Appendix J

Technical Noise Memorandum

Kimley»Horn

MEMORANDUM

To: Miles Eaton, Kimley-Horn and Associates, Inc.

From: Ryan Chiene, Kimley-Horn and Associates, Inc.

Date: May 24, 2024

Subject: Raising Cane's C1104 – Victorville, CA – Noise and Vibration Analysis

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Purpose

The purpose of this memorandum is to identify the noise and vibration impacts associated with construction and operation of the proposed Raising Cane's Project (project), located in the City of Victorville, California.

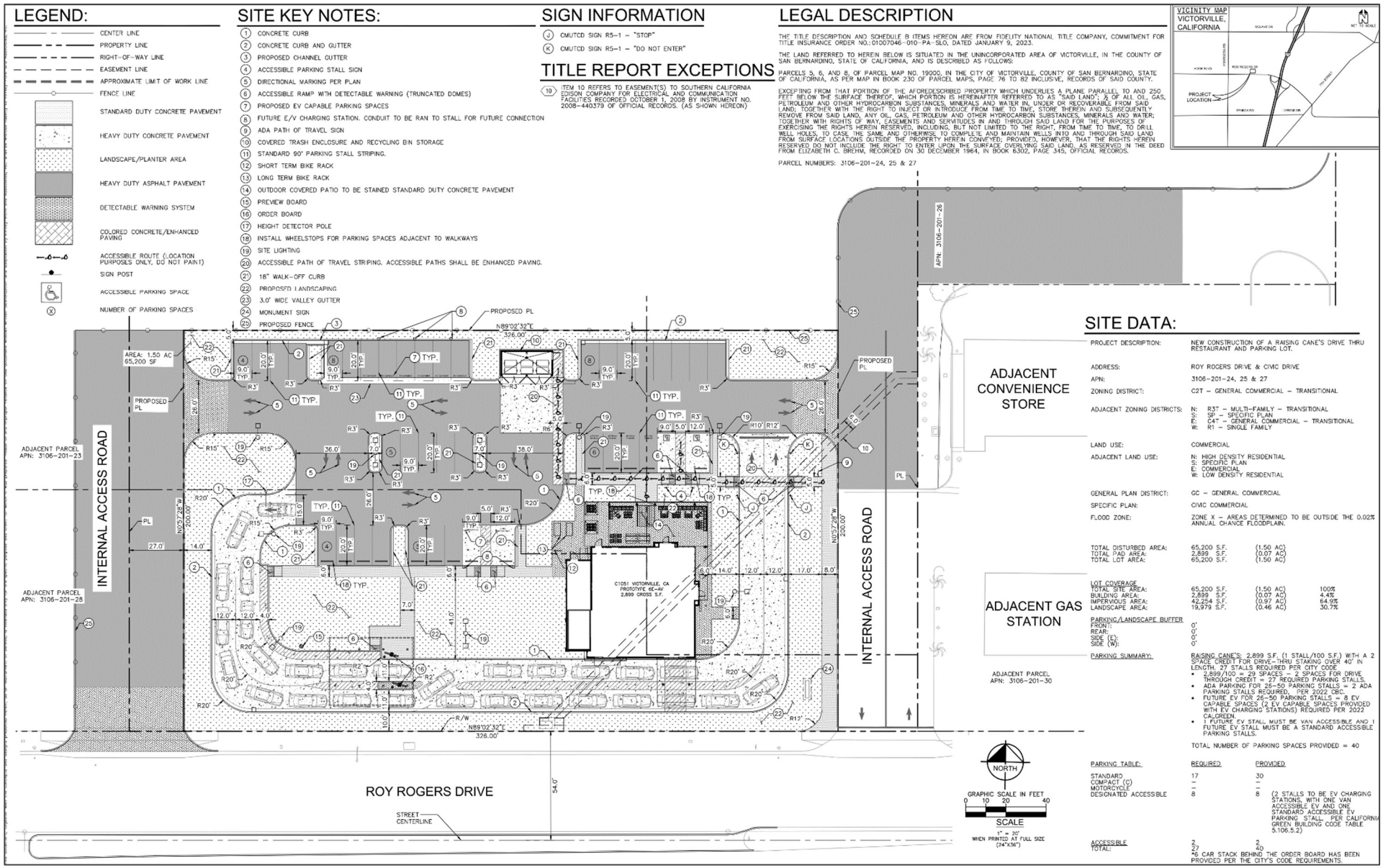
Project Location

The project site is generally located approximately 0.25-mile west of Interstate 15 (I-15) in the central portion of the City of Victorville (City), County of San Bernardino (County), California. The project site is specifically located approximately 350 west of the intersection of Roy Rogers Drive and Civic Drive (Assessor's Parcel Number [APN] 3106-201-24, -25, and -27) on an approximately 1.50-acre lot. The project site is currently vacant and is surrounded by vacant land to the north and west, a gas station to the east, and Roy Rogers Drive and commercial uses to the south; multi-family residential uses are also noted further to the north along Midtown Drive.

Project Description

The proposed project would construct a 2,899 square foot Raising Cane's restaurant with drive-thru access and an outdoor seating area. Vehicular access provisions to the project site would be provided via an east and west driveway on Roy Rogers Drive, and a driveway connecting to Civic Drive. All necessary utility improvements including water, sewer, and storm drain would be constructed within the property limits. Standard hours of operation are 9:00 a.m. to 3:30 a.m., seven days/week. See Figure 1: Site Plan for more details. Construction is anticipated to start in March 2025 and last for approximately eight months.

