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MEMO

Date: April 12, 2024

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From: Heather Bruce
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SUBJECT: Orange Barrel Electronic Signs, San José, CA – Vibration Memo

This memo has been prepared to describe the potential vibration impacts resulting from the construction of the proposed project located in the City of San José, California.

Project Description

The proposed project would install two free-standing electronic signs and four electronic signs attached to buildings. Two free-standing signs would be installed at the Center for Performing Arts. The four surface mounted electronic signs would be installed on the McEnery Convention Center, the Market & San Pedro Garage, the 2nd & San Carlos Garage, and the Tech Interactive.

Regulatory Criteria

City of San José General Plan policies related to construction vibration include the following:

EC-2.3 Require new development to minimize vibration impacts to adjacent uses during demolition and construction. For sensitive historic structures, a vibration limit of 0.08 in/sec PPV (peak particle velocity) will be used to minimize the potential for cosmetic damage to a building. A vibration limit of 0.20 in/sec PPV will be used to minimize the potential for cosmetic damage at buildings of normal conventional construction.

Significance Thresholds

The following criteria were used to evaluate the significance of vibration resulting from the construction of the project:

- A significant impact would be identified if the construction of the project would produce excessive vibration levels at sensitive buildings. Groundborne vibration levels exceeding 0.2 in/sec PPV would have the potential to result in cosmetic damage to normal buildings. Groundborne vibration levels exceeding 0.08 in/sec PPV would have the potential to result in cosmetic damage to sensitive historic structures.

Construction Vibration Impacts

Vibration levels would vary depending on soil conditions, construction methods, and equipment used. Table 1 summarizes the minimum setback distances of equipment to meet the 0.2 and 0.08 in/sec PPV thresholds that would be applied to the nearest buildings.

TABLE 1 Vibration Source Levels for Construction Equipment

Equipment	PPV at 25 ft. (in/sec)	Minimum Distance to Meet 0.2 in/sec PPV (feet)	Minimum Distance to Meet 0.08 in/sec PPV (feet)
Clam shovel drop	0.202	26	59
Hydromill (slurry wall)	in soil	0.008	2
	in rock	0.017	3
Vibratory Roller	0.210	27	61
Hoe Ram	0.089	13	28
Large bulldozer	0.089	13	28
Caisson drilling	0.089	13	28
Loaded trucks	0.076	11	24
Jackhammer	0.035	6	12
Small bulldozer	0.003	<1	2

Source: Transit Noise and Vibration Impact Assessment Manual, Federal Transit Administration, Office of Planning and Environment, U.S. Department of Transportation, September 2018, as modified by Illingworth & Rodkin, Inc., April 2024.

According to Policy EC-2.3 of the City of San José General Plan, a vibration limit of 0.08 in/sec PPV shall be used to minimize the potential for cosmetic damage to sensitive historical structures, and a vibration limit of 0.2 in/sec PPV shall be used to minimize damage at buildings of normal conventional construction. Cosmetic damage (also known as threshold damage) is defined as hairline cracking in plaster, the opening of old cracks, the loosening of paint or the dislodging of loose objects. Minor damage is defined as hairline cracking in masonry or the loosening of plaster. Major structural damage is defined as wide cracking or the shifting of foundation or bearing walls. The vibration limits contained in this policy are conservative and designed to provide the ultimate level of protection for existing buildings in San José.

A review of the City of San José Historic Resource Inventory¹ was made. The Center for Performing Arts, Gerhard Residence, 515 Vine Street, Fallon Residence, Garden City Modern Bakery, Argonaut Rooms, Tennant Residence, Hales Department Store, and Civic Auditorium were identified as historic buildings in the vicinity of the project.

