

***SAN CARLOS TRAIN DEPOT SITE
NOISE AND VIBRATION ASSESSMENT
SAN CARLOS, CALIFORNIA***

August 8, 2006



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Job No.: 06-046

INTRODUCTION

This report presents the results of the noise and vibration assessment conducted for the residential project proposed between El Camino Real and the railroad line to the north and south of the San Carlos Train Station from Oak Street to Cherry Street in the City of San Carlos, California. The project proposes underground parking with 4 stories of residential housing above. This assessment presents the fundamentals of environmental noise and vibration, provides a discussion of policies and standards applicable to the project, presents the results of measurements conducted at the site, and provides an evaluation of the potential significance of impacts resulting from the project. Mitigation measures are presented to reduce potentially significant noise impacts to less-than-significant levels.

SETTING

Fundamentals of Environmental Noise

Noise is defined as unwanted sound. Airborne sound is a rapid fluctuation of air pressure above and below atmospheric pressure. Sound levels are usually measured and expressed in decibels (dB) with 0 dB corresponding roughly to the threshold of hearing. Decibels and other technical terms are defined in Table 1.

Most of the sounds that we hear in the environment do not consist of a single frequency, but rather a broad band of frequencies, with each frequency differing in sound level. The sound levels of each frequency combine together to generate a sound. The method commonly used to quantify environmental sounds evaluates the frequencies of sound in accordance with a weighting that reflects human hearing, which is more sensitive in the mid-range frequencies than at low and extremely high frequencies. This method is called A-weighting, and the decibel level measured using this method is called the A-weighted sound level (dBA). In practice, the level of a sound source is conveniently measured using a sound level meter that includes an electrical filter corresponding to the A-weighting curve. Typical A-weighted levels measured in the environment and in industry are shown in Table 2 for different types of noise.

Although the A-weighted noise level may adequately indicate the level of environmental noise at any instant in time, community noise levels vary continuously. Most environmental noise includes a conglomeration of noise from distant sources that create a relatively steady background noise in which no particular source is identifiable. To describe the time-varying character of environmental noise, the statistical noise descriptors L_{01} , L_{10} , L_{50} , and L_{90} , are commonly used. These are the A-weighted noise levels equaled or exceeded during 1%, 10%, 50%, and 90% of a stated time period. A single number descriptor called the L_{eq} is also widely used. The L_{eq} is the average A-weighted noise level during a stated period of time. The instantaneous maximum noise level is called the L_{max} .

In determining the daily level of environmental noise exposure, it is important to account for the differences in human response between daytime and nighttime noises. At night, exterior background noises are generally lower than during the day. Most household noise also decreases at night, causing exterior noise to become very noticeable. People are particularly sensitive to noise intrusion while sleep, which also typically takes place during nighttime hours. To account for human sensitivity to nighttime noise levels, 24-hour descriptors have been developed that incorporate artificial noise penalties added to quiet-time noise events. The *Community Noise Equivalent Level*, *CNEL*, is a measure of the cumulative noise exposure in a community, with a 5 dB penalty added to evening (7:00 pm - 10:00 pm) and a 10 dB addition to nocturnal (10:00 pm - 7:00 am) noise levels.

Table 1: Definitions of Acoustical Terms Used in this Report

Term	Definitions
Decibel, dB	A unit 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. The reference pressure for air is 20.
Sound Pressure Level	Sound pressure is the sound force per unit area, usually expressed in micro Pascals (or 20 micro Newtons per square meter), where 1 Pascal is the pressure resulting from a force of 1 Newton exerted over an area of 1 square meter. The sound pressure level is expressed in decibels as 20 times the logarithm to the base 10 of the ratio between the pressures exerted by the sound to a reference sound pressure (e.g., 20 micro Pascals). Sound pressure level is the quantity that is directly measured by a sound level meter.
Frequency, Hz	The number of complete pressure fluctuations per second above and below atmospheric pressure. Normal human hearing is between 20 Hz and 20,000 Hz. Infrasonic sound are below 20 Hz and Ultrasonic sounds are above 20,000 Hz.
A-Weighted Sound Level, dBA	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 frequency response of the human ear and correlates well with subjective reactions to noise.
Equivalent Noise Level, L_{eq}	The average A-weighted noise level during the measurement period.
L_{max} , L_{min}	The maximum and minimum A-weighted noise level during the measurement period.
L_{01} , L_{10} , L_{50} , L_{90}	The A-weighted noise levels that are exceeded 1%, 10%, 50%, and 90% of the time during the measurement period.
Day/Night Noise Level, L_{dn} or DNL	The average A-weighted noise level during a 24-hour day, obtained after addition of 10 decibels to levels measured in the night between 10:00 pm and 7:00 am.
Community Noise Equivalent Level, CNEL	The average A-weighted noise level during a 24-hour day, obtained after addition of 5 decibels in the evening from 7:00 pm to 10:00 pm and after addition of 10 decibels to sound levels measured in the night between 10:00 pm and 7:00 am.
Ambient Noise Level	The composite of noise from all sources near and far. The normal or existing level of environmental noise at a given location.
Intrusive	That noise which intrudes over and above the existing ambient noise at a given location. The relative intrusiveness of a sound depends upon its amplitude, duration, frequency, and time of occurrence and tonal or informational content as well as the prevailing ambient noise level.

Table 2: Typical Noise Levels in the Environment

Common Outdoor Noise Source	Noise Level (dBA)	Common Indoor Noise Source
	120 dBA	
Jet fly-over at 300 meters		Rock concert
	110 dBA	
Pile driver at 20 meters		Night club with live music
	100 dBA	
Large truck pass by at 15 meters		Noisy restaurant
	90 dBA	
Gas lawn mower at 30 meters		Garbage disposal at 1 meter
Commercial/Urban area daytime		Vacuum cleaner at 3 meters
Suburban expressway at 90 meters		Normal speech at 1 meter
Suburban daytime		Active office environment
	80 dBA	
Urban area nighttime		Quiet office environment
	70 dBA	
Suburban nighttime		Library
Quiet rural areas		Quiet bedroom at night
	60 dBA	
Wilderness area		Quiet recording studio
Most quiet remote areas		
	50 dBA	
Threshold of human hearing		Threshold of human hearing
	40 dBA	
	30 dBA	
	20 dBA	
	10 dBA	
	0 dBA	

Fundamentals of Groundborne Vibration

Railroad operations are potential sources of substantial ground vibration depending on distance, the type and the speed of trains, soil conditions, and the type of railroad track. People’s response to ground vibration has been correlated best with the velocity of the ground. The velocity of the ground is expressed on the decibel scale. The reference velocity is 1×10^{-6} in./sec. RMS, which equals 0 VdB, and 1 in./sec. equals 120 VdB. Although not a universally accepted notation, the abbreviation “VdB” is used in this document for vibration decibels to reduce the potential for confusion with sound decibels.

Typical background vibration levels in residential areas are usually 50 VdB or lower, well below the threshold of perception for most humans. Perceptible vibration levels inside residences are attributed to the operation of heating and air conditioning systems, door slams and foot traffic. Construction activities, train operations, and street traffic are some of the most common external sources of vibration that can be perceptible inside residences. Table 3 illustrates some common sources of vibration and the association to human perception or the potential for structural damage.

Table 3: Typical Levels of Groundborne Vibration

Human/Structural Response	Velocity Level, VdB (re 1µinch/sec, RMS)	Typical Events (50 –foot setback)
Threshold, minor cosmetic damage	100	Blasting, pile driving, vibratory compaction equipment
		Heavy tracked vehicles (Bulldozers, cranes, drill rigs)
Difficulty with tasks such as reading a video or computer screen	90	
		Commuter rail, upper range
Residential annoyance, infrequent events	80	Rapid transit, upper range
Residential annoyance, frequent events		Commuter rail, typical Bus or truck over bump or on rough roads
	70	Rapid transit, typical
Approximate human threshold of perception to vibration		Buses, trucks and heavy street traffic
	60	
		Background vibration in residential settings in the absence of activity
Lower limit for equipment ultra-sensitive to vibration	50	

Source: Illingworth & Rodkin, Inc. and U.S. Department of Transportation, Federal Transit Administration, Transit Noise and Vibration Impact Assessment, April 1995, DOT-T-95-16

One of the problems with developing suitable criteria for groundborne vibration is the limited research into human response to vibration and more importantly human annoyance inside buildings. However, experience with rapid transit systems over the last few decades has developed rational vibration limits that can be used to evaluate human annoyance to groundborne vibration. These criteria are primarily based on experience with passenger train operations, such as rapid transit and commuter rail systems. The main difference between passenger and freight operations is the time duration of individual events; a passenger train lasts few seconds whereas a long freight train may last several minutes, depending on speed and length. Although these criteria are based on shorter duration events reflected by passenger trains, they are also used in this assessment to evaluate the potential of vibration annoyance on the site due to large freight trains.

Regulatory Criteria

The State of California and the City of San Carlos have established plans and policies designed to limit noise exposure at noise sensitive land uses. These plans and policies are contained in the following documents: (1) the State CEQA Guidelines, Appendix G, (2) the California Building Code, (3) the City of San Carlos Noise Element of the General Plan, and (4) the City of San Carlos Noise Ordinance. Vibration impact criteria proposed by the Federal Transit Administration (FTA) have been used in this document to address groundborne vibration (5).

