

Exhibit K

ACOUSTICAL ANALYSIS

**TRACT 6385
FRESNO, CALIFORNIA**

WJVA Project No. 22-52

PREPARED FOR

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INTRODUCTION

The project is a proposed 39-lot single-family residential development to be located in Fresno, California. The project site is located north of E. Copper Avenue and west of N. Willow Avenue. The City of Fresno has requested an acoustical analysis to quantify project site noise exposure and determine noise mitigation requirements. This analysis, prepared by WJV Acoustics, Inc. (WJVA), is based upon a project site plan prepared by Giannetta Engineering, traffic data provided by the Fresno Council of Governments (Fresno COG) and the findings of on-site noise level measurements. Revisions to the site plan may affect the findings and recommendations of this report. The site plan is provided as Figure 1.

Appendix A provides a description of the acoustical terminology used in this report. Unless otherwise stated, all sound levels reported are in A-weighted decibels (dB). A-weighting de-emphasizes the very low and very high frequencies of sound in a manner similar to the human ear. Most community noise standards utilize A-weighting, as it provides a high degree of correlation with human annoyance and health effects. Appendix B provides typical A-weighted sound levels for common noise sources.

NOISE EXPOSURE CRITERIA

General Plan

The City of Fresno General Plan Noise Element provides noise level criteria for land use compatibility for both transportation and non-transportation noise sources. The General Plan sets noise compatibility standards for transportation noise sources in terms of the Day-Night Average Level (L_{dn}). The L_{dn} represents the time-weighted energy average noise level for a 24-hour day, with a 10 dB penalty added to noise levels occurring during the nighttime hours (10:00 p.m.-7:00 a.m.). The L_{dn} represents cumulative exposure to noise over an extended period of time and are therefore calculated based upon *annual average* conditions. Table I provides the General Plan noise level standards for transportation noise sources.

TABLE I CITY OF FRESNO GENERAL PLAN NOISE LEVEL STANDARDS TRANSPORTATION (NON-AIRCRAFT) NOISE SOURCES			
Noise-Sensitive Land Use	Outdoor Activity Areas ¹	Interior Spaces	
	L_{dn} /CNEL, dB	L_{dn} /CNEL, dB	L_{eq} dB ²
Residential	65	45	---
Transient Lodging	65	45	---
Hospitals, Nursing Homes	65	45	---
Theaters, Auditoriums, Music Halls	---	---	35
Churches, Meeting Halls	65	---	45
Office Buildings	---	---	45
Schools, Libraries, Museums	---	---	45

1 Where the location of the outdoor activity areas is unknown or is not applicable, the exterior noise level standard shall be applied to the property line of the receiving land use.

2 As determined for a typical worst-case hour during periods of use.

Source: City of Fresno General Plan

Implementation Policy NS-1-a of the General Plan provides guidance in regards to the development of new noise sensitive land uses (including residential developments).

Desirable and Generally Acceptable Exterior Noise Environment. Establish 65 dBA L_{dn} or CNEL as the standard for the desirable maximum average exterior noise levels for defined usable exterior areas of residential and noise-sensitive uses for noise, but designate 60 dBA L_{dn} or CNEL (measured at the property line) for noise generated by stationary sources impinging upon residential and noise-sensitive uses. Maintain 65 dBA L_{dn} or CNEL as the maximum average exterior noise levels for non-sensitive commercial land uses, and maintain 70 dBA L_{dn} or CNEL as maximum average exterior noise level for industrial land uses, both to be measured at the property line of parcels where noise is generated which may impinge on neighboring properties.

The General Plan also provides noise level standards for non-transportation (stationary) noise sources. The General Plan noise level standards for non-transportation noise sources are identical to those provided in the City's Municipal code, provided below in Table II.

Implementation Policy NS-1-i of the General Plan Noise Element provides guidance in regards to mitigation for new developments and projects that have potential to result in a noise-related impact at existing noise-sensitive land uses.

