APPENDIX C

Noise Fundamentals and Noise Modeling Results

APPENDIX C
FUNDAMENTALS OF ENVIRONMENTAL NOISE

C.1 SOUND, NOISE, AND ACOUSTICS

Sound can be described as the mechanical energy of a vibrating object transmitted by pressure waves through a liquid or gaseous medium (e.g., air). Noise is generally defined as sound that is unwanted (loud, unexpected, or annoying). Acoustics is defined as the physics of sound. In acoustics, the fundamental scientific model consists of a sound (or noise) source, a receiver, and the propagation path between the two. The loudness of the noise source and obstructions or atmospheric factors affecting the propagation path to the receiver determines the sound level and characteristics of the noise perceived by the receiver. Acoustics addresses primarily the propagation and control of sound.

C.2 FREQUENCY

The number of sound pressure peaks traveling past a given point in a single second is referred to as the frequency, expressed in cycles per second or Hertz (Hz). A given sound may consist of energy at a single frequency (pure tone) or at many frequencies over a broad frequency range (or band). Human hearing is generally affected by sound frequencies between 20 Hz and 20,000 Hz (i.e., 20 kHz).

C.3 AMPLITUDE

The amplitude of pressure waves generated by a sound source determines the perceived loudness of that source. Sound pressure amplitude is measured in micro-Pascals (µPa). One µPa is approximately one hundred billionths (0.00000000001) of normal atmospheric pressure. Sound pressure amplitudes for different kinds of noise environments can range from less than 100 µPa to 100,000,000 µPa. Because of this huge range of values, sound is rarely expressed in terms of pressure. Instead, a logarithmic scale is used to describe sound pressure level in terms of decibels (dB). The threshold of human hearing (near-total silence) is approximately 0 dB, which corresponds to 20 µPa.

C.4 ADDITION OF DECIBELS

Because decibels are logarithmic units, sound pressure levels cannot be added or subtracted through ordinary arithmetic means. Under the decibel scale, a doubling of sound energy corresponds to a 3-dB increase. In other words, when two sources are each producing sound of the same loudness, the resulting sound level at a given distance would be approximately 3 dB higher than one of the sources under the same conditions. For example, if one automobile produces a sound pressure level of 70 dB when it passes an observer, two cars passing simultaneously would not produce 140 dB; rather, they would combine to produce 73 dB. Under the decibel scale, three sources of equal loudness together produce a sound level of approximately 5 dB louder than one source, and 10 sources of equal loudness together produce a sound level of approximately 10 dB louder than the single source.

C.5 A-WEIGHTED DECIBELS

Figure C-1 illustrates sound levels associated with common sound sources. The perceived loudness of sounds is dependent on many factors, including sound pressure level and frequency content. However, within the usual range of environmental sound levels, perception of loudness is relatively predictable, and can be approximated by frequency filtering using the standardized A-weighting network. There is a strong correlation between A-weighted sound levels (expressed as dBA) and community response to noise. For this reason, the A-weighted sound level has become the standard descriptor for environmental noise assessment. All noise levels reported in Section 3.11 of this draft environmental impact report are in terms of A-weighting.

C.6 HUMAN RESPONSE TO CHANGES IN NOISE LEVELS

As discussed above, doubling sound energy results in a 3-dB increase in sound. However, given a sound level change measured with precise instrumentation, the subjective human perception of a doubling of loudness will usually be different than what is measured.

Under controlled conditions in a laboratory setting, the trained, healthy human ear is able to discern 1-dB changes in sound levels when exposed to steady, single-frequency (“pure-tone”) signals in the mid-frequency range (1,000–8,000 Hz). In typical noisy environments, changes in noise of 1–2 dB are generally not perceptible. However, it is widely accepted that people can begin to detect sound level increases of 3 dB in typical noisy environments. Furthermore, a 5-dB increase is generally perceived as a distinctly noticeable increase, and a 10-dB increase is generally perceived as a doubling of loudness. Therefore, a doubling of sound energy that would result in a 3-dB increase in sound pressure level would generally be perceived as barely detectable (Table C-1).

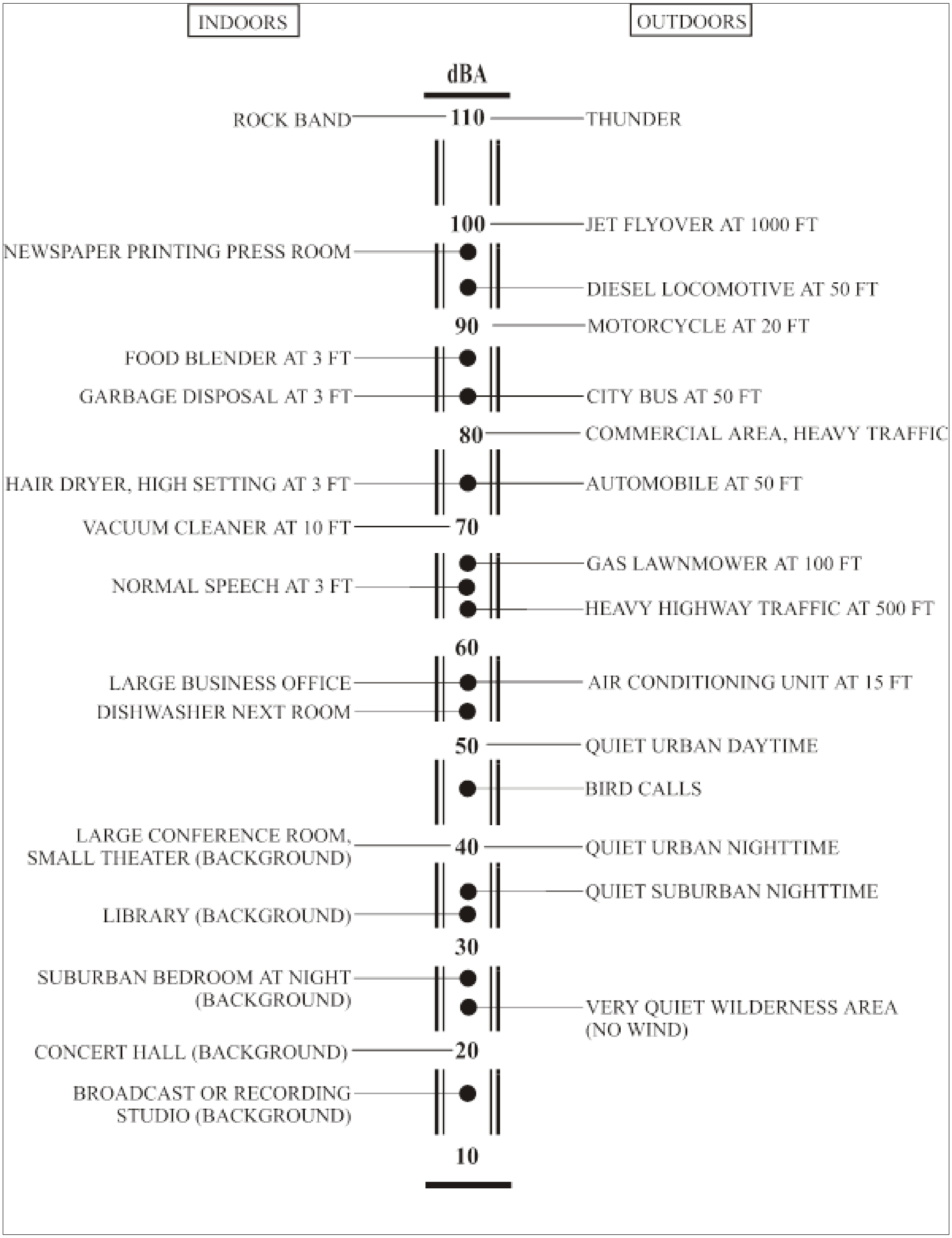
C.7 NOISE SENSITIVE LAND USES

Noise-sensitive land uses are generally defined as locations where people reside or where the presence of unwanted sound could adversely affect the use of the land. Noise-sensitive land uses typically include residences, hospitals, schools, transient lodging, libraries, and certain types of recreational uses. Noise-sensitive residential receivers are found throughout the planning area.

