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August 22, 2019

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VIA E-mail: brian@L37partners.com

SUBJECT: Public Utilities Commission Mixed-Use Development in South San Francisco, CA --Wind Issues Associated with the Project

Dear Brian:

This letter considers wind issues associated with the Public Utilities Commission Mixed Use Development in South San Francisco. In summary, adverse wind issues for off-site pedestrians are not expected since the project buildings do not exceed 100 feet in height. The proposed project would consist of three buildings that would be up to 85 feet high. Further, several features are included in the project that would lessen the channeling and downward acceleration of wind caused by the buildings. The project landscaping plan includes existing and planned trees in strategic areas to reduce wind flow The project includes articulated buildings that pose various angled obstructions to wind.

Figure 1. Project Building Massing (project buildings indicated in dark). Note this figure does not depict the landscaping plan that includes large trees.

Wind Conditions

Wind conditions in the project area are described using historical wind data collected at San Francisco International Airport. The airport is located 3 miles to the southeast and is assumed to experience the similar wind conditions that occur at the project site. A west-northwest wind is the typical wind condition experienced in the area. This is also the direction of the strongest winds that occur, although some winter storm systems may generate strong southerly winds on a very brief basis. A common illustrative aid to describe wind conditions in an area is a *wind rose*. The wind rose shows the frequency of wind direction and speed. The "petals" are oriented in the 32 directions, where a longer length reflects a higher percentage of the time that the wind blows from that direction. The petals are extended in the direction that the wind blows from. Various colors of the petal relate to the speed. A wind rose for San Francisco Airport that represents 5 years of hourly wind measurements from 2009 through 2013 is used to describe wind in the project area (see Attachment 1). The wind rose shows that winds with a westerly component occur about 60 percent of the time, with the most dominant winds being from the west-northwest. Winds from easterly directions occur less than 15 percent of the time and are generally light. Winter storm systems can bring relatively brief periods of south or southeast winds to the area, with some of these winds being strong. Winds are considered calm about 13 percent of the time.

Figure 2. Wind flow at the project site depicted by wind rose (see Attachment 1 for Wind Rose). Black outlines areas are existing structures 3 stories or higher near the project. The project buildings are outlined in red.

South San Francisco experiences persistent strong winds in the spring and summer. The average annual wind speed is 11 miles per hour or 4.75 meters per second. Windy conditions might be described when winds exceed 18 miles per hour (8 meters per second), which occurs about 16 percent of the time. Strong winds, in excess of 36 mph (16 m/s) occur about 0.2 percent of the time (18 hours per year). The strongest winds are from the west-northwest and, for short periods, from the south during storm systems.

General Building Effects on Wind Flow

Large buildings obstruct wind flow, causing wind to decelerate on the upwind, higher pressure, side and accelerate to areas of lower pressure behind and above the building. In general, tall slab shape buildings have the greatest potential for accelerating wind as they can deflect wind downward toward the ground. A fontal vortex can form upwind at upwind sides of tall buildings, creating a downward flow on the upstream side. Winds increase near the surface at upstream corners of the building where the prevailing flow and the outflow from the frontal vortex combine. This creates corner acceleration of the wind along the building. Channeling effects occur when canyons between two building are generally aligned with the wind flow. Buildings with unusual shapes, openings, rounded edges, or elevated setbacks result in lower winds speeds. Trees and building canopies, street furniture, large-scale artwork strategically placed will further reduce descending airflow and interrupt the formation of a frontal (upwind) vortex near the surface. Downwind of buildings in the wake or low-pressure zone, the wind direction becomes more variable and winds are generally lighter. Further downwind, the wind flow attempts to attain the normal unobstructed flow; however, this occurs at a considerable distance behind the buildings.

Wind speeds around a building are dependent on various factors, but in large part depend on the height and width of the building, as well as the orientation with respect to the wind flow. A different wind flow pattern emerges when wind encounters a single tall slab-like building, as shown in *Figure 3*. The wind divides at about three quarters of the building height and creates a stagnation region in the building wake. Above this, the air flows up the face of the building and over the roof; below, it flows down to form a vortex in front of the building before accelerating around the windward corners. Use of proper trees can reduce these localized effects.

