NOISE IMPACT ANALYSIS

STARFISH AVENUE RESIDENTIAL PROJECT

FOUNTAIN VALLEY, CALIFORNIA

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NOISE SETTING

Sound is mechanical energy transmitted by pressure waves in a compressible medium such as air. Noise is generally considered to be unwanted sound. Sound is characterized by various parameters that describe the rate of oscillation of sound waves, the distance between successive troughs or crests, the speed of propagation, and the pressure level or energy content of a given sound. In particular, the sound pressure level has become the most common descriptor used to characterize the loudness of an ambient sound level.

The decibel (dB) scale is used to quantify sound pressure levels. Although decibels are most commonly associated with sound, "dB" is a generic descriptor that is equal to ten times the logarithmic ratio of any physical parameter versus some reference quantity. For sound, the reference level is the faintest sound detectable by a young person with good auditory acuity.

Since the human ear is not equally sensitive to all sound frequencies within the entire auditory spectrum, human response is factored into sound descriptions by weighting sounds within the range of maximum human sensitivity more heavily in a process called "A-weighting," written as dB(A). Any further reference in this discussion to decibels written as "dB" should be understood to be A-weighted.

Time variations in noise exposure are typically expressed in terms of a steady-state energy level equal to the energy content of the time varying period (called LEQ), or alternately, as a statistical description of the sound pressure level that is exceeded over some fraction of a given observation period. Finally, because community receptors are more sensitive to unwanted noise intrusion during the evening and at night, state law requires that, for planning purposes, an artificial dB increment be added to quiet time noise levels in a 24-hour noise descriptor called the Ldn (day-night) or the Community Noise Equivalent Level (CNEL). The CNEL metric has gradually replaced the Ldn factor, but the two descriptors are essentially identical.

CNEL-based standards are generally applied to transportation-related sources because local jurisdictions are pre-empted from exercising direct noise control over vehicles on public streets, aircraft, trains, etc. The City of Fountain Valley therefore regulates the noise exposure of the receiving property through land use controls.

For "stationary" noise sources the City has established noise performance standards designed to not adversely impact adjoining uses. These standards are articulated in the Municipal Code. These standards recognize the varying noise sensitivity of both transmitting and receiving land uses. The property line noise performance standards are normally structured according to land use and time-of-day.

CITY OF FOUNTAIN VALLEY NOISE STANDARDS

The Noise Element of the City of Fountain Valley General Plan establishes noise quality standards for land use categories based on the State of California Office of Noise Control land use compatibility recommendations. Community noise exposures are recommended as normally acceptable, conditionally acceptable, normally unacceptable, and clearly unacceptable for various classes of land use sensitivity. As shown in Table 1, the City of Fountain Valley guidelines an exterior noise exposure standard of 60 dB CNEL is the most desirable level for single-family residential uses while levels of 70 dB CNEL are acceptable for usable outdoor space (patios, decks, pools, etc.). A level of 70 dB CNEL is considered "conditionally acceptable". In a "conditionally acceptable" noise category, new construction should be undertaken only after a noise analysis has been made and needed noise insulation features have been incorporated in the project design. These standards apply to exterior recreational noise.

An interior CNEL of 45 dB is mandated by the State of California Noise Insulation Standards (CCR, Title 24, Part 6, Section T25-28) for multiple-family dwellings and hotel and motel rooms. In 1988, the State Building Standards Commission expanded that standard to include all habitable rooms in residential use, including single-family dwelling units. For this project an exterior noise level of 70 dB CNEL in any usable outdoor recreational area and interior noise level of 45 dB in any habitable residential indoor space are considered to be the appropriate compatibility standards for residential use.

Ordinance limits generally apply to "stationary" sources such as mechanical equipment, or vehicles operating on private property as shown in Table 1. The applicable requirement is a function of the time of day and appropriate zone. As seen in Table 1, the City's noise ordinance limits are stated in terms of a 30-minute limit with allowable deviations from this 50^{th} percentile standard. The louder the level becomes, the shorter the time becomes that it is allowed to occur. The code allows the "not to exceed" noise limits to be adjusted upwards if the background noise level exceeds the applicable noise standard.

