City of San Luis Obispo

NOISE GUIDEBOOK

MEASUREMENT & MITIGATION TECHNIQUES

May 1996

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OUR MISSION STATEMENT

Our mission is to serve all persons in a positive and courteous manner and help ensure that San Luis Obispo continues to be a healthy, safe, attractive, and enjoyable place to live, work, or visit. We help plan the City's form and character, support community values, preserve the environment, promote the wise use of resources, and protect public health and safety.

OUR SERVICE PHILOSOPHY

The City of San Luis Obispo Community Development Department staff provides high quality service when you need it. We will:

- ♦ Listen to understand your needs;
- ♦ Give clear, accurate and prompt answers to your questions;
- ♦ Explain how you can achieve your goals under the City's rules;
- ♦ Help resolve problems in an open, objective manner;
- ♦ Maintain high ethical standards; and
- ♦ Work to improve our service.

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This publication is based on a draft Noise Element prepared for San Luis Obispo County and its included cities in September 1991, by Brown-Buntin Associates, Inc. of Visalia, California.

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CONTENTS

FIGURES

TABLES

INTRODUCTION

This Guidebook is to help assess noise exposure and to design projects so they will meet the standards of the City's General Plan Noise Element. The Guidebook applies to noise from road traffic, the railroad, and aircraft. This Guidebook's design suggestions can help reduce noise exposure in many situations. The suggestions may allow a project to meet noise exposure standards, when otherwise the project would not. Also, they may result in a project being quieter for its occupants or neighbors, even when compliance with noise exposure standards is not an issue.

The City's noise exposure information covers the major transportation noise sources, and a representative sampling of stationary sources, identified for study when the Noise Element was last updated. Since noise from most stationary sources is difficult to quantify, and not all stationary noise sources have been assessed, noise from potentially significant stationary noise sources should be evaluated by an acoustical expert. Unanticipated changes in transportation noise sources may also require new information.

The standard noise mitigation packages should be used with the noise exposure information, to achieve compliance with the Noise Element's standards in relatively simple situations. The standard noise mitigation packages may be used to reduce exterior noise exposure by up to 5 dB and interior noise levels by 15, 20, 25, and 30 dB. The standard packages may be used in place of following specific, detailed noise studies and recommendations, in some cases. This Guidebook is not intended to address noise produced by stationary sources (such as industrial or agricultural operations). Also, the methods described below should not be used where the noise source is at a much different elevation from the receiver, the noise source is shielded from the receiver by buildings or topography, or the project is exposed to noise from several sources. In such situations, the help of an acoustical expert should be obtained.

NOISE ASSESSMENT

Fundamentals of Noise Assessment

Noise is often defined simply as unwanted sound. However, this subjective approach is difficult to use in planning for and regulating development. The descriptors of community noise commonly used in noise elements and noise control regulations have resulted from years of effort to translate subjective reaction to noise into objective measurements of sound. Before explaining these descriptors, it is useful to discuss some fundamental concepts of sound.

Sound is defined as any pressure variation in air that the human ear can detect. The number of pressure variations per second is called the frequency of sound, and is expressed as cycles per second, now called Hertz (Hz) by international agreement. Some pressure variations at low frequencies, if sufficiently strong, can be felt as vibrations but are usually not considered to be sounds. Higher frequency variations are above the range of human hearing.

The speed of sound in air is about 770 miles per hour, or 1,130 feet per second. Knowing the speed and frequency of a sound, one may calculate its wavelength, the distance from one compression of the atmosphere to the next. An understanding of wavelength is useful in evaluating the effectiveness of physical noise control devices such as mufflers or barriers, which depend upon either absorbing or blocking sound waves to reduce sound levels.

To measure sound directly in terms of pressure would require an awkwardly large range of numbers. To avoid this, the decibel (dB) scale was devised. The decibel scale uses the hearing threshold as a point of reference, defined as 0 dB. Other sound pressures are then compared to the reference pressure, and the logarithm is taken to keep the numbers in a practical range. Use of the decibel scale allows a million-fold increase in pressure to be expressed as 120 dB. Another useful aspect of the decibel scale is that changes in levels (dB) correspond closely to human perception of relative loudness (Figure 1).

The perceived loudness of sounds is dependent upon many factors, including sound pressure level and frequency. In the range of usual environmental noise levels, perception of loudness is relatively predictable, and can be approximated by weighting the frequency response of a sound level measurement device (called a sound level meter) by means of the standardized A-weighting network. There is a strong correlation between A-weighted sound levels and community response to noise. For this reason, the A-weighted sound level has become the standard tool of environmental noise assessment. Figure 1 illustrates typical A-weighted sound levels from some commonly known sources.

Community noise is often described in terms of the "ambient" noise level, which is defined as the all-encompassing noise level associated with a certain location. A common statistical tool to measure the ambient noise level is the average, or equivalent, sound level (L_{eq}). This is the sound level corresponding to a steady-state, A-weighted sound level containing the same total energy as a time-varying signal over a given time period (usually one hour). The L_{eq} is the foundation of the composite noise descriptors such as L_{dn} and CNEL, and shows very good correlation with community response to noise.

Two composite noise descriptors in common use are L_{dn} and CNEL. The L_{dn} (day-night average level) is based upon the average hourly L_{eq} over a 24-hour day, with 10 decibels added to night (10:00 p.m. to 7:00 a.m.) L_{eq} values. The night penalty is based upon the assumption that people react to night noise exposures as though they were subjectively twice as loud as daytime exposures. The CNEL (Community Noise Equivalent Level) is also based on the weighted average hourly L_{eq} over a 24-hour day, except that an additional 4.77 decibel penalty is applied to evening (7:00 p.m. to 10:00 p.m.) hourly L_{eq} values.

The CNEL was developed for the California Airport Noise Regulations, and is applied specifically to airport and aircraft noise assessment. The L_{dn} scale is a simplification of the CNEL concept, but the two will usually agree, for a given situation, within 1 dB. Like the L_{eq}, these descriptors are also averages and tend to not reflect wide variations in noise (such as very loud but brief noises separated by quiet). Because L_{dn} and CNEL presume increased evening or night sensitivity, they are best applied as criteria for land uses where night noise exposures are critical to the acceptability of the noise environment, such as residences.

FIGURE 1
EXAMPLES OF NOISE LEVELS

Level, dBA	Activity	Subjective Evaluations
140		Deafening
	Sonic booms	
130	Threshold of pain	
120	Threshold of discomfort	
	Amplified music	
110	Commercial jet takeoff at 200 feet	
100	Auto horn at 10 feet	Very loud
90	Noisy factory interior	
	Heavy truck at 50 feet	
80		Loud
	New automobile at 50 feet	
70	Stenographic room	
60	Normal conversation at 6 feet	Moderate
50	Office interior	
40	Soft radio music	Faint
30	Residence interior	
20	Whisper at 6 feet	
10		Very faint
	Human breathing	
0	Threshold of audibility	

Criteria for Acceptable Noise Exposure

The *Guidelines for the Preparation and Content of the Noise Element of the General Plan* include recommendations for exterior and interior noise level standards to be used by local jurisdictions, to identify and prevent the creation of incompatible land uses due to noise. These State *Guidelines* contain a land use compatibility table which describes the compatibility of different land uses with a range of environmental noise levels in terms of L_{dn} or CNEL. An exterior noise environment of 50 to 60 dB L_{dn} or CNEL is considered to be "normally acceptable" for residential uses according to those guidelines. The recommendations in the State *Guidelines* also note that, under certain conditions, more restrictive standards may be appropriate. As an example, the standards for quiet suburban and rural communities may be reduced by 5 to 10 dB to reflect lower existing outdoor noise levels.

The U.S. Environmental Protection Agency (EPA) also has prepared guidelines for community noise exposure in *Information on the Levels of Environmental Noise Requisite to Protect Public Health and Welfare with an Adequate Margin of Safety*. These Federal guidelines consider occupational noise exposure as well as noise exposure away from work locations. The Federal guidelines recognize an exterior noise level of 55 dB L_{dn} as a goal to protect the public from hearing loss, activity interference, sleep disturbance, and annoyance. The EPA notes, however, that this level is not a regulation, but is a level defined by a negotiated scientific consensus without concern for economic and technological feasibility or the needs and desires of any particular community. The EPA and other agencies have suggested land use compatibility guidelines which indicate that residential noise exposures of 55 to 65 dB L_{dn} are acceptable.

For control of noise nuisances, a community noise control ordinance is the most appropriate tool. The State Office of Noise Control has prepared a *Model Community Noise Control Ordinance*, which contains recommended noise standards in terms of "time-weighted" sound levels. Time-weighting allows discrimination of both short-term and long-term noise exposures, and sets allowable levels for each. The model ordinance recommends more stringent standards for residential land uses than for commercial and industrial, with the most stringent standards recommended for "rural suburban" situations. The primary exterior noise standard for rural residential uses is 50 dB from 7 a.m. to 10 p.m., and 40 dB at night. The standard is expressed in terms of the level exceeded for 30 minutes of an hour, equivalent to the median level, or L_{50}. This ordinance format is successfully applied in many California cities and counties.

The U.S. Environmental Protection Agency also has prepared a Model Community Noise Control Ordinance, using the "Equivalent A-weighted Sound Level" (L_{eq}) as the means of defining allowable noise levels. The EPA model contains no specific recommendations for local noise level standards, but reports a range of L_{eq} values as adopted by various local jurisdictions. The mean daytime noise standard reported by the EPA is about 57 dB (L_{eq}); the mean nighttime noise standard is about 52 dB (L_{eq}). This ordinance format has been successfully applied by the City and County of San Diego and by many other jurisdictions looking for a simplified approach to the enforcement of a local noise control ordinance.

In addition to the A-weighted noise level, other factors should be considered in establishing criteria for noise sensitive land uses. For example, sounds with noticeable tonal content such as whistles, horns, or droning or high-pitched sounds may be more annoying than the A-weighted sound level alone will suggest. Many noise standards apply a penalty, or correction, of 5 dB to such sounds. The effects of unusual tonal content will generally be more of a concern at night, when residents may notice the sound in contrast to previously-experienced background noise.

Because many rural residential areas experience very low noise levels, residents may express concern about the loss of "peace and quiet" due to the introduction of a sound which was not audible previously. In very quiet environments, the introduction of virtually any change in local activities will cause an increase in noise levels. A change in noise level and the relative loss of "peace and quiet" is the inevitable result of land use or activity changes in such areas. Audibility of a new noise source or increases in noise levels within recognized acceptable limits are not usually considered to be significant noise impacts, but these concerns should be addressed during environmental review.

Table 1 is commonly used to show expected public reaction to changes in environmental noise levels. This table is based on test subjects' reactions to changes in the levels of steady-state pure tones or broad-band noise, or to changes in levels of a given noise source. Table 1 only shows the general relationship between changes in sound energy, sound pressure levels, and subjective reactions. It is most applicable to noise levels in the range of 50 to 70 dB, the usual range of voice and interior noise levels. It is least applicable to public perception of intrusive noises in very quiet environments, because of the difference in frequency content between background noise sources and intrusive sounds. Also the absolute amount of energy required to make a given change in sound pressure level is much smaller at low noise levels than at higher levels.

The comparisons of subjective reaction outlined in Table 1 may not apply to noise exposures which are very quiet or very loud. For example, a whisper which is increased by 10 decibels (from 20 dB to 30 dB) remains a whisper, and would still be described as quiet. In contrast, an increase in the noise level of a diesel locomotive from 90 dB to 100 dB would be a change from a loud noise to a very loud noise. Thus the subjective reaction to a 10 dB change may be different, even though the numerical change is the same.

TABLE 1
SUBJECTIVE REACTION TO CHANGES IN NOISE LEVELS OF SIMILAR SOURCES

Increase in Sound Pressure Level, dB	Relative Increase in Acoustical Energy	Subjective Reaction
1	1.26 times	Minimum Detectable Change (Lab)
3	2.0 times	Usually Noticeable Change
5	3.2 times	Definitely Noticeable Change
10	10.0 times	Twice as Loud as Before

Sources: Various, reported by Brown-Buntin Associates, Inc., 1991.

Noise Source Characteristics

In assessing potential noise impacts and strategies for reducing them, one must know about the characteristics of noise produced by different sources. Basic characteristics of the three principal transportation noise sources are described below.

Road traffic: For noise assessment, traffic is divided into cars, medium trucks (those having two axles), and heavy trucks (those with three or more axles). The effective heights of noise propagation from these types of vehicles are:

Cars - at the road crown (high point in the surface);
Medium trucks - 2 feet above the road crown
Heavy trucks are - 8 feet above the road crown.

Railroads: The effective source height of railroad noise is mostly determined by noise emitted by the locomotive, which is generally assumed to be 10 feet above the rails. However, the effective height of noise for a locomotive blowing its horn is increased to 15 feet above the rails, since the horn is situated on top of the locomotive. In many situations the effective source height of trains is even greater than these, since the rails rest on a gravel bed that is often two to three feet higher than surrounding ground.

Aircraft: Aircraft in flight near an airport are usually a few hundred to several thousand feet above the ground. When aircraft noise exposure is an issue, generally the aircraft are at least 30 degrees above the horizon, where barriers cannot reduce exterior noise levels.