(1) California Environmental Quality Act (CEQA)

Under the California Environmental Quality Act (CEQA), noise or vibration impacts would be considered significant if the project would result in:

- a. 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;
- b. Exposure of persons to or generation of excessive ground-borne vibration or ground-borne noise levels;
- c. A substantial permanent increase in ambient noise levels in the project vicinity above levels existing without the project;
- d. A substantial temporary or periodic increase in ambient noise levels in the project vicinity above levels existing without the project;
- e. 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, if the project would expose people residing or working in the project area to excessive noise levels;
- f. For a project within the vicinity of a private airstrip, if the project would expose people residing or working in the project area to excessive noise levels.

Of these guidelines, items (a), (b), (c), (d), and (e) are applicable to the proposed project. Guideline (f) is not applicable because the project is not located in the vicinity of a private airstrip.

CEQA does not define what noise level increase would be considered substantial. Typically, an increase in the CNEL noise level resulting from the project at noise sensitive land uses of 3 dBA or greater would be considered a significant impact when projected noise levels would exceed those considered acceptable for

the affected land use. An increase of 5 dBA or greater would be considered a significant impact when projected noise levels would remain within those considered acceptable for the affected land use.

(2) 2001 California Building Code

Title 24, Appendix Chapter 12, Section 1208A.8.2 of the California Building Code, which is applicable to multi-family and attached dwellings, specifies that interior noise levels attributable to exterior noise sources shall not exceed 45 dB L_{dn} or CNEL in any habitable room.

(3) City of San Carlos General Plan

The Noise Element of the San Carlos General Plan includes policies to minimize unwanted noise. The following applicable policies are set forth in the General Plan to help guide decision making with regard to noise in San Carlos:

1. Land use decisions shall be based on the Noise Compatibility Chart (not shown) and acoustical reports required for all developments in locations where noise levels exceed the “normally acceptable” range for specified land use types. If recommended in the report, mitigation measures shall be required as conditions of project approval.

The Land Use Compatibility for Community Noise Environments Chart (located on page N-4 of the General Plan), specifies that multifamily residential uses would be considered “normally acceptable” in noise environments not exceeding 60 dBA CNEL, “conditionally acceptable” in noise environments ranging from 60 to 70 dBA CNEL, “normally unacceptable” in noise environments ranging from 70 to 75 dBA CNEL, and “unacceptable” in noise environments exceeding 75 dBA CNEL.

2. A detailed acoustical report shall be required in all cases where hotels, motels, and multi-family dwellings are proposed in areas exposed to exterior noise levels of 60 CNEL or greater.
7. A noise analysis, including recommended mitigation measures, shall be required for new residential uses located within the 55 to 60 CNEL impact areas of the San Carlos Airport.

(4) City of San Carlos Municipal Code

Title 9, Chapter 9.30 of the City of San Carlos Municipal Code specifies that construction activities shall be limited to the hours of 7:00 a.m. to 6:00 p.m., Monday through Friday, and 9:00 a.m. to 5:00 p.m. on Saturday, Sunday and holidays.

(5) Groundborne Vibration

The City of San Carlos has not identified quantifiable vibration limits that can be used to evaluate the compatibility of land uses with the expected vibration environment. Although there are no local standards which control the allowable vibration in a new residential development, the U.S. Department of Transportation has developed vibration impact assessment criteria for evaluating vibration impacts associated with rapid transit projects.¹ Vibration impact criteria, based on maximum overall levels for a single event, have been proposed by the Federal Transit Administration (FTA). The criteria for groundborne vibration impact are shown in Table 4. Note that there are criteria for frequent events (more than 70 events per day) and infrequent events (less than 70 events per day).

¹U.S. Department of Transportation, Federal Transit Administration, Transit Noise and Vibration Impact Assessment, April 1995, DOT-T-95-16.

Table 4: Groundborne Vibration Impact Criteria

Land Use Category	Groundborne Vibration Impact Limits (VdB re 1 μinch/sec, RMS)	
	Frequent Events ¹	Infrequent Events ²
Category 1 Buildings where low ambient is essential for interior operations	65 VdB ³	65 VdB ³
Category 2 Residences and buildings where people normally sleep	72 VdB	80 VdB
Category 3 Institutional land uses with primarily daytime use	75 VdB	83 VdB
Notes: 1. "Frequent Events" is defined as more than 70 vibration events per day. Most rapid transit projects fall into this category. 2. "Infrequent Events" is defined as fewer than 70 vibration events per day. This category includes most commuter rail systems. 3. This limit is based on levels that are acceptable for most moderately sensitive equipment such as optical microscopes. Vibration sensitive manufacturing or research should always require detailed evaluation to define the acceptable vibration limits. Ensuring low vibration levels in a building requires special design of HVAC systems and stiffened floors.		

Source: U.S. Department of Transportation, Federal Transit Administration, Transit Noise and Vibration Impact Assessment, April 1995, DOT-T-95-16.

Existing Environment

The project site is located in San Carlos, along El Camino Real north of the San Carlos Train Station to approximately Oak Street and south of the San Carlos Train Station to approximately Cherry Street. The project site is bounded to the east by an active Caltrain Railroad line that carries freight and passenger trains. The railroad line consists of one northbound track and one southbound track and is elevated by about 12 to 15 feet above the site elevation. The San Carlos Train Station intersects the project site south of Holly Street. The noise environment on the project site results primarily from the adjacent railroad, and vehicular traffic along El Camino Real and local traffic on Holly Street. Train station announcements are clearly audible throughout the site, although noise levels generated by such announcements are indistinguishable from other noise sources in the area. Groundborne vibration levels are also generated as trains travel along the adjacent tracks. To quantify the existing noise and vibration environment at the project site, a noise monitoring survey was conducted from March 22nd to 23rd, 2006 and a vibration monitoring survey was conducted on March 22nd, 2006. Noise and vibration measurement locations are shown on Figure 1.

Figure 1 – Noise and Vibration Measurement Locations



(1) Noise Monitoring Survey

Two long-term and three short-term noise measurements were conducted at representative locations to complete the noise monitoring survey. The first long-term noise measurement (LT-1) was made approximately 20 feet from the center of the two railroad tracks, adjacent to the San Carlos Train Station, and elevated about 1-2 feet above the elevation of the tracks. This measurement location documented noise levels generated during train operations, as well as noise generated by vehicular traffic along El Camino Real (about 150 feet west of the noise measurement location). Approximately 100 train movements took place over the 24-hour period from 2:00 pm on March 22nd to 2:00 pm on March 23rd. The vast majority of the train passages are Caltrain passenger trains, which occur approximately 4 times per hour during weekdays (2 northbound and 2 southbound), with additional train operations during commuting hours. Caltrains are not scheduled to operate between 12:45 pm and 5:15 am, although freight trains could operate during these times and two trains were measured to occur between these hours during the measurement period (one at 12:50 pm and one at 1:15 am). Instantaneous maximum noise levels generated by train passbys ranged from 82 to 97 dBA. L₁ noise levels ranged from about 55 to 70 dBA during intervals with no train activity and were typically in the range of 75 to 90 dBA in intervals with train operations. Train speeds were measured during the afternoon of March 22nd to be between 5 and 30 mph, slowing as the trains approached or existed the San Carlos Train Station. The CNEL noise level (day-night average) over the course of the measurement period was 71 dBA. The data collected at Site LT-1 are summarized in Figure 2.

A second long-term noise measurement (LT-2) was conducted about 35 feet from the centerline of El Camino Real and about 135 feet from the railroad tracks, near the train station. The day-night average noise level (L_{dn}) at Site LT-2 was 72 dBA. Noise levels resulted primarily from traffic along El Camino Real and train passages along the adjacent tracks. Instantaneous maximum noise levels generated during train passages typically ranged from 75 to 95 dBA. The data collected at Site LT-2 are summarized on Figure 3.

Three short-term measurements were conducted to measure traffic and railroad noise levels at additional locations throughout the project site. Concurrent traffic volume counts were conducted during intervals along El Camino Real. A summary of the resulting noise levels at Sites ST-1, ST-2, and ST-3 is shown in Table 5.