Figure 1: Site Plan



Noise Background

Sound is technically described in terms of amplitude (loudness) and frequency (pitch). The standard unit of sound amplitude measurement is the decibel (dB). The decibel scale is a logarithmic scale that describes the physical intensity of the pressure vibrations that make up any sound. The pitch of the sound is related to the frequency of the pressure vibration. Since the human ear is not equally sensitive to a given sound level at all frequencies, a special frequency-dependent rating scale has been devised to relate noise to human sensitivity. The A-weighted decibel scale (dBA) provides this compensation by discriminating against frequencies in a manner approximating the sensitivity of the human ear.

Noise, on the other hand, is typically defined as unwanted sound. A typical noise environment consists of a base of steady ambient noise that is the sum of various distant and indistinguishable noise sources. Superimposed on this background noise is the sound from individual local sources. These can vary from an occasional aircraft or train passing by to virtually continuous noise from traffic on a major highway.

Several rating scales have been developed to analyze the adverse effect of community noise on people. Since environmental noise fluctuates over time, these scales consider that the effect of noise on people is largely dependent on the total acoustical energy content of the noise as well as the time of day when the noise occurs. For example, the equivalent continuous sound level (L_{eq}) is the average acoustic energy content of noise for a stated period of time; thus, the L_{eq} of a time-varying noise and that of a steady noise are the same if they deliver the same acoustic energy to the ear during exposure. The Day-Night Sound level (L_{dn}) is a 24-hour average L_{eq} with a 10 dBA "weighting" added to noise during the hours of 10:00 p.m. to 7:00 a.m. to account for noise sensitivity in the nighttime. The Community Noise Equivalent Level (CNEL) is a 24-hour average L_{eq} with a 10-dBA weighting added to noise during the hours of 10:00 p.m. to 7:00 a.m. and an additional 5 dBA weighting during the hours of 7:00 p.m. to 10:00 p.m. to account for noise sensitivity in the evening and nighttime.

Regulatory Setting

State

California Government Code

California Government Code Section 65302(f) mandates that the legislative body of each county and city adopt a noise element as part of its comprehensive general plan. The local noise element must recognize the land use compatibility guidelines established by the State Department of Health Services. The guidelines rank noise land use compatibility in terms of "normally acceptable", "conditionally acceptable", "normally unacceptable", and "clearly unacceptable" noise levels for various land use types. Single-family homes are "normally acceptable" in exterior noise environments up to 60 CNEL and "conditionally acceptable" up to 70 CNEL. Multiple-family residential uses are "normally acceptable" up to 65 CNEL and "conditionally acceptable" up to 70 CNEL. Schools, libraries, and churches are "normally acceptable" up to 70 CNEL, as are office buildings and business, commercial, and professional uses.

Local

City of Victorville General Plan

The *City of Victorville General Plan* Noise Element (Noise Element) identifies noise-sensitive land uses and noise sources, defines areas of noise impact, and contains policies and programs to achieve and maintain noise levels compatible with various types of land uses.

The Noise Element identifies land use guidelines to protect residential neighborhoods and noise-sensitive receptors such as schools and hospitals from potentially harmful noise sources. The noise and land use compatibly criteria are shown in Table 1: Land Use Compatibility for Community Noise Exposure.

Table 1: Land Use Compatibility for Community Noise Exposure

Land Use Category	Community Noise Exposure (L_{dn} or CNEL, dBA)					
	55	60	65	70	75	80+
Residential-Low Density Single-Family, Duplex, Multi-family, Mobile Homes	1	1	2	2	3	4
Transient Lodging-Motels and Hotels	1	1	2	2	3	3
Schools, Libraries, Churches, Hospitals, Nursing Homes	1	1	2	3	3	4
Auditoriums, Concert Hall, Amphitheaters	2	2	3	3	4	4
Sports Arenas, Outdoor Spectator Sports	2	2	2	2	3	3
Playgrounds, Neighborhood Parks	1	1	1	2	3	3
Golf Courses, Riding Stables, Water Recreation, Cemeteries	1	1	1	2	2	4
Office Buildings, Business Commercial, Professional, and Mixed-Use Developments	1	1	1	2	2	3
Industrial, Manufacturing, Utilities,	1	1	1	1	2	2
Agriculture	1	1	1	1	1	1

CNEL = Community Noise Equivalent Level; L_{dn} = Day/Night Average; NA = Not Applicable

Notes:
1. NORMAL ACCEPTABLE: Specified Land Use is satisfactory, based on the assumption that any buildings involved are of normal conventional construction, without any special insulation requirements.
2. CONDITIONALLY ACCEPTABLE: New construction or development should be undertaken only after a detailed analysis of the noise reduction requirements is made and needed noise insulation features included in the design. Conventional construction, with closed windows and fresh air supply systems or air conditioning will normally suffice.
3. NORMALLY UNACCEPTABLE: New construction or development should generally be discouraged. If new construction or development does proceed, a detailed analysis of the noise reduction requirements must be made and needed noise insulation features included in the design.
4. CLEARLY UNACCEPTABLE: New construction or development should generally not be undertaken.

Source: City of Victorville, *Noise Element*, 2022.

City of Victorville Municipal Code

The following sections of the City of Victorville Municipal Code (VMC) are applicable to the proposed project.

