APPENDIX H

Pedestrian Wind Study

REPORT

SFMTA POTRERO YARD MODERNIZATION PROJECT

SAN FRANCISCO, CA

PEDESTRIAN WIND STUDY
RWDI # 2000654
September 4, 2020

SUBMITTED TO

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EXECUTIVE SUMMARY

RWDI was retained to conduct a pedestrian wind assessment for the proposed SFMTA Potrero Yard Modernization Project in San Francisco, CA (Image 1). Based on our wind-tunnel testing for the proposed development under the Existing, Existing + Project and Project + Cumulative configurations (Images 2A through 2C), and the local wind records (Image 3), the potential wind comfort and hazard conditions are predicted as shown on site plans in Figures 1A through 2C, while the associated wind speeds are listed in Tables 1.1 through 3. These results can be summarized as follows:

Wind Comfort:

- Existing wind speeds around the project site average 13 mph across all tested locations at grade level. For wind comfort conditions in the Existing + Project and Project + Cumulative configurations, average wind speeds are expected to be 12 mph and 11 mph, respectively.

- In the Existing configuration, 47 out of 70 grade level locations exceed the 11-mph criterion. In the Existing + Project and Project + Cumulative configurations, the number of locations at grade level where winds are predicted to exceed the 11-mph criterion are 37 and 31, respectively out of 70.

- At the podium level, average wind speeds are expected to be 15 mph, with 20 out of 27 locations exceeding the 11-mph criterion for both the Existing + Project and Project + Cumulative configurations.

Wind Hazard:

- Wind speeds comply with the hazard criterion at all tested locations except two (2) in the Existing configuration.

- With the addition of proposed project and wind reduction measures (proposed landscaping, re-entrant corner and porous north, east and west façade) in the Existing + Project and Project + Cumulative configurations, wind speeds are expected to comply with the hazard criterion at all but two (2) locations at grade level, with reduced total hours of hazardous winds.

- In the Existing + Project configuration, wind speeds at all but three (3) locations on the podium locations are predicted to comply with the hazard criterion. In the Project + Cumulative configuration, the number of locations that do not comply with the hazard criterion is expected to be four (4) on the podium level.

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1 INTRODUCTION

RWDI was retained to conduct a pedestrian wind assessment for the proposed SFMTA Potrero Yard Modernization Project in San Francisco, CA. This report presents the project objectives, background and approach, and discusses the results of RWDI's assessment.

1.1 Project Description

The SFMTA Potrero Yard Modernization Project site is bounded by 17th Street to the north, Hampshire Street to the east, Mariposa Street to the south and Bryant Street to the west (Image 1). The project site is occupied by the existing bus maintenance facility, including a large, low building on the east portion of the site and a parking lot on the west portion.

The elevation of the project site changes approximately 27 feet from the lowest southwest corner to the highest northeast corner. Surrounding buildings are low and dense in all directions. The only exception is the open Franklin Square public park to the immediate north of the site.

The proposed project would consist of redeveloping the current bus maintenance facility into a multi-use site that would include a replacement bus facility, residential and commercial uses, and open spaces on the podium. The podium would be 6 stories above Mariposa Street (75 feet), including primarily the proposed bus maintenance facility, administration, commercial use and housing. Above the podium would be the proposed mixed income housing from Floor 7 to Floor 13. The tallest building elements would be located near the southwest and southeast corners of the site, for a total height of approximately 150 feet above local grade.

Public areas around the development site would include building entrances, sidewalks surrounding the site, Franklin Square public park to the immediate north and potentially podium open spaces at Floor 7 of the proposed development.

1.2 Objectives

The objective of the study was to assess the effect of the proposed development on local wind conditions in pedestrian areas on and around the study site and provide recommendations for minimizing adverse effects, if needed. This quantitative assessment was based on wind speed measurements on a scale model of the project and its surroundings in one of RWDI's boundary-layer wind tunnels. These measurements were combined with the local wind records and compared to appropriate criteria for gauging wind comfort and safety in pedestrian areas. The assessment focused on critical pedestrian areas, including public sidewalks.

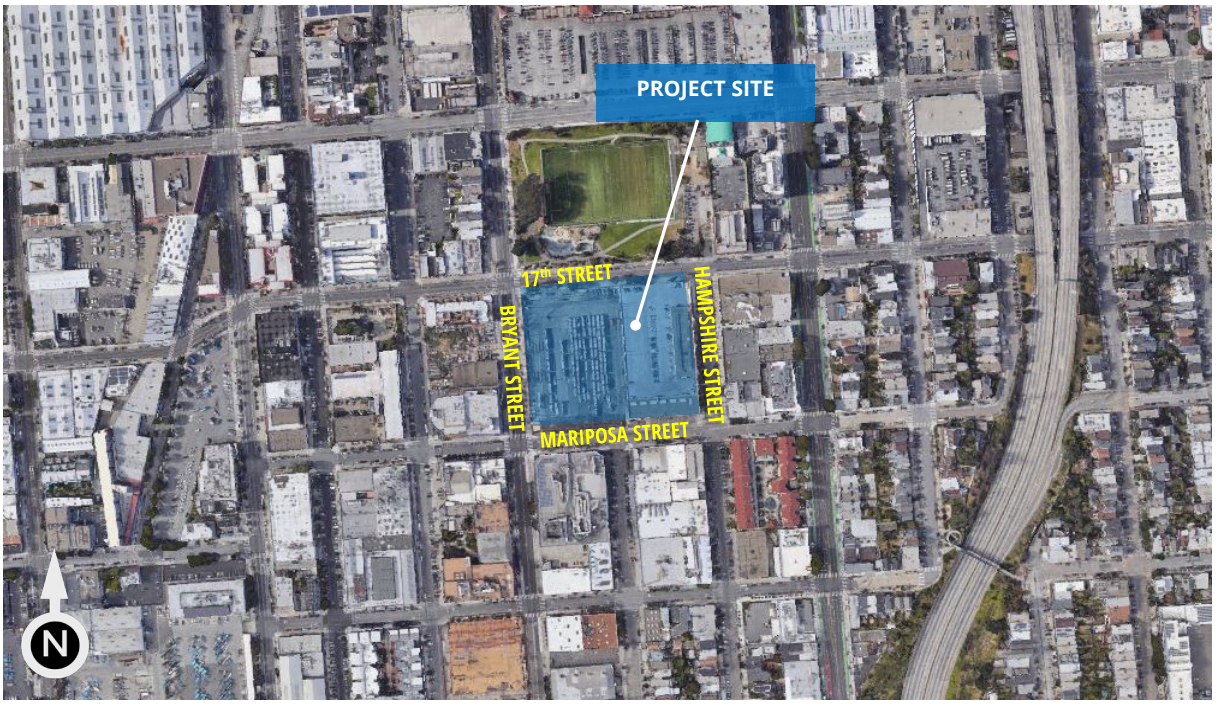


Image 1: Aerial View of Site and Surroundings (Photo Courtesy of Google™ Earth)

2 BACKGROUND AND APPROACH

2.1 Wind Tunnel Study Model

To assess the wind environment around the proposed project, a 1:300 scale model of the project site and surroundings was constructed for the wind tunnel tests of the following configurations:

A - Existing:	Existing site with existing surroundings (Image 2A),
B - Proposed:	Proposed project with existing surroundings (Image 2B), and,
C - Future:	Proposed project with existing and future surroundings (Image 2C).

The wind tunnel model included all relevant surrounding buildings and topography within an approximately 1,600 ft radius of the study site. The wind and turbulence profiles in the atmospheric boundary layer beyond the modelled area were also simulated in RWDI's wind tunnel. The wind tunnel model was instrumented with 109 specially designed wind speed sensors to measure mean and gust speeds at a full-scale height of approximately 5 ft above local grade in pedestrian areas throughout the study site. The first 70 sensors are located at grade level and sensors 71 through 97 were instrumented on the podium level. Bike lane locations (sensors 98 through 109) were also used to measure wind speeds for informational purpose. Wind speeds were measured for 16 directions in a 22.5-degree increment. The measurements at each sensor location were recorded in the form of ratios of local mean and gust speeds to the mean wind speed at a reference height above the model. The placement of wind measurement locations was based on our experience and understanding of the pedestrian usage for this site, and reviewed by the Planning Department.

RWDI conducted an initial wind tunnel testing of the Existing, Existing + Project and Project + Cumulative configurations in March 2020. These results can be found in Appendix B1. The preliminary wind tunnel testing identified increased wind speeds at a number of locations compared to the existing wind conditions that exceeded the wind hazard criterion. Following the initial test, RWDI developed wind control measures to address these areas, in conjunction with the design team and the Planning Department. The existing configuration model was also revised to reflect the influence of local terrain changes and existing landscaping. In addition to the revised existing configuration, two mitigation configurations (Options 1 and 2) were tested to mitigate the wind hazards in May 2020. The results of these wind tunnel tests can be found in Appendix B2. The results from the mitigation tests showed improvement on the wind conditions, but they were not enough to mitigate the hazard exceedances on-site, particularly at the southwest corner.

A third round of testing was conducted with some additional mitigation options (Options 3 through 7) in June 2020. The results of the third round of wind tunnel testing are shown in Appendix B3. Prior to the third round of wind tunnel testing, RWDI learned that the bus parking garage would include porous facades on the north, east and west sides for natural ventilation as well as to avoid complex HVAC system design and cost. These building features were incorporated in the mitigation testing along with other mitigation options such as vertical wind screens at grade level, proposed landscaping, re-entrant building corner, and vertical elevated screens on the west façade. The addition of all these options addressed the exceedance of the wind hazard criterion at the southwest corner of the project site. Therefore, the mitigation configuration with the least number of wind control measures was finalized. The conceptual design that addressed the exceedance of the wind hazard criterion includes porous north, east and west facades of the parking garage, re-entrant corner at the southwest corner of the building up to 12 feet in height and proposed landscaping (Previously tested as Option 7).

This report presents the results of the latest wind tunnel test for the Existing + Project and Project + Cumulative configurations with the wind reduction measures (Option 7 from the wind tunnel test), along with the revised Existing configuration. Appendices B1 through B3 contain all other mitigation results.

Image 2A: Wind Tunnel Study Model – Existing Configuration

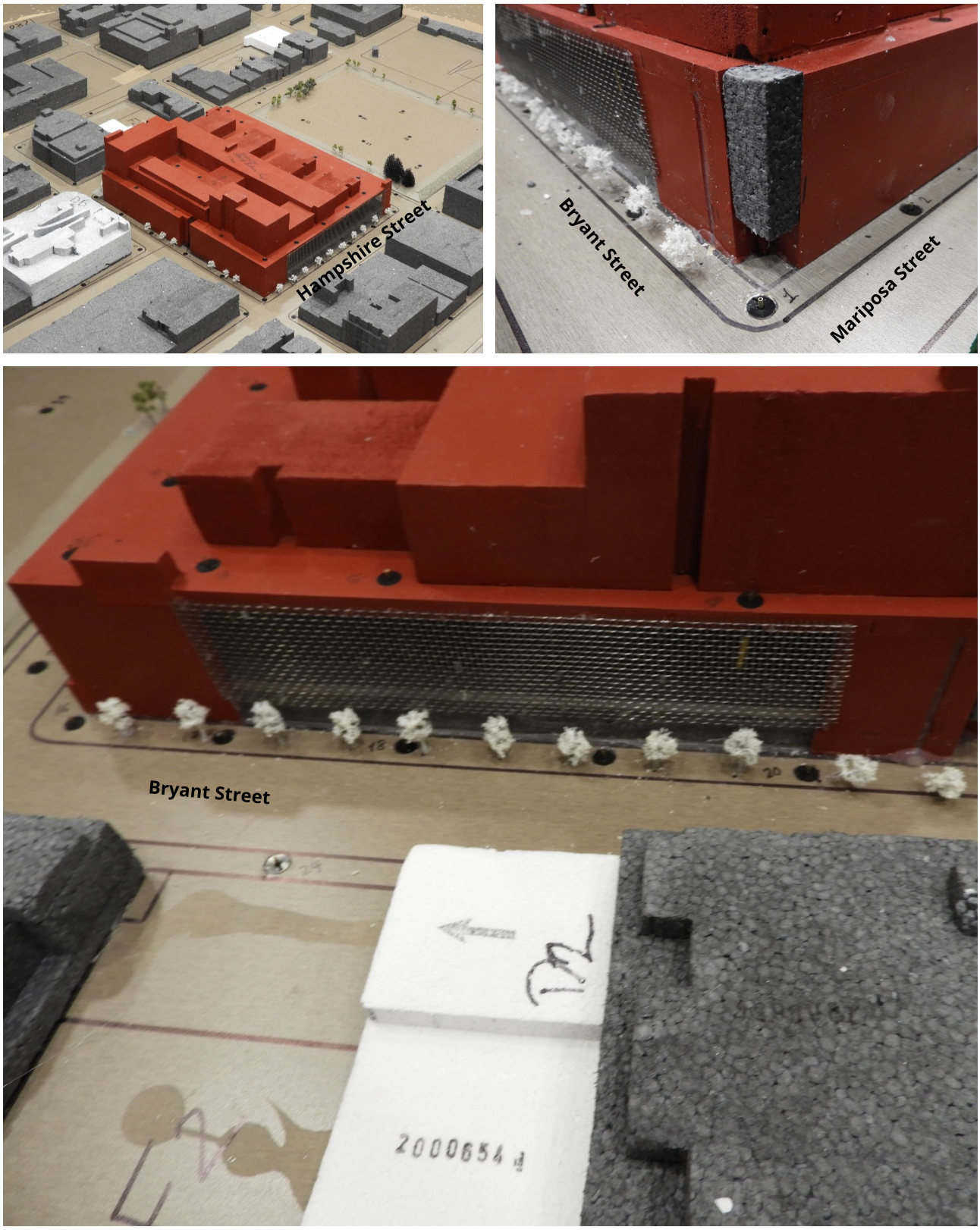


Image 2B: Wind Tunnel Study Model – Existing + Project Configuration

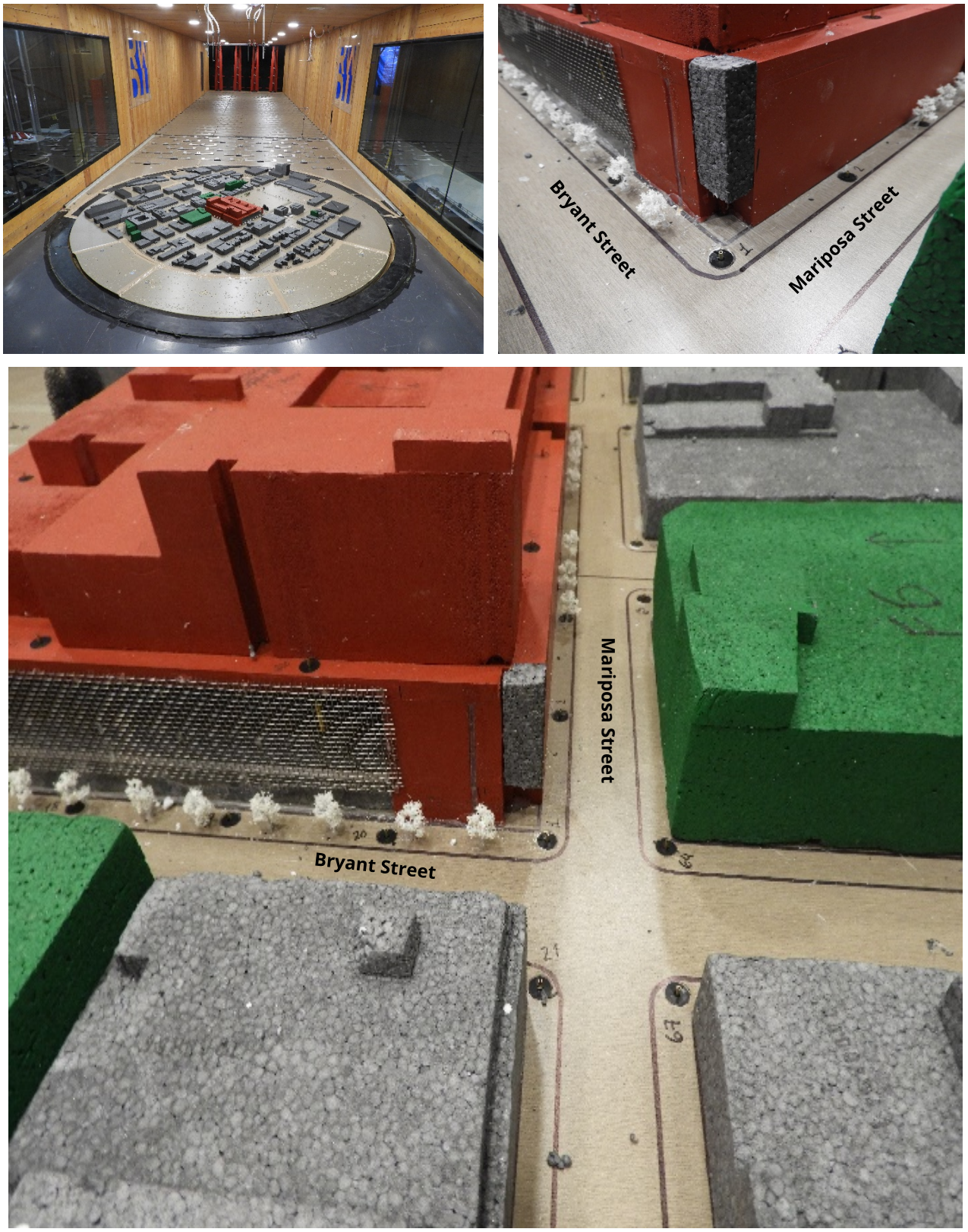


Image 2C: Wind Tunnel Study Model – Project + Cumulative Configuration

2.2 Cumulative Buildings

Anticipated future buildings within the study model radius were included in the Project + Cumulative configuration. These are shown in Image 3 and listed in the table below.

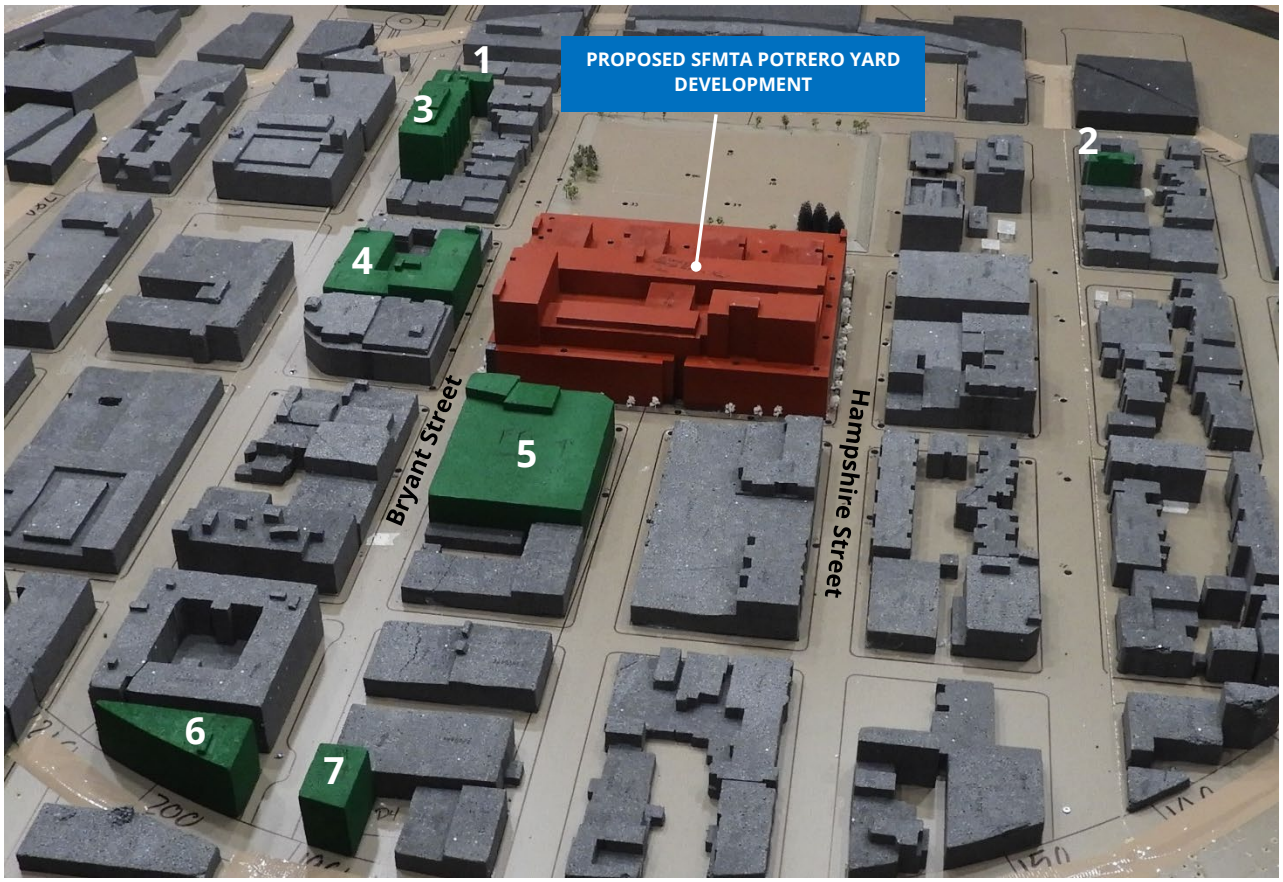


Image 3: Cumulative Buildings

LIST OF CUMULATIVE BUILDINGS AND HEIGHTS		
#	Address	Height
1	2435-2445 16TH Street	68'/ 78'
2	333-335 Potrero Avenue	64'/ 74'
3	321 Florida Street	104'
4	1850 Bryant Street	68'
5	2601 Mariposa Street	63'-6"/ 75'
6	681 Florida Street	87'/96'
7	2750 19th Street	68/ 77'-7"

2.3 Meteorological Data

Data describing the speed, direction and frequency of occurrence of winds were gathered at the old San Francisco Federal Building at 50 United Nations Plaza (at a height of 132 ft.) during the six-year period, 1945 to 1951. Average wind speeds in San Francisco are the highest in the summer and lowest in winter. However, the strongest peak winds occur in winter. Throughout the year the highest wind speeds occur in mid-afternoon and the lowest in the early morning. Westerly to northwesterly winds are the most frequent and strongest winds during all seasons. Of the primary wind directions, four have the greatest frequency of occurrence and make up the majority of the strong winds that occur. These winds include the northwest, west-northwest, west and west-southwest.

Wind statistics were combined with the wind tunnel data to predict the frequency of occurrence of full-scale wind speeds. The full-scale wind predictions were then compared against the criteria for wind comfort and hazard as stated in the San Francisco Planning Code Section 148 (see ***Appendix A***).

2.4 Planning Code Requirements

San Francisco Planning Code Section 148, Reduction of Ground-level Wind Currents in Downtown Commercial (C-3) Districts, requires buildings in the C-3 downtown districts to be shaped so as not to cause ground-level wind currents to exceed defined comfort and hazard criteria. (see ***Appendix A***).

The comfort criteria are that wind speeds will not exceed, more than 10% of the time, 11 mph in substantial pedestrian use areas, and 7 mph in public seating areas. Similarly, the hazard criterion of the Code requires that buildings not cause equivalent wind speeds to reach or exceed the hazard level of 26 mph as averaged from a single full hour of the year. The hazard criterion is based on winds that are measured for one hour and averaged, corresponding to a one-minute average of 36 mph.

The Planning Code defines these wind speeds in terms of equivalent wind speeds and they are calculated according to the specifications in the San Francisco Planning Code Section 148, whereby the mean hourly wind speed is increased when the turbulence intensity is greater than 10% 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.

As the project site is located outside the C-3 District, it is not subject to Planning Code Section 148. However, the wind hazard criterion is used as a threshold to determine if a proposed project would result in a significant impact under the California Environmental Quality Act (CEQA).

3 RESULTS AND DISCUSSION

This section presents the results of the wind tunnel measurements analyzed in terms of equivalent wind speeds as defined by the equation in Section 2.4. The text of the report simply refers to the data as wind speeds.

The wind comfort results for the configurations tested are graphically depicted on a site plan in Figures 1A through 1C located in the "Figures" sections of this report where locations have been color-coded according to the criteria of the 7-mph and 11-mph comfort categories explained in the Planning Code (***Appendix A***). This same data is also numerically depicted in Table 1.1 and Table 1.2, located in the "Tables" section of this report. For each measurement point, the measured 10% exceeded (90th percentile) wind speed and the percentage of time that the wind speed exceeds 11 mph are listed. The point is marked as a comfort exceedance if the 11-mph threshold is exceeded. A letter "e" in the last column of each configuration indicates a wind comfort exceedance.

Tables 2.1 and 2.2 present the wind hazard results for grade level and podium level, respectively, and list the predicted wind speeds to be exceeded one hour per year. The predicted number of hours per year that the Section 148 wind hazard criterion (one-minute wind speed of 36 mph) is exceeded is also provided. A letter "e" in the last column of each configuration indicates a wind hazard exceedance. Figures 2A through 2C depicts these locations on and around the project site.

Table 3 presents the mean wind speeds at select bike lane locations for information purposes. These locations are shown in a site plan in Image 3.

3.1 Existing Configuration

3.1.1 Wind Comfort

For the Existing configuration, the average 90th percentile wind speed for the 70 test locations is approximately 13 mph. Wind speeds at 47 of 70 test locations exceed the Planning Code's pedestrian-comfort criterion of 11 mph. Winds currently exceed the applicable criterion 17-% of the time on average (Table 1.1 and Figure 1a).

3.1.2 Wind Hazard

The wind hazard criterion is currently exceeded at two test locations to the northeast of the project site (Locations 44 and 47) for the Existing configuration for a total of 30 hours per year (Figure 2a and Table 2.1). For all locations, the average wind speed which is exceeded for 1 hour per year is 25 mph (Table 2.1).

3.2 Existing plus Project Configuration

3.2.1 Wind Comfort

Compared to the Existing configuration, the addition of the proposed project would result in better wind comfort conditions around the project site. The average 90th percentile wind speed for the 70 grade level test locations would be 12 mph. The wind speeds at 37 test locations (out of 70) would exceed the Planning Code's pedestrian-comfort criterion of 11 mph (Figure 1b). Winds would exceed the 11-mph comfort criterion approximately 14% of the time (Table 1.1).

On the podium amenity level, the average 90th percentile wind speed for the 27 test locations would be 15 mph. The wind speeds at a total of 20 test locations (out of 27) would exceed the Planning Code's pedestrian-comfort criterion of 11 mph (Figure 1b). Winds would exceed the 11-mph comfort criterion approximately 28% of the time (Table 1.2).

3.2.2 Wind Hazard

At grade level, the addition of the proposed project would result in two hazard locations (Locations 44 and 48 in Figure 2B). Of these, the wind hazard exceedance at Location 44 is an existing condition, and the wind hazard exceedance at Location 48 is new. An existing wind hazard exceedance at Location 47 would be eliminated with the addition of the proposed project. For all 70 locations, the average wind speed, which is exceeded for 1 hour per year, would decrease from 25 mph for the Existing configuration to 23 mph. The total number of hours per year that winds would exceed the applicable hazard criterion would decrease by 12 hours, from 30 to 18 (Table 2.1 and Figure 2B).

On the podium amenity level, the wind hazard criterion would be exceeded at three of 27 test locations (Locations 74, 84 and 92 in Figure 2B). For all locations, the average wind speeds which is exceeded for 1 hour per year is 29 mph (Table 2.2).

3.3 Project plus Cumulative Configuration

3.3.1 Wind Comfort

The addition of the approved cumulative (future) developments in the surrounding area would further reduce ground-level wind speeds compared to the Existing and Existing + Project configurations. The average 90th percentile wind speed for the 70 test locations at grade level would be 11 mph with the wind speeds at 31 test locations exceeding the Planning Code's pedestrian-comfort criterion of 11 mph. Winds would exceed the 11-mph comfort criterion approximately 13% of the time (Table 1.1).

On the podium amenity level, the average 90th percentile wind speed for the 27 test locations would be 15 mph, which is similar to the Existing + Project configuration. The wind speeds at a total of 20 test locations (out of 27) would exceed the Planning Code's pedestrian-comfort criterion of 11 mph (Figure 1C). Winds would exceed the 11-mph comfort criterion approximately 27% of the time (Table 1.2).

3.3.2 Wind Hazard

For the Project + Cumulative configuration, the total number of locations exceeding the wind hazard criterion at grade level would be two (Figure 1C), the same as the Existing + Project configuration. The total number of hours per year that winds would exceed the wind hazard criterion would decrease by seven hours (from 18 to 11) when compared to the Existing + Project configuration. For all locations, the average wind speed would be 22 mph (Table 2.1).

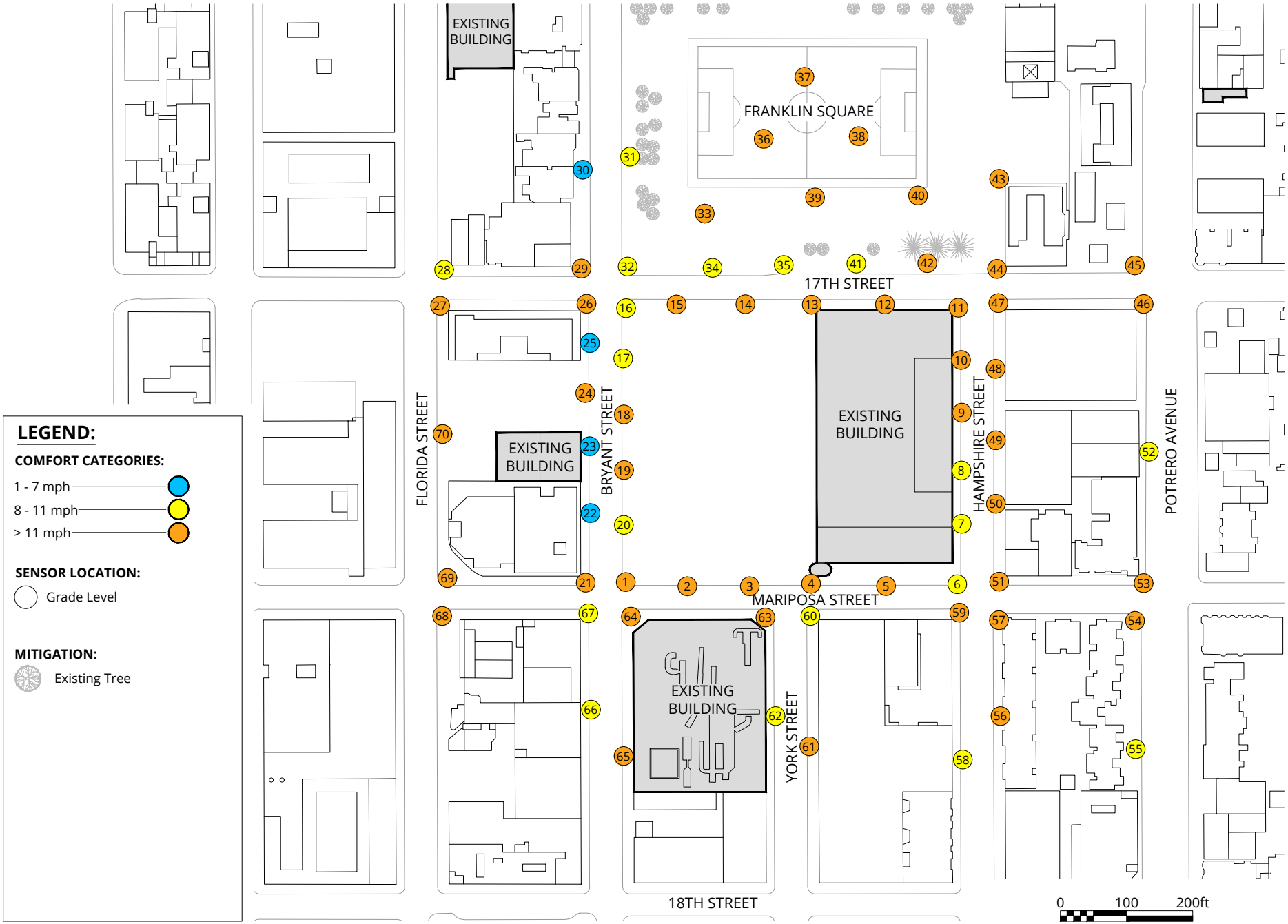
On the podium amenity level, the wind hazard criterion would be exceeded at four of 27 test locations (Locations 74, 83, 84 and 92 in Figure 2C). For all locations, the average wind speeds which is exceeded for 1 hour per year is 29 mph (Table 2.2).

4 APPLICABILITY OF RESULTS

The wind conditions presented in this report pertain to the model of the SFMTA Potrero Yard Modernization Project constructed using the conceptual design drawings and information listed below. Design changes that deviate from this list of drawings, including building materials, may change the wind condition predictions presented. Changes in the design should be reviewed by RWDI or a qualified wind consultant, to assess their potential effects on wind conditions.