NOISE LEVELS IN SAN LUIS OBISPO

Identification of Noise Sources

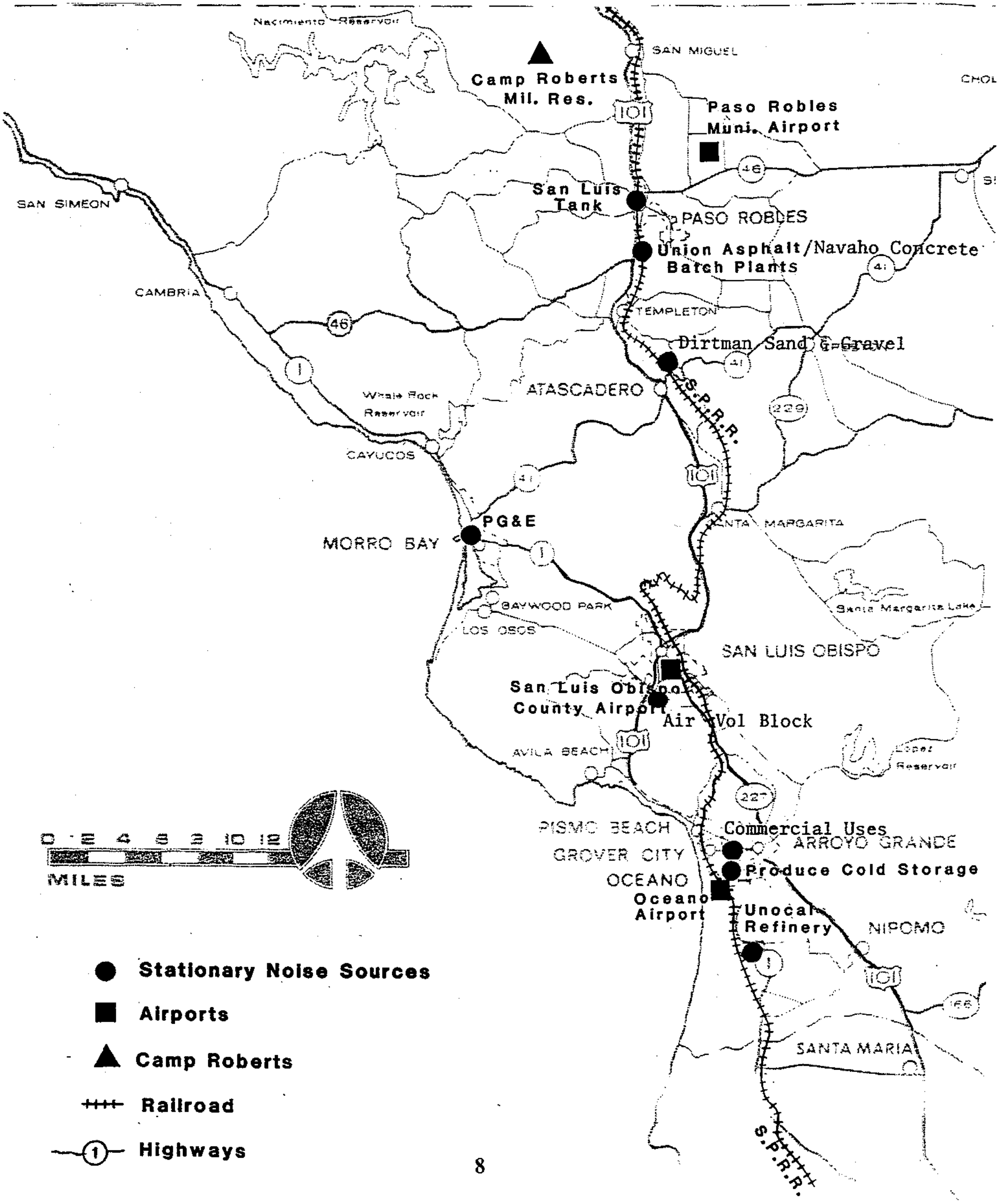
Field studies and discussions between local government planners and consultants retained to help with the Noise Element update identified several potentially significant sources of community noise within the City of San Luis Obispo. These sources include traffic on state highways and other major roads, railroad operations, airport operations, and industrial and commercial activities. Specific noise sources selected for study are discussed in the following sections. Figure 2 shows the locations of some major noise sources selected for study, and for which generalized noise exposure contours have been prepared.

Methods Used to Develop Noise Exposure Information

Brown-Buntin Associates, Inc., prepared generalized noise exposure contours for major sources of noise in San Luis Obispo County and its incorporated cities for 1990, and for future (generally, "build-out") conditions. Both mathematical modeling and sound level measurements were used. The future conditions were based on general plans then in effect or undergoing revision. In the case of San Luis Obispo, the land use patterns and traffic levels corresponded closely to the updates of the Land Use Element and the Circulation Element that were adopted in 1994. The exception to this method in San Luis Obispo was a street extension south of Terrace Hill, to link South Street and Bishop Street. An assessment of this link was prepared by City staff following adoption of the 1994 Circulation Element update, based on analogies with street segments projected to have similar traffic conditions. The noise contour information prepared by the consultants and staff generally reflects conservative (worst case) assumptions, so significant noise exposure concerns are not likely to be omitted or understated.

Noise models typically use average levels of activity, hours of operation, seasonal fluctuations, and average levels of noise from source operations. Such models have been developed for many environmental noise sources, including roads, rail line operations, railroad yard operations, industrial plants, and aircraft and airport operations. Such methods produce reliable results if data inputs and assumptions are valid for the sources being studied. The models used to prepare this element closely follow recommendations made by the State Office of Noise Control, and were supplemented where appropriate by source-specific sound level data to account for local conditions. Methods included the Federal Highway Administration (FHWA) "Highway Traffic Noise Prediction Model" for road sources, the Wyle Laboratories method for railroad noise exposure, and the Federal Aviation Administration (FAA) "Integrated Noise Model" for assessment of airport noise. For industrial, commercial, and other stationary sources, source-specific noise level data and accepted calculation procedures were used to characterize noise based on operations described by the source operators.

FIGURE 2
MAJOR NOISE SOURCES IN SAN LUIS OBISPO COUNTY



The noise exposure contours described in this Guidebook reflect annual average conditions, unless noted otherwise. They are not intended to be precise where local topography or structures may significantly affect noise exposure for a receiver. The contours should be used as a screening device when determining whether a project may result in a noise-related land use conflict. Generally, a site specific study will be required to determine noise exposure in situations involving complex topography or shielding by buildings. In some cases, site-specific traffic noise exposure can be estimated using the adjustment factors for topography presented in Table 3. A noise study is usually needed where multiple noise sources impact a site, to assess the combined noise exposure.

This Guidebook's noise exposure information for stationary industrial or commercial sources is a representative sampling, not a complete survey. Therefore, the data should be used only as an indicator of potential noise impacts when similar sources are considered.

Determining Noise Exposure for Specific Locations

Noise exposure information may be used to determine if a particular land use is consistent with the Noise Element, and if noise mitigation should be required. Noise exposure information for particular locations is found in the Noise Element's generalized maps (or larger scale maps in the City's planning office) and in this Guidebook's tables.

Roads and Highways

Brown-Buntin Associates used the Federal Highway Administration (FHWA) Highway Traffic Noise Prediction Model to develop L_{dn} contours for major traffic noise sources within the county and cities. The FHWA Model was the analytical method favored for traffic noise prediction by most state and local agencies, including Caltrans. The model is based on reference energy emission levels for automobiles, medium trucks (2 axles) and heavy trucks (3 axles or greater), with consideration given to vehicle volume, speed, roadway configuration, distance to the receiver, and the acoustical characteristics of the site. As recommended by Caltrans, the Calveno noise emission curves were used to more accurately portray noise exposure along roadways in California.

Traffic data for existing and projected future conditions, used in the calculations, were obtained from San Luis Obispo County and each of the cities in the County. For some roadways where traffic data were unavailable, traffic counts were conducted during peak traffic periods so daily vehicle movements could be estimated.

The FHWA Model was developed to predict hourly L_{eq} values for free-flowing traffic conditions, and is generally considered to be accurate within plus or minus 1.5 dB. To predict L_{dn} values it is necessary to determine the hourly distribution of traffic for a typical 24-hour day and to adjust the traffic volume input data to yield an equivalent hourly traffic volume. BBA experience with the use of the FHWA model indicated that for most situations where the roadway and receiving land use are at the same grade, the model will generally provide a conservative (worst-case) estimate of traffic noise exposure.

Traffic Noise Exposure Calculations

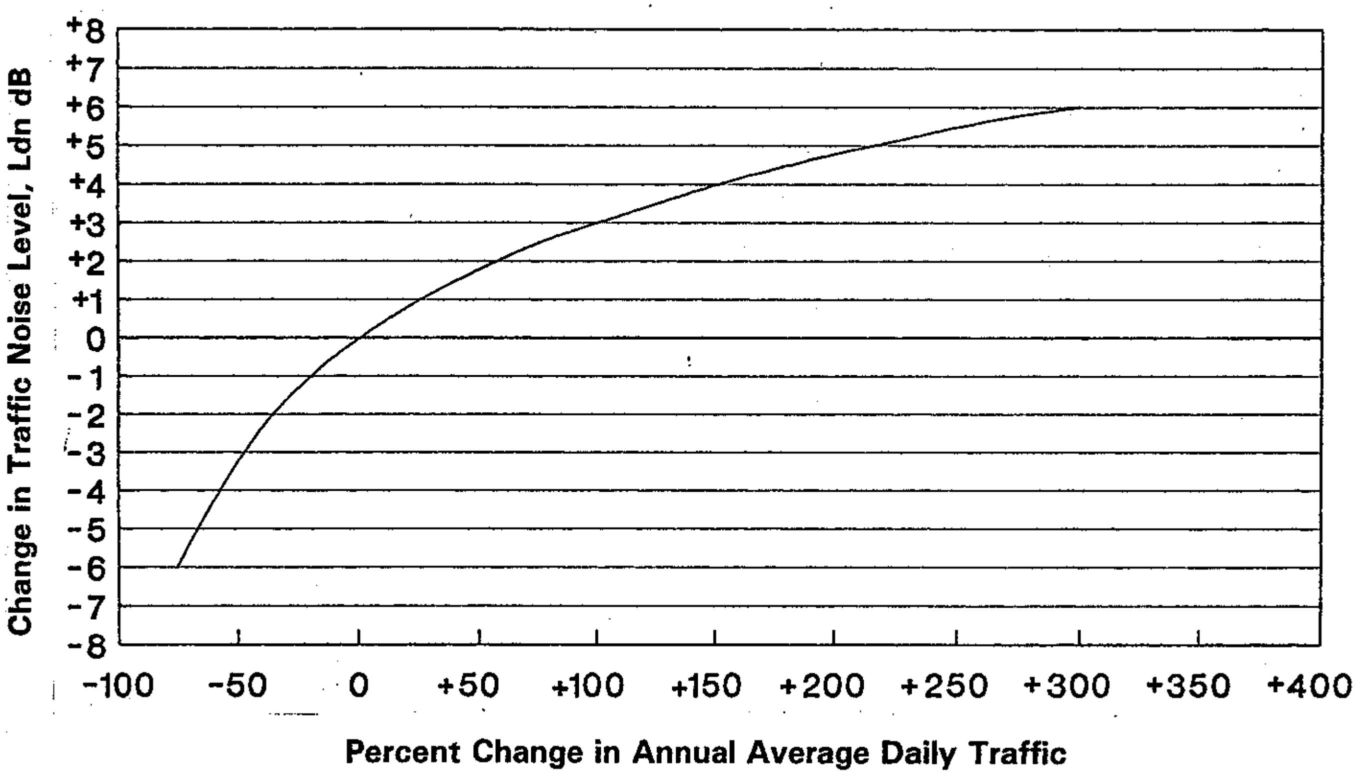
Traffic data representing annual average daily traffic volumes (AADT), truck mix, and the day/night distribution of traffic for 1990 and buildout conditions were obtained. For state highways, the future situation was assumed to be 2010, except for Highway 101 which was assumed to be 2005. Traffic data used in the traffic noise exposure model are summarized in Appendix A. The odd numbered segments in Appendix A refer to existing traffic volumes and the even numbered segments refer to future traffic volumes.

Using the FHWA Model and the traffic data summarized in Appendix A, the distances from the center of the roadway to the 60, 65 and 70 dB L_{dn} contours for existing and projected future traffic conditions were calculated. Contour distances are summarized in Table 2. Roadway segments listed in Table refer to the traffic data summarized in Appendix A. Noise contour calculations generally were performed only for roadways which had an existing or projected ADT of 5000 or more, since at lower traffic volumes the 60 dB L_{dn} contour would be closer to the road than normal residential setbacks. Where medium and heavy truck volumes were greater than about 5 percent or where speeds were greater than 50 mph, noise contours were calculated for roadways with less than 5000 AADT.

Since noise contour calculations did not consider shielding by buildings or land forms, the distances reported in Table and depicted in the noise exposure maps should be considered worst-case estimates of noise exposure. Noise exposure behind the first row of houses or other types of buildings may be reduced by up to 15 dB. The effects of elevated or depressed roadways or other topographic features are described in following sections.

For different traffic volumes, noise levels shown in Table 2 can be adjusted using Figure 3. For example, if it is known that a highway with 10,000 annual average daily trips (AADT) produces a noise level of 60 dB L_{dn} at 200 feet, the noise level at that same distance can be calculated if the AADT increases to 20,000 (assuming no changes in other traffic conditions, such as percentage of truck traffic and speed). From Figure 3 it can be seen that a 100% increase in traffic volume (10,000 to 20,000) increases the relative noise level by +3 dB. Therefore, the new traffic noise level is 63 dB L_{dn} (60 dB +3 dB) at 200 feet.

