Appendix F. Noise and Vibration Technical Memorandum

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Noise and Vibration Technical Memorandum

Anaheim Street and Walnut Avenue Development Project

City of Long Beach, California

May 2019

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Acronyms

CNEL	community noise equivalent level
dB	decibel
dBA	A-weighted decibel
FTA	Federal Transit Administration
LBMC	Long Beach Municipal Code
L_{dn}	day-night average sound level
L_{eq}	equivalent continuous sound level
L_{max}	maximum A-weighted sound level
PPV	peak particle velocity
project	Anaheim Street and Walnut Avenue Development Project
rms	root mean square
SF	square feet
VdB	root mean square velocity in decibels

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1 Introduction

1.1 Purpose of the Report

This Noise and Vibration Technical Memorandum was completed for the Anaheim Street and Walnut Avenue Development Project (project) to identify potential impacts on on-site and nearby sensitive land uses. Project construction and operational noise and vibration were calculated and compared with applicable laws, guidelines, and/or regulations.

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2 Project Location and Description

2.1 Project Location

The Anaheim Street and Walnut Avenue Development Project (project) site is approximately 1.54 acres and consists of seven parcels located between Hoffman Avenue and Walnut Avenue, south of East Anaheim Street, and north of East 11th Street in the central portion of the City of Long Beach (Figure 2-1). All parcels are currently vacant.

2.2 Project Description

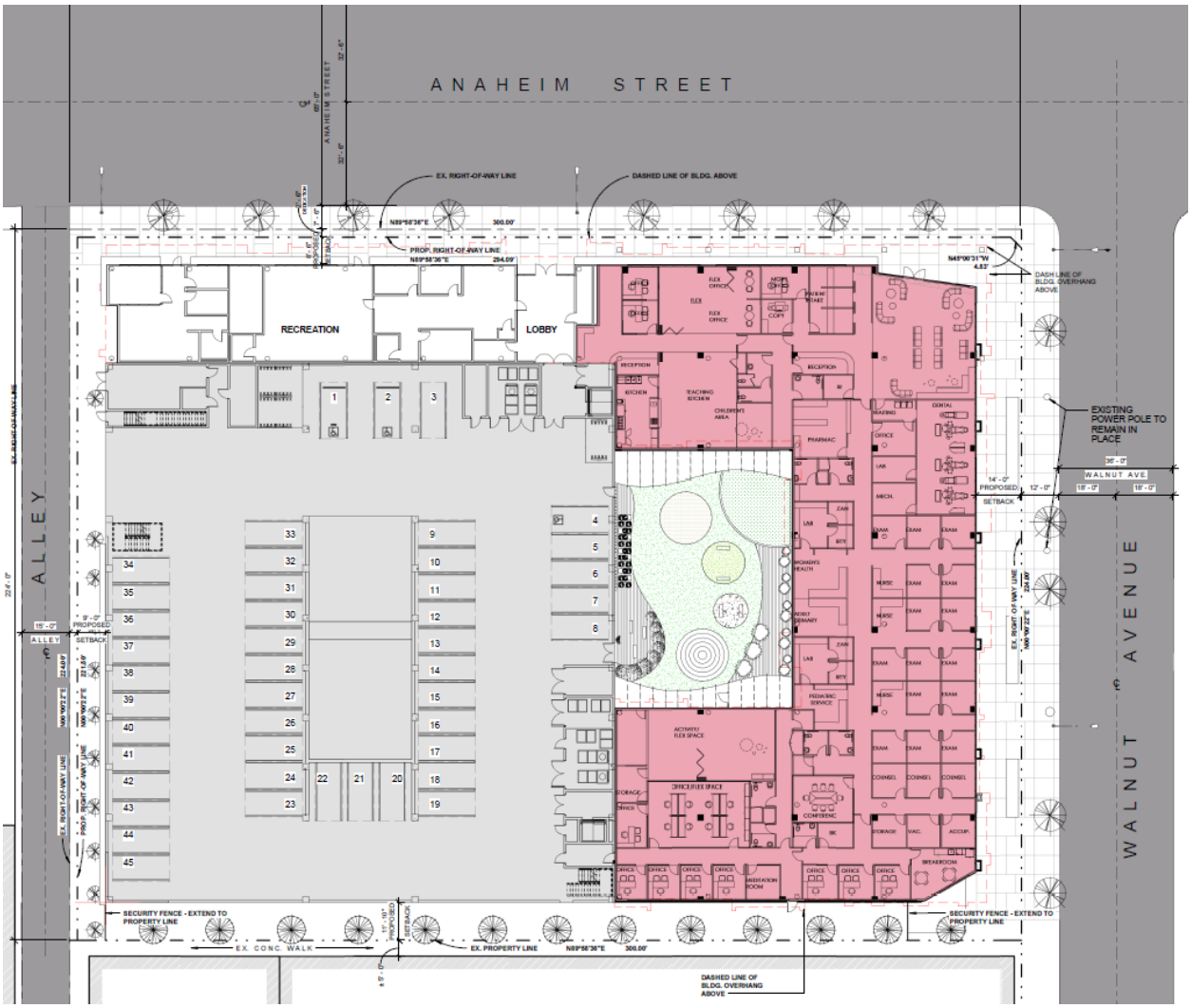
The project consists of a new 116,356-square-foot, mixed-use building that is approximately 61 feet above ground level (maximum five stories and 65 feet). The building includes an 88-unit, 5-story apartment building, with 93,656 square feet of residential space on levels two through five and 22,700 square feet on the street level with includes 18,136 square feet of medical clinic space, 1,100 square feet of commercial office space, 1,200 square feet of residential leasing office space, and 2,264 square feet of recreation and lobby space. The building also includes a 3-story, 156-stall parking structure with partial 4th floor outdoor terrace for a total of 116,356 square feet of building area and 81,903 square feet of parking garage, on a 1.54-acre site. The entrance for the parking structure would be on the west side of the property from an existing alley. The project consists of 100 percent affordable housing units. Units would include 1 bedroom (32 units), 2 bedroom (32 units), and 3 bedroom (24 unit) options.

Table 2-1 summarizes the key elements associated with the mixed-use building and attached parking structure. Figure 2-2 depicts the project site plan.

- The project requires the following entitlements and project approvals from City of Long Beach:
    - Zone change of three existing parcels and the northern portion of a large parcel on East Anaheim Street and one parcel on Walnut Avenue from CCP District to Community R-4-N Commercial (CCN) District.
    - Zone change of two existing parcels on Walnut Avenue and the southern portion of the large parcel on East Anaheim Street from R-2-N Two-family Residential to CCN.
    - Site plan review of a five-story, mixed-use building with a height of 60.2 feet and attached parking structure containing 116,356 square feet of building area and 81,903 square feet of parking space area.
    - Tentative Map for commercial or financing airspace subdivision (no individual residential condominiums).
    - Density bonus/development standards waiver/concessions, per California Government Code §65915 and §65915.7.
    - General Plan Amendment (Land Use District Map).

Figure 2-1. Regional Vicinity and Project Location

Figure 2-2. Project Site Plan



Source: BRIDGE Housing 2019

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Table 2-1. Anaheim Street and Walnut Avenue Development Project – Building and Site Characteristics

Project Element	Description		
Project Site Summary			
Project Address	1500 East Anaheim Street		
Lot Area	67,200 Square Feet		
Assessor Parcel Numbers	7267001900, 901, 902, 903, 904, 905, 906		
Zone	Existing: CCP/R-2-N / Proposed: CCN (HR-65/5)		
Project Summary			
Proposed Stories	Five stories		
Proposed Building Height	60 feet, 2 inches to top of parapet		
Setbacks	**Location**	**Required (over 45 feet tall)**	**Proposed**
	East Anaheim Street	20 feet, 0 inches (21.32.220.C)	8 feet, 6 inches minimum (Level 1) / 1 feet, 9 inches average setback*
	Walnut Avenue	20 feet, 0 inches (21.32.220.C)	14 feet (Level 1) / 9 feet, 3 inches average setback*
	Rear (South property line)	1/5 of building height, not to exceed 15% of lot depth (224 feet) (21.39.220.C)	11 feet, 10.5 inches (to stair) / 10 feet, 6 inches average setback
	Side (at alley on western property line)	(to centerline of alley)	9 feet average
	From Anaheim Street property line to 145 feet south	5 feet (21.39.220.C, 21.32.220)	10 feet, 6 inches average
	145 feet south of Anaheim Street to southwest corner	1/5 of building height, not to exceed 15% of lot width (300 feet) (21.32.200.C)	10 feet, 6 inches average
Proposed Building Area	**Level**	**Building Area (SF)**	**Additional Parking (SF)**
	1	22,700	27,301
	2	23,414	27,301

Table 2-1. Anaheim Street and Walnut Avenue Development Project – Building and Site Characteristics

Project Element	Description		
	3	23,414	27,301
	4	23,414	No parking above Level 3
	5	23,414	No parking above Level 3
	Total	**116,356**	**81,903**
Proposed Lot Coverage	40.18% (22,700 SF / 67,200 SF)		
Proposed Floor Area Ratio	1.73 (116,215 SF / 67,200 SF)		
Parking Summary			
Proposed Vehicular Spaces	156		
Proposed Bicycle Spaces	38		

Note:
* Setback compliance will be waived as a development standards concession under State density bonus law
CCP=Community Commercial Pedestrian-Oriented; CCN=to Community R-4-N Commercial; HR=High-Rise Overlay; SF=square feet