File Name	File Type	Date Received (dd/mm/yyyy)
191205_SFMTA Bus Yards_Potrero Yard_ToSWCA	.skp	9/12/2019
191205_SFMTA Bus Yards_Potrero Yard_ToSWCA	.dwg	9/12/2019
SFMTA_Potrero_3 Level Full Plan Set_022019 (1)	pdf	8/06/2020

FIGURES



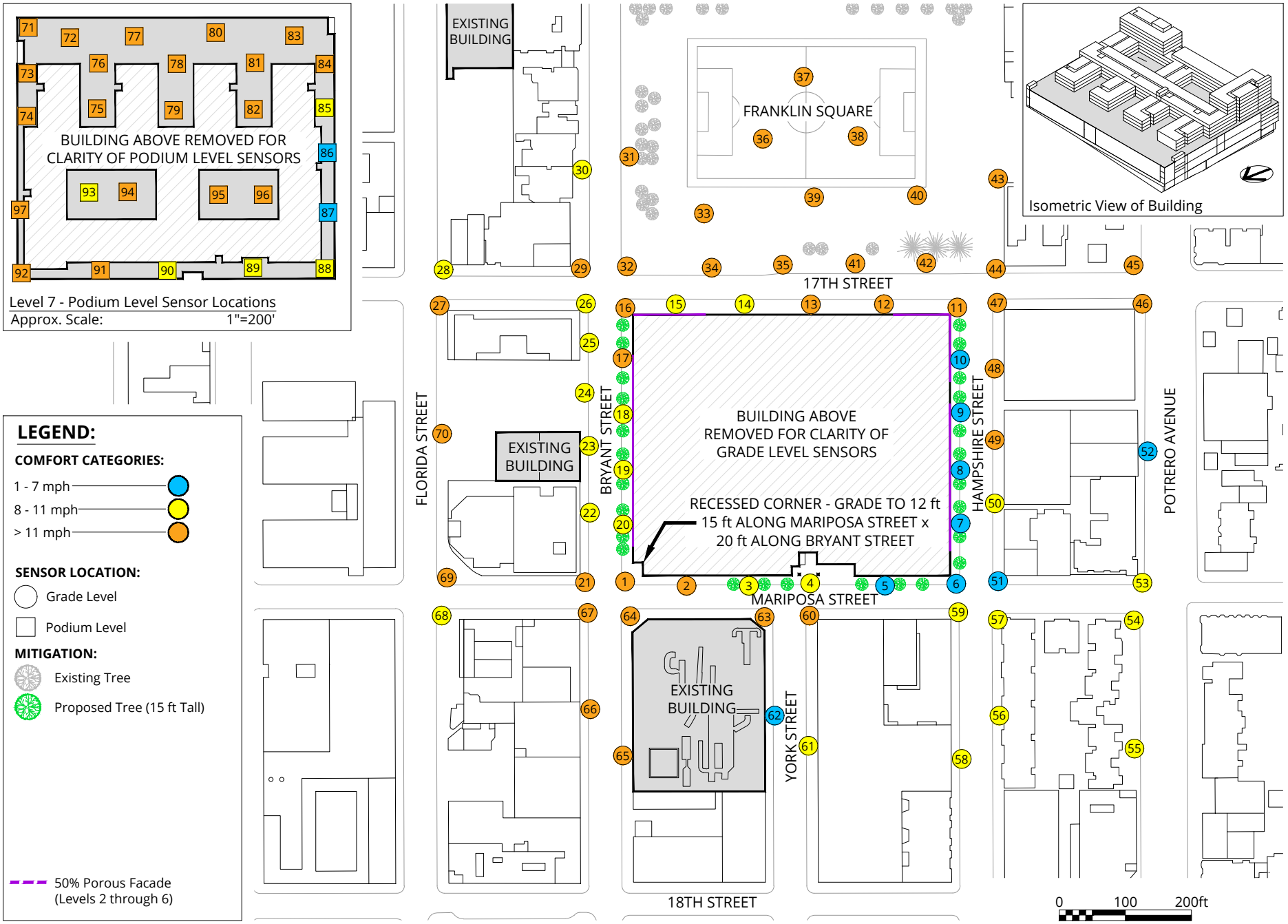
Pedestrian Wind Comfort Conditions
Existing
Annual

SFMTA Potrero Yard - San Francisco, CA

True North

Project #2000654

Drawn by: GRE	Figure: 1A
Approx. Scale:	1"=200'
Date Revised:	July 2, 2020



Pedestrian Wind Comfort Conditions

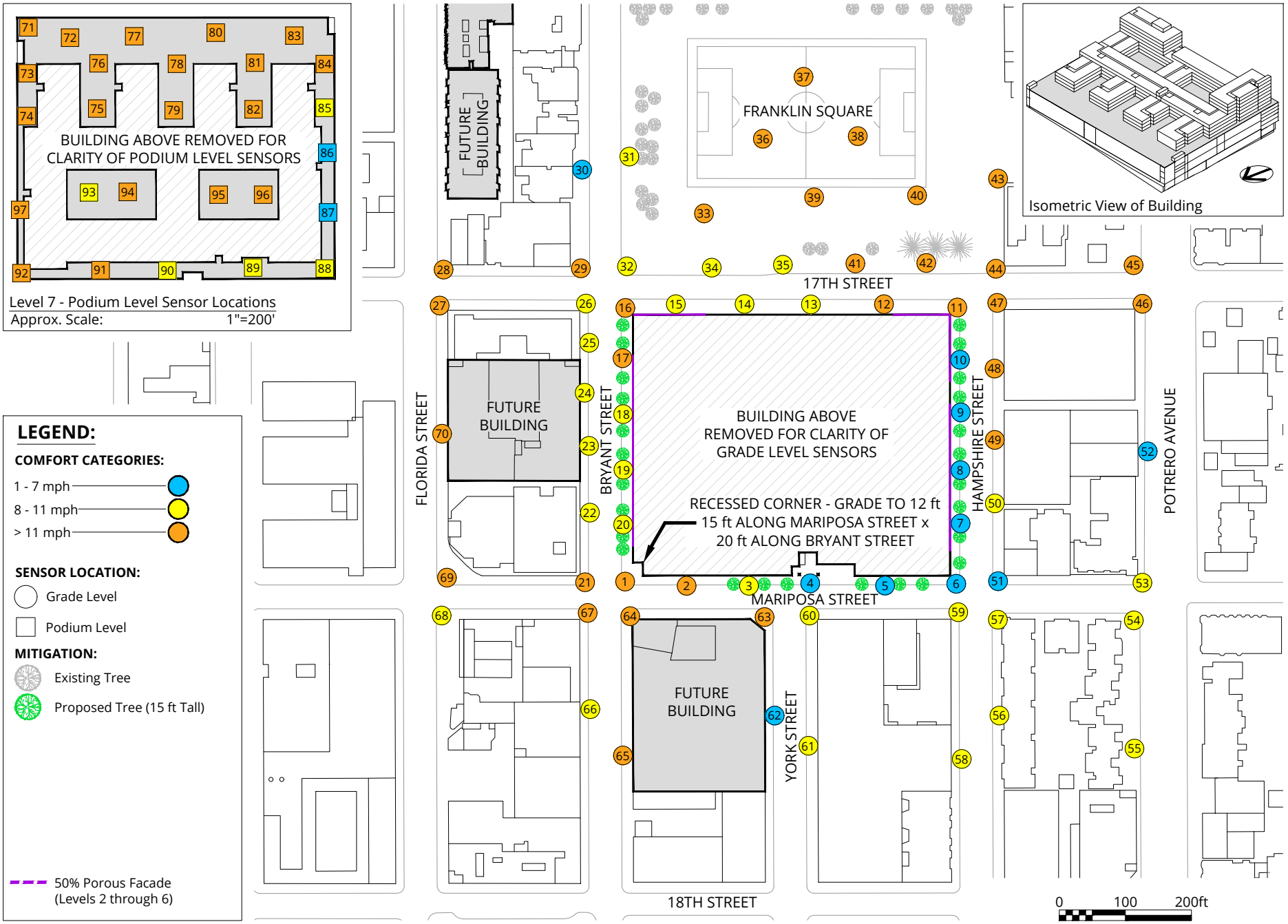
Existing + Project
Annual

SFMTA Potrero Yard - San Francisco, CA

Project #2000654

True North

Drawn by: GRE	Figure: 1B
Approx. Scale:	1"=200'
Date Revised:	July 2, 2020



Pedestrian Wind Comfort Conditions

Project + Cumulative

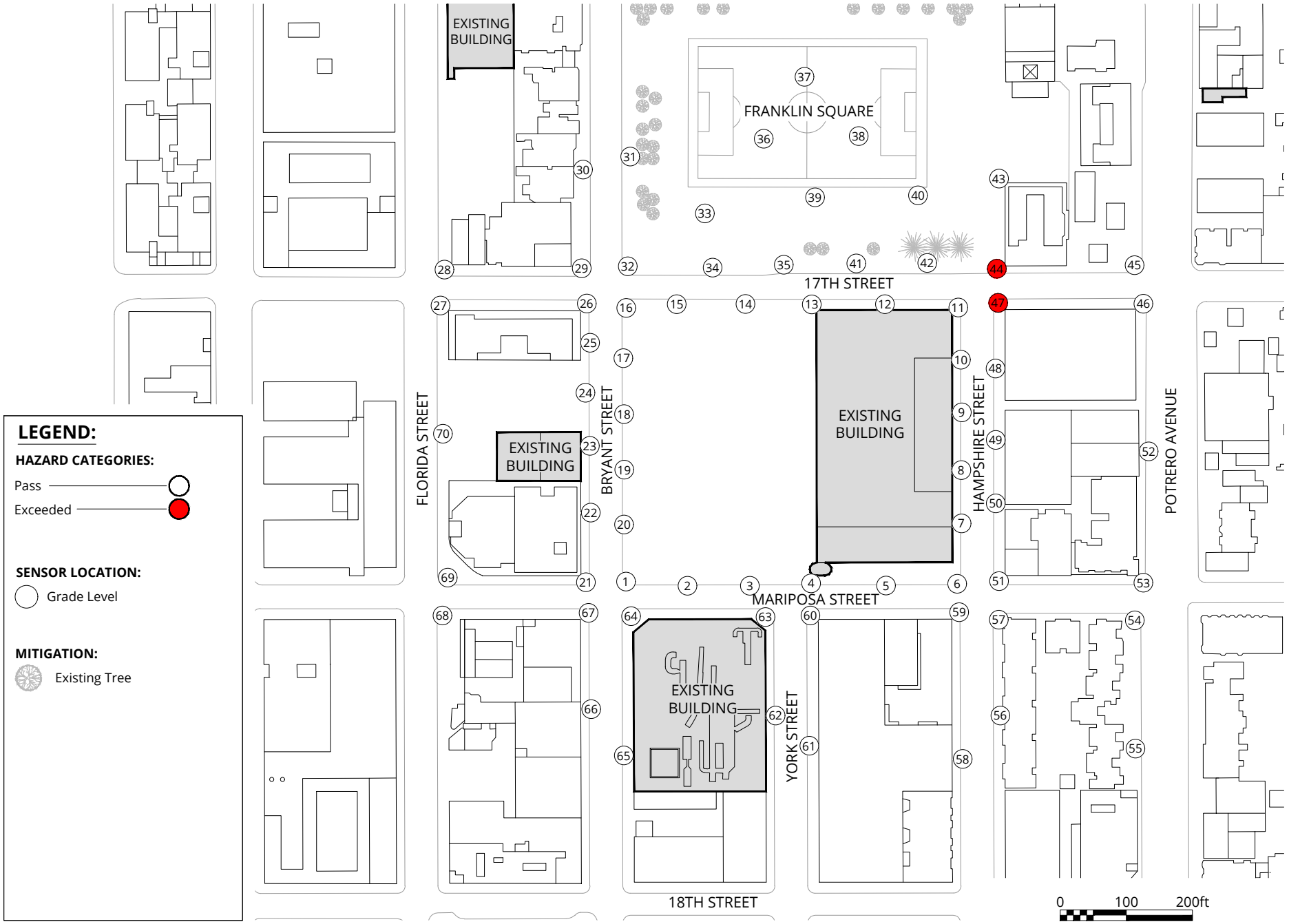
Annual

SFMTA Potrero Yard - San Francisco, CA

True North

Project #2000654

Drawn by: GRE	Figure: 1C
Approx. Scale:	1"=200'
Date Revised:	July 2, 2020



LEGEND:

HAZARD CATEGORIES:

Pass

Exceeded

SENSOR LOCATION:

Grade Level

MITIGATION:

Existing Tree

Pedestrian Wind Hazard Conditions

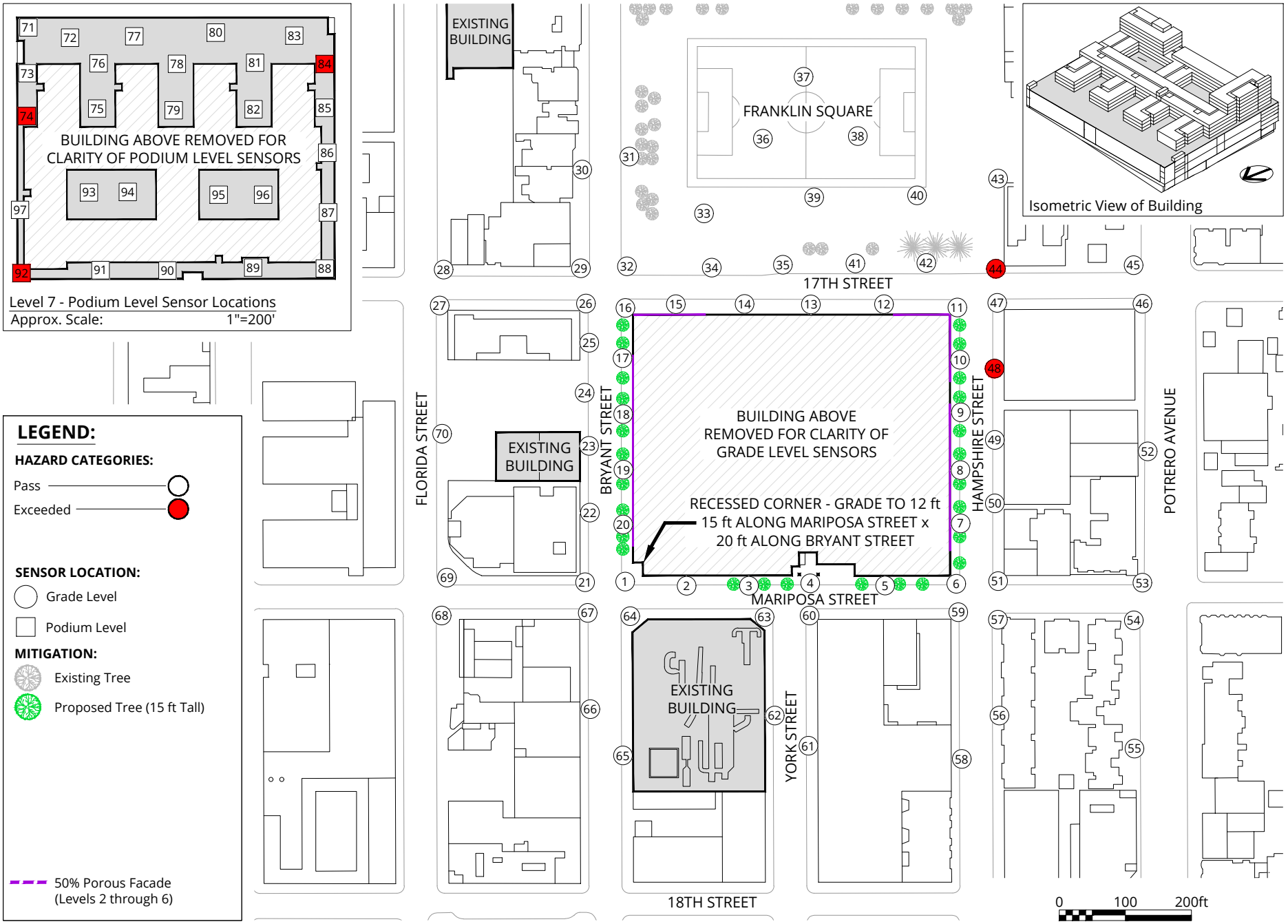
Existing
Annual

SFMTA Potrero Yard - San Francisco, CA

True North

Project #2000654

Drawn by: GRE	Figure: 2A
Approx. Scale:	1"=200'
Date Revised:	July 2, 2020



Pedestrian Wind Hazard Conditions

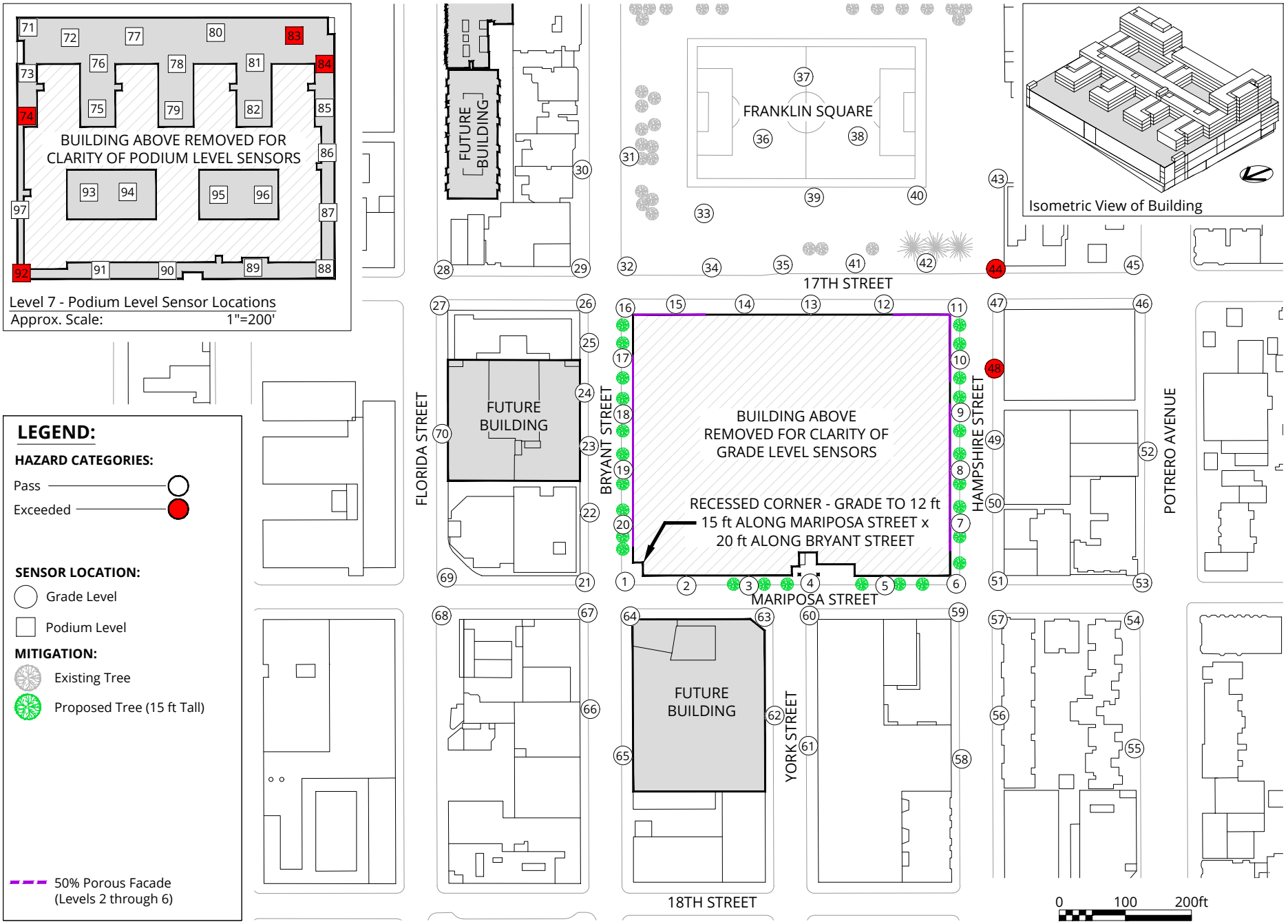
Existing + Project
Annual

SFMTA Potrero Yard - San Francisco, CA

Project #2000654

True North

Drawn by: GRE	Figure: 2B
Approx. Scale:	1"=200'
Date Revised:	July 2, 2020



Pedestrian Wind Hazard Conditions

Project + Cumulative

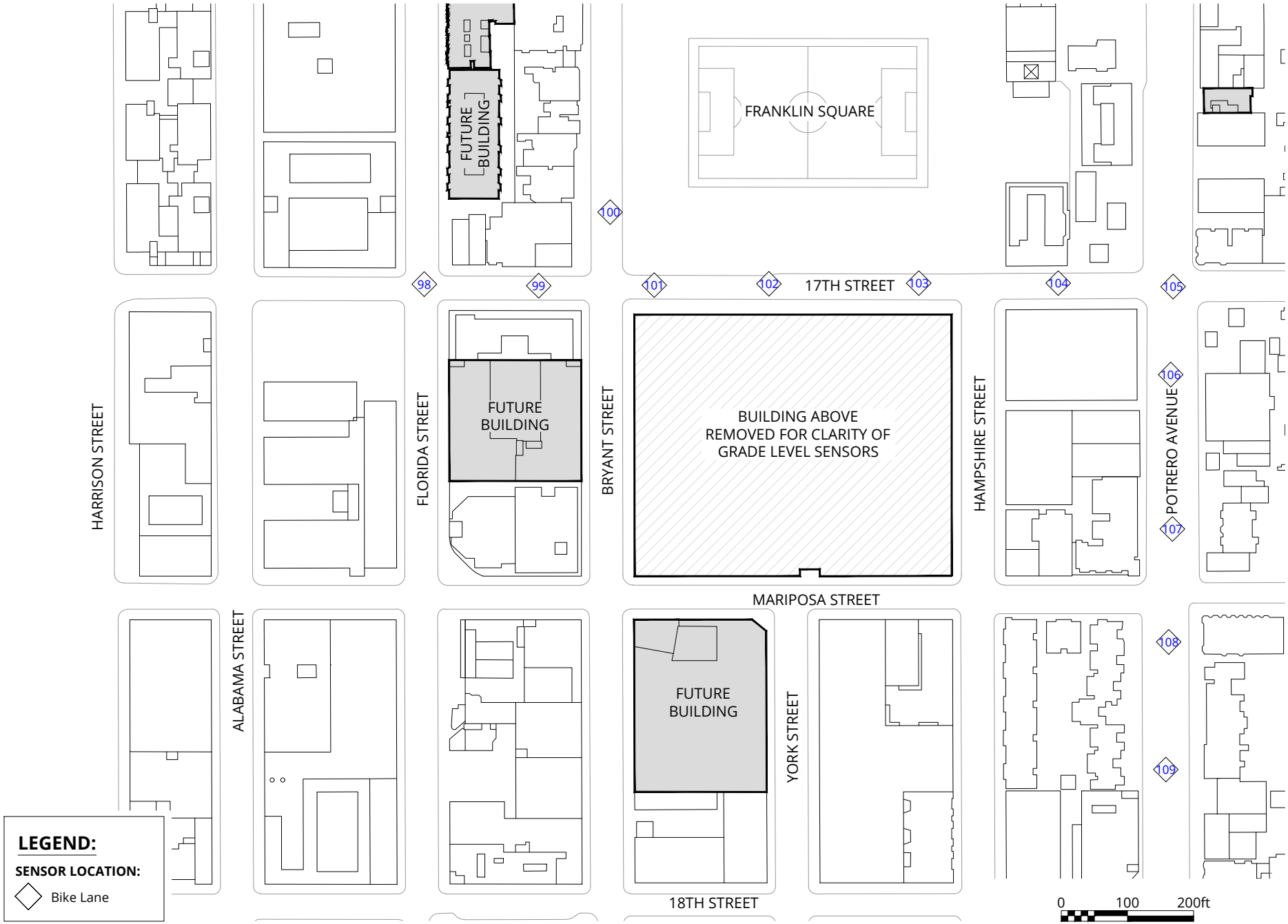
Annual

SFMTA Potrero Yard - San Francisco, CA

True North

Project #2000654

Drawn by: GRE	Figure: 2C
Approx. Scale:	1"=200'
Date Revised:	July 2, 2020



Bike Lane Test Locations

True North

SFMTA Potrero Yard - San Francisco, CA

Project #2000654

Drawn by: DF	Figure: 3□	
Approx. Scale: 1"=200'		
Date Revised: Mar. 4, 2020		

TABLES

Table 1.1: 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	12	18	e	16	30	4	e	15	25	3	e
2	12	12	e	13	17	1	e	12	15	0	e
3	12	14	e	9	4	-3		11	10	-1	
4	12	17	e	8	1	-4		7	1	-5	
5	13	15	e	7	0	-6		6	0	-7	
6	11	10		7	1	-4		7	0	-4	
7	10	6		6	0	-4		5	0	-5	
8	11	10		6	0	-5		5	0	-6	
9	12	13	e	6	0	-6		6	0	-6	
10	14	23	e	6	0	-8		7	0	-7	
11	17	32	e	16	28	-1	e	16	28	-1	e
12	13	15	e	14	19	1	e	13	16	0	e
13	14	22	e	12	12	-2	e	11	10	-3	
14	13	18	e	11	10	-2		10	8	-3	
15	12	13	e	11	10	-1		10	5	-2	
16	10	6		15	28	5	e	12	16	2	e
17	9	4		12	13	3	e	12	13	3	e
18	13	15	e	11	10	-2		11	10	-2	
19	13	18	e	9	5	-4		8	1	-5	
20	10	7		11	10	1		10	6	0	
21	13	17	e	13	20	0	e	14	21	1	e
22	7	1		10	8	3		9	3	2	
23	7	1		10	6	3		10	5	3	
24	13	20	e	11	10	-2		10	7	-3	
25	6	0		9	3	3		10	4	4	
26	12	13	e	9	5	-3		10	6	-2	
27	14	22	e	15	25	1	e	15	28	1	e
28	10	7		10	6	0		16	28	6	e
29	12	13	e	12	13	0	e	12	15	0	e
30	6	1		8	1	2		7	0	1	
31	11	10		12	18	1	e	11	10	0	
32	11	10		13	18	2	e	10	7	-1	
33	13	21	e	13	21	0	e	12	16	-1	e
34	11	10		13	17	2	e	11	10	0	
35	10	7		12	13	2	e	11	10	1	
36	13	17	e	13	17	0	e	12	14	-1	e
37	16	30	e	15	27	-1	e	15	25	-1	e
38	15	27	e	14	25	-1	e	14	23	-1	e
39	15	25	e	14	22	-1	e	13	21	-2	e
40	13	20	e	13	18	0	e	13	16	0	e
41	11	10		12	16	1	e	12	13	1	e
42	14	22	e	14	24	0	e	14	22	0	e
43	15	28	e	14	25	-1	e	15	26	0	e
44	21	46	e	22	50	1	e	21	47	0	e
45	15	25	e	13	16	-2	e	12	13	-3	e
46	16	29	e	15	27	-1	e	16	27	0	e
47	19	43	e	17	31	-2	e	17	33	-2	e

Table 1.1: Wind Comfort Conditions

Location				Existing + Project				Project + Cumulative			
				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
48											
49											
50											
51											
52											
53											
54											
55											
56											
57											
58											
59											
60											
61											
62											
63											
64											
65											
66											
67											
68											
69											
70											

Summary	Average (mph)	Average (%)	Total	Average (mph)	Average (%)	Speed Change (mph)	Total	Average (mph)	Average (%)	Speed Change (mph)	Total
	13	17	47 ---- 70	12	14	-1	37 ---- 70	11	13	-2	31 ---- 70

Table 1.2: Wind Comfort Conditions - Podium Level

Location				Existing + Project				Project + Cumulative			
				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
71											
72											
73											
74											
75											
76											
77											
78											
79											
80											
81											
82											
83											
84											
85											
86											
87											
88											
89											
90											
91											
92											
93											
94											
95											
96											
97											

Summary	Average (mph)	Average (%)	Total	Average (mph)	Average (%)	Speed Change (mph)	Total	Average (mph)	Average (%)	Speed Change (mph)	Total
	-	-	-	15	28	-	20 ---- 27	15	27	-	20 ---- 27

Table 2.1: 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	23	0		31	0	0		28	0	0	
2	23	0		24	0	0		23	0	0	
3	25	0		18	0	0		21	0	0	
4	23	0		15	0	0		15	0	0	
5	24	0		14	0	0		12	0	0	
6	21	0		15	0	0		14	0	0	
7	19	0		12	0	0		11	0	0	
8	21	0		11	0	0		9	0	0	
9	22	0		12	0	0		11	0	0	
10	28	0		14	0	0		14	0	0	
11	34	0		32	0	0		32	0	0	
12	27	0		30	0	0		29	0	0	
13	26	0		25	0	0		25	0	0	
14	26	0		21	0	0		22	0	0	
15	23	0		20	0	0		18	0	0	
16	18	0		29	0	0		23	0	0	
17	19	0		25	0	0		26	0	0	
18	26	0		20	0	0		21	0	0	
19	26	0		19	0	0		16	0	0	
20	24	0		24	0	0		20	0	0	
21	23	0		28	0	0		26	0	0	
22	16	0		21	0	0		17	0	0	
23	17	0		18	0	0		18	0	0	
24	25	0		20	0	0		19	0	0	
25	11	0		18	0	0		19	0	0	
26	23	0		18	0	0		19	0	0	
27	24	0		27	0	0		27	0	0	
28	20	0		19	0	0		35	0	0	
29	21	0		22	0	0		23	0	0	
30	15	0		16	0	0		15	0	0	
31	25	0		23	0	0		22	0	0	
32	22	0		23	0	0		22	0	0	
33	27	0		25	0	0		21	0	0	
34	21	0		21	0	0		20	0	0	
35	19	0		21	0	0		22	0	0	
36	24	0		24	0	0		24	0	0	
37	31	0		27	0	0		27	0	0	
38	29	0		27	0	0		27	0	0	
39	28	0		26	0	0		27	0	0	
40	25	0		24	0	0		24	0	0	
41	21	0		23	0	0		24	0	0	
42	26	0		27	0	0		27	0	0	
43	30	0		26	0	0		27	0	0	
44	44	28	e	41	16	-12	e	40	10	-18	e
45	32	0		26	0	0		22	0	0	
46	35	0		31	0	0		32	0	0	
47	38	2	e	32	0	-2		32	0	-2	

Table 2.1: Wind Hazard Conditions

Location				Existing + Project				Project + Cumulative			
				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
48											
49											
50											
51											
52											
53											
54											
55											
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60											
61											
62											
63											
64											
65											
66											
67											
68											
69											
70											

Summary	Average (mph)	Total Hours	Total	Average (mph)	Total Hours	Hours Change	Total	Average (mph)	Total Hours	Hours Change	Total
	25	30	2 ---- 70	23	18	-12	2 ---- 70	22	11	-19	2 ---- 70

Table 2.2: Wind Hazard Conditions - Podium Level

Location				Existing + Project				Project + Cumulative			
				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
71											
72											
73											
74											
75											
76											
77											
78											
79											
80											
81											
82											
83											
84											
85											
86											
87											
88											
89											
90											
91											
92											
93											
94											
95											
96											
97											

Summary	Average (mph)	Total Hours	Total	Average (mph)	Total Hours	Hours Change	Total	Average (mph)	Total Hours	Hours Change	Total
	-	-	-	29	99	-	3 ---- 27	29	75	-	4 ---- 27

Table 3: Bike Lane Wind Conditions - Informational

		Existing + Project	
Location		Mean Wind Speed (mph)	
98		6	
99		6	
100		6	
101		8	
102		7	
103		8	
104		8	
105		7	
106		7	
107		7	
108		6	
109		7	
SUMMARY	**Average (mph)**	**Average (mph)**	**Average (mph)**
	7	**7**	**7**

APPENDIX A

APPENDIX A:

San Francisco Planning Code Section 148
Reduction of Ground-Level Wind Currents In C-3 Districts

a) Requirement and Exception. In C-3 Districts, buildings and additions to existing buildings shall be shaped, or other wind-baffling measures shall be adopted, so that the developments will not cause ground-level wind currents to exceed, more than 10 percent of the time year round, between 7:00 a.m. and 6:00 p.m., the comfort level of 11 m.p.h. equivalent wind speed in areas of substantial pedestrian use and seven m.p.h. equivalent wind speed in public seating areas.

When preexisting ambient wind speeds exceed the comfort level, or when a proposed building or addition may cause ambient wind speeds to exceed the comfort level, the building shall be designed to reduce the ambient wind speeds to meet the requirements. An exception may be granted, in accordance with the provisions of Section 309, allowing the building or addition to add to the amount of time that the comfort level is exceed by the least practical amount if (1) it can be shown that a building or addition cannot be shaped and other wind-baffling measures cannot be adopted to meet the foregoing requirements without creating an unattractive and ungainly building form and without unduly restricting the development potential of the building site in question, and (2) it is concluded that, because of the limited amount by which the comfort level is exceeded, the limited location in which the comfort level is exceeded, or the limited time during which the comfort level is exceeded, the addition is insubstantial.

No exception shall be granted and no building or addition shall be permitted that causes equivalent wind speeds to reach or exceed the hazard level of 26 miles per hour for a single hour of the year.

b) Definition. The term "equivalent wind speed" shall mean an hourly mean wind speed adjusted to incorporate the effects of gustiness or turbulence on pedestrians.

c) Guidelines. Procedures and Methodologies for implementing this section shall be specified by the Office of Environmental Review of the Department of City Planning. (added by Ord. 414-85, App. 9/17/85)

APPENDIX B1

PRELIMINARY RESULTS

SFMTA POTRERO YARD

SAN FRANCISCO, CA

PEDESTRIAN WIND STUDY
RWDI # 2000654
March 5, 2020

SUBMITTED TO

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EXECUTIVE SUMMARY

RWDI was retained to conduct a pedestrian wind assessment for the proposed SFMTA Potrero Yards in San Francisco, CA (Image 1). Based on our wind-tunnel testing for the proposed development under the Existing, Existing + Project and Project + Cumulative configurations (Images 2A through 2C), the potential wind comfort and hazard conditions are predicted as shown on site plans in Figures 1A through 2C, while the associated wind speeds are listed in Tables 1.1 through 2.2. Nearby bike lane test locations are shown in Figure 3 and the associated mean wind speeds for those bike lane locations are listed in Table 3. The results can be summarized as follows:

Wind Comfort:

- Existing wind speeds around the project site are expected to average 13 mph across all tested locations. For wind comfort conditions In the Existing + Project and Project + Cumulative configurations, average wind speeds are expected to remain as 13 mph.

- In the Existing configuration, 46 out of 70 grade level locations are expected to exceed to 11-mph criterion. In the Existing + Project and Project + Cumulative configurations, the number of locations at grade level where winds are predicted to exceed the 11-mph criterion are 42 and 44 respectively.

- At the podium level, average wind speeds are expected to be 15 mph, with 20 out of 27 locations exceeding the 11-mph criterion for both Existing + Project and Project + Cumulative configurations.

Wind Hazard:

- Wind speeds are expected to comply with the hazard criterion at all tested locations except three (3) in the Existing configuration.

- With the addition of proposed project, wind speeds are expected to comply with the hazard criterion at all but four (4) locations at grade level.

- With the addition of the future developments in the Project + Cumulative configuration, wind speeds at all but six (6) locations are predicted to comply with the hazard criterion at grade level.

- In the Existing + Project configuration, wind speeds at all but three (3) locations on the podium locations are predicted to comply with the hazard criterion. In the Project + Cumulative configuration, the number of locations that do not comply with the hazard criterion is expected to be four (4) at the podium level.

While referring to the Pedestrian Wind Criteria description that follows, we encourage the design team to review the results and assess them against the intended pedestrian usage at specific locations. If there are locations where improved conditions are desired, the RWDI team is prepared to discuss and suggest conceptual wind control strategies. Additional commentary regarding background on wind flow patterns, wind comfort levels, and any further recommendations for wind control measures to help moderate wind activity in areas of high wind activity will be presented within the final report. Prior to issuing the report, we suggest that we have a teleconference to go over the results and discuss the types/locations/feasibilities of possible wind control measures.