Mitigation by New Development. *Require an acoustical analysis where new development of industrial, commercial or other noise generating land uses (including transportation facilities such as roadways, railroads, and airports) may result in noise levels that exceed the noise level exposure criteria established by [Table I] and [Table II] to determine impacts, and require developers to mitigate these impacts in conformance with Tables 9-2 and 9-3 as a condition of permit approval through appropriate means.*

Noise mitigation measures may include:

- *The screening of noise sources such as parking and loading facilities, outdoor activities, and mechanical equipment;*
- *Providing increased setbacks for noise sources from adjacent dwellings;*
- *Installation of walls and landscaping that serve as noise buffers;*
- *Installation of soundproofing materials and double-glazed windows; and*
- *Regulating operations, such as hours of operation, including deliveries and trash pickup.*

Alternative acoustical designs that achieve the prescribed noise level reduction may be approved by the City, provided a qualified Acoustical Consultant submits information demonstrating that the alternative designs will achieve and maintain the specific targets for outdoor activity areas and interior spaces. As a last resort, developers may propose to construct noise walls along roadways when compatible with aesthetic concerns and neighborhood character. This would be a developer responsibility, with no City funding.

Implementation Policy NS-1-j of the General Plan Noise Element provides guidance in regards to the establishment of a significance threshold when determining an increase in noise levels over existing ambient noise levels.

Significance Threshold. *Establish, as a threshold of significance for the City's environmental review process, that a significant increase in ambient noise levels is*

assumed if the project would increase noise levels in the immediate vicinity by 3 dB L_{dn} or CNEL or more above the ambient noise limits established in this General Plan Update.

Commentary: When an increase in noise would result in a “significant” impact (increase of three dBA or more) to residents or businesses, then noise mitigation would be required to reduce noise exposure. If the increase in noise is less than three dBA, then the noise impact is considered insignificant and no noise mitigation is needed. By setting a specific threshold of significance in the General Plan, this policy facilitates making a determination of environmental impact, as required by the California Environmental Quality Act. It helps the City determine whether (1) the potential impact of a development project on the noise environment warrants mitigation, or (2) a statement of overriding considerations will be required.

Municipal Code

Section 15-2506 of the City of Fresno Municipal code establishes hourly acoustical performance standards for non-transportation noise sources. The standards, provided in Table II, are made more restrictive during the nighttime hours of 10:00 p.m. to 7:00 a.m. Additionally, the municipal code states that when ambient noise levels exceed or equal the levels described in Table II, mitigation shall only be required to limit noise to the existing ambient noise levels, plus five (5) dB. Section 15-2506 of the Municipal Code is consistent with Implementing Policy NS-1-I of the Noise Element of the City of Fresno General Plan (adopted 12/18/14).

TABLE II			
NON-TRANSPORTATION NOISE LEVEL STANDARDS, dBA			
CITY OF FRESNO MUNICIPAL CODE, SECTION 15-2506			
Daytime (7 a.m.-10 p.m.)		Nighttime (10 p.m.-7 a.m.)	
L _{eq}	L _{max}	L _{eq}	L _{max}
50	70	45	60
Source: City of Fresno Municipal Code			

Additional guidance is provided in Section 10-102(b) of the City’s Municipal Code. Section 10 provides existing ambient noise levels to be applied to various districts, further divided into various hours of the day. Table III describes the assumed minimum ambient noise levels by district and time. Section 10-102(b) states *“For the purpose of this ordinance, ambient noise level is the level obtained when the noise level is averaged over a period of fifteen minutes, without inclusion of the offending noise, at the location and time of day at which a comparison with the offending noise is to be made. Where the ambient noise level is less than that designated in this section, however, the noise level specified herein shall be deemed to be the ambient noise level for that location”*.

TABLE III ASSUMED MINIMUM AMBIENT NOISE LEVEL, dBA CITY OF FRESNO MUNICIPAL CODE, SECTION 10-102(B)		
DISTRICT	TIME	SOUND LEVEL, dB L _{eq}
RESIDENTIAL	10 PM TO 7 AM	50
RESIDENTIAL	7 PM TO 10 PM	55
RESIDENTIAL	7 AM TO 7 PM	60
COMMERCIAL	10 PM TO 7 AM	60
COMMERCIAL	7 AM TO 10 PM	65
INDUSTRIAL	ANYTIME	70
Source: City of Fresno Municipal Code		

Section 10-106 (Prima Facie Violation) States *“Any noise or sound exceeding the ambient noise level at the properly line of any person offended thereby, or, if a condominium or apartment house, within any adjoining living unit, by more than five decibels shall be deemed to prima facie evidence of a violation of Section 8-305.”*

For noise sources that are not transportation related, which usually includes commercial or industrial activities and other stationary noise sources (such as amplified music), it is common to assume that a 3-5 dB increase in noise levels represents a substantial increase in ambient noise levels. This is based on laboratory tests that indicate that a 3 dB increase is the minimum change perceptible to most people, and a 5 dB increase is perceived as a “definitely noticeable change.”