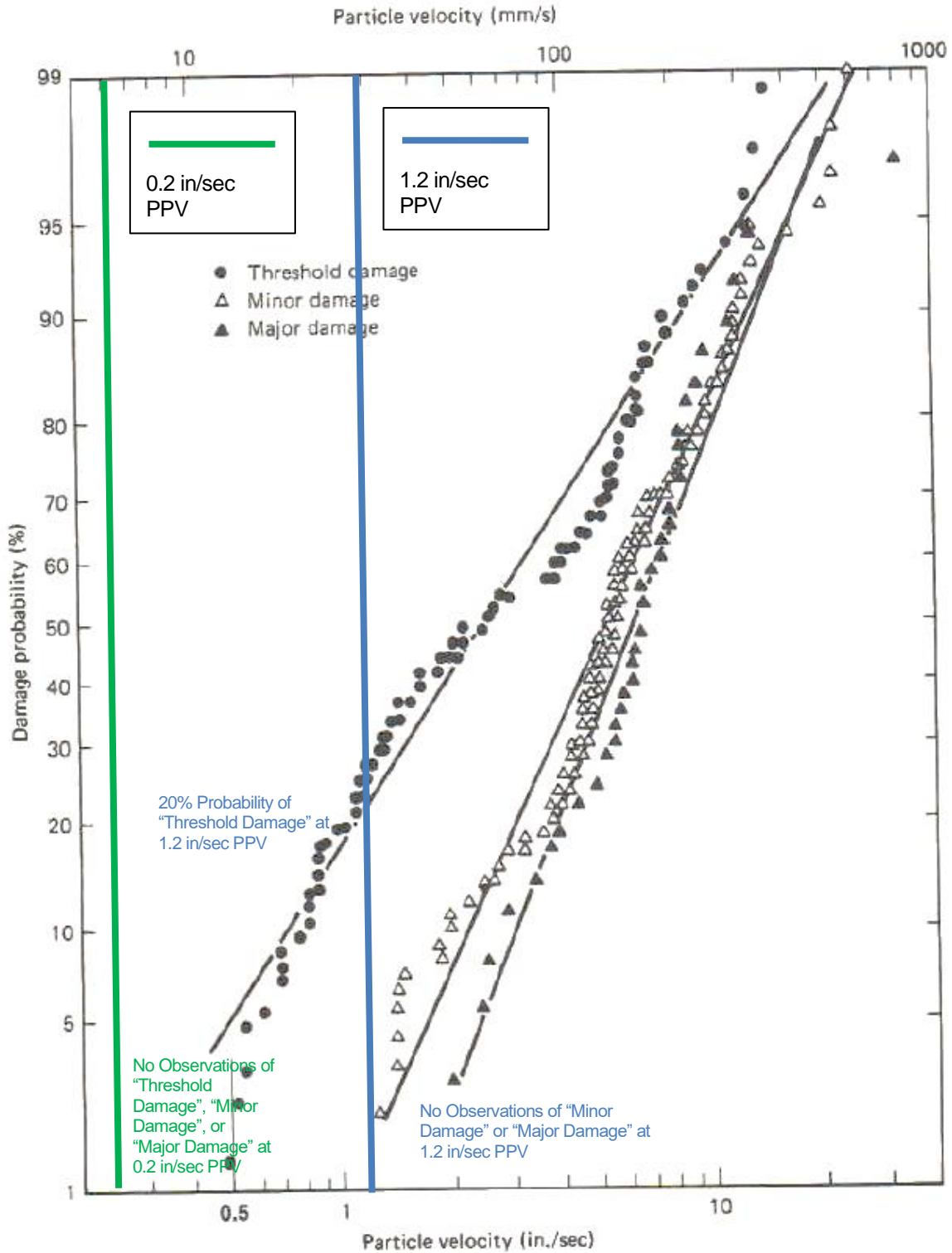
The US Bureau of Mines has analyzed the effects of blast-induced vibration on buildings in USBM RI 8507², and these findings have been applied to vibrations emanating from construction equipment on buildings³. As shown on Figure 1, these studies indicate an approximate 20% probability of “threshold damage” (referred to as cosmetic damage elsewhere in this report) at vibration levels of 1.2 in/sec PPV or less and no observations of “minor damage” or “major damage” at vibration levels of 1.2 in/sec PPV or less. Figure 1 presents the damage probability as reported in USBM RI 8507 and reproduced by Dowding assuming a maximum vibration level of 1.2 in/sec PPV. Based on these data, cosmetic or threshold damage would be manifested in the form of hairline cracking in plaster, the opening of old cracks, the loosening of paint or the dislodging of loose objects. However, minor damage (e.g., hairline cracking in masonry or the loosening of plaster) or major structural damage (e.g., wide cracking or shifting of foundation or bearing walls) would not occur assuming a maximum vibration level of 1.2 in/sec PPV.