C.8 NOISE DESCRIPTORS

Noise in our daily environments fluctuates over time. Some fluctuations are minor, but some are substantial. Some noise levels occur in regular patterns, but others are random. Some noise levels fluctuate rapidly, but others slowly. Some noise levels vary widely, but others are relatively constant. Various noise descriptors have been developed to describe time-varying noise levels. The following noise descriptors are those most commonly used in environmental noise analysis, and may be applicable to this study:

- **Equivalent Sound Level (L_{eq}):** An average of the sound energy occurring over a specified time period. In effect, the L_{eq} is the steady-state sound level containing the same acoustical energy as the time-varying sound that actually occurs during the same period. The 1-hour, A-weighted equivalent sound level (Leq[h]) is the energy average of A-weighted sound levels occurring during a 1-hour period, and is the basis for noise abatement criteria used by the California Department of Transportation and the Federal Highway Administration.



Source: Caltrans 2009

Figure C-1. Decibel Scale and Common Noise Sources

Table C-1. Approximate Relationship between Increases In Environmental Noise Level and Human Perception

Noise Level Increase, dB	Human Perception (typical)
Up to about 3	Not perceptible
About 3	Barely perceptible
About 6	Distinctly noticeable
About 10	Twice as loud
About 20	Four times as loud

Note: dB = decibels
Source: Egan 1988:21

- **Percentile-Exceeded Sound Level (L_n):** The sound level exceeded "n" percentage of a specified period (e.g., L_{10} is the sound level exceeded 10 percent of the time, and L_{90} is the sound level exceeded 90 percent of the time).

- **Maximum Sound Level (L_{max}):** The highest instantaneous sound level measured during a specified period.

- **Day-Night Average Level (L_{dn}):** The energy-average of A-weighted sound levels occurring over a 24-hour period, with a 10-dB penalty applied to A-weighted sound levels occurring during nighttime hours (10 p.m.–7 a.m.). The L_{dn} is often noted as the DNL.

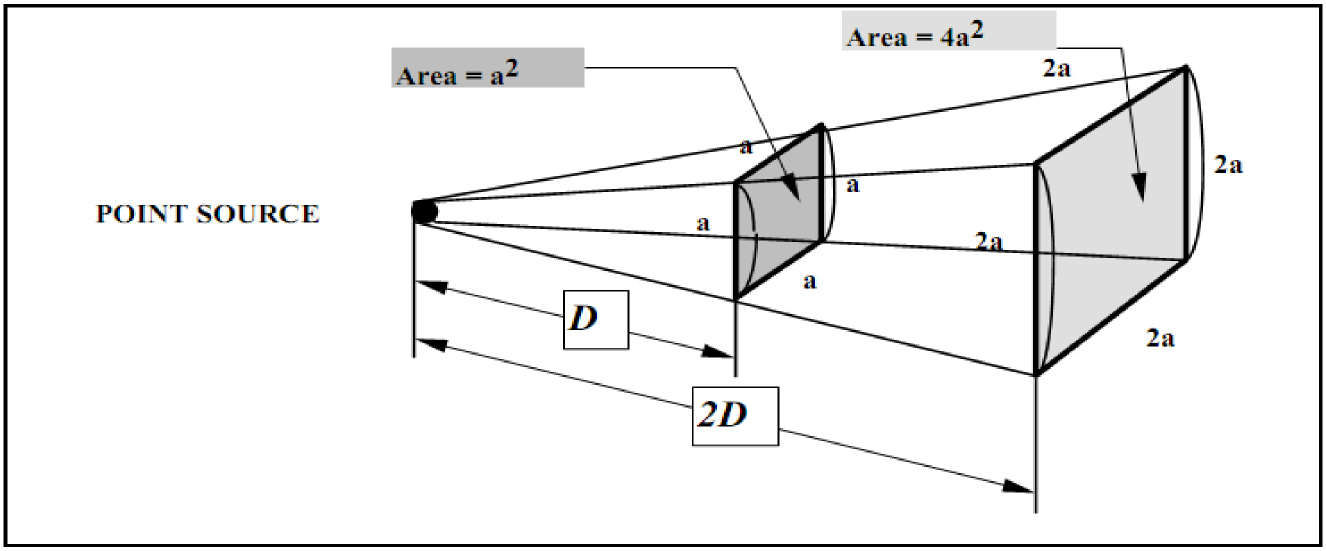
- **Community Noise Equivalent Level (CNEL):** Similar to L_{dn}, the energy-average of the A-weighted sound levels occurring over a 24-hour period, with a 10-dB penalty applied to A-weighted sound levels occurring during the nighttime hours (10 p.m.–7 a.m.) and a 5-dB penalty applied to the A-weighted sound levels occurring during evening hours (7 p.m.–10 p.m.). The CNEL is usually within 1 dB of the L_{dn}, and for all intents and purposes, the two are interchangeable. Because it is easier to compute and of more common use, the L_{dn} is used as the long-term noise measure in this study.

C.9 SOUND PROPAGATION

When sound propagates over a distance, it changes in level and frequency content. The manner in which noise reduces with distance depends on the factors described below.

C.9.1 GEOMETRIC SPREADING

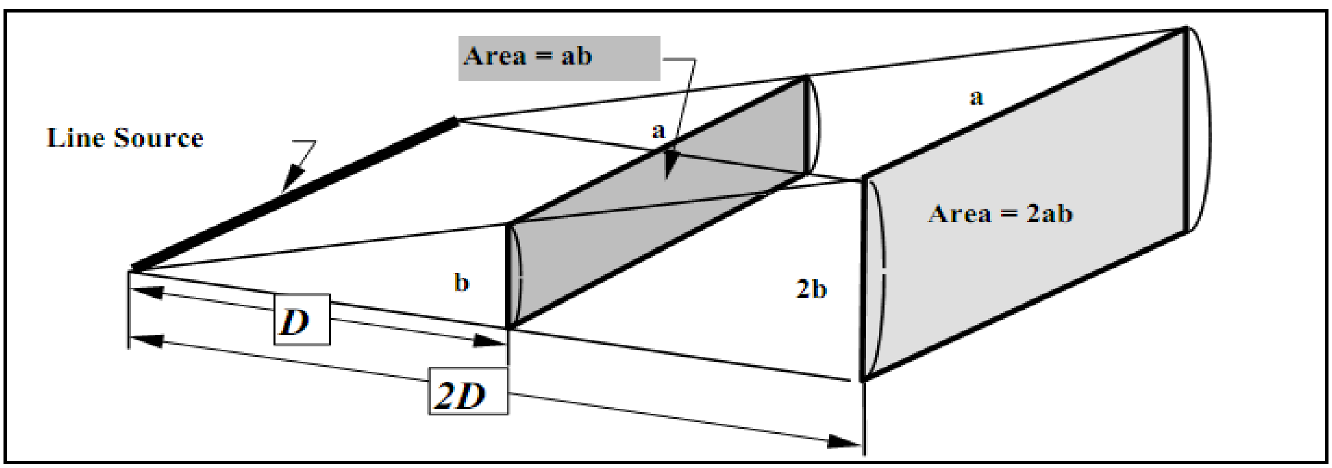
Sound from a localized source (i.e., point source) propagates uniformly outward in a spherical pattern; therefore, this type of propagation is called *spherical spreading*. The sound level attenuates (or decreases) at a rate of 6 dB for each doubling of distance from a point/stationary source as its energy is continuously spread out over a spherical surface (Figure C-2).