Appendix A provides definitions of the acoustical terminology used in this report. Unless otherwise stated, all sound levels reported in this analysis are A-weighted sound pressure levels in decibels (dB). A-weighting de-emphasizes the very low and very high frequencies of sound in a manner similar to the human ear. Most community noise standards utilize A-weighted sound levels, as they correlate well with public reaction to noise. Appendix B provides typical A-weighted sound levels for common noise sources.

PROJECT SITE NOISE EXPOSURE

The project site is located north of E. Copper Avenue and west of N. Willow Avenue, in Fresno, California. The project site is exposed traffic noise associated with vehicles on N. Willow Avenue. The distance from center of the backyards of the closest proposed lots to the centerline of N. Willow Avenue is approximately 120 feet. The distance from the center of the backyards of the closest proposed lots to West Barstow Avenue is approximately 100 feet.

Traffic Noise Exposure

Noise exposure from traffic on N. Willow Avenue was calculated for existing and future (2035) conditions using the FHWA Traffic Noise Model and traffic data obtained from Fresno COG. A description of the noise model, applied data, methodology and findings is provided below.

WJVA utilized the Federal Highway Administration (FHWA) Highway Traffic Noise Prediction Model (FHWA-RD-77-108). The FHWA Model is a standard analytical method used for roadway traffic noise calculations. The model is based upon reference energy emission levels for automobiles, medium trucks (2 axles) and heavy trucks (3 or more axles), with consideration given to vehicle volume, speed, roadway configuration, distance to the receiver, and the acoustical characteristics of the site. The FHWA Model was developed to predict hourly L_{eq} values for free-flowing traffic conditions, and is generally considered to be accurate within ± 1.5 dB. To predict L_{dn} values, it is necessary to determine the hourly distribution of traffic for a typical day and adjust the traffic volume input data to yield an equivalent hourly traffic volume.

Noise level measurements and concurrent traffic counts were conducted by WJVA staff within the project site on September 14, 2022. The purpose of the measurement was to evaluate the accuracy of the FHWA Model in describing traffic noise exposure within the project site. The traffic noise measurement site was located at a distance of approximately 80 feet from the centerline of N. Willow Avenue. The speed limit was assumed to be 55 mph (miles per hour). The project vicinity and noise monitoring site location are provided as Figure 2. A photograph showing the N. Willow Avenue noise measurement site is provided as Figure 3.

Noise monitoring equipment consisted of Larson-Davis Laboratories Model LDL-820 sound level analyzer equipped with a B&K Type 4176 1/2" microphone. The equipment complies with the specifications of the American National Standards Institute (ANSI) for Type I (Precision) sound level meters. The meter was calibrated in the field prior to use with a B&K Type 4230 acoustic calibrator to ensure the accuracy of the measurements. The microphone was located on a tripod at 5 feet above the ground. The project site presently consists of undeveloped land and a portion is currently used for industrial purposes.

Noise measurements were conducted in terms of the equivalent energy sound level (L_{eq}). Measured L_{eq} values were compared to L_{eq} values calculated (predicted) by the FHWA Model using as inputs the traffic volumes, truck mix and vehicle speed observed during the noise measurements. The results of the comparison are shown in Table IV.

From Table IV it may be determined that the traffic noise levels predicted by the FHWA Model were 0.9 dB lower than those measured for the conditions observed at the time of the noise measurements for N. Willow Avenue. This is considered to be reasonable agreement with the model and therefore no adjustments to the model are necessary.

TABLE IV COMPARISON OF MEASURED AND PREDICTED (FHWA MODEL) NOISE LEVELS TRACT 6385 FRESNO	
	N. Willow Ave.
Measurement Start Time	10:45 a.m.
Observed # Autos/Hr.	495
Observed # Medium Trucks/Hr.	0
Observed # Heavy Trucks/Hr.	60
Observed Speed (MPH)	55
Distance, ft. (from center of roadway)	80
L_{eq} , dBA (Measured)	67.6
L_{eq} , dBA (Predicted)	66.7
Difference between Predicted and Measured L_{eq}, dBA	0.9
Note: FHWA "soft" site assumed for calculations. Source: WJV Acoustics, Inc.	