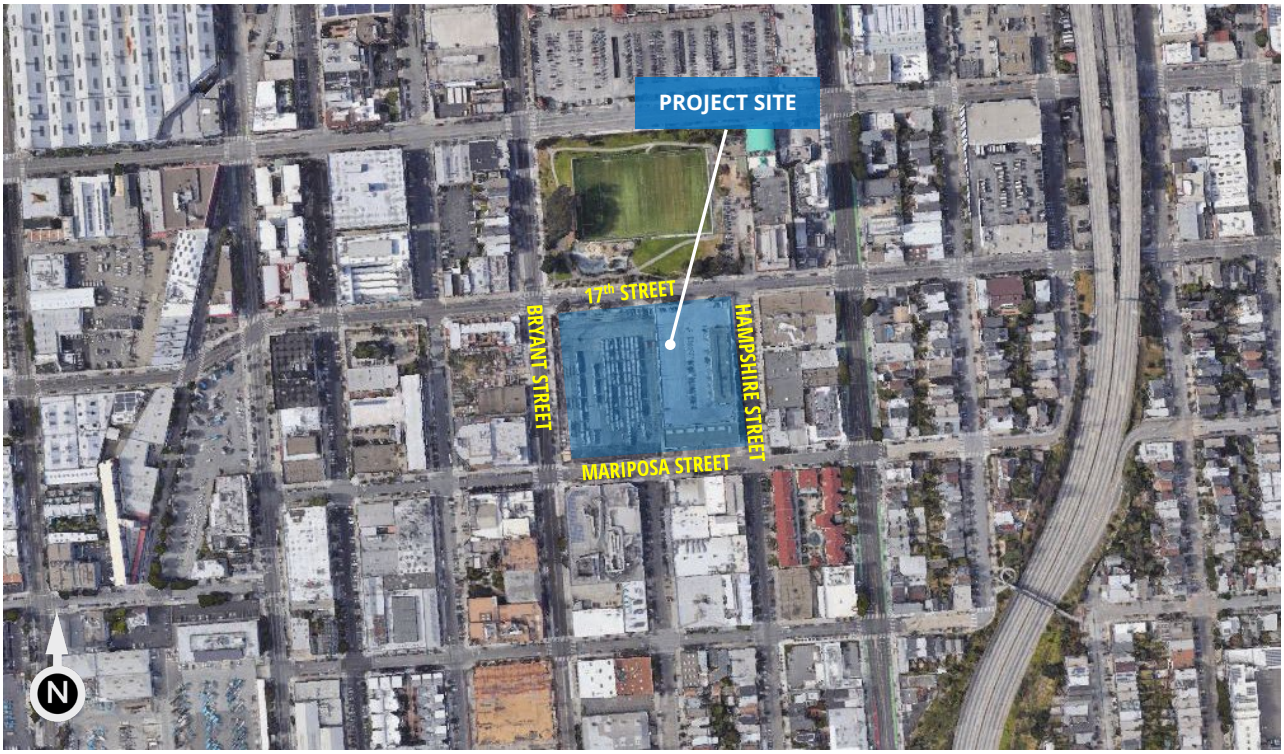


Image 1: Aerial View of Site and Surroundings (Photo Courtesy of Google™ Earth

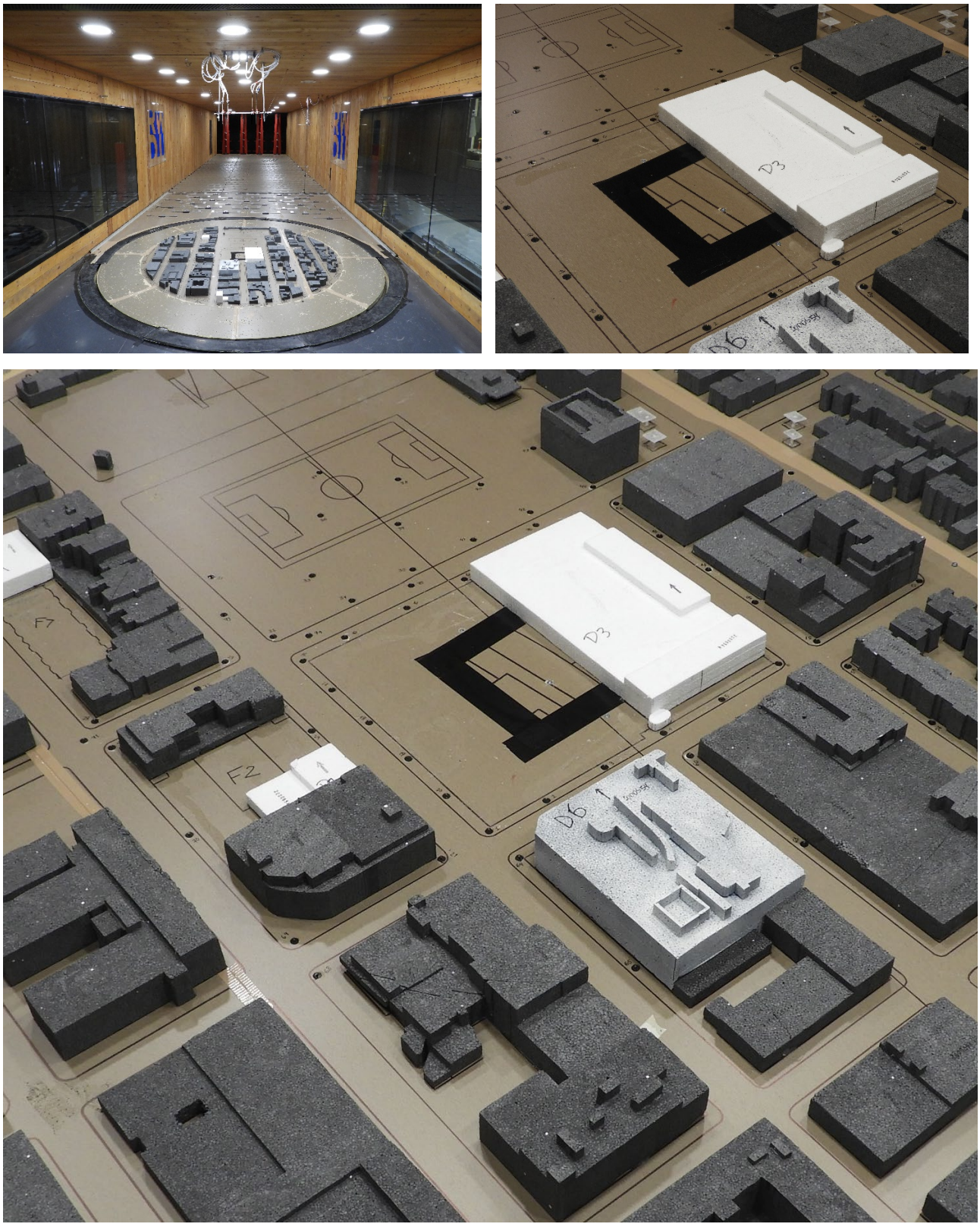


Image 2A: Wind Tunnel Study Model – Existing Configuration

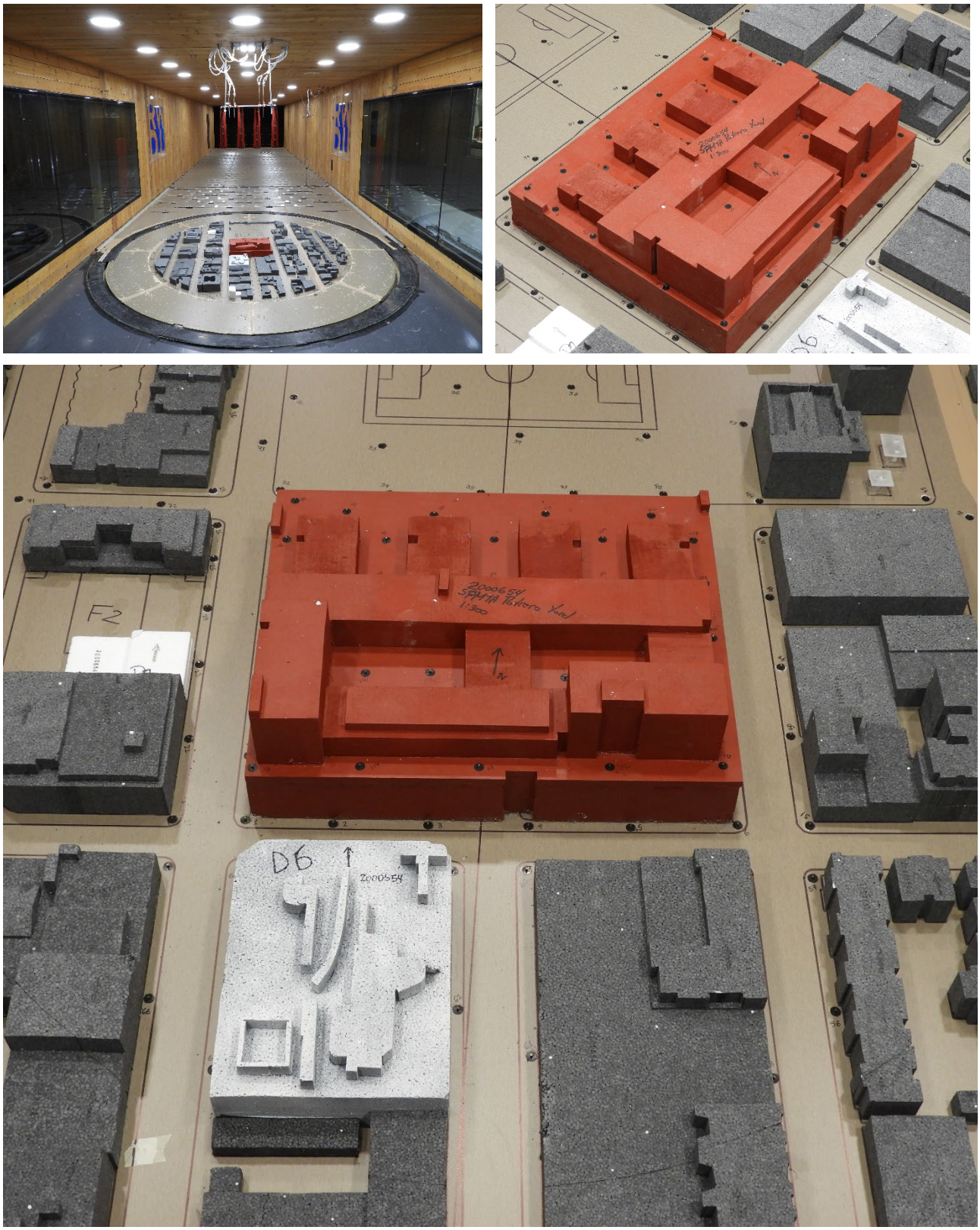


Image 2B: Wind Tunnel Study Model – Existing + Project Configuration

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

Meteorological Data

Data describing the speed, direction and frequency of occurrence of winds were gathered at the old San Francisco Federal Building at 50 United Nations Plaza (at a height of 132 ft.) during the six-year period, 1945 to 1951. Average wind speeds in San Francisco are the highest in the summer and lowest in winter. However, the strongest peak winds occur in winter. Throughout the year the highest wind speeds occur in mid-afternoon and the lowest in the early morning. Westerly to northwesterly winds are the most frequent and strongest winds during all seasons. Of the primary wind directions, four have the greatest frequency of occurrence and make up the majority of the strong winds that occur. These winds include the northwest, west-northwest, west and west-southwest.

Wind statistics were combined with the wind tunnel data to predict the frequency of occurrence of full-scale wind speeds. The full-scale wind predictions were then compared against the criteria for wind comfort and hazard as started in the San Francisco Planning Code Section 148.

Planning Code Requirements

This project is located in an area that is subject to the San Francisco Planning Code Section 148, Reduction of Ground-level Wind Currents in C-3 Districts. The Planning Code specifically outlines wind reduction criteria for the C-3 District. This analysis is performed using the wind testing analysis and evaluation methods to determine conformity with the Code. These requirements are described in Planning Code Section 148 (see ***Appendix A***).

The comfort criteria are that wind speeds will not exceed, more than 10% of the time, 11 mph in substantial pedestrian use areas, and 7 mph in public seating areas. Similarly, the hazard criterion of the Code requires that buildings not cause equivalent wind speeds to reach or exceed the hazard level of 26 mph as averaged from a single full hour of the year. The hazard criterion is based on winds that are measured for one hour and averaged, corresponding to a one-minute average of 36 mph.

The Planning Code defines these wind speeds in terms of equivalent wind speeds, and they are calculated according to the specifications in the San Francisco Planning Code Section 148, whereby the mean hourly wind speed is increased when the turbulence intensity is greater than 15% according to the following formula:

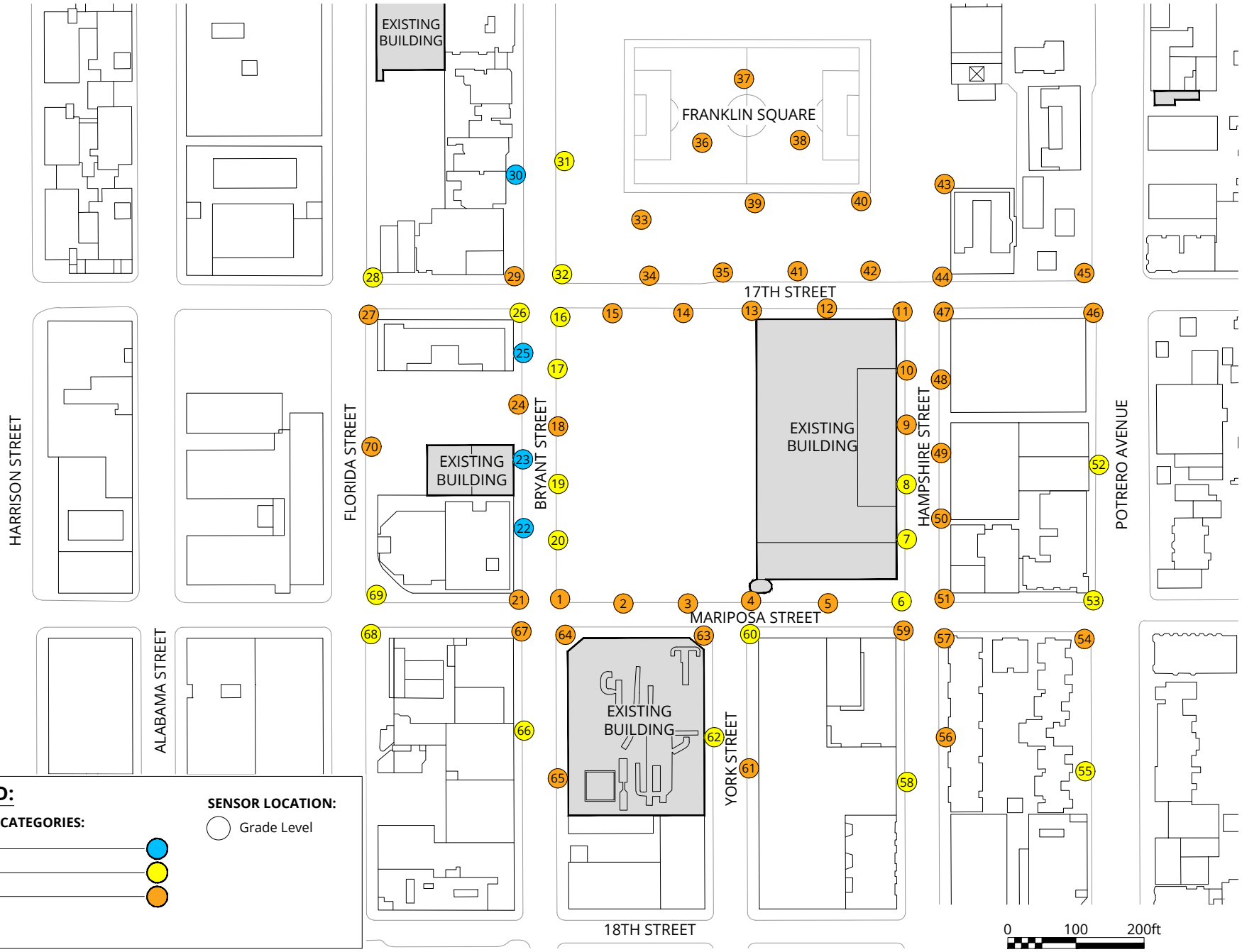
$$\boldsymbol{EWS} = \boldsymbol{V_m} \times (\mathbf{2} \times \boldsymbol{TI} + \mathbf{0.7})$$

Where: $\boldsymbol{EWS}$ = equivalent wind speed

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

$\boldsymbol{TI}$ = turbulence intensity.

FIGURES



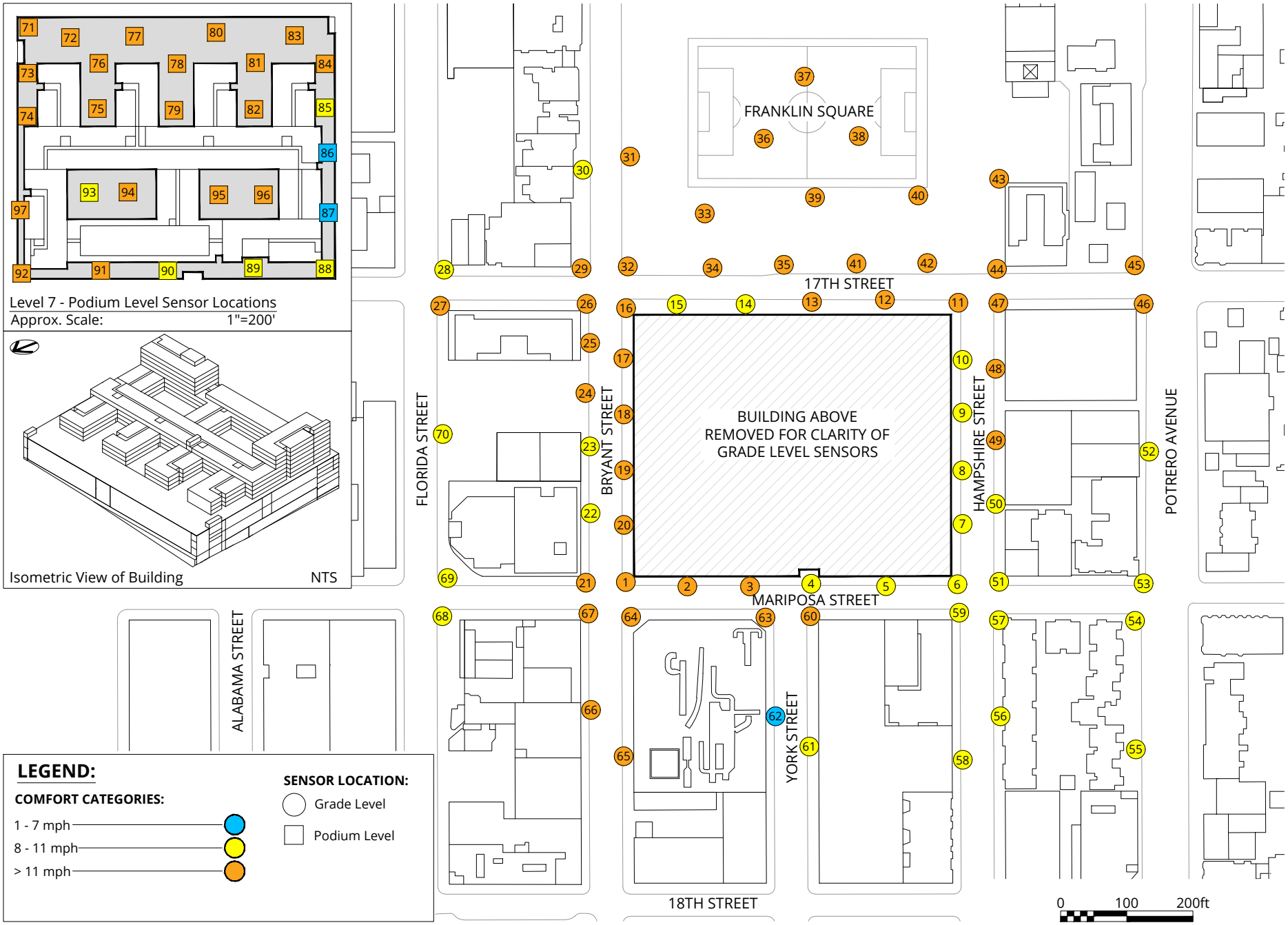
Pedestrian Wind Comfort Conditions
Existing
Annual

SFMTA Potrero Yard - San Francisco, CA

True North

Project #2000654

Drawn by:	DF	Figure:	1A
Approx. Scale:	1"=200'		
Date Revised:	Feb. 21, 2020		



Pedestrian Wind Comfort Conditions

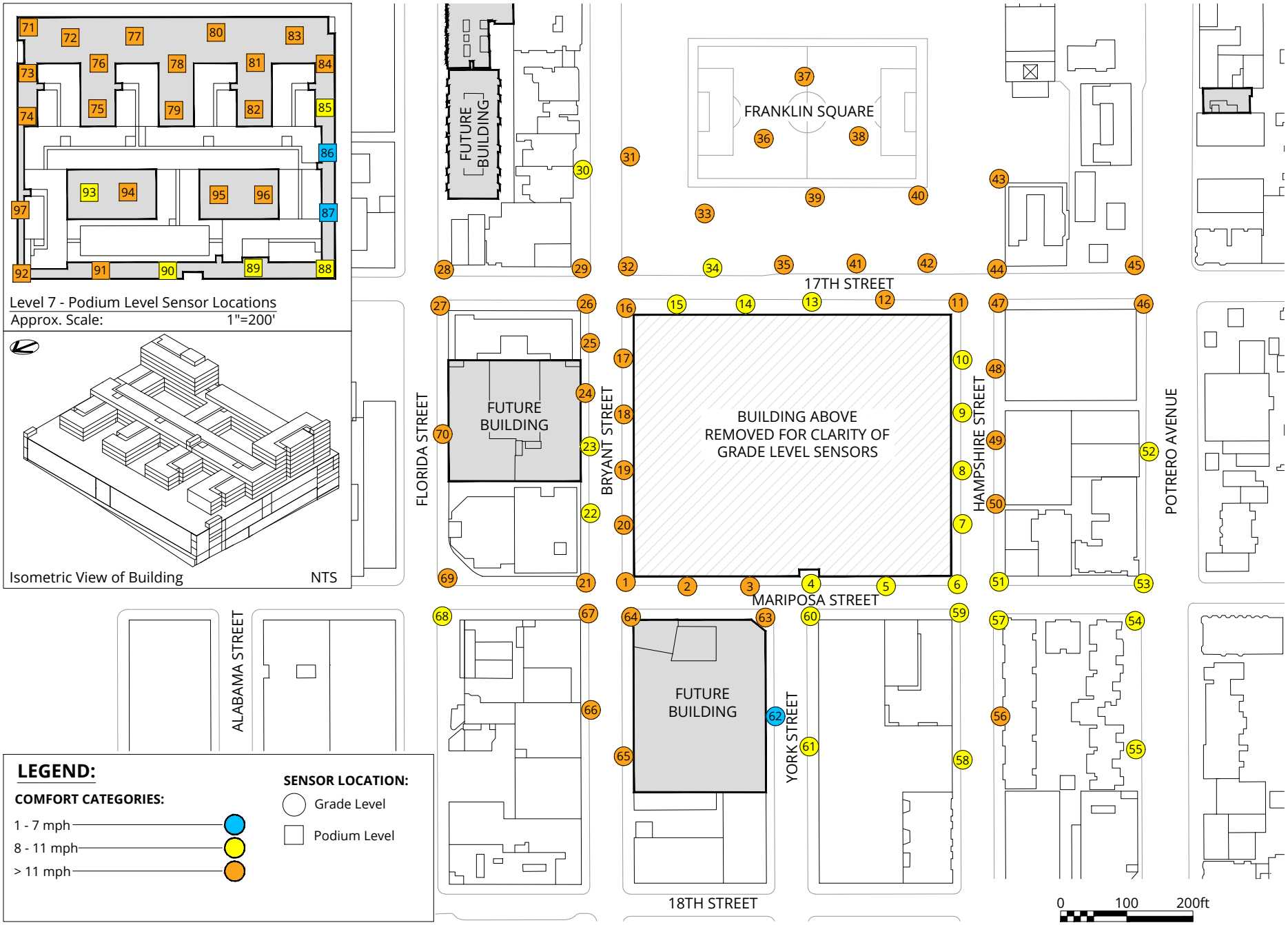
Existing + Project
Annual

SFMTA Potrero Yard - San Francisco, CA

Project #2000654

True North

Drawn by:	DF	Figure:	1B
Approx. Scale:	1"=200'		
Date Revised:	Mar. 4, 2020		



Pedestrian Wind Comfort Conditions

Project + Cumulative

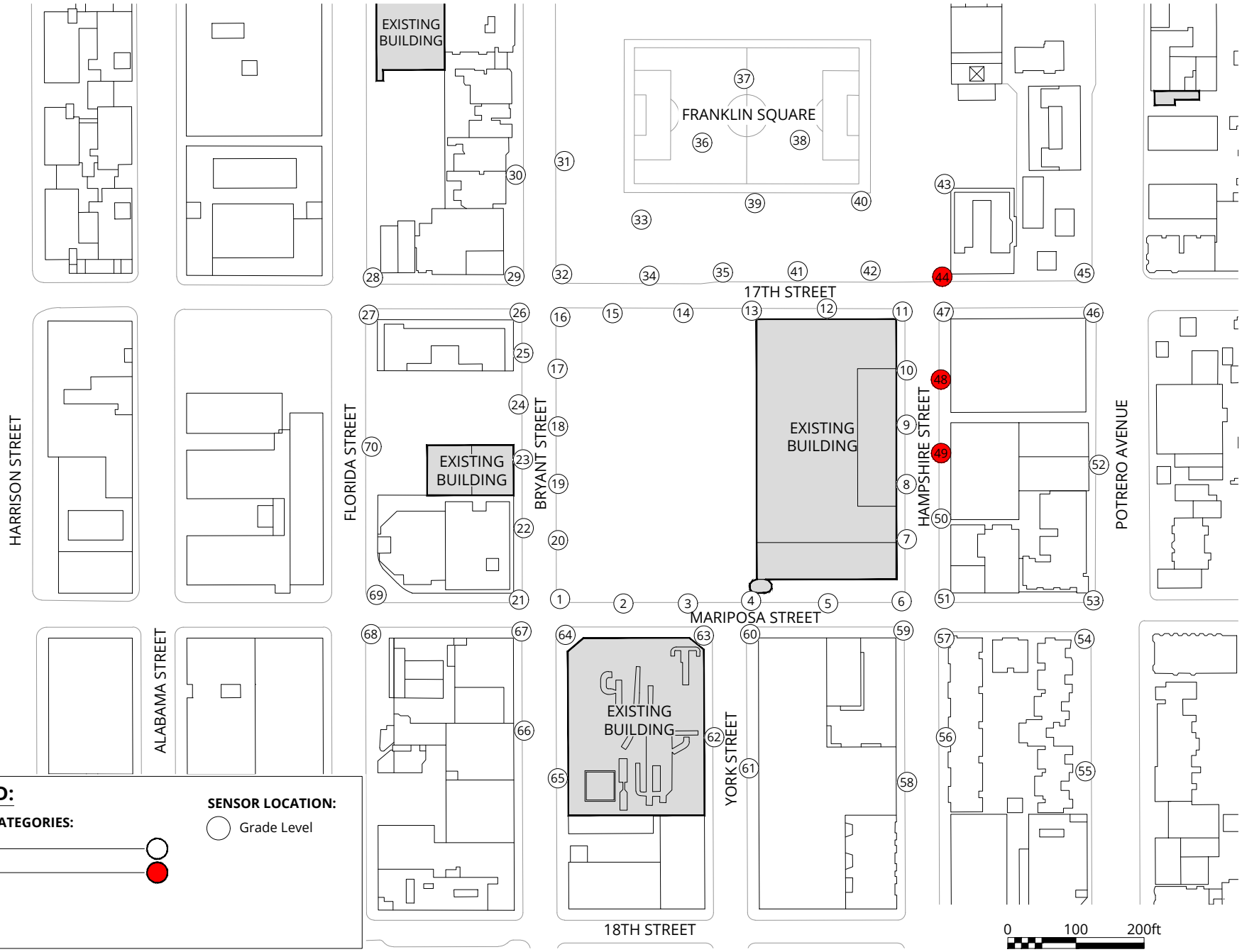
Annual

SFMTA Potrero Yard - San Francisco, CA

Project #2000654

True North

Drawn by:	DF	Figure:	1C
Approx. Scale:	1"=200'		
Date Revised:	Mar. 4, 2020		



LEGEND:

HAZARD CATEGORIES:

Pass

Exceeded

SENSOR LOCATION:

Grade Level

Pedestrian Wind Hazard Conditions

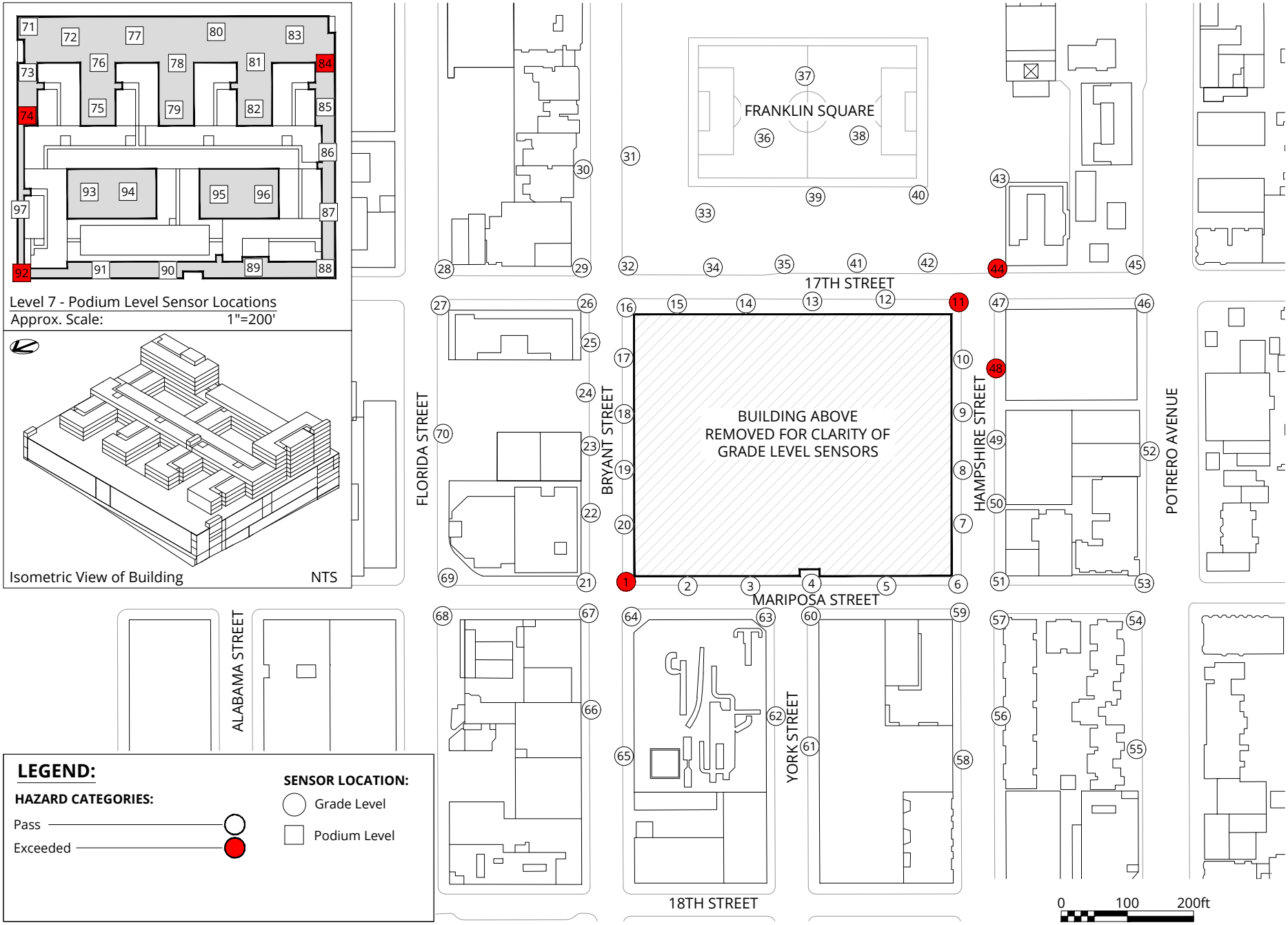
Existing
Annual

SFMTA Potrero Yard - San Francisco, CA

True North

Project #2000654

Drawn by: DF	Figure: 2A
Approx. Scale:	1"=200'
Date Revised:	Feb. 21, 2020



Pedestrian Wind Hazard Conditions

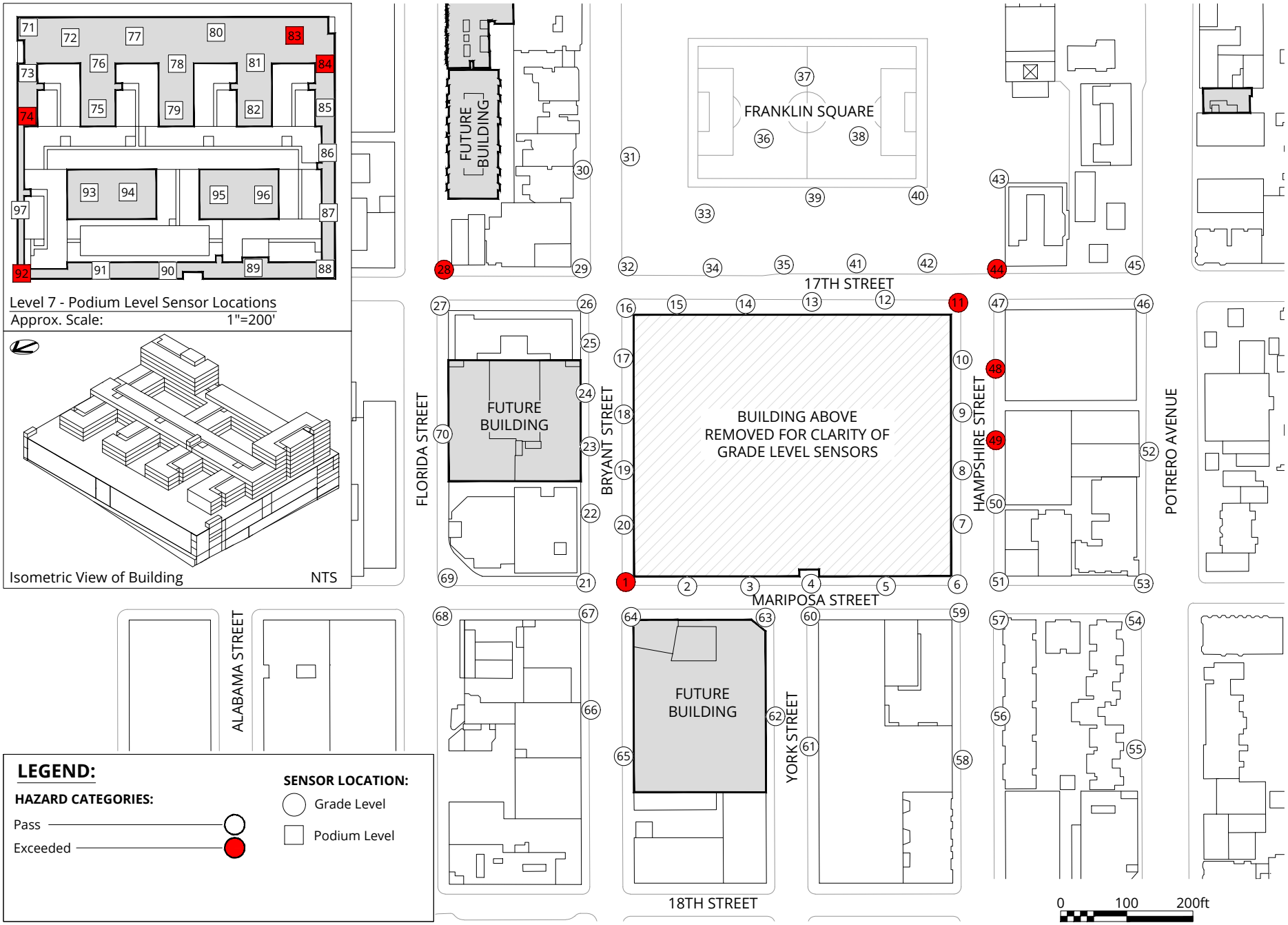
Existing + Project
Annual

SFMTA Potrero Yard - San Francisco, CA

Project #2000654

True North

Drawn by:	DF	Figure:	2B
Approx. Scale:	1"=200'		
Date Revised:	Mar. 4, 2020		



Pedestrian Wind Hazard Conditions

Project + Cumulative

Annual

SFMTA Potrero Yard - San Francisco, CA

True North

Project #2000654

Drawn by: DF	Figure: 2C	
Approx. Scale: 1"=200'		
Date Revised: Mar. 4, 2020		

TABLES

Table 1.1: Wind Comfort Conditions - Grade Level

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	20	e	21	50	8	e	19	40	6	e
2	13	19	e	16	28	3	e	17	32	4	e
3	13	15	e	13	19	0	e	13	18	0	e
4	13	20	e	9	5	-4		9	4	-4	
5	12	14	e	9	3	-3		9	4	-3	
6	10	7		8	3	-2		8	3	-2	
7	10	6		11	10	1		11	10	1	
8	11	10		11	10	0		11	10	0	
9	13	19	e	9	3	-4		9	4	-4	
10	15	25	e	8	2	-7		9	3	-6	
11	17	33	e	19	38	2	e	19	37	2	e
12	13	14	e	15	22	2	e	14	16	1	e
13	14	25	e	12	14	-2	e	11	10	-3	
14	14	19	e	11	10	-3		9	7	-5	
15	12	15	e	10	7	-2		9	4	-3	
16	10	5		19	43	9	e	16	31	6	e
17	9	4		15	26	6	e	14	22	5	e
18	12	13	e	13	21	1	e	15	28	3	e
19	11	10		13	16	2	e	13	21	2	e
20	10	6		15	24	5	e	12	13	2	e
21	13	20	e	16	31	3	e	16	31	3	e
22	6	1		11	10	5		10	8	4	
23	7	1		11	10	4		11	10	4	
24	13	17	e	16	33	3	e	13	17	0	e
25	6	0		12	16	6	e	13	18	7	e
26	11	10		12	15	1	e	13	18	2	e
27	14	23	e	14	21	0	e	16	30	2	e
28	10	4		10	4	0		18	34	8	e
29	12	13	e	13	17	1	e	14	22	2	e
30	6	0		10	7	4		9	2	3	
31	11	10		13	19	2	e	12	14	1	e
32	11	10		16	31	5	e	14	23	3	e
33	13	18	e	14	24	1	e	12	15	-1	e
34	13	18	e	13	20	0	e	11	10	-2	
35	14	21	e	14	23	0	e	13	16	-1	e
36	14	22	e	14	25	0	e	13	20	-1	e
37	15	25	e	14	22	-1	e	14	21	-1	e
38	16	29	e	15	28	-1	e	15	25	-1	e
39	14	23	e	14	23	0	e	13	20	-1	e
40	14	23	e	14	21	0	e	14	20	0	e
41	14	22	e	14	22	0	e	14	21	0	e
42	14	21	e	14	22	0	e	14	22	0	e
43	17	38	e	17	36	0	e	17	35	0	e
44	23	53	e	22	52	-1	e	22	51	-1	e
45	15	25	e	14	22	-1	e	13	20	-2	e
46	16	30	e	15	26	-1	e	16	30	0	e
47	17	36	e	16	29	-1	e	17	33	0	e