¹ <https://www.arcgis.com/apps/webappviewer/index.html?id=b2d7cc355a86493c8da904b8c2fc3e3e&extent=-13591970.1207%2C4462771.7617%2C-13533877.9792%2C4499308.6613%2C102100>, accessed April 2024.

² Siskind, D.E., M.S. Stagg, J.W. Kopp, and C.H. Dowding, Structure Response and Damage Produced by Ground Vibration from Surface Mine Blasting, RI 8507, Bureau of Mines Report of Investigations, U.S. Department of the Interior Bureau of Mines, Washington, D.C., 1980.

³ Dowding, C.H., Construction Vibrations, Prentice Hall, Upper Saddle River, 1996.

FIGURE 1 Probability of Cracking and Fatigue from Repetitive Loading



Source: Dowding, C.H., Construction Vibrations, Prentice Hall, Upper Saddle River, 1996 as modified by Illingworth & Rodkin, Inc., April 2024.

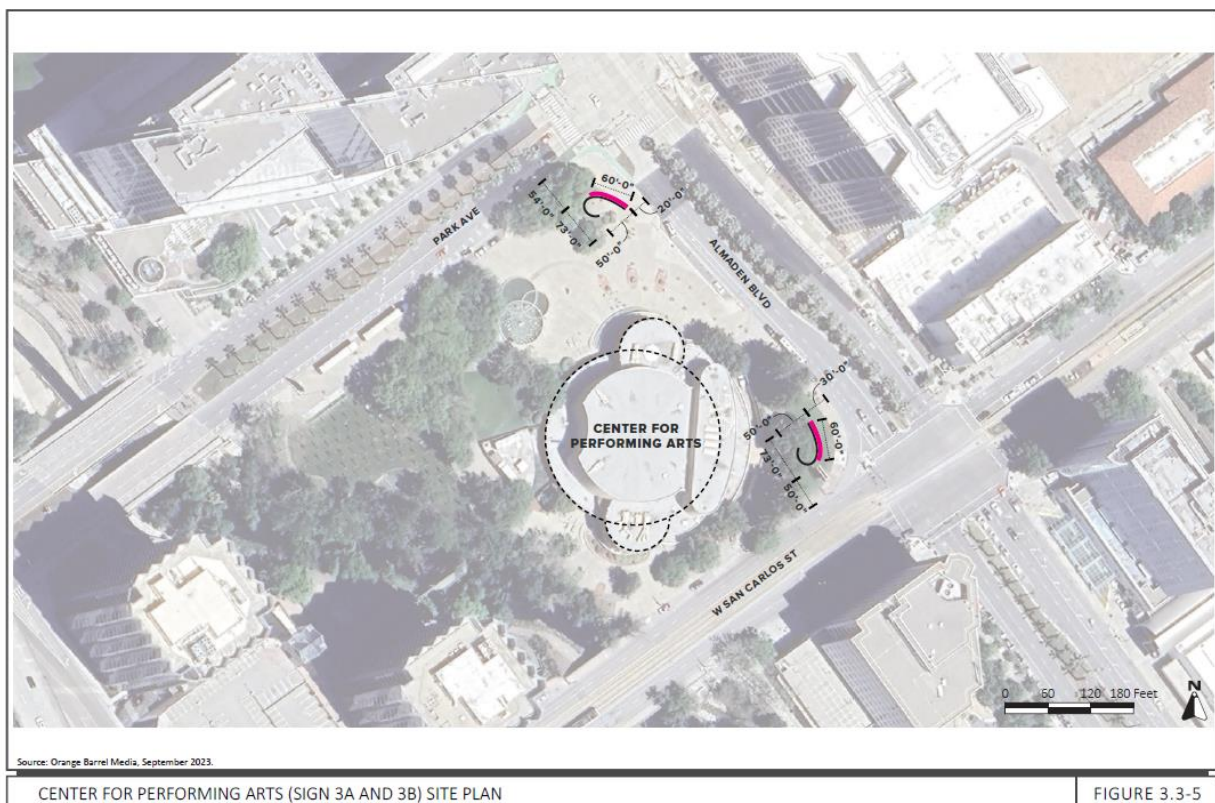
Center for Performing Arts

Construction activities associated with the installation of the electronic sign at the Center for Performing Arts would include demolition, site preparation, grading/excavation, trenching/foundation, and exterior building work. Table 2 lists the equipment planned during each phase of construction. Figure 2 shows the location of the proposed signs at the Center for Performing Arts.

