Report #2012-034

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CEQA Initial Noise Study
Uptown Orange
City of Orange, California

Prepared for:
ALMI Residential
3195 Red Hill Avenue, Loft F
Costa Mesa, CA 92626

Prepared by:
Justin W. Cook, INCE
Heather Bruce

Acoustics Division
20201 SW Birch Street
Suite 250
Newport Beach, CA 92660
T: 949-250-1222
F: 949-250-1225
Acoustics@AirportNetwork.com

1.0 Background Information

1.1 Characteristics of Sound

Sound can be described technically in terms of amplitude (loudness), frequency (pitch), or duration (time). The standard unit of measurement of the loudness of sound is the decibel (dB). Decibels are based on the logarithmic scale. The logarithmic scale compresses the wide range in sound pressure levels to a more usable range of numbers in a manner similar to the Richter scale used to measure earthquakes.

The human hearing system is not equally sensitive to sound at all frequencies. Sound waves below 16 Hz are not heard at all and are "felt" more as a vibration. Similarly, while people with extremely sensitive hearing can hear sounds as high as 20,000 Hz, most people cannot hear above 15,000 Hz. In all cases, hearing acuity falls off rapidly above about 10,000 Hz and below about 200 Hz. Since the human ear is not equally sensitive to sound at all frequencies, a special frequency-dependent rating scale has been devised to relate noise to human sensitivity. The A-weighted decibel scale (dBA) performs this compensation by discriminating against frequencies in a manner approximating the sensitivity of the human ear. Community noise levels are measured in terms of the "A-weighted decibel" abbreviated dBA.

Because of the physical characteristics of noise transmission and noise perception, the relative loudness of sound does not closely match the actual amounts of sound energy. Table 1 presents the subjective effect of changes in sound pressure levels. Typical human hearing can detect changes of approximately 3 dBA or greater under normal conditions. Changes of 1 to 3 dBA are detectable under quiet, controlled conditions and changes of less than 1 dBA are usually indiscernible. A change of 5 dBA or greater is typically noticeable to most people in an exterior environment and a change of 10 dBA is perceived as a doubling (or halving) of the noise.

Table 1 – Change in Sound Pressure Level (dB)

dB Change	Change in Apparent Loudness
+/- 3	Threshold of human perceptibility
+/- 5	Clearly noticeable change in noise level
+/- 10	Twice or half as loud
+/- 20	Much louder or quieter

Source: Engineering Noise Control, Bies and Hansen (1988)

1.2 Point and Line Sources

Noise may be generated from a point source, such as a piece of construction equipment, or from a line source, such as a roadway containing moving vehicles. Because noise spreads in an ever-widening pattern, the given amount of noise striking an object, such as an eardrum, is reduced with distance from the source. The typical distance reduction for point source noise is 6 dBA per doubling of the distance from the noise source.

A line source of noise, such as vehicles proceeding down a roadway, will also be reduced with distance, but the rate of reduction is affected by both distance the type of terrain over which the noise passes. Hard sites, such as developed areas with paving, reduce noise at a rate of 3 dBA per doubling of distance, while

soft sites, such as undeveloped areas, open space and vegetated areas reduce noise at a rate of 4.5 dBA per doubling of distance.

Objects that block the line of sight attenuate the noise source if the receptor is located within the "shadow" of the blockage (such as behind a sound wall). If a receptor is located behind the wall, but has a view of the source, the wall will do little to reduce the noise. Additionally a receptor located on the same side of the wall as the noise source may experience as increase in in the perceived noise level, as the wall will reflect noise back to the receptor compounding the noise.

1.3 Noise Metrics

Several rating scales (or noise "metrics") exist to analyze effects of noise, including traffic-generated noise, on a community. These account for: (1) the parameters of noise that have been shown to contribute to the effects of noise on man, (2) the variety of noises found in the environment, (3) the variations in noise levels that occur as a person moves through the environment, and (4) the variations associated with the time of day. A number of noise scales have been developed to account for this observation. Two of the predominate noise scales are the equivalent noise level (Leq) and the community noise equivalent level (CNEL). These scales are described in the following paragraphs.

> **Leq** is the sound level corresponding to a steady-state sound level containing the same total energy as a time-varying signal over a given sample period. Leq is the "energy" average noise level during the time period of the sample. Leq can be measured for any time period, but is typically measured for 15 minutes, 1 hour or 24-hours.
>
> **CNEL** is similar to Leq but is for twenty four hours, and applies a weighting factor which places greater significance on noise events occurring during the evening and night hours (when sleep disturbance is a concern). CNEL is a 24-hour, time-weighted annual average noise level. Time-weighted refers to the fact that noise which occurs during certain sensitive time periods is penalized for occurring at these times. The evening time period is penalized by 5 dB (7 p.m. to 10 p.m.) while night time period (10 p.m. to 7 a.m.) noises are penalized by 10 dB. This penalty and these time periods were selected to attempt to account for increased human sensitivity to noise during the quieter period of a day, where sleep is the most probable activity. A CNEL noise level may be reported as a "CNEL of 60 dBA," "60 dBA CNEL," or simply "60 CNEL."