Source: Caltrans 2009

Figure C-2. Point-Source Spreading with Distance

Roadways and highways, and to some extent moving trains, consist of several localized noise sources on a defined path, and hence are treated as "line" sources, which approximate the effect of several point sources (Figure C-3). Noise from a line source propagates over a cylindrical surface, often referred to as *cylindrical spreading*. Sound levels attenuate at a rate of 3 dB for each doubling of distance from a line source. Therefore, noise from a line source attenuates less with distance than noise from a point source with increased distance.



Source: Caltrans 2009

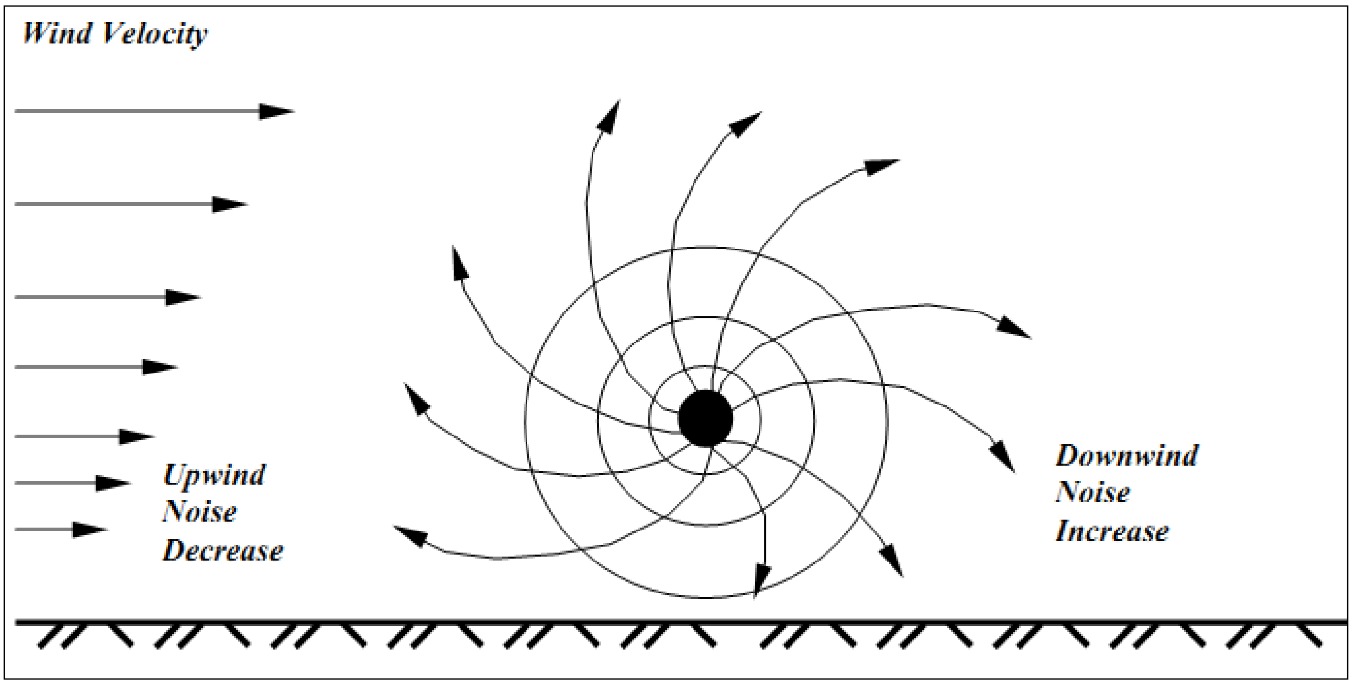
Figure C-3. Line-Source Spreading with Distance

C.9.2 Ground Absorption

The propagation path of noise from many typical sources, such as roadways, to a receiver is usually very close to the ground. Noise attenuation from ground absorption and reflective-wave canceling adds to the attenuation associated with geometric spreading. Traditionally, the excess attenuation also has been expressed in terms of attenuation per doubling of distance. For acoustically hard sites (sites with a reflective surface between the source and the receiver, such as a paved parking lot or body of water), no excess ground attenuation is generally assumed. For acoustically absorptive or soft sites (sites with an absorptive ground surface between the source and the receiver, such as soft dirt, grass, or scattered bushes and trees), an excess ground-attenuation value of 1.5 decibels per doubling of distance is typically assumed. When added to cylindrical spreading from traffic noise sources, the excess ground attenuation results in an overall drop-off rate of 4.5 dB per doubling of distance. When added to spherical spreading (point sources), it results in overall drop-off rates of approximately 7.5 dB. These approximations are generally applicable only for receivers within 300 feet of the noise source(s), and should not be applied to sound path lengths of more than 300 feet.

C.9.3 Atmospheric Effects

Receivers located downwind from a source can be exposed to increased noise levels relative to calm conditions, whereas receivers upwind from the source can have lowered noise levels. This phenomenon, illustrated in Figure C-4, is common and experienced thoughout much of California.



Source: Caltrans 2009

Figure C-4. Wind Effects on Noise Levels

In addition to the enhancing effect produced by wind, sound levels can increase at large distances from the source (e.g., more than 500 feet) as a result of atmospheric temperature inversions (increasing temperature with elevation). Sound levels also can decrease with distance from the source at a higher rate than the typical spreading loss with distance rate (see above) as a result of a temperature lapse condition (decreasing temperature with elevation).

Temperature inversions are a common part of the meteorological environment in California. During a temperature inversion, the air temperature at the ground is cooler than the temperature several hundred feet above the ground. These temperature inversions are typically caused when a warm, sunny day is followed by a cold, clear night; generally this occurs more frequently and with higher intensity in the fall and the spring seasons. The sun warms the earth's surface during the day and generally the air temperature near the ground is higher than the air temperature at higher elevations. When the sun sets, however, the earth cools quickly by infrared radiation into space and so does the air mass at lower elevations, so that the air temperature at high elevations soon becomes warmer than the air temperature near the ground. The speed of sound is higher in warmer air, and this inverted temperature profile causes the sound waves in the warmer air to overtake those traveling in cooler air, thus the sound “bends” back toward the ground (see Figure C-5).

Other factors such as air temperature, humidity, and turbulence also can have significant effects on sound propagation. For instance, air temperature and humidity have a significant effect on the rate of molecular absorption as sound travels large distances. A sound consisting primarily of middle frequencies such as speech or animal vocalization attenuates approximately 5 additional dB for every 1,000 feet of travel with an air temperature of 70 degrees Fahrenheit and a humidity of 30–40 percent, which is typical in much of California. This atmospheric effect is in addition to the other effects discussed above.

C.10 VIBRATION

Generally speaking, vibration is energy transmitted in waves through the ground. Because energy is lost during the transfer of energy from one particle to another, the vibratory energy is reduced with increasing distance from the source. Vibration attenuates at a rate of approximately 50 percent for each doubling of distance from the source. This approach only takes into consideration the attenuation from geometric spreading. Because there are additional factors that reduce vibration over distance (e.g., damping from soil condition), this approach tends to provide for a conservative assessment of vibration level at the receiver.