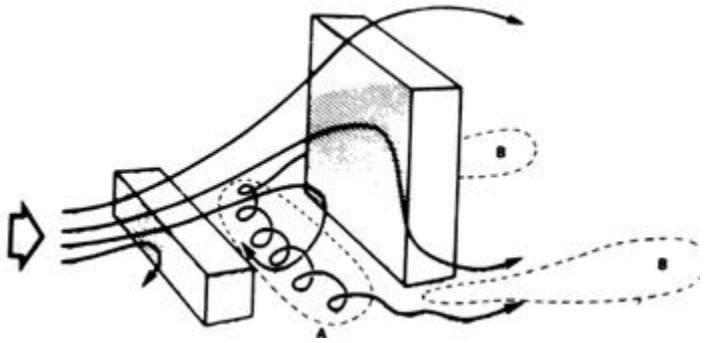

Figure 3 Flow patterns around tall, slab-like building. Note areas of increased wind speeds at pedestrian level.

Potential Impacts

We are aware of only two cities in Northern California that have developed criteria for evaluating wind impacts from new structures: San Francisco and Oakland. Both cities base their criteria on potential hazards to street-level pedestrians. In Oakland, the criterion for wind hazard is a one-minute mean wind speed of 36 miles per hour (mph). Wind analysis is only required for buildings 100 feet or greater and where one of the following conditions exist: (a) the project is located adjacent to a substantial water body (i.e., Oakland Estuary, Lake Merritt or San Francisco Bay); or (b) the project is located in Downtown Oakland.[1] Standards in San Francisco use a hazard criterion, an equivalent wind speed of

[1] City of Oakland, CEQA Thresholds of Significance Guidelines

26 mph as averaged for a single full hour of the year, and include comfort criteria for public seating areas and areas of substantial pedestrian use that are based on one minute averages[2]. Similarly, based on our understanding of the practice in San Francisco, wind tunnel testing is required for buildings over 100 feet tall.[3]

The tallest project buildings would not exceed 85 feet in height. The existing Kaiser Medical Center buildings to the west-northwest (generally upwind) are about 20 to 80 feet high and provide some obstruction to the prevailing wind flow. While taller than the existing buildings, the project would not be considered a "tall" building, because it is less than 100 feet in height. There are generally one, two- and three-story buildings to the east or downwind of the project site. The greatest wind effects outside the project would be experienced adjacent and downwind of building corners, where wind flow interrupted by the building would flow fast around the corners (referred to as a corner stream). The areas of concern would be opportunities for channeling of the prevailing winds where gaps between buildings are oriented to the west-northwest and channeling from two buildings could overlap. Wind could also be accelerated over the top of the building, but this is not a concern to pedestrians.

Features that Reduce Wind Effects

Several features are included in the project that would lessen the channeling and downward acceleration of wind caused by the buildings. The project includes articulated buildings that pose various angled obstructions to the wind. Trees and vegetation are effective at reducing wind flow. The landscape design uses trees that would soften the surface flow through building gaps, around corners and along the building frontages. Tree plantings are proposed at strategic areas to reduce wind flow upstream of the project and through the gaps such as Colma Creek. The buildings would also provide an obstruction to the wind downwind of the site.

* * *

In summary, we do not believe that an offsite "wind tunnel" effect will be caused by the proposed project and the design of the project would lessen wind effects off site by use of the building positions and planting trees in strategic areas where wind could cause localized effects.

Sincerely yours,

James A. Reyff
Senior Consultant, Principal
ILLINGWORTH & RODKIN, INC.