Table 5: Summary of Short-Term Noise Measurement Results

Location	L_{eq}	L_1	L_{10}	L_{50}	L_{90}	Est. L_{dn}	Noise Source
ST-1: ~50 feet from railroad tracks, North End of Site (3/23/2006, 13:10-13:20)	65	79	64	60	55	68	Train passage, Traffic on El Camino Real
ST-2: Corner of Holly St and El Camino Real (3/23/2006, 13:30-13:40)	67	73	70	66	62	70	Traffic on Holly St and El Camino Real
ST-3: ~45 feet from centerline of El Camino Real, South End of Site (3/23/2006, 14:30-14:40)	67	73	70	66	59	70	Traffic on El Camino Real

Figure 2: Daily Trend in Noise Levels at LT-1

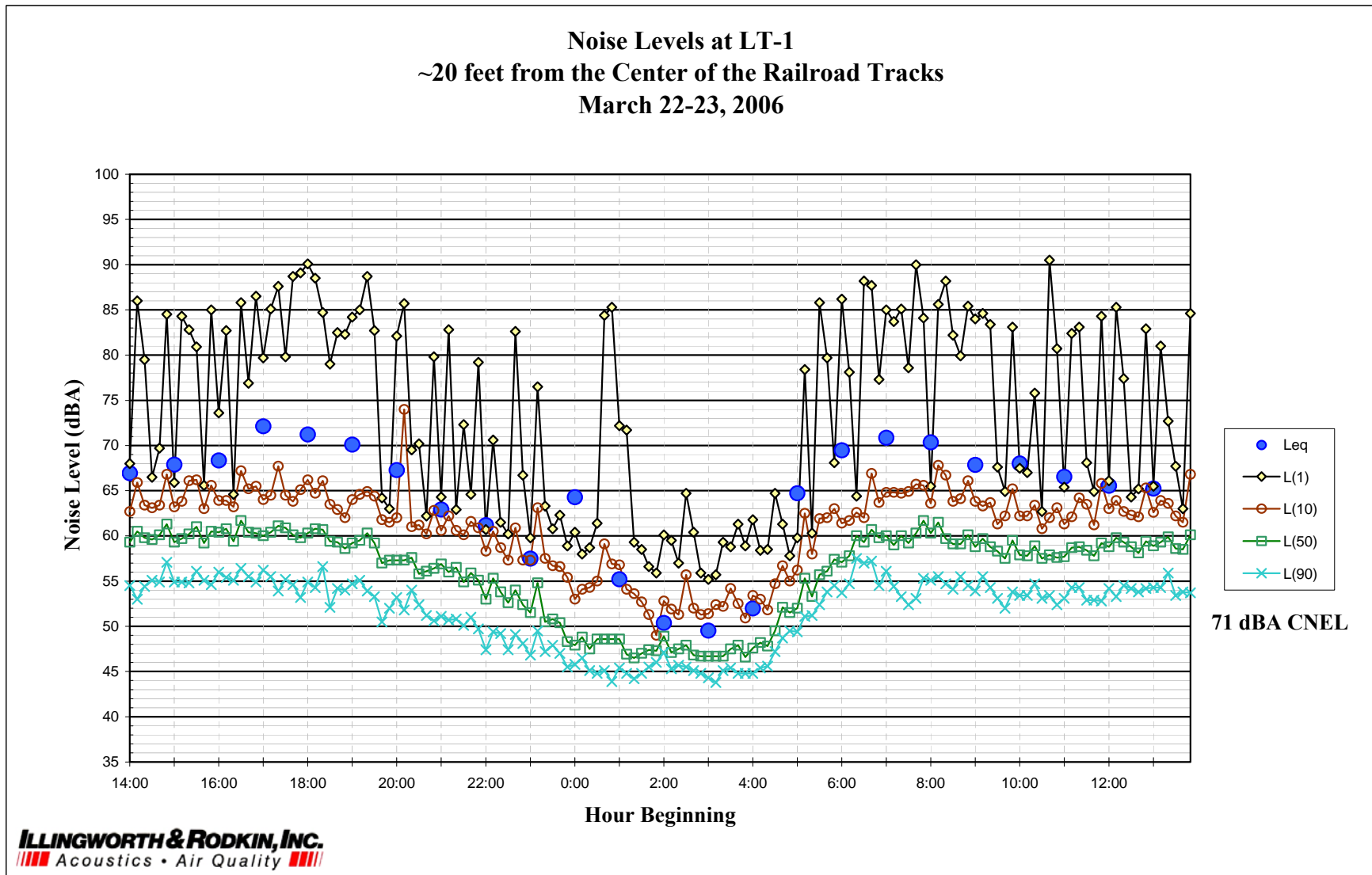
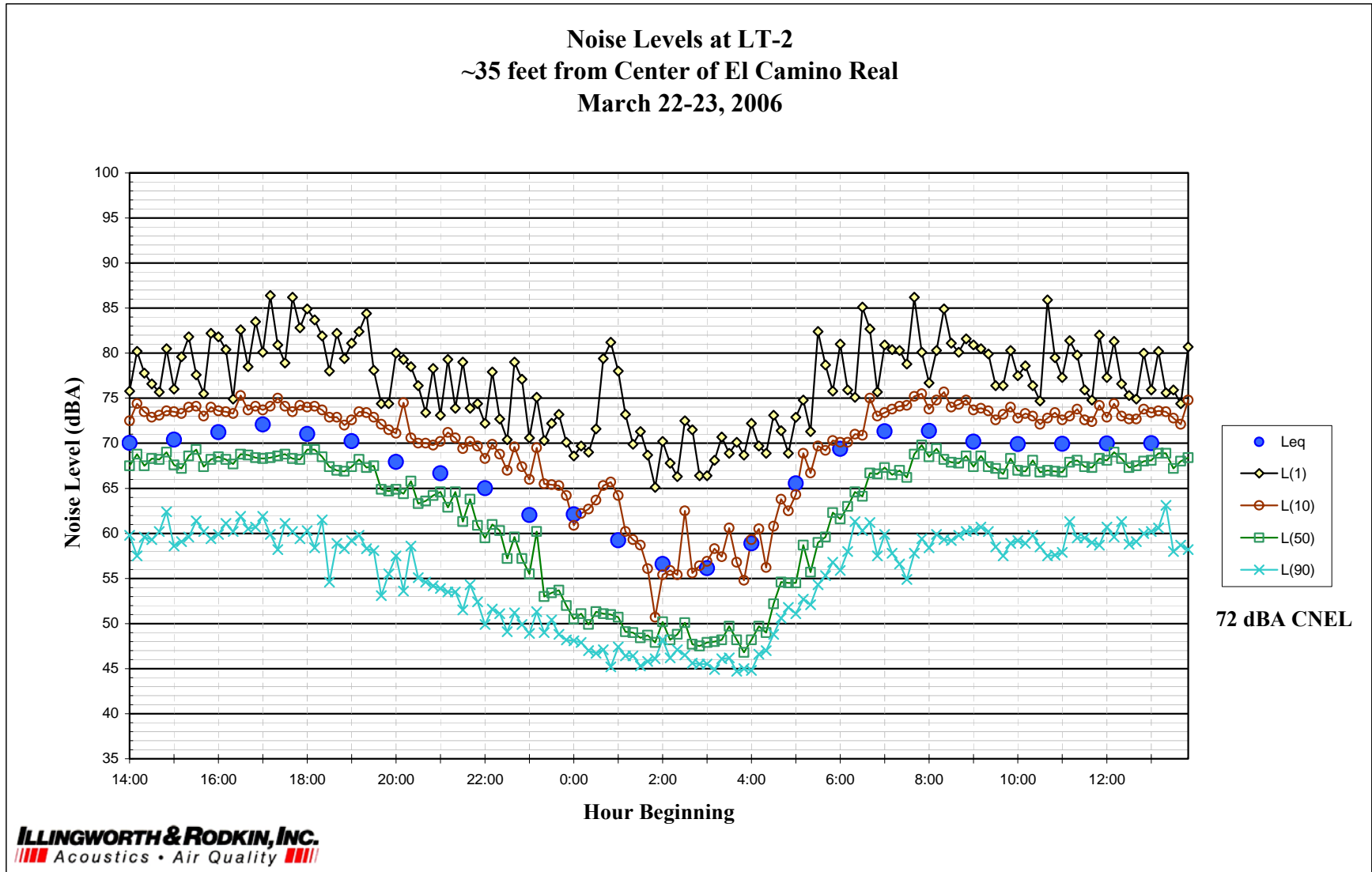


Figure 3: Daily Trend in Noise Levels at LT-2



(2) Vibration Monitoring Survey

The Caltrain railroad line, located east of the project site, consists of one northbound track and one southbound track and is elevated by about 12 to 15 feet above the site elevation. The southbound track is adjacent to the property line, with the northbound track located about 15 feet east of the southbound track. Both tracks are active and appear to be in good condition. The San Carlos train station intersects the site and train speeds are low as trains approach or depart the station. Train speeds were measured to range from less than 5 mph to 30 mph at the project site, with higher speeds in locations further from the station. At a given distance from the tracks, express trains (which did not stop at the station) were measured to travel faster than local trains and approaching trains traveled faster than departing trains.

The instrumentation used to conduct the measurements included a Sony Digital Audio Tape Recorder (DAT) and seismic grade, low noise accelerometers firmly fixed to the ground. This system is capable of measuring accurately very low vibration levels. Vibration levels measured on the site are representative of vibration levels at ground level, i.e. vibration levels that would enter the building foundation.

Vibration measurements were taken at three locations along the tracks (V-1, V-2, and V-3), with two setback positions from the railroad at each location (labeled a and b, as shown in Figure 1). At each location along the tracks, position (a) was located at the base of the railroad berm, approximately 25 feet from southbound track and about 40 feet from the northbound track (not including the changes in elevation). Position (b) was setback 40 feet from position (a). The two setback positions were used to develop a drop-off rate for ground vibration with distance at each location along the tracks. Vibration levels were only measured in the vertical axis because ground vibration is typically most dominant on the vertical axis and the data are adequate in characterizing the exposure of the site to vibration from railroad trains.