Annual Average Daily Traffic (AADT) data for N. Willow Avenue in the project vicinity was obtained from Fresno COG. Truck percentages and the day/night distribution of traffic were estimated by WJVA, based upon previous studies conducted in the project vicinity since project-specific data were not available from government sources. A speed limit of 55 mph was assumed for the roadway. Table V summarizes annual average traffic data used to model noise exposure within the project site.

TABLE V		
TRAFFIC NOISE MODELING ASSUMPTIONS		
TRACT 6385, FRESNO		
	N. Willow Ave (n/o Alicante Ave)	
	Existing	2035
Annual Avenue Daily Traffic (AADT)	11,586	36,568
Day/Night Split (%)	90/10	
Assumed Vehicle Speed (mph)	55	
% Medium Trucks (% AADT)	2	
% Heavy Trucks (% AADT)	2	
Sources: Fresno COG		
WJV Acoustics, Inc.		

Using data from Table V, the FHWA Model, annual average traffic noise exposure was calculated for the closest proposed backyards from N. Willow Avenue. Table VI provides the noise exposure levels for N. Willow Avenue, at the closest proposed residential lots to the roadway.

TABLE VI MODELED TRAFFIC NOISE LEVELS, N. WILLOW AVENUE, dB, L_{dn} TRACT 6385, FRESNO		
Roadway	Existing Conditions	2035 Conditions
N. Willow Avenue (north of Alicante Avenue)	65.0	70.0
Source: WJV Acoustics Fresno COG		

Reference to Table VI indicates that the traffic noise exposure at the closest proposed lots to N. Willow Avenue would be approximately 65 dB L_{dn} for existing conditions and approximately 70 dB L_{dn} for future (2035) traffic conditions on N. Willow Avenue. Such noise exposure levels exceed the City's 65 dB L_{dn} exterior noise level standard and mitigation measures are required for compliance with the City's exterior noise level standard.

Exterior Noise Mitigation

The City of Fresno Noise Element of the General Plan establishes a 65 dB L_{dn} criterion within outdoor activity areas (backyards) of single-family homes. The project site traffic noise exposure for future (2035) traffic conditions was calculated to be approximately 70 dB L_{dn} within the closest lots along N. Willow Avenue. Such noise exposure levels exceed and meet the City of Fresno exterior noise level standard and mitigation must be incorporated into project design.

To mitigate exterior traffic noise exposure along N. Willow Avenue, it will be necessary to construct a sound wall along the project roadway frontage. The sound wall would provide acoustical shielding of the outdoor activity areas located closest to the roadway.

A sound wall insertion loss program based on the FHWA Model was used to calculate the insertion loss (noise reduction) provided by the proposed sound walls. The model calculates the insertion loss of a wall of given height based on the effective height of the noise source, height of the receiver, distance from the receiver to the wall, and distance from the noise source to the wall. The standard assumptions used in the sound wall calculations are effective source heights of 8, 2 and 0 feet above the roadway for heavy trucks, medium trucks and automobiles, respectively. The standard height of a residential receiver is five (5) feet above the ground elevation.

Based upon the above-described assumptions and method of analysis, the noise level insertion loss values for sound walls of various heights were calculated. The calculations indicated that a

sound wall along N. Willow Avenue, constructed to a minimum height of six (6) feet relative to the closest building pad elevations to the roadway would reduce traffic noise exposure within individual backyards by approximately 6 dB, resulting in a projected future noise exposure of approximately 64 dB L_{dn} at the closest residential lots along N. Willow Avenue.

The sound wall should be constructed along the entire project site frontage adjacent to N. Willow Avenue. Additionally, the sound wall should be constructed toward the west, at the southern lot line of Lot 17. The sound wall should be constructed to a minimum height of 6 feet above each lot pad elevation along N. Willow Avenue.

It should be noted, the above-described sound wall would be effective at first-floor receiver locations only, and would not provide acoustical shielding to any proposed second-floor receivers. Therefore, if two-story construction is proposed, individual second-floor balconies should not be constructed facing N. Willow Avenue, for the first row of homes adjacent to the roadway (Lots 17,18,25).

Interior Noise Exposure:

The City of Fresno interior noise level standard is 45 dB L_{dn} . The worst-case noise exposure within the proposed residential development would be approximately 70 dB L_{dn} (2035 conditions). This means that the proposed residential construction must be capable of providing a minimum outdoor-to-indoor noise level reduction (NLR) of approximately 24 dB ($70-45=25$).