TABLE 2 Planned Construction Equipment During Each Phase of Construction-Center for Performing Arts

Phase of Construction	Construction Equipment (Quantity)
Demolition	Excavator (1)
Site Preparation	Aerial Lift (1)
Grading/Excavation	Excavator (2)
Trenching/Foundation	Excavator (2) Aerial Lift (1)
Building – Exterior	Crane (2) Aerial Lift (2)

FIGURE 2 Location of the Proposed Signs at the Center for Performing Arts



Excavators breaking up pavement would produce vibration levels similar to a clam-shovel drop, an excavator demolishing and digging a trench would produce vibration levels similar to a hoe-ram or a large bulldozer. Aerial lifts and cranes would not produce vibration levels that would affect nearby

buildings. Table 3 presents vibration levels from construction equipment at the nearest buildings surrounding the Center for Performing Arts. The nearest buildings of conventional construction are located 180 feet north across Park Avenue and 140 to 170 feet east across S Almaden Boulevard. The nearest historic building is the Center for Performing Arts which is located 90 feet northwest from sign 3B and 120 feet southwest from sign 3A.

Calculations were made to estimate vibration levels at distances of 90, 120, 140 and 170 feet from the site to represent vibration levels expected at nearby buildings. Vibration levels are highest close to the source, and then attenuate with increasing distance at the rate $(D_{ref}/D)^{1.1}$, where D is the distance from the source in feet and D_{ref} is the reference distance of 25 feet. Vibration levels would vary depending on soil conditions, construction methods, and equipment used.

TABLE 3 Vibration Levels for Construction Equipment at Various Distances

Equipment	PPV at 90 ft. (in/sec)	PPV at 120 ft. (in/sec)	PPV at 140 ft. (in/sec)	PPV at 170ft. (in/sec)
Clam shovel drop	0.049	0.036	0.030	0.025
Hoe Ram	0.022	0.016	0.013	0.011
Large bulldozer	0.022	0.016	0.013	0.011

Source: Transit Noise and Vibration Impact Assessment Manual, Federal Transit Administration, Office of Planning and Environment, U.S. Department of Transportation, September 2018, as modified by Illingworth & Rodkin, Inc., April 2024.

Based on vibration levels of similar equipment, project construction activities would be expected to generate vibration levels up to 0.049 in/sec PPV at the Center for Performing Arts building. Project-generated vibration levels would fall below the below the General Plan threshold of 0.08 in/sec PPV at the Center for Performing Arts and the General Plan threshold of 0.2 in/sec PPV at buildings of normal conventional construction.