Section 13.01.040 Ambient Noise Level

Stationary noise sources will comply with the following limits unless the ambient noise level in the given environment is determined to be higher:

Table 2: Exterior Noise Standards

Land Use Category	Time Period	Noise Level
Residential	Night (10:00 p.m. to 7:00 a.m.)	55 dBA
	Day (7:00 a.m. to 10:00 p.m.)	65 dBA
Commercial	Any Time	70 dBA
Industrial	Any Time	75 dBA

Source: City of Victorville, *Victorville Municipal Code*, 2022.

Section 13.01.050 Noise Levels Prohibited

Noise levels shall not exceed the ambient noise levels in Section 13.01.040 by the following dB(A) levels for the cumulative period of time specified:

(1) Less than 5 dB(A) for a cumulative period of more than thirty minutes in any hour;

(2) Less than 10 dB(A) for a cumulative period of more than fifteen minutes in any hour;

(3) Less than 15 dB(A) for a cumulative period of more than five minutes in any hour;

(4) Less than 20 dB(A) for a cumulative period of more than one minute in any hour;

(5) 20 dB(A) or more for any period of time.

Existing Setting

The project site is impacted by various noise sources. Mobile sources of noise, including traffic along Roy Rogers Drive to the south, Civic Drive to the east, and I-15 located further east are the most common and prominent sources of noise in the project area. The primary sources of stationary noise near the project site include parking lot noise at the nearby commercial properties, mechanical equipment (e.g., heating, ventilation, and air conditioning [HVAC] units) operating at the nearby commercial and residential uses, and other urban-related activities (e.g., idling cars/trucks, pedestrians, car radios and music playing, dogs barking, etc.). The noise associated with these sources may represent a single-event noise occurrence or short-term noise.

Sensitive Receptors

Noise exposure standards and guidelines for various types of land uses reflect the varying noise sensitivities associated with each of these uses. Residences, hospitals, schools, guest lodging, libraries, and churches are treated as the most sensitive to noise intrusion and therefore have more stringent noise exposure targets than do other uses, such as manufacturing or agricultural uses that are not subject to impacts such as sleep disturbance. Sensitive receptors near the project site are shown in Table 3: Sensitive Receptors.

Table 3: Sensitive Receptors

Receptor Description	Distance and Direction from the Project
Multi-Family Residential Dwellings	330 feet to the north
Single-Family Residences	790 feet to the east

Source: Google Earth, 2024.

Noise Impacts

Construction Noise

Construction noise typically occurs intermittently and varies depending on the nature or phase of construction (e.g., land clearing, grading, excavation, paving). Noise generated by construction equipment, including earth movers, material handlers, and portable generators, can reach high levels. During construction, exterior noise levels could affect the buildings near the construction site.

Construction activities would include site preparation, grading, building construction, paving, and architectural coating applications. Such activities may require graders, tractors/loaders/backhoes and dozers during site preparation; graders, dozers, and tractors/loaders/backhoes during grading; forklifts, generator sets, tractors/loaders/backhoes, and welders during building construction; pavers, rollers, mixers, tractors/loaders/backhoes, and paving equipment during paving; and air compressors during architectural coating applications. Typical operating cycles for these types of construction equipment may involve 1 or 2 minutes of full power operation followed by 3 to 4 minutes at lower power settings. Other primary sources of acoustical disturbance would be random incidents, which would last less than one minute (such as dropping large pieces of equipment or the hydraulic movement of machinery lifts). Noise generated by construction equipment, including earth movers, material handlers, and portable generators, can reach high levels. The site preparation and grading phases of project construction tend to be the shortest in duration and create the highest construction noise levels due to the operation of heavy equipment required to complete these activities. It should be noted that only a limited amount of equipment can operate near a given location at a particular time. Typical noise levels associated with individual construction equipment are listed in Table 4: Typical Construction Noise Levels.

Table 4: Typical Construction Noise Levels	
Equipment	**Typical Noise Level (dBA) at 50 feet from Source**
Air Compressor	80
Backhoe	80
Compactor	82
Concrete Mixer	85
Concrete Pump	82
Concrete Vibrator	76
Crane, Mobile	83
Dozer	85
Generator	82
Grader	85
Impact Wrench	85
Jack Hammer	88
Loader	80
Paver	85
Pneumatic Tool	85
Pump	77
Roller	85
Saw	76
Scraper	85
Shovel	82
Truck	84
Source: Federal Transit Administration, *Transit Noise and Vibration Impact Assessment Manual*, September 2018.	

The noise levels calculated in Table 5: Project Construction Noise Levels, show the exterior construction noise without accounting for attenuation from existing physical barriers which have been estimated using the Federal Highway Administration's Roadway Construction Noise Model (RCNM). The nearest noise-sensitive receptors are residences located approximately 330 feet north of the property line and 470 feet from the center of construction activity. Additionally, the nearest commercial uses are located approximately 115 feet from the center of construction activity. Following the Federal Transit Administration (FTA) methodology, all equipment is assumed to operate at the center of the project site because equipment would operate throughout the site and not a fixed location for extended periods of time. It is also noted that FTA's construction threshold is an 8-hour L_{eq}, which accounts for the percentage of time each individual piece of equipment operates under full power in that period.

Table 5: Project Construction Noise Levels

Construction Phase	Receptor Location			Worst Case Modeled Exterior Noise Level (dBA L_{eq})	Noise Threshold (dBA L_{eq})	Exceeded?
	Land Use	Direction	Distance (feet)[1]			
Site Preparation	Residential	North	470	64.1	80	No
	Commercial	East	115	76.3	85	No
Grading	Residential	North	470	65.1	80	No
	Commercial	East	115	77.3	85	No
Building Construction	Residential	North	470	64.4	80	No
	Commercial	East	115	76.6	85	No
Paving	Residential	North	470	67.9	80	No
	Commercial	East	115	80.1	85	No
Architectural Coating	Residential	North	470	54.3	80	No
	Commercial	East	115	66.5	85	No

Notes:
1. In accordance with methodology from the FTA Noise and Vibration Manual, the equipment distance is assumed at the center of the project site.
2. Threshold from the FTA *Transit Noise and Vibration Impact Assessment Manual*, September 2018.