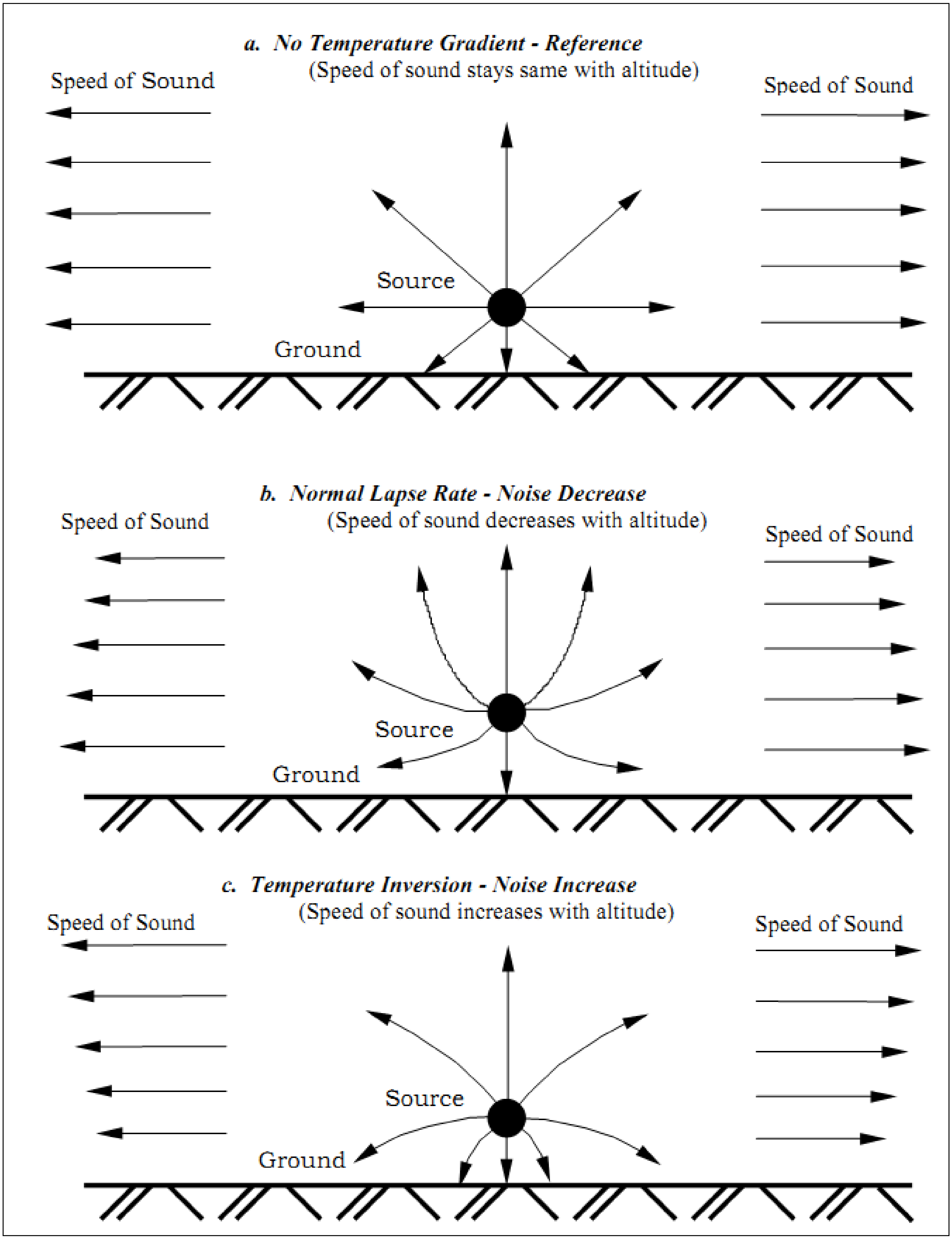
Vibration is an oscillatory motion that can be described in terms of the displacement, velocity, or acceleration. Vibration is typically described by its peak amplitude and its root-mean-square (RMS) amplitude. The RMS value can be considered an average value over a given time interval. The peak vibration velocity is the same as the “peak particle velocity” (PPV), generally presented in units of inches per second. Peak particle velocity is defined as the maximum instantaneous positive or negative peak of the vibration signal, and PPV is generally used to assess the potential for damage to buildings and structures. The RMS amplitude is typically used for assessing human annoyance about vibration.

C.11 REFERENCES

California Department of Transportation. 2009 (November). *Technical Noise Supplement.* Division of Environmental Analysis, Sacramento, CA. Prepared by ICF Jones & Stokes, Sacramento, CA.

Caltrans. *See* California Department of Transportation.

Egan, M. D. 1988. *Architectural Acoustics.* New York: McGraw-Hill, Inc.



Source: Caltrans 2009

Figure C-5. **Effects of Temperature Gradients on Noise**

Project-Generated Construction Source Noise Prediction Model

Carnegie SVRA

Location	Distance to Nearest Receiver in feet	Combined Predicted Noise Level (L_{eq} dBA)
Threshold*	892	55.0
	50	86.3
	100	78.8
	150	74.4
	200	71.2
	250	68.8
	300	66.8
	350	65.2
	400	63.7
	450	62.4
	500	61.3
	550	60.3
	600	59.3

Assumptions:	Reference Emission Noise Levels (L_{max}) at 50 feet[1]	Usage Factor[1]
Dump Truck	84	0.4
Dozer	85	0.4
Concrete Pump Truck	82	0.2
Concrete Mixer Truck	85	0.4
Backhoe	80	0.4

Ground Type	soft
Ground Factor	0.50

Predicted Noise Level [2]	L_{eq} dBA at 50 feet[2]
Dump Truck	80.0
Dozer	81.0
Concrete Pump Truck	75.0
Concrete Mixer Truck	81.0
Backhoe	76.0

Combined Predicted Noise Level (L_{eq} dBA at 50 feet)
86.3

Sources:

[1] Obtained from the FHWA Roadway Construction Noise Model, January 2006.

[2] Based on the following from the Federal Transit Noise and Vibration Impact Assessment, 2006.

L_{eq}(equip) = E.L.+10*log (U.F.) - 20*log (D/50) - 10*G*log (D/50)

Where: E.L. = Emission Level;

U.F.= Usage Factor;

G = Constant that accounts for topography and ground effects; and

D = Distance from source to receiver.

*Project specific threshold

Project-Generated Construction Source Noise Prediction Model

Carnegie SVRA

Location	Distance to Nearest Receiver in feet	Combined Predicted Noise Level (L_{eq} dBA)
Threshold*	924	55.0
	50	86.7
	100	79.1
	150	74.7
	200	71.6
	250	69.2
	300	67.2
	350	65.5
	400	64.1
	450	62.8
	500	61.7
	550	60.6
	600	59.7

Assumptions:	Reference Emission Noise Levels (L_{max}) at 50 feet[1]	Usage Factor[1]
Tractor	84	0.4
Paver	85	0.5
Grader	85	0.4
Generator	82	0.5

Ground Type	soft
Ground Factor	0.50

Predicted Noise Level [2]	L_{eq} dBA at 50 feet[2]
Tractor	80.0
Paver	82.0
Grader	81.0
Generator	79.0

Combined Predicted Noise Level (L_{eq} dBA at 50 feet)
86.7

Sources:

[1] Obtained from the FHWA Roadway Construction Noise Model, January 2006.

[2] Based on the following from the Federal Transit Noise and Vibration Impact Assessment, 2006.

$L_{eq}(equip) = E.L.+10*\log(U.F.) - 20*\log(D/50) - 10*G*\log(D/50)$

Where: E.L. = Emission Level;

U.F.= Usage Factor;

G = Constant that accounts for topography and ground effects; and

D = Distance from source to receiver.