A specific analysis of interior noise levels was not performed. However, it may be assumed that residential construction methods complying with current building code requirements will reduce exterior noise levels by approximately 25 dB if windows and doors are closed. This will be sufficient for compliance with the City's 45 dB L_{dn} interior standard at all proposed lots. Requiring that it be possible for windows and doors to remain closed for sound insulation means that air conditioning or mechanical ventilation will be required.

CONCLUSIONS AND RECOMMENDATIONS

The proposed 39-lot single-family residential development will comply with all City of Fresno exterior and interior noise level standards, provided the following mitigation measures are incorporated into final project design.

- A sound wall is constructed to a minimum height of six (6) feet relative to the closest building pad elevations. The sound wall should be constructed along the entire project site frontage adjacent to N. Willow Avenue. Additionally, the sound wall should be constructed toward the west, at the southern lot lines of Lot 17. The current site plan shows a 6-foot sound along both Portofino Drive and Alicante Drive, in addition to N. Willow Avenue, which will be sufficient for project compliance. Suitable construction materials include concrete blocks, masonry or stucco on both sides of a wood or steel stud wall.
- If two-story construction is proposed for the first row of homes facing N. Willow Avenue, second story balconies should not be incorporated for the first row of homes facing the roadway (Lots 17, 18, 25).
- Mechanical ventilation or air conditioning must be provided for all homes so that windows and doors can remain closed for sound insulation purposes.
- Acoustic baffles should be installed on the interior side of gable vents that face, or are perpendicular to, N. Willow Avenue, for Lots 17, 28 and 25. An example of a suitable attic vent baffle is shown by Appendix C.

The conclusions and recommendations of this acoustical analysis are based upon the best information known to WJV Acoustics Inc. (WJVA) at the time the analysis was prepared concerning the proposed lot layout plan, project site elevation, traffic volumes and roadway configurations. Any significant changes in these factors will require a reevaluation of the findings of this report. Additionally, any significant future changes in motor vehicle technology, noise regulations or other factors beyond WJVA's control may result in long-term noise results different from those described by this analysis.

Respectfully submitted,



Walter J. Van Groningen
President

WJV:wjv

[illegible]