Construction noise is exempt from numerical noise standards from 7 a.m. to 8 p.m. Monday through Friday and 9 a.m. through 8 p.m. on Saturdays with no construction allowed on Sundays and any legal holiday.

Table 1
Fountain Valley Noise Ordinance Standards
Section 6.28.050

Noise Zone 1	Time Period	Exterior Noise Standard
All properties located in residential zone districts	7 a.m.- 10 p.m.	55 dB
	10 p.m.-7 a.m.	50 dB

The not to exceed value for these standards is as follows:

1) The noise standard for a cumulative period of more than thirty (30) minutes in any hour; or
2) The noise standard plus five (5) dB(A) for a cumulative period of more than fifteen (15) minutes in any hour; or
3) The noise standard plus ten (10) dB(A) for a cumulative period of more than five (5) minutes in any hour; or
4) The noise standard plus fifteen (15) dB(A) for a cumulative period of more than one (1) minute in any hour; or
5) The noise standard plus twenty (20) dB(A) for any period of time

The Municipal Code has the following caveat:

In the event the ambient noise level exceeds any of the first four noise limit categories set forth in subsection (b) of this section, the cumulative period applicable to said category shall be increased to reflect said ambient noise level. In the event the ambient noise level exceeds the fifth noise limit category, the maximum allowable noise level under said category shall be increased to reflect the maximum ambient noise level. (Ord. 806 § 2, 1976)

BASELINE NOISE LEVELS

Short term on-site noise measurements were made to document baseline levels in the project area. These help to serve as a basis for projecting future noise exposure from the project upon the surrounding community and noise from the community on the project. Noise measurements were conducted on Thursday, February 25, 2021, at approximately 3 p.m., at the two locations indicated below. A map of the locations is provided in Figure 2.

Measured Noise Levels (dBA)

Site No.	Location	Leq	Lmax	Lmin
1	Adjacent to Starfish Avenue	65.9	78.0	44.2
2	Back of Site, near adjacent homes (off Winemast Street)	59.4	63.5	37.9

Monitoring experience shows that 24-hour weighted CNELs can be reasonably well estimated from mid-afternoon noise readings. CNELs are approximately equal to Leq plus 2-3 dBA (Caltrans Technical Noise Supplement, 2009).

Meter location 1 is representative of noise levels at homes closest to Starfish Avenue. The 65.9 dBA Leq would translate to a CNEL of 68-69 dBA. Meter 2 was located towards the back of the site, and noise levels are lower. The observed 59.4 dBA Leq would translate to a CNEL of 61-62 dBA.

The City of Fountain Valley considers a noise level of up to 70 dB CNEL "conditionally acceptable" for residential uses. In a "conditionally acceptable" noise category, new construction should be undertaken only after a noise analysis has been made and needed noise insulation features have been incorporated in the project design.

Figure 1
Noise Meter Locations

NOISE IMPACTS

NOISE SIGNIFICANCE CRITERIA

According to the current CEQA Appendix G guidelines, noise impacts are considered potentially significant if they result in:

1. Generation of a substantial temporary or permanent increase in ambient noise levels in the vicinity of a project in excess of standards established in the local general plan or noise ordinance, or applicable standards of other agencies?
2. Generation of excessive groundborne vibration or groundborne noise levels?
3. 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 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?

The terms "substantial" or "excessive" are not defined in most environmental compliance guidelines. Noise analysis methodology is accurate only to the nearest whole decibel and the human ear can only clearly detect changes of around 3 dBA; changes of less than 3 dBA, while audible under controlled circumstances, are not readily discernable in an outdoor environment. Thus, a change of 3 dBA is considered as a perceptible audible change. It would require a doubling of traffic to create a +3 dBA noise increase due to the logarithmic nature of noise calculations. The project is not within the vicinity of an airport.

SOURCES OF IMPACT

Several characteristic noise sources are typically identified with general development such as the proposed residences. Construction activities, especially heavy equipment, will create short-term noise increases near the project site. Upon completion, vehicular traffic on streets around the proposed project area may create a higher noise exposure. In already-developed areas, the added land use intensity associated with a single project only increases traffic incrementally on existing roadways. These noise impacts are often masked by the baseline, and often preclude perception of any substantial noise level increase. Proposed residential uses represent a passive noise source and it is not anticipated that addition of the proposed homes would measurably alter the existing noise environment.