FIGURE 3
RELATIONSHIP OF TRAFFIC VOLUME CHANGE AND NOISE LEVEL CHANGE



Source: Brown-Buntin Associates

TABLE 2
DISTANCE (FEET) FROM CENTER OF ROADWAY
TO L_{dn} CONTOURS

Segment Nos.	Description	1990			Build-out		
		60 dB	65 dB	70 dB	60 dB	65 dB	70 dB
Highway 1							
9-10	Jct. Route 101 to Highland Dr. (Santa Rosa St.)	296	137	64	384	178	83
11-12	Highland Dr. to S. Morro Bay	478	222	103	644	299	139
Highway 101							
63-64	Avila Rd. to Los Osos Valley Rd.	986	457	212	1,391	645	300
65-66	Los Osos Valley Rd. to Higuera St.	891	414	192	1,268	589	273
67-68	Higuera St. to Jct. Route 1	1,077	500	232	1,588	737	342
69-70	Jct. Route 1 to Grand Ave.	970	450	209	1,698	788	366
71-72	Grand Ave. to S. Paso Robles	861	400	185	1,420	659	306
Highway 227							
81-82	Jct. Rt. 101 (Arroyo Grande) to Price Canyon Rd.	76	35	16	129	60	28
83-84	Price Canyon Rd. to Tank Farm Rd.	174	81	37	292	135	63
85-86	Tank Farm Rd. to Orcutt Rd.	208	97	45	311	145	67
87-88	Orcutt Rd. to South St. (within SLO City limits)	251	117	54	371	172	80
89-90	South St. to Higuera St. (within SLO City limits)	127	59	27	176	82	38
S.L.O. Area Roads							
159-160	Los Osos Valley Rd. (W. SLO City lim. to Foothill); For Hwy 101 to Madonna Rd., see segments 221-222	329	153	71	410	190	88
161-162	L.O.V. Rd. (Foothill to Estero planning area)	293	136	63	469	218	101
163-164	Tank Farm Rd. (South Higuera to Broad St.)	200	93	43	278	129	60
165-166	Orcutt Rd. (SLO urban area)	52	24	11	207	96	45

TABLE 2
Continued

Segment Nos.	Description	1990 60 dB	1990 65 dB	1990 70 dB	Build-out 60 dB	Build-out 65 dB	Build-out 70 dB
181-182	Augusta/Bishop St. (Johnson Ave. to Laurel Ln.)	29	14	6	29	14	6
183-184	Broad St. (Higuera St. to South St.)	127	59	27	176	82	38
185-186	Broad St. (South St. to Orcutt Rd.)	251	117	54	371	172	80
187-188	Broad St. (Orcutt Rd. to Tank Farm Rd.)	208	97	45	311	145	67
189-190	Buchon St. (High St. to Johnson Ave.)	32	15	7	58	27	13
191-192	California Blvd. (north of Hwy. 101)	126	59	27	163	76	35
193-194	California Blvd. (south of Hwy. 101)	83	38	18	81	38	18
195-196	Chorro St. (Broad St. to Higuera St.)	28	13	6	91	42	20
197-198	Chorro St. (Higuera St. to Hwy. 101)	73	34	16	87	40	19
199-200	High St. (Higuera St. to Broad St.)	30	14	6	62	29	13
201-202	Highland Dr. (west of Hwy. 1)	84	39	18	103	48	22
203-204	Johnson Ave. (Mill St. to Sydney St.)	79	37	17	157	73	34
205-206	Johnson Ave. (Sydney St. to south City limits)	79	37	17	103	48	22
207-208	Higuera St. (Santa Rosa to Marsh St.)	98	46	21	124	57	27
209-210	Higuera St. (Marsh St. to South St.)	109	51	24	210	98	45
211-212	Higuera St. (South St. to Prado Rd.)	146	68	31	237	110	51
213-214	Higuera St. (Prado Rd. to Tank Farm Rd.)	157	73	34	206	96	44
215-216	Higuera St. (Tank Farm Rd. to south City limits)	199	92	43	213	99	46
217-218	Foothill Blvd. (Crandall Way to W. City limits)	174	81	37	240	111	52
219-220	Tank Farm Rd. (Broad St. to Orcutt Rd.); for Tank Farm Rd. west of Broad St. see segments 163-164.	60	28	13	129	60	28
221-222	Los Osos Valley Rd. (Hwy 101 to Madonna Rd.)	128	60	28	177	82	38
223-224	Los Osos Valley Rd. (Madonna Rd. to west City limits)	195	91	42	243	113	52
225-226	Madonna Rd. (Higuera St. to Los Osos Valley Rd.)	294	137	63	393	183	85
227-228	Monterey St. (Chorro St. to Hwy 101)	93	43	20	118	55	25

TABLE 2
Continued

Segment Nos.	Description	1990			Build-out		
		60 dB	65 dB	70 dB	60 dB	65 dB	70 dB
229-230	Grand Ave. (Monterey St. to Slack)	85	40	18	114	53	25
231-232	Osos St./Santa Barbara Ave.	90	42	19	96	44	21
233-234	Marsh St. (Hwy 101 to Santa Rosa)	112	52	24	148	69	32
235-236	Santa Rosa St. (Hwy. 101 to Buchon); for Santa Rosa St. north of Hwy 101 see segments 9-10.	121	56	26	170	79	37
237-238	South St. (Broad to Higuera)	111	52	24	176	82	38
239-240	Laurel Lane (Orcutt to Johnson)	71	33	15	111	51	24
241-242	Orcutt Road (Broad to Johnson)	114	53	25	158	74	34
243-244	Orcutt Road (Johnson to south city limits)	52	24	11	207	96	45
245-246	Mill St. (Chorro to Grand)	25	12	5	40	19	9
247-248	Patricia Dr. (Highland to Foothill)	29	14	6	33	15	7
249-250	Pismo St. (Higuera to Johnson)	26	12	6	32	15	7
251-252	Prado Rd. (Highway 101 to Broad Street)	40	18	9	157	73	34
--	Bishop (Johnson to Santa Barbara)	--	--	--	76	38	18

Table 3 guides the application of traffic noise exposure contour information to areas with varying topography. The adjustment factors presented in Table 3 generally provide conservative (worst-case) results. More precise assessments for complex situations can be provided by a trained professional. The background for these correction factors is explained in the following section, "Traffic Calibration Study."

TABLE 3
ADJUSTMENTS TO TRAFFIC NOISE LEVELS DUE TO TOPOGRAPHY

Topographical Situation	Distance from Center of Roadway (feet)		
	less than 200	200 to 400	400 or more
Hillside overlooks roadway	-0-	+1 dB	+3 dB
Road is elevated (more than 15')	-5 dB	-2 dB	-0-
Road in cut or below embankment	-5 dB	-5 dB	-5 dB

Source: Brown-Buntin Associates

Noise exposure may also be reduced when the receiver is located behind a row of buildings. The amount of shielding provided depends on the height and continuity of the row of buildings. Noise reduction can be effective if the row is continuous, and effectively interrupts line-of-sight between the noise source and receiver. Shielding by buildings can reduce noise exposure by up to 15 dB.

It is sometimes assumed that trees and other vegetation can provide significant noise attenuation. However, approximately 100 feet of dense foliage is required to achieve a 5 dB attenuation of traffic noise. (The vegetation must be sufficiently dense that there is no line of sight through the foliage.) For this reason, vegetation generally cannot be considered a noise barrier unless there exists a substantial depth of dense foliage.

Traffic Calibration Study

Since many roadway segments are not at the same level as noise receivers, a traffic calibration study was conducted to determine the needed adjustments for traffic noise levels that were calculated using same-level assumptions. The findings of the traffic calibration study may also be applied to other noise sources where the height and precise location of the source with respect to the location of the receiver are known. The calibration study consisted of conducting sound level measurements and concurrent traffic counts in areas where the following topographic relationships between the roadway and surrounding area exist.

- Terrain gradually rises above roadway. This is typical of many areas where a potential receptor would look down on the roadway.

- Roadway is elevated above surrounding terrain.

- Roadway is located in a cut or is below a steep embankment.

Traffic noise levels were measured in terms of the L_{eq} descriptor for 15 minute intervals while traffic counts were being conducted. Traffic counts were projected for a one-hour period and measured L_{eq} values were compared to the levels calculated by the FHWA Model using the projected hourly number of vehicles, posted speed, and distance to the microphone. Calculations were based upon an acoustically "soft" site (that is, a site where absorption of sound by the ground is significant) since experience has shown that this generally provides the closest correlation with measured results. These comparisons are summarized in Table 6.

From Table 4 it may be seen that the FHWA Model generally overpredicted noise exposure in all situations. This was consistent with BBA experience with the use of the model. The model probably does not account for excess ground attenuation or atmospheric absorption over distance. The greatest amount of overprediction occurred in areas which were shielded from view of all or part of the roadway by either a cut or steep embankment, or an elevated-roadway situation. In these instances, predicted noise levels were found to be approximately 4 to 10 dB higher than measured levels, at distances of 150 feet or less from the center of the roadway. The shielding effect was found to diminish as the distance from the roadway increased.

For topography that rises above the roadway, such as on a hillside overlooking the roadway it was found that the FHWA Model generally overpredicted noise exposure at distances of approximately 100-200 feet from the center of the roadway and somewhat underpredicted noise exposure at distances greater than 400 feet. The greatest amount of underprediction was found to occur in instances where the observer was elevated significantly above the roadway and there was a clear view of the entire roadway surface.

TABLE 4
SUMMARY OF TRAFFIC NOISE CALIBRATION STUDIES

Distance from Center of Roadway	Hourly Vehicle Volumes			Posted Speed	Predicted L_{eq} dB*	Measured L_{eq} dB	Measured higher than predicted, by:	Measured lower than predicted, by:
	Cars	Medium Trucks	Heavy Trucks					
Rising Topography								
100' (Highway 1)	1636	16	108	55	69.1	69.5	0.4	
150' (Highway 101)	2656	72	96	55	67.9	64.8		3.1
150' (Highway 101)	2868	68	140	55	68.6	65.5		3.1
200' (Highway 1)	1636	16	108	55	64.6	63.1		1.5
300' (Highway 101)	2656	72	96	55	63.3	62.8		0.5
300' (Highway 101)	2868	68	140	55	64.0	63.3		0.7
400' (Highway 1)	1636	16	108	55	60.1	62.3	2.2	
450' (Highway 101)	2656	72	96	55	60.7	60.0		0.7
405' (Highway 101)	2868	68	140	55	61.4	63.5	2.1	
500' (Highway 1)	1636	16	108	55	58.6	62.4	3.8	
Elevated Roadway								
100' (Highway 1)	2096	52	20	55	68.4	60.8		7.6
120' (Highway 1)	1172	32	24	55	65.2	55.9		9.3
240' (Highway 1)	1172	32	24	55	60.7	57.0		3.7
240' (Highway 1)	1416	12	-0-	55	60.2	56.8		3.4
480' (Highway 1)	1416	12	-0-	55	55.7	54.9		0.8
Roadway in Cut								
75' (Highway 1)	1592	28	4	55	68.6	64.7		3.9
150' (Highway 1)	1612	44	16	55	64.7	59.1		5.6
150' (Highway 101)	2656	72	96	55	67.9	63.1		4.8
150' (Highway 101)	2868	68	140	55	68.6	63.4		5.2

* Using the FHWA Model and Calveno noise emission curves for an acoustically "soft" site.

Source: Brown-Buntin Associates, Inc., 1991.

Railroad Noise

A main line of the Southern Pacific Transportation Company passes through the City's planning area. In 1995, there were four passenger trains and, on average, four freight trains per day. Two of the freight trains generally pass through between 10:00 p.m. and 7:00 a.m. While the number of trains is not expected to increase in the immediate future, the projections of future noise levels assume more frequent operations. Several railroad operating conditions occur in the city. The yard, grade crossings, curves, and grades cause engine throttle levels, use of brakes, and the use of warning horns to vary considerably from location to location.

To document railroad noise exposure within different areas of the county where residential or other noise-sensitive development has occurred, measurements of noise levels generated by individual train pass-bys were conducted. Measurement sites were selected to quantify the effects of grade crossings, grades, and variations in speeds. The results of railroad noise level measurements are summarized in Table 5. From Table 5 it is apparent that measured sound levels from railroad pass-bys as defined by the Sound Exposure Level (SEL) at approximately 100 feet from the tracks were about 100 dB for freights and about 93 to 104 dB for passenger trains. At approximately 50 feet from the tracks, SEL values were approximately 110 dB for a freight train and 87 to 106 dB for passenger trains. The most significant variable in measured levels was whether or not the horn was in use during the measurements.

Railroad noise exposure may be quantified in terms of L_{dn} using the following formula:

$$L_{dn} = SEL_{avg} + 10 \text{ Log } N_{eq} - 49.4$$

where SEL_{avg} is the average SEL for a train pass-by, N_{eq} is the equivalent number of pass-bys in a typical 24-hour period, determined by adding 10 times the number of nighttime events (10:00 p.m-7:00 a.m.) to the actual number of daytime events (7:00 a.m.-10:00 p.m.), and 49.4 is a time constant equal to 10 log the number of seconds in the day.

Operational data used for the calculation of railroad noise exposure for 1990 conditions were obtained from the railroad. For future conditions, an estimate was developed by BBA in conjunction with county staff which includes ten freight and four passenger trains per day. Fifty percent of the freight trains and one of the passenger trains would pass through during the night. This should be considered a worst-case estimate of future railroad operations.

Using the above-described railroad noise level and operational data, the distances from tracks to the L_{dn} 60, 65, and 70 dB contours were calculated for existing and future conditions. Calculated distances are summarized in Table 6. The mean SEL values at 100 feet used for the calculations for areas away from grade crossings and horn usage were 94.5 dB for passenger trains and 99.7 dB for freight trains. For areas within 1000 feet of grade crossings where horns are likely to be used, mean SEL values used for calculations were 100.4 dB for passenger trains and 101.7 dB for freight trains. As shown by Table 5, noise levels from individual trains pass-bys can vary considerably from event to event.

TABLE 5
SUMMARY OF RAILROAD NOISE LEVEL MEASUREMENTS

Location	Date	Time	Type	Dir	Distance (Feet)	#Locos/ #Cars	Speed (mph)	Lmax	SEL (dB)	Horn
Atascadero										
Hwy 41 and SPRR	8/21/90	2:18 pm	P	S	100	---	60	86.7	97.0	N
	8/21/90	2:45 pm	F	N	100	---	50	85.0	98.7	N
Santa Margarita										
West of Wilhelma Ave. Crossing	8/28/90	2:00 pm	P	S	100	3/15	35	105.0	104.2	Y
	8/28/90	4:07 pm	P	N	100	2/15	35	96.0	100.8	Y
	8/28/90	4:52 pm	F	N	100	4/65	25	90.0	98.4	Y
East of Wilhelma Ave. Crossing	8/28/90	2:00 pm	P	S	100	3/15	35	87.9	94.1	Y
	8/28/90	4:07 pm	P	N	100	2/15	40	83.1	92.7	Y
	8/28/90	4:52 pm	F	N	100	4/65	25	83.8	97.6	Y
Oceano										
Railroad St. near Highway 1	8/22/90	3:05 pm	P	S	110	2/13	---	82.0	92.5	N
	8/23/90	2:45 pm	F	N	110	---	---	88.0	98.4	N
	8/24/90	3:14 pm	P	S	110	---	---	92.0	98.0	N
South of Oceano near Callender	8/29/90	9:00 am	F	S	120	4/55	55	92.0	101.3	N
San Luis Obispo										
Near Industrial Way	8/21/90	3:04 pm	P	N	48	2/16	40	84.5	92.9	N
	8/21/90	3:30 pm	P	S	54	2/15	40	101.0	104.6	Y
Near Marsh St.	8/24/90	2:19 pm	P	S	50	---	40	78.0	87.0	N
	8/24/90	3:00 pm	P	N	50	---	40	103.0	105.5	Y
	8/24/90	3:50 pm	F	N	50	---	40	104.0	109.5	Y

Source: Brown-Buntin Associates, Inc.