3 Acoustic and Vibration Terminology

3.1 Acoustic Terminology

Noise levels are presented on a logarithmic scale to account for the large pressure response range of the human ear and are expressed in units of decibels (dB). A decibel is defined as the ratio between a measured value and a reference value usually corresponding to the lower threshold of human hearing defined as 20 micropascals. Because the human ear does not perceive every frequency with equal loudness, sounds are often adjusted with a weighting filter. The A-weighted decibel (dBA) filter is applied to compensate for the frequency response of the human auditory system. An inherent property of the logarithmic decibel scale is that the sound pressure levels of two separate sources are not directly additive. For example, if a sound of 50 dBA is added to another sound of 50 dBA in the proximity, the result is a 3-decibel increase (or 53 dBA), not an arithmetic doubling to 100 dBA. With respect to how the human ear perceives changes in sound pressure level relative to changes in "loudness," scientific research demonstrates the following general relationships between sound level and human perception for two sound levels with the same or very similar frequency characteristics:

- One dBA is the practical limit of accuracy for sound measurement systems and corresponds to an approximate 10 percent variation in the sound pressure level. A 1 dBA increase or decrease is a non-perceptible change in sound.
- A 3-dBA increase or decrease is a doubling (or halving) of acoustic pressure level, and it corresponds to the threshold of change in loudness perceptible in a laboratory environment. In practice, the average person is not able to distinguish a 3-dBA difference in environmental sound outdoors.
- A 5-dBA increase or decrease is described as a perceptible change in sound level and is a discernible change in an outdoor environment.
- A 10-dBA increase or decrease is a tenfold increase or decrease in acoustic pressure level but is perceived as a doubling or halving in loudness (i.e., the average person will judge a 10-dBA change in sound level to be twice or half as loud).

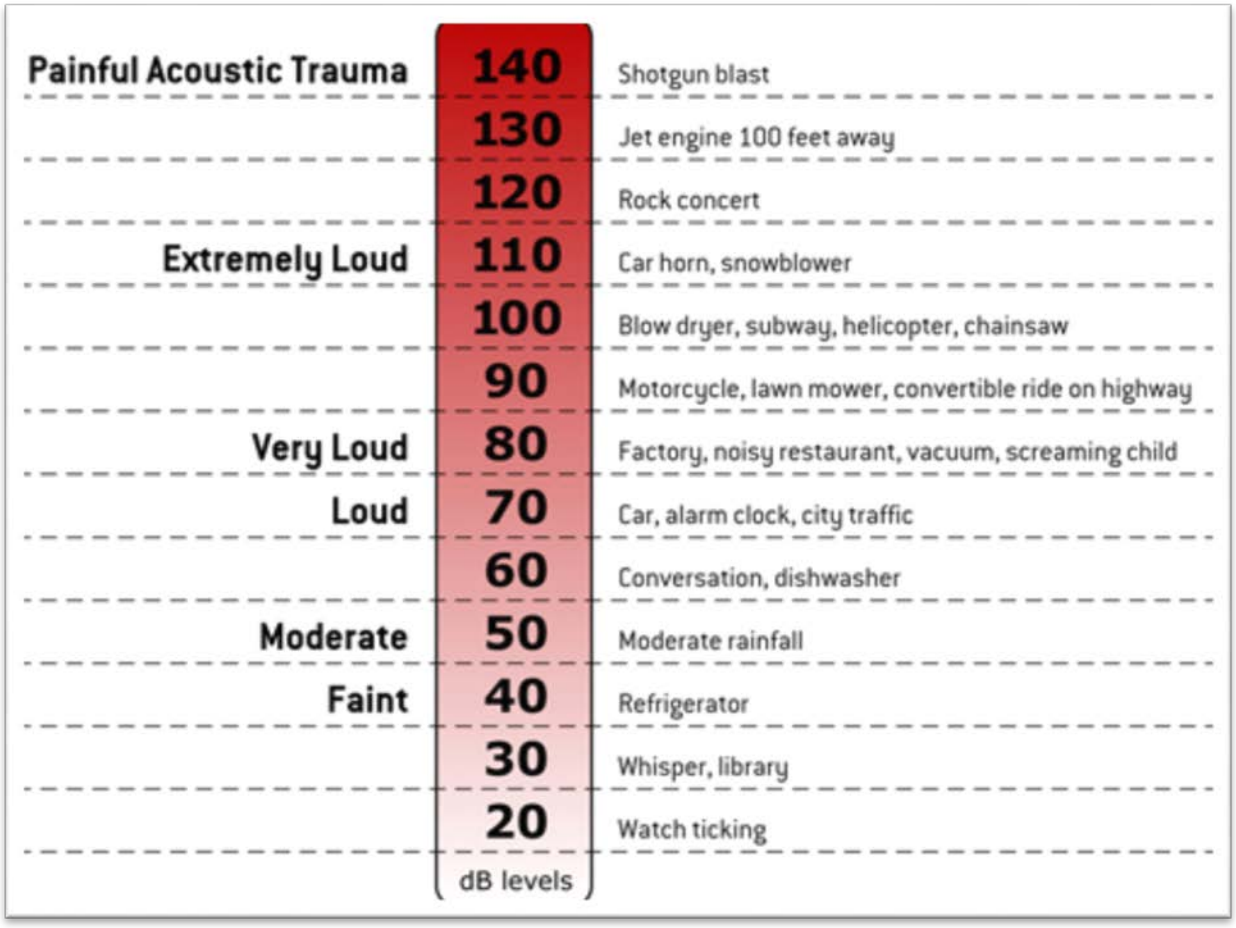
Estimations of common noise sources and outdoor acoustic environments, and the comparison of relative loudness are presented on Figure 3-1.

Noise levels can be measured, modeled, and presented in various formats. The noise metrics that were employed in this analysis have the following definitions:

- ***L_{eq}:*** Conventionally expressed in dBA, the L_{eq} is the equivalent continuous sound level over a specified time period. It is defined as the steady, continuous sound level over a specified time, which has the same acoustic energy as the actual varying sound levels over the specified period. It is a mean average sound level.
- ***L_{max}:*** L_{max} is the maximum A-weighted sound level as determined during a specified measurement period. It can also be described as the maximum instantaneous sound pressure level generated by a piece of equipment or during a construction activity.
- ***L_{dn}:*** The L_{dn} is the day-night average sound level over a 24-hour period with a 10 dB penalty added to sound levels occurring during the evening hours (7:00 p.m. to 10:00 p.m.) to account for individuals' increased sensitivity to noise levels during nighttime hours.

- ***CNEL:*** Community noise equivalent level is another average A-weighted L_{eq} sound level measured over a 24-hour period; however, this noise scale is adjusted to account for some individuals' increased sensitivity to noise levels during the evening and nighttime hours. A CNEL noise measurement is obtained after adding 5 dB to sound levels occurring during evening hours (7:00 p.m. to 10:00 p.m.) and 10 dB to noise levels occurring during nighttime hours (10:00 p.m. to 7:00 a.m.).

Figure 3-1. Relative Loudness



3.2 Vibration Terminology

According to the Federal Transit Administration (FTA) Transit Noise and Vibration Impact Assessment Manual (FTA 2018), construction activities can be a source of ground-borne vibration. Activities such as pile driving and operation of heavy equipment may cause ground-borne vibration during project construction. Vibration is an oscillatory motion that can be described in terms of the displacement, velocity, or acceleration (FTA 2006). Velocity or acceleration is typically used to describe vibration. Two descriptors are frequently used when discussing quantification of vibration, the peak particle velocity (PPV) and the root mean square (rms):

- ***PPV:*** PPV is the maximum instantaneous positive or negative peak of the vibration signal (FTA 2006). The potential for damage to buildings due to construction-related vibration is evaluated using PPV.
- ***Rms:*** RMS is the square root of the average of the squared amplitude of the vibration signal, typically calculated over a 1-second period (FTA 2006). The potential to annoy humans due to construction-related vibration is evaluated using rms.

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4 Regulatory Setting

This section provides an overview of state and local regulations related to noise issues applicable to the project.

4.1 State

4.1.1 California Department of Health Services

Noise Guidelines

In 1987, the California Department of Health Services published guidelines for the noise element of local general plans (Office of Planning and Research 2003). These guidelines include a noise level/land use compatibility chart that categorizes various outdoor L_{dn} ranges up to four compatibility categories (normally acceptable, conditionally acceptable, normally unacceptable, and clearly unacceptable), depending on land use. For many land uses, the chart shows exterior L_{dn} ranges for two or more compatibility categories. The noise element guidelines chart identifies the normally acceptable range for low-density residential uses as less than 60 dBA, while the conditionally acceptable range is 60 to 70 dBA. The normally acceptable range for high-density residential uses is identified as Ldn values below 65 dBA, while the conditionally acceptable range is identified as 65 to 70 dBA. For educational and medical facilities, L_{dn} values below 60 dB are considered normally acceptable, while Ldn values of 60 to 70 dBA are considered conditionally acceptable. For office and commercial land uses, L_{dn} values below 67.5 dBA are considered normally acceptable, while L_{dn} values of 67.5 to 77.5 dBA are categorized as conditionally acceptable.

These normally and conditionally acceptable L_{dn} ranges are intended to indicate that local conditions (existing noise levels and community attitudes toward dominant noise sources) should be considered in evaluating land use compatibility at specific locations. These guidelines are used by many agencies, environmental planners, and acoustical specialists as a starting point to evaluate the potential for noise impact on and by a project. The guidelines are also employed to evaluate methods for achieving noise compatibility with respect to nearby existing uses. Table 4-1 summarizes these guidelines for the normally and conditionally acceptable L_{dn} exposures.

