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Memo

Date: August 22, 2018

To: Tyler Rogers
David J. Powers & Associates, Inc.

From: Michael Thill
Illingworth & Rodkin, Inc.

SUBJECT: **West Santa Clara and North Almaden Avenue Development, San José, California (IR Job # 18-140)**

This memo has been prepared to describe the potential vibration impacts resulting from the construction of the project proposed at the northeast corner of the North Almaden Avenue/West Santa Clara Street intersection in San José, California.

Project Description

The proposed project is seeking a Site Development Permit (H17-062) and a Historic Preservation Permit (HP18-002) to demolish the existing staircases and patio to construct an approximately 35-foot tall, partial two-story, mixed use building totaling 6,099 square feet. The project proposes a 3,759 square-foot restaurant or commercial space on the first-floor and a total of 2,340 square feet of office space between the first and second floors. The second floor office space would also have a connecting corridor to the adjacent Lyndon Building (189 West Santa Clara Street). The proposed building would be about 35 feet tall. The project also proposes to demolish the existing rear stairs at the northwest corner of the Lyndon Building and replace them with code-compliant fire exit stairs.

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 expose persons to excessive vibration levels. 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

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.

Construction activities associated with the project would include demolition of existing site improvements, site preparation, foundation work, and new building framing and finishing. Foundation construction techniques involving impact or vibratory pile driving, which can cause excessive vibration, are not anticipated as part of the project. The use of other high vibration generating equipment will be avoided. The compaction method to be used would follow the soil moisture condition per the soils report and place in thin lifts with grading tractor and roller in static mode (no vibration). The lift could be 4" to 6" pending the makeup of the soil. Equipment expected to complete these tasks would be a John Deere Skip Loader 210 L (11,350 lb. Operating Weight) and a Caterpillar CB24 DBL Drum (6,003 lb. Operating Weight).

Heavy vibration generating construction equipment, such as vibratory rollers or clam shovel drops, would have the potential to produce vibration levels of 0.08 in/sec PPV or more at historic buildings within 60 feet of the project site. This same equipment would have the potential to produce vibration levels of 0.2 in/sec PPV or more at buildings of normal conventional construction located within 25 feet of the project site.

A review of the City of San José Historic Resource Inventory[1] was made, and the only property of historical significance within 60 feet of the site was the Lyndon Building located immediately east of the site. Therefore, the vibration limit of 0.08 in/sec PPV would apply to the Lyndon Building and the vibration limit of 0.2 in/sec PPV would apply to the nearest buildings to the north, west,

[1] http://www.sanjoseca.gov/DocumentCenter/View/35475, accessed August 2018.

and south. Figure 1 shows the project site plan and Lyndon Building overlaid on an aerial image of the site vicinity.

Table 1 presents vibration levels from construction equipment at the nearest buildings surrounding the site. Calculations were made to estimate vibration levels at distances of 5 feet from the building, as well as distances of 30, 60, and 95 feet from the site to represent other 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.

Project construction activities, such as drilling, the use of jackhammers, rock drills and other high-power or vibratory tools, and rolling stock equipment (tracked vehicles, compactors, etc.) may generate substantial vibration in the immediate vicinity of the historic Lyndon Building. Some activities would occur at distances of about 5 feet from the building, and at this distance, vibration levels due to construction are conservatively calculated to reach up to 1.2 in/sec PPV, which would exceed the 0.08 in/sec PPV threshold for historic buildings.

The US Bureau of Mines has analyzed the effects of blast-induced vibration on buildings in USBM RI 8507[2], and these findings have been applied to vibrations emanating from construction equipment on buildings[3]. As shown on Figure 2, 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 2 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) to the Lyndon Building would not occur assuming a maximum vibration level of 1.2 in/sec PPV. Buildings of normal conventional construction are located approximately 30 to 95 feet from the project site on the north, west, and south. At these distances, vibration levels would be up to 0.17 in/sec PPV, which is below the 0.2 in/sec PPV threshold for normal buildings. Based on the data summarized in Figure 2, there were no observations of "threshold damage", "minor damage", or "major damage" at vibration levels of 0.2 in/sec PPV or less.