TABLE 6
DISTANCE FROM CENTER OF TRACK TO L_{dn} CONTOURS

	Distance (feet)			
	1990		Future*	
L_{dn} Contour Values	w/o Horn	w/Horn	w/o Horn	w/Horn
70 dB	25'	35'	76'	113'
65 dB	53'	76'	163'	244'
60 dB	115'	163'	352'	525'

* Based on 10 freight and 4 passenger trains per day.

Source: Brown-Buntin Associates, Inc., 1991.

Airport

The State requires that aircraft noise be quantified in terms of the CNEL descriptor (Code of Regulations Title 21). CNEL is considered to be equivalent to the L_{dn} descriptor used for other noise sources addressed in this guidebook within approximately one decibel. Figure 6 of the Noise Element shows the CNEL 70, 65 and 60 contours for the theoretical capacity of the airport. These contours should be used for determining potential conflicts with the Noise Element as the result of existing or proposed development of noise-sensitive land uses.

Brown-Buntin Associates (BBA) estimated aircraft noise exposure which would occur when the airport reaches its capacity. The airport noise exposure map shows noise levels of aircraft in flight only. BBA did not evaluate noise from aircraft engine run-ups on the ground and other stationary noise sources at the airport. Engine run-up noise has been an issue at the airport. In response, some activities were shifted to Santa Maria and some to enclosures.

BBA prepared noise exposure contours using Version 3.9 of the FAA Integrated Noise Model, and operational assumptions representative of the theoretical maximum capacity for the existing airfield. It is unknown when the airfield would reach capacity, although airport management indicated that this would occur beyond the year 2010.

Aviation trends which were incorporated into the airport capacity scenario included a shift to larger turboprop commuter aircraft capable of carrying 60 passengers. Jet aircraft types in service at other airports were not included, since the runway does not have sufficient length or load bearing capacity. Projections of aircraft operations are otherwise similar to those in the 1986 Airport Master Plan Update for the year 2005, with the total annual number of aircraft operations being approximately 314,000. The aircraft fleet mix used to prepare the noise exposure map is summarized in Table 7.

TABLE 7
FUTURE (AIRPORT CAPACITY) DAILY AIRCRAFT OPERATIONS
SAN LUIS OBISPO COUNTY AIRPORT

Aircraft	Day	Evening	Night	Total
Itinerant Operations				
50-60 Pass Turboprop	47.6	12.2	12.2	72.0
GA Jet Quiet	3.6	0.4	0	4.0
GA Jet Moderately Quiet	1.8	0.2	0	2.0
GA Jet Moderately Noisy	1.8	0.2	0	2.0
Twin Eng. Turboprop	28.4	8.3	3.4	40.1
Twin Eng. Piston	18.9	5.6	2.2	26.7
Single Eng. Prop.-Large	122.3	15.6	6.7	144.6
Single Eng. Prop.-Small	183.4	23.4	10.0	216.8
Civil Helicopter	4.0	2.0	0	6.0
Military-Helicopter	2.7	0	0	2.7
Military-Fixed Wing	1.3	0	0	1.3
Local Operations				
Twin Eng. Piston	61.6	6.8	0	68.4
Single Eng. Prop.	246.6	27.4	0	274.0
Daily Totals	**724.0**	**102.1**	**34.5**	**860.6**

Source: Brown-Buntin Associates, Inc.
San Luis Obispo County

Major Stationary Noise Sources

Noise is an inherent part of many industrial, commercial, and agricultural processes, even when the best available noise control technology is applied. Noise production in industrial or commercial facilities or close to many types of agricultural equipment is controlled indirectly by Federal and State employee health and safety regulations (OSHA and Cal-OSHA). However, outdoor noise exposure from such operations can exceed locally acceptable standards for noise-sensitive land uses, even if employees are protected.

Noise conflicts can be avoided by preventing new noise-producing uses in noise-sensitive areas, and by preventing new noise-sensitive land uses near existing noise-generating facilities. When the City cannot, or chooses not to, separate generally incompatible types of land uses, performance standards can reduce noise at the source or receiver.

BBA obtained noise exposure information for some major stationary noise sources, based on operational data obtained from source operators and from noise level measurements at reference locations around the noise sources. Consistent with the L_{dn} methodology, a 10 dB penalty was added to noise from night (10:00 p.m. - 7:00 a.m.) operations. In discussing future operations with source operators, BBA concluded that reliable projections of future activity cannot be made, because there are too many variables. The following discussions of major stationary noise sources in the San Luis Obispo planning area provide general information concerning the relative noise impacts of each source, and identify specific noise sources which should be considered in the review of development proposals. The following discussions do not represent a comprehensive accounting of all noise sources in the planning area. Other sources may be identified during environmental review of projects.

- Southern Pacific Milling Company Concrete Batch Plant, 131 Suburban Road,

  This facility operates from 6:00 a.m. to 2:00 p.m. During the busy season (April to August), about seven to nine loads of concrete are produced each day. During the rest of the year, one or two loads per day are produced. Approximately two truckloads per day of material are delivered. At 100 feet from a loading operation, the measured sound level was 78 dB L_{eq}. Noise from the loading operation at the north property line (about 800 feet from the source) was inaudible above roadway traffic. No noise-sensitive land uses are located near the plant.

- Air-Vol Block, 1 Suburban Road

  Air-Vol Block manufactures concrete blocks. Operating hours are 7:00 a.m. to 3:00 p.m. The principal noise sources are the block fabricating machine and fork lifts. Measured sound levels at the north property line, due to the block machine (about 250 feet from the block machine) were an L_{eq} of 61 dB and an L_{max} of 67 dB. The 50 dB L_{eq} contour is located about 890 feet from the block machine (Figure 15). A few residences are located west of South Higuera Street near the plant within the 50 dB L_{eq} contour.

FIGURE 4
EXAMPLE OF STATIONARY NOISE SOURCE CONTOURS

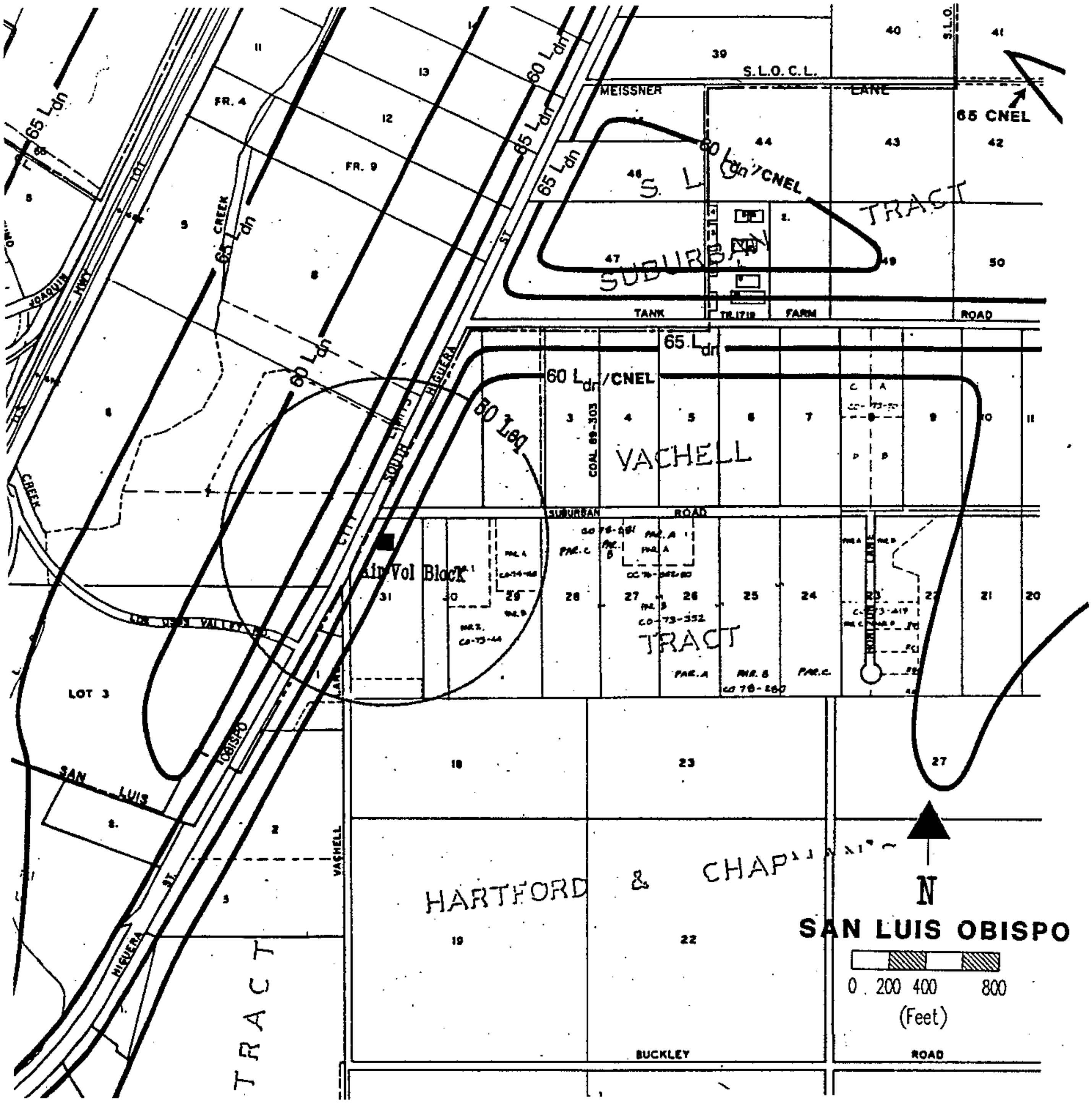
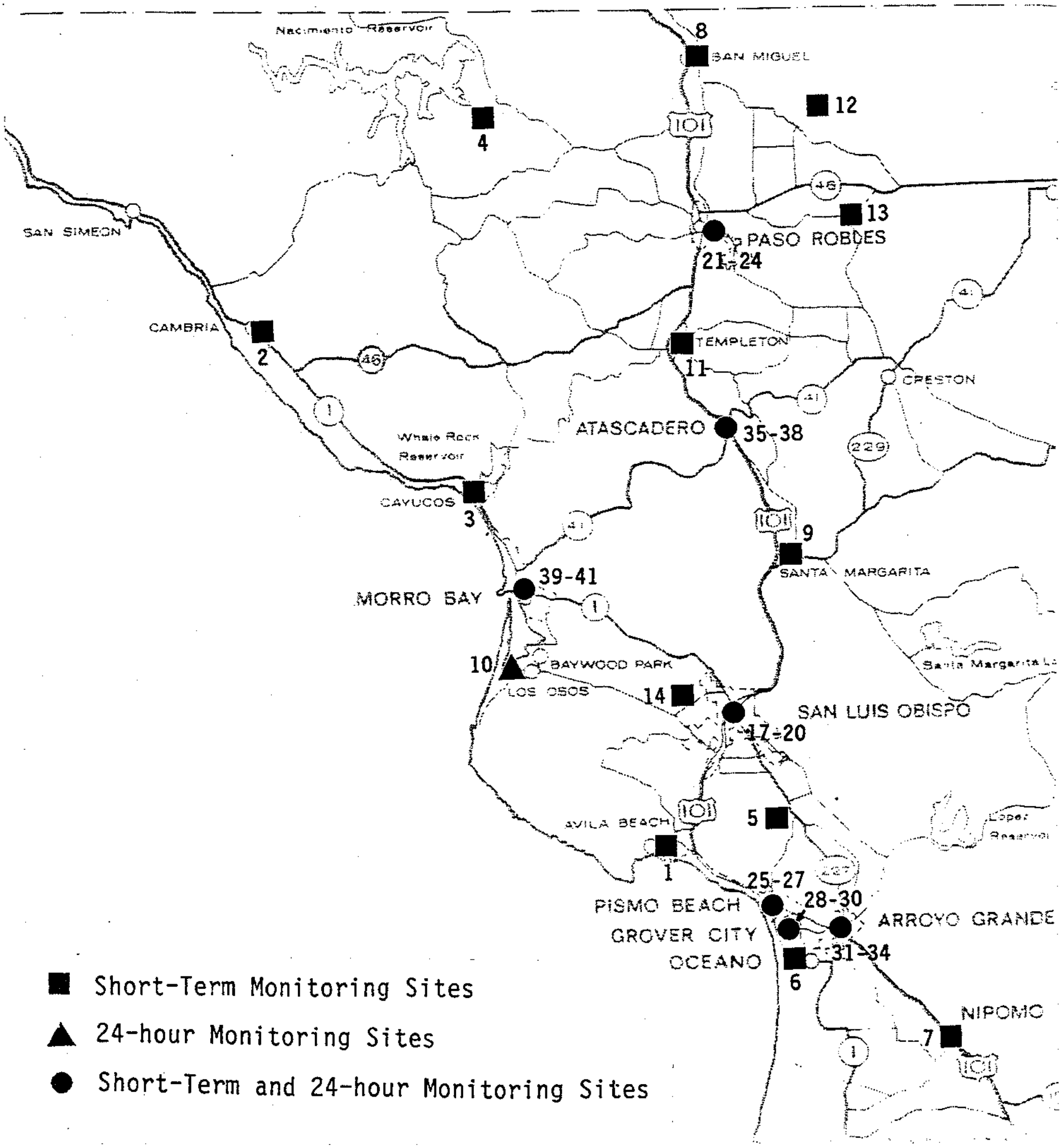


FIGURE 5
COMMUNITY NOISE MONITORING LOCATIONS



Community Noise Survey

As recommended by the Government Code and Office of Noise Control Guidelines, a community noise survey was conducted to document noise exposure in representative areas of the county and cities containing noise-sensitive land uses. The following noise-sensitive land uses have been identified for the purpose of this survey:

1. All residential uses
2. Schools
3. Long-term care medical facilities, such as hospitals and nursing homes
4. Office buildings
5. Parks

Noise monitoring sites were selected to be representative of typical conditions where such uses are located. Forty-one monitoring sites were selected, as shown in Figure 5. A combination of short-term and continuous noise monitoring was used to document existing noise levels at these locations during August 1990.