SENSITIVE RECEPTORS

The project site is located at 9801 Starfish Avenue in the City of Fountain Valley, California. The project site is currently developed with a basketball court used by the adjacent church facility. The project consists of developing the project site with 7-single family dwelling units. Adjacent residential uses to the north and east uses take access from Windmast Street.

Homes to the north of the site are 50-60 feet from the closest on-site structure and there is an intervening 6-foot block wall. Homes to the east have an approximate 20-foot setback to the property line. On-site structure rear yards have an 18-foot setback to the shared property line. The AC condensers have an approximate 16-foot setback to the property line. There will be a 6-foot block wall at the shared property line.

There is a church and church parking lot to the west along Starfish Avenue. A pre-school and kindergarten program operate at the church. The new private access road, with a 29-foot width, will be adjacent to the church. The front yards of project homes will be setback 20-feet from the road. In total, the homes themselves will be approximately 95-feet from the closest church building and there will be a new 6-foot block wall at the shared property line.

CONSTRUCTION NOISE IMPACTS

Temporary construction noise impacts vary markedly because the noise strength of construction equipment ranges widely as a function of the equipment used and its activity level. Short-term construction noise impacts tend to occur in discrete phases dominated by large, earth-moving equipment sources for demolition and grading. During construction and paving, equipment is generally less noisy.

In 2006, the Federal Highway Administration (FHWA) published the Roadway Construction Noise Model that includes a national database of construction equipment reference noise emissions levels. In addition, the database provides an acoustical usage factor to estimate the fraction of time each piece of construction equipment is operating at full power during a construction phase. The usage factor is a key input variable that is used to calculate the average Leq noise levels.

Table 3 identifies highest (Lmax) noise levels associated with each type of equipment identified for use, then adjusts this noise level for distance to the closest sensitive receptor and the extent of equipment usage (usage factor), which is represented as Leq. The table is organized by construction activity and equipment associated with each activity

Quantitatively, the primary noise prediction equation is expressed as follows for the hourly average noise level (Leq) at distance D between the source and receiver (dBA):

Leq = Lmax @ 50’ – 20 log (D/50’) + 10log (U.F%/100) – I.L.(bar)
Where:
Lmax @ 50’ is the published reference noise level at 50 feet
U.F.% is the usage factor for full power operation per hour
I.L.(bar) is the insertion loss for intervening barriers

For the proposed project, the construction fleet would include equipment such as shown in Table 2. Table 2 describes the noise level for each individual piece of equipment at a reference 50-foot distance.

Table 2
Construction Equipment Noise Levels

Phase Name and Duration	Equipment	Usage Factor[1]	Noise @ 50 feet (dB)[2]	Hourly Noise Level @ 50 feet (dB))
Demolition	Concrete Saw	20%	90	83
	Dozer	40%	85	82
	Loader/Backhoe	37%	78	74
Grading	Grader	40%	85	81
	Dozer	40%	85	82
	Loader/Backhoe	37%	78	74
Construction	Crane	16%	81	73
	Loader/Backhoe	37%	78	74
	Welders	46%	74	71
	Generator Set	50%	81	78
	Forklift	20%	75	69
Paving	Paver	50%	77	74
	Mixer	40%	79	75
	Paving Equipment	40%	76	72
	Loader/Backhoe	37%	78	74
	Roller	20%	80	74

Source: FHWA's Roadway Construction Noise Model, 2006

1. Estimates the fraction of time each piece of equipment is operating at full power during a construction operation
2. The Lmax values presented are the actual measured values summarized in the Roadway Noise Model User Guide (FHWA 2006) unless the actual is unavailable in which case the equipment specifications were used.

As discussed, this project could have setbacks closer or farther than the 50-foot reference distance.

The distances that were examined are as follows:

- 60 feet to homes at northern boundary.
- 35 feet to homes at eastern boundary.
- 95 feet to closest church building at western boundary.