FIGURE 2: PROJECT SITE VICINITY AND NOISE MEASUREMENT LOCATION

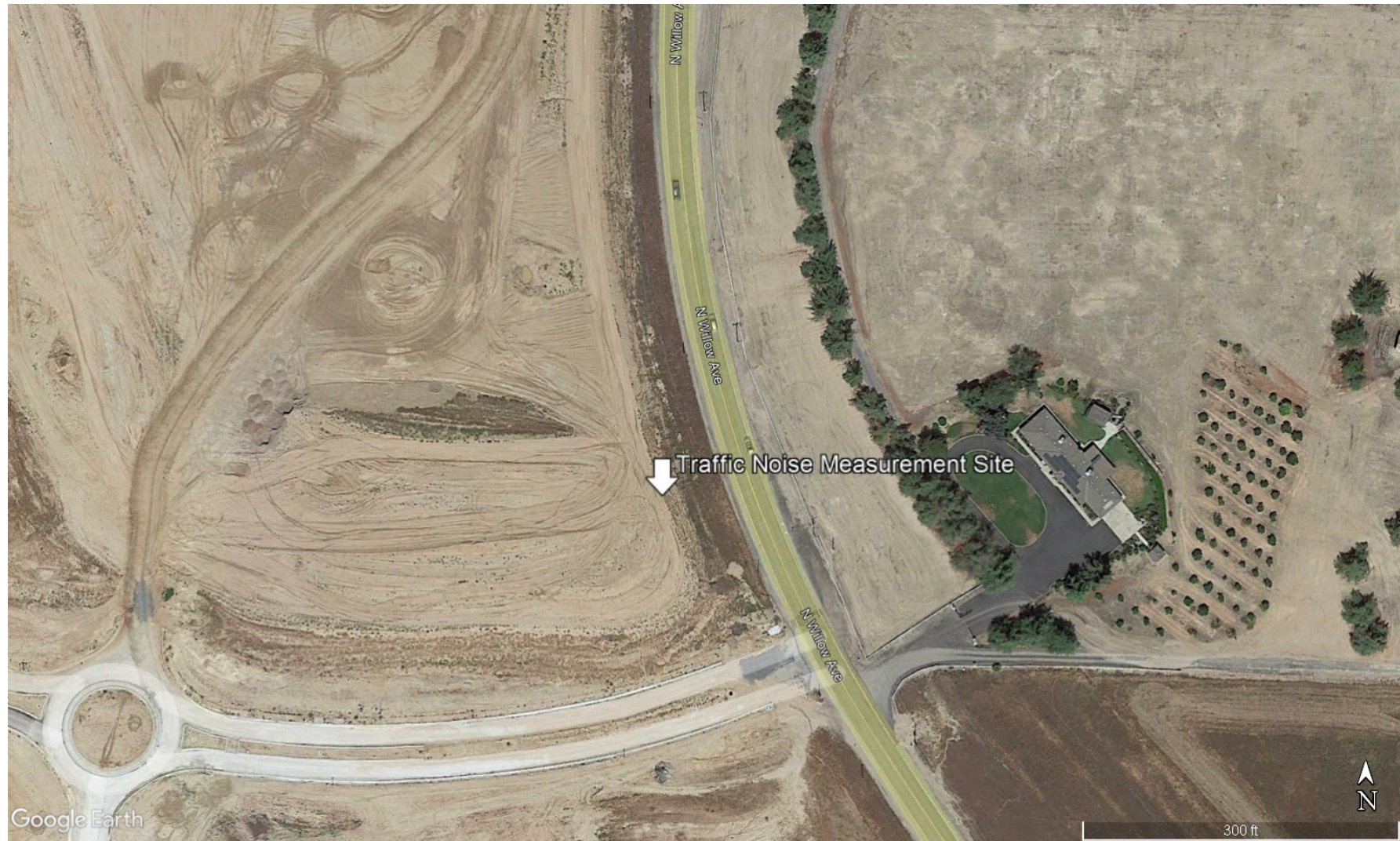


FIGURE 3: N. WILLOW AVENUE NOISE MEASUREMENT SITE



APPENDIX A

ACOUSTICAL TERMINOLOGY

AMBIENT NOISE LEVEL:	The composite of noise from all sources near and far. In this context, the ambient noise level constitutes the normal or existing level of environmental noise at a given location.
CNEL:	Community Noise Equivalent Level. The average equivalent sound level during a 24-hour day, obtained after addition of approximately five decibels to sound levels in the evening from 7:00 p.m. to 10:00 p.m. and ten decibels to sound levels in the night before 7:00 a.m. and after 10:00 p.m.
DECIBEL, dB:	A unit for describing the amplitude of sound, equal to 20 times the logarithm to the base 10 of the ratio of the pressure of the sound measured to the reference pressure, which is 20 micropascals (20 micronewtons per square meter).
DNL/L_{dn}:	Day/Night Average Sound Level. The average equivalent sound level during a 24-hour day, obtained after addition of ten decibels to sound levels in the night after 10:00 p.m. and before 7:00 a.m.
L_{eq}:	Equivalent Sound Level. The sound level containing the same total energy as a time varying signal over a given sample period. L_{eq} is typically computed over 1, 8 and 24-hour sample periods.
NOTE:	The CNEL and DNL represent daily levels of noise exposure averaged on an annual basis, while L_{eq} represents the average noise exposure for a shorter time period, typically one hour.
L_{max}:	The maximum noise level recorded during a noise event.
L_n:	The sound level exceeded "n" percent of the time during a sample interval (L_{90} , L_{50} , L_{10} , etc.). For example, L_{10} equals the level exceeded 10 percent of the time.

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ACOUSTICAL TERMINOLOGY

NOISE EXPOSURE CONTOURS:

Lines drawn about a noise source indicating constant levels of noise exposure. CNEL and DNL contours are frequently utilized to describe community exposure to noise.

NOISE LEVEL REDUCTION (NLR):

The noise reduction between indoor and outdoor environments or between two rooms that is the numerical difference, in decibels, of the average sound pressure levels in those areas or rooms. A measurement of “noise level reduction” combines the effect of the transmission loss performance of the structure plus the effect of acoustic absorption present in the receiving room.

SEL or SENEL:

Sound Exposure Level or Single Event Noise Exposure Level. The level of noise accumulated during a single noise event, such as an aircraft overflight, with reference to a duration of one second. More specifically, it is the time-integrated A-weighted squared sound pressure for a stated time interval or event, based on a reference pressure of 20 micropascals and a reference duration of one second.