Table 4-1. California Department of Health Services Noise Guidelines

Land Use Category	Community Noise Exposure (Ldn or CNEL, dBA)	
	Normally Acceptable	Conditionally Acceptable
Residential – Low Density	50 - 60	60 - 70
Residential – High Density	50 - 65	65 - 70
Transient Lodging – Motels, Hotels	50 - 65	65 – 70
Schools, Libraries, Churches, Hospitals, Nursing Homes	50 – 60	60 - 65
Auditoriums, Concert Halls, Amphitheaters	—	50 - 70
Sports Arenas, Outdoor Spectator Sports	—	50 - 75

Table 4-1. California Department of Health Services Noise Guidelines

Land Use Category	Community Noise Exposure (Ldn or CNEL, dBA)	
	Normally Acceptable	Conditionally Acceptable
Playgrounds, Neighborhood Parks	50 – 67.5	—
Golf Courses, Riding Stables, Water Recreation, Cemeteries	50 - 70	—
Office Buildings, Business Commercial and Professional	50 – 67.5	67.5 – 77.5
Industrial, Manufacturing, Utilities, Agriculture	50 - 70	70 - 80

Notes:
CNEL=community noise equivalent level; dBA=A-weighted decibel; L_{dn}=average hourly noise level

4.1.2 California Environmental Quality Act

The California Environmental Quality Act requires that significant environmental impacts be identified and that such impacts be eliminated or mitigated to the extent feasible. Appendix G of the *California Environmental Quality Act Statutes and Guidelines* (Office of Planning and Research and the Natural Resources Agency 2019) sets forth a series of suggested thresholds for determining a potentially significant impact. Under the thresholds suggested in Appendix G, a project could be considered to have significant noise and vibration impacts if it results in one or more of the following:

- Generation of a substantial temporary or permanent increase in ambient noise levels in the vicinity of the project in excess of standards established in the local general plan or noise ordinance, or applicable standards of other agencies
- Generation of excessive groundborne vibration or groundborne noise levels
- For a project located within the vicinity of a private airstrip or an airport land use plan or, where such a plan has not been adopted, within 2 miles of a public airport or public use airport, would the project expose people residing or working in the project area to excessive noise levels

4.2 City of Long Beach Noise Standards

4.2.1 Noise Element of the General Plan

The goals and policies contained in the *City of Long Beach General Plan* Noise Element address noise in relation to land use planning, the noise environment, transportation noise, construction and industrial noise, population and housing noise, and public health and safety (City of Long Beach 1975). Table 4-2 summarizes the criteria for sensitive receivers.

Table 4-2. Recommended Criteria for Maximum Acceptable Noise Levels (A-weighted Decibels)

Major Land Use Type	Outdoor			Indoor
	Maximum Single Hourly Peak	L10	L50	L_{dn}
Residential (7 a.m. to 10 p.m.)	70	55	45	45
Residential (10 p.m. to 7 a.m.)	60	45	35	35
Commercial (anytime)	75	65	55	—
Industrial (anytime)	85	70	60	—

Notes:
L10=noise level exceeded 10 percent of the time during a stated period; L50=median noise level; L_{dn}=average hourly noise level

4.2.2 Municipal Code

Chapter 8.80, Noise, of the Long Beach Municipal Code (LBMC) establishes exterior and interior noise limits for the generation of sound within the City of Long Beach. The maximum noise levels vary based on the receiving land use type and the cumulative duration of noise.

Exterior Noise Limits

Section 8.80.150 of the LBMC establishes the exterior noise limits by receiving land use. Table 4-3 summarizes the exterior noise limits.

No person shall operate or cause to be operated any source of sound at any location within the incorporated limits of the city or allow the creation of any noise on property owned, leased, occupied, or otherwise controlled by such person, which causes the noise level when measured from any other property, either incorporated or unincorporated, to exceed:

1. The noise standard for that land use district as specified in Table 4-3 for a cumulative period of more than 30 minutes in any hour; or
2. The noise standard plus 5 decibels for a cumulative period of more than 15 minutes in any hour; or
3. The noise standard plus 10 decibels for a cumulative period of more than 5 minutes in any hour; or
4. The noise standard plus 15 decibels for a cumulative period of more than 1 minute in any hour; or
5. The noise standard plus 20 decibels or the maximum measured ambient, for any period of time.

Table 4-3. Exterior Noise Limits

Receiving Land Use District	Time Period	Noise Level (dBA)	L_{max} (dBA)
District One	Night (10 p.m. to 7 a.m.)	45	65
	Day (7 a.m. to 10 p.m.)	50	70
District Two	Night (10 p.m. to 7 a.m.)	55	75
	Day (7 a.m. to 10 p.m.)	60	80
District Three	Any time	65	85
District Four	Any time	70	90
District Five	Regulated by other agencies and laws		

Notes:
District One: Predominantly residential with other land use types also present
District Two: Predominantly commercial with other land use types also present
District Three and Four: Predominantly industrial with other land use types also present
District Five: Airports, freeways, and waterways regulated by other agencies
District Three and Four limits are intended primarily for use at their boundaries rather than for noise control within those districts
dBA=A-weighted decibel; L_{max}= maximum A-weighted sound level

Interior Noise Limits

Section 8.80.170 of the LBMC establishes the interior noise limits by receiving land use. Table 4-4 summarizes the interior noise limits.

Table 4-4. Interior Noise Limits

Receiving Land Use District	Type of Land Use	Time Interval	Allowable Interior Noise Level (dBA)
All	Residential	10 p.m. to 7 a.m. 7 a.m. to 10 p.m.	35 45
All	School	7 a.m. to 10 p.m. (while school is in session	45
Hospital, designated quiet zones, and noise sensitive zones	—	Any time	40

Notes:
dBA=A-weighted decibel

No person shall operate, or cause to be operated, any source of sound indoors at any location within the incorporated limits of the city or allow the creation of any indoor noise which causes the noise level when measured inside the receiving dwelling unit to exceed:

1. The noise standard for that land use district, as specified in Table 4-4, for a cumulative period of more than 5 minutes in any hour; or
2. The noise standard plus 5 dB for a cumulative period of more than 1 minute in any hour; or
3. The noise standard plus 10 dB or the maximum measured ambient, for any period of time.

Construction Noise Limits

Section 8.80.202 of the LBMC restricts construction activities to weekdays between 7:00 a.m. and 7:00 p.m. and Saturdays between 9:00 a.m. and 6:00 p.m., except for emergency work. Construction work on Sundays is prohibited unless the City of Long Beach's Noise Control Officer issues a permit. The permit may allow work on Sundays between 9:00 a.m. and 6:00 p.m.

Loading and Unloading Noise Limits

Section 8.80.200(E) of the LBMC states that loading, unloading, opening, closing, or other handling of boxes, crates, containers, building materials, garbage cans, or similar objects between 10:00 p.m. and 7:00 a.m. is restricted to the noise level provisions of exterior noise limits shown in Table 4-3 and the interior noise limits shown in Table 4-4.

4.3 Vibration

4.3.1 Vibration Annoyance

Ground-borne noise is the vibration of floors and walls that may cause rattling of items, such as windows or dishes on shelves, or a rumbling noise. The rumbling is created by the motion of the room surfaces, which act as a giant loudspeaker. FTA provides criteria for acceptable levels of ground-borne vibration based on the relative perception of a vibration event for vibration-sensitive land uses (Table 4-5).

Table 4-5. Ground-borne Vibration and Noise Impact Criteria – Human Annoyance

Land Use Category	Max Lv (VdB)[1]	Description
Workshop	90	Distinctly felt vibration. Appropriate to workshops and non-sensitive areas.
Office	84	Felt vibration. Appropriate to offices and non-sensitive areas.
Residential – daytime	78	Barely felt vibration. Adequate for computer equipment.
Residential – nighttime	72	Vibration not felt, but ground-borne noise may be audible inside quiet rooms.

Notes:
[1] As measured in 1/3-octave bands of frequency over the frequency ranges of 8 to 80 Hertz
Lv=vibration level; VdB=RMS velocity in decibels

4.3.2 Vibration-related Structural Damage

The level at which ground-borne vibration is strong enough to cause structural damage has not been determined conclusively. The most conservative estimates are reflected in the FTA standards, shown in Table 4-6. Vibration-related problems generally occur due to resonances in the structural components of a building. The maximum vibration amplitudes of the floors and walls of a building will often be at the resonance frequencies of various components of the building. That is, structures amplify ground-borne vibration. Wood-frame buildings, such as typical residential structures, are more easily excited by ground vibration than heavier buildings. According to *Transportation Related Earthborne Vibration* (California Department of Transportation 2002), extreme care must be taken when sustained

pile driving occurs within 25 feet of any building, the threshold at which there is a risk of architectural damage to normal houses with plastered walls and ceilings is 0.2 inch per second.

