

**ACOUSTICAL ANALYSIS**

**TRACT 7408  
BAKERSFIELD, CALIFORNIA**

**WJVA Project No. 22-09**

**PREPARED FOR**

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## INTRODUCTION

The project (Tract 7408) is a proposed 91-lot single-family residential development. The project site is located north of Pensinger Road and east of the future alignment of S. Allen Road, in Bakersfield. The northern portion of the project site is located adjacent to the San Joaquin Valley Railroad (SJVR) Buttonwillow Subdivision Branch Line.

The project applicant has requested an acoustical analysis to quantify project site railroad noise exposure and determine noise mitigation requirements. This analysis, prepared by WJV Acoustics, Inc. (WJVA), is based upon a project site plan provided by the project applicant, reference noise level measurements, a project site visit and reference noise level measurements previously conducted by WJVA along the SJRV railroad line. 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

### CITY OF BAKERSFIELD

For transportation noise sources (e.g., traffic and railway noise), the Metropolitan Bakersfield General Plan establishes noise level criteria in terms of the Community Noise Equivalent Level (CNEL) metric. The CNEL is the time-weighted energy average noise level for a 24-hour day, with a 4.77 dB penalty added to noise levels occurring during the evening hours (7:00 p.m.-10:00 p.m.) and a 10 dB penalty added to noise levels occurring during the nighttime hours (10:00 p.m.-7:00 a.m.). The CNEL represents cumulative exposure to noise over an extended period of time and is therefore calculated based upon *annual average* conditions.

The Noise Element establishes a land use compatibility criterion of 65 dB CNEL for exterior noise levels in outdoor activity areas of new residential developments. Outdoor activity areas generally include backyards of single-family residences, individual patios or decks of multi-family developments and common outdoor recreation areas of multi-family developments. The intent of the exterior noise level requirement is to provide an acceptable noise environment for outdoor activities and recreation.

The Noise Element also requires that interior noise levels attributable to exterior noise sources not exceed 45 dB CNEL. The intent of the interior noise level standard is to provide an acceptable noise environment for indoor communication and sleep.

For non-transportation noise sources (e.g., commercial property), the Noise Element applies hourly noise level performance standards at residential and other noise-sensitive uses. Table I summarizes the hourly standards for non-transportation noise sources.

TABLE I		
HOURLY NOISE LEVEL PERFORMANCE STANDARDS METROPOLITAN BAKERSFIELD GENERAL PLAN NON-TRANSPORTATION NOISE SOURCES		
Maximum Acceptable Noise Level, dBA		
Min./Hr. ( $L_n$ )	Day (7a-10p)	Night (10p-7a)
30 ( $L_{50}$ )	55	50
15 ( $L_{25}$ )	60	55
5 ( $L_{8.3}$ )	65	60
1 ( $L_{1.7}$ )	70	65
0 ( $L_{max}$ )	75	70

Note:  $L_n$  means the percentage of time the noise level is exceeded during an hour.  $L_{50}$  means the level exceeded 50% of the hour,  $L_{25}$  is the level exceeded 25% of the hour, etc.

## PROJECT SITE NOISE EXPOSURE

The project (Tract 7408) is a proposed 91-lot single-family residential development. The project site is located north of Pensinger Road and east of the future alignment of S. Allen Road, in Bakersfield. The northern portion of the project site is located adjacent to the San Joaquin Valley Railroad (SJVR) Buttonwillow Subdivision Branch Line. The project site is exposed to noise levels associated with railroad activity from the SJVR Buttonwillow Subdivision Branch Line.

### Railroad Noise Exposure:

The Buttonwillow Branch railroad line of the San Joaquin Valley Railroad (SJVR) is located along the northern boundary of the project site. The railroad consists of jointed rail with the top of the rails being approximately two to three feet above the grade of the project site. The closest grade crossing is located approximately 1 mile east of the project site, at Buena Vista Road. At this distance, warning horn noise would not be a factor at the project site. Federal Railroad Administration (FRA) requirements state that locomotive engineers must begin to sound the train warning horns between 15 to 20 seconds in advance of all public grade crossings. Due to the low-speed nature of rail operations adjacent to the project site, horn usage would be expected to be minimal at distances greater than 500 feet from the crossings.

Figure 1 shows the project site in relation to the railroad. The approximate distance from the center of the rail line to the closest proposed lots (center of individual backyards) is approximately 90 feet.

According to the Kern County Rail Study (Kern COG, February 2011), approximately two (2) train operations occur per day (Monday through Friday) along the SJVR Buttonwillow Branch Line, in the vicinity of the project site. According the Kern County Rail Study, but operations occur during daytime hours According to the Kern County Rail Study (Kern COG, February 2011), the daily operations occur at a maximum speed of 20 mph (miles per hour). However, according to data provided by the FRA, an average total of 4 daily train operations occur along the railroad line. For the purpose of this analysis, a worst-case assumption of four daily trains was applied. It was also assumed that these operations could be evenly dispersed over a 24-hour period.