A block wall would assist in blocking construction noise at the adjacent uses. A -5 dBA noise credit was taken for the 6-foot wall.

At the indicated setback distances, the noise levels shown in Table 3 would likely be observed:

Table 3
Construction Noise Equipment Levels at Off-Site Sensitive Uses (dBA Leq)

Phase Name and Duration	Equipment	Noise @ Northern Perimeter Homes	Noise @ Eastern Perimeter Homes	Noise @ Closest Church Structure
Demolition	Concrete Saw	76	81	72
	Dozer	75	80	71
	Loader/Backhoe	67	72	63
Grading	Grader	74	79	70
	Dozer	75	80	71
	Loader/Backhoe	67	72	63
Construction	Crane	66	71	62
	Loader/Backhoe	67	72	63
	Welders	64	69	60
	Generator Set	71	76	67
	Forklift	62	67	58
Paving	Paver	67	72	63
	Mixer	68	73	64
	Paving Equipment	65	70	61
	Loader/Backhoe	67	72	63
	Roller	67	72	63

Older homes with single pane windows can reduce noise levels by 25 dB with the windows closed[1]. However, most modern homes are constructed with dual paned windows, which can afford up to a 30-dB noise reduction with closed windows. This would mean that homes to the north would have an interior noise level of 52-57 dBA and homes to the east would have an interior noise level of 51-56 dBA. Church classrooms could have an interior noise level of 42-47. This noise reduction could be maintained only on a temporary basis, since it requires that windows remain closed at all times assuming the structures have air conditioning.

Indoor speech interference can be expressed as a percentage of sentence intelligibility between two average adults with normal hearing speaking fluently in relaxed conversation approximately one meter apart in a typical living room or bedroom (EPA 1974). Indoor sound levels of up to 45 dBA Leq allow 100% intelligibility of sentences. At a 52-dBA level intelligibility is reduced slightly but still around 97%. Church classrooms, with an interior noise level of 42-47 dBA would be capable of maintaining an acceptable interior noise environment with closed windows.

The potential for construction-related noise to adversely affect nearby residential receptors would depend on the location and proximity of construction activities to these receptors. Most construction equipment will be located at a much greater setback than the worst-case examples provided in Table 3.

[1] U.S. Environmental Protection Agency, Information on Levels of Environmental Noise Requisite to Protect Public Health and Welfare with an Adequate Margin of Safety, 1974.

In addition to adhering to the allowable hours of construction (7 a.m. to 8 p.m. Monday through Friday and 9 a.m. through 8 p.m. on Saturdays with no construction allowed on Sundays and any legal holiday) the following measures are recommended to ensure construction noise impacts are reduced to the lowest level possible:

- Locate stationary construction equipment away from the occupied residential residences or church classroom buildings; and
- Shut off construction equipment that is not in use; and
- Use electrical power to run air compressors and similar power tools.

These measures are included as conditions on any project construction permits and these limits will serve to minimize any adverse construction noise impact potential. Although construction equipment noise may be noticeable at times, construction noise impacts are minimized by time restrictions placed on permits which in addition to the recommended measures will minimize any adverse noise impact.

CONSTRUCTION ACTIVITY VIBRATION

Ground-borne vibration occurs 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 groundborne vibration. Within the "soft" sedimentary surfaces of much of Southern California, ground vibration is quickly damped out. Groundborne vibration is almost never annoying to people who are outdoors (FTA 2006).

Groundborne vibrations from construction activities rarely reach levels that can damage structures. Because vibration is typically not an issue, very few jurisdictions have adopted vibration significance thresholds. Vibration thresholds have been adopted for major public works construction projects, but these relate mostly to structural protection (cracking foundations or stucco) rather than to human annoyance.

The vibration descriptor commonly used to determine structural damage is the peak particle velocity (ppv) which is defined as the maximum instantaneous positive or negative peak of the vibration signal, usually measured in in/sec. The range of such vibration is shown in Table 4.

Table 4
Human Response To Transient Vibration

Average Human Response	ppv (in/sec)
Severe	2.00
Strongly perceptible	0.90
Distinctly perceptible	0.24
Barely perceptible	0.03

Source: Caltrans Transportation and Construction Vibration Guidance Manual, 2013.