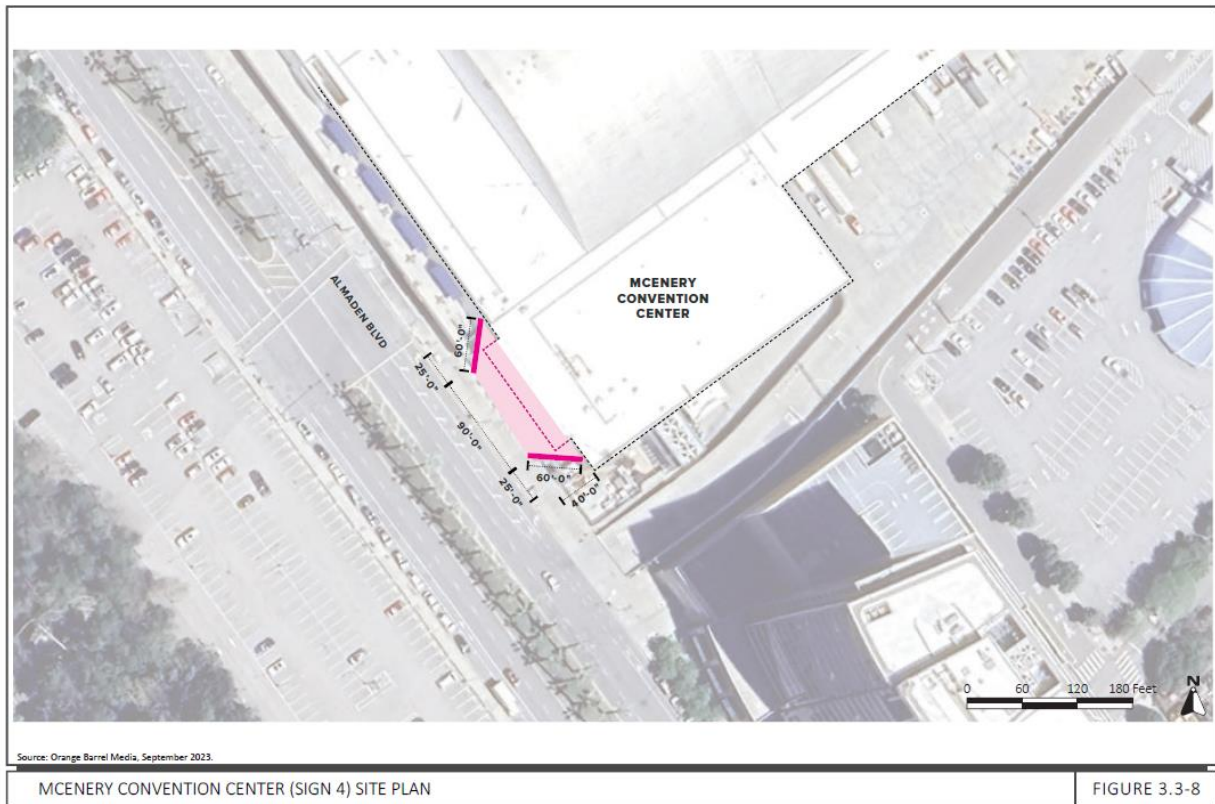
McEnery Convention Center

Construction activities associated with the installation of the electronic sign at the McEnery Convention Center would include demolition, site preparation, exterior building work, and interior building work. Table 4 lists the equipment planned during each phase of construction. Figure 3 shows the location of the proposed sign attached to the McEnery Convention Center Building.

TABLE 4 Planned Construction Equipment During Each Phase of Construction-McEnery Convention Center

Phase of Construction	Construction Equipment (Quantity)
Demolition	Aerial Lift (1)
Site Preparation	Aerial Lift (4)
Building – Exterior	Crane (2) Aerial Lift (2)
Building – Interior/ Architectural Coating	Aerial Lift (2)

FIGURE 3 Location of the Proposed Sign attached to the McEnery Convention Center



Aerial lifts and cranes would not produce vibration levels that would affect nearby buildings. The nearest buildings of convention construction are located 90 feet south of the proposed sign location and the nearest historic buildings, the Gerhard Residence and 515 Vine Street, are located 530 feet southeast and 600 feet south from the proposed sign location, respectively. Project-generated vibration levels would fall below the General Plan threshold of 0.2 in/sec PPV at the nearest buildings of normal conventional construction and 0.08 in/sec PPV at the nearest historic buildings.