Table 4-6. Ground-borne Vibration and Noise Impact Criteria – Structural Damage

Building Category	PPV (inch/second)[1]	VdB
I. Reinforced concrete, steel, or timber (no plaster)	0.5	102
II. Engineered concrete and masonry (no plaster)	0.3	98
III. Nonengineered timber and masonry buildings	0.2	94
IV. Buildings extremely susceptible to vibration damage	0.12	90

Notes:
[1] RMS velocity calculated from vibration level (VdB) using the reference of 1 microinch/second
PPV=peak particle velocity; VdB=RMS velocity calculated from vibration level

5 Existing Conditions

5.1 Sensitive Land Uses

Certain land uses are considered more sensitive to noise than others. Examples of these types of land uses include residential areas, educational facilities, hospitals, childcare facilities, and senior housing. The project site is located in an urban area. The closest sensitive receptor to the project site is the short-term healthcare facility located on the southern property line. The closest residences to the project site are located 15-20 feet to the west across the existing alley.

5.2 Overview of the Existing Noise Environment

The primary existing noise sources in the project area are transportation facilities. Traffic on Anaheim Street and Walnut Avenue is the dominant source contributing to area ambient noise levels. Noise from motor vehicles is generated by engine vibrations, the interaction between the tires and the road, and the exhaust system.

5.3 Existing Traffic Noise Levels

The primary existing noise source in the project area is traffic on the local roadways. The Federal Highway Administration (FHWA) highway traffic noise prediction model (FHWA RD-77-108) was used to evaluate highway traffic-related noise conditions along the roadway segments in the project vicinity. Existing traffic volumes included in the traffic study prepared for the project (Translutions 2019) were used to assess the existing traffic noise levels. A typical vehicle mix for Southern California was used. Table 5-1 provides the traffic noise levels along the roadways adjacent to the project site under the existing conditions. These noise levels represent the worst-case scenario, which assumes that no shielding is provided between the traffic and the location where the noise contours are drawn. The specific assumptions used in developing these noise levels and model printouts are provided in Appendix A.

Table 5-1. Existing Traffic Volumes

Roadway Segment	Average Daily Traffic	Centerline to 70 CNEL (feet)	Centerline to 65 CNEL (feet)	Centerline to 60 CNEL (feet)	CNEL (dBA) 50 feet from Centerline of Outermost Lane
Anaheim Street between Alamitos Avenue and Orange Avenue	24,520	54.8	173.2	547.8	69.0
Anaheim Street between Orange Avenue and Gundry Court	24,290	54.3	171.6	542.7	69.0
Anaheim Street between Gundry Court and Peterson Avenue	24,950	55.7	176.3	557.4	69.1
Anaheim Street between Peterson Avenue and Walnut Avenue	24,630	55.0	174.0	550.3	69.1

Table 5-1. Existing Traffic Volumes

Roadway Segment	Average Daily Traffic	Centerline to 70 CNEL (feet)	Centerline to 65 CNEL (feet)	Centerline to 60 CNEL (feet)	CNEL (dBA) 50 feet from Centerline of Outermost Lane
Anaheim Street east of Walnut Avenue	24,550	54.8	173.4	548.5	69.0
Walnut Avenue North of Anaheim Street	3,840	<50	<50	61.9	60.4
Walnut Avenue South of Anaheim Street	3,840	<50	<50	61.9	60.4

Notes:
CNEL=community noise equivalent level; dBA=A-weighted decibels

6 Noise and Vibration Impact Analysis

Noise generated by the project would consist of (1) short duration noise resulting from construction activities and (2) long-term noise from on-site stationary sources and off-site traffic noise from vehicles operated by employees using the proposed industrial buildings. Vibration from the project would only result during construction. Construction activities would take place only during daytime hours. An evaluation was performed of anticipated noise and vibration levels compared to regulatory requirements.

Airborne noise dissipates with increasing distance from the noise source. The distances involved depend primarily on the intensity of the noise generated by the source, terrain, and ground cover between source and receiver, as well as weather conditions, such as wind speed and direction, the height and strength of temperature inversions, and the height of cloud cover. Temperature inversions and cloud cover can reflect or refract sound that is radiated upward; this effect can increase noise levels at locations that receive the reflected or refracted sound. Such reflection and refraction effects are important primarily for high intensity sounds and the calculation of sound propagation over large distances. For noise sources such as construction activity and vehicle traffic, the region of influence is typically less than 0.5 mile from the noise source. Temperature inversions and cloud cover are not accounted for in this analysis.

The region of interest for noise and vibration issues is typically localized. Ground-borne vibrations generally attenuate rapidly with increasing distance from the vibration source. The distances involved depend primarily on the intensity of the vibrations generated by the source, as well as soil and geologic conditions. Detectable vibrations will travel the greatest distance through solid rock and the least distance through loose, unconsolidated soils or saturated soils. For vibration sources such as construction activity and vehicle traffic, the region of influence is typically less than 1,000 feet from the vibration source.

6.1 Construction

6.1.1 Noise

Construction noise, although temporary, can potentially affect nearby sensitive receptors, such as residences closest to the project site. Project construction would require the use of heavy equipment that may be periodically audible at off-site locations. Received noise levels would fluctuate, depending on the construction activity, equipment type, and distance between noise source and receiver. Additionally, noise from construction equipment would vary dependent on the construction phase and the number and type of equipment at a location at any given time. For the purposes of the air quality/greenhouse gas evaluation, the project is divided into five phases of construction consistent with the CalEEMod:

1. Site preparation
2. Grading
3. Building construction
4. Paving
5. Architectural coating

The variation in power and usage of the various construction equipment types creates complexity in characterizing construction noise levels. Expected equipment types for each phase of construction are presented in Table 6-1 and were used to screen for potential construction noise impacts. Each phase identified would require different types of construction equipment. The estimated composite site noise level is based on the assumption that all equipment would operate at a given usage load factor, for a given hour (i.e., front end loaders are assumed to be used for up to 40 percent of 1 hour, or 24 minutes), to calculate the composite average daytime hourly L_{eq}. The load factor accounts for the fraction of time that the equipment is in use over the specified time period. The composite noise level from several pieces of equipment operating during the same phase is obtained from decibel addition of the L_{eq} of each individual unit. Although it is not possible for all the construction equipment to operate at one point simultaneously, the screening level analysis represented in Table 6-1 conservatively assumes concurrent operation of equipment in the same location.

The closest sensitive receptor to the project site is the short-term healthcare facility located on the southern property line. At its closest point, the construction activity would be located within 50 feet of this land use. The average distance from the construction activities on the project site to these sensitive land uses on a daily basis is approximately 125 feet. Construction noise would attenuate with increased distance from the noise sources.

Maximum noise levels at 50 feet and composite L_{eq} noise levels at 125 feet represented in Table 6-1 were evaluated assuming spherical free-field spreading. As a general construction practice, functional mufflers are anticipated to be maintained on all equipment to attenuate noise levels as low as reasonably achievable. As shown in Table 6-1, during the loudest construction phase, the maximum noise level is projected to be 85.0 dBA L_{max}, and the average level is projected to be 75.5 dBA L_{eq}.

Compliance with the City of Long Beach's Noise Ordinance would ensure construction noise impacts are reduced to the greatest extent feasible. Although construction noise would be higher than the ambient noise in the project vicinity, construction noise would cease to occur once project construction is complete.

Traffic noise associated with project construction is not anticipated to be a significant source of noise. Traffic noise is not greatly influenced by lower levels of traffic, such as those associated with the project's construction effort. For example, traffic levels would have to double for traffic noise on adjacent roadways to increase by 3 dBA. The project's construction traffic on adjacent roadways would increase hourly traffic volumes by much less than a factor of two; therefore, the increase in construction related traffic noise would be less than 3 dBA and is not significant.

Table 6-1. Project Construction Noise Levels by Phase

Phase	Equipment[1]			Composite Sound Level[3]	
	Type	Quantity	L_{max} at 50 feet[2]	L_{max} at 50 feet[2]	L_{eq} at 125 feet
Site preparation	Grader	1	85.0	85.0	75.4
	Dozer	1	81.7		
	Loader	1	79.1		
Grading	Grader	1	85.0	85.0	75.4
	Dozer	1	81.7		
	Loader	1	79.1		
Building construction	Crane	2	80.6	80.6	75.5
	Forklift	1	74.7		
	Generator	2	80.6		
	Loader	1	79.1		
	Welder	3	74.0		
Paving	Mixers	1	78.8	80.0	73.4
	Paver	1	77.2		
	Paving equipment	1	77.2		
	Roller	1	80.0		
	Loader	1	79.1		
Architectural coating	Compressor	2	80.6	80.6	68.7

Notes:

[1] Equipment mix obtained from the CalEEMod emission calculations prepared for the project (HDR 2019).

[2] Measured L_{max} at given reference distance obtained from the 2006 FHWA Roadway Construction Noise Model.

[3] Distance factor determined by the inverse square law defined as 6 dBA per doubling of distance as sound travels away from an idealized point.

L_{eq}=equivalent continuous sound level; L_{max}=maximum A-weighted sound level

6.1.2 Vibration

Construction activities generate ground-borne vibration when heavy equipment travels over unpaved surfaces or when it is engaged in soil movement. The effects of ground-borne vibration include discernable movement of building floors, rattling of windows, shaking of items on shelves or hanging on walls, and rumbling sounds. Vibration-related problems generally occur due to resonances in the structural components of a building because structures amplify ground-borne vibration.

Table 6-2 lists the vibration source amplitudes for construction equipment. As pile driving is not required, the highest reference PPV for the proposed project would be 0.210 inches per second (in/sec) associated with on-site vibration rollers.