Eleven train passbys were measured between 12:00 p.m. and 4:00 p.m. on March 22nd, 2006; three at V-1, five at V-2, and three at V-3. Thirteen train passbys were measured on April 18th, 2006 between 7:30 a.m. and 9:30 a.m.; eight at V-1, and five at V-2. Caltrain was measured in both the northbound and southbound direction at each of the measurement locations and positions. The Baby Bullet, which did not stop at the San Carlos Station, was measured in both the northbound and southbound directions at locations V-1 and V-2. There were no freight operations during either measurement period. Vibration levels measured at each measurement location and position during train passby events are summarized in Table 6 and on Figures 7, 8, 9, 10, 11, and 12.

Table 6: Results of Vibration Measurements

Location	Time	Activity	Track	Speed (mph)	Vibration Level (VdB re 1µinch/sec, RMS)		Cars
					Position (a)	Position (b)	
V-1 (3/22/06)	12:25 pm	NB Caltrain	Far	*	78	65	*
	12:26 pm	SB Caltrain	Near	15	86	68	*
	12:55 pm	NB/SB Caltrains	Both	30/15	80	67	*
V-1 (4/18/06)	7:48 a.m.	SB Caltrain	Near	8	83	67	Engine + 5 Cars
	7:49 a.m.	NB Caltrain	Far	8	84	68	2 Engines + 4 Cars
	7:59 a.m.	NB Caltrain	Far	7	77	64	2 Engines + 5 Cars
	8:09 a.m.	SB Caltrain	Near	7	81	66	Engine + 5 Cars
	8:12 a.m.	NB Baby Bullet	Far	13	84	71	Engine + 5 Cars
	8:13 a.m.	SB Caltrain	Near	8	79	66	Engine + 5 Cars
	8:24 a.m.	NB Caltrain	Far	6	79	66	Engine + 5 Cars
V-2 (3/22/06)	8:29 a.m.	SB Baby Bullet	Near	13	89	72	Engine + 4 Cars
	1:22 pm	NB Caltrain	Far	5	74	64	Engine + 5 Cars
	1:52 pm	SB Caltrain	Near	10	75	63	Engine + 5 Cars
	1:53 pm	NB Caltrain	Far	6	74	65	Engine + 5 Cars
	2:15 pm	SB Caltrain	Near	13	84	*	Engine + 5 Cars
V-2 (4/18/06)	2:23 pm	NB Caltrain	Far	6	78	*	Engine + 5 Cars
	8:40 a.m.	SB Baby Bullet	Near	7	77	65	Engine + 5 Cars
	8:48 a.m.	NB Baby Bullet	Far	12	79	71	Engine + 5 Cars
	8:49 a.m.	SB Caltrain	Near	6	81	68	Engine + 4 Cars
	8:56 a.m.	NB Caltrain	Far	<5	74	65	Engine + 5 Cars
V-3	9:08 a.m.	SB Caltrain	Near	7	81	67	Engine + 4 Cars
	3:18 pm	SB Caltrain	Near	8	81	71	Engine + 5 Cars
	3:22 pm	NB Caltrain	Far	15	74	71	2 Engines + 5 Cars
	3:37 pm	SB Caltrain	Near	5	74	69	Engine + 5 Cars

Note: Position (a) is located at the base of the berm, position (b) is setback 40 feet from position (a).