Source: Federal Highway Administration, *Roadway Construction Noise Model,* 2006. Refer to Appendix A: Noise Data for noise modeling results.

As depicted in Table 5, construction noise levels would range between 54.3 dBA L_{eq} and 67.9 dBA L_{eq} at the nearest residential uses to the north, and between 66.5 dBA L_{eq} and 80.1 dBA L_{eq} at the commercial (gas station) use to the east of the project site and would not exceed the FTA's construction noise thresholds for residential or commercial uses. Additionally, compliance with VMC Section 9.04.150 would minimize potential impacts from construction noise, as construction would be limited to the hours between 7:00 a.m. and 6:00 p.m. The City's permitted hours of construction are required in recognition that construction activities undertaken during daytime hours are a typical part of living in an urban environment and do not cause a significant impact. Because project construction noise levels would not exceed any applicable standards and would be required to comply with the City's allowable construction hours, construction noise impacts would be less than significant.

Operational Noise

On-Site Operations

The project proposes to operate a Raising Cane's restaurant with drive-thru access and an outdoor seating area. The primary noise sources associated with the proposed Raising Cane's restaurant would consist of drive-thru operations (i.e., sound from the ordering intercom and vehicles idling/queuing in the drive-thru lanes), parking lot noise, outdoor dining, mechanical equipment, and truck deliveries. A discussion of each of these project noise sources is provided below.

Drive-Thru Operations

The project would include two drive-thru menu boards and intercoms located in the southern portion of the project site, west of the restaurant building and adjacent to Roy Rogers Drive. Project noise sources

from drive-thru operations include amplified speech from the intercom, idling vehicles, vehicles circulating along the drive-thru lanes. The measured noise level associated with active drive-thru operations is 64 dBA at a distance of 20 feet.[1] The closest sensitive receptors to the project site are the single-family residences located approximately 560 feet from the closest menu board and intercom, and approximately 480 feet from the drive-thru lane/queuing area.

Parking Lot Noise

Traffic associated with parking lots is typically not of sufficient volume to exceed community noise standards, which are based on a time-averaged scale such as the one-hour L_{eq} and CNEL scales. The instantaneous maximum sound levels generated by a car door slamming, engine starting up, and car pass-bys range from 53 to 61 dBA[2] and may be an annoyance to nearby noise-sensitive receptors. Conversations in parking areas may also be an annoyance to nearby sensitive receptors. Sound levels of speech typically range from 33 dBA at 50 feet for normal speech to 50 dBA at 50 feet for very loud speech.[3] Parking lot noise would occur at the proposed surface parking lot as close as approximately 330 feet from the multi-family residences to the north of the project site.

Outdoor Dining Noise

The project would include an outdoor dining area on the northern façade of the proposed Raising Cane's restaurant. The outdoor dining area would be used by individuals or small groups to gather outside for a meal and may include low-level background music. Outdoor dining areas with music can generate noise levels up to approximately 82 dBA at one meter from the source.[4] The nearest sensitive receptors (multi-family residences to the north) would be located approximately 485 feet from the outdoor dining area of the proposed restaurant.

Mechanical Equipment

The project would include HVAC units located on the rooftop of the restaurant building. Mechanical equipment (e.g., HVAC equipment) typically generates noise levels of approximately 52 dBA at 50 feet.[5] The nearest sensitive receptors (multi-family residences to the north) would be located approximately 530 feet from the proposed rooftop HVAC equipment.

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1 Drive-thru noise sample collected at Raising Cane's restaurant by Kimley-Horn on August 17, 2018.
2 Kariel, H. G., *Noise in Rural Recreational Environments*, Canadian Acoustics 19(5), 3-10, 1991.
3 Elliott H. Berger, Rick Neitzel1, and Cynthia A. Kladden. *Noise Navigator Sound Level Database with Over 1700 Measurement Values*, June 26, 2015.
4 Obtained from the SoundPLAN Essential version 5.1 reference noise level database.
5 Elliott H. Berger, Rick Neitzel, and Cynthia A. Kladden, *Noise Navigator Sound Level Database with Over 1700 Measurement Values*, June 26, 2015.

Combined Exterior Noise Levels

Exterior noise levels associated with drive-thru operations, parking lot noise, outdoor dining, and mechanical equipment were modeled with the SoundPLAN software. SoundPLAN allows computer simulations of noise situations, and creates noise contour maps using reference noise levels, topography, point and area noise sources, mobile noise sources, and intervening walls and structures. Inputs to the SoundPLAN model included ground topography and ground type, noise source locations and heights, receiver locations, sound power level data. The SoundPLAN run for project operations conservatively assumes the simultaneous operation of all on-site noise sources.

Utilizing the input data described above, SoundPLAN was used to calculate noise levels at the nearest properties surrounding the project site. It should be noted that predicted noise levels are conservative estimates since it was assumed that all equipment and operational activity at the project site would occur in a constant, simultaneous manner. In reality, it is anticipated that these noise sources would occur intermittently throughout the day and night (except for rooftop HVAC which would operate in a steady-state manner). The modeled noise levels for the project are provided in Table 6: Project Operational Noise Levels and Figure 2: Operational Noise Contours.