Table 1.1: Wind Comfort Conditions - Grade Level

Location				Existing + Project				Project + Cumulative			
				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
48											
49											
50											
51											
52											
53											
54											
55											
56											
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59											
60											
61											
62											
63											
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65											
66											
67											
68											
69											
70											

Summary	Average (mph)	Average (%)	Total	Average (mph)	Average (%)	Speed Change (mph)	Total	Average (mph)	Average (%)	Speed Change (mph)	Total
	13	18	46 ---- 70	13	18	0	42 ---- 70	13	18	0	44 ---- 70

Table 1.2: Wind Comfort Conditions - Podium Level

Location				Existing + Project				Project + Cumulative			
				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
71											
72											
73											
74											
75											
76											
77											
78											
79											
80											
81											
82											
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96											
97											

Summary	Average (mph)	Average (%)	Total	Average (mph)	Average (%)	Speed Change (mph)	Total	Average (mph)	Average (%)	Speed Change (mph)	Total
	-	-	-	15	28	-	20 ---- 27	15	27	-	20 ---- 27

Table 2.1: Wind Hazard Conditions - Grade Level

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	24	0		42	18	18	e	36	1	1	e
2	26	0		29	0	0		33	0	0	
3	25	0		28	0	0		26	0	0	
4	25	0		20	0	0		19	0	0	
5	24	0		18	0	0		18	0	0	
6	19	0		19	0	0		19	0	0	
7	20	0		20	0	0		21	0	0	
8	21	0		21	0	0		22	0	0	
9	25	0		16	0	0		18	0	0	
10	29	0		16	0	0		17	0	0	
11	35	0		37	2	2	e	38	5	5	e
12	27	0		30	0	0		30	0	0	
13	28	0		26	0	0		24	0	0	
14	27	0		25	0	0		21	0	0	
15	24	0		19	0	0		17	0	0	
16	17	0		35	0	0		30	0	0	
17	21	0		28	0	0		26	0	0	
18	24	0		25	0	0		28	0	0	
19	22	0		27	0	0		25	0	0	
20	23	0		31	0	0		26	0	0	
21	24	0		33	0	0		31	0	0	
22	14	0		22	0	0		20	0	0	
23	17	0		21	0	0		21	0	0	
24	24	0		30	0	0		23	0	0	
25	10	0		23	0	0		24	0	0	
26	19	0		23	0	0		24	0	0	
27	25	0		24	0	0		31	0	0	
28	19	0		18	0	0		39	5	5	e
29	21	0		23	0	0		24	0	0	
30	10	0		20	0	0		18	0	0	
31	23	0		23	0	0		23	0	0	
32	20	0		31	0	0		27	0	0	
33	25	0		25	0	0		22	0	0	
34	25	0		24	0	0		24	0	0	
35	26	0		26	0	0		26	0	0	
36	26	0		25	0	0		26	0	0	
37	30	0		28	0	0		27	0	0	
38	30	0		29	0	0		29	0	0	
39	27	0		26	0	0		26	0	0	
40	28	0		26	0	0		27	0	0	
41	26	0		27	0	0		27	0	0	
42	27	0		27	0	0		28	0	0	
43	32	0		29	0	0		31	0	0	
44	47	55	e	45	36	-19	e	45	34	-21	e
45	31	0		28	0	0		25	0	0	
46	35	0		30	0	0		33	0	0	
47	33	0		31	0	0		32	0	0	

Table 2.1: Wind Hazard Conditions - Grade Level

Location				Existing + Project				Project + Cumulative			
				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
48											
49											
50											
51											
52											
53											
54											
55											
56											
57											
58											
59											
60											
61											
62											
63											
64											
65											
66											
67											
68											
69											
70											

Summary	Average (mph)	Total Hours	Total	Average (mph)	Total Hours	Hours Change	Total	Average (mph)	Total Hours	Hours Change	Total
	25	58	3 ---- 70	25	86	28	4 ---- 70	25	76	18	6 ---- 70

Table 2.2: Wind Hazard Conditions - Podium Level

Location				Existing + Project				Project + Cumulative			
				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
71											
72											
73											
74											
75											
76											
77											
78											
79											
80											
81											
82											
83											
84											
85											
86											
87											
88											
89											
90											
91											
92											
93											
94											
95											
96											
97											

Summary	Average (mph)	Total Hours	Total	Average (mph)	Total Hours	Hours Change	Total	Average (mph)	Total Hours	Hours Change	Total
	-	-	-	29	99	-	3 ---- 27	29	75	-	4 ---- 27

APPENDIX B2

PRELIMINARY RESULTS

SFMTA POTRERO YARD

SAN FRANCISCO, CA

PEDESTRIAN WIND STUDY
RWDI # 2000654
May 25, 2020

SUBMITTED TO

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EXECUTIVE SUMMARY

RWDI was retained to conduct a pedestrian wind assessment for the proposed SFMTA Potrero Yards in San Francisco, CA (Image 1). RWDI conducted an initial wind tunnel testing of the Existing, Existing + Proposed and Proposed + Cumulative configurations in February 2020. Based on our initial wind-tunnel testing, RWDI developed some wind control measures for the identified windy areas in conjunction with the design team and the San Francisco Planning Department. Two mitigation options were tested recently, together with a revised Existing configuration. Following is a description of four configurations presented in this report:

A. Existing	Existing site and surroundings with existing landscaping and localized contouring around Franklin Square (tested in May 2020)
B. Existing + Project	Proposed project with existing surroundings, but without any landscaping (tested in February 2020, but presented here again for comparison purpose only)
D. Option 1	Proposed project with existing surroundings and landscaping, including the following wind control measures: • 10ft deep solid canopy at the southwest corner of the project • 10 x10 ft. recess at the southwest corner Proposed landscaping on-site
E. Option 2	Proposed project with existing surroundings and landscaping, including the following wind control measures: • 10ft deep solid canopy at the southwest corner of the project • 15 x 20 ft. recess at the southwest corner Proposed landscaping on-site

The potential wind comfort and hazard conditions are shown in a site plan in Figures 1A through 2E and the associated wind comfort and wind hazard speeds are listed in Tables 1 and Table 2 respectively.

Image 2A: Wind Tunnel Study Model – Existing Configuration

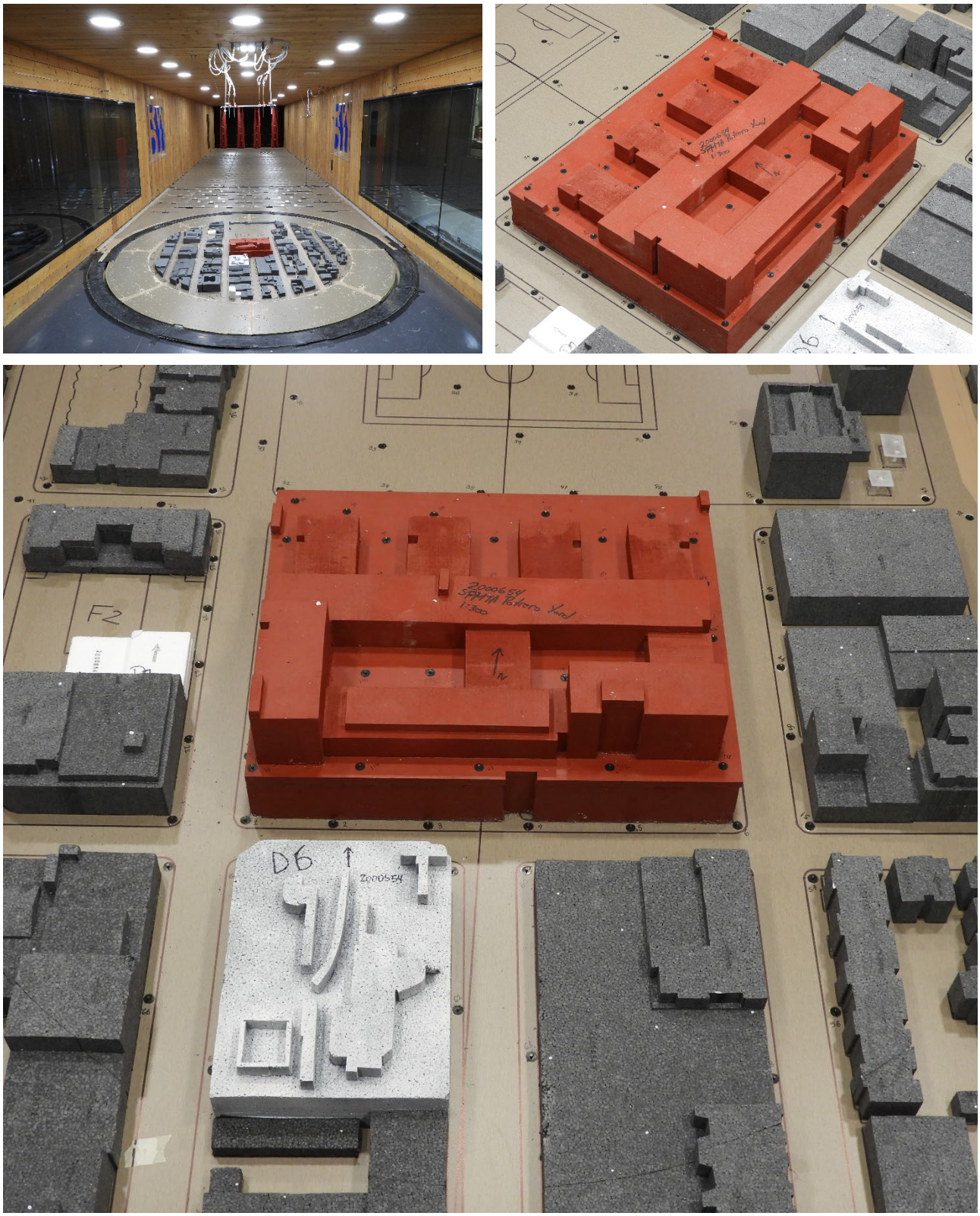


Image 2B: Wind Tunnel Study Model – Existing + Project Configuration

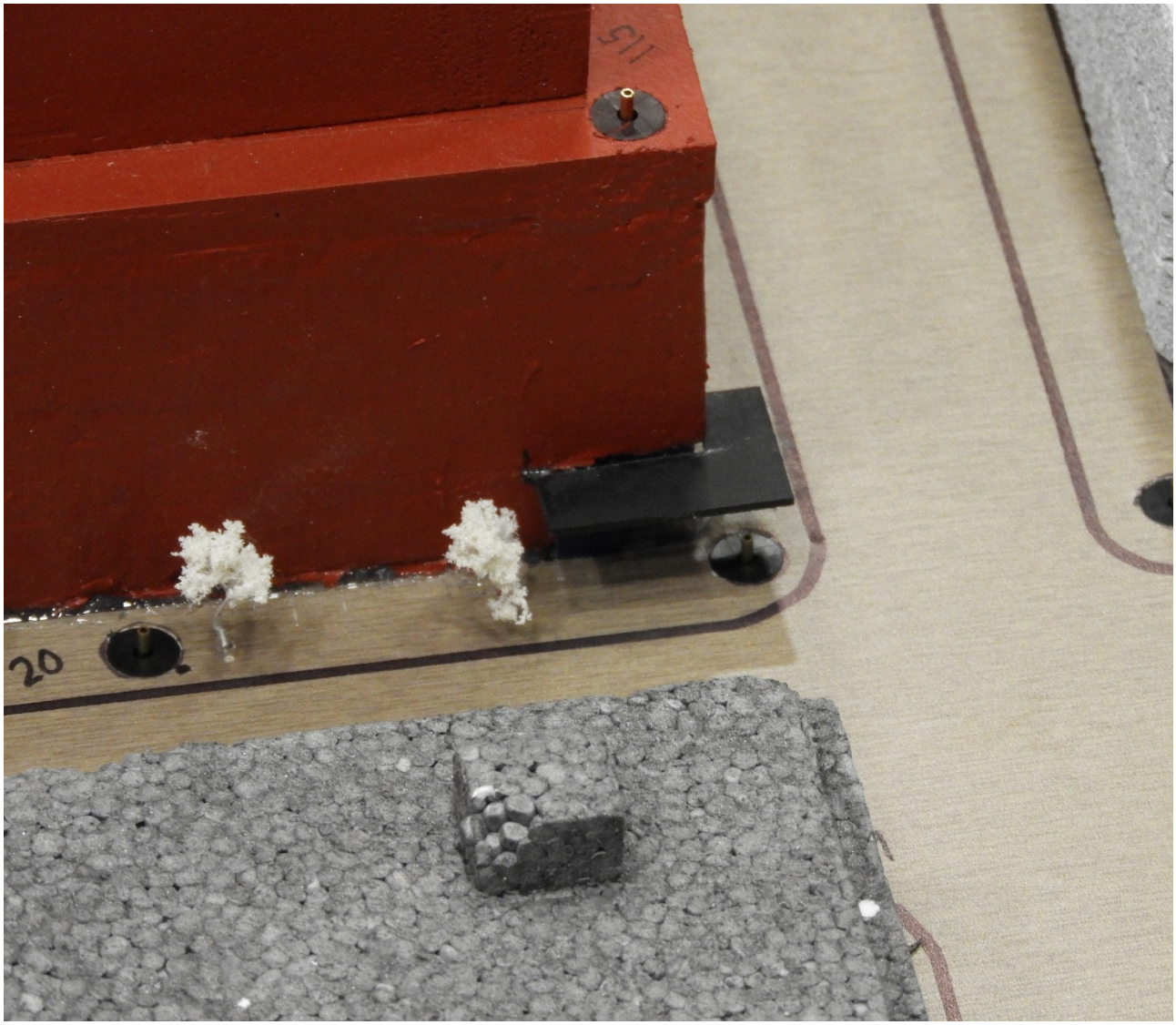


Image 2D: Wind Tunnel Study Model – Option 1 Configuration

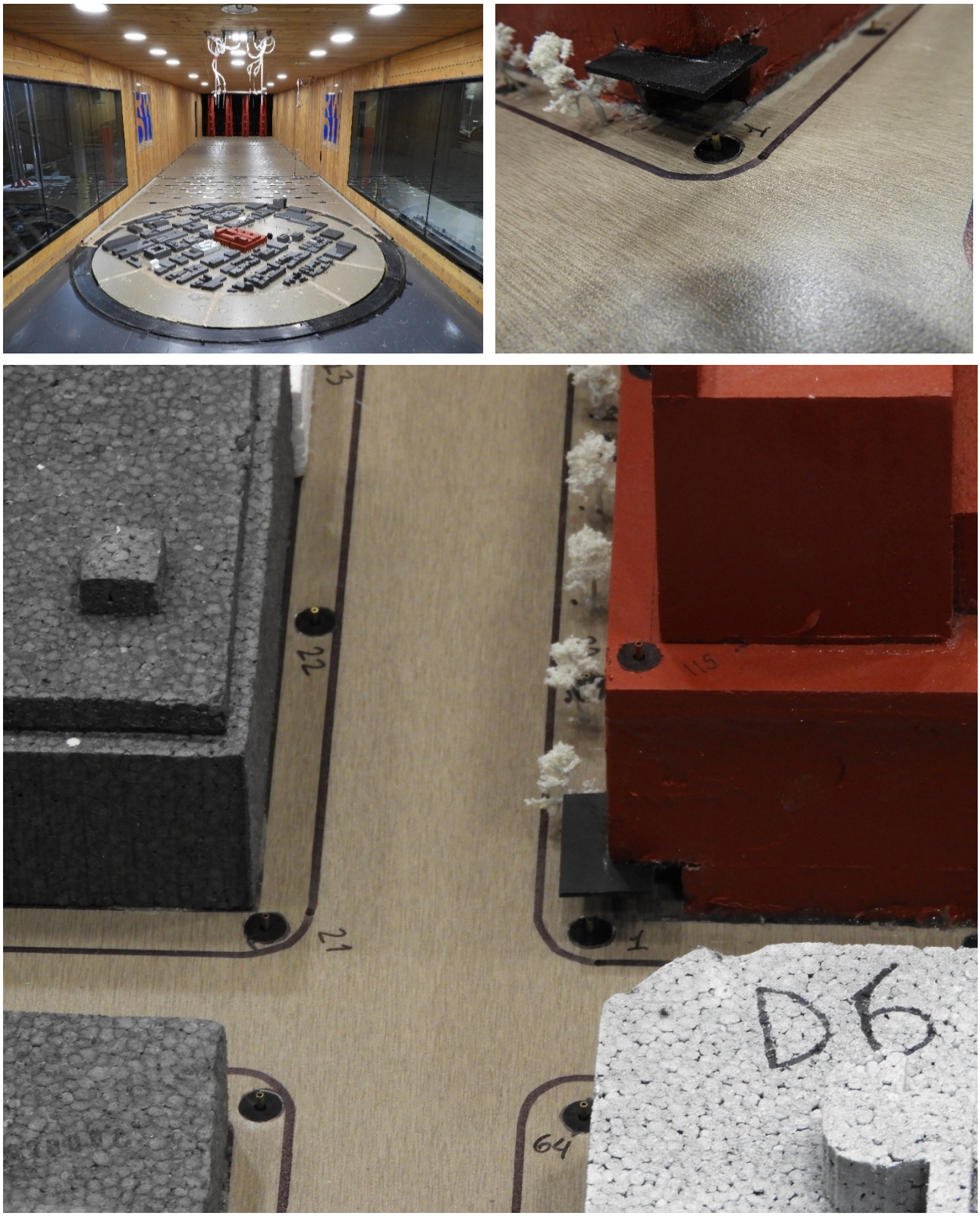
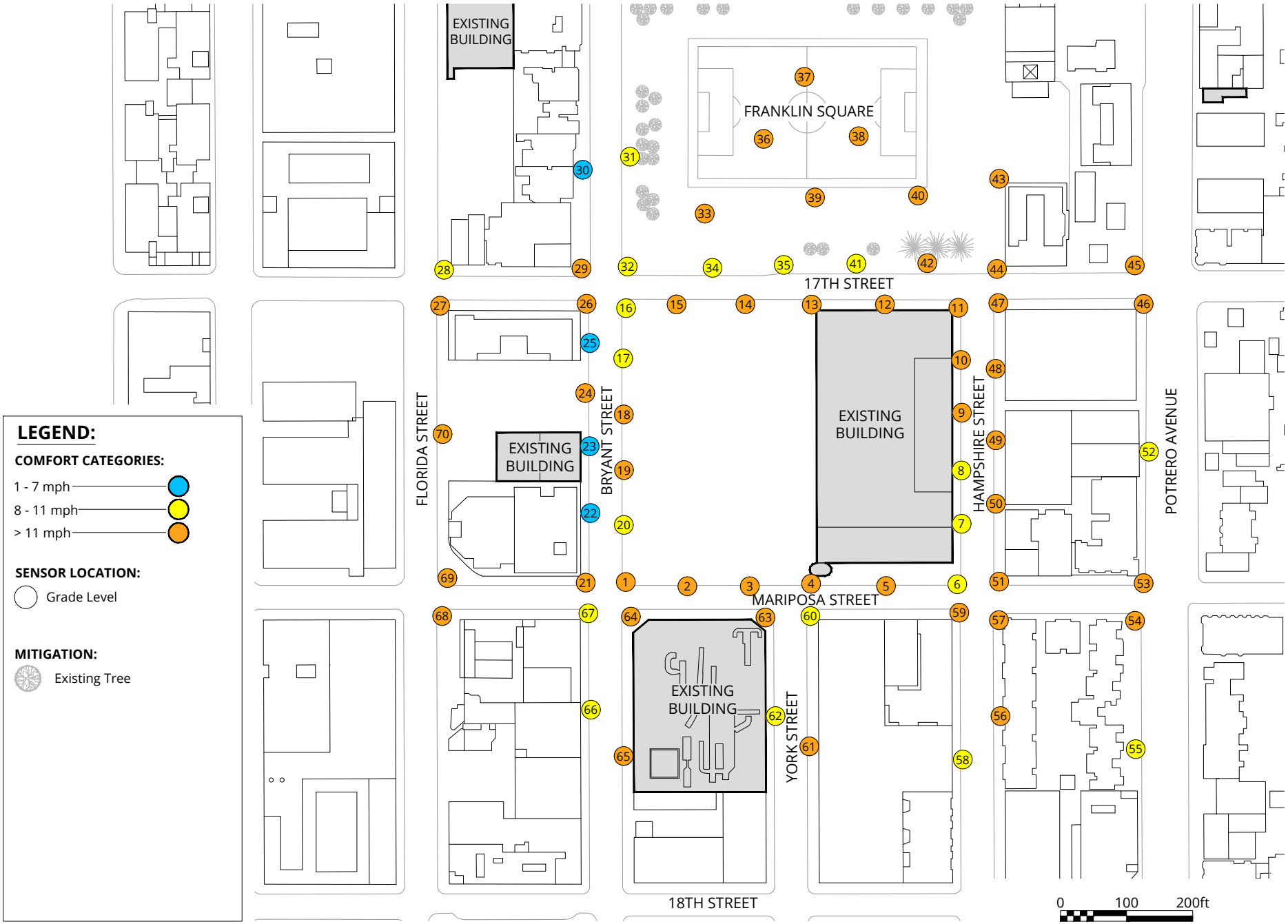


Image 2E: Wind Tunnel Study Model – Option 2 Configuration

FIGURES



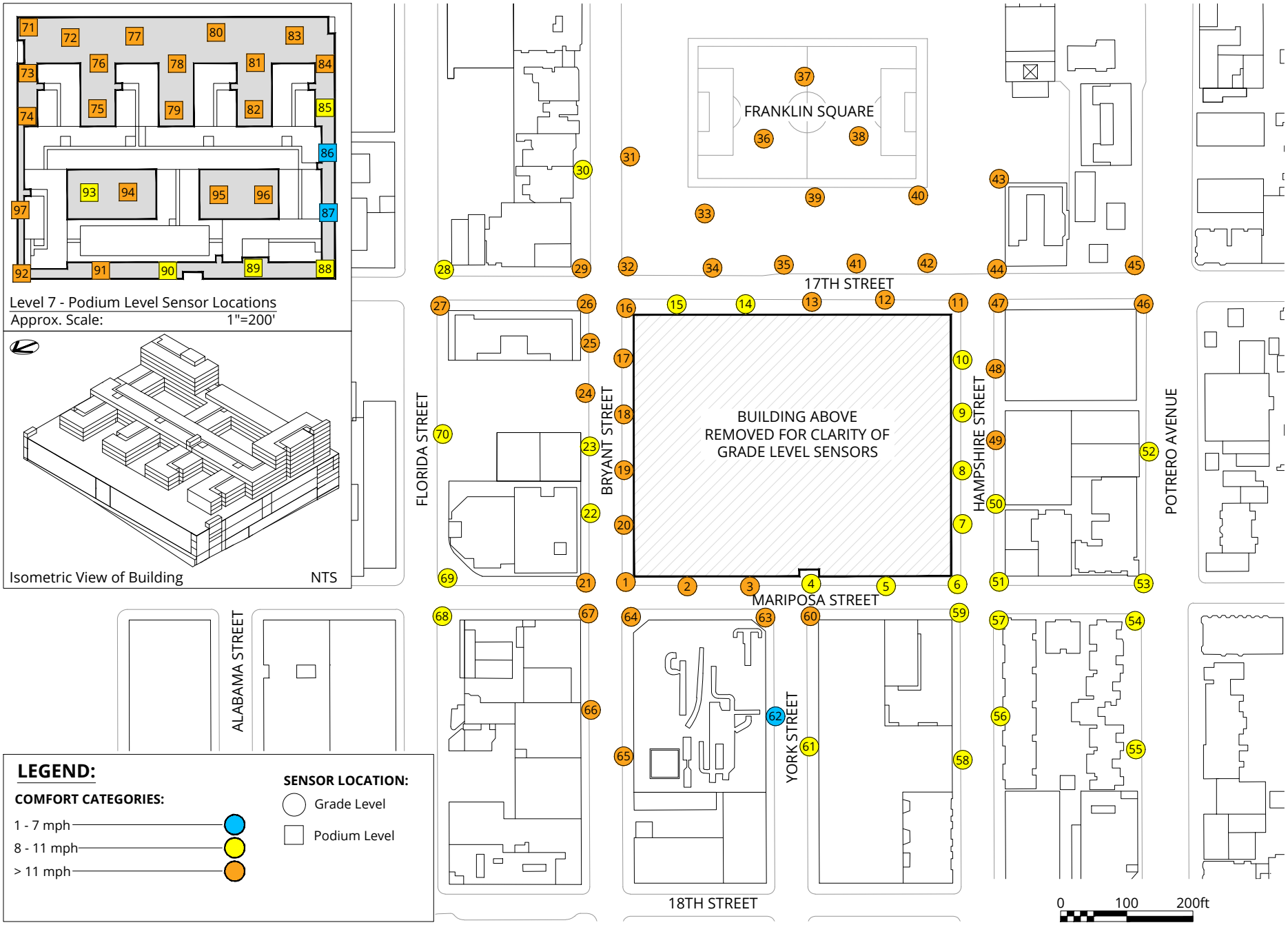
Pedestrian Wind Comfort Conditions
Existing
Annual