1.4 Vibration

Vibrating objects in contact with the ground radiate vibration waves through various soil and rock to the foundations of nearby buildings. When assessing annoyance from groundborne noise, vibration is typically expressed as root mean square (rms) velocity in units of decibels of 1 micro-inch per second. To distinguish vibration levels from noise levels, the unit is written as VdB. Human perception to vibration starts at levels as low as 67 VdB and sometimes lower. Annoyance due to vibration in residential settings starts at approximately 70 VdB. Groundborne vibration is almost never annoying to people who are outdoors. In extreme cases, excessive groundborne vibration has the potential to cause structural damage to buildings. The damage threshold for non-historic buildings is 100 VdB. Common sources of groundborne vibration include trains and construction activities such as blasting, pile riving and operating heavy earthmoving equipment.

1.5 Noise Standards

1.5.1 State of California

Within the 2010 California Building Code (CBC) (California Code of Regulations, Title 24, Part 2, Volume 1, Chapter 12 – Interior Environment, Section 1207 [HCD] – Sound Transmission), it is stated that residential structures located in noise critical areas shall be designed to prevent the intrusion of exterior noises beyond prescribed levels and should be consistent with the local land-use standards. Interior noise levels attributable to exterior sources shall not exceed 45 dB CNEL in any habitable room and should be consistent with the noise element of the local general plan.

Worst-case noise levels, either existing or future, shall be used as the basis for determining compliance. Future noise levels shall be predicted for a period of at least 10 years from the time of the building permit application.

Residential structures to be located where the CNEL exceeds 60 dB shall require an acoustical analysis showing that the proposed design will limit the exterior noise to the prescribed allowable interior noise level.

1.5.2 City of Orange's Noise Element of the General Plan (Transportation Noise Sources)

The City of Orange's Noise Element of the General Plan specifies guidelines for acceptable community noise levels segmented by land use. According to the City of Orange's Land Use Element of the General Plan, the proposed project is located within an area designated as urban mixed-use. For multi-family residential land use in this area, the exterior noise standard is 65 dB CNEL for common outdoor recreational areas only and the interior noise standard is 45 dB CNEL. The interior habitable environment excludes bathrooms, closets and corridors. The interior noise standard shall be satisfied with windows in the closed position and mechanical ventilation shall be provided per uniform building code (UBC) requirements.

The City of Orange's Noise Element also defines when an increase in ambient noise levels is assumed to be a significant noise impact. A significant noise impact will occur if a project causes ambient noise levels to exceed the following:

- Where the existing ambient noise level is less than 65 dB CNEL, a project related permanent increase in ambient noise levels of 5 dB CNEL or greater.

- Where the existing ambient noise level is greater than 65 dB CNEL, a project related permanent increase in ambient noise levels of 3 dB CNEL or greater.

1.5.3 City of Orange's Noise Ordinance of the Municipal Code (Stationary Noise Sources)

The City applies the noise ordinance standards to non-transportation stationary noise sources. It is designed to protect all residential properties from objectionable non-transportation stationary noise sources such as music, construction activity, machinery, pumps, and heating, ventilation and air conditioning (HVAC) systems. According to the noise ordinance, non-transportation stationary noise generated on a property is prohibited from exceeding the maximum sound levels as shown in Table 2 at the nearest residential property line.

Table 2 – Maximum Exterior Noise Limits (dBA)

Land Use	Time Period	L50	L25	L8	L2	Lmax
Residential	7:00 a.m. to 10:00 p.m.	55	60	65	70	75
	10:00 p.m. to 7:00 a.m.	50	55	60	65	70

Source: City of Orange Noise Ordinance of the Municipal Code

Notes: The noise standards shall be increased by 8 dB where the alleged offensive noise source is an air conditioner installed prior to January 19, 1979. In the event that the ambient noise levels exceeds the exterior noise limits, the noise standards shall be increased to reflect the ambient noise level. Each of the noise limits specified above shall be reduced by 5 dBA for impact or simple tone noise, or for noise consisting of speech or music.

The City realizes that construction noise is difficult to control and therefore provides exemptions for this type of noise from the non-transportation stationary noise limitations above. In addition, the City limits the hours of construction activity to the least noise sensitive portions of the day. According to the noise ordinance, construction activities are prohibited between 8 p.m. and 7 a.m. on weekdays and Saturday, and anytime on Sundays and Federal holidays.

1.5.4 Federal Transit Administration (FTA) Vibration Criteria

The City of Orange has not yet adopted vibration criteria. The human reaction to various levels of vibration is highly subjective, and varies from person to person. Table 3 shows the Federal Transit Administration's (FTA) criteria for acceptable groundborne vibration for various types of land uses that are sensitive to vibration. For purposes of identifying potential project-related vibration impacts, the FTA criteria will be used.