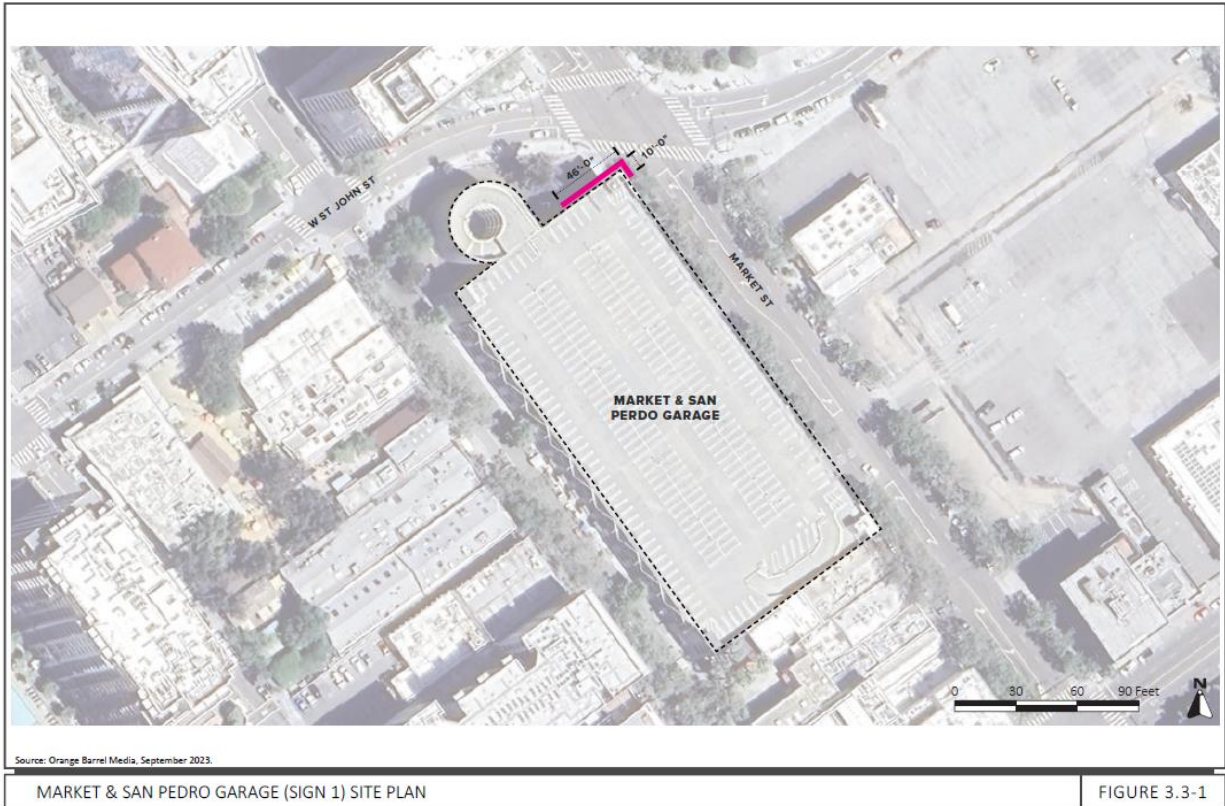
Market & San Pedro Garage

Construction activities associated with the installation of the electronic sign at the Market & San Pedro Garage would include site preparation and building exterior building work. Table 5 lists the equipment planned during each phase of construction. Figure 4 shows the location of the proposed sign attached to the 2nd and San Carlos Garage Building.

TABLE 5 Planned Construction Equipment During Each Phase of Construction- Market & San Pedro Garage

Phase of Construction	Construction Equipment (Quantity)
Site Preparation	Aerial Lift (1)
Building – Exterior	Crane (1) Aerial Lift (1)

FIGURE 4 Location of the Proposed Sign attached to the Market & San Pedro Garage



Aerial lifts and cranes would not produce vibration levels that would affect nearby buildings. The nearest buildings of convention construction are located 150 feet north across W St John Street and 290 feet northwest across W St John Street. The nearest historic buildings, Garden City Modern Bakery, Argonaut Rooms, and the Fallon Residence, are located 180 feet west across N San Pedro Street, 180 feet southeast across Market Street, and 330 feet northwest across W St John Street from the proposed sign location, respectively. The Market & San Pedro Garage is a non-vibration sensitive structure and is subject to much higher vibration levels due to daily use. Project-generated vibration levels would fall below the General Plan threshold of 0.2 in/sec PPV at the nearest buildings of normal conventional construction as well as the nearest non-vibration sensitive structures and 0.08 in/sec PPV at the nearest historic buildings.