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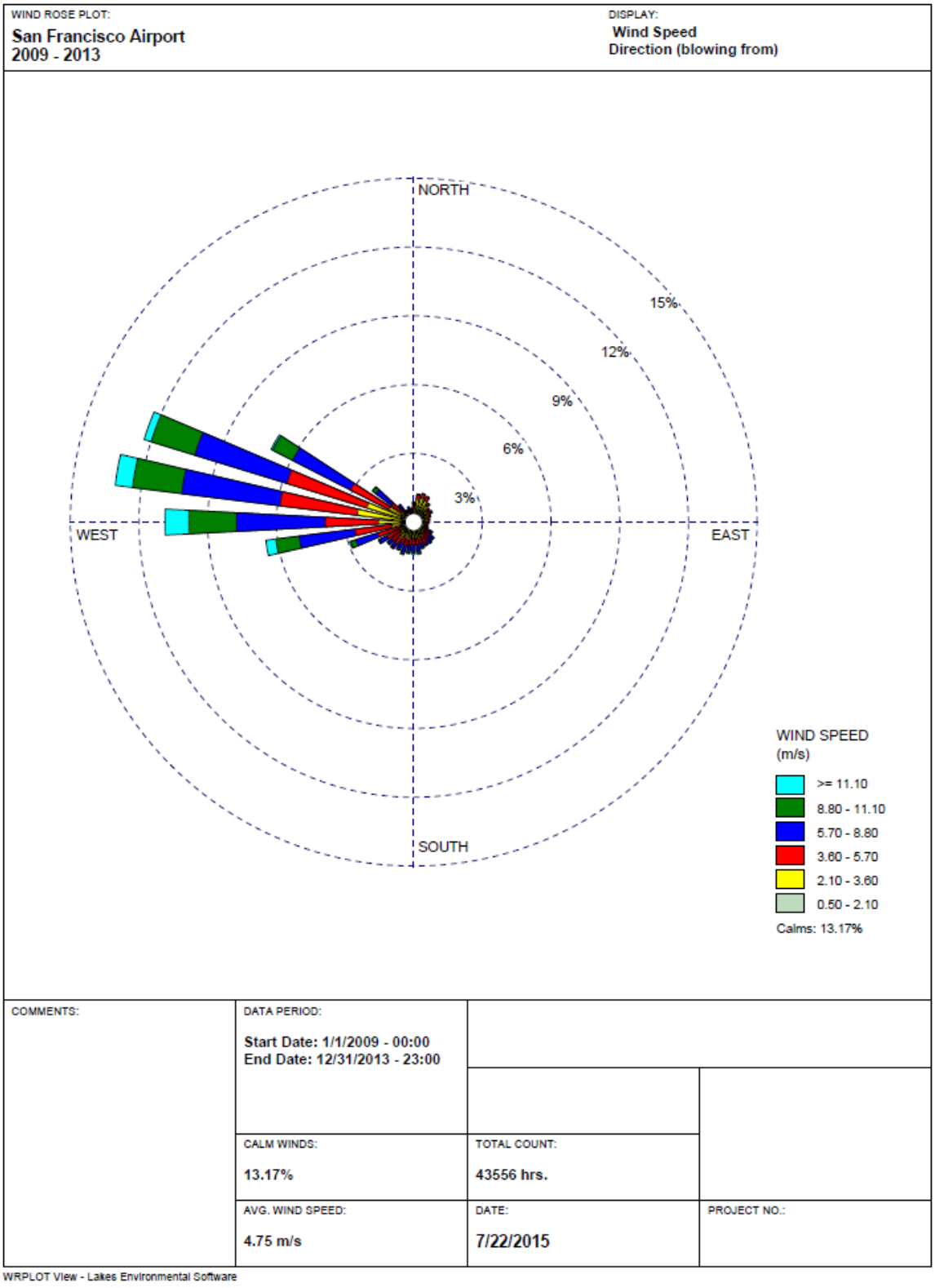
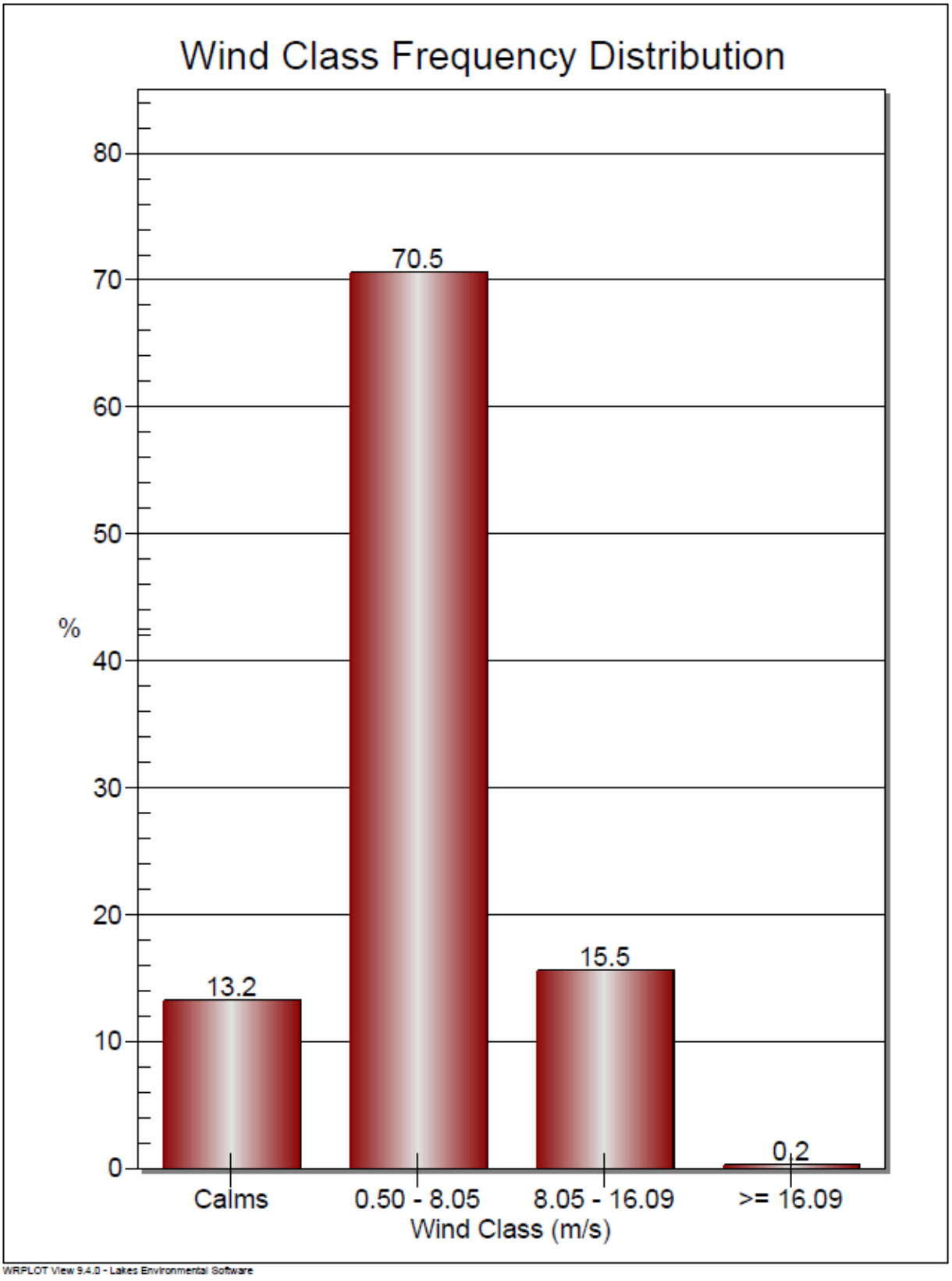
Attachment: Wind Rose for San Francisco International Airport 2009-2013