Table 3 – Groundborne Vibration and Noise Impact Criteria – Human Annoyance

Land Use Category	Max VdB	Discription of Use
Workshop	90	Distinctly feelable vibration. Appropriate for workshops and non-sensitive areas
Office	84	Feelable vibration. Appropriate to offices and non-sensitive areas.
Residential - Daytime	78	Barely feelable vibration. Adequate for computer equipment and low-power optical microscopes.
Residential - Nighttime	72	Vibration not feelable, but ground-borne noise may be audible inside quiet rooms. Suitable for medium-power optical microscopes and other equipment of low sensitivity.

Source: Federal Transit Administration (FTA), Transit Noise and Vibration Impact Assessment, May 2006

In addition to the human annoyance criteria presented above, the FTA also applies vibration criteria for structural damage, as shown in Table 4. This criterion is the threshold at which there is a risk of damage to different building categories.

Table 4 – Groundborne Vibration and Noise Impact Criteria – Structural Damage

	Building Category	PPV (in/sec)	Approximate VdB
I	Reinforced-concrete, steel or timber (no plaster)	0.5	102
II	Engineered concrete and masonry (no plaster)	0.3	98
III	Non-engineered timber and masonry buildings	0.2	94
IV	Buildings extremely susceptible to vibration damage	0.12	90

Source: Federal Transit Administration (FTA), Transit Noise and Vibration Impact Assessment, May 2006

1.6 Sensitive Noise Receptors

Certain land uses are particularly sensitive to noise and vibration. Noise- and vibration-sensitive land uses include residential, school and open/space recreation areas where quiet environments are necessary for enjoyment, public health and safety. The proposed project is located within an area designated as urban mixed-use within the City of Orange. The areas adjacent to the north, west and south are also designated as urban mixed-use. The areas to the east are designated as public facilities and institutions. It is important to note that a hospital and several hotels are located near to the proposed project. Currently there are not any adjacent noise- and vibration-sensitive land uses, such as residential, to the proposed project, but the proposed project itself will be a noise- and vibration-sensitive residential land use.

2.0 Existing Noise Environment

Existing ambient daytime noise levels were measured on August 3, 2012 by Heather Bruce and Daniel Khim of BridgeNet International, which included a total of three noise measurement locations located at the proposed project to identify major noise sources in the area and to quantify representative noise levels.

The sound level meters used to measure the noise levels were 01dB-Metravib Blue Solo sound level meters. The microphones used were 01dB-Metravib 1/2" condenser microphones. The equipment used meets the American National Standards Institute (ANSI) S1.4 specification for Type 1 precision sound level meters. The measurement systems were calibrated before and after the measurements with a Brüel & Kjær Type 4231 sound level calibrator with calibration traceable to the National Institute of Standards and Technology (NIST).

During all measurements the sound level meters were mounted on tripods five feet above ground and equipped with windscreens. Weather conditions during the measurement periods were favorable and representative of typical conditions with clear skies.

The noise measurements were made on the proposed project's property line. Refer to Figure 1 for noise measurement locations. The noise measurements were conducted between the hours of 7 a.m. to 9 a.m. The results of the noise measurement survey are presented in Table 5.

Figure 1 – Noise Measurement Locations

Table 5 - Noise Measurement Survey Results

Noise Measurement Location	Primary Noise Source	Date	Start Time	End Time	Leq (dBA)	Lmax (dBA)	Lmin (dBA)
1	Traffic Noise from The City Drive	8/3/2012	7:00 a.m.	8:00 a.m.	69.4	85.9	51.3
			8:00 a.m.	9:00 a.m.	69.8	86.8	53.5
2	Traffic Noise from The City Way	8/3/2012	7:00 a.m.	8:00 a.m.	59.2	81.1	49.2
			8:00 a.m.	9:00 a.m.	58.5	74.5	49.5
3	Traffic Noise from The City Boulevard E	8/3/2012	7:00 a.m.	8:00 a.m.	59.0	74.9	49.8
			8:00 a.m.	9:00 a.m.	60.6	73.1	51.4

Table 5 shows that the proposed project site is exposed to noise levels that range from 59.0 to 69.8 dBA Leq. According to Section 2.2.3 of the Caltrans Technical Noise Supplement (TeNS), prepared November 2009, the CNEL values are generally within ± 2 dB of the measured peak-hour Leq. Based on the worst-case Leq to CNEL conversion, the existing noise level at the project site would range from 61.0 dB CNEL to 71.8 dB CNEL.

3.0 Impact Analysis

		Potentially Significant Impact	Less than Significant With Mitigation Incorporated	Less Than Significant Impact	No Impact
1	Exposure of persons to or generation of noise levels in excess of standards established in the local general plan or noise ordinance, or applicable standards of other agencies?	☐	■	☐	☐
2	Exposure of persons to or generation of excessive groundborne vibration or groundborne noise levels?	☐	☐	■	☐
3	A substantial permanent increase in ambient noise levels in the project vicinity above levels existing, without the project	☐	☐	■	☐
4	A substantial temporary or periodic increase in ambient noise levels in the project vicinity above levels existing	☐	■	☐	☐
5	For a project located within an airport land use plan or, where such a plan has not been adopted, within two 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?	☐	☐	☐	■
6	For a project within the vicinity of a private airstrip, would the project expose people residing or working in the project area to excessive noise levels?	☐	☐	☐	■

1. Exposure of persons to or generation of noise levels in excess of standards established in the local general plan or noise ordinance, or applicable standard of other agencies?