Table 6: Project Operational Noise Levels

Receptor No.[1]	Land Use	Modeled Noise Level (dBA L_{eq})	Daytime Noise Standard (dBA)	Exceeds Standard?	Nighttime Noise Standard (dBA)	Exceeds Standard?
1	Residential	36.0	65	No	55	No
2	Residential	38.7	65	No	55	No
3	Residential	39.7	65	No	55	No
4	Residential	40.4	65	No	55	No
5	Residential	41.1	65	No	55	No
6	Residential	41.5	65	No	55	No
7	Residential	41.6	65	No	55	No
8	Residential	41.2	65	No	55	No
9	Residential	32.0	65	No	55	No
10	Residential	31.9	65	No	55	No
11	Residential	32.3	65	No	55	No
12	Residential	31.3	65	No	55	No
13	Residential	33.0	65	No	55	No
14	Commercial	56.0	70	No	70	No
15	Commercial	57.8	70	No	70	No
16	Commercial	58.7	70	No	70	No
17	Commercial	58.8	70	No	70	No
18	Commercial	57.4	70	No	70	No
19	Commercial	57.2	70	No	70	No
20	Commercial	56.0	70	No	70	No
21	Commercial	47.1	70	No	70	No
22	Commercial	51.1	70	No	70	No
23	Commercial	51.8	70	No	70	No
24	Commercial	45.6	70	No	70	No

Table 6: Project Operational Noise Levels						
Receptor No.[1]	**Land Use**	**Modeled Noise Level (dBA L_{eq})**	**Daytime Noise Standard (dBA)**	**Exceeds Standard?**	**Nighttime Noise Standard (dBA)**	**Exceeds Standard?**
25	Commercial	36.7	70	No	70	No
26	Commercial	38.0	70	No	70	No
27	Commercial	41.8	70	No	70	No
28	Commercial	40.0	70	No	70	No
Notes: 1. Receptor locations are provided in Appendix A.						
Source: SoundPLAN version 5.1. See Appendix A for noise modeling data and results.						

As shown in Table 6, project-generated noise levels would range from approximately 31.3 dBA L_{eq} to 41.6 dBA L_{eq} at the nearest residential uses, and between 36.7 dBA L_{eq} and 58.8 dBA L_{eq} at the nearest commercial uses and would not exceed the City's daytime or nighttime noise standards. As such, project noise levels from standard operations would result in a less than significant impact.

Truck Delivery Back-Up Alarms

The project would also include infrequent truck deliveries to the restaurant for goods replenishment. Medium and heavy-duty trucks reversing into the on-site loading area would produce noise from back-up alarms (also known as back-up beepers). Back-up beepers produce a typical volume of 97 dBA at one meter from the source.[6] The nearest sensitive receptors (multi-family residences) would be located as close as approximately 460 feet north of truck delivery activities. Truck delivery noise was modeled in SoundPLAN, and the results are provided in Table 7: Truck Delivery Noise Levels. Truck delivery noise was not included in the combined noise modeling and analysis above as truck deliveries would be infrequent and would generally not occur during the restaurant's operational hours (9:00 a.m. to 3:30 a.m.).

As shown in Table 7, truck delivery noise levels would range from approximately 38.4 dBA L_{eq} to 54.4 dBA L_{eq} at the nearest residential uses, and between 44.5 dBA L_{eq} and 66.3 dBA L_{eq} at the nearest commercial uses and would not exceed the City's daytime or nighttime noise standards. It is also noted that on-site truck movements and the use of backup beepers would be short in duration (ranging from approximately 30 seconds to one minute), and thus, the exposure of temporary noise levels at the nearest sensitive receptors would be limited. As such, truck delivery noise levels from the proposed project would be less than significant.

[6] Environmental Health Perspectives, *Vehicle Motion Alarms: Necessity, Noise Pollution, or Both?* https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3018517/, accessed April 2024.