At 33 of the community noise survey sites, noise levels were sampled for approximately 15 minutes during each of three periods of the day and night so that reliable estimates of L_{dn} could be prepared. The data collected during the short-term sampling program included the L_{eq}, maximum noise level, minimum noise level, and a description of noise sources which were audible at the monitoring sites.

Continuous noise monitoring was conducted at eight of the community noise survey sites to document fluctuations in noise levels over a typical 24-hour period within the different types of noise environments. Noise level data collected during continuous monitoring included the L_{eq}, maximum noise level, and the statistical distribution of noise levels for each hour of the sample period.

Community noise survey results for San Luis Obispo are summarized in Table 8. Hourly fluctuations of noise levels at the site where continuous noise monitoring was conducted are shown in graphic form in Figure 6. Hourly L_{eq} values in this figure are representative of energy average sound levels, and are very sensitive to single events such as vehicle or railroad pass-bys or aircraft overflights. L_{max} and L_{min} values represent the maximum and minimum values measured each hour.

Countywide, the community noise survey results indicate that typical noise levels in noise-sensitive areas range from about 39 to 62 dB L_{dn}. As would be expected, the quietest areas are those which are removed from major transportation noise sources and local industrial or other stationary noise sources. Examples of these quiet areas are the County Rural Areas defined by the El Pomar-Estrella, San Luis Obispo, and South County Planning Areas and some of the County Urban/Village Areas such as Heritage Ranch. The noisier locations monitored during the survey were near Highway 101 and major local streets.

TABLE 8
SUMMARY OF COMMUNITY NOISE MONITORING

Map. Loc. #	Location	Decibel Level				
		L_D	L_N	L_{max} (Source)	L_{min} (Source)	Estimated L_{dn}*
14	Johe Lane (near Foothill Blvd.)	45	41	53 (wind)	34 (dist. traffic)	46-50 dB
15	1595 Tiffany Ranch Road	45	27	61 (aircraft)	21 (crickets)	41-45 dB
17	2325 Parkland Terrace	48	38	82	27	46-50 dB
18	Brookpine Drive (south end of road)	46	33	56 (traffic)	30 (crickets)	43-47 dB
19	C. L. Smith School	45	40	54 (aircraft)	29 (wind)	46-50 dB
20	Bishop's Peak School	46	30	59 (wind)	26 (crickets)	43-47 dB

Source: Brown-Buntin Associates, Inc., 1990.

L_D = Average L_{eq} of two 15-minute samples obtained between 7:00 a.m. and 10:00 p.m. except for sites where 24-hour monitoring was conducted.

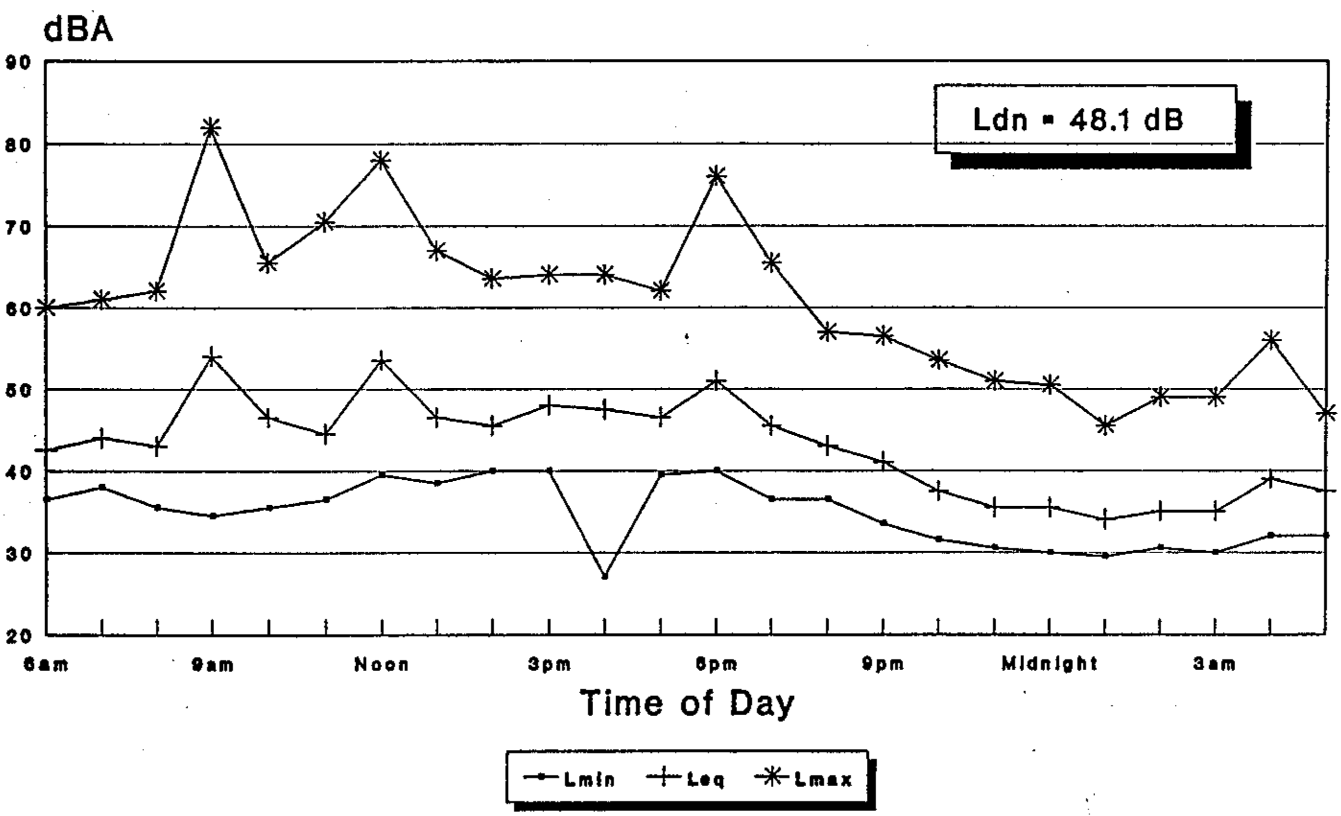
L_N = Leq for one 15-minute sample obtained between 10:00 p.m. and 7:00 a.m. except for sites where 24-hour monitoring was conducted.

* L_{dn} estimated from L_D and L_N

Maximum noise levels observed during the survey were generally caused by local automobile traffic or heavy trucks. Other sources of maximum noise levels included occasional aircraft overflights, construction activities, and nearby industrial or commercial equipment. Background noise levels in the absence of the above-described sources were generally caused by distant traffic, wind, birds, the surf or insects.

One factor that is difficult to quantify, but is often mentioned by people who live in rural areas or quiet neighborhoods, is the greater expectation for a quiet living environment by those who have made the choice to live away from urbanized areas. This factor, coupled with the quiet existing background noise levels discussed above, greatly increases the likelihood that noise from a new noise generating land use will be perceived by residents of these areas as a significant intrusion over existing conditions.

FIGURE 6
AMBIENT NOISE LEVELS
San Luis Obispo Residential Area, 1990



Location: Parkland Terrace
Source: Brown-Buntin Associates

NOISE MITIGATION

Overview

Each noise problem has three basic elements: the source, a transmission path, and a receiver. In land use planning, the emphasis is usually on separation --having a long path between the source and the receiver. In project design, the emphasis is usually on putting sound barriers in the path and in the receiving structures. Project designers should consider the nature of the noise source and the sensitivity of the receiver. The problem should be defined in terms of the adopted noise level criteria (such as L_{dn} or L_{eq}), the location of the sensitive receiver (indoors or outdoors), and when the problem occurs (day or night). Noise control techniques should then be selected to provide an acceptable noise environment for the receiver, while also responding to aesthetic standards and structural and economic limits.

The preferred noise mitigation is effective design of a project so noise-sensitive uses are not located in areas exposed to excessive noise. This may be accomplished by using building setbacks, natural topography, building orientation, and intervening buildings which do not contain noise-sensitive land uses to reduce noise exposure at the receiver. Such measures may minimize or eliminate the need to construct noise barriers, or to include special features in buildings.

Following sections summarize techniques for noise mitigation. There is no simple way to be certain if a proposed design will adequately reduce noise exposure, short of an expert's acoustical analysis of the project. If there is a question about the effectiveness of proposed noise mitigation measures, the City may require a noise study or apply the standard noise mitigation packages described below.

City Review Process

When a building permit is the only City approval for a project:

- Compliance with noise exposure standards is determined through the building "plan-check" process. If plans comply with all applicable codes, they must be approved; if plans do not comply, they cannot be approved. Public comment and appeals are not part of the process. A technical committee can consider applicants' appeals of staff decisions on the equivalence of construction materials and methods.

- Environmental review is not required.

- The City typically requires the noise mitigation features that are recommended by a qualified, independent expert hired by the applicant to evaluate the project or, if it qualifies, the project can use the standard noise mitigation packages described in a following section of this Guidebook.

- The applicant is encouraged to follow the order of preference for mitigation approaches listed in policy #8 of the Noise Element.

When a project is approved by the City through a use permit, architectural review, subdivision, or planned-development zoning:

- Compliance with noise exposure standards is determined through discretionary project review, which considers all aspects of a project. The City can approve certain noise mitigation approaches. This process usually involves public hearings, and broad opportunities for appeal by the applicant and others.

- The first step usually is an environmental determination which evaluates compliance with noise policies and standards.

- The applicant must follow the order of preference for mitigation approaches listed in policy #8 of the Noise Element, or show that doing so is not practical or would prevent compliance with other design standards based on the General Plan --whether the source for the measures is an expert's study for that project or the standard noise mitigation packages described in a following section of this Guidebook.

- Details of the noise mitigation approaches approved during the discretionary review will be checked when the building permit application is received.

Noise Studies

Noise studies required by the City shall:

A. Be the financial responsibility of the applicant.

B. Be prepared by a qualified person experienced in the fields of environmental noise assessment and architectural acoustics.

C. Include sufficient locations and periods of noise level measurements to adequately describe area conditions. Where measurements cannot be made, identify the sources of data and the assumptions used to calculate noise levels (such as noise attenuation, absorption, reflection, or shielding). For commercial uses, consider all noise from operations, maintenance, and servicing, including parking lot and landscape maintenance, refuse collection, and truck loading and unloading.

D. Estimate existing and projected buildout noise levels in terms of the descriptors used in Noise Element Tables 1 and 2, and compare them to the element's standards. Projected noise levels shall reflect planned streets and highways.

E. Recommend appropriate mitigation to achieve compliance with Noise Element standards, giving preference to measures as listed in the Noise Element.

F. Estimate noise exposure with prescribed mitigation measures in effect.

G. Describe how to evaluate the effectiveness of the proposed mitigation measures.

The Community Development Director may waive the requirement for a noise study if all the following conditions are met:

A. The development consists of four or fewer single-family dwellings, or of offices, churches, or meeting halls having a total gross floor area less than 10,000 square feet.

B. (1) For a development where acceptable noise exposure of an outdoor activity area is in question: The only noise source is a single road or rail line for which up-to-date noise information is available.

(2) For a development where noise exposure of an outdoor activity area is clearly acceptable and the only question is indoor noise exposure: The only noise source is a single road, rail line, or airport for which up-to-date noise information is available.

(A noise study will be required when the noise source is a stationary noise source or consists of multiple transportation noise sources.)

C. Prior to mitigation, the expected noise exposure at the exterior of buildings which will contain noise-sensitive uses, or within proposed outdoor activity areas, does not exceed 65 dB L_{dn} (or CNEL). Exception: for playgrounds the level is 75 and for neighborhood parks the level is 70 dB L_{dn} (or CNEL).

D. The topography in the project area is essentially flat, and the noise source and receiver are at the same elevation.

E. Effective noise mitigation, as determined by the City, is incorporated into the project design to reduce noise exposure to the levels specified in Tables 1 and 2. (Such measures may include the use of building setbacks, building orientation, noise barriers, and the standard noise mitigation packages in the Design Guidelines. If closed windows are required for compliance with interior noise standards, a mechanical ventilation system may be required by the building code.)