Less than Significant With Mitigation Incorporated. The following evaluates potential noise impacts from the project and to the project; from transportation and stationary noise sources.

Noise Impacts from the Project – Transportation Noise Sources

The roadway noise exposure was computed using the Federal Highway Administration (FHWA) Traffic Noise Model (TNM) computer program. TNM Version 2.5 is the latest state-of-the-art program used for predicting noise impacts in the vicinity of roadways. Table 6[1] lists the arterial roadway vehicle mix percentages for day, evening and night time periods. The vehicles are divided into automobiles, medium trucks and heavy trucks.

Table 6 – Aerial Roadway Vehicle Mix Percentages

	Day	Evening	Night
Automobiles	75.51%	12.57%	9.34%
Medium Trucks	1.56%	0.09%	0.19%
Heavy Trucks	0.64%	0.02%	0.08%

The project will be subject to noise from the three roadways closest to the site: The City Drive, The City Way and The City Boulevard E. The centerline of the 5 Freeway is at least 1,300 feet away from the nearest point of the proposed project site. The noise contour map within the City of Orange's General Plan EIR contains unmitigated contours and therefore does not take into account the shielding that the buildings between the freeway and the proposed project site will provide. Due to distance reduction and shielding from the buildings, the 24-hour noise level (dB CNEL) at the proposed project site from the 5 Freeway will be less than significant. The traffic on The City Drive will be the dominate roadway noise source at the proposed project site.

The latest existing with and without project (2012) and future with and without project (2017) average daily traffic (ADT) volumes for the roadways were obtained from Linscott, Law & Greenspan, Engineers. The speed limits for the roadways were obtained from a site visit. The traffic volumes and speeds utilized in calculating the traffic noise exposure are presented in Table 7.

Table 7 – Traffic Volumes and Speeds

Roadway	Type	Existing (2012)		Future (2017)		Speed Limit (mph)
		Without Project	With Project	Without Project	With Project	
The City Drive	Arterial	30,830	31,000	36,240	36,410	35
The City Way	Arterial	8,770	9,020	9,790	10,040	25
The City Boulevard E, South of the Existing	Arterial	5,070	5,490	5,350	5,770	25
The City Boulevard E, North of the Existing	Arterial	4,660	4,910	4,910	5,160	25

[1] County of Orange Environmental Management Agency, *Sound Attenuation Guidelines,* File C54-115, September 4, 1984.

Tables 8 and 9 show the roadway traffic noise at 50 feet from the outermost lane of the roadways for existing (2012) and future (2017) timeframes, respectively; both with and without the project. Under existing (2012) conditions the proposed project will result in noise level increases between 0.0 and 0.3 dB CNEL. For future (2017) conditions, the proposed project will typically result in noise level increases between 0.0 and 0.2 dB CNEL.

Table 8 – Existing (2012) Conditions – With and Without Project

Roadway Segment	Noise Level (dB CNEL) at 50 Feet		Change Due To Project
	Without Project	With Project	
Corner of The City Drive and Medical Circle Drive	65.4	65.4	0.0
Corner of The City Drive and The City Way	65.6	65.6	0.0
Corner of The City way and The City Boulevard E	61.7	61.8	0.1
Corner of The City Boulevard E and The City Boulevard W	58.2	58.5	0.3

Table 9 – Future (2017) Conditions – With and Without Project

Roadway Segment	Noise Level (dB CNEL) at 50 Feet		Change Due To Project
	Without Project	With Project	
Corner of The City Drive and Medical Circle Drive	66.1	66.1	0.0
Corner of The City Drive and The City Way	66.3	66.3	0.0
Corner of The City way and The City Boulevard E	62.3	62.4	0.1
Corner of The City Boulevard E and The City Boulevard W	58.7	58.9	0.2

The City of Orange's Noise Element defines when an increase in ambient noise levels is assumed to be a significant noise impact. A significant noise impact will occur if a project causes ambient noise levels to exceed the following:

- Where the existing ambient noise level is less than 65 dB CNEL, a project related permanent increase in ambient noise levels of 5 dB CNEL or greater.
- Where the existing ambient noise level is greater than 65 dB CNEL, a project related permanent increase in ambient noise levels of 3 dB CNEL or greater.

As mentioned in Section 2.0 – Existing Noise Environment, the existing worst-case noise levels range from 61.0 dB CNEL to 71.8 dB CNEL. Therefore a significant noise impact will occur if the proposed project causes an increase in ambient noise levels of 3 dB CNEL or greater.

<u>With the implementation of the proposed project, changes in traffic noise due to the project will be less than significant and therefore no mitigation is required</u>.

According to the noise section of the City of Orange's General Plan EIR (Dated 4/8/2010), the future (2030) without implementation of the General Plan noise level for The City Drive between Metropolitian and Chapman Avenue (adjust to the proposed project site) at a distance of 100 feet will be as high as 65.0 dB CNEL. At 50 feet, this noise level will be as high as 68.0 dB CNEL. The future (2030) with implementation of the General Plan noise level will be as high as 66.2 dB CNEL. At 50 feet, this noise level will be as high as 69.2 dB CNEL.