Table 6-2. Vibration Source Amplitudes for Construction Equipment

Equipment	PPV at 25 feet (inch/second)	Approximate Lv[1] at 25 feet (VdB)
Pile driver (impact) – upper range	1.518	112
Pile driver (impact) – typical	0.644	104
Pile drive (sonic) – upper range	0.734	105
Pile drive (sonic) – typical	0.170	93
Clam shovel drop (slurry wall)	0.202	94
Hydromill (slurry wall) – in soil	0.008	66
Hydromill (slurry wall) – in rock	0.017	75
Vibratory roller	0.210	94
Hoe ram	0.089	87
Large bulldozer	0.089	87
Caisson drilling	0.089	87
Loaded trucks	0.076	86
Jackhammer	0.035	79
Small bulldozer	0.003	58

Source: FTA 2018
Notes:
[1] RMS velocity in decibels (VdB) re 1 micro-inch/second
Lv=vibration level; PPV=peak particle velocity; VdB=RMS velocity calculated from vibration level

The residential structures to the south of the project site will be located approximately 50 feet from project construction areas that would require the use of rollers. The FTA vibration guidance provides the following equation to calculate PPV at sensitive receptors:

$PPV_{equipment} = PPV_{Ref} (25/D)^n$ (in/sec)

Where:

PPVRef = reference PPV at 25 feet

D = distance from equipment to the receiver in feet

n = 1.5 is a value related to the vibration attenuation rate through ground

Distance attenuation would reduce the construction vibration levels from the proposed project to 0.074 in/sec. This level is much lower than the 0.12 in/sec threshold listed in Table 4-6 for buildings extremely susceptible to vibration damage.

For consideration of annoyance or interference with vibration-sensitive activities, the vibration level at any distance is calculated using the following formula:

$L_v(D) = L_v(25\ ft) – 30\log(D/25)$

Where:

Lv(D) = Vibration level at distance D

D = distance from equipment to the receiver in feet

Lv(25 ft) = reference vibration level at 25 feet from source

At 50 feet the roller vibration level would be reduced from 94 to 85 VdB. This level would exceed FTA's daytime annoyance threshold of 78 VdB listed in Table 4-5. Compliance with the City's Noise Ordinance would ensure that construction vibration impacts are reduced to the greatest extent feasible and limited to daytime hours.

6.2 Operation

6.2.1 Long-term Traffic Noise Impacts

Project-related long-term vehicular trip increases are anticipated to be minimal when distributed to adjacent street segments. The FHWA highway traffic noise prediction model (FHWA RD-77-108) was used to evaluate highway traffic-related noise conditions along the roadway segments in the project vicinity. The typical vehicle mix for Southern California was used.

As discussed in Section 3, a 3-dBA increase or decrease is a doubling (or halving) of sound pressure level, and it corresponds to the threshold of change in loudness perceptible in a laboratory environment. In practice, the average person is not able to distinguish a 3-dBA difference in environmental sound outdoors. An increase of 3-dBA is considered to be a significant off-site traffic noise impact requiring mitigation. The City of Long Beach has not established an exterior CNEL noise standard for industrial uses. Therefore, for the purposes of this analysis, a significant on-site traffic noise impact would occur if the interior noise exceeds 45 dBA CNEL.

Existing Year Conditions

Table 5-1 provides the existing year traffic noise levels in the area around the project site. Table 6-3 provides the existing traffic noise level with project conditions on the roadways in the project area.

As shown in Table 6-3, the project-related traffic noise level increase would be 0.1 dBA or less for all analyzed roadway segments. Therefore, no significant off-site traffic noise impacts would occur under existing year conditions. No mitigation measures would be required for off-site land uses.

Table 6-3. Existing With Project Traffic Noise Levels

Roadway Segment	Average Daily Traffic	Centerline to 70 CNEL (feet)	Centerline to 65 CNEL (feet)	Centerline to 60 CNEL (feet)	CNEL (dBA) 50 feet from Centerline of Outermost Lane	Project Related Increase CNEL (Dba)
Anaheim Street between Alamitos Avenue and Orange Avenue	24,950	55.7	176.3	557.4	69.1	0.1
Anaheim Street between Orange Avenue and Gundry Court	24,710	55.2	174.6	552.1	69.1	0.1
Anaheim Street between Gundry Court and Peterson Avenue	25,370	56.7	179.2	566.8	69.2	0.1
Anaheim Street between Peterson Avenue and Walnut Avenue	25,170	56.2	177.8	562.3	69.2	0.1
Anaheim Street east of Walnut Avenue	24,990	55.8	176.6	558.3	69.1	0.1
Walnut Avenue North of Anaheim Street	3,890	<50	<50	62.7	60.5	0.1
Walnut Avenue South of Anaheim Street	3,890	<50	<50	62.7	60.5	0.1

Notes:
CNEL=community noise equivalent level; dBA=A-weighted decibels

Cumulative Conditions

Table 6-4 provides the traffic noise levels along the roadways adjacent to the project site under the cumulative (2038) without project traffic conditions. Table 6-5 provides the cumulative (2038) traffic noise level with project conditions on the roadways adjacent to the project site.

As shown in Table 6-5, the project-related traffic noise level increase would be 0.1 dBA or less for all analyzed roadway segments. Therefore, no significant off-site traffic noise impacts would occur under the cumulative conditions. No mitigation measures would be required for off-site land uses.

Standard building construction in warm climates provides 24 dBA of exterior to interior noise attenuation when windows are closed and 12 dBA of exterior to interior noise attenuation when windows are open (Protective Noise Levels, Environmental Protection Agency [EPA] 550/9-79-100, November 1978). All new construction residential units require some form of mechanical ventilation to ensure that proper indoor air quality is maintained even with all windows and doors closed. Therefore, with windows closed, new residential units located within the 69 dBA CNEL noise contour of the local roads would be exposed to interior noise levels exceeding the 45 dBA CNEL standard (69 – 24 = 45). Based on the results listed in Table 6-5, the 69 dBA CNEL noise contour extends beyond the roadway right-of-way along Anaheim Street. Residences located within 76 feet of the roadway centerline would be exposed to noise levels exceeding 69 dBA CNEL.

Based on the preliminary site plan shown in Figure 2-2, the proposed residential units will be constructed within 40 feet of the centerline of Anaheim Street. At this distance the proposed residential

units would be exposed to noise levels of up to 72 dBA CNEL. This would exceed the noise limits of the LBMC; therefore, would conflict with the *City of Long Beach General Plan* Noise Element and the LBMC. However, this conflict would not create a significant impact on the environment. Therefore, the following condition is recommended to reduce impacts:

- Windows and doors with a Sound Transmission Class (STC) of 32 or higher shall be installed in the residential uses facing Anaheim Street.

Table 6-4. Cumulative Without Project Traffic Volumes

Roadway Segment	Average Daily Traffic	Centerline to 70 CNEL (feet)	Centerline to 65 CNEL (feet)	Centerline to 60 CNEL (feet)	CNEL (dBA) 50 feet from Centerline of Outermost Lane
Anaheim Street between Alamitos Avenue and Orange Avenue	26,590	59.4	187.9	594.1	69.4
Anaheim Street between Orange Avenue and Gundry Court	26,240	58.6	185.4	586.3	69.3
Anaheim Street between Gundry Court and Peterson Avenue	26,770	59.8	189.1	598.1	69.4
Anaheim Street between Peterson Avenue and Walnut Avenue	26,440	59.1	186.8	590.7	69.4
Anaheim Street east of Walnut Avenue	26,140	58.4	184.7	584.0	69.3
Walnut Avenue North of Anaheim Street	3,980	<50	<50	64.1	60.6
Walnut Avenue South of Anaheim Street	4,070	<50	<50	65.6	60.7

Notes:
CNEL=community noise equivalent level; dBA=A-weighted decibels

Table 6-5. Cumulative With Project Traffic Volumes

Roadway Segment	Average Daily Traffic	Centerline to 70 CNEL (feet)	Centerline to 65 CNEL (feet)	Centerline to 60 CNEL (feet)	CNEL (dBA) 50 feet from Centerline of Outermost Lane	Project-Related Increase CNEL (dBA)
Anaheim Street between Alamitos Avenue and Orange Avenue	27,020	60.4	190.9	603.7	69.5	0.1
Anaheim Street between Orange Avenue and Gundry Court	26,660	59.6	188.4	595.6	69.4	0.1

Table 6-5. Cumulative With Project Traffic Volumes

Roadway Segment	Average Daily Traffic	Centerline to 70 CNEL (feet)	Centerline to 65 CNEL (feet)	Centerline to 60 CNEL (feet)	CNEL (dBA) 50 feet from Centerline of Outermost Lane	Project-Related Increase CNEL (dBA)
Anaheim Street between Gundry Court and Peterson Avenue	27,190	60.7	192.1	607.5	69.5	0.1
Anaheim Street between Peterson Avenue and Walnut Avenue	26,980	60.3	190.6	602.8	69.5	0.1
Anaheim Street east of Walnut Avenue	26,580	59.4	187.8	593.8	69.4	0.1
Walnut Avenue North of Anaheim Street	4,030	<50	<50	64.9	60.6	0.1
Walnut Avenue South of Anaheim Street	4,120	<50	<50	66.4	60.7	0.1

Notes:
CNEL=community noise equivalent level; dBA=A-weighted decibels

6.2.2 Stationary Noise Impacts

Operation of the project would result in some acoustic emissions but would not result in vibration emissions. On-site stationary noise would include building heating, ventilation, and air conditioning (HVAC) systems and parking lot usage, including door closing/slamming, horn honking, and car alarms. HVAC systems typically result in noise levels that average between 50 and 60 dBA L_{max} at 50 feet from the equipment. Parking lots typically generate noise levels of up to 70 dBA L_{max} at 50 feet. The closest sensitive receptors to the project site, the residential uses to the south, are located within 50 feet of the on-site stationary sources. In addition, there are existing residences located to the west at a distance of approximately 50 feet. The safety barriers and proposed landscaping along the edge of the parking structure would reduce the parking lot noise by 5-8 dB to 62 to 65 dBA L_{max}. Therefore, the proposed project's stationary source noise impacts would be lower than the City's nighttime threshold of 65 dBA L_{max} (Table 4-3).

