSOR LOCATION:

Grade Level

Entrance Location

0 50 100ft

Pedestrian Wind Comfort Conditions
Project + Cumulative
Annual

Emeryville Public Market - Parcel B - Emeryville, CA

True North

Project #1902969

Drawn by: GRE	Figure: 2C
Approx. Scale:	1"=100'
Date Revised:	May 13, 2019

AR2088

TABLES

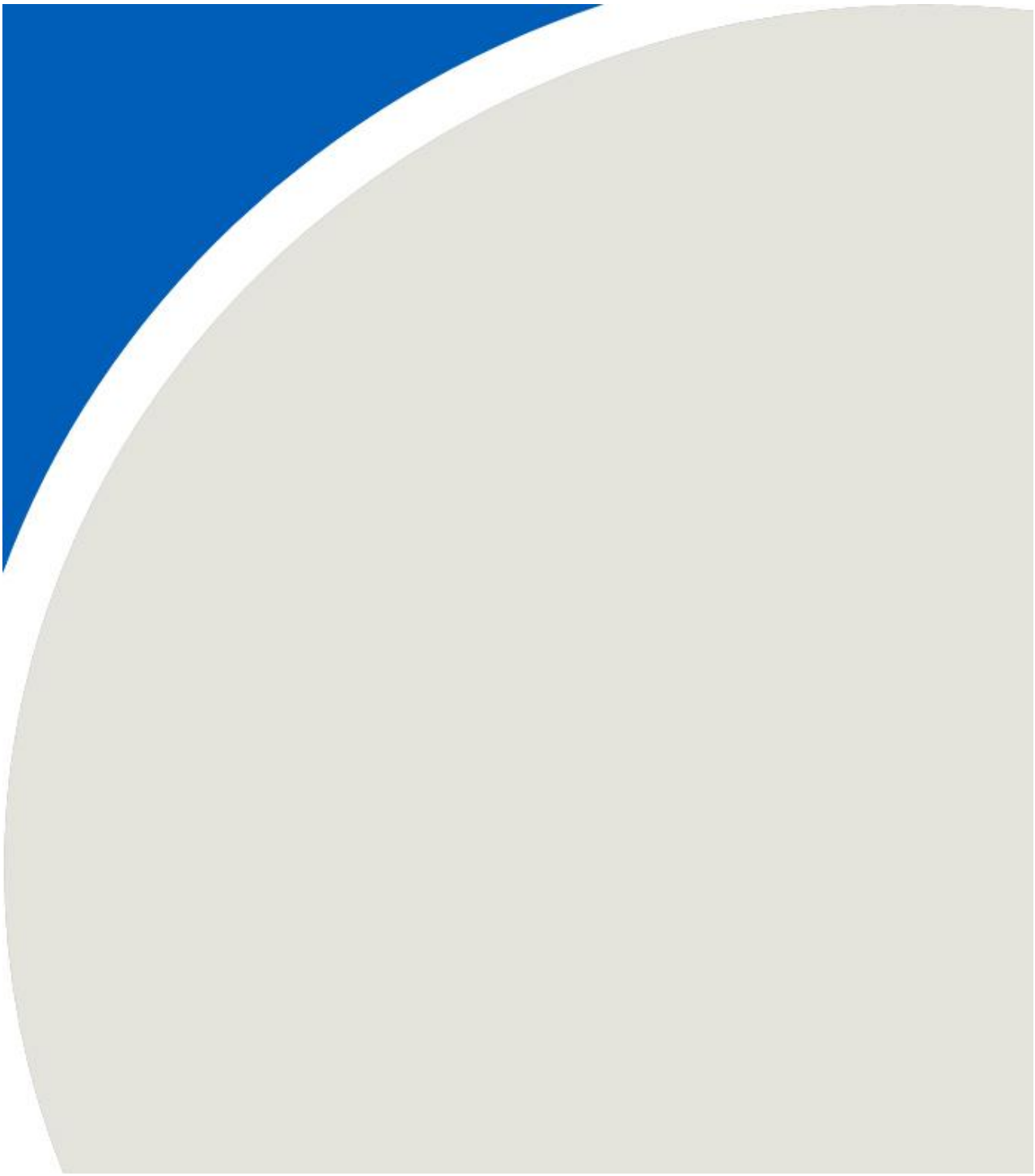


Table 1: Wind Hazard Conditions

Location	Existing			Existing + Project				Project + Cumulative			
	Wind Speed Exceeded 1hr/year (mph)	Hours per Year Wind Speed Exceeds Hazard Criteria	Exceeds	Wind Speed Exceeded 1hr/year (mph)	Hours per Year Wind Speed Exceeds Hazard Criteria	Hours Change Relative to Existing	Exceeds	Wind Speed Exceeded 1hr/year (mph)	Hours per Year Wind Speed Exceeds Hazard Criteria	Hours Change Relative to Existing	Exceeds
1	28	0		25	0	0		25	0	0	
2	30	0		25	0	0		25	0	0	
3	27	0		23	0	0		22	0	0	
4	25	0		19	0	0		21	0	0	
5	31	0		26	0	0		27	0	0	
6	33	0		30	0	0		30	0	0	
7	32	0		31	0	0		31	0	0	
8	31	0		33	0	0		32	0	0	
9	24	0		20	0	0		21	0	0	
10	24	0		28	0	0		28	0	0	
11	27	0		32	0	0		32	0	0	
12	29	0		32	0	0		32	0	0	
13	30	0		29	0	0		29	0	0	
14	35	0		33	0	0		33	0	0	
15	28	0		33	0	0		33	0	0	
16	34	0		30	0	0		30	0	0	
17	24	0		21	0	0		21	0	0	
18	24	0		22	0	0		25	0	0	
19	25	0		24	0	0		27	0	0	
20	28	0		22	0	0		22	0	0	
21	29	0		20	0	0		21	0	0	
22	27	0		27	0	0		27	0	0	
23	23	0		26	0	0		25	0	0	
24	29	0		24	0	0		24	0	0	
25	34	0		33	0	0		33	0	0	
26	25	0		25	0	0		25	0	0	
27	28	0		28	0	0		28	0	0	
28	25	0		24	0	0		25	0	0	
29	34	0		29	0	0		30	0	0	
30	24	0		27	0	0		27	0	0	
31	25	0		24	0	0		24	0	0	
32	25	0		22	0	0		22	0	0	
33	22	0		27	0	0		26	0	0	
34	24	0		20	0	0		19	0	0	
35	21	0		21	0	0		22	0	0	
36	28	0		26	0	0		28	0	0	

Table 1: Wind Hazard Conditions

Location	Existing			Existing + Project				Project + Cumulative			
	Wind Speed Exceeded 1hr/year (mph)	Hours per Year Wind Speed Exceeds Hazard Criteria	Exceeds	Wind Speed Exceeded 1hr/year (mph)	Hours per Year Wind Speed Exceeds Hazard Criteria	Hours Change Relative to Existing	Exceeds	Wind Speed Exceeded 1hr/year (mph)	Hours per Year Wind Speed Exceeds Hazard Criteria	Hours Change Relative to Existing	Exceeds