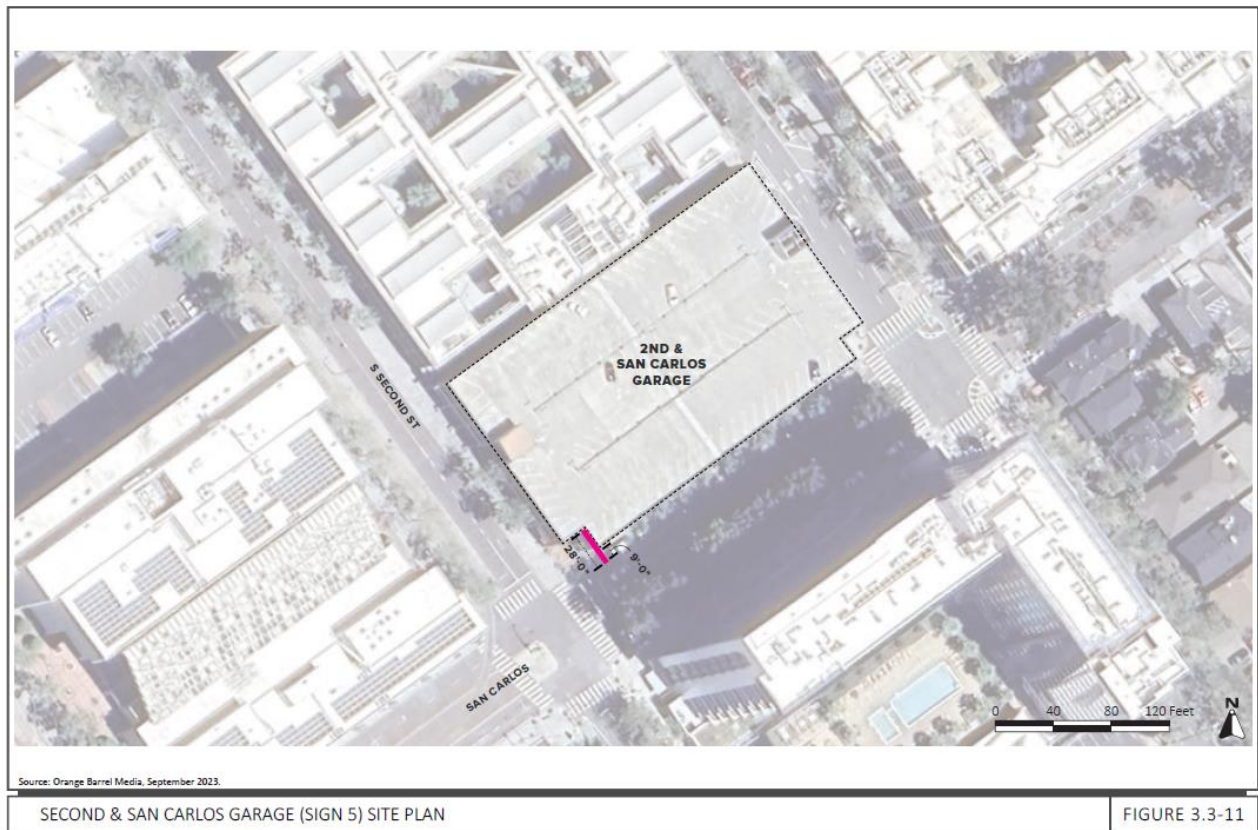
2nd and San Carlos Garage

Construction activities associated with the installation of the electronic sign at the 2nd and San Carlos Garage would include site preparation, building exterior building work, and building interior work. Table 6 lists the equipment planned during each phase of construction. Figure 5 shows the location of the proposed sign attached to the 2nd and San Carlos Garage Building.

TABLE 6 Planned Construction Equipment During Each Phase of Construction-2nd & San Carlos Garage

Phase of Construction	Construction Equipment (Quantity)
Site Preparation	Aerial Lift (1)
Building – Exterior	Crane (1) Aerial Lift (1)
Building – Interior/ Architectural Coating	Aerial Lift (1)

FIGURE 5 Location of the Proposed Sign attached to the 2nd & Can Carlos Garage



Aerial lifts and cranes would not produce vibration levels that would affect nearby buildings. The nearest conventional buildings are located 85 feet south of the proposed sign across San Carlos Street and 100 feet southwest across S Second Street. The two nearest historic buildings, the Hales Department Store and the Tennant Residence, are located approximately 250 feet southwest and 360 feet northeast, respectively from the proposed sign location. The 2nd & San Carlos Garage is a non-vibration sensitive structure and is subject to much higher vibration levels due to daily use. Project-generated vibration levels would fall below the General Plan threshold of 0.2 in/sec PPV at the nearest buildings of normal conventional construction as well as the nearest non-vibration sensitive structures and 0.08 in/sec PPV at the nearest historic buildings.