6.2.3 Airport Noise Impacts

The project site is located approximately 2.5 miles southwest of the Long Beach Airport. Based on the airport's influence area map, the project site would be located outside of the 65 dBA CNEL noise contour. Therefore, aircraft noise levels would be below a level of significance.

7 Mitigation Measures and Recommended Conditions

7.1 Construction Noise

The following mitigation measure would be implemented during construction activities to reduce significant impacts from construction noise:

NOI-1 Construction shall be limited to the hours of 7:00 a.m. and 7:00 p.m. Monday through Friday and Saturdays between 9:00 a.m. and 6:00 p.m., in accordance with City of Long Beach standards. No construction activities shall occur outside of these hours or on Sundays and federal holidays.

The following measures shall be implemented to reduce potential construction noise impacts on nearby sensitive receptors.

1. During all site excavation and grading, the project contractors shall equip all construction equipment, fixed or mobile, with properly operating and maintained mufflers consistent with manufacturers' standards.
2. The project contractor shall place all stationary construction equipment so that emitted noise is directed away from sensitive receptors nearest the project site.
3. The construction contractor shall locate equipment staging in areas that would create the greatest distance between construction-related noise sources and noise-sensitive receptors nearest the project site during all project construction.

7.2 Operational Noise

The following condition is recommended to reduce the conflict with the *City of Long Beach General Plan* Noise Element and the LBMC, which occurs due to traffic noise levels exceedance impacts on the on-site residential uses.

LU-1 Windows and doors with a Sound Transmission Class (STC) of 32 or higher shall be installed in the residential uses facing Anaheim Street.

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8 Conclusion

Project construction and operational noise and vibration were calculated and compared with applicable laws, guidelines, and/or regulations. Implementation of Mitigation Measure NOI-1, which restricts construction activity to daytime hours (7:00 a.m. to 7:00 p.m. Monday through Friday and 9:00 a.m. and 6:00 p.m. on Saturdays), would reduce the noise and vibration impacts to below a level of significance.

Operational noise is not predicted to result in an increase in received noise levels at nearby noise sensitive receptors; however, on-site uses would require building façade upgrades to reduce the interior noise levels to below the 45 dBA CNEL noise standard. Implementation of Mitigation Measure LU-1 would reduce this impact to a level less than significant.

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9 References

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Appendix A. Traffic and Construction Noise Calculations

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FHWA Noise Model

Project Name: Anaheim/Walnut
Year: Existing

Roadway Link	ADT	AHW	Speed	Hard or Soft Site? (H or S)	CNEL at 50ft from Centerline of Outside Lane	CNEL 50 feet from Centerline	Centerline to 70 dBA CNEL Countour	Centerline to 65 dBA CNEL Countour	Centerline to 60 dBA CNEL Countour
Anaheim Street between Alamitos Avenue and Orange Avenue	24,520	18	40	H	69.0	70.4	54.8	173.2	547.8
Anaheim Street between Orange Avenue and Gundry Court	24,290	18	40	H	69.0	70.4	54.3	171.6	542.7
Anaheim Street between Gundry Court and Peterson Avenue	24,950	18	40	H	69.1	70.5	55.7	176.3	557.4
Anaheim Street between Peterson Avenue and Walnut Avenue	24,630	18	40	H	69.1	70.4	55.0	174.0	550.3
Anaheim Street east of Walnut Avenue	24,550	18	40	H	69.0	70.4	54.8	173.4	548.5
Walnut Avenue North of Anaheim Street	3,840	6	35	H	60.4	60.9	<50	<50	61.9
Walnut Avenue South of Anaheim Street	3,840	6	35	H	60.4	60.9	<50	<50	61.9

FHWA Noise Model

Project Name: Anaheim/Walnut
Year: Existing Plus Project

Roadway Link	ADT	AHW	Speed	Hard or Soft Site? (H or S)	CNEL at 50ft from Centerline of Outside Lane	CNEL 50 feet from Centerline	Centerline to 70 dBA CNEL Countour	Centerline to 65 dBA CNEL Countour	Centerline to 60 dBA CNEL Countour	Increase from No Build
Anaheim Street between Alamitos Avenue and Orange Avenue	24,950	18	40	H	69.1	70.5	55.7	176.3	557.4	0.1
Anaheim Street between Orange Avenue and Gundry Court	24,710	18	40	H	69.1	70.4	55.2	174.6	552.1	0.1
Anaheim Street between Gundry Court and Peterson Avenue	25,370	18	40	H	69.2	70.5	56.7	179.2	566.8	0.1
Anaheim Street between Peterson Avenue and Walnut Avenue	25,170	18	40	H	69.2	70.5	56.2	177.8	562.3	0.1
Anaheim Street east of Walnut Avenue	24,990	18	40	H	69.1	70.5	55.8	176.6	558.3	0.1
Walnut Avenue North of Anaheim Street	3,890	6	35	H	60.5	61.0	<50	<50	62.7	0.1
Walnut Avenue South of Anaheim Street	3,890	6	35	H	60.5	61.0	<50	<50	62.7	0.1

FHWA Noise Model

Project Name: Anaheim/Walnut
Year: Cumulative No Project

Roadway Link	ADT	AHW	Speed	Hard or Soft Site? (H or S)	CNEL at 50ft from Centerline of Outside Lane	CNEL 50 feet from Centerline	Centerline to 70 dBA CNEL Countour	Centerline to 65 dBA CNEL Countour	Centerline to 60 dBA CNEL Countour
Anaheim Street between Alamitos Avenue and Orange Avenue	26,590	18	40	H	69.4	70.7	59.4	187.9	594.1
Anaheim Street between Orange Avenue and Gundry Court	26,240	18	40	H	69.3	70.7	58.6	185.4	586.3
Anaheim Street between Gundry Court and Peterson Avenue	26,770	18	40	H	69.4	70.8	59.8	189.1	598.1
Anaheim Street between Peterson Avenue and Walnut Avenue	26,440	18	40	H	69.4	70.7	59.1	186.8	590.7
Anaheim Street east of Walnut Avenue	26,140	18	40	H	69.3	70.7	58.4	184.7	584.0
Walnut Avenue North of Anaheim Street	3,980	6	35	H	60.6	61.1	<50	<50	64.1
Walnut Avenue South of Anaheim Street	4,070	6	35	H	60.7	61.2	<50	<50	65.6

FHWA Noise Model

Project Name: Anaheim/Walnut
Year: Cumulative With Project

Roadway Link	ADT	AHW	Speed	Hard or Soft Site? (H or S)	CNEL at 50ft from Centerline of Outside Lane	CNEL 50 feet from Centerline	Centerline to 70 dBA CNEL Countour	Centerline to 65 dBA CNEL Countour	Centerline to 60 dBA CNEL Countour	Increase from No Build
Anaheim Street between Alamitos Avenue and Orange Avenue	27,020	18	40	H	69.5	70.8	60.4	190.9	603.7	0.1
Anaheim Street between Orange Avenue and Gundry Court	26,660	18	40	H	69.4	70.8	59.6	188.4	595.6	0.1
Anaheim Street between Gundry Court and Peterson Avenue	27,190	18	40	H	69.5	70.8	60.7	192.1	607.5	0.1
Anaheim Street between Peterson Avenue and Walnut Avenue	26,980	18	40	H	69.5	70.8	60.3	190.6	602.8	0.1
Anaheim Street east of Walnut Avenue	26,580	18	40	H	69.4	70.7	59.4	187.8	593.8	0.1
Walnut Avenue North of Anaheim Street	4,030	6	35	H	60.6	61.1	<50	<50	64.9	0.1
Walnut Avenue South of Anaheim Street	4,120	6	35	H	60.7	61.2	<50	<50	66.4	0.1

Site Prep
Roadway Construction Noise Model (RCNM),Version 1.1

Report date: 03/25/2019
Case Description: Site Preparation

**** Receptor #1 ****

Description	Land Use	Baselines (dBA) Daytime	Evening	Night
Residential - Lmax	Residential	60.0	50.0	55.0

Equipment

Description	Impact Device	Usage (%)	Spec Lmax (dBA)	Actual Lmax (dBA)	Receptor Distance (feet)	Estimated Shielding (dBA)
Grader	No	40	85.0		50.0	0.0
Dozer	No	40		81.7	50.0	0.0
Front End Loader	No	40		79.1	50.0	0.0

Results

Equipment	Calculated (dBA) Day Lmax	Day Leq	Evening Lmax	Evening Leq	Night Lmax	Night Leq	Noise Limits (dBA) Day Lmax	Day Leq	Evening Lmax	Evening Leq	Night Lmax	Night Leq	Noise Limit Exceedance (dBA) Day Lmax	Day Leq	Evening Lmax	Evening Leq	Night Lmax	Night Leq
Grader	85.0	81.0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Dozer	81.7	77.7	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Front End Loader	79.1	75.1	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