[2] San Francisco Planning Code section 148: Reduction of Ground level Wind Currents in Downtown Commercial (C-3) Districts describes wind comfort and hazard criteria for downtown San Francisco. Note that when stated as a hazard criterion the one-hour criteria is restated as a one-minute' average of 36 mph.
[3]SF Planning. 2016. *Draft Environmental Report. -Central SoMa Plan. Planning Department Case No.. 2011.1356E State Clearinghouse No. 2013042070* December 14.

Attachment


WIND ROSE PLOT:
San Francisco Airport
2009 - 2013
DISPLAY:
Wind Speed
Direction (blowing from)
NORTH
EAST
SOUTH
WEST
3%
6%
9%
12%
15%
WIND SPEED
(m/s)
>= 11.10
8.80 - 11.10
5.70 - 8.80
3.60 - 5.70
2.10 - 3.60
0.50 - 2.10
Calms: 13.17%
COMMENTS:
DATA PERIOD:
Start Date: 1/1/2009 - 00:00
End Date: 12/31/2013 - 23:00
CALM WINDS:
13.17%
TOTAL COUNT:
43556 hrs.
AVG. WIND SPEED:
4.75 m/s
DATE:
7/22/2015
PROJECT NO.:
WRPLOT View - Lakes Environmental Software


Wind Class Frequency Distribution
80
70
60
50
%
40
30
20
10
0
70.5
13.2
15.5
0.2
Calms
0.50 - 8.05
8.05 - 16.09
>= 16.09
Wind Class (m/s)
WRPLOT View 9.4.0 - Lakes Environmental Software