As discussed in detail above, project-generated vibration levels would be capable of cosmetically damaging the adjacent historic building but would fall below the General Plan threshold of 0.2 in/sec PPV at other surrounding conventional buildings located 30 feet or more from the project site. Neither cosmetic, minor, or major damage would occur at conventional buildings in the project vicinity. At these locations, and in other surrounding areas where vibration would not be expected to cause structural damage, vibration levels may still be perceptible. However, as with any type of construction, this would be anticipated and would not be considered significant, given the intermittent and short duration of the phases that have the highest potential of producing vibration. By use of administrative controls, such as

[2] Siskind, D.E., M.S. Stagg, J.W. Kopp, and C.H. Dowding, Structure Response and Damage Produced by Ground Vibration form 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.

notifying neighbors of scheduled construction activities and scheduling construction activities with the highest potential to produce perceptible vibration during hours with the least potential to affect nearby residences and businesses, perceptible vibration can be kept to a minimum.

In summary, the construction of the project would generate vibration levels exceeding the General Plan threshold of 0.08 in/sec PPV at the historic Lyndon Building, and such vibration levels would be capable of cosmetically damaging the historic building. Project-generated vibration levels would fall below the General Plan threshold of 0.2 in/sec PPV at other surrounding buildings of normal conventional construction located 30 feet or more from the project site, and no damage would occur at these buildings because of the project.

Mitigation Measures:

- Prohibit impact or vibratory pile driving.
- Place operating equipment on the construction site as far as possible from the historic Lyndon Building.
- Use smaller equipment to minimize vibration levels below the limits.
- Avoid using vibratory rollers and tampers near the historic Lyndon Building.
- Select demolition methods not involving impact tools.
- Modify/design or identify alternative construction methods to reduce vibration levels below the limits.
- Avoid dropping heavy objects or materials.
- A list of all heavy construction equipment to be used for this project known to produce high vibration levels (tracked vehicles, vibratory compaction, jackhammers, hoe rams, etc.) shall be submitted to the City by the contractor. This list shall be used to identify equipment and activities that would potentially generate substantial vibration and to define the level of effort for reducing vibration levels below the thresholds.
- A construction vibration monitoring plan shall be implemented to document conditions at the historic Lyndon Building prior to, during, and after construction. All plan tasks shall be undertaken under the direction of a licensed Professional Structural Engineer in the State of California and be in accordance with industry-accepted standard methods. The construction vibration monitoring plan should be implemented and include the following tasks:
    - Identification of sensitivity to ground-borne vibration of the Lyndon Building. A vibration survey (generally described below) would need to be performed.

- Performance of a photo survey, elevation survey, and crack monitoring survey for the historic Lyndon Building. Surveys shall be performed prior to, during, and after construction and shall include internal and external crack monitoring, settlement, and distress and shall document the condition of foundations, walls and other structural elements in the interior and exterior of said structure.

- Development of a vibration monitoring and construction contingency plan to identify where monitoring would be conducted, set up a vibration monitoring schedule, define structure-specific vibration limits, and address the need to conduct photo, elevation, and crack surveys to document before and after construction. Alternative construction methods would be identified for when vibration levels approach the limits that are stated in the General Plan such as Policy EC-2.3.

- If vibration levels approach the 0.08 in/sec PPV limit at the Lyndon Building, suspend construction and implement alternative construction methods to either lower vibration levels or secure the affected structure.

- Conduct post-construction surveys where either monitoring has indicated high levels or complaints of damage has been made. Make appropriate repairs or compensation where damage has occurred as a result of construction activities.

- The results of all vibration monitoring shall be summarized and submitted in a report shortly after substantial completion of each phase identified in the project schedule. The report will include a description of measurement methods, equipment used, calibration certificates, and graphics as required to clearly identify vibration-monitoring locations. An explanation of all events that exceeded vibration limits will be included together with proper documentation supporting any such claims.

- Designate a person responsible for registering and investigating claims of excessive vibration. The contact information of such person shall be clearly posted on the construction site.

The implementation of these measures would reduce the impact to a less-than-significant level.