Site Prep

	Total	85.0	83.4	N/A	N/A	N/A	N/A	N/A	N/A

**** Receptor #2 ****

Baselines (dBA)

Description	Land Use	Daytime	Evening	Night
Residential - Leq	Residential	60.0	50.0	55.0

Equipment

Description	Impact Device	Usage (%)	Spec Lmax (dBA)	Actual Lmax (dBA)	Receptor Distance (feet)	Estimated Shielding (dBA)
Grader	No	40	85.0		125.0	0.0
Dozer	No	40		81.7	125.0	0.0
Front End Loader	No	40		79.1	125.0	0.0

Results

Noise Limits (dBA)

Noise Limit Exceedance (dBA)

	Calculated (dBA)								Day		Evening		Night	
	Day		Evening		Night									
Equipment	Lmax	Leq	Lmax	Leq	Lmax	Leq			Lmax	Leq	Lmax	Leq	Lmax	Leq
Grader	77.0	73.1	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Dozer	73.7	69.7	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Front End Loader	71.2	67.2	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Total	77.0	75.4	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

Site Prep

**** Receptor #3 ****

Description	Land Use	Baselines (dBA) Daytime	Evening	Night
		0.0	0.0	0.0

Equipment

Description	Impact Device	Usage (%)	Spec Lmax (dBA)	Actual Lmax (dBA)	Receptor Distance (feet)	Estimated Shielding (dBA)
Grader	No	40	85.0		0.0	0.0
Dozer	No	40		81.7	0.0	0.0
Front End Loader	No	40		79.1	0.0	0.0

Results

	Calculated (dBA) Day		Evening		Night		Noise Limits (dBA) Day		Evening		Night	
Equipment	Lmax	Leq	Lmax	Leq	Lmax	Leq	Lmax	Leq	Lmax	Leq	Lmax	Leq
Grader					-4.0		N/A	N/A	N/A	N/A	N/A	N/A
Dozer					-4.0		N/A	N/A	N/A	N/A	N/A	N/A
Front End Loader					-4.0		N/A	N/A	N/A	N/A	N/A	N/A
Total	0.0	4.5					N/A	N/A	N/A	N/A	N/A	N/A

	Noise Limit Exceedance (dBA) Day		Evening		Night	
Equipment	Lmax	Leq	Lmax	Leq	Lmax	Leq
Grader	N/A	N/A	N/A	N/A	N/A	N/A
Dozer	N/A	N/A	N/A	N/A	N/A	N/A
Front End Loader	N/A	N/A	N/A	N/A	N/A	N/A
Total	N/A	N/A	N/A	N/A	N/A	N/A

Grading
Roadway Construction Noise Model (RCNM),Version 1.1

Report date: 03/25/2019
Case Description: Site Preparation

**** Receptor #1 ****

Description	Land Use	Baselines (dBA) Daytime	Evening	Night
Residential - Lmax	Residential	60.0	50.0	55.0

Equipment

Description	Impact Device	Usage (%)	Spec Lmax (dBA)	Actual Lmax (dBA)	Receptor Distance (feet)	Estimated Shielding (dBA)
Grader	No	40	85.0		50.0	0.0
Dozer	No	40		81.7	50.0	0.0
Front End Loader	No	40		79.1	50.0	0.0

Results

Equipment	Calculated (dBA) Day Lmax	Day Leq	Evening Lmax	Evening Leq	Night Lmax	Night Leq	Noise Limits (dBA) Day Lmax	Day Leq	Evening Lmax	Evening Leq	Night Lmax	Night Leq	Noise Limit Exceedance (dBA) Day Lmax	Day Leq	Evening Lmax	Evening Leq	Night Lmax	Night Leq
Grader	85.0	81.0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Dozer	81.7	77.7	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Front End Loader	79.1	75.1	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

Grading

	Total	85.0	83.4	N/A	N/A	N/A	N/A	N/A	N/A
N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A		

**** Receptor #2 ****

		Baselines (dBA)		
Description	Land Use	Daytime	Evening	Night
Residential - Leq	Residential	60.0	50.0	55.0

Equipment

Description	Impact Device	Usage (%)	Spec Lmax (dBA)	Actual Lmax (dBA)	Receptor Distance (feet)	Estimated Shielding (dBA)
Grader	No	40	85.0		125.0	0.0
Dozer	No	40		81.7	125.0	0.0
Front End Loader	No	40		79.1	125.0	0.0

Results

		Calculated (dBA)				Noise Limits (dBA)			
		Day		Evening		Night		Noise Limit Exceedance (dBA)	
								Day	
Evening		Night							
Equipment		Lmax	Leq	Lmax	Leq	Lmax	Leq	Lmax	Leq
Lmax	Leq	Lmax	Leq	Lmax	Leq	Lmax	Leq		
Grader		77.0	73.1	N/A	N/A	N/A	N/A	N/A	N/A
N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A		
Dozer		73.7	69.7	N/A	N/A	N/A	N/A	N/A	N/A
N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A		
Front End Loader		71.2	67.2	N/A	N/A	N/A	N/A	N/A	N/A
N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A		
	Total	77.0	75.4	N/A	N/A	N/A	N/A	N/A	N/A
N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A		

Grading

**** Receptor #3 ****

Description	Land Use	Baselines (dBA) Daytime	Evening	Night
		0.0	0.0	0.0

Equipment

Description	Impact Device	Usage (%)	Spec Lmax (dBA)	Actual Lmax (dBA)	Receptor Distance (feet)	Estimated Shielding (dBA)
Grader	No	40	85.0		0.0	0.0
Dozer	No	40		81.7	0.0	0.0
Front End Loader	No	40		79.1	0.0	0.0

Results

	Calculated (dBA)				Noise Limits (dBA)			
	Day		Evening		Night		Noise Limit Exceedance (dBA)	
Equipment	Lmax	Leq	Lmax	Leq	Lmax	Leq	Lmax	Leq
Grader			-4.0		N/A	N/A	N/A	N/A
	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Dozer			-4.0		N/A	N/A	N/A	N/A
	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Front End Loader			-4.0		N/A	N/A	N/A	N/A
	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Total	0.0	4.5			N/A	N/A	N/A	N/A
	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

Building Construction
Roadway Construction Noise Model (RCNM),Version 1.1

Report date: 03/25/2019
Case Description: Building Construction

**** Receptor #1 ****

Description	Land Use	Baselines (dBA) Daytime	Evening	Night
Residential - Lmax	Residential	60.0	50.0	55.0

Equipment

Description	Impact Device	Usage (%)	Spec Lmax (dBA)	Actual Lmax (dBA)	Receptor Distance (feet)	Estimated Shielding (dBA)
Crane	No	16		80.6	50.0	0.0
Crane	No	16		80.6	50.0	0.0
Man Lift	No	20		74.7	50.0	0.0
Generator	No	50		80.6	50.0	0.0
Generator	No	50		80.6	50.0	0.0
Welder / Torch	No	40		74.0	50.0	0.0
Welder / Torch	No	40		74.0	50.0	0.0
Welder / Torch	No	40		74.0	50.0	0.0
Front End Loader	No	40		79.1	50.0	0.0

Results

Calculated (dBA) Day	Evening	Night	Noise Limits (dBA) Day	Evening	Night	Noise Limit Exceedance (dBA) Day	Evening	Night

	Building Construction							
Equipment	Lmax	Leq	Lmax	Leq	Lmax	Leq	Lmax	Leq
	Lmax	Leq	Lmax	Leq	Lmax	Leq	Lmax	Leq
Crane	80.6	72.6	N/A	N/A	N/A	N/A	N/A	N/A
Crane	80.6	72.6	N/A	N/A	N/A	N/A	N/A	N/A
Man Lift	74.7	67.7	N/A	N/A	N/A	N/A	N/A	N/A
Generator	80.6	77.6	N/A	N/A	N/A	N/A	N/A	N/A
Generator	80.6	77.6	N/A	N/A	N/A	N/A	N/A	N/A
Welder / Torch	74.0	70.0	N/A	N/A	N/A	N/A	N/A	N/A
Welder / Torch	74.0	70.0	N/A	N/A	N/A	N/A	N/A	N/A
Welder / Torch	74.0	70.0	N/A	N/A	N/A	N/A	N/A	N/A
Front End Loader	79.1	75.1	N/A	N/A	N/A	N/A	N/A	N/A
Total	80.6	83.4	N/A	N/A	N/A	N/A	N/A	N/A

**** Receptor #2 ****

		Baselines (dBA)		
Description	Land Use	Daytime	Evening	Night
Residential - Leq	Residential	60.0	50.0	55.0

	Equipment					
			Spec	Actual	Receptor	Estimated
	Impact	Usage	Lmax	Lmax	Distance	Shielding
Description	Device	(%)	(dBA)	(dBA)	(feet)	(dBA)
Crane	No	16		80.6	125.0	0.0
Crane	No	16		80.6	125.0	0.0
Man Lift	No	20		74.7	125.0	0.0
Generator	No	50		80.6	125.0	

Building Construction

	0.0				
Generator		No	50	80.6	125.0
	0.0				
Welder / Torch		No	40	74.0	125.0
	0.0				
Welder / Torch		No	40	74.0	125.0
	0.0				
Welder / Torch		No	40	74.0	125.0
	0.0				
Front End Loader		No	40	79.1	125.0
	0.0				

Results

Noise Limits (dBA)

Noise Limit Exceedance (dBA)

Calculated (dBA)