SFMTA Potrero Yard - San Francisco, CA

True North

Project #2000654

Drawn by: GRE	Figure: 1A
Approx. Scale:	1"=200'
Date Revised:	July 2, 2020



Pedestrian Wind Comfort Conditions

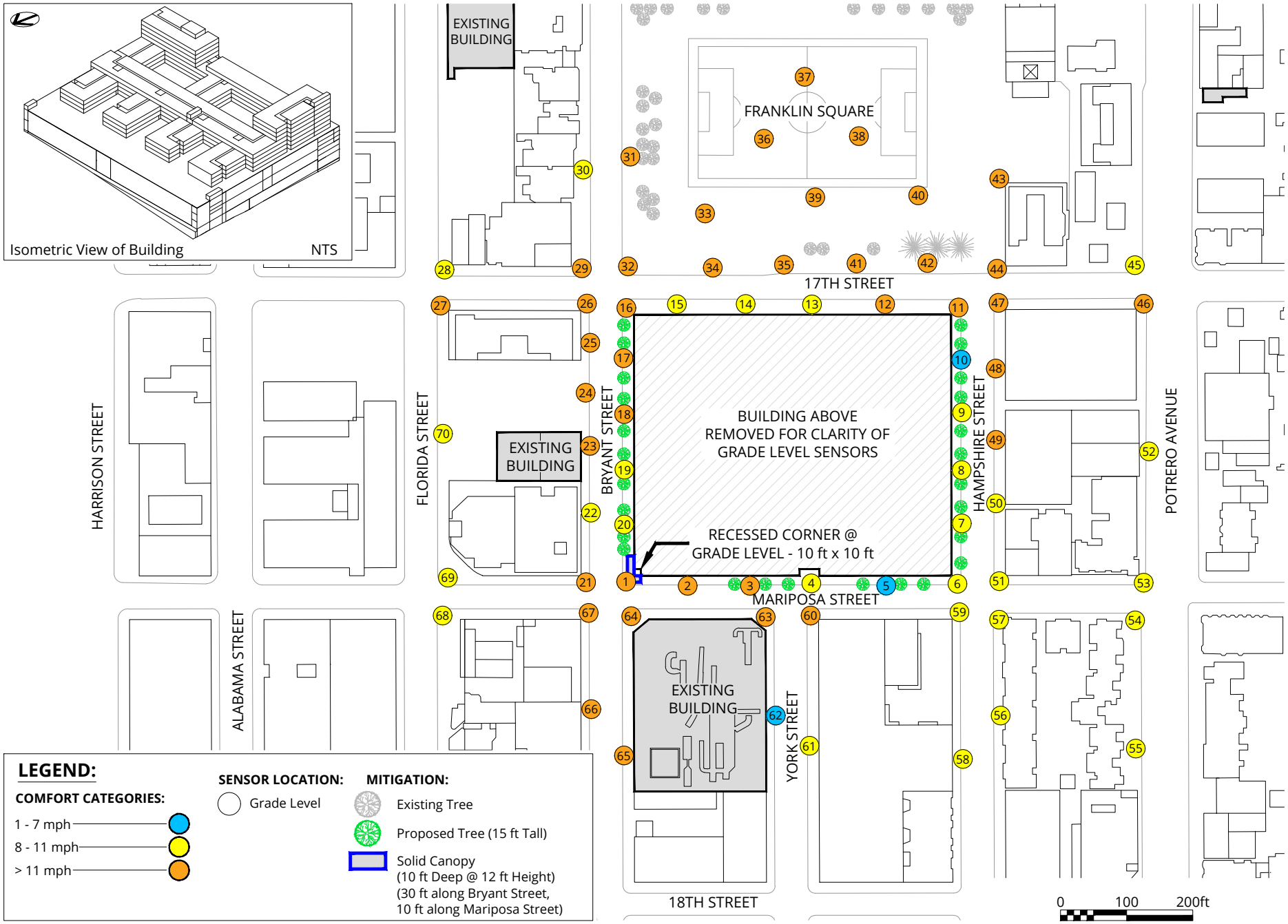
Existing + Project
Annual

SFMTA Potrero Yard - San Francisco, CA

Project #2000654

True North

Drawn by:	DF	Figure:	1B
Approx. Scale:	1"=200'		
Date Revised:	Mar. 4, 2020		



Pedestrian Wind Comfort Conditions

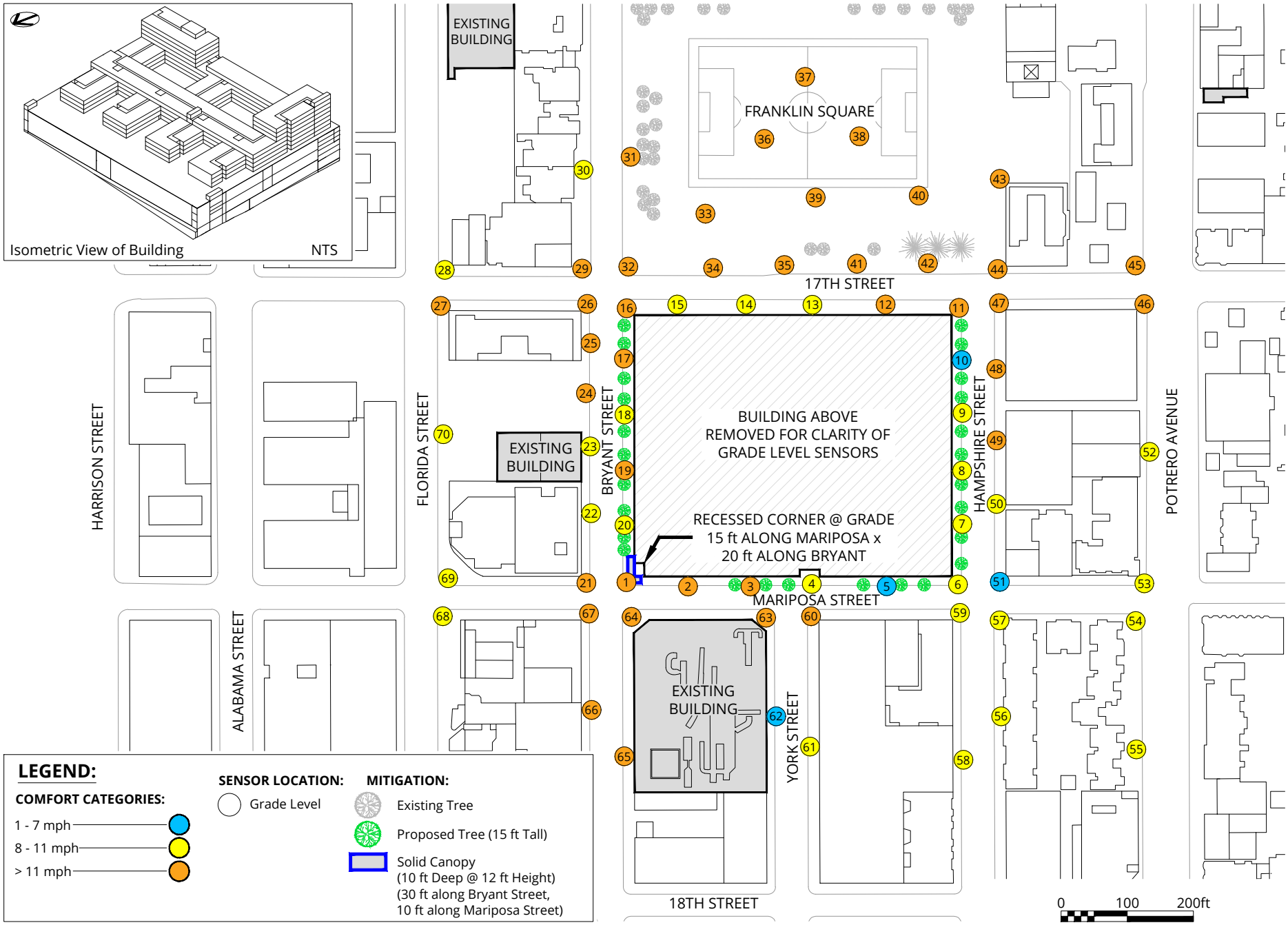
Option 1
Annual

SFMTA Potrero Yard - San Francisco, CA

True North

Project #2000654

Drawn by: GRE	Figure: 1D
Approx. Scale:	1"=200'
Date Revised:	May 21, 2020



Pedestrian Wind Comfort Conditions

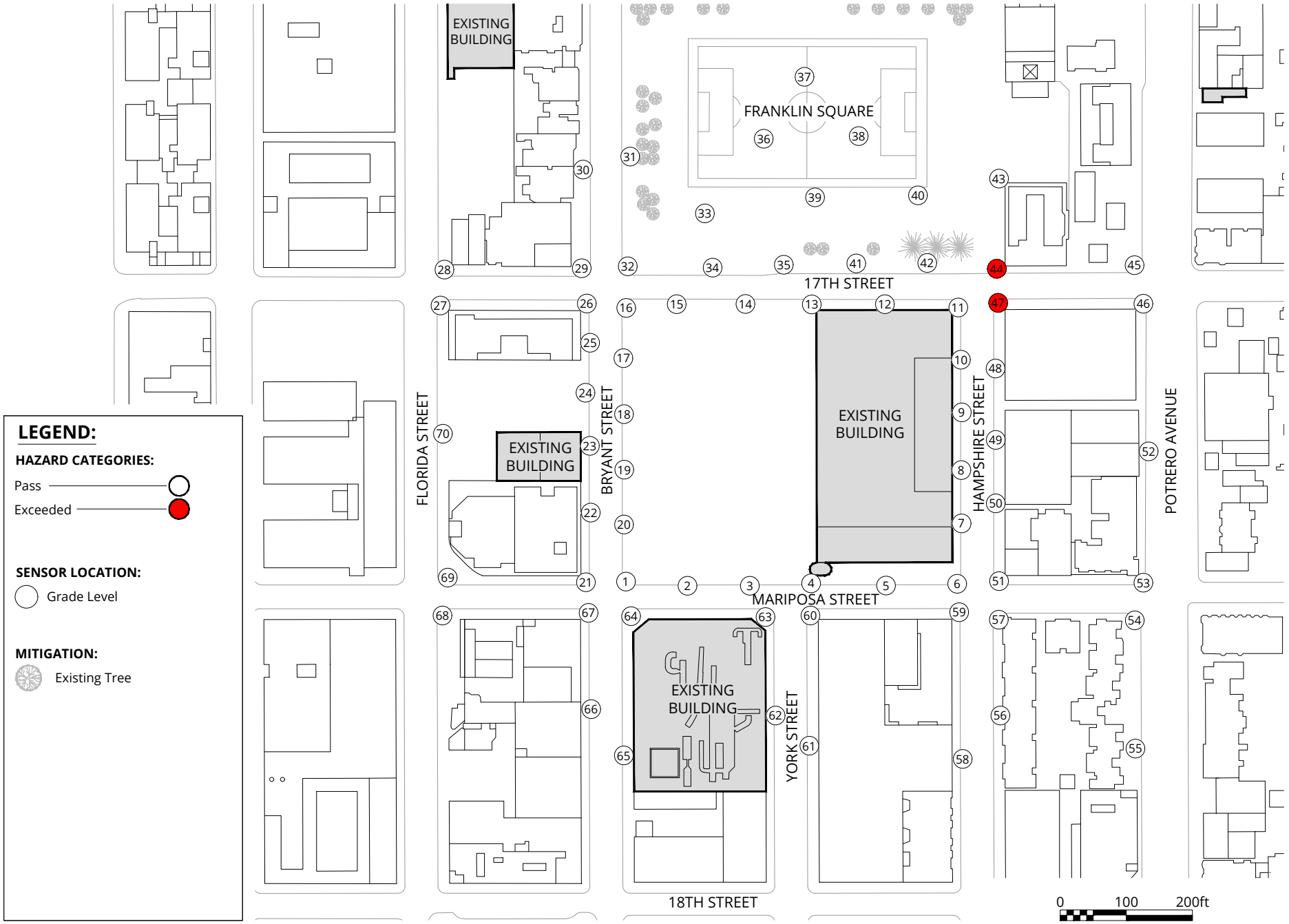
Option 2
Annual

SFMTA Potrero Yard - San Francisco, CA

True North

Project #2000654

Drawn by: GRE	Figure: 1E
Approx. Scale:	1"=200'
Date Revised:	May 21, 2020



LEGEND:

HAZARD CATEGORIES:

Pass

Exceeded

SENSOR LOCATION:

Grade Level

MITIGATION:

Existing Tree

Pedestrian Wind Hazard Conditions

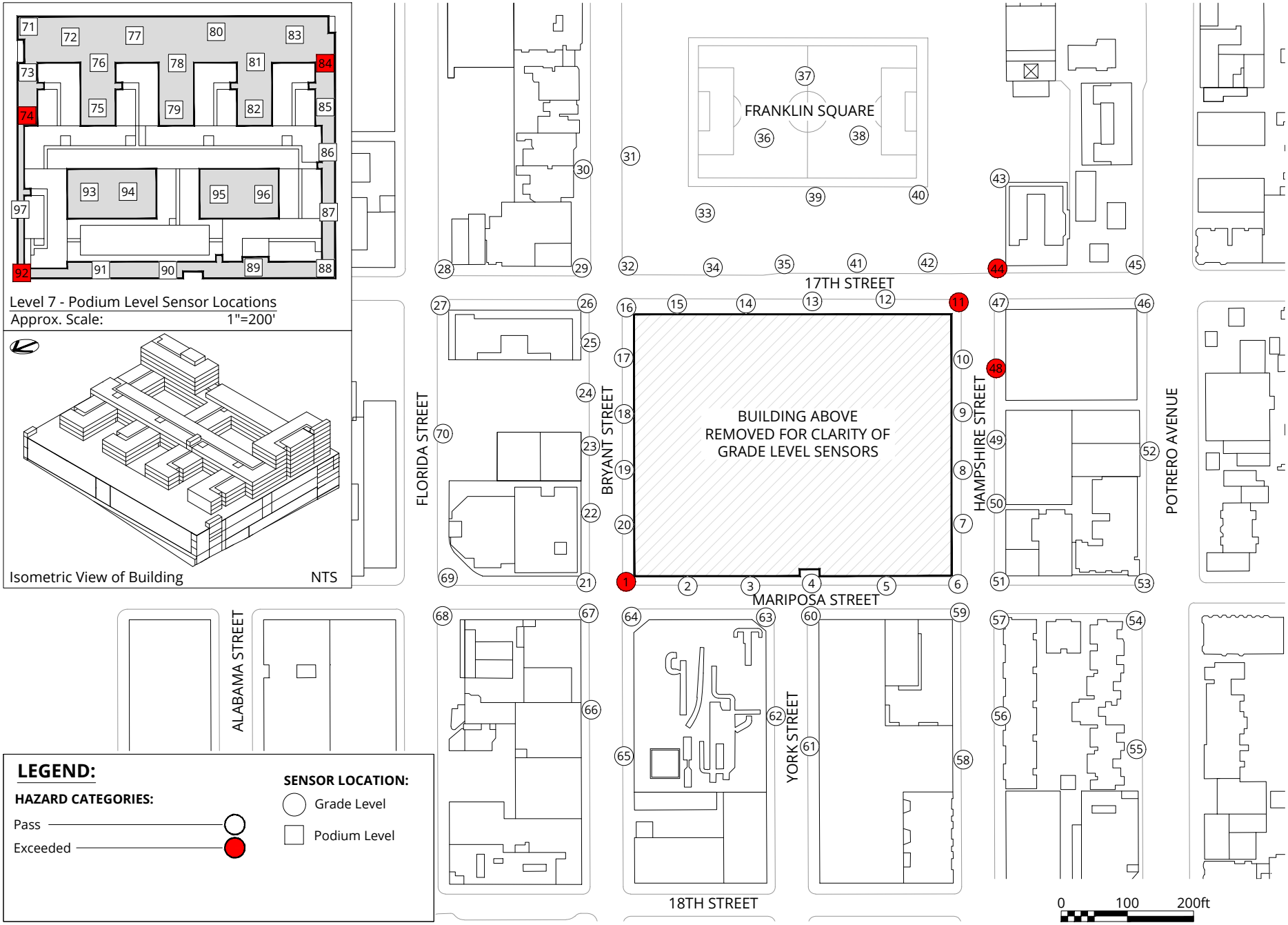
Existing
Annual

SFMTA Potrero Yard - San Francisco, CA

True North

Project #2000654

Drawn by: GRE	Figure: 2A
Approx. Scale:	1"=200'
Date Revised:	July 2, 2020



Pedestrian Wind Hazard Conditions

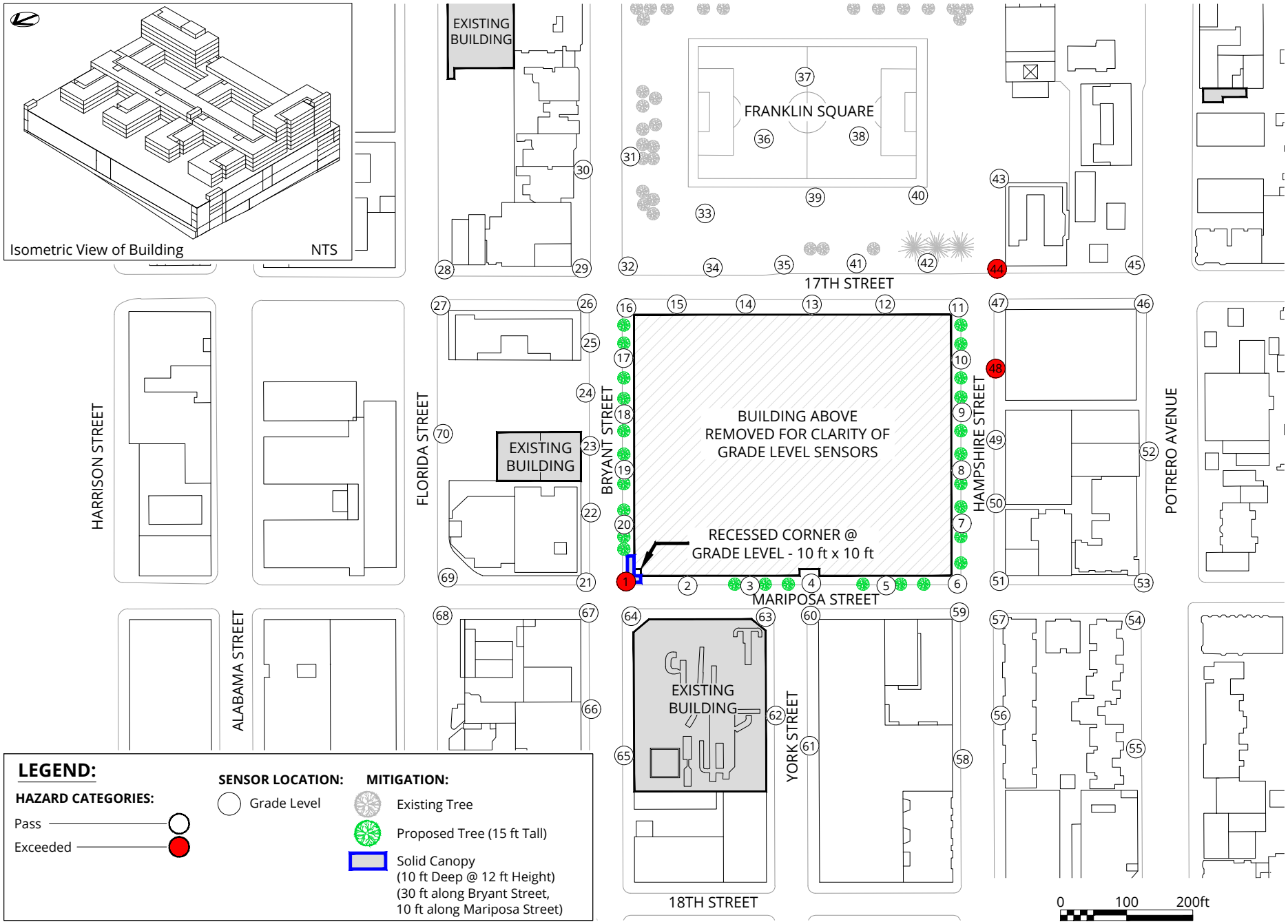
Existing + Project
Annual

SFMTA Potrero Yard - San Francisco, CA

Project #2000654

True North

Drawn by:	DF	Figure:	2B
Approx. Scale:	1"=200'		
Date Revised:	Mar. 4, 2020		



Pedestrian Wind Hazard Conditions

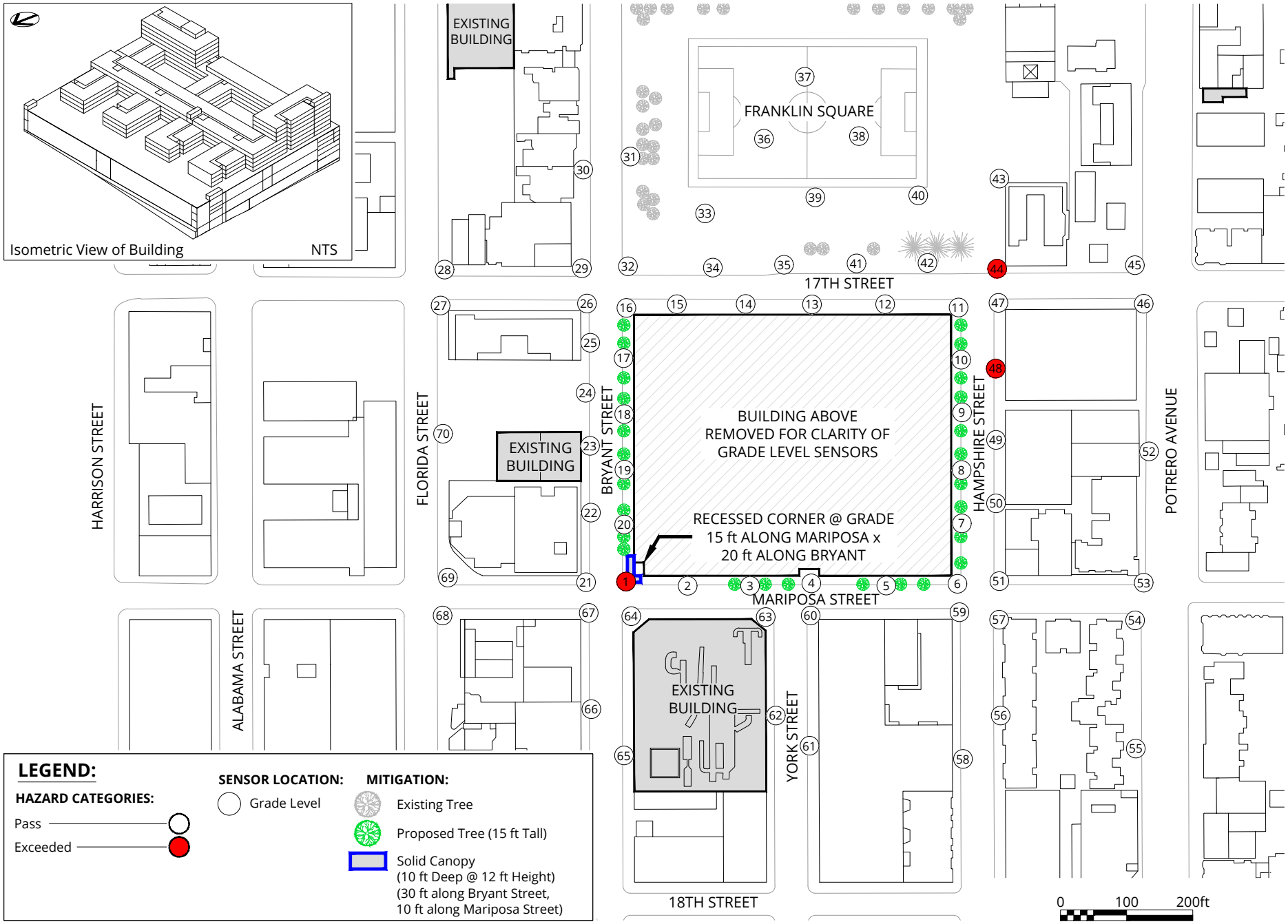
Option 1
Annual

SFMTA Potrero Yard - San Francisco, CA

True North

Project #2000654

Drawn by: GRE	Figure: 2D
Approx. Scale:	1"=200'
Date Revised:	May 21, 2020



Pedestrian Wind Hazard Conditions

Option 2
Annual

SFMTA Potrero Yard - San Francisco, CA

True North

Project #2000654

Drawn by: GRE	Figure: 2E
Approx. Scale:	1"=200'
Date Revised:	May 21, 2020

TABLES

Table 1: Wind Comfort Conditions

Location	Existing			Existing + Project				Option 1				Option 2			
	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	Wind Speed Exceeded 10% of Time (mph)	% of Time Wind Speed Exceeds 11 mph (%)	Speed Change Relative to Existing (mph)	Exceeds
1	12	18	e	21	50	9	e	22	51	10	e	21	51	9	e
2	12	12	e	16	28	4	e	14	22	2	e	13	20	1	e
3	12	14	e	13	19	1	e	12	15	0	e	12	13	0	e
4	12	17	e	9	5	-3		8	3	-4		8	3	-4	
5	13	15	e	9	3	-4		7	1	-6		7	1	-6	
6	11	10		8	3	-3		8	1	-3		8	1	-3	
7	10	6		11	10	1		9	3	-1		9	3	-1	
8	11	10		11	10	0		10	6	-1		10	6	-1	
9	12	13	e	9	3	-3		8	2	-4		9	2	-3	
10	14	23	e	8	2	-6		7	0	-7		7	1	-7	
11	17	32	e	19	38	2	e	16	30	-1	e	17	34	0	e
12	13	15	e	15	22	2	e	12	14	-1	e	13	16	0	e
13	14	22	e	12	14	-2	e	11	10	-3		11	10	-3	
14	13	18	e	11	10	-2		11	10	-2		10	7	-3	
15	12	13	e	10	7	-2		10	6	-2		10	6	-2	
16	10	6		19	43	9	e	17	36	7	e	17	38	7	e
17	9	4		15	26	6	e	13	19	4	e	12	15	3	e
18	13	15	e	13	21	0	e	13	17	0	e	11	10	-2	
19	13	18	e	13	16	0	e	11	10	-2		12	12	-1	e
20	10	7		15	24	5	e	11	10	1		11	10	1	
21	13	17	e	16	31	3	e	15	28	2	e	15	27	2	e
22	7	1		11	10	4		11	10	4		11	10	4	
23	7	1		11	10	4		12	15	5	e	11	10	4	
24	13	20	e	16	33	3	e	16	33	3	e	16	30	3	e
25	6	0		12	16	6	e	12	14	6	e	12	14	6	e
26	12	13	e	12	15	0	e	12	16	0	e	12	14	0	e
27	14	22	e	14	21	0	e	13	18	-1	e	13	20	-1	e
28	10	7		10	4	0		10	5	0		10	6	0	
29	12	13	e	13	17	1	e	12	17	0	e	12	17	0	e
30	6	1		10	7	4		10	7	4		10	5	4	
31	11	10		13	19	2	e	13	20	2	e	13	20	2	e
32	11	10		16	31	5	e	13	20	2	e	13	19	2	e

Table 1: Wind Comfort Conditions

Location	Existing			Existing + Project				Option 1				Option 2			
	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	Wind Speed Exceeded 10% of Time (mph)	% of Time Wind Speed Exceeds 11 mph (%)	Speed Change Relative to Existing (mph)	Exceeds
33	13	21	e	14	24	1	e	13	21	0	e	13	21	0	e
34	11	10		13	20	2	e	12	16	1	e	12	17	1	e
35	10	7		14	23	4	e	12	14	2	e	12	14	2	e
36	13	17	e	14	25	1	e	12	17	-1	e	12	18	-1	e
37	16	30	e	14	22	-2	e	14	21	-2	e	15	25	-1	e
38	15	27	e	15	28	0	e	14	23	-1	e	14	24	-1	e
39	15	25	e	14	23	-1	e	14	23	-1	e	13	20	-2	e
40	13	20	e	14	21	1	e	12	14	-1	e	13	20	0	e
41	11	10		14	22	3	e	12	15	1	e	12	16	1	e
42	14	22	e	14	22	0	e	14	24	0	e	15	25	1	e
43	15	28	e	17	36	2	e	14	23	-1	e	14	24	-1	e
44	21	46	e	22	52	1	e	20	45	-1	e	21	50	0	e
45	15	25	e	14	22	-1	e	11	10	-4		12	16	-3	e
46	16	29	e	15	26	-1	e	13	17	-3	e	14	22	-2	e
47	19	43	e	16	29	-3	e	17	32	-2	e	18	37	-1	e
48	17	33	e	22	51	5	e	20	44	3	e	21	48	4	e
49	18	40	e	18	38	0	e	16	29	-2	e	17	32	-1	e
50	15	25	e	11	10	-4		9	3	-6		9	5	-6	
51	14	23	e	8	1	-6		8	1	-6		7	0	-7	
52	11	10		8	2	-3		8	1	-3		8	2	-3	
53	12	12	e	8	2	-4		10	4	-2		9	3	-3	
54	14	22	e	9	2	-5		9	3	-5		9	2	-5	
55	9	4		8	3	-1		8	4	-1		8	3	-1	
56	15	23	e	11	10	-4		11	10	-4		11	10	-4	
57	14	22	e	8	2	-6		8	3	-6		8	2	-6	
58	11	10		8	2	-3		8	2	-3		8	2	-3	
59	16	28	e	10	6	-6		11	10	-5		10	6	-6	
60	11	10		12	12	1	e	12	12	1	e	12	12	1	e
61	16	31	e	10	6	-6		10	7	-6		10	7	-6	
62	11	10		7	0	-4		7	1	-4		7	0	-4	
63	17	34	e	15	26	-2	e	16	28	-1	e	16	28	-1	e
64	15	26	e	18	37	3	e	16	31	1	e	15	27	0	e

Table 1: Wind Comfort Conditions

Location	Existing			Existing + Project				Option 1				Option 2			
	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	Wind Speed Exceeded 10% of Time (mph)	% of Time Wind Speed Exceeds 11 mph (%)	Speed Change Relative to Existing (mph)	Exceeds
65	14	22	e												
66	10	6													
67	11	10													
68	13	18	e												
69	12	17	e												
70	13	19	e												

Summary	Average (mph)	Average (%)	Total	Average (mph)	Average (%)	Speed Change (mph)	Total	Average (mph)	Average (%)	Speed Change (mph)	Total	Average (mph)	Average (%)	Speed Change (mph)	Total
	13	**17**	**47 ---- 70**	**13**	**18**	**0**	**42 ---- 70**	**12**	**15**	**-1**	**39 ---- 70**	**12**	**15**	**-1**	**39 ---- 70**

Table 2: Wind Hazard Conditions

Location	Existing			Existing + Project				Option 1				Option 2			
	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	Wind Speed Exceeded 1hr/year (mph)	Hours per Year Wind Speed Exceeds Hazard Criteria	Hours Change Relative to Existing	Exceeds
1	23	0		42	18	18	e	41	11	11	e	39	4	4	e
2	23	0		29	0	0		30	0	0		28	0	0	
3	25	0		28	0	0		27	0	0		25	0	0	
4	23	0		20	0	0		18	0	0		18	0	0	
5	24	0		18	0	0		15	0	0		14	0	0	
6	21	0		19	0	0		17	0	0		16	0	0	
7	19	0		20	0	0		16	0	0		17	0	0	
8	21	0		21	0	0		19	0	0		19	0	0	
9	22	0		16	0	0		16	0	0		16	0	0	
10	28	0		16	0	0		13	0	0		14	0	0	
11	34	0		37	2	2	e	33	0	0		35	0	0	
12	27	0		30	0	0		27	0	0		28	0	0	
13	26	0		26	0	0		24	0	0		24	0	0	
14	26	0		25	0	0		25	0	0		23	0	0	
15	23	0		19	0	0		19	0	0		19	0	0	
16	18	0		35	0	0		31	0	0		32	0	0	
17	19	0		28	0	0		24	0	0		24	0	0	
18	26	0		25	0	0		22	0	0		21	0	0	
19	26	0		27	0	0		25	0	0		26	0	0	
20	24	0		31	0	0		23	0	0		24	0	0	
21	23	0		33	0	0		31	0	0		32	0	0	
22	16	0		22	0	0		23	0	0		24	0	0	
23	17	0		21	0	0		20	0	0		21	0	0	
24	25	0		30	0	0		30	0	0		30	0	0	
25	11	0		23	0	0		22	0	0		22	0	0	
26	23	0		23	0	0		23	0	0		23	0	0	
27	24	0		24	0	0		22	0	0		24	0	0	
28	20	0		18	0	0		19	0	0		20	0	0	
29	21	0		23	0	0		23	0	0		23	0	0	
30	15	0		20	0	0		19	0	0		19	0	0	
31	25	0		23	0	0		23	0	0		23	0	0	
32	22	0		31	0	0		25	0	0		25	0	0	

Table 2: Wind Hazard Conditions

Location	Existing			Existing + Project				Option 1				Option 2			
	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	Wind Speed Exceeded 1hr/year (mph)	Hours per Year Wind Speed Exceeds Hazard Criteria	Hours Change Relative to Existing	Exceeds
33	27	0		25	0	0		24	0	0		24	0	0	
34	21	0		24	0	0		23	0	0		23	0	0	
35	19	0		26	0	0		23	0	0		22	0	0	
36	24	0		25	0	0		22	0	0		23	0	0	
37	31	0		28	0	0		26	0	0		27	0	0	
38	29	0		29	0	0		26	0	0		27	0	0	
39	28	0		26	0	0		26	0	0		25	0	0	
40	25	0		26	0	0		23	0	0		24	0	0	
41	21	0		27	0	0		24	0	0		23	0	0	
42	26	0		27	0	0		27	0	0		27	0	0	
43	30	0		29	0	0		26	0	0		26	0	0	
44	44	28	e	45	36	8	e	38	3	-25	e	41	14	-14	e
45	32	0		28	0	0		22	0	0		23	0	0	
46	35	0		30	0	0		26	0	0		28	0	0	
47	38	2	e	31	0	-2		31	0	-2		34	0	-2	
48	32	0		43	30	30	e	40	6	6	e	40	10	10	e
49	35	0		35	0	0		32	0	0		33	0	0	
50	28	0		22	0	0		20	0	0		20	0	0	
51	26	0		16	0	0		15	0	0		14	0	0	
52	24	0		17	0	0		16	0	0		17	0	0	
53	21	0		18	0	0		19	0	0		18	0	0	
54	29	0		15	0	0		15	0	0		14	0	0	
55	20	0		18	0	0		20	0	0		18	0	0	
56	28	0		21	0	0		22	0	0		21	0	0	
57	30	0		16	0	0		19	0	0		16	0	0	
58	21	0		16	0	0		17	0	0		16	0	0	
59	32	0		18	0	0		20	0	0		18	0	0	
60	22	0		24	0	0		25	0	0		24	0	0	
61	32	0		21	0	0		22	0	0		21	0	0	
62	22	0		14	0	0		14	0	0		14	0	0	
63	34	0		32	0	0		34	0	0		33	0	0	
64	27	0		33	0	0		29	0	0		27	0	0	

Table 2: Wind Hazard Conditions

Location	Existing			Existing + Project				Option 1				Option 2			
	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	Wind Speed Exceeded 1hr/year (mph)	Hours per Year Wind Speed Exceeds Hazard Criteria	Hours Change Relative to Existing	Exceeds
65	30	0													
66	18	0													
67	22	0													
68	22	0													
69	25	0													
70	27	0													

Summary	Average (mph)	Total Hours	Total	Average (mph)	Total Hours	Hours Change	Total	Average (mph)	Total Hours	Hours Change	Total	Average (mph)	Total Hours	Hours Change	Total
	25	**30**	**2 ---- 70**	**25**	**86**	**56**	**4 ---- 70**	**24**	**20**	**-10**	**3 ---- 70**	**24**	**28**	**-2**	**3 ---- 70**

APPENDIX B3

PRELIMINARY RESULTS

SFMTA POTRERO YARD

SAN FRANCISCO, CA

PEDESTRIAN WIND STUDY
RWDI # 2000654
June 22, 2020

SUBMITTED TO

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EXECUTIVE SUMMARY

RWDI was retained to conduct a pedestrian wind assessment for the proposed SFMTA Potrero Yards in San Francisco, CA (Image 1). RWDI conducted an initial wind tunnel testing of the Existing, Existing + Proposed and Proposed + Cumulative configurations in February 2020. Based on our initial wind-tunnel testing, RWDI developed some wind control measures for the identified windy areas in conjunction with the design team and the San Francisco Planning Department. Two mitigation options were tested recently (Option 1 and Option 2), together with a revised Existing configuration in May 2020. Based on the results for those mitigation configurations, additional recommendations were made to mitigate winds at the southwest corner of the project site, and six additional configurations were tested. **Note that porous portions of the façade on the north, east and west sides of the project were modeled during this round of wind tunnel testing.** Following is a description of the configurations presented in this report:

A. Existing	Existing site and surroundings with existing landscaping and localized contouring around Franklin Square (tested in May 2020)
B. Existing + Project	Proposed project with existing surroundings, but without any landscaping (tested in February 2020, but presented here again for comparison purpose only)
F. Option 3	Proposed project with existing surroundings and landscaping, including the following wind control measures: • Proposed landscaping on-site • 15 x20 ft. recess at the southwest corner, from grade level to the podium roof • Elevated porous screens on the west façade • Porous canopy at the southwest corner of the project • Vertical porous wind screen to the north of Location #1 at grade level
G. Option 4	Same as Option 3, with the vertical porous wind screen to the north of Location #1 removed
H. Option 5	Same as Option 4, with 15 x20 ft. recess at the southwest corner, from grade level to 12 ft and then squared corner from 12ft to the podium roof
I. Option 6	Same as Option 5, with the porous canopy at the southwest corner removed
J. Option 7	Same Option 6, with elevated porous wind screens on the west facade removed
K. Option 7 + Cumulative	Proposed project with existing and future surroundings and landscaping, including the wind control measures tested for Option 7.

The potential wind comfort and hazard conditions are shown in a site plan in Figures 1A through 2K and the associated wind comfort and wind hazard speeds are listed in Tables 1.