The ADT volume used to calculate the noise level for The City Drive was obtained from the traffic analysis prepared for the Circulation Element of the General Plan (P&B America, Inc. 2008), which included traffic generated from development of the project site, as well as development projects citywide. The traffic noise level represents an application of conservative traffic noise modeling methodologies, which assume no natural or artificial shielding form existing or proposed structures or topography.

According to the document, the implementation of the General Plan under future (2030) conditions would result in a change of +1.2 dB CNEL for The City Drive adjacent to the proposed project site. Therefore, according to the document, the change in traffic noise (including traffic noise generated from the projects site) under 2030 conditions will be less than the 3 dB threshold and therefore less than significant. Because the project is consistent with the General Plan land use designation for the site, project build out would not cause any new impact not previously considered in the Program EIR, not an increase in the severity of an impact. No further 2030 cumulative noise analysis is necessary.

Noise Impacts from the Project – Stationary Noise Sources

Heating, Ventilation and Air Conditioning (HVAC) Units

The proposed multi-family residential development will lead to the introduction of heating, ventilation and air conditioning (HVAC) units which will contribute to the ambient noise environment. The new HVAC units are expected to be located on the roofs of the buildings and generate noise by cycling on and off. The HVAC units will be grouped into clusters. According to the plans provided by AMLI Residential, the largest cluster will be 24 units.

Potential noise impacts from the HVAC units would be mitigated by selecting and installing the HVAC units to comply with the City of Orange's Noise Ordinance of the Municipal Code. The selection of the HVAC units shall be verified prior to the issuance of building permits. Currently, there are not any adjacent residential land uses for this section of the noise ordinance to be applicable. As a result, noise from the HVAC units will have a less than significant impact. To ensure that HVAC units are selected and installed to comply with the City of Orange's Noise Ordinance of the Municipal Code, Project Design Feature NO-1 is recommended.

Project Design Feature NO-1:

- The HVAC units must be selected and installed to comply with the City of Orange's Noise Ordinance of the Municipal Code.

Construction

Construction activities related to development of the proposed project will occur in different phases, approximately 9 months for the hotel parking garage and 24 months for the apartments.

Construction activities will cause short-term elevated noise levels throughout the proposed project site. Noise generated during construction will be dependent on the mix and make up of construction equipment used during construction, site geometry and the distance between the noise source and receiver. Construction will occur throughout the project site and will not be concentrated in or confined to one specific area. Therefore, construction noise will be acoustically dispersed throughout the project site and not concentrated in one area near adjacent noise sensitive land-uses.

Construction will consist of demolition of existing structures, grading, excavation and foundation work, framing and interior work. A list of typical construction equipment that will be used was obtained from AMLI Residential. Some of the typical construction equipment that will be used consists of: excavators, graders and scrapers, backhoes, loaders, dump trucks, bull dozers, compactors, generators, air compressors, cranes, forklifts, jack hammers, concrete pumps and concrete trucks. According to AMLI Residential, pile driving will not occur, which is usually the loudest of all construction related activities.

Noise levels associated with various construction phases where all pertinent equipment is present and operating, at a reference distance of 50 feet, are shown in Table 10. As provided in Table 10, the highest overall average noise level generated during construction is estimated to be 88 dBA at a distance of 50 feet during excavation and finishing phases. The noise levels presented in Table 10 are value ranges that average the magnitude of construction noise over time. The value range is provided because construction activity is intermittent and the power demands on construction equipment are intermittent and cyclical.

Table 10 – Typical Noise Levels from Construction Activities for Domestic Housing Projects

Construction Activity	Average Sound Level at 50 Feet (dBA)[1]	Standard Deviation (dB)
Ground Clearing	83	8
Excavation	88	8
Foundations	81	10
Erection	81	10
Finishing	88	7

Source: U.S. Environmental Protection Agency, 1971.

Noise levels generated by construction equipment (or by any point source) decrease at a rate of approximately 6 dBA per doubling of distance from the source. Therefore, if a particular construction activity generated average noise levels of 88 dBA at 50 feet, the Leq will be 82 dBA at 100 feet, 76 dBA at 200 feet, 70 dBA at 400 feet and so on.

The closest structures to the project site are located 40 feet to the north (hotel), 100 feet to the south (restaurant), 130 feet to the east (medical center and hospital) and 175 feet to the west (office building and parking structure). Using the highest overall average noise level from

excavation and finishing phases, the worst-case noise levels at the closest structures would be as high as 86 dBA, 82 dBA, 80 dBA and 77 dBA, respectively.

The City of Orange's Noise Ordinance of the Municipal Code exempts construction activities from the noise standard (providing that such activities not occur between 8 p.m. and 7 a.m. on weekdays and Saturday, and at any time on Sunday and Federal holidays).