Figure 1 Project Site Plan and Vicinity

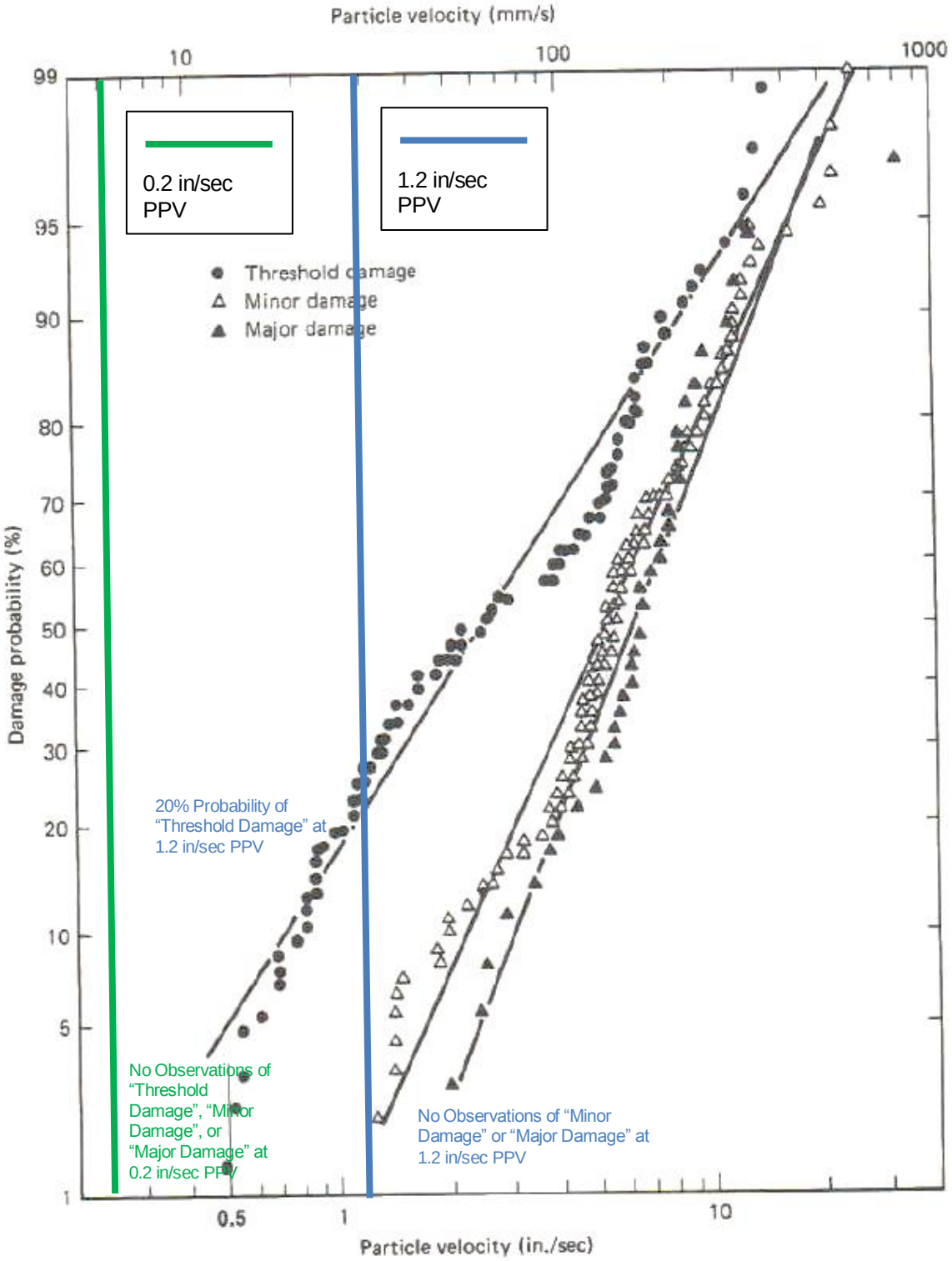
Source: Google Earth, August 2018.

TABLE 1 Vibration Levels for Construction Equipment at Various Distances

Equipment		PPV at 5 ft. (in/sec)	PPV at 30 ft. (in/sec)	PPV at 60 ft. (in/sec)	PPV at 95 ft. (in/sec)
Clam shovel drop		**1.186**	0.165	0.077	0.047
Hydromill (slurry wall)	in soil	0.047	0.007	0.003	0.002
	in rock	**0.100**	0.014	0.006	0.004
Vibratory Roller		**1.233**	0.172	0.080	0.048
Hoe Ram		**0.523**	0.073	0.034	0.020
Large bulldozer		**0.523**	0.073	0.034	0.020
Caisson drilling		**0.523**	0.073	0.034	0.020
Loaded trucks		**0.446**	0.062	0.029	0.018
Jackhammer		**0.206**	0.029	0.013	0.008
Small bulldozer		0.018	0.002	0.001	0.001

Source: Transit Noise and Vibration Impact Assessment, United States Department of Transportation, Office of Planning and Environment, Federal Transit Administration, May 2006, as modified by Illingworth & Rodkin, Inc., August 2018.

Figure 2 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., August 2018.