37	21	0		22	0	0		22	0	0	
38	25	0		27	0	0		26	0	0	
39	24	0		25	0	0		24	0	0	
40	32	0		27	0	0		27	0	0	
41	32	0		27	0	0		27	0	0	
42	31	0		28	0	0		29	0	0	
43	30	0		28	0	0		28	0	0	
44	40	3	e	28	0	-3		28	0	-3	
45	19	0		17	0	0		17	0	0	

SUMMARY	Average (mph)	Total Hours	Total	Average (mph)	Total Hours	Hours Change	Total	Average (mph)	Total Hours	Hours Change	Total
	28	**3**	**1 ---- 45**	**26**	**0**	**-3**	**0 ---- 45**	**26**	**0**	**-3**	**0 ---- 45**

Table 2: Wind Comfort Conditions

Location	Existing			Existing + Project				Project + Cumulative			
	Wind Speed Exceeded 10% of Time (mph)	% of Time Wind Speed Exceeds 11 mph (%)	Exceeds	Wind Speed Exceeded 10% of Time (mph)	% of Time Wind Speed Exceeds 11 mph (%)	Speed Change Relative to Existing (mph)	Exceeds	Wind Speed Exceeded 10% of Time (mph)	% of Time Wind Speed Exceeds 11 mph (%)	Speed Change Relative to Existing (mph)	Exceeds
1	13	19	e	11	10	-2		11	10	-2	
2	13	18	e	10	6	-3		10	6	-3	
3	12	15	e	11	10	-1		10	6	-2	
4	12	14	e	9	4	-3		10	5	-2	
5	15	30	e	12	16	-3	e	13	19	-2	e
6	16	34	e	14	24	-2	e	14	27	-2	e
7	15	30	e	14	26	-1	e	15	26	0	e
8	14	24	e	15	31	1	e	15	31	1	e
9	10	7		8	3	-2		8	3	-2	
10	10	6		13	18	3	e	13	18	3	e
11	12	12	e	13	22	1	e	14	23	2	e
12	12	12	e	14	25	2	e	14	25	2	e
13	10	7		14	22	4	e	14	25	4	e
14	12	14	e	14	21	2	e	14	21	2	e
15	13	19	e	15	27	2	e	15	28	2	e
16	16	34	e	15	29	-1	e	14	27	-2	e
17	10	7		9	5	-1		9	4	-1	
18	11	10		10	7	-1		12	13	1	e
19	12	14	e	11	10	-1		12	16	0	e
20	12	17	e	10	6	-2		10	7	-2	
21	12	16	e	9	3	-3		9	3	-3	
22	10	6		11	10	1		11	10	1	
23	8	2		11	10	3		11	10	3	
24	10	7		11	10	1		11	10	1	
25	15	26	e	14	24	-1	e	15	26	0	e
26	10	5		9	5	-1		10	5	0	
27	12	12	e	11	10	-1		12	13	0	e
28	11	10		11	10	0		11	10	0	
29	15	23	e	13	17	-2	e	13	19	-2	e
30	9	5		13	17	4	e	13	18	4	e
31	9	5		11	10	2		11	10	2	
32	10	7		9	3	-1		9	3	-1	
33	11	10		11	10	0		11	10	0	
34	9	3		7	1	-2		7	1	-2	
35	10	7		9	4	-1		9	4	-1	
36	11	10		10	5	-1		10	5	-1	