Currently there are not any adjacent noise- and vibration-sensitive land uses, such as residential, to the proposed project, but there is a hospital and hotels nearby. Although the construction activities could result in infrequent periods of high noise, this noise will not be sustained and will occur only during the City's permitted construction hours. Short-term noise levels will be reduced to a less than significant level with the implementation by the superintendent of the contractor who works for the developer of Mitigation Measure NO-1 described below.

Mitigation Measure NO-1:

- As required by the City of Orange's Noise Ordinance of the Municipal Code, construction shall not occur between 8 p.m. and 7 a.m. on weekdays and Saturday, and at anytime on Sundays and Federal holidays.

- All heavy construction equipment used on the proposed project shall be maintained in good operating condition, with all internal combustion, engine-driven equipment fitted with intake and exhaust muffles that are in good condition.

- All mobile or fixed noise producing equipment used on the project site that is regulated for noise output by a local, state, or federal agency shall comply with such regulation while in the source of project activity.

- Where feasible, use electrically powered equipment instead of pneumatic or internal combustion powered equipment.

- All stationary noise-generating equipment shall be located as far away as possible from neighboring property lines.

- Post signs prohibiting unnecessary idling of internal combustion engines.

- A truck route haul plan shall be created to avoid residential areas.

- The use of noise producing signals, including horns, whistles, alarms and bells will be for safety warning purposes only.

Noise Impacts to the Project – Transportation Noise Sources

Exterior

The City of Orange's Noise Element of the General Plan specifies guidelines for acceptable community noise levels segmented by land use. According to the City of Orange's Land Use Element of the General Plan, the proposed project is located within an area designated as urban mixed-use. For multi-family residential land use in this area, the exterior noise standard is 65 dB CNEL for common outdoor recreational areas only.

The roadway noise exposure at the building faces were calculated using Federal Highway Administration (FHWA) Traffic Noise Model (TNM) computer program. The greatest future (2017) with project roadway noise exposure for the project will occur at the building face adjacent to The City Drive and was calculated to be as high as 69.2 dB CNEL. According to the noise section of the City of Orange's General Plan EIR, the future (2030) with implementation of the General Plan noise level for The City Drive will be as high as 69.2 dB CNEL at a distance of 50 feet from the centerline of The City Drive.

The worst-case future (2017 and 2030) with project exterior noise levels at Courtyard 2 of the proposed project was calculated to be as high as 57.9 dB CNEL. The worst-case future (2017 and 2030) with project exterior noise levels within Courtyards 1 and 3 of the proposed project was estimated to be less than 65 dB CNEL because the courtyard are surrounded on all sides by the buildings of the project and do not have direct line of sight to the adjacent roadways. Therefore, since the exterior noise levels will be less than 65 dB CNEL for the common outdoor recreational areas in 2017 and 2030 future years, the proposed project is projected to comply with the exterior noise standard in the City of Orange's Noise Element of the General Plan.

To ensure that the exterior noise standard of the City of Orange's Noise Element of the General plan is met, Mitigation Measure NO-2 is recommended.

It is also important to note that the UCI Medical Center helipad is located at the northeast corner of the intersection of The City Drive and Chapman Avenue. According to the City of Orange's General Plan EIR, helicopter activity from emergency and medical helicopters can contribute to the general noise environment in the City. In particular, low-flying helicopters can be a source of annoyance to residences, especially at night. Helicopter landing pads and operation are regulated by the Federal Aviation Administration (FAA) and Caltrans Department of Aeronautics. Helicopter noise levels are considered notable; however they would not have a substantial impact on the health and safety of people residing or working in the City and will be less than significant. However, Mitigation Measure NO-3 is recommended to provide disclosure information to tenants about noise from the UCI Medical Center helipad.

According to the City of Orange's Noise Element of their General Plan, the City of Orange will also work with the FAA, Caltrans Department of Aeronautics and the Orange County Airport Land Use Commission to ensure compliance with all state and federal laws pertaining to helicopter operations. Also, the City of Orange's Noise Ordinance of their Municipal Code states, "Any medical device, apparatus or equipment used, related to or connected with emergency machinery, vehicle or work is exempt."

Another noise source in the project area is fireworks from nearby sports and entertainment venues (Disneyland, Angels Stadium). Noise levels from fireworks are considered notable; however they would not have a substantial impact on the health and safety of people residing or working in the City and will be less than significant. However, Mitigation Measure NO-3 is recommended to provide disclosure to the tenants about fireworks noise from nearby sports and entertainment venues.

Interior

The City of Orange's Noise Element of the General Plan as well as the 2010 California Building Code (CBC) specifies an interior noise standard of 45 dB CNEL for multi-family residential land

use. The interior habitable environment excludes bathrooms, closets and corridors. The interior noise standard shall be satisfied with windows in the closed position and mechanical ventilation shall be provided per uniform building code (UBC) requirements.

To comply with the interior noise standard, the buildings must provide sufficient exterior to interior noise attenuation to reduce the inter noise exposure to acceptable levels. The worst case future (2017) with project exterior noise level at the building face adjacent to The City Drive was calculated to be as high as 69.2 dB CNEL. This is also the same noise level as contained within the noise section of the City of Orange's General Plan EIR for future (2030) with implementation of the General Plan at a distance of 50 feet from the centerline of The City Drive.