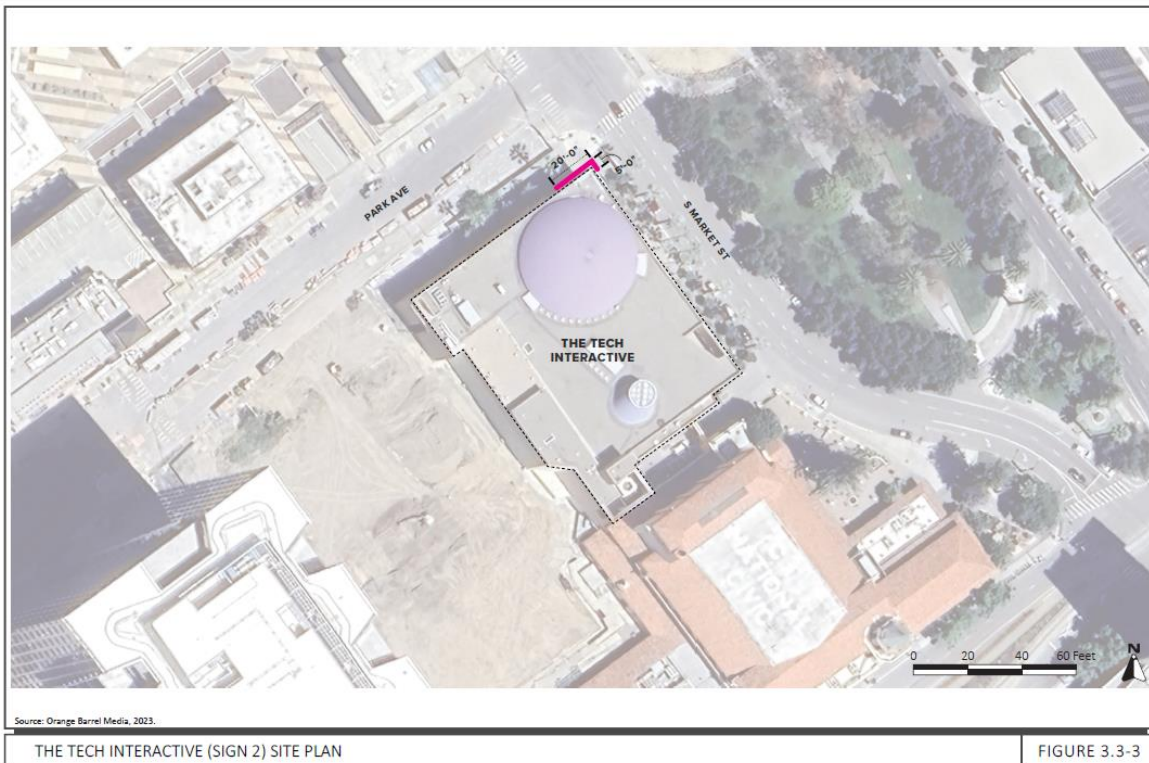
Tech Interactive

Construction activities associated with the installation of the electronic sign at the Tech Interactive would include site preparation and building exterior building work. Table 7 lists the equipment planned during each phase of construction. Figure 6 shows the location of the proposed sign attached to the Tech Interactive Building.

TABLE 7 Planned Construction Equipment During Each Phase of Construction-Tech Interactive

Phase of Construction	Construction Equipment (Quantity)
Site Preparation	Aerial Lift (1)
Building – Exterior	Crane (1) Aerial Lift (1)

FIGURE 6 Location of the Proposed Sign attached to the Tech Interactive



Aerial lifts and cranes would not produce vibration levels that would affect nearby buildings. The nearest buildings of convention construction are located 140 feet north across Park Avenue and 180 feet to the southwest of the proposed sign location. The nearest historic building, the Civic Auditorium, is located 250 feet south of the proposed sign location. Calculations were made to estimate vibration levels at distances of 5, 140, 180, and 250 feet from the site to represent other nearby buildings. Project-generated vibration levels would fall below the General Plan threshold of 0.2 in/sec PPV at the nearest buildings of normal conventional construction and 0.08 in/sec PPV at the nearest historic buildings.

Conclusion

In summary, the construction of the project would not generate vibration levels exceeding the General Plan threshold of 0.2 in/sec PPV at nearest buildings of normal conventional construction or exceed the General Plan threshold of 0.08 in/sec PPV at any of the nearest historic buildings.