Image 2A: Wind Tunnel Study Model – Existing Configuration

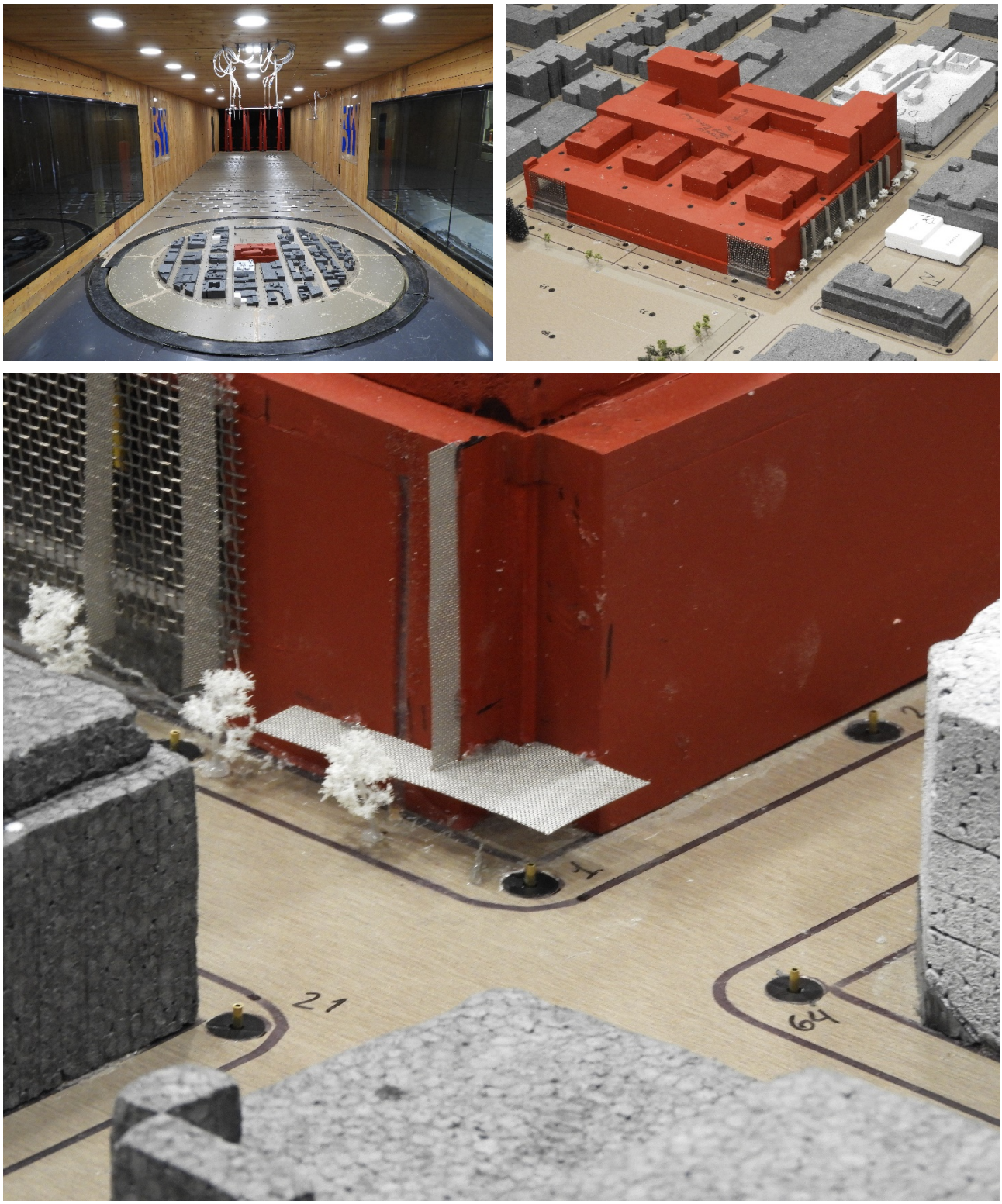


Image 2F: Wind Tunnel Study Model – Option 3 Configuration

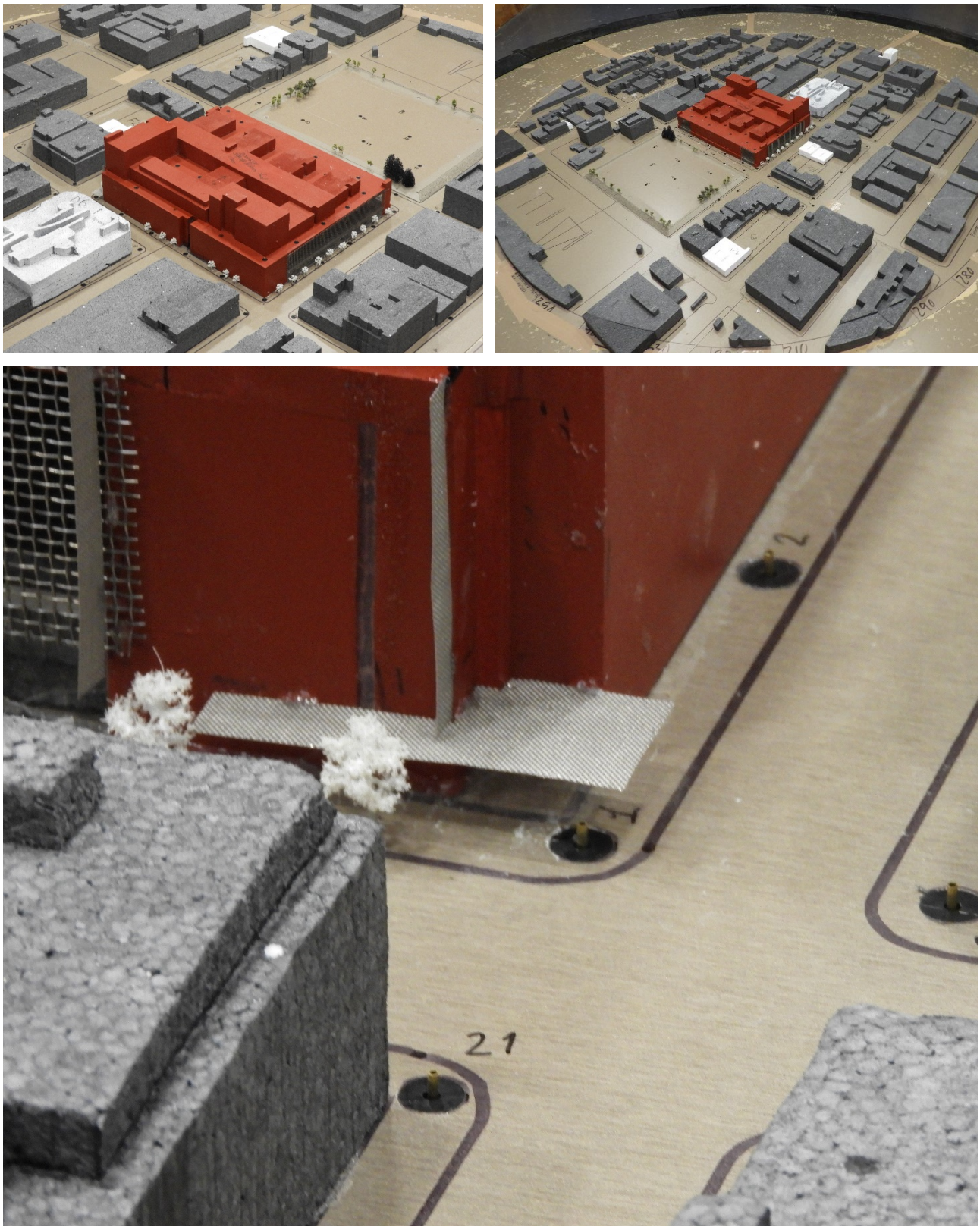


Image 2G: Wind Tunnel Study Model – Option 4 Configuration

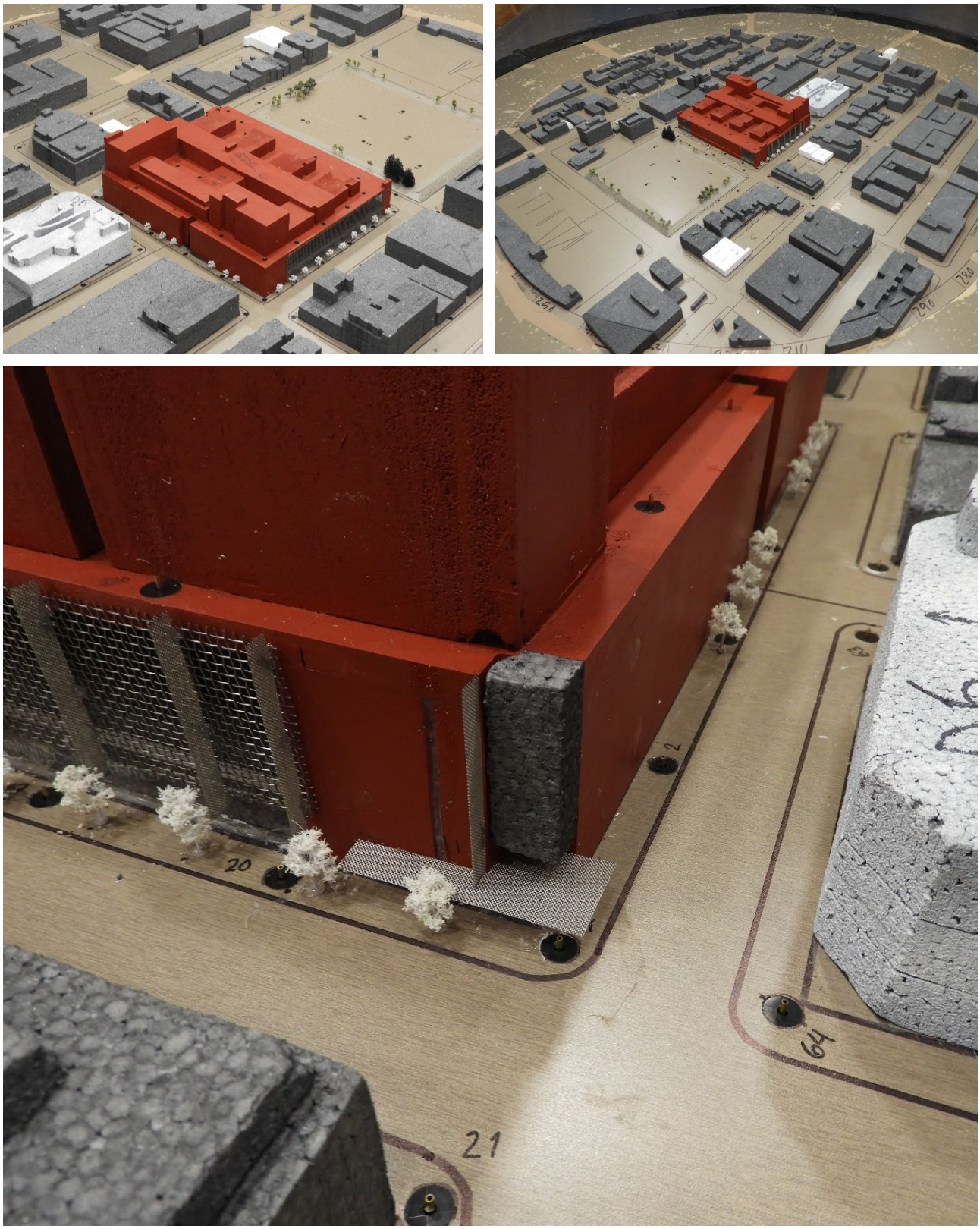


Image 2H: Wind Tunnel Study Model – Option 5 Configuration

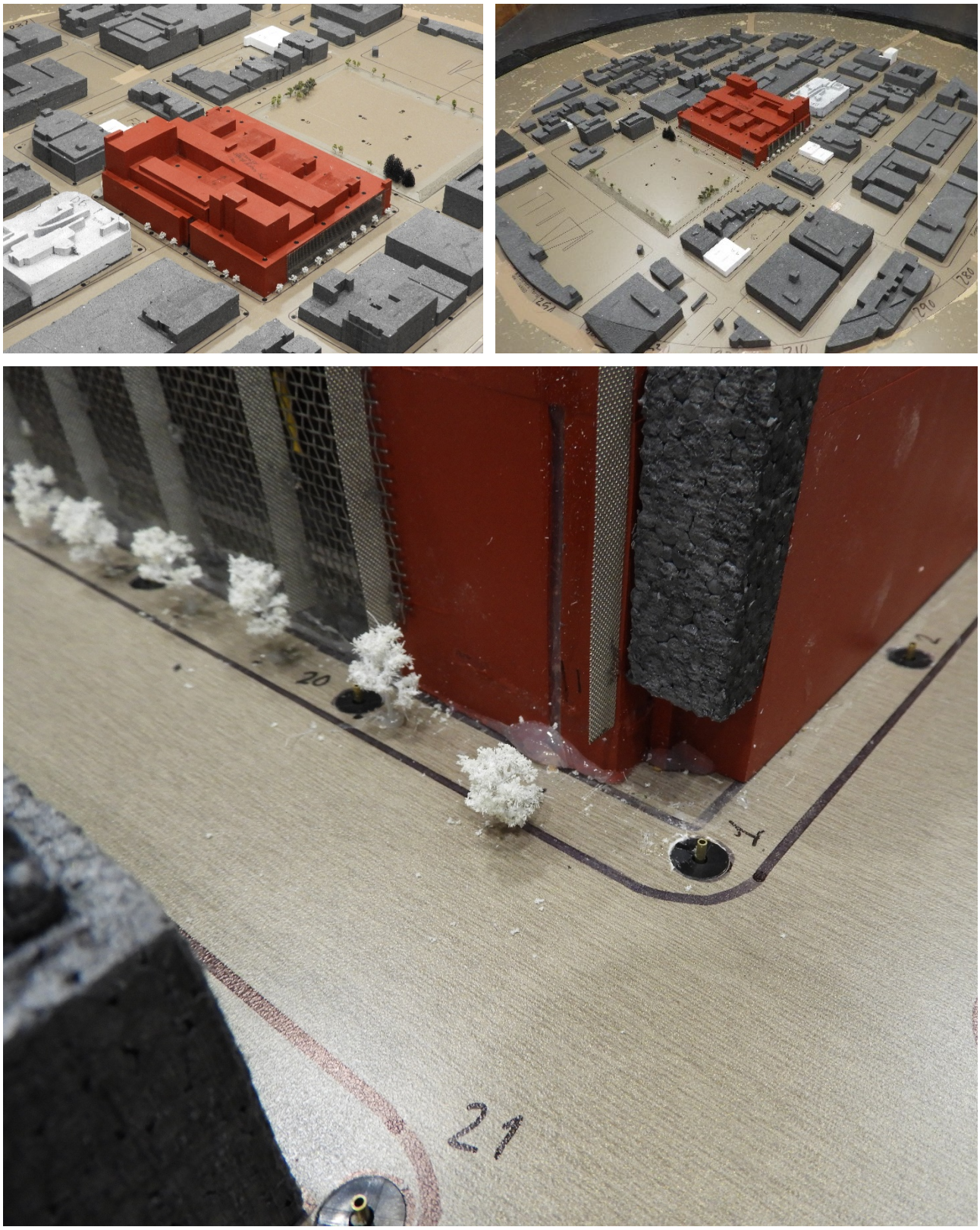
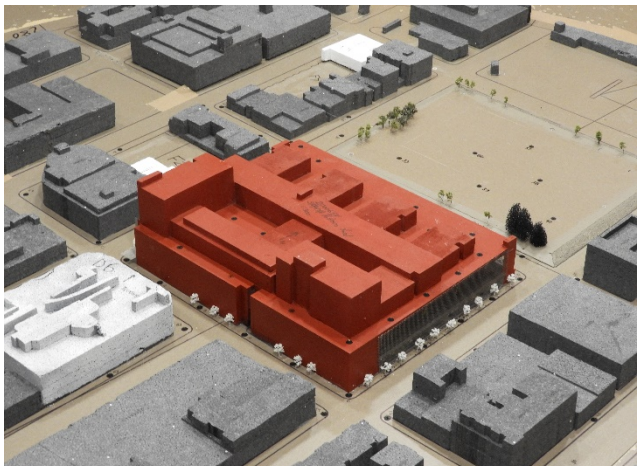


Image 2I: Wind Tunnel Study Model – Option 6 Configuration



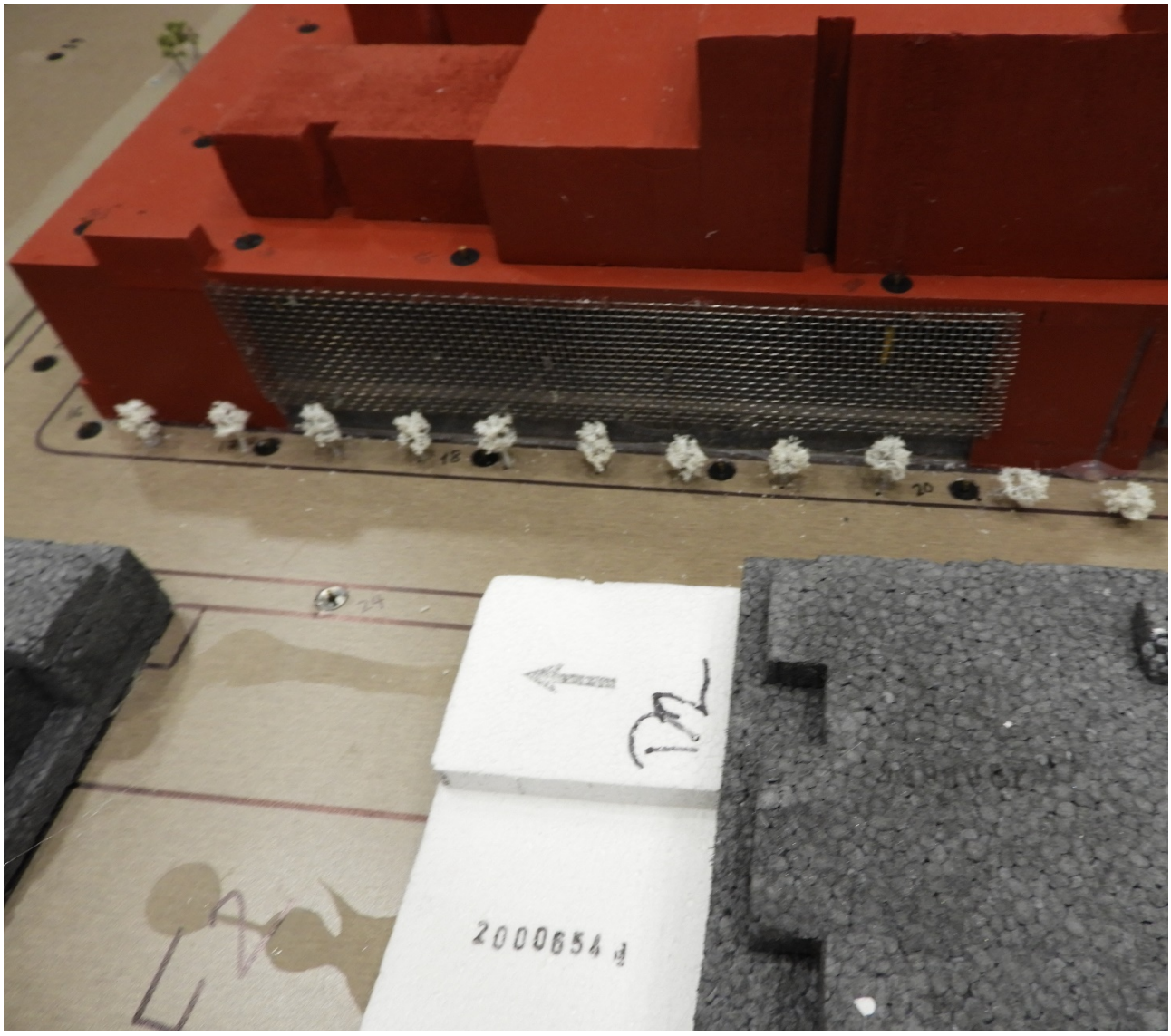
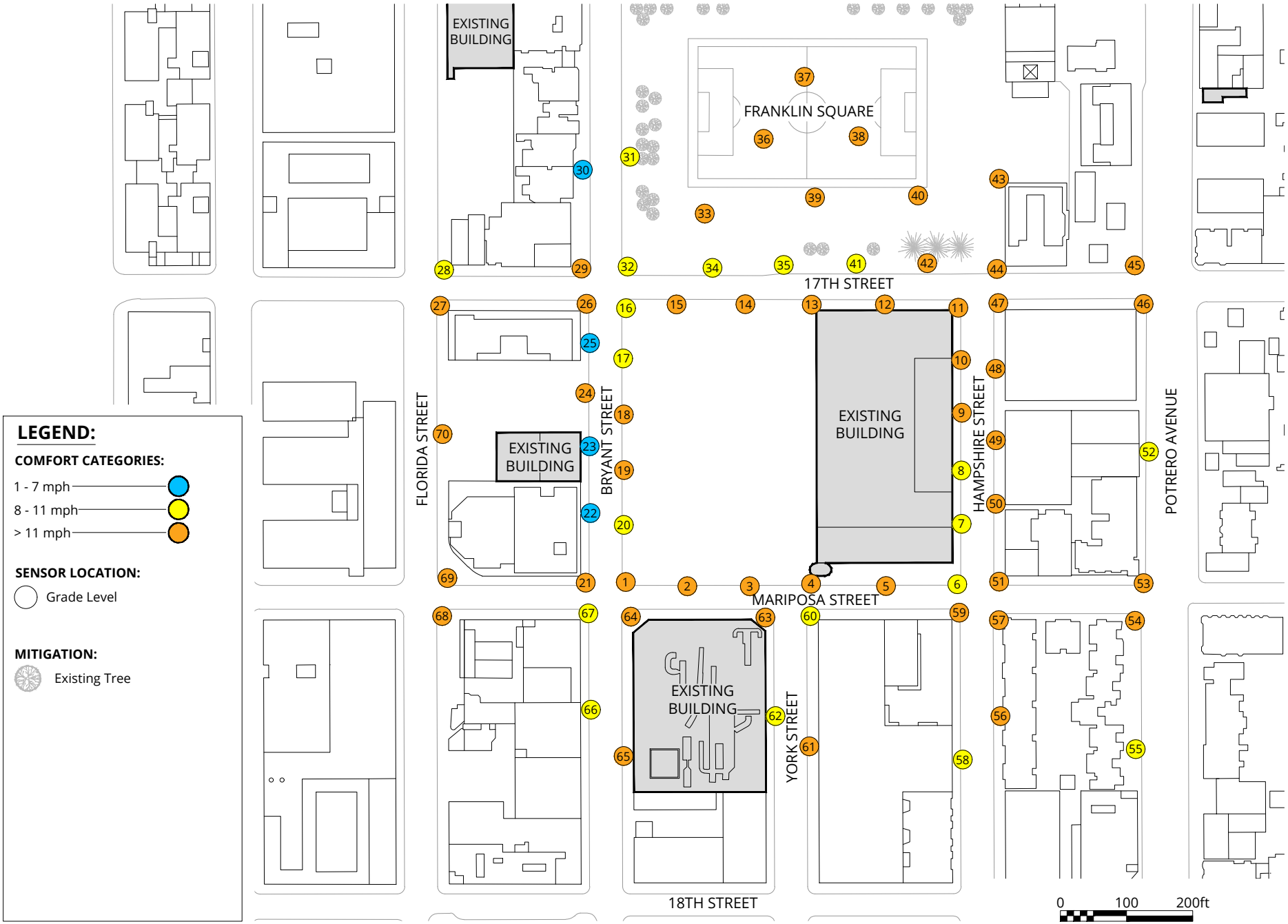


Image 2J: Wind Tunnel Study Model – Option 7 Configuration

Image 2K: Wind Tunnel Study Model – Option 7 + Cumulative Configuration

FIGURES



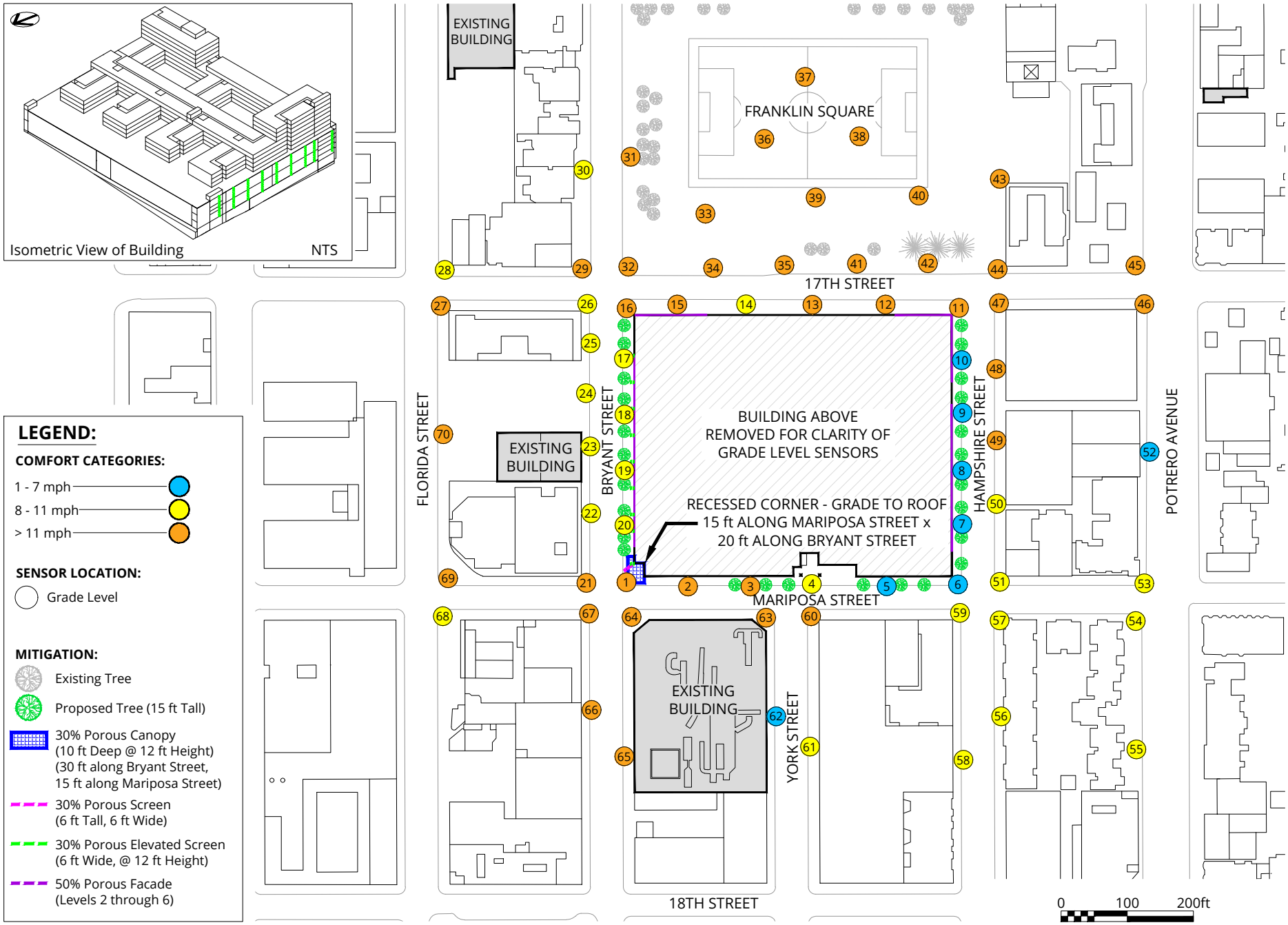
Pedestrian Wind Comfort Conditions
Existing
Annual

SFMTA Potrero Yard - San Francisco, CA

True North

Project #2000654

Drawn by: GRE	Figure: 1A
Approx. Scale:	1"=200'
Date Revised:	July 2, 2020



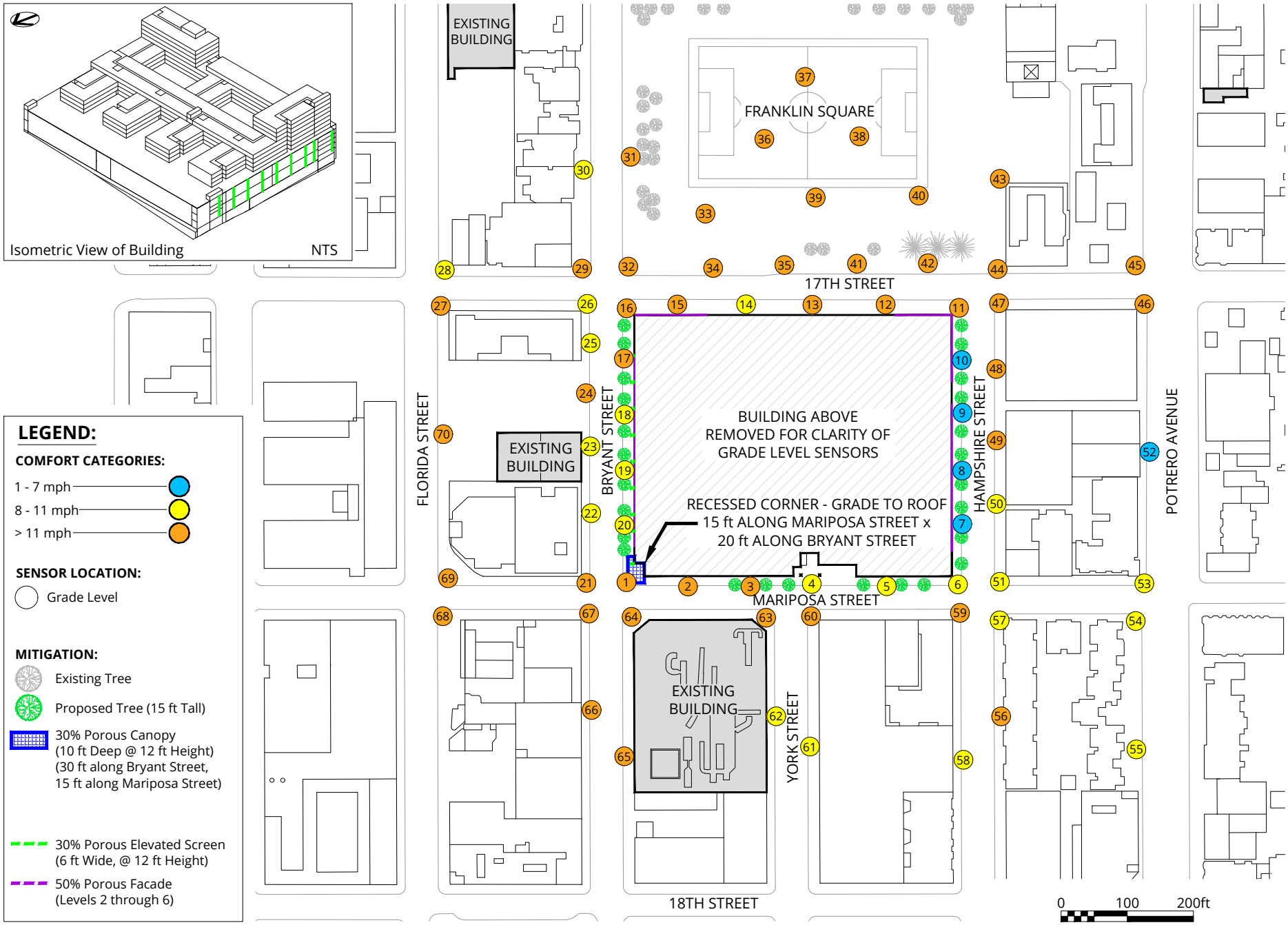
Pedestrian Wind Comfort Conditions
Option 3
Annual