F. The Noise Level Reduction required to meet indoor noise standards is 30 dB or less.

Distance

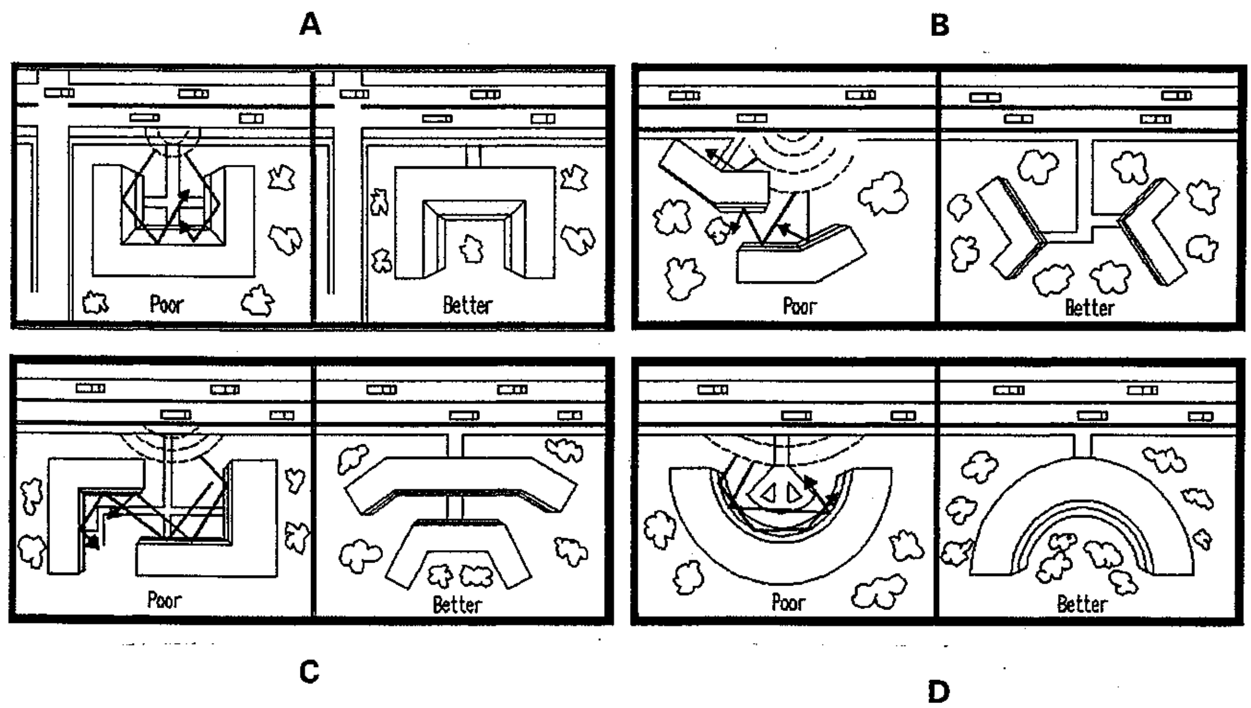
Noise exposure can be reduced by increasing the distance between the source and the receiver. Each doubling of distance from the noise source will reduce noise exposure by about 4 to 6 dB. Distance is often provided by spaces called "setbacks" or "buffers." These areas can take the form of some types of open space or recreation, frontage roads, storage yards, or other uses less sensitive to noise. The noise reduction that can be provided by distance is often limited by the characteristics of the noise source and its relationship to the noise-sensitive use.

Building Location and Orientation

Buildings containing noise-sensitive uses may be located so they are outside the area requiring noise mitigation. Buildings can be placed to shield other buildings or areas, and to avoid increased noise levels caused by reflection. Shielding by buildings can reduce noise levels by up to 15 decibels, though the exact amount of reduction depends on the specific design. The use of one building to shield another can reduce noise control costs, particularly if the shielding structure is insensitive to noise. As an example, carports or garages can be used to form or complement a barrier shielding adjacent dwellings or an outdoor activity area. Similarly, one residential unit can be placed to shield another so that building components for noise reduction are needed for only the building closest to the noise source. Placement of outdoor activity areas within the shielded portion of a building complex, such as a central courtyard, can be an effective method of providing a quiet retreat in an otherwise noisy environment. Patios or balconies should be placed on the side of a building opposite the noise source, and "wing walls" can be added to buildings or patios to help shield sensitive uses.

Where project design does not allow using buildings or other land uses to shield sensitive receivers, noise control costs can be reduced by orienting buildings with the narrow end facing the noise source, thereby reducing total area of the building needing noise-control components. Some examples of building orientation to reduce noise impacts are shown in Figure 7.

FIGURE 7
BUILDING ORIENTATION FOR NOISE REDUCTION



If existing topography or development adjacent to the project site provides some shielding, as in the case of an existing berm, knoll or building, sensitive structures or activity areas may be placed behind those features to reduce noise control costs (Figure 8).

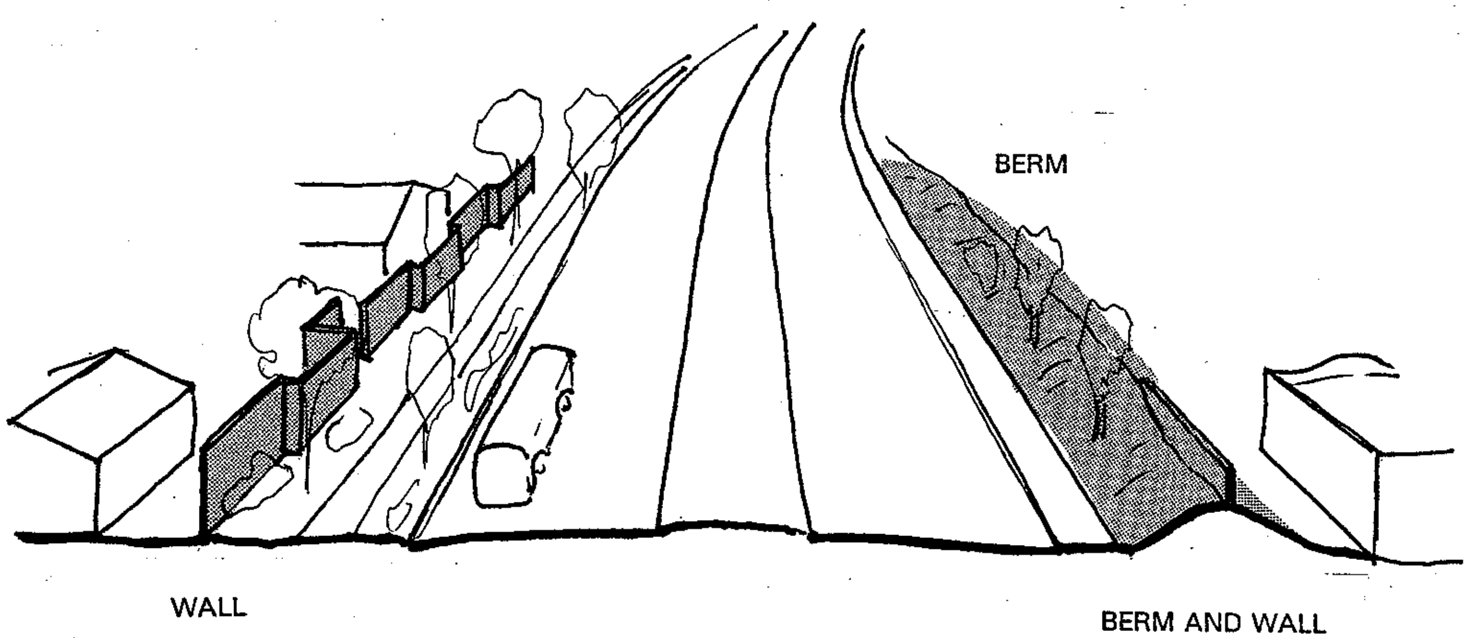
Site layout should avoid reflecting surfaces which may increase on-site noise levels. For example, two buildings placed at an angle facing a noise source may cause noise levels within that angle to increase by up to 3 dB (parts B and C of Figure 7). The open end of a "U"-shaped building should point away from noise sources for the same reason (part A of Figure 7). Noise walls or other walls may inadvertently reflect noise back to a receiver unless carefully located.

Building facades can influence reflected noise levels, thereby impacting public spaces and buildings on neighboring sites. This is primarily a problem with high-rise buildings. The effect is most evident in urban centers, where an "urban canyon" may be created. Bell-shaped or irregular building facades, setbacks, and building orientation can reduce this effect. Avoidance of these problems, as well as attaining a functional and attractive design, requires coordination between the City, the project architect and engineer, and any acoustical consultant.

Barriers

Noise can be reduced by putting walls, earth berms, or other masses between the noise source and the receiver. A barrier's effectiveness depends on blocking line-of-sight between the source and receiver, and is improved with greater mass and height (the distance sound must travel to pass over the barrier as compared to a straight line from source to receiver).

FIGURE 8
NOISE BARRIERS



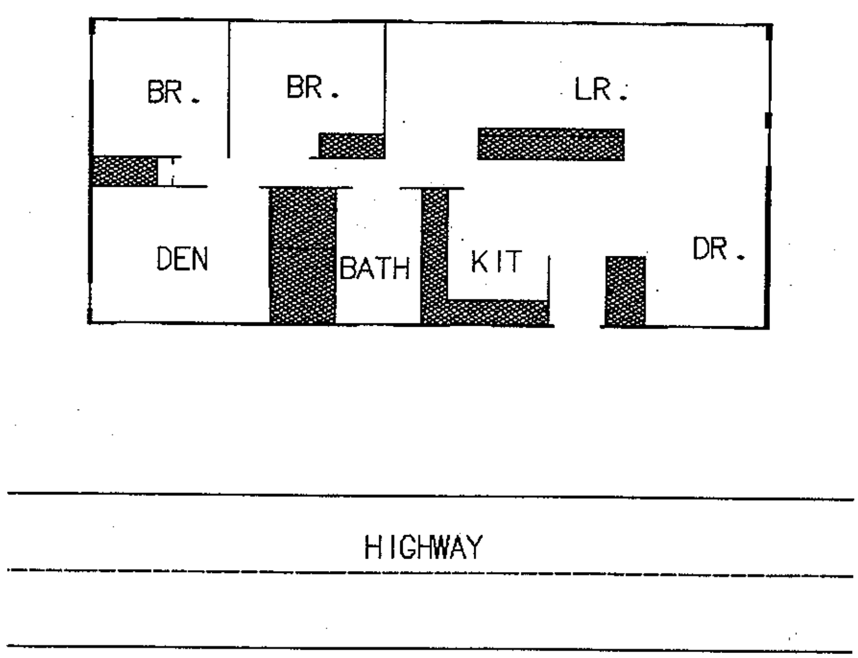
Building Components

When buildings have been located to avoid most noise exposure, noise reduction measures still may be required to achieve acceptable interior noise levels. The cost of such measures may be reduced by the thoughtful placement of rooms. For example, bedrooms, living rooms, family rooms, and other more noise-sensitive parts of a dwelling can be located on the side farthest from the noise source, as shown in Figure 9.

Bathrooms, closets, stairwells, and food preparation areas are relatively insensitive to exterior noise sources, and can be placed on the noisy side. With such techniques, noise reduction requirements for the building facade can be reduced, although the designer must take care to isolate the noise impacted areas by the use of partitions or doors.

When buildings containing noise-sensitive uses are to be located in a noisy environment, interior noise exposure may be reduced through the acoustical design of building facades. Standard noise mitigation packages are recommended below.

FIGURE 9
FLOOR PLAN TO REDUCE NOISE IN MOST SENSITIVE ROOMS



Vegetation

It is sometimes assumed that trees and other vegetation can provide significant noise attenuation. However, approximately 100 feet of dense foliage (so that no visual path extends through the foliage) is required to achieve a 5 dB reduction of traffic noise. The use of vegetation as a noise barrier should not be considered a practical method of noise control unless large tracts of dense foliage are part of the existing landscape.

Vegetation can be used to acoustically "soften" intervening ground between a noise source and receiver by increasing ground absorption of sound. Vegetative barriers have been shown to reduce tire noise and other high frequency components of traffic noise. Trees and shrubs may reduce adverse reaction to a noise source by removing the source from view, even though noise levels may be largely unaffected.

Sound Absorbing Materials

Absorptive materials such as fiberglass, foam, cloth, and acoustical tiles are used to reduce reflection or reverberation in closed spaces. Their outdoor use is usually directed toward reducing reflections between parallel noise barriers or other reflective surfaces. Maintenance of absorptive materials used outdoors is difficult because such materials are easily damaged by sunlight and moisture. Their application as an outdoor noise control tool is limited to cases where the control of reflected noise is critical.

Standard Noise Mitigation Packages

Where buildings containing noise-sensitive land uses or outdoor activity areas are proposed for locations where noise levels exceed the standards of this element, noise mitigation will be required as part of project approval. Generally, a noise study by an expert will be required to quantify site-specific noise exposure and to propose effective noise mitigation measures. At the option of the City, the requirement for a noise study may be waived and standard noise mitigation packages may be used to achieve compliance with this element.

Standard noise mitigation packages are sets of measures which may be used to reduce noise exposure by prescribed amounts. The standard noise mitigation packages below are intended to reduce exterior noise exposure in outdoor activity areas or at building facade by up to 5 dB. Reductions greater than this are significantly more difficult to achieve, and should be based on the recommendations of an expert after a detailed study has been performed.

For indoor noise exposure, standard noise mitigation packages to achieve outdoor to indoor noise level reductions (NLR) of 15, 20, 25 and 30 dB have been developed. Since these are generalized packages intended to address a variety of specific conditions, a conservative approach has been taken. Some of the package's components can be modified or eliminated and the prescribed NLR values could still be achieved under certain conditions. A noise expert's recommendations, based on detailed study of a particular situation, may therefore differ from the standardized packages and yet achieve the desired results.

Mitigation in Outdoor Activity Areas

The following standard noise mitigation packages may be implemented to reduce exterior noise levels by approximately 5 dB.

Traffic

Construct a barrier of sufficient height to interrupt line-of-sight between the source and receiver. For roadways where trucks are less than 5% of the Average Daily Traffic, a source height of 2 feet above the crown of the roadway should be used. For roadways where trucks are 5% or more of the ADT, a source height of 8 feet above the crown of the roadway should be used. In both cases, a receiver height of 5 feet above the grade of the location of the outdoor activity area of concern or building pad elevation should be used.

Railroad

Construct a barrier of sufficient height to interrupt line-of-sight between the source and receiver. Within 1000 feet of a railroad grade crossing, a noise source height of 15 feet above the rails should be assumed. At other locations, a noise source height of 10 feet above the rails should be assumed. When determining the total height of a railroad noise source, the height of the roadbed must be added to the source heights described above. A receiver height of 5 feet above the outdoor activity area of concern or building pad elevation should be used.

Aircraft

Mitigation of exterior noise exposure due to aircraft overflights is generally not possible. Sideline aircraft noise exposure may be reduced by barriers in some cases, but such exposure should be evaluated by an acoustical expert.

Stationary Sources

Standard noise mitigation packages should not be applied to stationary noise sources due to the unpredictability of source height, the various pitches of noise, and the noise levels associated with such sources.

The following procedure can determine if a barrier will interrupt line-of-sight between the source and receiver.

Step #1: Select an appropriate scale on graph paper to accommodate the distance from the noise source to receiver, and the heights of the noise source and receiver (such as 1" = 20' or 1" = 50').

Step #2: Mark a point representing the effective height of the noise source above the crown of the road or top of the railroad track.

Step #3: Scale off the distance from the noise source to the receiver and mark a point that is 5 feet above the building pad or outdoor activity area of concern.

Step #4: Using a ruler, draw a straight line between the noise source and receiver. This line represents line-of-sight between the noise source and receiver.