Rail operations were not observed by WJVA during the project site inspection on January 25, 2022. It was therefore necessary to calculate railroad noise exposure within the site based on noise measurement data obtained by WJVA during the performance of similar studies along various branches of the SJVR in the Fresno and Visalia areas. A total of 17 measurements have been obtained over the past several years. WJVA has found that there is substantial variability in the noise levels produced by individual train pass-bys due to train length, speed, horn usage and other factors. At distances of 500 feet or less from a grade crossing, the average Sound Exposure Level (SEL) during low-speed train operations was determined to be 97.8 dBA at an assumed distance of 150 feet from the track. At distances of 500 feet or more from a grade crossing, the

average SEL during low-speed train operations was determined to be 96.1 dBA at an assumed distance of 150 feet from the track.

The SEL is a measure of the total energy of a noise event, including consideration of event duration. The SEL is not actually heard, but is a derived value used for the calculation of energy-based noise exposure metrics such as the CNEL.

Railroad noise exposure may be quantified in terms of the CNEL using the following formula:

$$CNEL = SEL + 10 \log N_{eq} - 49.4$$

where,

*SEL is the average SEL for a train pass-by,  $N_{eq}$  is the equivalent number of passbys in a typical 24-hour period determined by adding 10 times the number of nighttime events (10 p.m. - 7 a.m.) to 3 times the number of evening events (7 p.m. - 10 p.m.) to the actual number of daytime events (7 a.m. - 7 p.m.), and 49.4 is a time constant equal to 10 log the number of seconds in the day.*

Using the above-described formula, railroad operations data and noise measurement results, the railroad noise exposure at the closest proposed residential lots to the railroad was calculated to be approximately 62 dB CNEL. This complies with the 65 dB CNEL standard of the Noise Element for exterior noise exposure. The calculation assumed two train operation occurs during the daytime hours and one train operation occurs during evening hours of 7:00 p.m. to 10:00 p.m. and one train operation occurs during nighttime hours, between 10:00 p.m. to 7:00 a.m. Therefore, the project site noise exposure is below the applicable 65 dB CNEL exterior noise level standard, and mitigation measures are not required for project compliance.

#### **Interior Noise Levels-**

The interior noise level standard is 45 dB  $L_{dn}$ /CNEL. This means that the proposed residential construction for the homes adjacent to the SJVR line must be capable of providing a minimum outdoor-to-indoor noise level reduction (NLR) of approximately 17 dB (62-45=17).

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 of Bakersfield 45 dB  $L_{dn}$ /CNEL 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

Exterior noise exposure levels at the closest proposed residential lots to the San Joaquin Valley Railroad (SJRV) Buttonwillow Branch for Tract 7408 would not exceed the City of Bakersfield's 65 dB CNEL exterior noise level standard. The Buttonwillow Branch is a low-speed railroad line (approximately 20 mph) with only two to four (2-4) daily operations. The calculated exterior noise level exposure for the lots closest to the SJRV would be approximately 62 dB CNEL. As a result, there are no required mitigation measures necessary to comply with the City of Bakersfield 65 dB CNEL exterior noise level standard along the SJRV line. Construction of a sound wall of any height is not required along the SJRV line for exterior noise compliance.

The proposed homes would also comply with the applicable 45 dB CNEL interior noise level standard provided the following is incorporated into project design:

- Air conditioning or mechanical ventilation should be installed in the units so that it will be possible for windows and doors to remain closed for sound insulation purposes.

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 site plan and railway operations. Any significant changes in these factors will require a reevaluation of the findings of this report. Additionally, any significant future changes in railway 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



## APPENDIX A

### ACOUSTICAL TERMINOLOGY

<b>AMBIENT NOISE LEVEL:</b>	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.
<b>CNEL:</b>	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.
<b>DECIBEL, dB:</b>	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).
<b>DNL/L<sub>dn</sub>:</b>	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.
<b>L<sub>eq</sub>:</b>	Equivalent Sound Level. The sound level containing the same total energy as a time varying signal over a given sample period. L <sub>eq</sub> is typically computed over 1, 8 and 24-hour sample periods.
<b>NOTE:</b>	The CNEL and DNL represent daily levels of noise exposure averaged on an annual basis, while L <sub>eq</sub> represents the average noise exposure for a shorter time period, typically one hour.
<b>L<sub>max</sub>:</b>	The maximum noise level recorded during a noise event.
<b>L<sub>n</sub>:</b>	The sound level exceeded "n" percent of the time during a sample interval (L <sub>90</sub> , L <sub>50</sub> , L <sub>10</sub> , etc.). For example, L <sub>10</sub> 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

NOISE SOURCE	SOUND LEVEL	SUBJECTIVE DESCRIPTION
AMPLIFIED ROCK 'N ROLL ▶	120 dB	DEAFENING
JET TAKEOFF @ 200 FT ▶		
	100 dB	VERY LOUD
BUSY URBAN STREET ▶		
	80 dB	LOUD
FREEWAY TRAFFIC @ 50 FT ▶		
	60 dB	MODERATE
CONVERSATION @ 6 FT ▶		
TYPICAL OFFICE INTERIOR ▶		FAINT
SOFT RADIO MUSIC ▶	40 dB	
RESIDENTIAL INTERIOR ▶		VERY FAINT
WHISPER @ 6 FT ▶	20 dB	
HUMAN BREATHING ▶	0 dB	