SFMTA Potrero Yard - San Francisco, CA

Project #2000654

True North

Drawn by: GRE	Figure: 1F
Approx. Scale:	1"=200'
Date Revised:	June 18, 2020



Pedestrian Wind Comfort Conditions

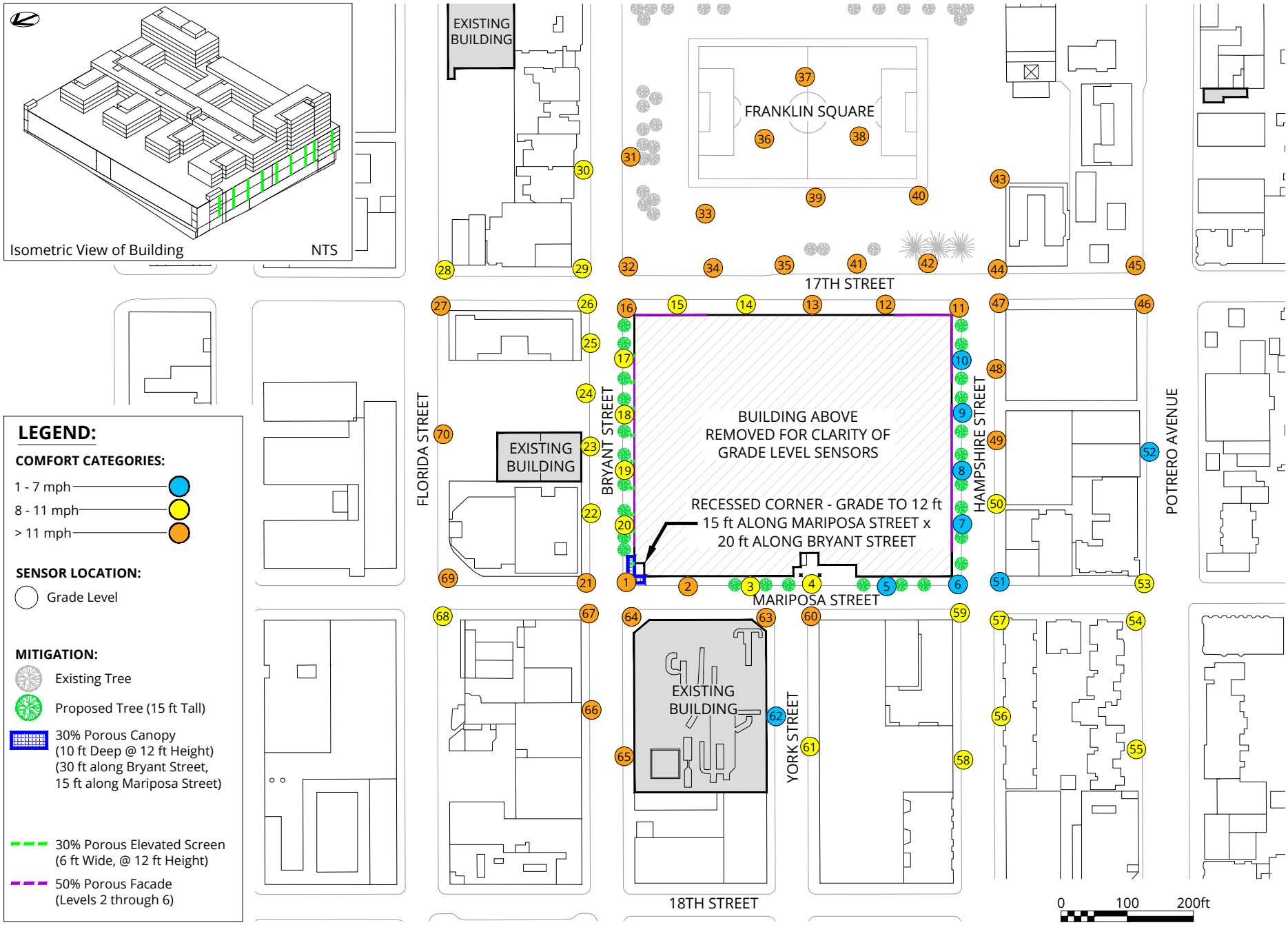
Option 4
Annual

SFMTA Potrero Yard - San Francisco, CA

Project #2000654

True North

Drawn by: GRE	Figure:	1G
Approx. Scale:	1"=200'	
Date Revised:	June 18, 2020	



Pedestrian Wind Comfort Conditions

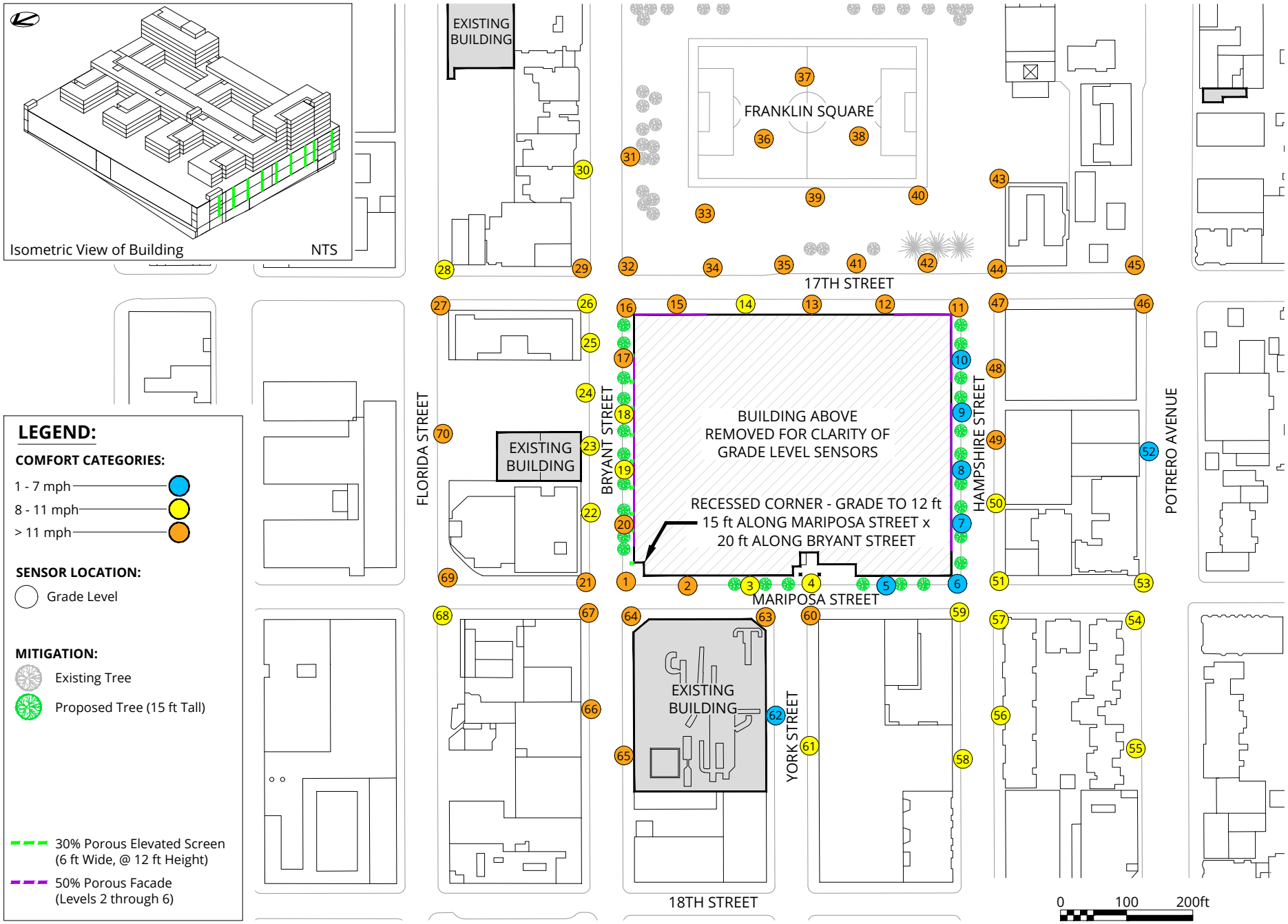
Option 5
Annual

SFMTA Potrero Yard - San Francisco, CA

Project #2000654

True North

Drawn by: GRE	Figure: 1H
Approx. Scale:	1"=200'
Date Revised:	June 18, 2020



Pedestrian Wind Comfort Conditions

Option 6

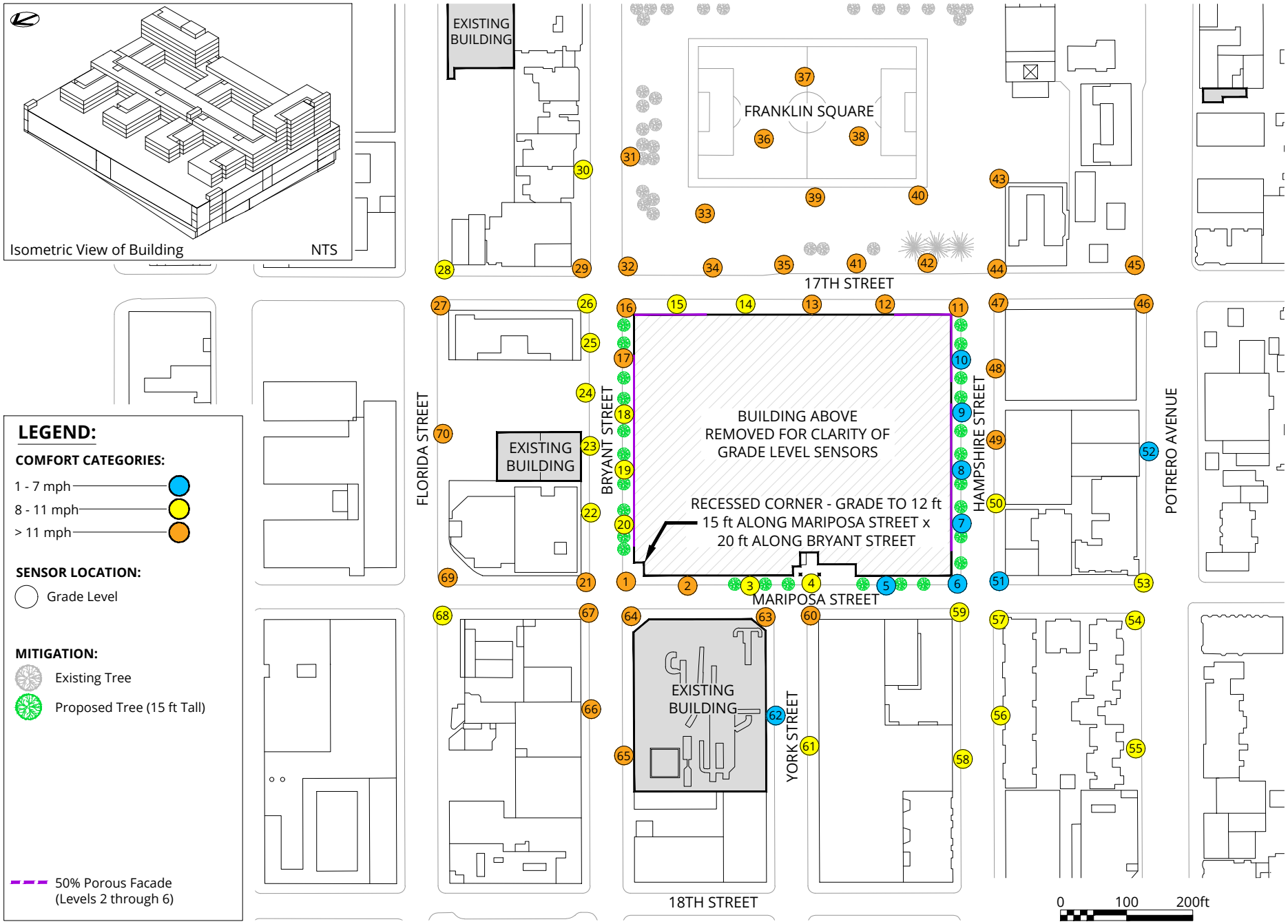
Annual

SFMTA Potrero Yard - San Francisco, CA

Project #2000654

True North

Drawn by: GRE	Figure: 1I
Approx. Scale:	1"=200'
Date Revised:	June 18, 2020



Pedestrian Wind Comfort Conditions

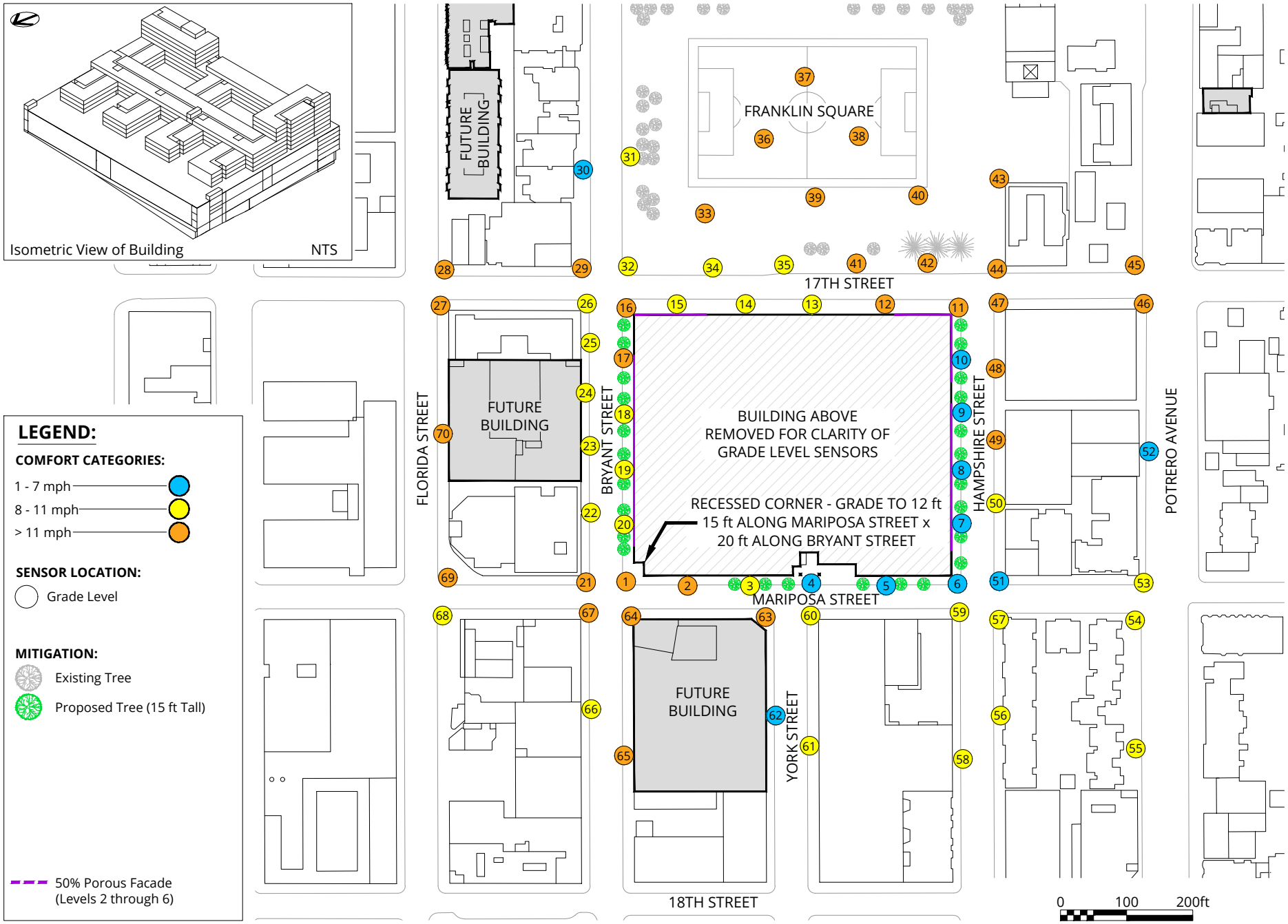
Option 7
Annual

SFMTA Potrero Yard - San Francisco, CA

True North

Project #2000654

Drawn by: GRE	Figure: 1J
Approx. Scale:	1"=200'
Date Revised:	June 18, 2020



Pedestrian Wind Comfort Conditions

Project + Cumulative

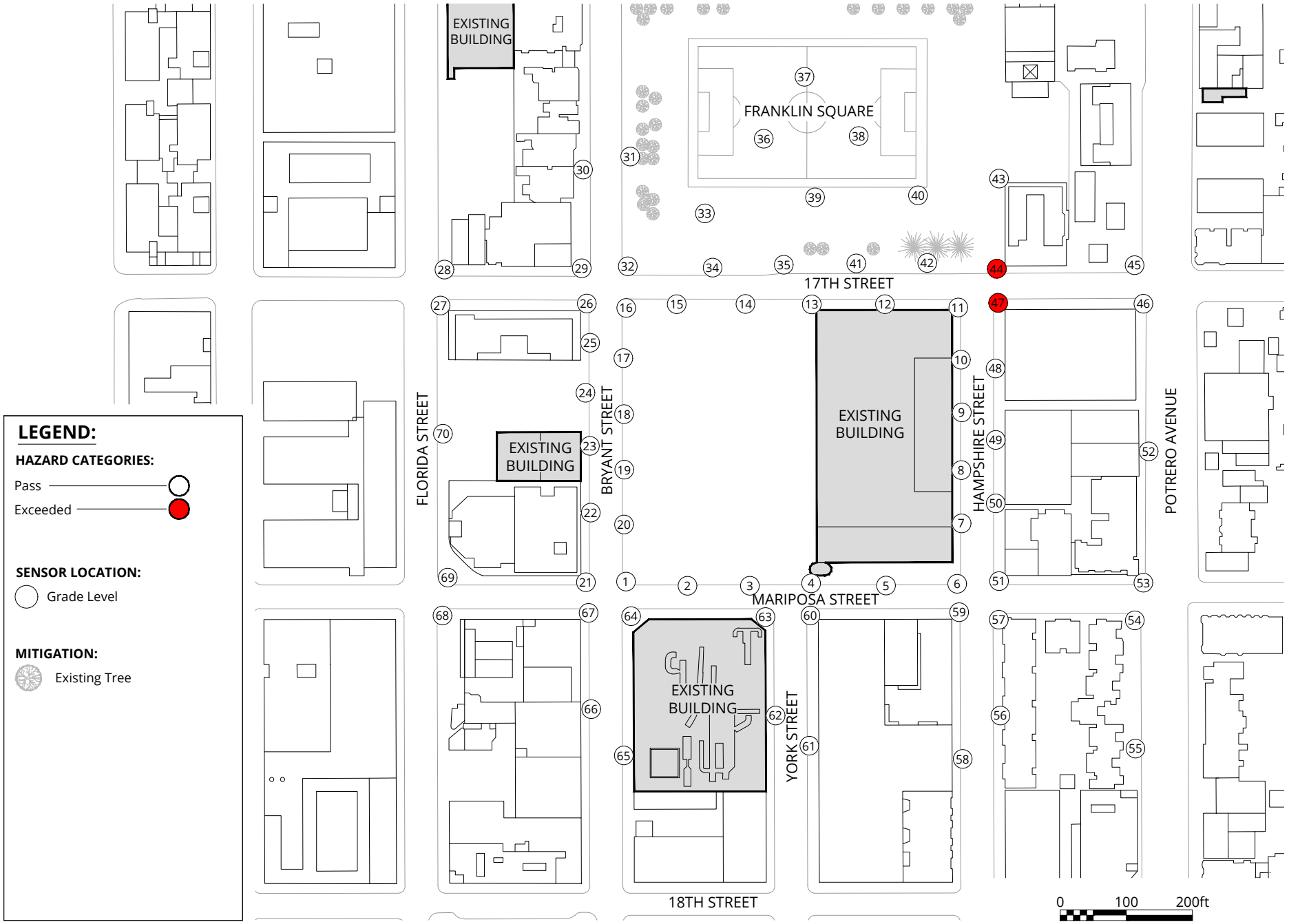
Annual

SFMTA Potrero Yard - San Francisco, CA

True North

Project #2000654

Drawn by: GRE	Figure: 1K
Approx. Scale:	1"=200'
Date Revised:	June 18, 2020



LEGEND:

HAZARD CATEGORIES:

Pass

Exceeded

SENSOR LOCATION:

Grade Level

MITIGATION:

Existing Tree

Pedestrian Wind Hazard Conditions

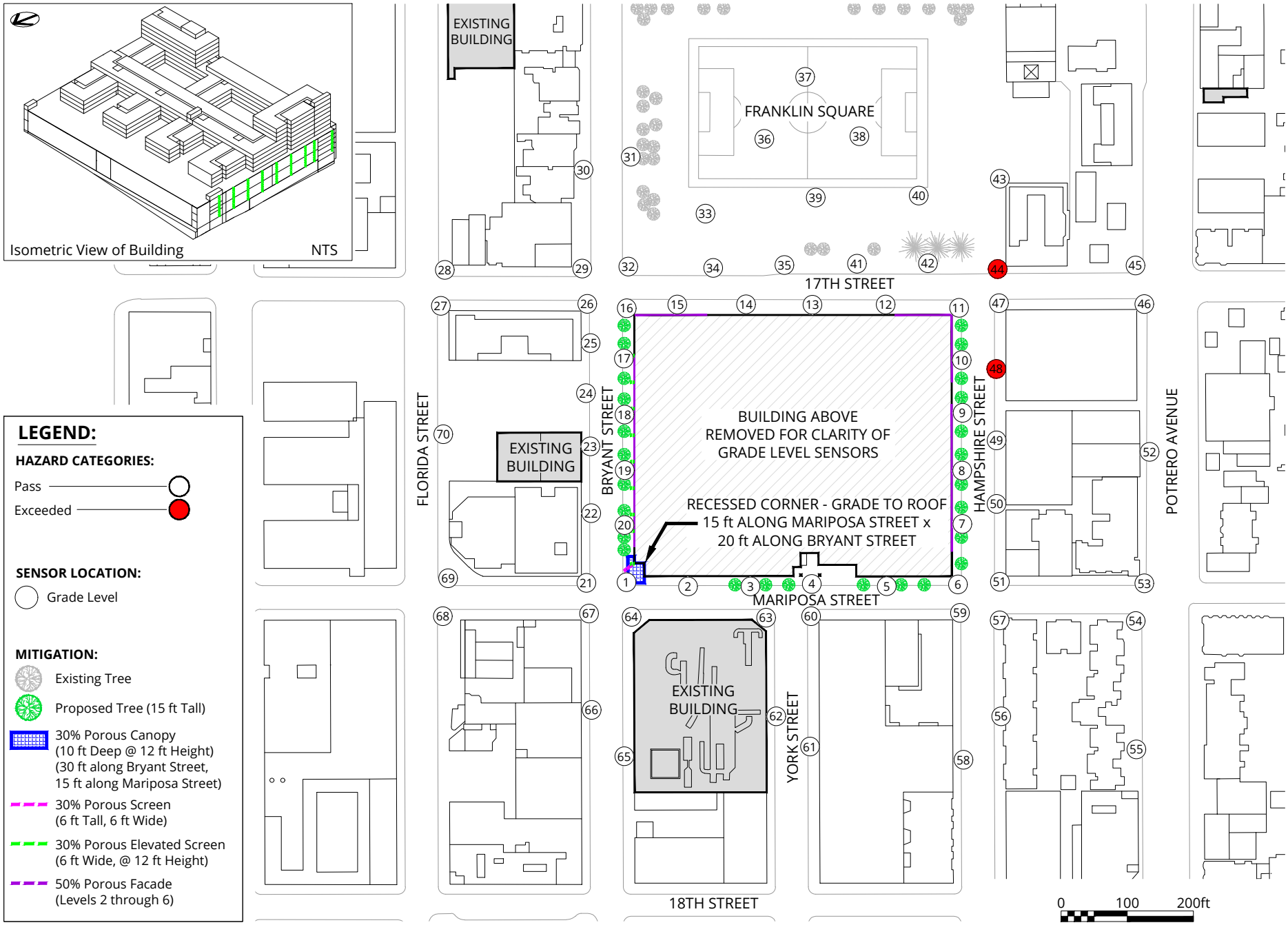
Existing
Annual

SFMTA Potrero Yard - San Francisco, CA

True North

Project #2000654

Drawn by: GRE	Figure: 2A
Approx. Scale:	1"=200'
Date Revised:	July 2, 2020



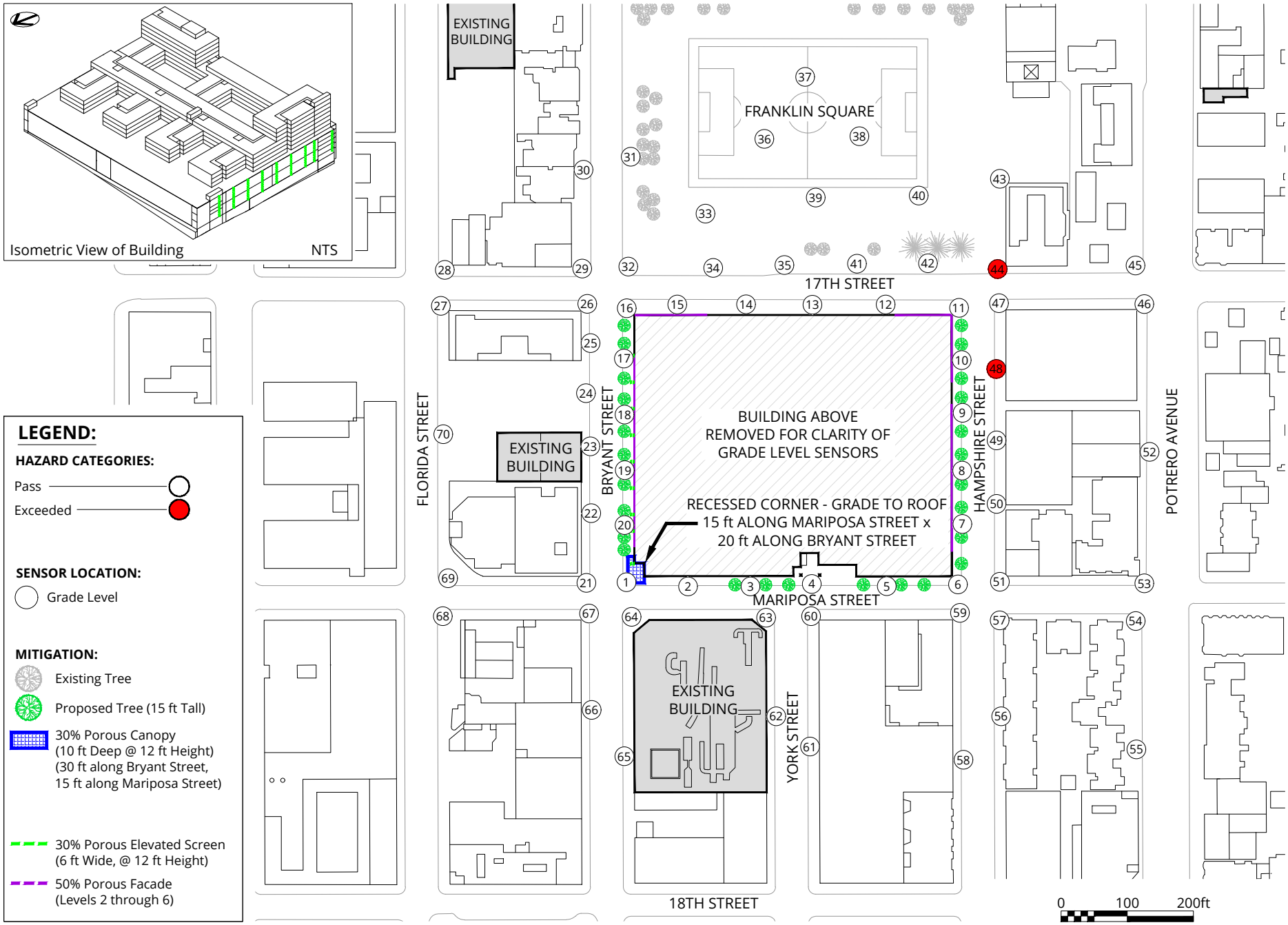
Pedestrian Wind Hazard Conditions
Option 3
Annual