*Project specific threshold

Traffic Noise Prediction Model, (FHWA RD-77-108)
Model Input Sheet

AECOM

Project Name : Carnegie SVRA
Project Number : 60209087
Modeling Condition : Existing - Week
Ground Type : Soft
Metric (L_{eq}, L_{dn}, CNEL) : Ldn
K Factor : 10
Traffic Desc. (Peak or ADT) : Peak

Segment	Roadway	Segment From	Segment To	Traffic Vol.	Speed (Mph)	Distance to CL	% Autos	%MT	% HT	Day %	Eve %	Night %	Offset (dB)
1	Tesla Road	Vasco Road	West of Vasco Road	1462	50	100	97	2	1	85	5	10	
2	Tesla Road	Vasco Road	East of Vasco Road	741	50	100	97	2	1	85	5	10	
3	Vasco Road	Tesla Road	North of Tesla Road	911	35	100	97	2	1	85	5	10	
4	Tesla Road	Greenville Road	West of Greenville Road	741	50	100	97	2	1	85	5	10	
5	Tesla Road	Greenville Road	East of Greenville Road	479	50	100	97	2	1	85	5	10	
6	Greenville Road	Tesla Road	North of Tesla Road	375	35	100	97	2	1	85	5	10	
7	Greenville Road	Tesla Road	South of Tesla Road	92	35	100	97	2	1	85	5	10	
8	Corral Hollow Road	SVRA park access	West of SVRA park access	281	50	100	97	2	1	85	5	10	
9	Corral Hollow Road	SVRA park access	East of SVRA park access	285	50	100	97	2	1	85	5	10	
10	SVRA park access	Corral Hollow Road	South of Corral Hollow Road	26	25	100	97	2	1	85	5	10	
11	Corral Hollow Road	I-580 southbound ramps	West of Southbound Ramps	314	50	100	97	2	1	85	5	10	
12	Corral Hollow Road	I-580 southbound ramps	East of Southbound Ramps	456	50	100	97	2	1	85	5	10	
13	I-580 southbound Off ramp	1-580 SB	Corral Hollow Road	255	45	100	97	2	1	85	5	10	
14	I-580 southbound On ramp	Corral Hollow Road	1-580 SB	234	45	100	97	2	1	85	5	10	
15	Corral Hollow Road	I-580 northbound ramps	West of Northbound Ramps	456	50	100	97	2	1	85	5	10	
16	Corral Hollow Road	I-580 northbound ramps	East of Northbound Ramps	504	50	100	97	2	1	85	5	10	
17	I-580 northbound Off ramp	1-580 NB	Corral Hollow Road	72	45	100	97	2	1	85	5	10	
18	I-580 northbound On ramp	Corral Hollow Road	1-580 NB	44	45	100	97	2	1	85	5	10	
19	Altamont Pass Road	I-580 westbound ramps	West of Ramps	732	35	100	97	2	1	85	5	10	
20	Altamont Pass Road	I-580 westbound ramps	East of Ramps	669	35	100	97	2	1	85	5	10	
21	I-580 westbound Off Ramp	I-580 WB	Altamont Pass Road	536	45	100	97	2	1	85	5	10	
22	I-580 westbound On Ramp	Altamont Pass Road	I-580 WB	363	45	100	97	2	1	85	5	10	
23	Southfront Road	I-580 eastbound ramps	West of Ramps	372	35	100	97	2	1	85	5	10	
24	Southfront Road	I-580 eastbound ramps	East of Ramps	669	35	100	97	2	1	85	5	10	
25	I-580 Eastbound Off Ramp	I-580 EB	Southfront Road	219	45	100	97	2	1	85	5	10	
26	I-580 Eastbound On Ramp	Southfront Road	I-580 EB	502	45	100	97	2	1	85	5	10	

0

Traffic Noise Prediction Model, (FHWA RD-77-108)

Predicted Noise Levels

Project Name : Carnegie SVRA
Project Number : 60209087
Modeling Condition : Existing - Week
Metric (Leq, Ldn, CNEL) : Ldn

		Segment		Noise Levels, dB Ldn				Distance to Traffic Noise Contours, Feet				
Segment	Roadway	From	To	Auto	MT	HT	Total	70 dB	65 dB	60 dB	55 dB	50 dB
1	Tesla Road	Vasco Road	West of Vasco Ro	63.5	54.3	55.5	64.6	44	94	202	436	939
2	Tesla Road	Vasco Road	East of Vasco Roa	60.6	51.4	52.6	61.6	28	60	129	277	597
3	Vasco Road	Tesla Road	North of Tesla Roa	57.0	49.8	52.0	58.8	18	39	83	179	386
4	Tesla Road	Greenville Road	West of Greenville	60.6	51.4	52.6	61.6	28	60	129	277	597
5	Tesla Road	Greenville Road	East of Greenville	58.7	49.5	50.7	59.7	21	45	96	207	446
6	Greenville Road	Tesla Road	North of Tesla Roa	53.2	46.0	48.2	54.9	10	21	46	99	214
7	Greenville Road	Tesla Road	South of Tesla Ro	47.1	39.9	42.1	48.8	4	8	18	39	84
8	Corral Hollow Road	SVRA park access	West of SVRA par	56.4	47.2	48.3	57.4	15	31	67	145	313
9	Corral Hollow Road	SVRA park access	East of SVRA park	56.4	47.2	48.4	57.5	15	32	68	146	316
10	SVRA park access	Corral Hollow Roa	South of Corral Ho	37.4	32.1	36.7	40.7	1	2	5	11	24
11	Corral Hollow Road	I-580 southbound	West of Southbou	56.8	47.6	48.8	57.9	16	34	73	156	337
12	Corral Hollow Road	I-580 southbound	East of Southbour	58.5	49.3	50.4	59.5	20	43	93	200	432
13	I-580 southbound Off ramp	1-580 SB	Corral Hollow Roa	54.6	46.0	47.5	55.9	11	25	53	114	246
14	I-580 southbound On ramp	Corral Hollow Roa	1-580 SB	54.2	45.6	47.1	55.5	11	23	50	108	232
15	Corral Hollow Road	I-580 northbound	West of Northbour	58.5	49.3	50.4	59.5	20	43	93	200	432
16	Corral Hollow Road	I-580 northbound	East of Northboun	58.9	49.7	50.9	60.0	21	46	99	214	462
17	I-580 northbound Off ramp	1-580 NB	Corral Hollow Roa	49.1	40.5	42.0	50.4	5	11	23	49	106
18	I-580 northbound On ramp	Corral Hollow Roa	1-580 NB	47.0	38.4	39.9	48.2	4	8	16	35	76
19	Altamont Pass Road	I-580 westbound r	West of Ramps	56.1	48.9	51.1	57.8	15	33	72	155	334
20	Altamont Pass Road	I-580 westbound r	East of Ramps	55.7	48.5	50.7	57.5	15	31	68	146	314
21	I-580 westbound Off Ramp	I-580 WB	Altamont Pass Ro	57.8	49.2	50.7	59.1	19	40	87	187	404
22	I-580 westbound On Ramp	Altamont Pass Ro	I-580 WB	56.2	47.5	49.0	57.4	14	31	67	145	311
23	Southfront Road	I-580 eastbound ra	West of Ramps	53.1	46.0	48.1	54.9	10	21	46	99	212
24	Southfront Road	I-580 eastbound ra	East of Ramps	55.7	48.5	50.7	57.5	15	31	68	146	314
25	I-580 Eastbound Off Ramp	I-580 EB	Southfront Road	54.0	45.4	46.8	55.2	10	22	48	103	222
26	I-580 Eastbound On Ramp	Southfront Road	I-580 EB	57.6	49.0	50.4	58.8	18	39	83	179	387