Equipment	Day Lmax	Day Leq	Evening Lmax	Evening Leq	Night Lmax	Night Leq	Day Lmax	Day Leq	Evening Lmax	Evening Leq	Night Lmax	Night Leq
Crane		72.6	64.6		N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Crane		72.6	64.6		N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Man Lift		66.7	59.8		N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Generator		72.7	69.7		N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Generator		72.7	69.7		N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Welder / Torch		66.0	62.1		N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Welder / Torch		66.0	62.1		N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Welder / Torch		66.0	62.1		N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Front End Loader		71.2	67.2		N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	Total	72.7	75.5		N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

**** Receptor #3 ****

Building Construction

Description	Land Use	Baselines (dBA) Daytime	Evening	Night
		0.0	0.0	0.0

Equipment

Description	Impact Device	Usage (%)	Spec Lmax (dBA)	Actual Lmax (dBA)	Receptor Distance (feet)	Estimated Shielding (dBA)
Crane	No	16		80.6	0.0	0.0
Crane	No	16		80.6	0.0	0.0
Man Lift	No	20		74.7	0.0	0.0
Generator	No	50		80.6	0.0	0.0
Generator	No	50		80.6	0.0	0.0
Welder / Torch	No	40		74.0	0.0	0.0
Welder / Torch	No	40		74.0	0.0	0.0
Welder / Torch	No	40		74.0	0.0	0.0
Front End Loader	No	40		79.1	0.0	0.0

Results

Equipment	Calculated (dBA) Day Lmax	Day Leq	Evening Lmax	Evening Leq	Night Lmax	Night Leq	Noise Limits (dBA) Day Lmax	Day Leq	Evening Lmax	Evening Leq	Night Lmax	Night Leq	Noise Limit Exceedance (dBA) Day Lmax	Day Leq	Evening Lmax	Evening Leq	Night Lmax	Night Leq
Crane	-8.0	N/A	N/A	N/A	N/A	N/A												

	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	
Crane				-8.0		N/A	N/A	N/A	N/A
	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	
Man Lift				-7.0		N/A	N/A	N/A	N/A
	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	
Generator				-3.0		N/A	N/A	N/A	N/A
	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	
Generator				-3.0		N/A	N/A	N/A	N/A
	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	
Welder / Torch				-4.0		N/A	N/A	N/A	N/A
	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	
Welder / Torch				-4.0		N/A	N/A	N/A	N/A
	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	
Welder / Torch				-4.0		N/A	N/A	N/A	N/A
	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	
Front End Loader				-4.0		N/A	N/A	N/A	N/A
	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	
		Total	0.0	4.9		N/A	N/A	N/A	N/A
	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	

arch coating

Roadway Construction Noise Model (RCNM),Version 1.1

Report date: 03/25/2019
Case Description: Architectural Coating

**** Receptor #1 ****

Description	Land Use	Baselines (dBA) Daytime	Evening	Night
Residential - Lmax	Residential	60.0	50.0	55.0

Equipment

Description	Impact Device	Usage (%)	Spec Lmax (dBA)	Actual Lmax (dBA)	Receptor Distance (feet)	Estimated Shielding (dBA)
Compressor (air)	No	40		77.7	50.0	0.0
Compressor (air)	No	40		77.7	50.0	0.0

Results

Noise Limits (dBA)

Noise Limit Exceedance (dBA)

	Calculated (dBA)				Day		Evening		Night	
Equipment	Day Lmax	Day Leq	Evening Lmax	Evening Leq	Night Lmax	Night Leq	Day Lmax	Day Leq	Evening Lmax	Evening Leq	Night Lmax	Night Leq
Compressor (air)	77.7	73.7	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Compressor (air)	77.7	73.7	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Total	77.7	76.7	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

**** Receptor #2 ****

Description	Land Use	Baselines (dBA) Daytime	Evening	Night
Residential - Leq	Residential	60.0	50.0	55.0

Equipment

Description	Impact Device	Usage (%)	Spec Lmax (dBA)	Actual Lmax (dBA)	Receptor Distance (feet)	Estimated Shielding (dBA)
Compressor (air)	No	40		77.7	125.0	0.0
Compressor (air)	No	40		77.7	125.0	0.0

Results

Noise Limits (dBA)	Noise Limit Exceedance (dBA)							
	Calculated (dBA)		Day		Evening		Night	
Equipment	Lmax	Leq	Lmax	Leq	Lmax	Leq	Lmax	Leq
Compressor (air)	69.7	65.7	N/A	N/A	N/A	N/A	N/A	N/A
Compressor (air)	69.7	65.7	N/A	N/A	N/A	N/A	N/A	N/A
Total	69.7	68.7	N/A	N/A	N/A	N/A	N/A	N/A

**** Receptor #3 ****

Description	Land Use	Baselines (dBA) Daytime	Evening	Night
		0.0	0.0	0.0

arch coating

Equipment

Estimated Shielding Description (dBA)	Impact Device	Usage (%)	Spec Lmax (dBA)	Actual Lmax (dBA)	Receptor Distance (feet)
Compressor (air) 0.0	No	40		77.7	0.0
Compressor (air) 0.0	No	40		77.7	0.0

Results

Noise Limits (dBA)

Noise Limit Exceedance (dBA)

Equipment	Calculated (dBA) Day Lmax	Day Leq	Evening Lmax	Evening Leq	Night Lmax	Night Leq	Day Lmax	Day Leq	Evening Lmax	Evening Leq	Night Lmax	Night Leq
Compressor (air)			-8.0		N/A		N/A		N/A		N/A	
	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A				
Compressor (air)			-8.0		N/A		N/A		N/A		N/A	
	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A				
Total		0.0		4.9		N/A		N/A		N/A		N/A
	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A				

Paving

Roadway Construction Noise Model (RCNM),Version 1.1

Report date: 03/25/2019
Case Description: Paving

**** Receptor #1 ****

Description	Land Use	Baselines (dBA) Daytime	Evening	Night
Residential - Lmax	Residential	60.0	50.0	55.0

Equipment

Description	Impact Device	Usage (%)	Spec Lmax (dBA)	Actual Lmax (dBA)	Receptor Distance (feet)	Estimated Shielding (dBA)
Concrete Mixer Truck	No	40		78.8	50.0	0.0
Paver	No	50		77.2	50.0	0.0
Paver	No	50		77.2	50.0	0.0
Roller	No	20		80.0	50.0	0.0
Front End Loader	No	40		79.1	50.0	0.0

Results

Equipment	Calculated (dBA) Day Lmax	Day Leq	Evening Lmax	Evening Leq	Night Lmax	Night Leq	Noise Limits (dBA) Day Lmax	Day Leq	Evening Lmax	Evening Leq	Night Lmax	Night Leq	Noise Limit Exceedance (dBA) Day Lmax	Day Leq	Evening Lmax	Evening Leq	Night Lmax	Night Leq
Concrete Mixer Truck	78.8	74.8	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

			Paving						
Paver			77.2	74.2	N/A	N/A	N/A	N/A	
N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A		
Paver			77.2	74.2	N/A	N/A	N/A	N/A	
N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A		
Roller			80.0	73.0	N/A	N/A	N/A	N/A	
N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A		
Front End Loader			79.1	75.1	N/A	N/A	N/A	N/A	
N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A		
		Total	80.0	81.3	N/A	N/A	N/A	N/A	
N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A		

**** Receptor #2 ****

		Baselines (dBA)		
Description	Land Use	Daytime	Evening	Night
Residential - Leq	Residential	60.0	50.0	55.0

Equipment

Description	Impact Device	Usage (%)	Spec Lmax (dBA)	Actual Lmax (dBA)	Receptor Distance (feet)	Estimated Shielding (dBA)
Concrete Mixer Truck	No	40		78.8	125.0	0.0
Paver	No	50		77.2	125.0	0.0
Paver	No	50		77.2	125.0	0.0
Roller	No	20		80.0	125.0	0.0
Front End Loader	No	40		79.1	125.0	0.0

Results

Calculated (dBA)			Noise Limits (dBA)		
	Noise Limit Exceedance (dBA)				
Day	Evening	Night	Day	Evening	Night

Equipment	Lmax	Leq	Lmax	Leq	Paving Lmax	Leq	Lmax	Leq	Lmax	Leq
Concrete Mixer Truck	69.3	66.3	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Paver	69.3	66.3	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Paver	69.3	66.3	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Roller	72.0	65.1	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Front End Loader	71.2	67.2	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Total	72.0	73.0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

**** Receptor #3 ****

Description	Land Use	Baselines (dBA) Daytime	Evening	Night
		0.0	0.0	0.0

Equipment

Description	Impact Device	Usage (%)	Spec Lmax (dBA)	Actual Lmax (dBA)	Receptor Distance (feet)	Estimated Shielding (dBA)
Concrete Mixer Truck	No	40		78.8	0.0	0.0
Paver	No	50		77.2	0.0	0.0
Paver	No	50		77.2	0.0	0.0
Roller	No	20		80.0	0.0	0.0
Front End Loader	No	40		79.1	0.0	0.0

Results

(dBA)	Noise Limit Exceedance (dBA)	Noise Limits

Paving

Calculated (dBA)

Equipment	Day Lmax	Day Leq	Evening Lmax	Evening Leq	Night Lmax	Night Leq	Day Lmax	Day Leq	Evening Lmax	Evening Leq	Night Lmax	Night Leq
Concrete Mixer Truck			-3.0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Paver			-3.0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Paver			-3.0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Roller			-7.0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Front End Loader			-4.0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Total	0.0	3.4		N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A