Table 2: Wind Comfort Conditions

Location	Existing			Existing + Project				Project + Cumulative			
	Wind Speed Exceeded 10% of Time (mph)	% of Time Wind Speed Exceeds 11 mph (%)	Exceeds	Wind Speed Exceeded 10% of Time (mph)	% of Time Wind Speed Exceeds 11 mph (%)	Speed Change Relative to Existing (mph)	Exceeds	Wind Speed Exceeded 10% of Time (mph)	% of Time Wind Speed Exceeds 11 mph (%)	Speed Change Relative to Existing (mph)	Exceeds
37	8	2		9	3	1		9	4	1	
38	11	10		11	10	0		11	10	0	
39	11	10		10	7	-1		10	7	-1	
40	15	26	e	11	10	-4		11	10	-4	
41	15	26	e	11	10	-4		11	10	-4	
42	15	27	e	11	10	-4		11	10	-4	
43	14	22	e	9	5	-5		9	5	-5	
44	18	39	e	14	22	-4	e	13	21	-5	e
45	8	1		7	1	-1		7	1	-1	

SUMMARY	Average (mph)	Average (%)	Total	Average (mph)	Average (%)	Speed Change (mph)	Total	Average (mph)	Average (%)	Speed Change (mph)	Total
	12	**15**	**24 ---- 45**	**11**	**12**	**-1**	**15 ---- 45**	**11**	**13**	**-1**	**18 ---- 45**

APPENDIX A - DESCRIBES SCOPE OF WORK

PEDESTRIAN LEVEL WINDS

Pedestrian level wind services evaluate wind speeds and frequencies and how they impact the comfort and safety of people in outdoor spaces.

WIND TUNNEL TESTING

A scale replica of the redevelopment site and surroundings will be tested in a wind tunnel to simulate the winds approaching and interacting with the project site. This is the most advanced and accurate means of predicting wind speeds around buildings and structures.

Wind Climate Analysis

As required by the City of Emeryville, data describing the speed, direction and frequency of occurrence of wind gathered at Metropolitan Oakland International Airport between 1982 and 2012 will be used for this study.

Proximity Model

A proximity model of the existing buildings and relevant surroundings within an approximate 1600 foot radius of the center of the development site will be constructed at an approximate scale (i.e., 1:400 scale). The buildings immediately surrounding the study site will be modeled in more detail than buildings beyond this radius. The model will incorporate relevant topographic changes as applicable. Surroundings beyond the limits of the proximity model will be appropriately simulated by spires and roughness blocks situated on the wind tunnel floor upwind of the study model. This will provide an accurate representation of the wind speed and turbulence profiles of wind approaching the study model.

Scale Model Construction

A scale replica of the redevelopment site will be constructed. The scale will be selected so that it is appropriate for the size of the project, to capture the relevant architectural details and surroundings. A series of wind speed sensors that measure both mean and gusts will be installed on the model to measure wind conditions at key pedestrian areas. The sensors are meant to represent an average person's height, and we will work with the design team to locate sensors in all areas of interest. *The proposed test locations will be provided to the project team and City for review and comment prior to the testing.*

Wind Tunnel Testing

A boundary-layer wind tunnel will be used to simulate the natural wind speed and turbulence levels at the site. The wind tunnel is equipped with spires and dynamic roughness that will be used to simulate the approaching wind speed and turbulence profiles. *The context of the surrounding buildings to include during the Cumulative test configuration (as described below) and the need for testing this configuration will be confirmed with the project team and the City in advance of testing*.

PEDESTRIAN LEVEL WINDS

Pedestrian level wind services evaluate wind speeds and frequencies and how they impact the comfort and safety of people in outdoor spaces.

Two development configurations of the study site and surroundings will be tested:

- **Existing:** the existing surroundings, with any buildings currently on site, without the proposed development.
- **Existing plus Project:** the proposed development along with existing surroundings.

Optional, if required:

- **Existing plus Project plus Cumulative:** the proposed development, along with existing surrounding structures and surrounding future buildings.

Analysis

The data collected from the wind tunnel will be analyzed together with the the area's long-term meteorological statistics to predict how often selected wind speed ranges will occur at each location. Results will first be reviewed against the pedestrian wind comfort and safety criteria determined appropriate with the city. Results will be presented in a diagrammatic form, relating each measurement location with its resulting comfort/safety rating.

In the event that undesirable conditions are predicted, we will use our experience and judgment to suggest wind control strategies in an effort to improve conditions. If conditions are particularly severe in critical areas, we may recommend or the City may require additional testing to develop specific solutions and satisfy planning code requirements additional scope would be provided to accommodate this effort if required.

LEGEND:

COMFORT CATEGORIES:

1 - 7 mph

8 - 11 mph

> 11 mph