Figure 2: Operational Noise Contours

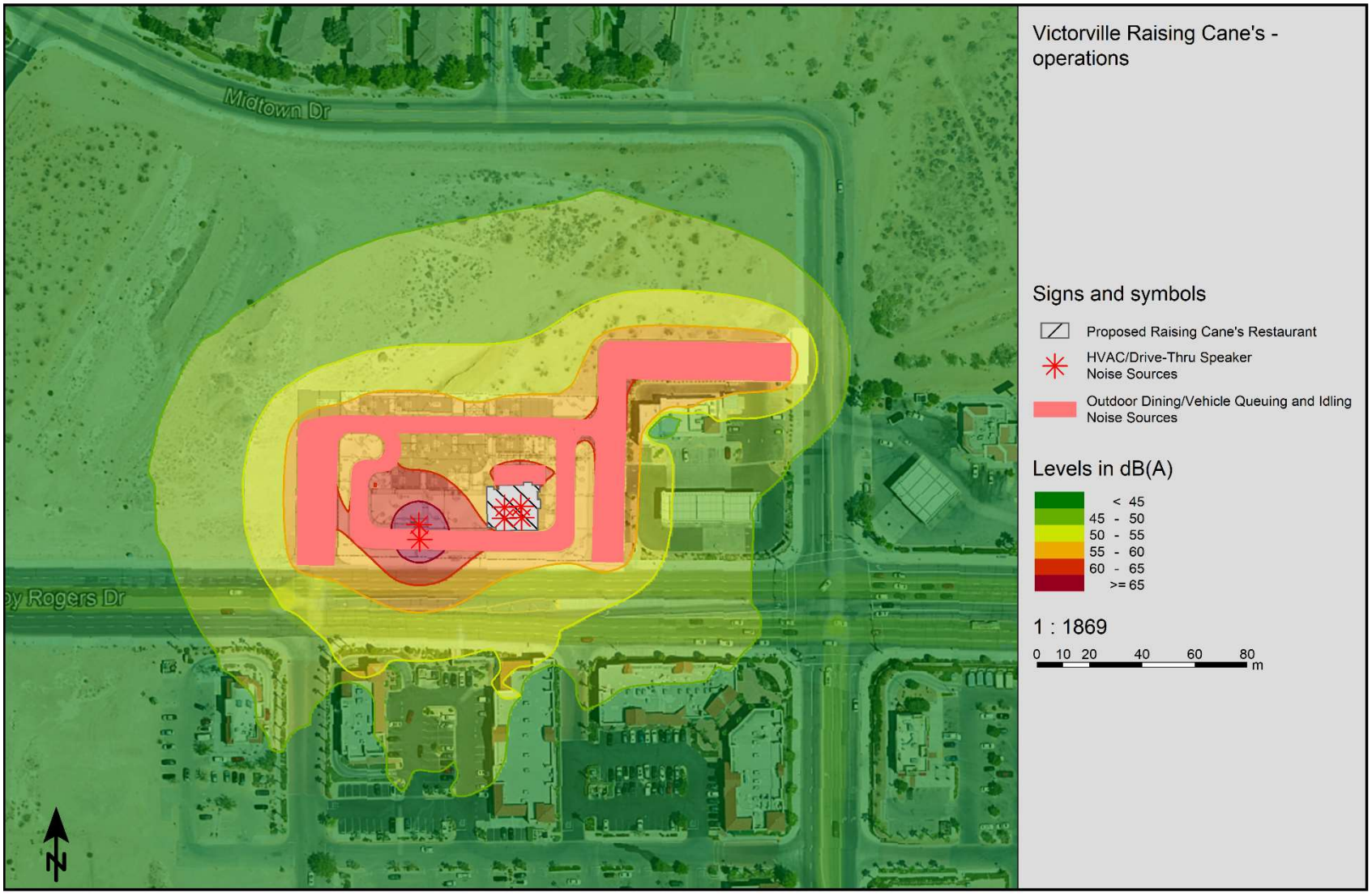

Table 7: Truck Delivery Noise Levels

Receptor No.[1]	Land Use	Modeled Noise Level (dBA L_{eq})	Daytime Noise Standard (dBA)	Exceeds Standard?	Nighttime Noise Standard (dBA)	Exceeds Standard?
1	Residential	44.2	65	No	55	No
2	Residential	49.0	65	No	55	No
3	Residential	52.1	65	No	55	No
4	Residential	53.1	65	No	55	No
5	Residential	53.9	65	No	55	No
6	Residential	54.4	65	No	55	No
7	Residential	52.7	65	No	55	No
8	Residential	52.0	65	No	55	No
9	Residential	43.4	65	No	55	No
10	Residential	42.8	65	No	55	No
11	Residential	40.0	65	No	55	No
12	Residential	38.4	65	No	55	No
13	Residential	44.4	65	No	55	No
14	Commercial	44.5	70	No	70	No
15	Commercial	52.9	70	No	70	No
16	Commercial	62.8	70	No	70	No
17	Commercial	66.3	70	No	70	No
18	Commercial	64.3	70	No	70	No
19	Commercial	63.0	70	No	70	No
20	Commercial	61.2	70	No	70	No
21	Commercial	57.9	70	No	70	No
22	Commercial	44.9	70	No	70	No
23	Commercial	50.5	70	No	70	No
24	Commercial	53.1	70	No	70	No
25	Commercial	45.6	70	No	70	No
26	Commercial	46.7	70	No	70	No
27	Commercial	52.9	70	No	70	No
28	Commercial	50.8	70	No	70	No

Notes:
1. Receptor locations are provided in Appendix A.

Source: SoundPLAN version 5.1. See Appendix A for noise modeling data and results.

Off-Site Traffic Noise

In general, a 3-dBA increase in traffic noise is barely perceptible to people, while a 5-dBA increase is readily noticeable. Traffic volumes on project area roadways would have to approximately double for the resulting traffic noise levels to generate a 3-dBA increase.[7] According to the project's Traffic Study (Kimley-Horn, 2024), the proposed restaurant would result in approximately 982 net new daily vehicle trips which is not enough to double the existing traffic volumes on Roy Rogers Drive (11,287 average daily traffic [ADT]) or Civic Drive (2,251 ADT).[8] Therefore, the proposed project would not generate enough traffic to result in a noticeable 3-dBA increase in ambient noise levels. Impacts would be less than significant in this regard.

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7 According to the California Department of Transportation, *Technical Noise Supplement to Traffic Noise Analysis Protocol* (September 2013), it takes a doubling of traffic to create a noticeable (i.e., 3 dBA) noise increase.

8 Replica HQ, *Victorville, CA Annual Average Daily Traffic (AADT)*, https://studio.replicahq.com/data/downloads/aadt, accessed April 2024.

Vibration Impacts

Increases in groundborne vibration levels attributable to the project would be primarily associated with short-term construction-related activities. Project construction would have the potential to result in varying degrees of temporary groundborne vibration, depending on the specific construction equipment used and the operations involved.