* Not Measured

Figure 4: Vibration Levels at V-1a

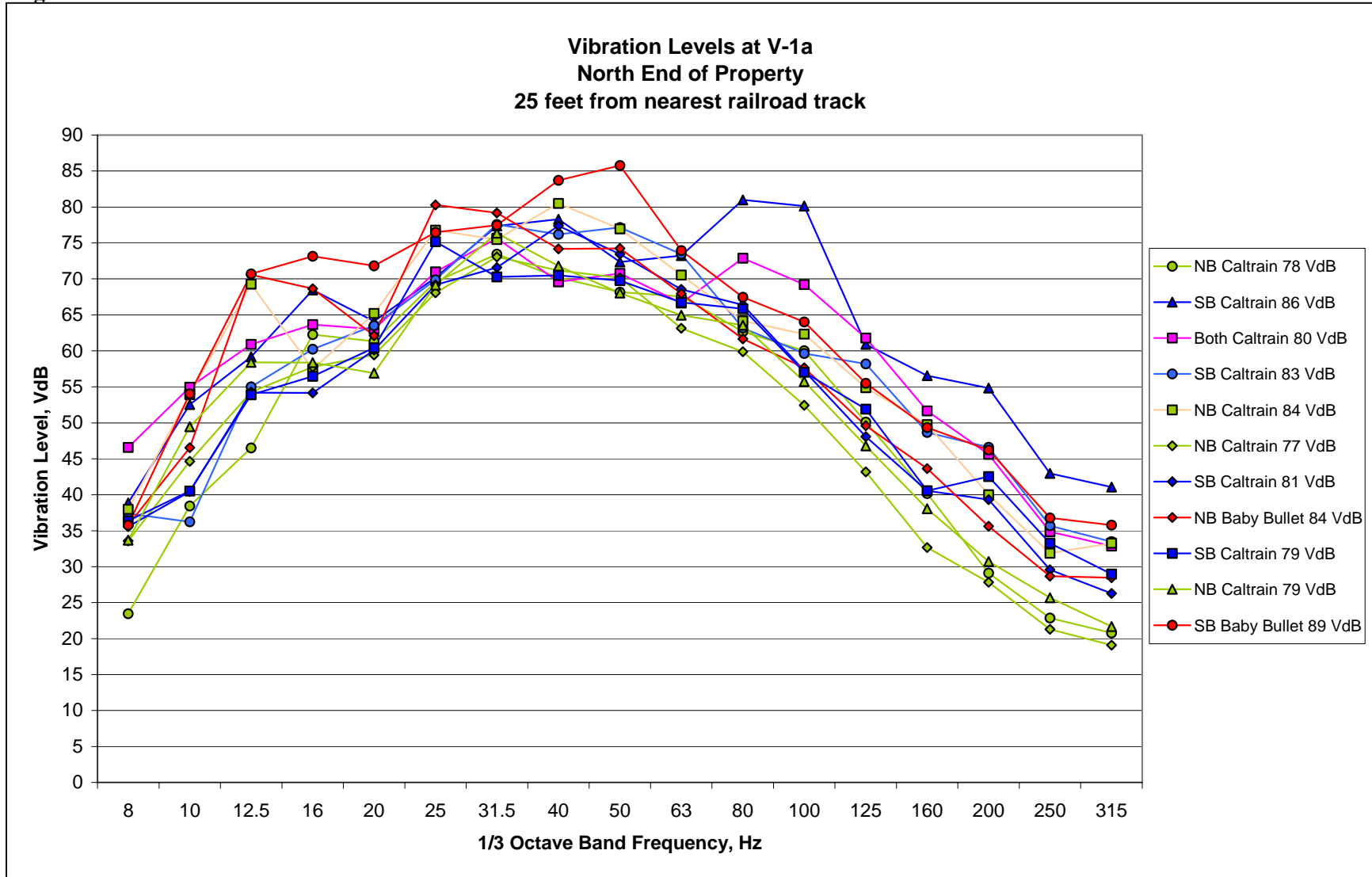


Figure 5: Vibration Levels at V-2a

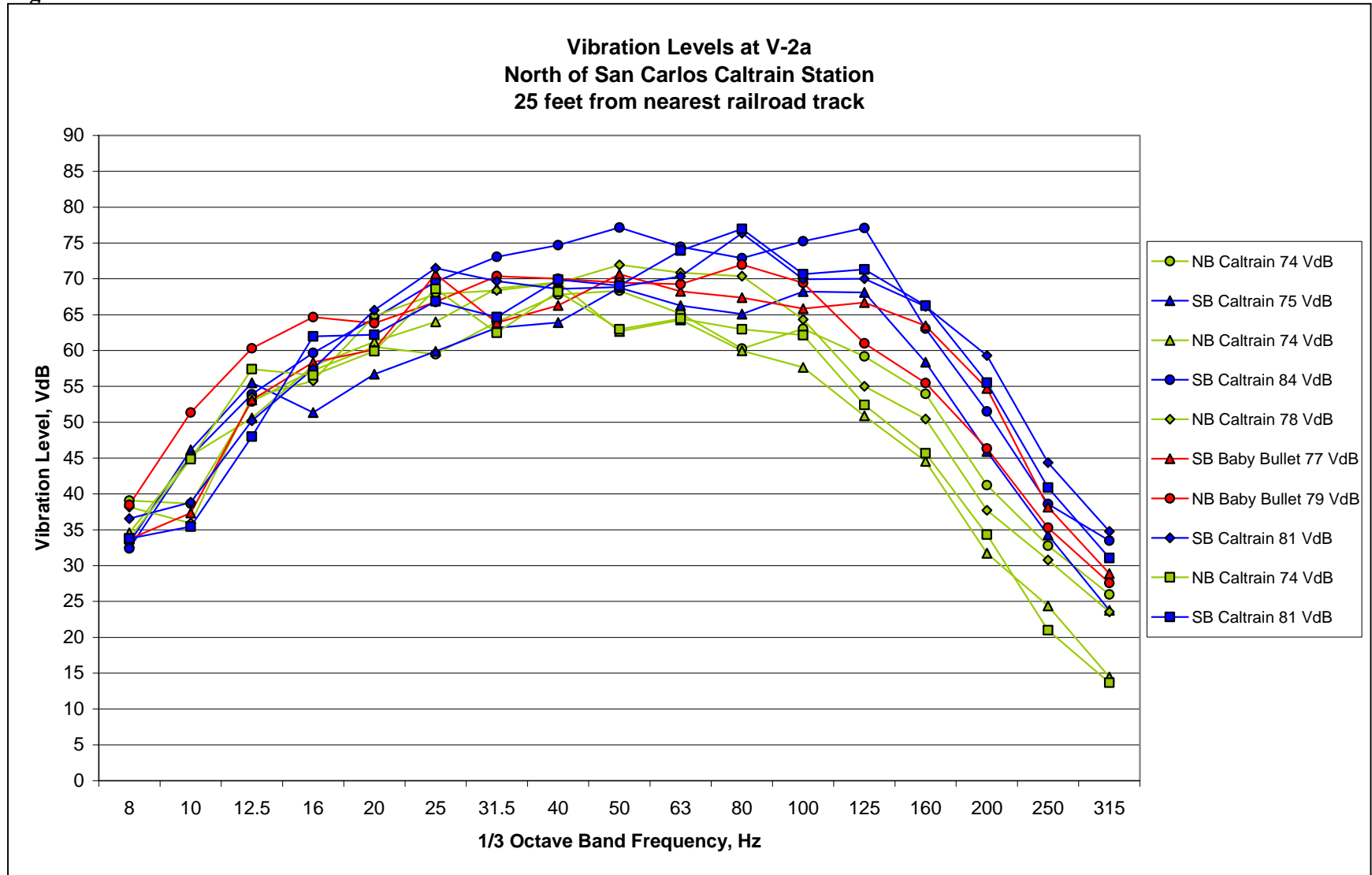


Figure 6: Vibration Levels at V-3a

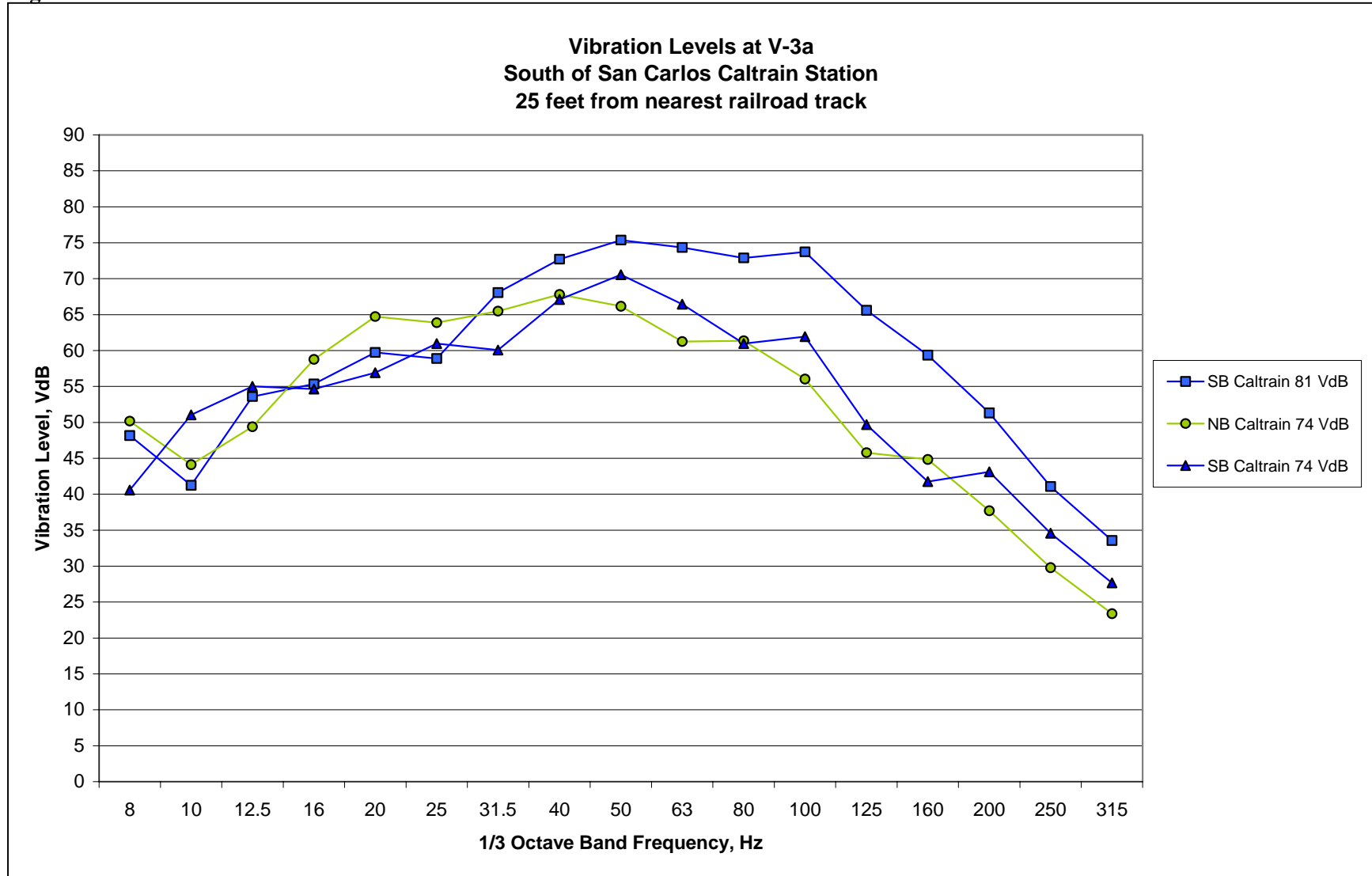


Figure 7: Vibration Levels at V-1b

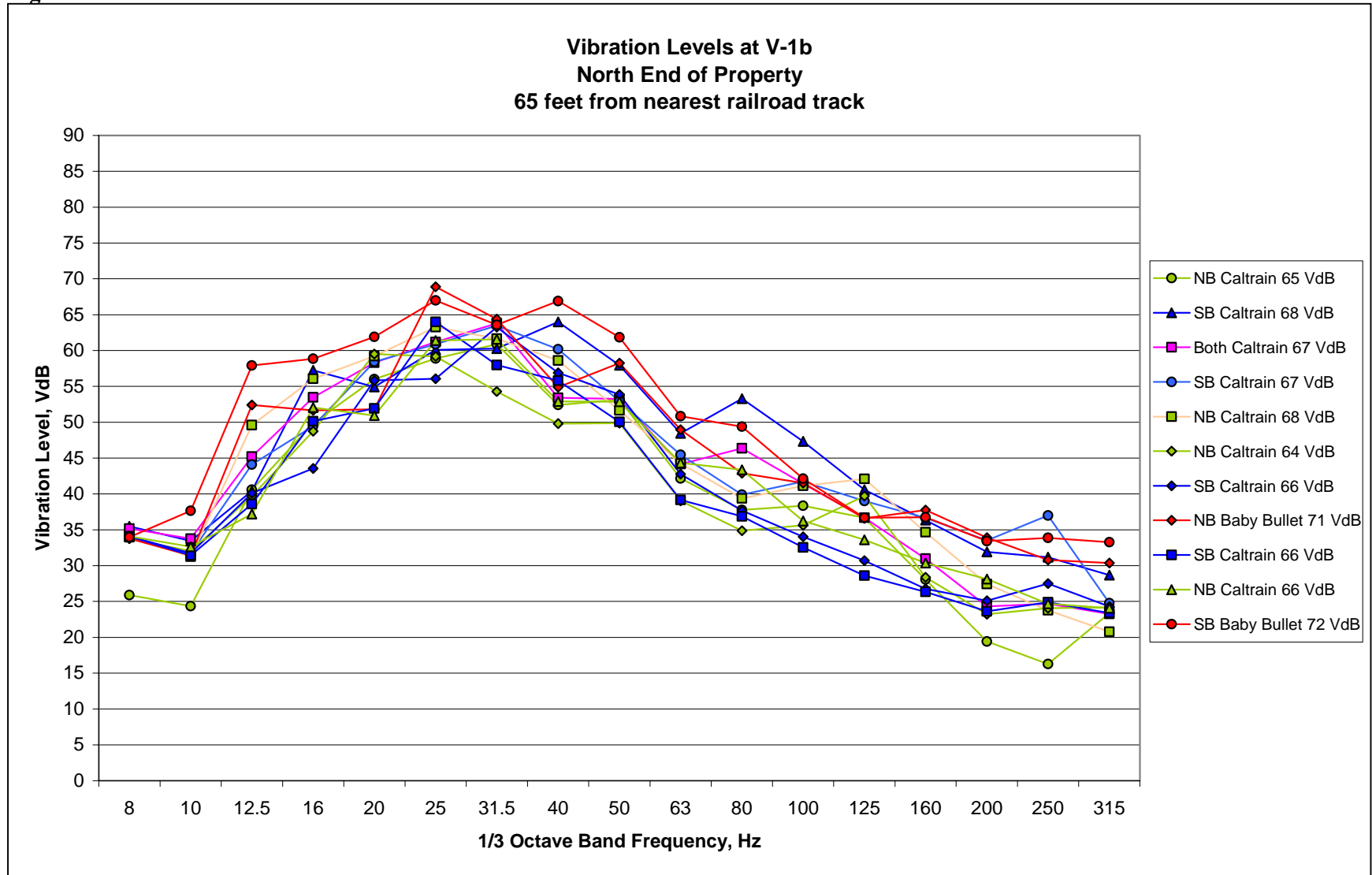


Figure 8: Vibration Levels at V-2b

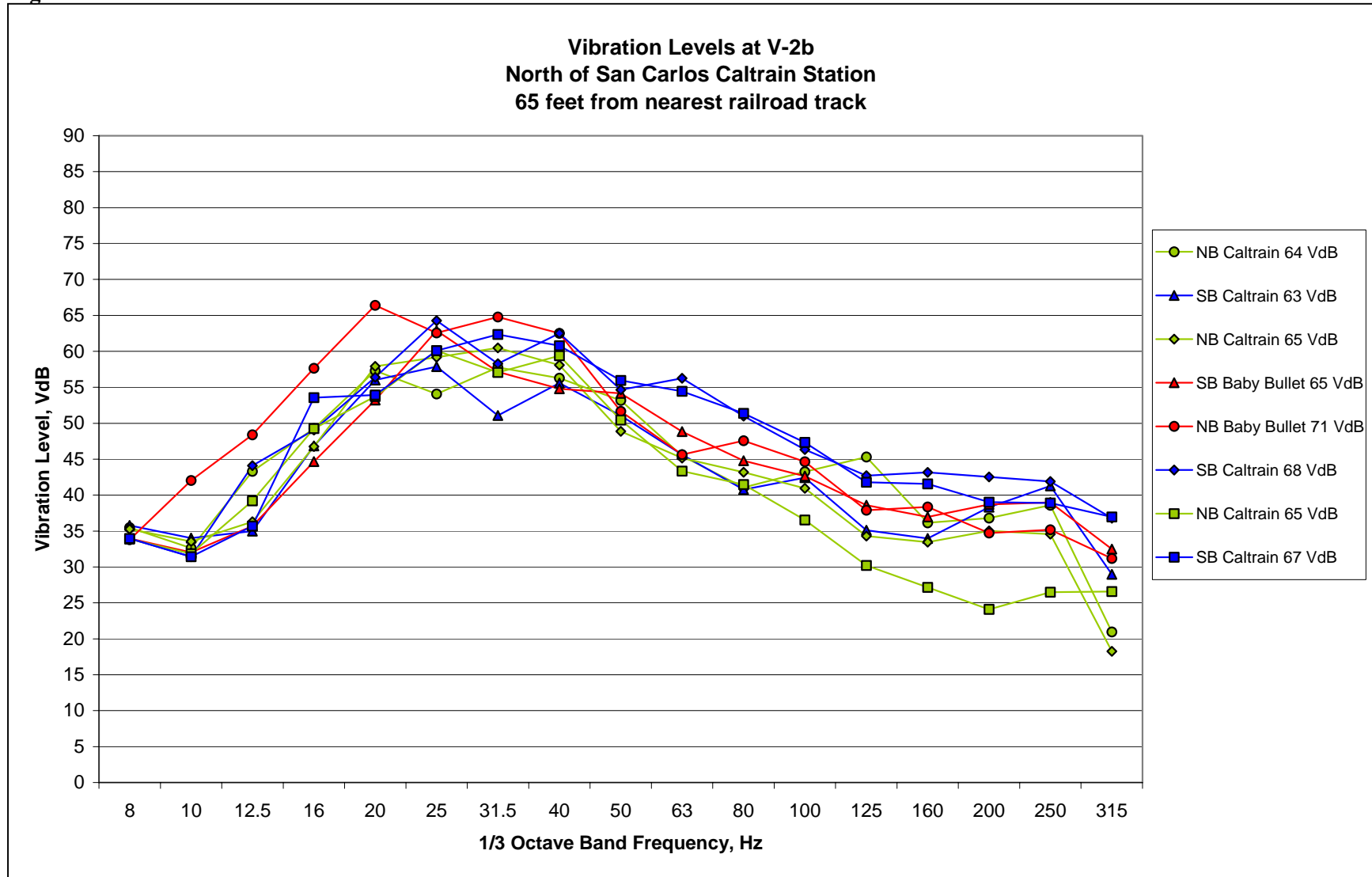
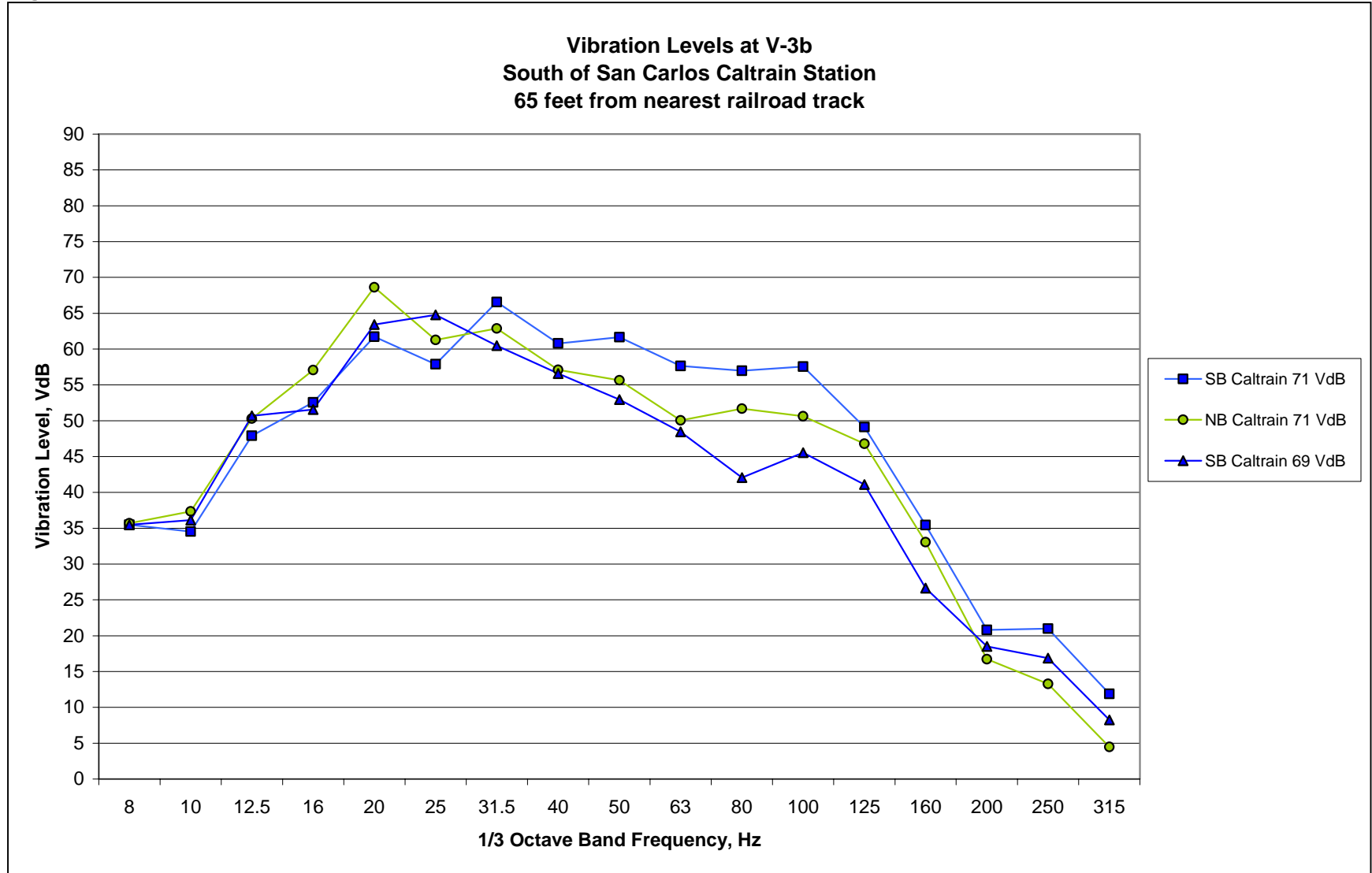


Figure 9: Vibration Levels at V-3b



NOISE AND VIBRATION IMPACTS AND MITIGATION MEASURES

Significance Criteria

Appendix G of the CEQA Guidelines states that a project would normally be considered to have a significant impact if noise levels conflict with adopted environmental standards or plans, if persons are exposed to excessive groundborne vibration, if noise levels generated by the project would substantially increase existing noise levels on a permanent or temporary basis, or if persons would be located within two miles of a public airport and exposed to excessive noise levels.