This means that the buildings must provide at least 24.2 dB of exterior to interior noise reduction with windows closed. Based upon our experience, new standard construction in southern California will typically provide 20-30 dB of noise reduction.

The following is a typical construction summary for the type of buildings proposed:

Roofs are either built-up and/or incorporate tiles on the exterior and gypsum drywall on the interior surface. Joist spaces are insulated.

Exterior walls are wood stud construction with stucco on the exterior and gypsum drywall on the interior. All exterior walls include insulation in the stud cavities.

Operable and fixed windows dual glazed with a STC rating of 26-30.

French and sliding glass doors dual glazed with a STC rating of 26-30.

Adequate mechanical ventilation with windows closed must be provided as per the 2010 California Building Code (Title 24, Part 2, Volume 1, Chapter 12 – Interior Environment, Section 1203 – Ventilation) and the 2010 California Mechanical Code (Title 24, Part 4, Chapter 4 – Ventilation Air Supply). To ensure that adequate mechanical ventilation with windows closed is provided, Project Design Feature NO-2 is recommended.

<u>Typical construction of the buildings (as summarized above) should provide enough noise reduction to comply with the interior noise standard in the City of Orange's Noise Element of the General Plan</u>. <u>Because the precise details of the building design cannot be known and to ensure that the interior noise standard of the City of Orange's Noise Element of the General plan is met, Mitigation Measure NO-2 is recommended</u>.

Mitigation Measure NO-2:

- To ensure that the exterior and interior noise standards of the City of Orange's Noise Element of the General plan are met, it is recommended full exterior and interior noise analysis reports be prepared by an acoustical engineering consultant once complete civil and architectural plans have been developed.

  The exterior noise analysis report should address compliance of the project with the City's exterior noise standard. Exterior noise levels for existing and future conditions should be estimated based on computer modeling. The latest version of the Federal Highway Administration (FHWA) Traffic Noise Model (TNM) should be used to model the noise from

the adjacent roadways. If necessary, mitigation measures to protect the common outdoor recreational areas of the project should be developed. Mitigation measures may include, but are not limited to: a berm, wall or combination of berm/wall.

The interior noise analysis report should address compliance of the project with the City's interior noise standard. The outdoor-to-indoor noise reduction of the proposed unit plans will be calculated based upon construction details specified in the architectural plans for the project. If necessary, mitigation measures to protect indoor living areas of the project will be developed for each plan type. Mitigation measures may include, but are not limited to: increasing the STC rating of the operable/fixed windows and increasing the STC rating of the French or sliding glass doors.

Mitigation Measure NO-3:

- Full disclosure information should be provided to tenants about intermittent noise from the UCI Medical Center helipad and fireworks from nearby sports and entertainment venues.

Project Design Feature NO-2:

- Adequate mechanical ventilation with windows closed must be provided as per the 2010 California Building Code (Title 24, Part 2, Volume 1, Chapter 12 – Interior Environment, Section 1203 – Ventilation) and the 2010 California Mechanical Code (Title 24, Part 4, Chapter 4 – Ventilation Air Supply).

2. Exposure of persons to or generation of excessive groundborne vibration or groundborne noise levels?

Less Than Significant Impact. Groundborne vibration and groundborne noise may be generated during the construction and operations phases of the proposed project, but impacts from these effects will be less than significant, as discussed below.

Project construction may expose people to groundborne vibration. Construction activities can generate varying degrees of ground vibration, depending on the construction procedures, types of equipment used and proximity to noise- and vibration-sensitive land uses. Operation of construction equipment generates vibrations that spread through the ground and diminish in amplitude with increasing distance from the source. Vibration is typically noticed nearby when objects in a building generate noise from rattling windows or picture frames. It is typically not perceptible outdoors, and therefore, impacts are based on distance to the nearest building. The effect on buildings near a construction site varies depending on soil type, ground strata and receptor building construction. The generation of vibration can range from no perceptible effects at the lowest vibration levels, to low rumbling sounds and perceptible ranges in buildings close to a construction site. Vibration would primarily occur during the grading phase of construction. Peak vibration levels occur when construction equipment operates closest to the boundaries of the project site's property line. Although the maximum vibration could be perceptible in certain instances, peak vibration events will occur infrequently. These peak events would occur during the portions of the day when most people have increased tolerance to vibration intrusions. Also, the duration for which equipment would be working in close proximity would be limited. Construction-related vibration impacts are described below.

Structural Damage

Ground vibrations from construction activities do not often reach the levels that can damage structures. Pile-driving generate the highest levels of vibration. However, according to AMLI Residential, pile-driving will not occur during construction. Nonetheless, minor architectural (e.g. cosmetic) damage from heavy construction equipment operating at the boundary of the site could occur. Project-related construction vibration was evaluated for its potential to cause minor architectural damage based on FTA's structural damage criteria. According to guidelines from the FTA for assessing damage from vibration caused by construction equipment, the worst-case building threshold at which there is a risk of architectural damage is 0.12 peak particle velocity (PPV) in inches per second (in/sec). Heavy construction equipment operating at the project site would include bulldozers, scrapers, and compactors, which could be as close as 40 feet from the nearest hotel building to the north. Table 11 shows the vibration levels from typical earthmoving construction equipment at the reference distance of 25 feet and at the nearest structure, 40 feet away.