Traffic Noise Prediction Model, (FHWA RD-77-108)

Model Input Sheet

AECOM

Project Name : Carnegie SVRA
Project Number : 60209087
Modeling Condition : Existing - Saturday
Ground Type : Soft
K Factor : 10
Metric (L_{eq}, L_{dn}, **CNEL**) **:** Ldn
Traffic Desc. (Peak or ADT) : Peak

Segment	Roadway	Segment From	Segment To	Traffic Vol.	Speed (Mph)	Distance to CL	% Autos	%MT	% HT	Day %	Eve %	Night %	Offset (dB)
1	Tesla Road	Vasco Road	West of Vasco Road	624	50	100	97	2	1	85	5	10	
2	Tesla Road	Vasco Road	East of Vasco Road	352	50	100	97	2	1	85	5	10	
3	Vasco Road	Tesla Road	North of Tesla Road	482	35	100	97	2	1	85	5	10	
4	Tesla Road	Greenville Road	West of Greenville Road	352	50	100	97	2	1	85	5	10	
5	Tesla Road	Greenville Road	East of Greenville Road	199	50	100	97	2	1	85	5	10	
6	Greenville Road	Tesla Road	North of Tesla Road	173	35	100	97	2	1	85	5	10	
7	Greenville Road	Tesla Road	South of Tesla Road	136	35	100	97	2	1	85	5	10	
8	Corral Hollow Road	SVRA park access	West of SVRA park access	67	50	100	97	2	1	85	5	10	
9	Corral Hollow Road	SVRA park access	East of SVRA park access	68	50	100	97	2	1	85	5	10	
10	SVRA park access	Corral Hollow Road	South of Corral Hollow Road	43	25	100	97	2	1	85	5	10	
11	Corral Hollow Road	I-580 southbound ramps	West of Southbound Ramps	73	50	100	97	2	1	85	5	10	
12	Corral Hollow Road	I-580 southbound ramps	East of Southbound Ramps	169	50	100	97	2	1	85	5	10	
13	I-580 southbound Off ramp	1-580 SB	Corral Hollow Road	77	45	100	97	2	1	85	5	10	
14	I-580 southbound On ramp	Corral Hollow Road	1-580 SB	45	45	100	97	2	1	85	5	10	
15	Corral Hollow Road	I-580 northbound ramps	West of Northbound Ramps	169	50	100	97	2	1	85	5	10	
16	Corral Hollow Road	I-580 northbound ramps	East of Northbound Ramps	243	50	100	97	2	1	85	5	10	
17	I-580 northbound Off ramp	1-580 NB	Corral Hollow Road	107	45	100	97	2	1	85	5	10	
18	I-580 northbound On ramp	Corral Hollow Road	1-580 NB	69	45	100	97	2	1	85	5	10	
19	Altamont Pass Road	I-580 westbound ramps	West of Ramps	168	35	100	97	2	1	85	5	10	
20	Altamont Pass Road	I-580 westbound ramps	East of Ramps	265	35	100	97	2	1	85	5	10	
21	I-580 westbound Off Ramp	I-580 WB	Altamont Pass Road	85	45	100	97	2	1	85	5	10	
22	I-580 westbound On Ramp	Altamont Pass Road	I-580 WB	119	45	100	97	2	1	85	5	10	
23	Southfront Road	I-580 eastbound ramps	West of Ramps	119	35	100	97	2	1	85	5	10	
24	Southfront Road	I-580 eastbound ramps	East of Ramps	265	35	100	97	2	1	85	5	10	
25	I-580 Eastbound Off Ramp	I-580 EB	Southfront Road	123	45	100	97	2	1	85	5	10	
26	I-580 Eastbound On Ramp	Southfront Road	I-580 EB	97	45	100	97	2	1	85	5	10	

Traffic Noise Prediction Model, (FHWA RD-77-108)

Predicted Noise Levels

AECOM

Project Name : Carnegie SVRA
Project Number : 60209087
Modeling Condition : Existing - Saturday
Metric (Leq, Ldn, CNEL) : Ldn

		Segment		Noise Levels, dB Ldn				Distance to Traffic Noise Contours, Feet				
Segment	Roadway	From	To	Auto	MT	HT	Total	70 dB	65 dB	60 dB	55 dB	50 dB
1	Tesla Road	Vasco Road	West of Vasco Ro	59.8	50.6	51.8	60.9	25	53	115	247	532
2	Tesla Road	Vasco Road	East of Vasco Roa	57.3	48.1	49.3	58.4	17	36	78	169	363
3	Vasco Road	Tesla Road	North of Tesla Roa	54.2	47.1	49.3	56.0	12	25	54	117	252
4	Tesla Road	Greenville Road	West of Greenville	57.3	48.1	49.3	58.4	17	36	78	169	363
5	Tesla Road	Greenville Road	East of Greenville	54.9	45.7	46.8	55.9	12	25	54	115	248
6	Greenville Road	Tesla Road	North of Tesla Roa	49.8	42.6	44.8	51.6	6	13	27	59	127
7	Greenville Road	Tesla Road	South of Tesla Ro	48.7	41.6	43.8	50.5	5	11	23	50	109
8	Corral Hollow Road	SVRA park access	West of SVRA par	50.1	40.9	42.1	51.2	6	12	26	56	120
9	Corral Hollow Road	SVRA park access	East of SVRA parl	50.2	41.0	42.2	51.3	6	12	26	56	121
10	SVRA park access	Corral Hollow Roa	South of Corral Hc	39.5	34.3	38.9	42.9	2	3	7	16	34
11	Corral Hollow Road	I-580 southbound	West of Southbou	50.5	41.3	42.5	51.6	6	13	27	59	127
12	Corral Hollow Road	I-580 southbound	East of Southbour	54.2	44.9	46.1	55.2	10	22	48	103	223
13	I-580 southbound Off ramp	1-580 SB	Corral Hollow Roa	49.4	40.8	42.3	50.7	5	11	24	51	111
14	I-580 southbound On ramp	Corral Hollow Roa	1-580 SB	47.1	38.5	40.0	48.3	4	8	17	36	77
15	Corral Hollow Road	I-580 northbound	West of Northbour	54.2	44.9	46.1	55.2	10	22	48	103	223
16	Corral Hollow Road	I-580 northbound	East of Northboun	55.7	46.5	47.7	56.8	13	28	61	132	284
17	I-580 northbound Off ramp	1-580 NB	Corral Hollow Roa	50.9	42.2	43.7	52.1	6	14	30	64	138
18	I-580 northbound On ramp	Corral Hollow Roa	1-580 NB	48.9	40.3	41.8	50.2	5	10	22	48	103
19	Altamont Pass Road	I-580 westbound r	West of Ramps	49.7	42.5	44.7	51.5	6	13	27	58	125
20	Altamont Pass Road	I-580 westbound r	East of Ramps	51.6	44.5	46.7	53.4	8	17	36	79	169
21	I-580 westbound Off Ramp	I-580 WB	Altamont Pass Ro	49.9	41.2	42.7	51.1	5	12	25	55	118
22	I-580 westbound On Ramp	Altamont Pass Ro	I-580 WB	51.3	42.7	44.2	52.6	7	15	32	69	148
23	Southfront Road	I-580 eastbound ra	West of Ramps	48.2	41.0	43.2	50.0	5	10	21	46	99
24	Southfront Road	I-580 eastbound ra	East of Ramps	51.6	44.5	46.7	53.4	8	17	36	79	169
25	I-580 Eastbound Off Ramp	I-580 EB	Southfront Road	51.5	42.8	44.3	52.7	7	15	33	70	151
26	I-580 Eastbound On Ramp	Southfront Road	I-580 EB	50.4	41.8	43.3	51.7	6	13	28	60	129