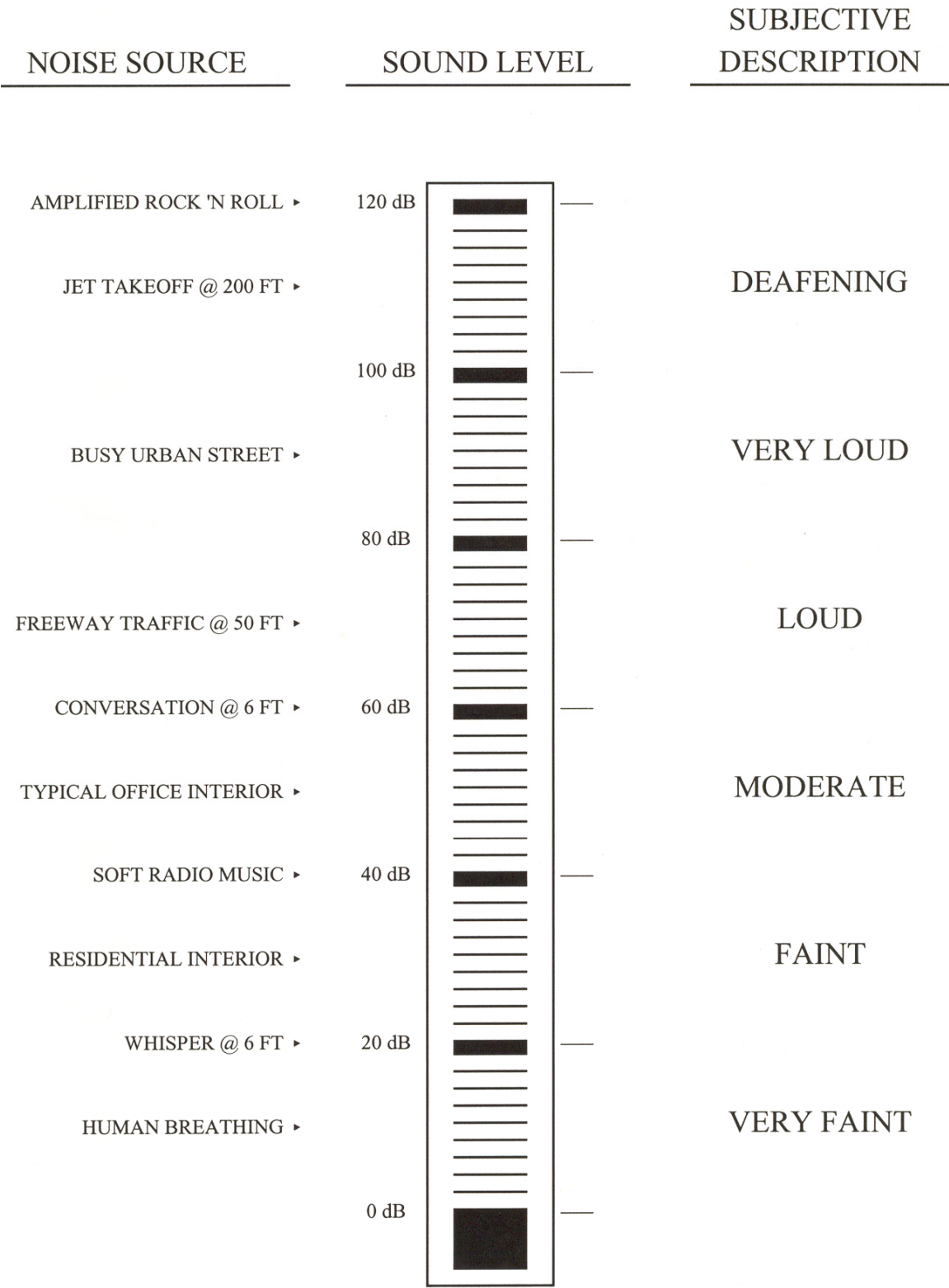
SOUND LEVEL:

The sound pressure level in decibels as measured on a sound level meter using the A-weighting filter network. The A-weighting filter de-emphasizes the very low and very high frequency components of the sound in a manner similar to the response of the human ear and gives good correlation with subjective reactions to noise.

SOUND TRANSMISSION CLASS (STC):

The single-number rating of sound transmission loss for a construction element (window, door, etc.) over a frequency range where speech intelligibility largely occurs.

APPENDIX B
EXAMPLES OF SOUND LEVELS



Appendix C
Example of Attic Vent Baffle Treatment