Step #5: At the location of the noise barrier, draw a vertical line extending from the ground to intercept the line-of-sight. The height of this line represents the minimum height of a noise barrier necessary to reduce exterior noise by approximately 5 decibels. Taller barriers will further reduce noise levels.

Figure 10 provides examples of noise barrier cross-sections.

For a noise barrier to be effective, it must consist of massive, tight-fitting materials, such as a grouted concrete block or stucco wall. No openings or gaps may be present in the wall or at the ground. Other noise barrier materials may be acceptable, but should be approved by a qualified acoustical expert. The use of wood for noise barriers is generally not recommended due to problems with warpage, shrinkage and deterioration over time.

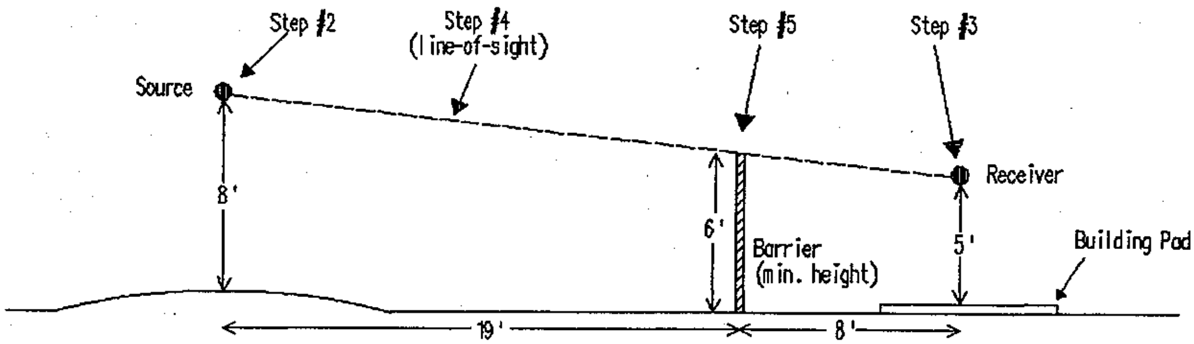
Barriers are most effective when placed close to either the source or receiver. A barrier that breaks line-of-sight will reduce noise levels by about 5 dB. Barrier noise reductions ranging from 5 to 15 dB are more difficult to achieve, and the design of such barriers should be based on the recommendations of an expert who has prepared a site-specific study. Noise reductions greater than 15 dB from barriers are generally not feasible.

Interior Noise Mitigation

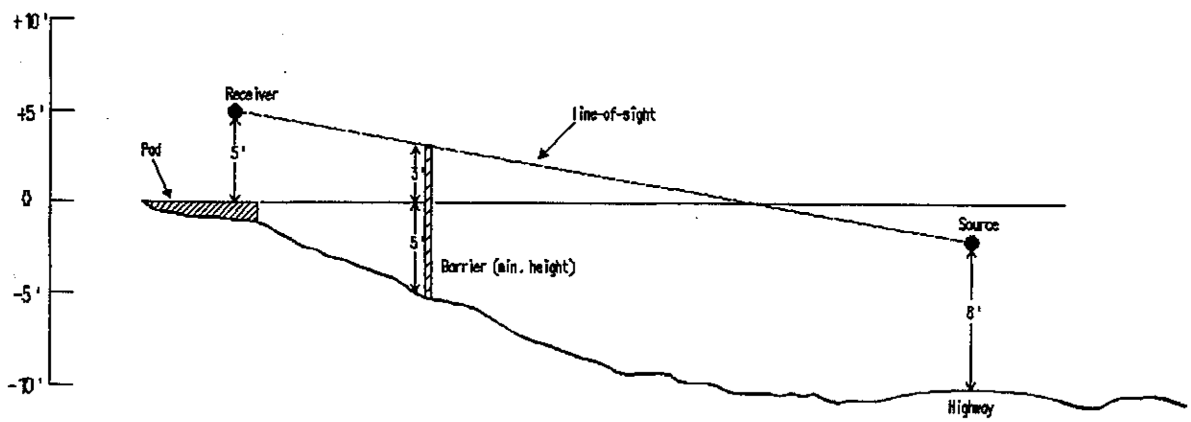
The most direct way to determine the interior noise level within a building is through noise level measurements. However, this is not possible if the structure has not yet been constructed. Also, it may not be practical to perform interior noise level measurements in an occupied building, due to interference from activities in the building and the time needed to obtain representative results.

Interior noise levels can be estimated if the exterior noise level is known and the outdoor-to-indoor Noise Level Reduction (NLR) provided by the building is known. NLR is defined as the arithmetic difference between the level of sound outside and inside a structure, measured in decibels. For example, if the noise level outside a residence is 70 dB and the level inside a room of the residence is 45 dB, the NLR of the structure is 25 dB (70 - 45 = 25).

FIGURE 10
EXAMPLES OF NOISE BARRIER CROSS SECTIONS



Example of Simple Barrier Situation
(may use standard noise mitigation packages)



Example of Complex Barrier Situation
(consult an acoustical expert)

To satisfy the interior noise level standards (Table 1) the NLR provided by a building should equal or exceed the arithmetic difference between the exterior noise level at the building location and the required interior noise level. Referring to the example in the previous paragraph, if the exterior noise level is 70 dB L_{dn} and the required interior noise level is 45 dB L_{dn}, the minimum NLR of the structure must be 25 dB.

The following standard noise mitigation packages should be implemented to achieve NLR values of 15, 20, 25 and 30 dB. If an NLR greater than 30 dB is needed or if the effectiveness of the standard noise mitigation packages is questionable in a particular situation, the City may require a noise study by an expert.

For all of the following noise mitigation packages, careful workmanship, including caulking of joints and base plates and installation of weather stripping, is essential to ensure the proper performance of building assemblies. Acoustical "leaks" in walls, roofs, and ceilings should be avoided by properly sealing penetrations and by eliminating flanking paths.

NLR of 15 dB Follow normal construction practices and the Uniform Building Code.

NLR of 20 dB Follow normal construction practices, the Uniform Building Code, and:

1) Provide air conditioning or a mechanical ventilation system, so windows and doors may remain closed.

2) Mount windows and sliding glass doors in low air infiltration rate frames (0.5 cfm or less, per ANSI specifications).

3) Provide solid-core exterior doors, with perimeter weather-stripping and threshold seals.

NLR of 25 dB Follow normal construction practices, the Uniform Building Code, and:

1) Provide air conditioning or a mechanical ventilation system, so windows and doors may remain closed.

2) Mount windows and sliding glass doors in low air infiltration rate frames (0.5 cfm or less, per ANSI specifications).

3) Provide solid-core exterior doors with perimeter weather stripping and threshold seals.

4) Cover exterior walls with stucco or brick veneer, or wood siding over ½" minimum thickness fiberboard ("soundboard").

5) Keep glass area in windows and doors below 20% of the floor area in a room.

6) Provide baffles for roof or attic vents facing the noise source (see Figure 11 for an example of a suitable vent treatment).

For aircraft noise exposure, all of the above plus:

1) Provide fireplaces with tight-fitting dampers and glass doors.

2) Provide solid sheeting with a minimum thickness of ½" under roof coverings.

3) Do not use skylights in occupied rooms.

NLR of 30 dB Follow normal construction practices, the Uniform Building Code, and:

1) Provide air conditioning or a mechanical ventilation system, so windows and doors may remain closed.

2) Mount windows and sliding glass doors in low air infiltration rate frames (0.5 cfm or less, per ANSI specifications).

3) Provide solid-core exterior doors with perimeter weather stripping and threshold seals.

4) Cover exterior walls with stucco or brick veneer.

5) Keep glass area in windows and doors below 20% of the floor area in a room.

6) Baffle roof or attic vents facing the noise source (see Figure 11 for an example of a suitable vent treatment).

7) At exterior walls, attach interior sheetrock to studs by resilient channels, or use staggered studs or double walls.

8) Provide windows with a laboratory-tested STC rating of 30 or more. (Windows that provide superior noise reduction capability and that are laboratory-tested are sometimes called "sound-rated" windows. In general, these windows have thicker glass and/or increased air space between panes. However, standard energy-conservation double-pane glazing with an 1/8" or 1/4" air space may be less effective in reducing noise from some noise sources than single-pane glazing).

For aircraft noise exposure, all of the above plus:

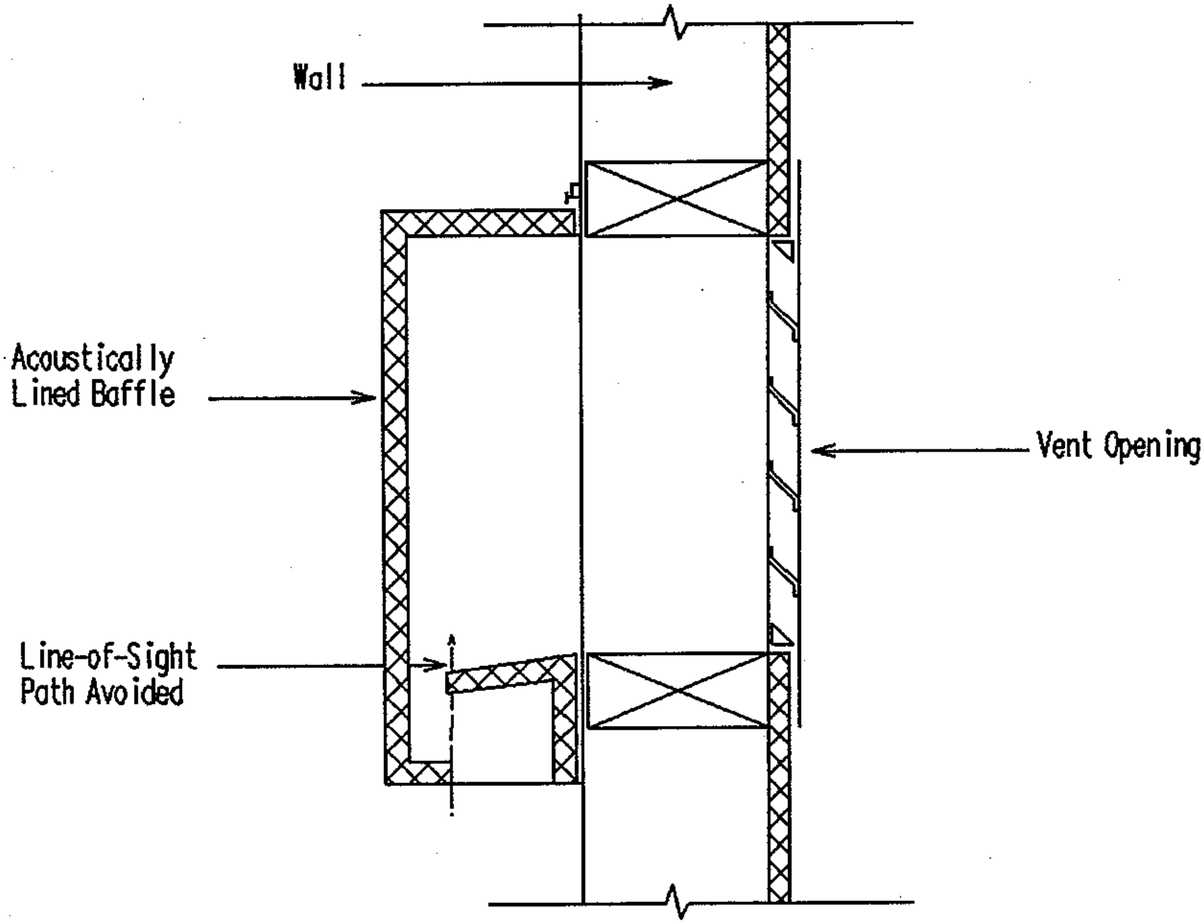
1) Do not use fireplaces.

2) Provide solid sheeting with a minimum thickness of ½" under roof coverings.

3) Attach ceiling to joists with resilient channels.

4) Do not use skylights in occupied rooms.

FIGURE 11
EXAMPLE OF ATTIC VENT BAFFLE



Note that the baffle must allow any minimum effective ventilation area required by the building code.

DEFINITIONS

A-weighted sound level is the sound level obtained by using an A-weighting filter for a sound level meter. All sound levels referred to in the policies are in A-weighted decibels (abbreviated "dBA"). A-weighting de-emphasizes the very low and very high frequencies (pitches) 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.

Buildout means substantial completion of the maximum development allowed by the Land Use Element within the urban area.

Community noise equivalent level, abbreviated "CNEL," is the equivalent energy (or energy average) sound level during a 24-hour day, obtained by adding approximately five decibels to sound levels from 7:00 p.m. to 10:00 p.m. and ten decibels to sound levels between 10:00 p.m and 7:00 a.m. CNEL is generally computed for annual average conditions.

Day/night average sound level, abbreviated "L_{dn}," is the equivalent energy (or energy average) sound level during a 24-hour day, obtained by adding ten decibels to sound levels between 10:00 p.m. and 7:00 a.m. The L_{dn} is generally computed for annual average conditions.

Decibel, abbreviated "dB," is a measure of sound, which people perceive as loudness. Technically, decibel is 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).

Equivalent sound level, abbreviated "L_{eq}," is the constant or single sound level containing the same total energy as a time-varying sound, over a certain time. For example, if 64 dB is measured for 10 minutes, 68 dB is measured for 20 minutes, and 73 dB is measured for 30 minutes, the 1-hour L_{eq} is about 71 dB. The L_{eq} is typically computed over one, eight, or 24-hour sample periods.

Impulsive noise is a noise of short duration, usually less than one second, such as a hammer blow.

New development means projects requiring land use or building permits, but excluding remodelling or additions to existing structures.

Noise exposure contours are lines drawn around a noise source, indicating constant levels of noise exposure.

Noise level reduction, abbreviated "NLR," is the arithmetic difference between the levels of sound outside and inside a building, measured in decibels. For example, if the sound level outside

Noise-sensitive land use means: residential land uses; hotels, motels, bed-and-breakfast inns, or hostels; schools; libraries; churches; hospitals and nursing homes; playgrounds and parks; theaters, auditoriums, and music halls; museums; meeting halls and convention facilities; professional offices; and, similar uses as determined by the Community Development Director.