Traffic Noise Prediction Model, (FHWA RD-77-108)

Model Input Sheet

AECOM

Project Name : Carnegie SVRA
Project Number : 60209087
Modeling Condition : 2030 - Week
Ground Type : Soft
Metric (L_{eq}, L_{dn}, CNEL) : Ldn

K Factor : 10
Traffic Desc. (Peak or ADT) : Peak

Segment	Roadway	Segment From	Segment To	Traffic Vol.	Speed (Mph)	Distance to CL	% Autos	%MT	% HT	Day %	Eve %	Night %	Offset (dB)
1	Tesla Road	Vasco Road	West of Vasco Road	1880	50	100	97	2	1	85	5	10	
2	Tesla Road	Vasco Road	East of Vasco Road	1110	50	100	97	2	1	85	5	10	
3	Vasco Road	Tesla Road	North of Tesla Road	1010	35	100	97	2	1	85	5	10	
4	Tesla Road	Greenville Road	West of Greenville Road	1110	50	100	97	2	1	85	5	10	
5	Tesla Road	Greenville Road	East of Greenville Road	1120	50	100	97	2	1	85	5	10	
6	Greenville Road	Tesla Road	North of Tesla Road	800	35	100	97	2	1	85	5	10	
7	Greenville Road	Tesla Road	South of Tesla Road	150	35	100	97	2	1	85	5	10	
8	Corral Hollow Road	SVRA park access	West of SVRA park access	709	50	100	97	2	1	85	5	10	
9	Corral Hollow Road	SVRA park access	East of SVRA park access	714	50	100	97	2	1	85	5	10	
10	SVRA park access	Corral Hollow Road	South of Corral Hollow Road	33	25	100	97	2	1	85	5	10	
11	Corral Hollow Road	I-580 southbound ramps	West of Southbound Ramps	835	50	100	97	2	1	85	5	10	
12	Corral Hollow Road	I-580 southbound ramps	East of Southbound Ramps	1055	50	100	97	2	1	85	5	10	
13	I-580 southbound Off ramp	1-580 SB	Corral Hollow Road	698	45	100	97	2	1	85	5	10	
14	I-580 southbound On ramp	Corral Hollow Road	1-580 SB	688	45	100	97	2	1	85	5	10	
15	Corral Hollow Road	I-580 northbound ramps	West of Northbound Ramps	1055	50	100	97	2	1	85	5	10	
16	Corral Hollow Road	I-580 northbound ramps	East of Northbound Ramps	525	50	100	97	2	1	85	5	10	
17	I-580 northbound Off ramp	1-580 NB	Corral Hollow Road	210	45	100	97	2	1	85	5	10	
18	I-580 northbound On ramp	Corral Hollow Road	1-580 NB	960	45	100	97	2	1	85	5	10	
19	Greenville Road	Altamont Pass Road	North of Altamont Pass Road	2290	35	100	97	2	1	85	5	10	
20	Greenville Road	Altamont Pass Road	South of Altamont Pass Road	3200	35	100	97	2	1	85	5	10	
21	Altamont Pass Road	Greenville Road	East of Greenville Road	700	45	100	97	2	1	85	5	10	
22	Altamont Pass Road	Greenville Road	West of Greenville Road	930	45	100	97	2	1	85	5	10	
23	Greenville Road	Southfront Road	North of Southfront Road	3100	35	100	97	2	1	85	5	10	
24	Greenville Road	Southfront Road	South of Southfront Road	3150	35	100	97	2	1	85	5	10	
	Southfront Road	Greenville Road	East of Greenville Road	0	45	100		2	1	85	5		
26	Southfront Road	Greenville Road	West of Greenville Road	1030	45	100	97	2	1	85	5	10	

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Traffic Noise Prediction Model, (FHWA RD-77-108)

Predicted Noise Levels

AECOM

Project Name : Carnegie SVRA
Project Number : 60209087
Modeling Condition : 2030 - Week
Metric (Leq, Ldn, CNEL) : Ldn

		Segment		Noise Levels, dB Ldn				Distance to Traffic Noise Contours, Feet				
Segment	Roadway	From	To	Auto	MT	HT	Total	70 dB	65 dB	60 dB	55 dB	50 dB
1	Tesla Road	Vasco Road	West of Vasco Ro	64.6	55.4	56.6	65.7	52	111	239	515	1110
2	Tesla Road	Vasco Road	East of Vasco Roa	62.3	53.1	54.3	63.4	36	78	168	363	781
3	Vasco Road	Tesla Road	North of Tesla Roa	57.5	50.3	52.5	59.2	19	41	89	192	413
4	Tesla Road	Greenville Road	West of Greenville	62.3	53.1	54.3	63.4	36	78	168	363	781
5	Tesla Road	Greenville Road	East of Greenville	62.4	53.2	54.3	63.4	36	79	169	365	786
6	Greenville Road	Tesla Road	North of Tesla Roa	56.4	49.3	51.5	58.2	16	35	76	164	354
7	Greenville Road	Tesla Road	South of Tesla Ro	49.2	42.0	44.2	51.0	5	12	25	54	116
8	Corral Hollow Road	SVRA park access	West of SVRA par	60.4	51.2	52.4	61.4	27	58	125	269	579
9	Corral Hollow Road	SVRA park access	East of SVRA parl	60.4	51.2	52.4	61.5	27	58	125	270	582
10	SVRA park access	Corral Hollow Roa	South of Corral Hc	38.4	33.2	37.8	41.7	1	3	6	13	28
11	Corral Hollow Road	I-580 southbound	West of Southbou	61.1	51.9	53.1	62.2	30	65	139	300	646
12	Corral Hollow Road	I-580 southbound	East of Southbour	62.1	52.9	54.1	63.2	35	76	163	351	755
13	I-580 southbound Off ramp	1-580 SB	Corral Hollow Roa	59.0	50.4	51.9	60.2	22	48	104	224	482
14	I-580 southbound On ramp	Corral Hollow Roa	1-580 SB	58.9	50.3	51.8	60.2	22	48	103	221	477
15	Corral Hollow Road	I-580 northbound	West of Northbour	62.1	52.9	54.1	63.2	35	76	163	351	755
16	Corral Hollow Road	I-580 northbound	East of Northboun	59.1	49.9	51.1	60.1	22	47	102	220	474
17	I-580 northbound Off ramp	1-580 NB	Corral Hollow Roa	53.8	45.2	46.7	55.0	10	22	47	100	216
18	I-580 northbound On ramp	Corral Hollow Roa	1-580 NB	60.4	51.8	53.3	61.6	28	60	128	276	596
19	Greenville Road	Altamont Pass Ro	North of Altamont	61.0	53.8	56.0	62.8	33	71	154	331	713
20	Greenville Road	Altamont Pass Ro	South of Altamont	62.5	55.3	57.5	64.3	41	89	192	414	892
21	Altamont Pass Road	Greenville Road	East of Greenville	59.0	50.4	51.9	60.3	22	48	104	224	482
22	Altamont Pass Road	Greenville Road	West of Greenville	60.2	51.6	53.1	61.5	27	58	126	271	583
23	Greenville Road	Southfront Road	North of Southfror	62.3	55.2	57.3	64.1	41	87	188	405	873
24	Greenville Road	Southfront Road	South of Southfror	62.4	55.2	57.4	64.2	41	88	190	410	882
	Southfront Road	Greenville Road	East of Greenville									
26	Southfront Road	Greenville Road	West of Greenville	60.7	52.1	53.6	61.9	29	62	134	290	624