Table 11 – Typical Vibration Levels from Construction Equipment

Equipment	PPV (in/sec) at 25 Feet	PPV (in/sec) at 40 Feet	Approximate VdB at 25 Feet	Approximate VdB at 40 Feet
Hoe Ram	0.089	0.044	87	81
Large Bulldozer	0.089	0.044	87	81
Caisson Drilling	0.089	0.044	87	81
Loaded Trucks	0.076	0.038	86	80
Jackhammer	0.035	0.017	79	73
Small Bulldozer	0.003	0.001	58	52

Source: Federal Transit Administration (FTA), Transit Noise and Vibration Impact Assessment, May 2006

As shown in Table 11, construction activities associated with the project would not exceed 0.044 PPV in/sec at the nearest hotel building to the north (due to rapid decrease of vibrational energy with increasing distance from the source). These predicted values are well below the FTA's criteria for vibration-induced structural damage.

Further, according to Caltrans' research, earthmovers and haul trucks have never exceeded 0.1 PPV in/sec at 10 feet (Caltrans 2002). Currently there are not any adjacent noise- and vibration-sensitive land uses, such as residential, to the proposed project, but there is a hospital and hotels nearby. Therefore, vibration-induced structural damage will be less than significant and no mitigation is required.

Human Annoyance

The level where vibration becomes readily perceptible is 0.08 PPV in/sec, and the level where continuous vibration becomes annoying to people is 0.1 PPV in/sec. Human annoyance occurs with construction vibration rises significantly above the threshold of human perception for extended periods of time. Construction activities will be distributed throughout the project site. The closest structures to the project site are located 40 feet to the north, 100 feet to the south, 130 feet to the east and 175 feet to the west. Currently there are not any adjacent noise- and vibration-sensitive land uses, such as residential, to the proposed project, but there is a hospital and hotels nearby.

When heavy construction equipment is operating near the northern boundary of the project site, approximately 40 feet away from the nearest structure to the north, vibration levels would not exceed 0.044 PPV in/sec, and would be barely perceptible. As heavy construction equipment moves around the project site, average vibration levels at the nearest structures would diminish with increasing distance between structures and the equipment and would generally not be perceptible. Vibration during construction would be very sporadic and barely perceptible at the nearest structures, and therefore the impact will be less than significant and no mitigation measures are required.

3. A substantial permanent increase in ambient noise levels in the project vicinity above levels existing without the project?

Less than Significant Impact. See response to question 1 above; the section on noise impacts from the project – transportation noise sources as well as the section on Noise Impacts from the Project – Stationary Noise Sources, HVAC Units, which both concluded less than significant impacts.

The long-term use of the project will be residential. The proposed project will not generate high ambient noise levels or result in a significant increase in vehicle noise in the project area. Future occupants will be required to comply with the City of Orange's Noise Ordinance of the Municipal Code. Therefore, no significant permanent increase in ambient noise levels is expected as a result of project implementation. No further analysis on this issue is required.

The proposed project will include new HVAC units, which will produce periodic increases in noise at sensitive receptors surrounding the project site. These units will be selected and installed to comply with the City of Orange's Noise Ordinance of the Municipal Code. Currently, there are not any adjacent residential land uses for this section of the noise ordinance to be applicable. As a result, the noise impact will be less than significant.

4. A substantial temporary or periodic increase in ambient noise levels in the project vicinity above levels existing without the project?

Less than Significant With Mitigation Incorporated. See response to question 1 above; the section on Noise Impacts from the Project – Stationary Noise Sources, Construction, Mitigation Measure NO-1.

Construction related activities and equipment used during construction of the proposed project will result in a temporary or periodic increase in ambient noise levels above existing levels. The City of Orange's Noise Ordinance of the Municipal Code exempts construction activities from the noise standard (providing that such activities not occur between 8 p.m. and 7 a.m. on weekdays and Saturday, and at any time on Sunday and Federal holidays). However, the short-term noise from construction will be loud at times at the nearby noise-sensitive land uses and could be disruptive. Therefore, Mitigation Measure NO-1, which implements noise control measures for construction, is provided to reduce construction noise levels to a less than significant level.

5. For a project located within an airport land use plan or, where such a plan has not been adopted, within two 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?

No Impact. The proposed project is not located within an airport land use plan or within 2 miles of an airport. Therefore, implementation of the proposed project will not expose people residing or working in the project area to excessive noise levels. No further analysis of this issue is required.

6. For a project within the vicinity of a private airstrip, would the project expose people residing or working in the project area to excessive noise levels?

No Impact. The proposed project is not located within the vicinity of a private airstrip. Therefore, implementation of the proposed project will not expose people residing or working in the project area to excessive noise levels. No further analysis of this issue is required.