SFMTA Potrero Yard - San Francisco, CA

True North

Project #2000654

Drawn by: GRE	Figure: 2F
Approx. Scale:	1"=200'
Date Revised:	June 18, 2020



Pedestrian Wind Hazard Conditions

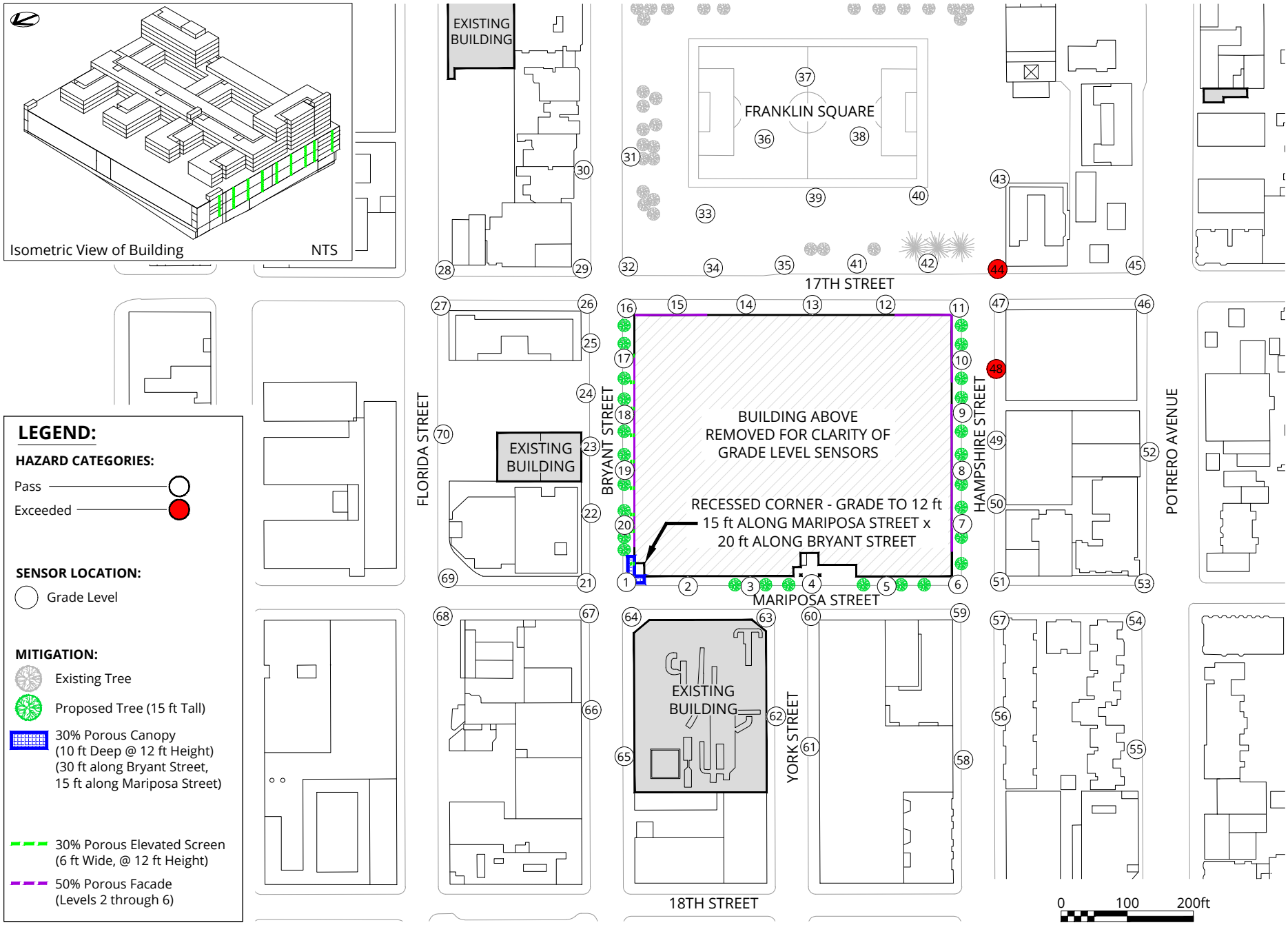
Option 4
Annual

SFMTA Potrero Yard - San Francisco, CA

True North

Project #2000654

Drawn by: GRE	Figure: 2G
Approx. Scale:	1"=200'
Date Revised:	June 18, 2020



Pedestrian Wind Hazard Conditions

Option 5

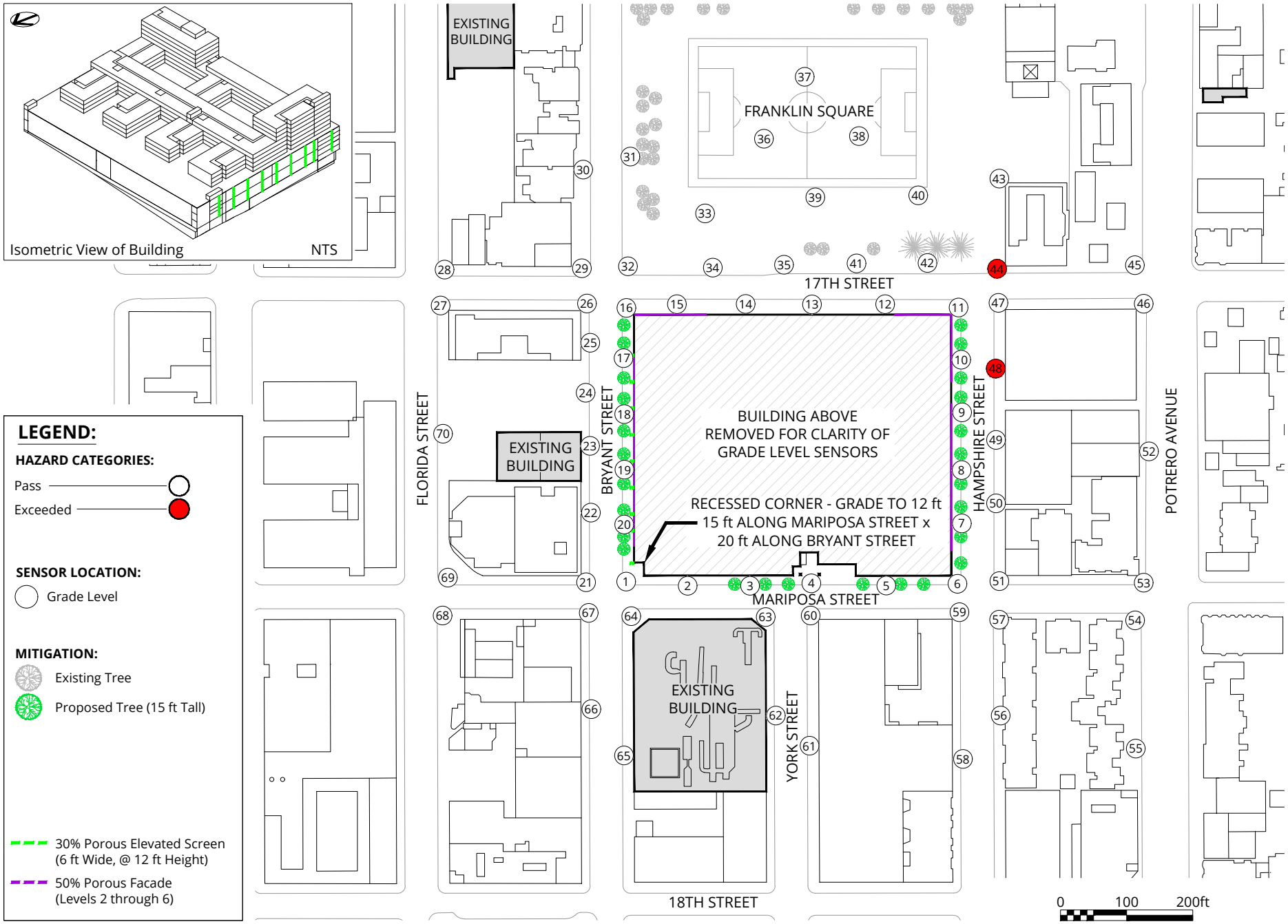
Annual

SFMTA Potrero Yard - San Francisco, CA

Project #2000654

True North

Drawn by: GRE	Figure: 2H
Approx. Scale:	1"=200'
Date Revised:	June 18, 2020



Pedestrian Wind Hazard Conditions

Option 6

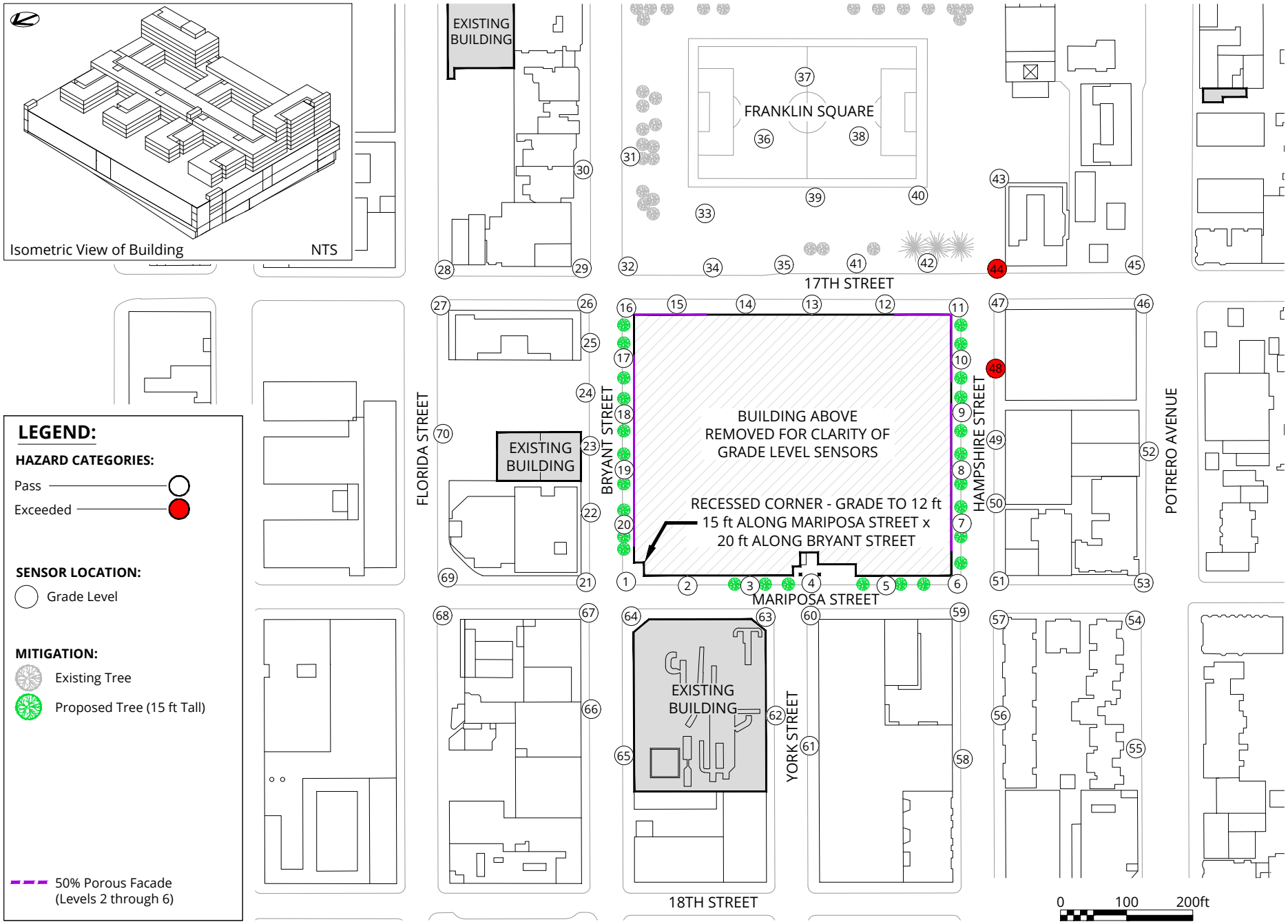
Annual

SFMTA Potrero Yard - San Francisco, CA

True North

Project #2000654

Drawn by: GRE	Figure: 2I
Approx. Scale:	1"=200'
Date Revised:	June 18, 2020



Pedestrian Wind Hazard Conditions

Option 7

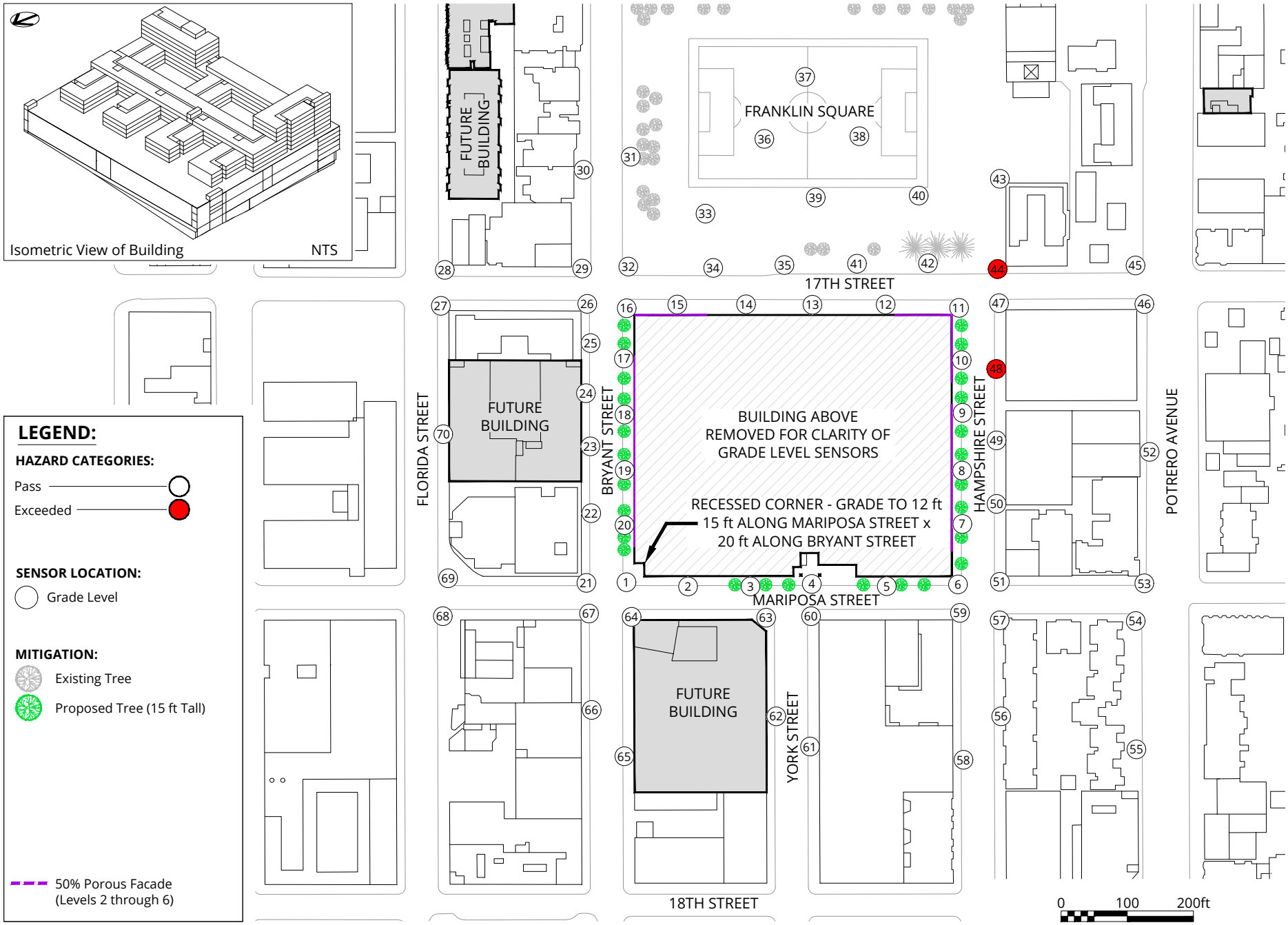
Annual

SFMTA Potrero Yard - San Francisco, CA

True North

Project #2000654

Drawn by: GRE	Figure: 2J
Approx. Scale:	1"=200'
Date Revised:	June 18, 2020



Pedestrian Wind Hazard Conditions

Project + Cumulative

Annual

SFMTA Potrero Yard - San Francisco, CA

True North

Project #2000654

Drawn by: GRE	Figure: 2K
Approx. Scale:	1"=200'
Date Revised:	June 18, 2020

TABLES

Table 1: Pedestrian Wind Comfort and Hazard Conditions

Location	Configuration	WIND COMFORT				WIND HAZARD			
		Wind Speed Exceeded (mph)	% of Time Exceeding	Speed Change (mph)	Exceeds	Wind Speed Exceeded (mph)	Hours per Year Exceeding	Hours Change	Exceeds
1	Existing	12	18	-	e	23	0	-	
	Option 3	12	13	0	e	22	0	0	
	Option 4	18	39	6	e	32	0	0	
	Option 5	17	34	5	e	31	0	0	
	Option 6	16	29	4	e	32	0	0	
	Option 7	16	30	4	e	31	0	0	
	Option 7 + Cumulative	15	25	3	e	28	0	0	
2	Existing	12	12	-	e	23	0	-	
	Option 3	14	23	2	e	31	0	0	
	Option 4	15	27	3	e	32	0	0	
	Option 5	12	12	0	e	25	0	0	
	Option 6	13	18	1	e	24	0	0	
	Option 7	13	17	1	e	24	0	0	
	Option 7 + Cumulative	12	15	0	e	23	0	0	
3	Existing	12	14	-	e	25	0	-	
	Option 3	12	15	0	e	26	0	0	
	Option 4	13	19	1	e	28	0	0	
	Option 5	10	8	-2		22	0	0	
	Option 6	10	7	-2		21	0	0	
	Option 7	9	4	-3		18	0	0	
	Option 7 + Cumulative	11	10	-1		21	0	0	
4	Existing	12	17	-	e	23	0	-	
	Option 3	9	3	-3		17	0	0	
	Option 4	9	4	-3		17	0	0	
	Option 5	8	2	-4		16	0	0	
	Option 6	8	2	-4		16	0	0	
	Option 7	8	1	-4		15	0	0	
	Option 7 + Cumulative	7	1	-5		15	0	0	
5	Existing	13	15	-	e	24	0	-	
	Option 3	7	1	-6		15	0	0	
	Option 4	8	2	-5		16	0	0	
	Option 5	7	1	-6		14	0	0	
	Option 6	7	1	-6		15	0	0	
	Option 7	7	0	-6		14	0	0	
	Option 7 + Cumulative	6	0	-7		12	0	0	
6	Existing	11	10	-		21	0	-	
	Option 3	7	1	-4		15	0	0	
	Option 4	8	1	-3		16	0	0	
	Option 5	7	0	-4		14	0	0	
	Option 6	7	0	-4		14	0	0	
	Option 7	7	1	-4		15	0	0	

Table 1: Pedestrian Wind Comfort and Hazard Conditions

Location	Configuration	WIND COMFORT				WIND HAZARD			
		Wind Speed Exceeded (mph)	% of Time Exceeding	Speed Change (mph)	Exceeds	Wind Speed Exceeded (mph)	Hours per Year Exceeding	Hours Change	Exceeds
	Option 7 + Cumulative	7	0	-4		14	0	0	
7	Existing	10	6	-		19	0	-	
	Option 3	6	0	-4		12	0	0	
	Option 4	6	0	-4		12	0	0	
	Option 5	6	0	-4		12	0	0	
	Option 6	6	0	-4		13	0	0	
	Option 7	6	0	-4		12	0	0	
	Option 7 + Cumulative	5	0	-5		11	0	0	
8	Existing	11	10	-		21	0	-	
	Option 3	5	0	-6		10	0	0	
	Option 4	5	0	-6		11	0	0	
	Option 5	5	0	-6		11	0	0	
	Option 6	5	0	-6		11	0	0	
	Option 7	6	0	-5		11	0	0	
	Option 7 + Cumulative	5	0	-6		9	0	0	
9	Existing	12	13	-	e	22	0	-	
	Option 3	6	0	-6		12	0	0	
	Option 4	6	0	-6		12	0	0	
	Option 5	6	0	-6		11	0	0	
	Option 6	6	0	-6		12	0	0	
	Option 7	6	0	-6		12	0	0	
	Option 7 + Cumulative	6	0	-6		11	0	0	
10	Existing	14	23	-	e	28	0	-	
	Option 3	7	0	-7		13	0	0	
	Option 4	7	0	-7		13	0	0	
	Option 5	7	0	-7		13	0	0	
	Option 6	7	1	-7		14	0	0	
	Option 7	6	0	-8		14	0	0	
	Option 7 + Cumulative	7	0	-7		14	0	0	
11	Existing	17	32	-	e	34	0	-	
	Option 3	16	28	-1	e	32	0	0	
	Option 4	16	27	-1	e	32	0	0	
	Option 5	16	27	-1	e	32	0	0	
	Option 6	16	29	-1	e	33	0	0	
	Option 7	16	28	-1	e	32	0	0	
	Option 7 + Cumulative	16	28	-1	e	32	0	0	
12	Existing	13	15	-	e	27	0	-	
	Option 3	14	19	1	e	30	0	0	
	Option 4	14	18	1	e	30	0	0	
	Option 5	14	17	1	e	30	0	0	

Table 1: Pedestrian Wind Comfort and Hazard Conditions

Location	Configuration	WIND COMFORT				WIND HAZARD			
		Wind Speed Exceeded (mph)	% of Time Exceeding	Speed Change (mph)	Exceeds	Wind Speed Exceeded (mph)	Hours per Year Exceeding	Hours Change	Exceeds
	Option 6	14	19	1	e	30	0	0	
	Option 7	14	19	1	e	30	0	0	
	Option 7 + Cumulative	13	16	0	e	29	0	0	
13	Existing	14	22	-	e	26	0	-	
	Option 3	12	12	-2	e	24	0	0	
	Option 4	12	13	-2	e	24	0	0	
	Option 5	12	11	-2	e	25	0	0	
	Option 6	12	12	-2	e	26	0	0	
	Option 7	12	12	-2	e	25	0	0	
	Option 7 + Cumulative	11	10	-3		25	0	0	
14	Existing	13	18	-	e	26	0	-	
	Option 3	11	10	-2		21	0	0	
	Option 4	11	10	-2		21	0	0	
	Option 5	10	8	-3		21	0	0	
	Option 6	11	10	-2		22	0	0	
	Option 7	11	10	-2		21	0	0	
	Option 7 + Cumulative	10	8	-3		22	0	0	
15	Existing	12	13	-	e	23	0	-	
	Option 3	12	15	0	e	20	0	0	
	Option 4	12	17	0	e	20	0	0	
	Option 5	11	10	-1		20	0	0	
	Option 6	12	15	0	e	20	0	0	
	Option 7	11	10	-1		20	0	0	
	Option 7 + Cumulative	10	5	-2		18	0	0	
16	Existing	10	6	-		18	0	-	
	Option 3	16	30	6	e	30	0	0	
	Option 4	16	31	6	e	30	0	0	
	Option 5	15	27	5	e	29	0	0	
	Option 6	15	29	5	e	29	0	0	
	Option 7	15	28	5	e	29	0	0	
	Option 7 + Cumulative	12	16	2	e	23	0	0	
17	Existing	9	4	-		19	0	-	
	Option 3	11	10	2		23	0	0	
	Option 4	12	15	3	e	23	0	0	
	Option 5	11	10	2		24	0	0	
	Option 6	12	12	3	e	24	0	0	
	Option 7	12	13	3	e	25	0	0	
	Option 7 + Cumulative	12	13	3	e	26	0	0	
18	Existing	13	15	-	e	26	0	-	
	Option 3	10	6	-3		19	0	0	

Table 1: Pedestrian Wind Comfort and Hazard Conditions

Location	Configuration	WIND COMFORT				WIND HAZARD			
		Wind Speed Exceeded (mph)	% of Time Exceeding	Speed Change (mph)	Exceeds	Wind Speed Exceeded (mph)	Hours per Year Exceeding	Hours Change	Exceeds
	Option 4	11	10	-2		19	0	0	
	Option 5	10	4	-3		18	0	0	
	Option 6	10	6	-3		18	0	0	
	Option 7	11	10	-2		20	0	0	
	Option 7 + Cumulative	11	10	-2		21	0	0	
19	Existing	13	18	-	e	26	0	-	
	Option 3	9	5	-4		20	0	0	
	Option 4	10	6	-3		20	0	0	
	Option 5	9	5	-4		19	0	0	
	Option 6	9	5	-4		20	0	0	
	Option 7	9	5	-4		19	0	0	
	Option 7 + Cumulative	8	1	-5		16	0	0	
20	Existing	10	7	-		24	0	-	
	Option 3	11	10	1		24	0	0	
	Option 4	11	10	1		24	0	0	
	Option 5	11	10	1		23	0	0	
	Option 6	12	13	2	e	24	0	0	
	Option 7	11	10	1		24	0	0	
	Option 7 + Cumulative	10	6	0		20	0	0	
21	Existing	13	17	-	e	23	0	-	
	Option 3	14	20	1	e	30	0	0	
	Option 4	15	25	2	e	30	0	0	
	Option 5	13	20	0	e	28	0	0	
	Option 6	14	21	1	e	29	0	0	
	Option 7	13	20	0	e	28	0	0	
	Option 7 + Cumulative	14	21	1	e	26	0	0	
22	Existing	7	1	-		16	0	-	
	Option 3	10	9	3		22	0	0	
	Option 4	11	10	4		22	0	0	
	Option 5	10	8	3		22	0	0	
	Option 6	10	9	3		22	0	0	
	Option 7	10	8	3		21	0	0	
	Option 7 + Cumulative	9	3	2		17	0	0	
23	Existing	7	1	-		17	0	-	
	Option 3	10	6	3		19	0	0	
	Option 4	11	10	4		19	0	0	
	Option 5	10	5	3		18	0	0	
	Option 6	10	6	3		18	0	0	
	Option 7	10	6	3		18	0	0	
	Option 7 + Cumulative	10	5	3		18	0	0	

Table 1: Pedestrian Wind Comfort and Hazard Conditions

Location	Configuration	WIND COMFORT				WIND HAZARD			
		Wind Speed Exceeded (mph)	% of Time Exceeding	Speed Change (mph)	Exceeds	Wind Speed Exceeded (mph)	Hours per Year Exceeding	Hours Change	Exceeds
24	Existing	13	20	-	e	25	0	-	
	Option 3	11	10	-2		21	0	0	
	Option 4	12	13	-1	e	21	0	0	
	Option 5	11	10	-2		21	0	0	
	Option 6	11	10	-2		21	0	0	
	Option 7	11	10	-2		20	0	0	
	Option 7 + Cumulative	10	7	-3		19	0	0	
25	Existing	6	0	-		11	0	-	
	Option 3	10	5	4		18	0	0	
	Option 4	10	5	4		18	0	0	
	Option 5	9	4	3		18	0	0	
	Option 6	9	4	3		18	0	0	
	Option 7	9	3	3		18	0	0	
	Option 7 + Cumulative	10	4	4		19	0	0	
26	Existing	12	13	-	e	23	0	-	
	Option 3	10	6	-2		19	0	0	
	Option 4	10	6	-2		19	0	0	
	Option 5	10	5	-2		18	0	0	
	Option 6	10	6	-2		19	0	0	
	Option 7	9	5	-3		18	0	0	
	Option 7 + Cumulative	10	6	-2		19	0	0	
27	Existing	14	22	-	e	24	0	-	
	Option 3	16	29	2	e	29	0	0	
	Option 4	16	30	2	e	29	0	0	
	Option 5	15	25	1	e	28	0	0	
	Option 6	15	26	1	e	28	0	0	
	Option 7	15	25	1	e	27	0	0	
	Option 7 + Cumulative	15	28	1	e	27	0	0	
28	Existing	10	7	-		20	0	-	
	Option 3	10	8	0		21	0	0	
	Option 4	11	10	1		21	0	0	
	Option 5	10	6	0		20	0	0	
	Option 6	10	6	0		20	0	0	
	Option 7	10	6	0		19	0	0	
	Option 7 + Cumulative	16	28	6	e	35	0	0	
29	Existing	12	13	-	e	21	0	-	
	Option 3	12	15	0	e	22	0	0	
	Option 4	13	19	1	e	22	0	0	
	Option 5	11	10	-1		21	0	0	
	Option 6	12	14	0	e	22	0	0	
	Option 7	12	13	0	e	22	0	0	

Table 1: Pedestrian Wind Comfort and Hazard Conditions

Location	Configuration	WIND COMFORT				WIND HAZARD			
		Wind Speed Exceeded (mph)	% of Time Exceeding	Speed Change (mph)	Exceeds	Wind Speed Exceeded (mph)	Hours per Year Exceeding	Hours Change	Exceeds
	Option 7 + Cumulative	12	15	0	e	23	0	0	
30	Existing	6	1	-		15	0	-	
	Option 3	9	2	3		17	0	0	
	Option 4	9	3	3		17	0	0	
	Option 5	8	2	2		16	0	0	
	Option 6	9	3	3		17	0	0	
	Option 7	8	1	2		16	0	0	
	Option 7 + Cumulative	7	0	1		15	0	0	
31	Existing	11	10	-		25	0	-	
	Option 3	13	19	2	e	23	0	0	
	Option 4	13	21	2	e	24	0	0	
	Option 5	12	17	1	e	23	0	0	
	Option 6	13	19	2	e	24	0	0	
	Option 7	12	18	1	e	23	0	0	
	Option 7 + Cumulative	11	10	0		22	0	0	
32	Existing	11	10	-		22	0	-	
	Option 3	14	20	3	e	24	0	0	
	Option 4	13	19	2	e	24	0	0	
	Option 5	13	19	2	e	23	0	0	
	Option 6	13	19	2	e	24	0	0	
	Option 7	13	18	2	e	23	0	0	
	Option 7 + Cumulative	10	7	-1		22	0	0	
33	Existing	13	21	-	e	27	0	-	
	Option 3	13	21	0	e	24	0	0	
	Option 4	14	23	1	e	25	0	0	
	Option 5	13	20	0	e	24	0	0	
	Option 6	14	22	1	e	25	0	0	
	Option 7	13	21	0	e	25	0	0	
	Option 7 + Cumulative	12	16	-1	e	21	0	0	
34	Existing	11	10	-		21	0	-	
	Option 3	13	20	2	e	22	0	0	
	Option 4	13	21	2	e	23	0	0	
	Option 5	13	18	2	e	22	0	0	
	Option 6	13	19	2	e	22	0	0	
	Option 7	13	17	2	e	21	0	0	
	Option 7 + Cumulative	11	10	0		20	0	0	
35	Existing	10	7	-		19	0	-	
	Option 3	12	13	2	e	21	0	0	
	Option 4	12	14	2	e	21	0	0	
	Option 5	12	14	2	e	21	0	0	

Table 1: Pedestrian Wind Comfort and Hazard Conditions

Location	Configuration	WIND COMFORT				WIND HAZARD			
		Wind Speed Exceeded (mph)	% of Time Exceeding	Speed Change (mph)	Exceeds	Wind Speed Exceeded (mph)	Hours per Year Exceeding	Hours Change	Exceeds
	Option 6	12	15	2	e	22	0	0	
	Option 7	12	13	2	e	21	0	0	
	Option 7 + Cumulative	11	10	1		22	0	0	
36	Existing	13	17	-	e	24	0	-	
	Option 3	12	16	-1	e	24	0	0	
	Option 4	13	19	0	e	24	0	0	
	Option 5	12	17	-1	e	24	0	0	
	Option 6	13	17	0	e	24	0	0	
	Option 7	13	17	0	e	24	0	0	
	Option 7 + Cumulative	12	14	-1	e	24	0	0	
37	Existing	16	30	-	e	31	0	-	
	Option 3	15	26	-1	e	28	0	0	
	Option 4	14	24	-2	e	27	0	0	
	Option 5	15	27	-1	e	28	0	0	
	Option 6	15	28	-1	e	28	0	0	
	Option 7	15	27	-1	e	27	0	0	
	Option 7 + Cumulative	15	25	-1	e	27	0	0	
38	Existing	15	27	-	e	29	0	-	
	Option 3	14	24	-1	e	27	0	0	
	Option 4	14	24	-1	e	27	0	0	
	Option 5	15	26	0	e	27	0	0	
	Option 6	15	26	0	e	28	0	0	
	Option 7	14	25	-1	e	27	0	0	
	Option 7 + Cumulative	14	23	-1	e	27	0	0	
39	Existing	15	25	-	e	28	0	-	
	Option 3	14	21	-1	e	27	0	0	
	Option 4	14	23	-1	e	27	0	0	
	Option 5	14	22	-1	e	26	0	0	
	Option 6	14	23	-1	e	28	0	0	
	Option 7	14	22	-1	e	26	0	0	
	Option 7 + Cumulative	13	21	-2	e	27	0	0	
40	Existing	13	20	-	e	25	0	-	
	Option 3	13	17	0	e	24	0	0	
	Option 4	13	18	0	e	24	0	0	
	Option 5	13	19	0	e	24	0	0	
	Option 6	13	20	0	e	25	0	0	
	Option 7	13	18	0	e	24	0	0	
	Option 7 + Cumulative	13	16	0	e	24	0	0	
41	Existing	11	10	-		21	0	-	
	Option 3	13	18	2	e	23	0	0	

Table 1: Pedestrian Wind Comfort and Hazard Conditions

Location	Configuration	WIND COMFORT				WIND HAZARD			
		Wind Speed Exceeded (mph)	% of Time Exceeding	Speed Change (mph)	Exceeds	Wind Speed Exceeded (mph)	Hours per Year Exceeding	Hours Change	Exceeds
	Option 4	13	17	2	e	23	0	0	
	Option 5	12	16	1	e	23	0	0	
	Option 6	13	18	2	e	24	0	0	
	Option 7	12	16	1	e	23	0	0	
	Option 7 + Cumulative	12	13	1	e	24	0	0	
42	Existing	14	22	-	e	26	0	-	
	Option 3	15	25	1	e	27	0	0	
	Option 4	15	25	1	e	28	0	0	
	Option 5	14	24	0	e	27	0	0	
	Option 6	15	25	1	e	28	0	0	
	Option 7	14	24	0	e	27	0	0	
	Option 7 + Cumulative	14	22	0	e	27	0	0	
43	Existing	15	28	-	e	30	0	-	
	Option 3	14	25	-1	e	27	0	0	
	Option 4	15	27	0	e	28	0	0	
	Option 5	15	25	0	e	27	0	0	
	Option 6	15	27	0	e	28	0	0	
	Option 7	14	25	-1	e	26	0	0	
	Option 7 + Cumulative	15	26	0	e	27	0	0	
44	Existing	21	46	-	e	44	28	-	e
	Option 3	21	49	0	e	41	19	-9	e
	Option 4	21	47	0	e	40	20	-8	e
	Option 5	22	50	1	e	42	21	-7	e
	Option 6	22	50	1	e	41	18	-10	e
	Option 7	22	50	1	e	41	16	-12	e
	Option 7 + Cumulative	21	47	0	e	40	10	-18	e
45	Existing	15	25	-	e	32	0	-	
	Option 3	12	15	-3	e	25	0	0	
	Option 4	12	14	-3	e	24	0	0	
	Option 5	13	16	-2	e	26	0	0	
	Option 6	13	16	-2	e	26	0	0	
	Option 7	13	16	-2	e	26	0	0	
	Option 7 + Cumulative	12	13	-3	e	22	0	0	
46	Existing	16	29	-	e	35	0	-	
	Option 3	15	26	-1	e	31	0	0	
	Option 4	15	23	-1	e	30	0	0	
	Option 5	15	27	-1	e	31	0	0	
	Option 6	16	27	0	e	33	0	0	
	Option 7	15	27	-1	e	31	0	0	
	Option 7 + Cumulative	16	27	0	e	32	0	0	

Table 1: Pedestrian Wind Comfort and Hazard Conditions

Location	Configuration	WIND COMFORT				WIND HAZARD			
		Wind Speed Exceeded (mph)	% of Time Exceeding	Speed Change (mph)	Exceeds	Wind Speed Exceeded (mph)	Hours per Year Exceeding	Hours Change	Exceeds
47	Existing	19	43	-	e	38	2	-	e
	Option 3	16	30	-3	e	32	0	-2	
	Option 4	16	29	-3	e	32	0	-2	
	Option 5	17	33	-2	e	33	0	-2	
	Option 6	17	31	-2	e	33	0	-2	
	Option 7	17	31	-2	e	32	0	-2	
	Option 7 + Cumulative	17	33	-2	e	32	0	-2	
48	Existing	17	33	-	e	32	0	-	
	Option 3	19	39	2	e	37	1	1	e
	Option 4	19	39	2	e	37	2	2	e
	Option 5	19	38	2	e	36	1	1	e
	Option 6	19	40	2	e	37	2	2	e
	Option 7	19	39	2	e	37	2	2	e
	Option 7 + Cumulative	19	39	2	e	37	1	1	e
49	Existing	18	40	-	e	35	0	-	
	Option 3	15	26	-3	e	30	0	0	
	Option 4	15	25	-3	e	30	0	0	
	Option 5	15	25	-3	e	29	0	0	
	Option 6	15	26	-3	e	31	0	0	
	Option 7	15	26	-3	e	30	0	0	
	Option 7 + Cumulative	15	26	-3	e	30	0	0	
50	Existing	15	25	-	e	28	0	-	
	Option 3	10	6	-5		20	0	0	
	Option 4	10	6	-5		20	0	0	
	Option 5	10	6	-5		20	0	0	
	Option 6	10	7	-5		20	0	0	
	Option 7	10	6	-5		20	0	0	
	Option 7 + Cumulative	11	10	-4		22	0	0	
51	Existing	14	23	-	e	26	0	-	
	Option 3	8	1	-6		15	0	0	
	Option 4	8	2	-6		15	0	0	
	Option 5	7	1	-7		15	0	0	
	Option 6	8	1	-6		15	0	0	
	Option 7	7	0	-7		15	0	0	
	Option 7 + Cumulative	7	0	-7		15	0	0	
52	Existing	11	10	-		24	0	-	
	Option 3	6	1	-5		17	0	0	
	Option 4	6	1	-5		17	0	0	
	Option 5	6	1	-5		17	0	0	
	Option 6	6	1	-5		17	0	0	
	Option 7	6	1	-5		18	0	0	

Table 1: Pedestrian Wind Comfort and Hazard Conditions

Location	Configuration	WIND COMFORT				WIND HAZARD			
		Wind Speed Exceeded (mph)	% of Time Exceeding	Speed Change (mph)	Exceeds	Wind Speed Exceeded (mph)	Hours per Year Exceeding	Hours Change	Exceeds
	Option 7 + Cumulative	7	2	-4		17	0	0	
53	Existing	12	12	-	e	21	0	-	
	Option 3	10	6	-2		19	0	0	
	Option 4	11	10	-1		19	0	0	
	Option 5	10	4	-2		19	0	0	
	Option 6	10	7	-2		20	0	0	
	Option 7	10	6	-2		20	0	0	
	Option 7 + Cumulative	9	4	-3		19	0	0	
54	Existing	14	22	-	e	29	0	-	
	Option 3	9	2	-5		15	0	0	
	Option 4	9	3	-5		15	0	0	
	Option 5	8	1	-6		14	0	0	
	Option 6	8	1	-6		15	0	0	
	Option 7	9	3	-5		16	0	0	
	Option 7 + Cumulative	8	1	-6		14	0	0	
55	Existing	9	4	-		20	0	-	
	Option 3	9	6	0		22	0	0	
	Option 4	9	7	0		22	0	0	
	Option 5	9	6	0		21	0	0	
	Option 6	9	6	0		22	0	0	
	Option 7	9	6	0		22	0	0	
	Option 7 + Cumulative	8	4	-1		19	0	0	
56	Existing	15	23	-	e	28	0	-	
	Option 3	11	10	-4		23	0	0	
	Option 4	12	16	-3	e	23	0	0	
	Option 5	11	10	-4		23	0	0	
	Option 6	11	10	-4		23	0	0	
	Option 7	11	10	-4		23	0	0	
	Option 7 + Cumulative	11	10	-4		23	0	0	
57	Existing	14	22	-	e	30	0	-	
	Option 3	9	5	-5		20	0	0	
	Option 4	10	7	-4		20	0	0	
	Option 5	9	3	-5		18	0	0	
	Option 6	9	4	-5		19	0	0	
	Option 7	9	4	-5		19	0	0	
	Option 7 + Cumulative	8	2	-6		16	0	0	
58	Existing	11	10	-		21	0	-	
	Option 3	9	3	-2		17	0	0	
	Option 4	9	5	-2		17	0	0	
	Option 5	8	3	-3		18	0	0	

Table 1: Pedestrian Wind Comfort and Hazard Conditions

Location	Configuration	WIND COMFORT				WIND HAZARD			
		Wind Speed Exceeded (mph)	% of Time Exceeding	Speed Change (mph)	Exceeds	Wind Speed Exceeded (mph)	Hours per Year Exceeding	Hours Change	Exceeds
	Option 6	8	3	-3		18	0	0	
	Option 7	9	3	-2		18	0	0	
	Option 7 + Cumulative	9	3	-2		17	0	0	
59	Existing	16	28	-	e	32	0	-	
	Option 3	11	10	-5		22	0	0	
	Option 4	12	14	-4	e	22	0	0	
	Option 5	10	7	-6		20	0	0	
	Option 6	11	10	-5		21	0	0	
	Option 7	11	10	-5		21	0	0	
	Option 7 + Cumulative	10	6	-6		19	0	0	
60	Existing	11	10	-		22	0	-	
	Option 3	13	15	2	e	27	0	0	
	Option 4	13	17	2	e	27	0	0	
	Option 5	12	12	1	e	25	0	0	
	Option 6	12	13	1	e	26	0	0	
	Option 7	12	13	1	e	26	0	0	
	Option 7 + Cumulative	11	10	0		23	0	0	
61	Existing	16	31	-	e	32	0	-	
	Option 3	11	10	-5		22	0	0	
	Option 4	11	10	-5		22	0	0	
	Option 5	10	6	-6		22	0	0	
	Option 6	10	6	-6		22	0	0	
	Option 7	10	8	-6		23	0	0	
	Option 7 + Cumulative	9	5	-7		22	0	0	
62	Existing	11	10	-		22	0	-	
	Option 3	7	1	-4		14	0	0	
	Option 4	8	1	-3		14	0	0	
	Option 5	7	1	-4		15	0	0	
	Option 6	7	1	-4		15	0	0	
	Option 7	7	1	-4		15	0	0	
	Option 7 + Cumulative	6	1	-5		15	0	0	
63	Existing	17	34	-	e	34	0	-	
	Option 3	15	27	-2	e	32	0	0	
	Option 4	16	30	-1	e	32	0	0	
	Option 5	16	27	-1	e	33	0	0	
	Option 6	16	29	-1	e	35	0	0	
	Option 7	16	30	-1	e	35	0	0	
	Option 7 + Cumulative	16	28	-1	e	31	0	0	
64	Existing	15	26	-	e	27	0	-	
	Option 3	15	25	0	e	28	0	0	

Table 1: Pedestrian Wind Comfort and Hazard Conditions

Location	Configuration	WIND COMFORT				WIND HAZARD			
		Wind Speed Exceeded (mph)	% of Time Exceeding	Speed Change (mph)	Exceeds	Wind Speed Exceeded (mph)	Hours per Year Exceeding	Hours Change	Exceeds
	Option 4	17	33	2	e	30	0	0	
	Option 5	15	25	0	e	27	0	0	
	Option 6	16	29	1	e	29	0	0	
	Option 7	16	31	1	e	30	0	0	
	Option 7 + Cumulative	15	27	0	e	29	0	0	
65	Existing	14	22	-	e	30	0	-	
	Option 3	16	32	2	e	30	0	0	
	Option 4	18	39	4	e	30	0	0	
	Option 5	16	31	2	e	30	0	0	
	Option 6	16	33	2	e	30	0	0	
	Option 7	16	32	2	e	29	0	0	
	Option 7 + Cumulative	16	33	2	e	29	0	0	
66	Existing	10	6	-		18	0	-	
	Option 3	12	13	2	e	24	0	0	
	Option 4	13	17	3	e	24	0	0	
	Option 5	12	12	2	e	23	0	0	
	Option 6	12	13	2	e	24	0	0	
	Option 7	12	13	2	e	23	0	0	
	Option 7 + Cumulative	11	10	1		21	0	0	
67	Existing	11	10	-		22	0	-	
	Option 3	13	19	2	e	27	0	0	
	Option 4	14	24	3	e	27	0	0	
	Option 5	13	17	2	e	27	0	0	
	Option 6	13	19	2	e	28	0	0	
	Option 7	13	19	2	e	27	0	0	
	Option 7 + Cumulative	12	16	1	e	25	0	0	
68	Existing	13	18	-	e	22	0	-	
	Option 3	11	10	-2		22	0	0	
	Option 4	12	16	-1	e	22	0	0	
	Option 5	11	10	-2		23	0	0	
	Option 6	11	10	-2		24	0	0	
	Option 7	11	10	-2		23	0	0	
	Option 7 + Cumulative	11	10	-2		22	0	0	
69	Existing	12	17	-	e	25	0	-	
	Option 3	12	12	0	e	27	0	0	
	Option 4	13	16	1	e	27	0	0	
	Option 5	12	13	0	e	26	0	0	
	Option 6	12	13	0	e	27	0	0	
	Option 7	12	12	0	e	27	0	0	
	Option 7 + Cumulative	13	16	1	e	27	0	0	

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Location	Configuration	WIND COMFORT				WIND HAZARD			
		Wind Speed Exceeded (mph)	% of Time Exceeding	Speed Change (mph)	Exceeds	Wind Speed Exceeded (mph)	Hours per Year Exceeding	Hours Change	Exceeds
70	Existing	13	19	-	e	27	0	-	
	Option 3	12	13	-1	e	27	0	0	
	Option 4	14	23	1	e	27	0	0	
	Option 5	12	13	-1	e	27	0	0	
	Option 6	12	14	-1	e	27	0	0	
	Option 7	12	15	-1	e	28	0	0	
	Option 7 + Cumulative	16	31	3	e	30	0	0	

SUMMARY	Configurations	WIND COMFORT				WIND HAZARD			
		Average (mph)	Average (%)	Speed Change (mph)	Total	Average (mph)	Total Hours	Hours Change	Total
	Existing	**13 mph**	**17%**	**-**	**47 / 70**	**25 mph**	**30 Hrs**	**-**	**2 / 70**
	Option 3	**12 mph**	**14%**	**-1**	**38 / 70**	**23 mph**	**20 Hrs**	**-10**	**2 / 70**
	Option 4	**12 mph**	**16%**	**-1**	**43 / 70**	**23 mph**	**22 Hrs**	**-8**	**2 / 70**
	Option 5	**12 mph**	**13%**	**-1**	**35 / 70**	**23 mph**	**22 Hrs**	**-8**	**2 / 70**
	Option 6	**12 mph**	**14%**	**-1**	**39 / 70**	**23 mph**	**20 Hrs**	**-10**	**2 / 70**
	Option 7	**12 mph**	**14%**	**-1**	**37 / 70**	**23 mph**	**18 Hrs**	**-12**	**2 / 70**
	Option 7 + Cumulative	**11 mph**	**13%**	**-2**	**31 / 70**	**22 mph**	**11 Hrs**	**-19**	**2 / 70**

Notes:

1) Wind Comfort = Wind speeds exceeding 11 mph for ≥ 10% of the time

2) Wind Hazard = Wind speeds exceeding 36 mph for ≥ 1 hour/year