Traffic Noise Prediction Model, (FHWA RD-77-108)

Model Input Sheet

AECOM

Project Name : Carnegie SVRA
Project Number : 60209087
Modeling Condition : 2030 - Saturday
Ground Type : Soft **K Factor :** 10
Metric (L_{eq}, L_{dn}, CNEL) : Ldn **Traffic Desc. (Peak or ADT) :** Peak

		Segment											
Segment	Roadway	From	To	Traffic Vol.	Speed (Mph)	Distance to CL	% Autos	%MT	% HT	Day %	Eve %	Night %	Offset (dB)
1	Tesla Road	Vasco Road	West of Vasco Road	790	50	100	97	2	1	85	5	10	
2	Tesla Road	Vasco Road	East of Vasco Road	510	50	100	97	2	1	85	5	10	
3	Vasco Road	Tesla Road	North of Tesla Road	550	35	100	97	2	1	85	5	10	
4	Tesla Road	Greenville Road	West of Greenville Road	510	50	100	97	2	1	85	5	10	
5	Tesla Road	Greenville Road	East of Greenville Road	480	50	100	97	2	1	85	5	10	
6	Greenville Road	Tesla Road	North of Tesla Road	370	35	100	97	2	1	85	5	10	
7	Greenville Road	Tesla Road	South of Tesla Road	245	35	100	97	2	1	85	5	10	
8	Corral Hollow Road	SVRA park access	West of SVRA park access	166	50	100	97	2	1	85	5	10	
9	Corral Hollow Road	SVRA park access	East of SVRA park access	167	50	100	97	2	1	85	5	10	
10	SVRA park access	Corral Hollow Road	South of Corral Hollow Road	53	25	100	97	2	1	85	5	10	
11	Corral Hollow Road	I-580 southbound ramps	West of Southbound Ramps	285	50	100	97	2	1	85	5	10	
12	Corral Hollow Road	I-580 southbound ramps	East of Southbound Ramps	515	50	100	97	2	1	85	5	10	
13	I-580 southbound Off ramp	1-580 SB	Corral Hollow Road	236	45	100	97	2	1	85	5	10	
14	I-580 southbound On ramp	Corral Hollow Road	1-580 SB	156	45	100	97	2	1	85	5	10	
15	Corral Hollow Road	I-580 northbound ramps	West of Northbound Ramps	515	50	100	97	2	1	85	5	10	
16	Corral Hollow Road	I-580 northbound ramps	East of Northbound Ramps	625	50	100	97	2	1	85	5	10	
17	I-580 northbound Off ramp	1-580 NB	Corral Hollow Road	355	45	100	97	2	1	85	5	10	
18	I-580 northbound On ramp	Corral Hollow Road	1-580 NB	310	45	100	97	2	1	85	5	10	
19	Greenville Road	Altamont Pass Road	North of Altamont Pass Road	1020	35	100	97	2	1	85	5	10	
20	Greenville Road	Altamont Pass Road	South of Altamont Pass Road	1465	35	100	97	2	1	85	5	10	
21	Altamont Pass Road	Greenville Road	East of Greenville Road	205	45	100	97	2	1	85	5	10	
22	Altamont Pass Road	Greenville Road	West of Greenville Road	500	45	100	97	2	1	85	5	10	
23	Greenville Road	Altamont Pass Road	North of Southfront Road	1450	35	100	97	2	1	85	5	10	
24	Greenville Road	Altamont Pass Road	South of Southfront Road	1390	35	100	97	2	1	85	5	10	
	Southfront Road	Greenville Road	East of Greenville Road	0	45	100		2	1	85	5		
26	Southfront Road	Greenville Road	West of Greenville Road	400	45	100	97	2	1	85	5	10	

Traffic Noise Prediction Model, (FHWA RD-77-108)

Predicted Noise Levels

AECOM

Project Name : Carnegie SVRA
Project Number : 60209087
Modeling Condition : 2030 - Saturday
Metric (Leq, Ldn, CNEL) : Ldn

		Segment		Noise Levels, dB Ldn				Distance to Traffic Noise Contours, Feet				
Segment	Roadway	From	To	Auto	MT	HT	Total	70 dB	65 dB	60 dB	55 dB	50 dB
1	Tesla Road	Vasco Road	West of Vasco Ro	60.9	51.6	52.8	61.9	29	62	134	289	623
2	Tesla Road	Vasco Road	East of Vasco Roa	59.0	49.7	50.9	60.0	22	47	100	216	465
3	Vasco Road	Tesla Road	North of Tesla Roa	54.8	47.7	49.8	56.6	13	28	59	128	276
4	Tesla Road	Greenville Road	West of Greenville	59.0	49.7	50.9	60.0	22	47	100	216	465
5	Tesla Road	Greenville Road	East of Greenville	58.7	49.5	50.7	59.8	21	45	96	207	447
6	Greenville Road	Tesla Road	North of Tesla Roa	53.1	45.9	48.1	54.9	10	21	46	98	212
7	Greenville Road	Tesla Road	South of Tesla Ro	51.3	44.1	46.3	53.1	7	16	35	75	161
8	Corral Hollow Road	SVRA park acces	West of SVRA par	54.1	44.9	46.1	55.1	10	22	47	102	220
9	Corral Hollow Road	SVRA park acces	East of SVRA par	54.1	44.9	46.1	55.2	10	22	48	103	221
10	SVRA park access	Corral Hollow Roa	South of Corral H	40.4	35.2	39.8	43.8	2	4	8	18	39
11	Corral Hollow Road	I-580 southbound	West of Southbou	56.4	47.2	48.4	57.5	15	32	68	146	316
12	Corral Hollow Road	I-580 southbound	East of Southbour	59.0	49.8	51.0	60.1	22	47	101	217	468
13	I-580 southbound Off ramp	1-580 SB	Corral Hollow Roa	54.3	45.7	47.2	55.5	11	23	50	108	234
14	I-580 southbound On ramp	Corral Hollow Roa	1-580 SB	52.5	43.9	45.4	53.7	8	18	38	82	177
15	Corral Hollow Road	I-580 northbound	West of Northbour	59.0	49.8	51.0	60.1	22	47	101	217	468
16	Corral Hollow Road	I-580 northbound	East of Northboun	59.8	50.6	51.8	60.9	25	53	115	247	533
17	I-580 northbound Off ramp	1-580 NB	Corral Hollow Roa	56.1	47.5	48.9	57.3	14	31	66	142	307
18	I-580 northbound On ramp	Corral Hollow Roa	1-580 NB	55.5	46.9	48.3	56.7	13	28	60	130	280
19	Greenville Road	Altamont Pass Ro	North of Altamont	57.5	50.3	52.5	59.3	19	42	90	193	416
20	Greenville Road	Altamont Pass Ro	South of Altamont	59.1	51.9	54.1	60.9	25	53	114	246	530
21	Altamont Pass Road	Greenville Road	East of Greenville	53.7	45.1	46.6	54.9	10	21	46	99	213
22	Altamont Pass Road	Greenville Road	West of Greenville	57.5	48.9	50.4	58.8	18	39	83	179	386
23	Greenville Road	Altamont Pass Ro	North of Southfro	59.0	51.9	54.0	60.8	24	53	113	244	526
24	Greenville Road	Altamont Pass Ro	South of Southfro	58.8	51.7	53.9	60.6	24	51	110	237	511
	Southfront Road	Greenville Road	East of Greenville									
26	Southfront Road	Greenville Road	West of Greenville	56.6	48.0	49.5	57.8	15	33	72	154	332