Over the years, numerous vibration criteria and standards have been suggested by researchers, organizations, and governmental agencies. There are no Caltrans or Federal Highway Administration standards for vibration.

According to Caltrans, the threshold for structural vibration damage for modern structures is 0.5 in/sec for intermittent sources, which include impact pile drivers, pogo-stick compactors, crack-and-seat equipment, vibratory pile drivers, and vibratory compaction equipment. The American Association of State Highway and Transportation Officials (AASHTO) (1990) identifies maximum vibration levels for preventing damage to structures from intermittent construction or maintenance activities for residential buildings in good repair with gypsum board walls to be 0.4–0.5 in/sec. The damage threshold criterion of 0.2 in/sec is appropriate for fragile buildings. For the purpose of this analysis because area residences can be older, the 0.2 in/sec damage threshold for older fragile buildings is used as the evaluation criteria. Below this level there is virtually no risk of building damage. Table 5 shows the predicted vibration levels generated by construction equipment at varying distances.

Table 5
Estimated Vibration Levels During Project Construction

Equipment	PPV at 25 ft (in/sec)	PPV at 35ft (in/sec)	PPV at 60 ft (in/sec)	PPV at 90 ft (in/sec)
Large Bulldozer	0.089	0.053	0.024	0.013
Loaded trucks	0.076	0.046	0.021	0.011
Jackhammer	0.035	0.021	0.009	0.005
Small Bulldozer	0.003	0.002	0.001	<0.001

Source: FHWA Transit Noise and Vibration Impact Assessment

The calculation to determine PPV at a given distance is:

PPVdistance = PPVref*(25/D)^1.5

Where:

PPVdistance = the peak particle velocity in inches/second of the equipment adjusted for distance,

PPVref = the reference vibration level in inches/second at 25 feet, and

D = the distance from the equipment to the receiver.

The closest off-site home to the project has approximately a 35-foot separation. As seen on Table 5, even at a 25-foot setback the vibration levels are well below levels that could create structural damage in fragile buildings (i.e., 0.2 in/sec). Operation of jackhammers as a typical source of construction vibration would generate vibration levels below the threshold for possible cosmetic damage level. Vibration would be much less than the recommended acceptability threshold of 0.2 inches per second for fragile buildings.

VEHICULAR NOISE IMPACTS

The project is expected to generate 66 daily trips. This would translate to a CNEL of 41 dBA which is much lower than the City of Fountain Valley noise compatibility guidelines and lower than background traffic noise measured near the site.

MECHANICAL EQUIPMENT

Individual unit AC compressors are located in the rear (east facing) yards of the proposed homes. The condensers have a 16-foot setback to the property line. There will be a 6-foot block wall at the shared property line.

Variable speed air compressors have a sound power noise level of approximately 58 dBA. Adjusting for distance and the 6-foot perimeter noise wall the adjacent homes would be expected to experience a noise level in the very low 30's. The exterior noise standard for the City of Fountain Valley is 55 dBA daytime and 50 dBA at night. Noise from the HVAC equipment will not exceed thresholds at the closest sensitive uses with the 6-foot tall masonry wall at the shared property line. Regardless, all HVAC equipment would be required to demonstrate compliance with the City of Fountain Valley Noise Ordinance Standard.

SUMMARY

Short-term construction noise intrusion and vibration impacts will be limited by conditions on construction permits requiring compliance with the City of Fountain Valley Noise Ordinance. The allowed hours of construction are 7 a.m. to 8 p.m. Monday through Friday and 9 a.m. through 8 p.m. on Saturdays with no construction allowed on Sundays and any legal holiday. In addition, the following construction practices are recommended:

- Locate stationary construction equipment away from the occupied residential structures; and
- Shut off construction equipment that is not in use; and
- Use electrical power to run air compressors and similar power tools.

Project traffic noise impacts on area roadways will be less-than-significant.

Stationary source noise such as HVAC equipment at the project homes will not exceed the City of Fountain Valley noise standards at the closest existing homes to the east. Nevertheless, all HVAC equipment would be required to demonstrate compliance with the City of Fountain Valley Noise Ordinance Standard.