The FTA has published standard vibration velocities for construction equipment operations. In general, the FTA architectural damage criterion for continuous vibrations (i.e., 0.2 in/sec) appears to be conservative. The types of construction vibration impacts include human annoyance and building damage. Human annoyance occurs when construction vibration rises significantly above the threshold of human perception for extended periods of time. Building damage can be cosmetic or structural. Ordinary buildings that are not particularly fragile would not experience any cosmetic damage (e.g., plaster cracks) at distances beyond 30 feet. This distance can vary substantially depending on the soil composition and underground geological layer between vibration source and receiver. In addition, not all buildings respond similarly to vibration generated by construction equipment. For example, for a building that is constructed with reinforced concrete with no plaster, the FTA guidelines show that a vibration level of up to 0.50 in/sec is considered safe and would not result in any construction vibration damage. This evaluation uses the FTA architectural damage criterion for continuous vibrations at non-engineered timber and masonry buildings of 0.2 inch-per-second peak particle velocity (PPV) and human annoyance criterion of 0.4 inch-per-second PPV in accordance with Caltrans guidance.[9]

Table 8: Typical Construction Equipment Vibration Levels, lists vibration levels at 15 and 25 feet for typical construction equipment. Groundborne vibration generated by construction equipment spreads through the ground and diminishes in magnitude with increases in distance. As indicated in Table 8, based on FTA data, vibration velocities from typical heavy construction equipment operations that would be used during project construction range from 0.003 to 0.089 in/sec PPV at 25 feet and from 0.007 to 0.192 in/sec PPV at 15 feet from the source of activity.

[9] California Department of Transportation, *Transportation and Construction Vibration Guidance Manual, Table 20*, September 2013.

Table 8: Typical Construction Equipment Vibration Levels		
Equipment	**Peak Particle Velocity at 25 Feet (in/sec)**	**Peak Particle Velocity at 15 Feet (in/sec)[1]**
Large Bulldozer	0.089	0.192
Caisson Drilling	0.089	0.192
Loaded Trucks	0.076	0.164
Rock Breaker	0.059	0.127
Jackhammer	0.035	0.008
Small Bulldozer/Tractors	0.003	0.007
Notes: 1. Calculated using the following formula: $PPV_{equip} = PPV_{ref} \times (25/D)^{1.5}$, where: PPV_{equip} = the peak particle velocity in in/sec of the equipment adjusted for the distance; PPV_{ref} = the reference vibration level in in/sec from Table 7-4 of the Federal Transit Administration, *Transit Noise and Vibration Impact Assessment Manual*, 2018; D = the distance from the equipment to the receiver.		
Source: Federal Transit Administration, *Transit Noise and Vibration Impact Assessment Manual*, 2018.		

As shown in Table 8, at 15 feet (the closest distance to off-site structures that heavy construction equipment would be used during project construction) the vibration velocities from construction equipment would reach approximately 0.192 in/sec PPV, which is below the FTA's 0.20 in/sec PPV threshold for building damage and Caltrans' 0.4 in/sec PPV threshold for human annoyance. As indicated above, the use of heavy construction equipment would occur no closer than 15 feet from the nearest off-site buildings for build-up construction and would not create construction vibration impacts. Once operational, the project would not include vibration-generating uses or operations. Therefore, vibration impacts associated with the project would be less than significant.

Conclusion

Project implementation would result in less than significant short- and long-term noise and vibration impacts. No mitigation measures would be required. Therefore, the proposed project would not result in significant effects related to noise and vibration.

Appendix A

NOISE DATA

Project: **Victorville Raising Cane's**

Construction Noise Impact on Sensitive Receptors

Parameters

Construction Hours:	Daytime hours (7 am to 7 pm)	8
	Evening hours (7 pm to 10 pm)	0
	Nighttime hours (10 pm to 7 am)	0
Leq to L10 factor		3

	Receptor (Land Use)	Average Distance (feet)	Distance to Property Line (feet)	Shielding	Direction
1	Multi-family residential	470	470	0	N
2	Gas Station	115	115	0	E

						RECEPTOR 1		RECEPTOR 2	
Construction Phase	**Equipment Type**	**No. of Equip.**	**Acoustical Usage Factor**	**Reference Noise Level at 50ft per Unit, Lmax**	**Noise Level at Receptor 1, Lmax**	**Noise Level at Receptor 1, Leq**	**Noise Level at Receptor 2, Lmax**	**Noise Level at Receptor 2, Leq**
Site Preparation								
	grader	1	40%	85	65.5	61.6	77.8	73.8
	Tractor	1	40%	84	64.5	60.6	76.8	72.8
Combined LEQ						**64.1**		**76.3**
Grading								
	graders	1	40%	85	65.5	61.6	77.8	73.8
	dozer	1	40%	82	62.2	58.3	74.5	70.5
	tractor	1	40%	84	64.5	60.6	76.8	72.8
Combined LEQ						**65.1**		**77.3**
Building Construction								
	crane	1	16%	81	61.1	53.2	73.4	65.4
	forklift	2	40%	74	57.8	53.9	70.1	66.1
	tractor	2	40%	84	67.5	63.6	79.8	75.8
Combined LEQ						**64.4**		**76.6**
Paving								
	cement mixer	4	50%	83	69.6	66.5	81.8	78.8
	paver	1	50%	77	57.7	54.7	70.0	67.0
	tractor	1	40%	84	64.5	60.6	76.8	72.8
	roller	1	20%	80	60.5	53.5	72.8	65.8
Combined LEQ						**67.9**		**80.1**
Architectural Coating								
	Compressor (air)	1	40%	78	58.2	54.3	70.5	66.5
Combined LEQ						**54.3**		**66.5**