Impact 1: Noise and Land Use Compatibility. The project site would be exposed to exterior noise levels greater than 60 dBA CNEL and would exceed the noise and land use compatibility standards presented in the City of San Carlos' General Plan for residential land uses. Interior noise levels would be expected to exceed 45 dBA CNEL without the incorporation of noise insulation features in the project design. **This is a potentially significant impact.**

The noise environment at the project site exceeds the Noise and Land Use Compatibility standard for exterior noise (60 dBA CNEL) as a result of transportation noise sources in the site vicinity (i.e., railroad, and El Camino Real, Holly Avenue).

Exterior Noise Levels

The existing noise environment on the project site results primarily from the adjacent railroad, vehicular traffic along El Camino Real, and local traffic on Holly Street. Caltrain has reserved property to install two additional tracks through San Carlos, located east of the 15-foot easement between the project site and the existing railroad property. Currently, Caltrain has no plans to build these extra tracks, nor does it plan to run additional trains on the existing lines². For this assessment, railroad activities are assumed to increase moderately over time on the existing tracks without the development of the additional tracks. This analysis assumes that railroad generated noise levels would increase by 1 dBA CNEL over existing levels.

Traffic noise levels along El Camino Real and Holly Street would also increase as the area is developed. The Traffic Impacts and Mitigation Strategies Report³ indicates a total of 3441 peak-hour trips are anticipated take place on El Camino Real in the Future (Year 2015) and 1611 peak-hour trips would take place on Holly Street. Based on the information provided in the Traffic Impacts and Mitigation Strategies Report, existing traffic volumes provided by Caltrans for El Camino Real⁴, and noise monitoring with corresponding traffic volume counts conducted for this analysis, traffic noise is calculated to increase by 0 to 1 dBA CNEL over existing levels along El Camino Real and Holly Street (Year 2015).

With the acoustical shielding provided by project structures, the impact of these noise sources would be reduced in areas located away from and/or shielded from the noise source. Many of the exterior use areas are designed in courtyard areas⁵, which would be shielded from the adjacent train line, but exposed to traffic noise from El Camino Real. The two pool areas, however, would be exposed to noise generated by both railroad and traffic noise. Both the courtyard areas and the pool areas would receive partial shielding from the adjacent noise sources provided by the building structures located to the sides. Table 7

² Based on email correspondence from Brian Fitzpatrick, Real Estate Department Manager, SamTrans.

³ Traffic Impacts and Mitigation Strategies, Draft Final Report, City of San Carlos, Hexagon Transportation Consultants, Inc.

⁴ Traffic and Vehicle Data Systems Unit, State of California, 2004.

⁵ Site Plan, Christiani Johnson Architects, received April 12, 2006.

summarizes the predicted noise levels generated at receivers located in the proposed courtyard and pool areas. Noise levels take into account the potential shielding provided by project structures.

Table 7: Anticipated CNEL Noise Levels at Common Exterior Use Areas

Use Area	Resulting CNEL Noise Level (at specified distance from the centerline of El Camino Real)		Noise Source
	50 feet	100 feet	
Courtyards (Shielded from Railroad Noise)	71 dBA CNEL	63 dBA CNEL	Traffic Only
Pool Area (Open to both Railroad and Traffic)	71 dBA CNEL	67 dBA CNEL	Traffic and Railroad

Noise levels throughout the site would exceed the City’s 60 dBA CNEL exterior noise standard. Preliminary barrier calculations for a sound barrier located along the exterior exposure to El Camino Real found that a 6-foot high barrier would reduce traffic noise levels by 5 to 6 dBA; an 8-foot high barrier would reduce traffic noise levels by 7 to 8 dBA; a 10-foot high barrier would reduce traffic noise levels by 9 to 10 dBA; and a 12-foot high barrier would reduce traffic noise levels by 11 to 13 dBA. Because the railroad is elevated, railroad noise levels could not be reduced much through the use of noise barriers located on the project site. With the inclusion of a 6-foot sound barrier along the courtyard exposures to El Camino Real, noise levels in courtyard areas that are shielded from railroad noise would meet the 60 dBA CNEL criteria at distances of about 75 feet and further from the centerline of El Camino Real. Outdoor use areas exposed to both El Camino Real and railroad noise would be about 65 to 66 dBA CNEL at distances of 50 to 100 feet from the centerline of El Camino Real, with the inclusion of a 6-foot barrier along the exposure to El Camino Real.

Interior Noise Levels

Residences throughout the site would be exposed to exterior noise levels that exceed 60 dBA CNEL. Standard California residential construction typically provides about 15 dB of exterior-to-interior noise reduction with windows partially open and 20 to 25 dB of exterior-to-interior noise reduction with windows closed. Where exterior noise levels exceed 60 dBA CNEL, interior noise levels could exceed State standards (45 dBA CNEL), assuming standard California construction methods with windows partially open. Where exterior noise levels are 65 to 70 dBA CNEL or less, interior noise level can typically be maintained below 45 dBA CNEL with the incorporation of forced air mechanical ventilation systems in residential units to allow occupants the option of maintaining windows in the closed position.

The project would construct multi-story residential units throughout the site. Due to the shielding provided by the residential structures, units would be exposed primarily to noise generated by the noise source in line-of-sight to the unit (i.e., units along El Camino Real would be exposed primarily to traffic noise and units along the railroad would be exposed primarily to railroad noise). Taking into account the shielding provided by the project buildings, noise levels outside the façades of residences would be about 71 dBA CNEL in units fronting El Camino Real (assuming a distance of 50 feet from the centerline of the roadway), about 65 dBA CNEL in units fronting the railroad (assuming a distance of 55 feet from near tracks), and about 71 to 73 dBA CNEL in units fronting the Holly Street (which would be exposed to Holly Street, El Camino Real, and railroad noise). Units located in more exposed areas (such as adjacent to the unshielded pool areas) would be provided with less shielding from the surrounding noise sources and would be exposed to noise levels of up to 73 dBA CNEL. In addition, instantaneous maximum noise

levels generated by railroad operations would range from 75 to 90 dBA L_{max} during train passbys at the facades of adjacent units.

Noise barriers would not be effective at reducing noise levels at upper level facades of buildings adjacent to El Camino Real or at units located along the railroad. To meet the State standard (45 dBA CNEL), forced-air ventilation and sound rated construction would be required throughout the site. The exact specifications of window and wall systems cannot be accurately predicted at this time. These specifications can be made once final building elevations and floor plans are developed. Preliminary calculations estimated that windows with STC rating of 28 to 35 would be required to meet the 45 dBA CNEL interior standard.

To control interior maximum noise levels to minimize the potential for activity interference and sleep disturbance, noise insulation features such as stucco-sided walls with resilient furring elements and sound-rated windows and doors would be required for residences located near the adjacent railroad. To reduce sleep and indoor activity disturbance during train passbys, the noise control treatments should be designed to reduce typical maximum instantaneous noise levels from the railroad operations to 50 dBA inside bedrooms and 55 dBA inside other occupied areas. Again, noise insulation features to be included in the project's design will need to be developed once detailed plans are available. Preliminary calculations estimated that stucco siding with resilient channels and windows with STC ratings of 38 to 45 would be required in units adjacent to the railroad to reduce maximum instantaneous noise levels.

Mitigation 1: The following mitigation measures shall be included in the project to reduce the impact to a *less-than-significant* level:

- When finalizing the project's site plan, locate noise-sensitive outdoor use areas away from adjacent noise sources. Shield noise-sensitive spaces with buildings or noise barriers whenever possible. Due to the elevated configuration of the railroad, it is recommended that all exterior use areas be shielded from the railroad by building structures (similar to the courtyard areas).
- Design and construct noise barriers to reduce noise generated by adjacent roadways at exterior use areas. Noise barriers would not be effective at reducing noise generated by the elevated train lines. The final detailed design of the heights and limits of these barriers shall be completed at the time that the final grading plan is submitted.
- Project-specific acoustical analyses should be conducted to insure that interior noise levels will be reduced to 45 dBA CNEL or lower and typical maximum instantaneous noise levels generated during train passbys will be reduced to 50 dBA in bedrooms and 55 dBA in other occupied spaces. Building sound insulation requirements would need to include the provision of forced-air mechanical ventilation for all units, so that windows could be kept closed at the occupant's discretion to control noise. In addition, special building construction techniques (e.g., sound-rated windows and building facade treatments) may be required for residential uses exposed to higher noise levels. These treatments include, but are not limited to, sound rated windows and doors, sound rated wall constructions, acoustical caulking, etc. The specific determination of what treatments are necessary will be conducted on a unit-by-unit basis. Results of the analysis, including the description of the necessary noise control treatments, will be submitted to the City along with the building plans and approved prior to issuance of a building permit.

Impact 2: Groundborne Vibration. Caltrain borders the project site’s eastern property line. Vibration generated during railroad train passbys would exceed FTA guidelines for vibration on portions of the property. **This is a potentially significant impact.**

Based on the published Caltrain schedule (dated January 1, 2006), 96 Caltrain passenger trains pass the site each weekday and 28 to 32 Caltrain passenger trains pass the site each Saturday/Sunday. Since the total number of trains passing the site exceeds 70 events per day, the 72 VdB limit is used in the evaluation of the project with respect to vibration compatibility for the location of occupied structures. The vibration compatibility limit is not applicable to outdoor use areas.