Source for Ref. Noise Levels: RCNM, 2005

Victorville Raising Cane's

Signs and symbols

Receiver

Receiver at building

1 : 3364

0 15 30 60 90 120

m

Receiver Results - Operations

No.	Receiver name	Building side	Floor	Limit Day	Limit Night	Level Day	Level Night	Conflict Day	Conflict Night
				dB(A)		dB(A)		dB	
1	1	South west	1.Fl	-	-	35.7	35.6	-	-
			2.Fl	-	-	36.0	35.9	-	-
2	2	South west	1.Fl	-	-	38.5	38.4	-	-
			2.Fl	-	-	38.7	38.6	-	-
3	3	South	1.Fl	-	-	39.5	39.4	-	-
			2.Fl	-	-	39.7	39.6	-	-
4	4	South	1.Fl	-	-	40.2	40.1	-	-
			2.Fl	-	-	40.4	40.3	-	-
5	5	South	1.Fl	-	-	40.9	40.7	-	-
			2.Fl	-	-	41.1	41.0	-	-
6	6	South	1.Fl	-	-	41.2	41.1	-	-
			2.Fl	-	-	41.5	41.3	-	-
7	7	South	1.Fl	-	-	41.4	41.2	-	-
			2.Fl	-	-	41.6	41.5	-	-
8	8	South	1.Fl	-	-	40.9	40.8	-	-
			2.Fl	-	-	41.2	41.1	-	-
9	9	-	1.Fl	-	-	32.0	31.9	-	-
10	10	-	1.Fl	-	-	31.9	31.8	-	-
11	11	-	1.Fl	-	-	32.3	32.2	-	-
12	12	-	1.Fl	-	-	31.3	31.3	-	-
13	13	-	1.Fl	-	-	33.0	33.0	-	-
14	14	-	1.Fl	-	-	56.0	56.0	-	-
15	15	-	1.Fl	-	-	57.8	57.8	-	-
16	16	-	1.Fl	-	-	58.7	58.7	-	-
17	17	-	1.Fl	-	-	58.8	58.8	-	-
18	18	-	1.Fl	-	-	57.4	57.4	-	-
19	19	-	1.Fl	-	-	57.2	57.2	-	-
20	20	-	1.Fl	-	-	56.0	56.0	-	-
21	21	-	1.Fl	-	-	47.1	47.1	-	-
22	22	-	1.Fl	-	-	51.1	51.0	-	-
23	23	-	1.Fl	-	-	51.8	51.8	-	-
24	24	-	1.Fl	-	-	45.6	45.6	-	-
25	25	-	1.Fl	-	-	36.7	36.7	-	-
26	26	-	1.Fl	-	-	38.0	37.9	-	-
27	27	-	1.Fl	-	-	41.8	41.7	-	-
28	28	-	1.Fl	-	-	40.0	40.0	-	-

Receiver Results - Delivery Trucks

No.	Receiver name	Building side	Floor	Limit Day	Limit Night	Level Day	Level Night	Conflict Day	Conflict Night
				dB(A)		dB(A)		dB	
1	1	South west	1.Fl	-	-	42.5	42.5	-	-
			2.Fl	-	-	44.2	44.2	-	-
2	2	South west	1.Fl	-	-	48.7	48.7	-	-
			2.Fl	-	-	49.0	49.0	-	-
3	3	South	1.Fl	-	-	51.8	51.8	-	-
			2.Fl	-	-	52.1	52.1	-	-
4	4	South	1.Fl	-	-	52.8	52.8	-	-
			2.Fl	-	-	53.1	53.1	-	-
5	5	South	1.Fl	-	-	53.6	53.6	-	-
			2.Fl	-	-	53.9	53.9	-	-
6	6	South	1.Fl	-	-	54.1	54.1	-	-
			2.Fl	-	-	54.4	54.4	-	-
7	7	South	1.Fl	-	-	52.3	52.3	-	-
			2.Fl	-	-	52.7	52.7	-	-
8	8	South	1.Fl	-	-	51.6	51.6	-	-
			2.Fl	-	-	52.0	52.0	-	-
9	9	-	1.Fl	-	-	43.4	43.4	-	-
10	10	-	1.Fl	-	-	42.8	42.8	-	-
11	11	-	1.Fl	-	-	40.0	40.0	-	-
12	12	-	1.Fl	-	-	38.4	38.4	-	-
13	13	-	1.Fl	-	-	44.4	44.4	-	-
14	14	-	1.Fl	-	-	44.5	44.5	-	-
15	15	-	1.Fl	-	-	52.9	52.9	-	-
16	16	-	1.Fl	-	-	62.8	62.8	-	-
17	17	-	1.Fl	-	-	66.3	66.3	-	-
18	18	-	1.Fl	-	-	64.3	64.3	-	-
19	19	-	1.Fl	-	-	63.0	63.0	-	-
20	20	-	1.Fl	-	-	61.2	61.2	-	-
21	21	-	1.Fl	-	-	57.9	57.9	-	-
22	22	-	1.Fl	-	-	44.9	44.9	-	-
23	23	-	1.Fl	-	-	50.5	50.5	-	-
24	24	-	1.Fl	-	-	53.1	53.1	-	-
25	25	-	1.Fl	-	-	45.6	45.6	-	-
26	26	-	1.Fl	-	-	46.7	46.7	-	-
27	27	-	1.Fl	-	-	52.9	52.9	-	-
28	28	-	1.Fl	-	-	50.8	50.8	-	-