Vibration levels were measured for northbound and southbound Caltrain passenger trains at three on-site locations along the tracks, with two setbacks at each location. Table 8 summarizes the maximum measured train vibration and typical vibration levels measured at each location during train passbys. The typical train vibration is representative of the 80-90% vibration level that was measured at each location.

Table 8: Summary of Measured Vibration Levels

Location	Measured Activity Description	Vibration Level (VdB re 1μinch/sec, RMS)		Number of Trains Analyzed
		Position (a)	Position (b)	
V-1	Maximum	89	72	11
	Typical	85	68	
V-2	Maximum	84	71	10
	Typical	81	68	
V-3	Maximum	81	71	3
	Typical	*	*	

Note: Position (a) is located at the base of the berm approximately 25 feet from the near track, and position (b) is setback 40 feet from position (a) at approximately 65 feet from the near track.

*Sample size was not large enough to support a calculated typical train vibration level.

Vibration levels in the range of 70 to 90 VdB are unlikely to cause architectural or structural damage of any type. However, these vibration levels would be readily perceptible to people and, depending on the sensitivity of the individual and the activity in which they are engaged, could cause annoyance and disrupt indoor activities. Annoyance is often caused by secondary vibrations, such as a slight rattling of doors and windows.

Typically, the setback to the 72 VdB contour is 100 feet or greater from the center of the near track. As a result of the slow train speeds adjacent to the site and the railroad berm, measured vibration levels at this site were lower. Based on the results of vibration measurements, the calculated 72 VdB contour distances were about 65 feet from the center of the near railroad track for the maximum measured train vibration level and about 55 feet from the center of the near railroad track for typical train passbys. Residential units located within these distances would be exposed to ground vibration levels which exceed the 72 VdB vibration limit for “frequent events”.

Mitigation 2: The following mitigation measure shall be included in the project to reduce the impact to a *less-than-significant* level:

- Provide sufficient setback between occupied structures and the railroad tracks. To meet the 72 VdB limit for typical train vibration levels at the project site, residential buildings should be

setback 55 feet or further from the center of the near railroad track. To meet the limit for the maximum measured train vibration level, residential buildings should be setback 65 feet or further from the center of the near track.

Impact 3: Off-Site Project-Generated Traffic Noise. The proposed residential project will not measurably increase traffic noise levels along roadways in the project vicinity. **This is a less-than-significant impact.**

A traffic impact analysis was not prepared for this project. Standard assumptions regarding project traffic have been made to calculate a credible worst-case noise level increase resulting from project traffic. Traffic generated by the project would enter and exit the site from El Camino Real. Project trips would then distribute themselves along the roadway network. The project is anticipated to develop 320 units on the site. Assuming 10 vehicle trips per unit per day (3,200 ADT), full build out of the site would generate approximately 320 peak hour trips (10% of the ADT). The current peak-hour traffic volume along El Camino Real⁶ is 2400 trips north of Holly Street, 2400 trips between Holly Street and San Carlos Avenue, and 2200 trips south of San Carlos Avenue. The addition of project traffic would increase noise levels by less than 1 dBA CNEL at receivers along roadway segments experiencing future project trips. Increases of less than 1 dBA CNEL are not considered substantial. This is a less-than-significant impact.

Mitigation 3: None Recommended

Impact 4: Construction Noise. Future noise generated by the construction on the site would not be expected to adversely affect land uses in the immediate vicinity of the site or distant noise-sensitive land uses. **This is a less-than-significant impact.**

The project site is located in a primarily commercial area, with commercial and railroad uses bordering the project site. The nearest residences are located east of Old Country Road (about 150 feet east of the project site) and west of the commercial uses along El Camino Real (along Laurel Street, about 250 feet west of the project site) and are partially shielded by intervening terrain and/or structures.

Project construction activities would take place in a period of less than one year and would include grading of the site, excavation for underground parking, paving of roadways, construction of project infrastructure, and construction of the project buildings. Future construction on the site would generate noise, and would temporarily increase noise levels at adjacent land uses. Noise impacts resulting from construction depend on the noise generated by various pieces of construction equipment, the timing and duration of noise generating activities, and the distance between construction noise sources and noise sensitive receptors. The highest noise levels would typically be generated during excavation and grading of the site, with lower noise levels generated during building construction. Where noise from construction activities is anticipated to take place for a period of more than one year, exceeds 60 dBA L_{eq} , and exceeds the ambient noise environment by at least 5 dBA at noise-sensitive uses in the project vicinity, the impact would be considered significant.

Large pieces of earth-moving equipment, such as graders, scrapers, and bulldozers, generate maximum noise levels of 80 to 85 dBA at a distance of 100 feet. Typical hourly average construction-generated noise levels are about 75 to 80 dBA measured at a distance of 100 feet from the site during busy construction periods. These noise levels drop off at a rate of about 6 dBA per doubling of distance

⁶Traffic and Vehicle Data System Unit, Caltrans, <http://www.dot.ca.gov/hq/traffops/saferesr/trafdata/>, 2004.

between the noise source and receptor. Typically, small residential, commercial, or office construction projects do not generate significant noise impacts when standard construction noise control measures are enforced at the project site and when the duration of the noise generating construction period is limited to one construction season (typically one year) or less. Construction noises associated with projects of this type are disturbances that are necessary for the construction or repair of buildings and structures in urban areas. Reasonable regulation of the hours of construction, as well as regulation of the arrival and operation of heavy equipment and the delivery of construction materials, are necessary to protect the health and safety of persons, promote the general welfare of the community, and maintain the quality of life.

Construction noise impacts primarily result when construction activities occur during noise-sensitive times of the day (early morning, evening, or nighttime hours), the construction occurs in areas immediately adjoining noise sensitive land uses, or when construction durations last over extended periods of time. The City of San Carlos Municipal Code limits construction activities to the hours of 7:00 a.m. to 6:00 p.m., Monday through Friday, and 9:00 a.m. to 5:00 p.m. on Saturday, Sunday and holidays. Limiting the hours when construction can occur to daytime hours is often a simple method to reduce the potential for noise impacts.

The construction of the project is not anticipated to adversely affect commercial or industrial uses in the immediate vicinity or distant residential receivers. At residences east of Old Country Road (about 150 feet from the site), construction noise levels would be expected to be about 10 decibels lower as a result of increased distance from the noise source. Shielding by the railroad berm would provide an additional 10 to 15 decibels of attenuation at these receivers, resulting in worst-case hourly average construction noise levels of 60 to 70 dBA L_{eq} . In addition to noise generated by traffic along Old Country Road and local noise sources, the railroad is calculated to generate hourly noise levels of 65 to 70 dBA L_{eq} during daytime hours (when construction would take place) at these residences. The anticipated construction noise levels at these residences would generally coincide with existing noise levels generated by transportation noise sources in the area.

Residences along Laurel Street (about 250 feet from the site) would experience hourly average construction noise levels of 55 to 65 dBA during busy construction periods. During worst-case hours when construction is located adjacent to these residences, noise levels could occasionally exceed 60 dBA L_{eq} and ambient noise levels by 5 dBA. Noise levels produced by heavy equipment may interfere with normal residential activities during busy construction periods. As the buildings are constructed and as construction is moved south towards San Carlos Avenue, noise would be noticeable but would not be significant.

The duration of construction is anticipated to be less than one year and noise levels would be expected to exceed 60 dBA L_{eq} for only a small percentage of the construction period. Therefore, with the inclusion of good neighbor construction practices and compliance with the City's Municipal Code, as follows, this is a less-than-significant impact.

- Construction hours shall be limited to 7:00 a.m. to 6:00 p.m., Monday through Friday, and 9:00 a.m. to 5:00 p.m. on Saturday, Sunday and holidays, as specified by the City of San Carlos Municipal Code.
- Use available noise suppression devices and properly maintain and muffle loud construction equipment.

- Stage construction equipment as far as reasonable from noise-sensitive land use and avoid unnecessary idling of equipment.
- Designate a “noise disturbance coordinator” who would be responsible for responding to any local complaints about construction noise. The disturbance coordinator would determine the cause of the noise complaint (e.g., starting too early, bad muffler, etc.) and institute reasonable measures warranted to correct the problem. Conspicuously post a telephone number for the disturbance coordinator at the construction site.

Mitigation 4: None Recommended

Impact 5: Noise and Land Use Compatibility (Aircraft). Residential uses developed at the site would be located in a compatible noise environment in the vicinity of the San Carlos Airport. **This is a less-than-significant impact.**

The project site is located within 2 miles of the San Carlos Airport. The San Carlos General Plan specifies that a noise analysis be required in new residential uses located within the 55 to 60 dBA CNEL impact area of the San Carlos Airport. The noise contour map established in the City of San Carlos’ General Plan (Future Noise Levels at Buildout) indicates that the project site is located outside of the future 55 dBA CNEL noise contour for San Carlos Airport. Therefore, this is a less-than-significant impact.

Mitigation 5: None Recommended