Outdoor activity areas are: patios, decks, balconies, outdoor eating areas, swimming pool areas, yards of dwellings, and other areas commonly used for outdoor activities and recreation.

Resilient channel, or resilient clip, is a metal device that allows indirect attachment of an interior wall or ceiling surface to a framing member. Resilient channels reduce sound transmission through walls or ceilings.

Sound transmission class, abbreviated "STC," is a single-number rating of the amount of noise reduction provided by a window, door, or other building component. The higher the STC rating, the more effective the component will be in reducing noise. Windows and doors having a minimum STC rating are sometimes required to ensure that a building facade will achieve a minimum Noise Level Reduction (NLR). However, STC ratings cannot be subtracted from exterior noise exposure values to determine interior noise exposure values.

Stationary noise source is any noise source not preempted from local control by Federal or State regulations. Examples of such sources include industrial and commercial facilities, and vehicle movements on private property (such as parking lots, truck terminals, or auto race tracks).

Transportation noise source means traffic on public roadways, rail line operations, and aircraft in flight. Control of noise from these sources is preempted by Federal and State regulations. However, the effects of noise from transportation sources may be controlled by regulating the location and design of land uses affected by transportation noise sources.

REFERENCES

1. California Department of Health Services, *Guidelines for the Preparation and Content of the Noise Elements of the General Plan*, 1990 (included in the 1990 State of California *General Plan Guidelines*, State Office of Planning and Research).

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

3. California Department of Health, Office of Noise Control, *Model Community Noise Control Ordinance*, April, 1977.

4. U.S. Environmental Protection Agency, *Model Community Noise Control Ordinance*, September, 1975.

5. Federal Highway Administration, *FHWA Highway Traffic Noise Prediction Model*, December, 1978.

6. Brown-Buntin Associates, Inc., *Aircraft Noise Assessment*, Chandler Ranch Specific Plan EIR, July, 1990.

7. Federal Aviation Administration, *Integrated Noise Model*, Version 3.9, October, 1982.

APPENDIX A
ROAD SEGMENT TRAFFIC DATA

FHWA Model RD-77-108: Brown-Buntin Associates, Inc.
Calveno Emission Curves   Run Date: 05-15-1991
Project Number: 90-001   Run Time: 15:14:13
Year: 1991
Soft Site

INPUT DATA SUMMARY:

Segment	ADT	Day%	Eve%	Nite%	%MT	%HT	Speed	Distance	Offset
1	3800	90.0	0.0	10.0	5.0	2.1	50.0	100.0	0.0
2	6500	90.0	0.0	10.0	5.0	2.1	50.0	100.0	0.0
3	5800	89.0	0.0	11.0	6.1	10.1	40.0	100.0	0.0
4	10300	89.0	0.0	11.0	6.1	10.1	40.0	100.0	0.0
5	7400	89.0	0.0	11.0	6.1	10.1	40.0	100.0	0.0
6	12700	89.0	0.0	11.0	6.1	10.1	40.0	100.0	0.0
7	12400	89.0	0.0	11.0	1.5	0.7	40.0	100.0	0.0
8	19700	89.0	0.0	11.0	1.5	0.7	40.0	100.0	0.0
9	30000	87.0	0.0	13.0	1.9	0.9	45.0	100.0	0.0
10	44300	87.0	0.0	13.0	1.9	0.9	45.0	100.0	0.0
11	21000	85.0	0.0	15.0	3.0	1.2	65.0	100.0	0.0
12	32800	85.0	0.0	15.0	3.0	1.2	65.0	100.0	0.0
13	17800	88.0	0.0	12.0	3.3	1.5	70.0	100.0	0.0
14	27800	88.0	0.0	12.0	3.3	1.5	70.0	100.0	0.0
15	21700	90.0	0.0	10.0	2.4	0.8	70.0	100.0	0.0
16	30900	90.0	0.0	10.0	2.4	0.8	70.0	100.0	0.0
17	15000	90.0	0.0	10.0	2.9	0.8	70.0	100.0	0.0
18	21000	90.0	0.0	10.0	2.9	0.8	70.0	100.0	0.0
19	8200	95.0	0.0	5.0	4.4	1.2	65.0	100.0	0.0
20	9500	95.0	0.0	5.0	4.4	1.2	65.0	100.0	0.0
21	6500	95.0	0.0	5.0	5.1	2.2	65.0	100.0	0.0
22	8600	95.0	0.0	5.0	5.1	2.2	65.0	100.0	0.0
23	8000	95.0	0.0	5.0	1.9	0.4	65.0	100.0	0.0
24	9800	95.0	0.0	5.0	1.9	0.4	65.0	100.0	0.0
25	2500	95.0	0.0	5.0	1.9	0.4	65.0	100.0	0.0
26	3700	95.0	0.0	5.0	1.9	0.4	65.0	100.0	0.0
27	9000	90.0	0.0	10.0	3.0	1.2	55.0	100.0	0.0
28	17400	90.0	0.0	10.0	3.0	1.2	55.0	100.0	0.0
29	6000	90.0	0.0	10.0	2.7	1.6	55.0	100.0	0.0
30	9400	90.0	0.0	10.0	2.7	1.6	55.0	100.0	0.0
31	11900	90.0	0.0	10.0	2.7	1.6	45.0	100.0	0.0
32	30500	90.0	0.0	10.0	2.7	1.6	45.0	100.0	0.0
33	25000	90.0	0.0	10.0	2.2	1.5	45.0	100.0	0.0
34	46100	90.0	0.0	10.0	2.2	1.5	45.0	100.0	0.0
35	2800	90.0	0.0	10.0	2.2	1.5	45.0	100.0	0.0
36	4800	90.0	0.0	10.0	2.2	1.5	45.0	100.0	0.0
37	1900	90.0	0.0	10.0	2.3	1.2	45.0	100.0	0.0
38	3000	90.0	0.0	10.0	2.3	1.2	45.0	100.0	0.0
39	560	90.0	0.0	10.0	10.4	3.1	45.0	100.0	0.0
40	1100	90.0	0.0	10.0	10.4	3.1	45.0	100.0	0.0
41	4300	84.0	0.0	16.0	5.6	8.7	60.0	100.0	0.0
42	7900	84.0	0.0	16.0	5.6	8.7	60.0	100.0	0.0
43	2100	94.0	0.0	6.0	2.4	1.1	65.0	100.0	0.0
44	2600	94.0	0.0	6.0	2.4	1.1	65.0	100.0	0.0
45	3900	94.0	0.0	6.0	2.8	1.2	60.0	100.0	0.0

FHWA Model RD-77-108: Brown-Buntin Associates, Inc.
Calveno Emission Curves   Run Date: 05-15-1991
Project Number: 90-001   Run Time: 15:14:16
Year: 1991
Soft Site

INPUT DATA SUMMARY:

Segment	ADT	Day%	Eve%	Nite%	%MT	%HT	Speed	Distance	Offset
46	5000	94.0	0.0	6.0	2.8	1.2	60.0	100.0	0.0
47	16000	85.0	0.0	15.0	8.6	11.4	65.0	100.0	0.0
48	23400	85.0	0.0	15.0	8.6	11.4	65.0	100.0	0.0
49	10000	81.0	0.0	19.0	8.3	12.5	65.0	100.0	0.0
50	17000	81.0	0.0	19.0	8.3	12.5	65.0	100.0	0.0
51	5200	84.0	0.0	16.0	5.8	18.2	65.0	100.0	0.0
52	8840	84.0	0.0	16.0	5.8	18.2	65.0	100.0	0.0
53	5100	88.0	0.0	12.0	3.5	2.5	60.0	100.0	0.0
54	8500	88.0	0.0	12.0	3.5	2.5	60.0	100.0	0.0
55	2400	88.0	0.0	12.0	3.0	3.0	60.0	100.0	0.0
56	4000	88.0	0.0	12.0	3.0	3.0	60.0	100.0	0.0
57	40000	89.0	0.0	11.0	2.2	5.3	70.0	100.0	0.0
58	66800	89.0	0.0	11.0	2.2	5.3	70.0	100.0	0.0
59	52000	90.0	0.0	10.0	2.3	5.3	70.0	100.0	0.0
60	133200	90.0	0.0	10.0	2.3	5.3	70.0	100.0	0.0
61	45000	90.0	0.0	10.0	2.6	5.9	70.0	100.0	0.0
62	95700	90.0	0.0	10.0	2.6	5.9	70.0	100.0	0.0
63	50000	90.0	0.0	10.0	2.6	5.9	70.0	100.0	0.0
64	83800	90.0	0.0	10.0	2.6	5.9	70.0	100.0	0.0
65	43000	90.0	0.0	10.0	2.6	5.9	70.0	100.0	0.0
66	73000	90.0	0.0	10.0	2.6	5.9	70.0	100.0	0.0
67	56000	90.0	0.0	10.0	2.7	6.3	70.0	100.0	0.0
68	100200	90.0	0.0	10.0	2.7	6.3	70.0	100.0	0.0
69	44000	89.0	0.0	11.0	3.0	7.0	70.0	100.0	0.0
70	102000	89.0	0.0	11.0	3.0	7.0	70.0	100.0	0.0
71	33000	86.0	0.0	14.0	3.0	6.6	70.0	100.0	0.0
72	69900	86.0	0.0	14.0	3.0	6.6	70.0	100.0	0.0
73	24000	86.0	0.0	14.0	3.9	8.5	65.0	100.0	0.0
74	53900	86.0	0.0	14.0	3.9	8.5	65.0	100.0	0.0
75	17000	86.0	0.0	14.0	4.6	13.3	70.0	100.0	0.0
76	30200	86.0	0.0	14.0	4.6	13.3	70.0	100.0	0.0
77	15500	86.0	0.0	14.0	4.6	13.3	70.0	100.0	0.0
78	30200	86.0	0.0	14.0	4.6	13.3	70.0	100.0	0.0
79	2450	90.0	0.0	10.0	5.6	16.0	60.0	100.0	0.0
80	3400	90.0	0.0	10.0	5.6	16.0	60.0	100.0	0.0
81	3000	91.0	0.0	9.0	4.3	1.7	50.0	100.0	0.0
82	6700	91.0	0.0	9.0	4.3	1.7	50.0	100.0	0.0
83	11000	92.0	0.0	8.0	4.3	1.7	50.0	100.0	0.0
84	23900	92.0	0.0	8.0	4.3	1.7	50.0	100.0	0.0
85	21900	92.0	0.0	8.0	2.0	3.0	40.0	100.0	0.0
86	40000	92.0	0.0	8.0	2.0	3.0	40.0	100.0	0.0
87	29000	92.0	0.0	8.0	2.0	3.0	40.0	100.0	0.0
88	52000	92.0	0.0	8.0	2.0	3.0	40.0	100.0	0.0
89	10400	92.0	0.0	8.0	2.0	3.0	40.0	100.0	0.0
90	17000	92.0	0.0	8.0	2.0	3.0	40.0	100.0	0.0

FHWA Model RD-77-108: Brown-Buntin Associates, Inc.
Calveno Emission Curves   Run Date: 05-15-1991
Project Number: 90-001   Run Time: 15:14:18
Year: 1991
Soft Site

INPUT DATA SUMMARY:

Segment	ADT	Day%	Eve%	Nite%	%MT	%HT	Speed	Distance	Offset
91	14300	90.0	0.0	10.0	2.0	2.4	60.0	100.0	0.0
92	29000	90.0	0.0	10.0	2.0	2.4	60.0	100.0	0.0
93	17000	90.0	0.0	10.0	2.5	2.5	50.0	100.0	0.0
94	30000	90.0	0.0	10.0	2.5	2.5	50.0	100.0	0.0
95	17000	90.0	0.0	10.0	2.5	2.5	36.0	100.0	0.0
96	30000	90.0	0.0	10.0	2.5	2.5	36.0	100.0	0.0
97	10100	90.0	0.0	10.0	1.0	1.0	40.0	100.0	0.0
98	20000	90.0	0.0	10.0	1.0	1.0	40.0	100.0	0.0
99	8500	90.0	0.0	10.0	1.0	1.0	40.0	100.0	0.0
100	11000	90.0	0.0	10.0	1.0	1.0	40.0	100.0	0.0
101	13000	90.0	0.0	10.0	2.5	2.5	52.0	100.0	0.0
102	22000	90.0	0.0	10.0	2.5	2.5	52.0	100.0	0.0
103	2800	90.0	0.0	10.0	1.0	1.0	35.0	100.0	0.0
104	7000	90.0	0.0	10.0	1.0	1.0	35.0	100.0	0.0
105	3300	90.0	0.0	10.0	1.0	1.0	41.0	100.0	0.0
106	5500	90.0	0.0	10.0	1.0	1.0	41.0	100.0	0.0
107	2900	90.0	0.0	10.0	1.0	1.0	40.0	100.0	0.0
108	6000	90.0	0.0	10.0	1.0	1.0	40.0	100.0	0.0
109	3000	90.0	0.0	10.0	1.0	1.0	40.0	100.0	0.0
110	5000	90.0	0.0	10.0	1.0	1.0	40.0	100.0	0.0
111	6100	90.0	0.0	10.0	1.0	1.0	32.0	100.0	0.0
112	10500	90.0	0.0	10.0	1.0	1.0	32.0	100.0	0.0
113	5800	90.0	0.0	10.0	1.0	1.0	35.0	100.0	0.0
114	8000	90.0	0.0	10.0	1.0	1.0	35.0	100.0	0.0
115	6300	90.0	0.0	10.0	1.0	1.0	33.0	100.0	0.0
116	10500	90.0	0.0	10.0	1.0	1.0	33.0	100.0	0.0
117	4500	90.0	0.0	10.0	1.0	1.5	39.0	100.0	0.0
118	17000	90.0	0.0	10.0	1.0	1.5	39.0	100.0	0.0
119	5500	90.0	0.0	10.0	1.0	1.0	35.0	100.0	0.0
120	12000	90.0	0.0	10.0	1.0	1.0	35.0	100.0	0.0
121	4200	90.0	0.0	10.0	1.0	1.0	31.0	100.0	0.0
122	13000	90.0	0.0	10.0	1.0	1.0	31.0	100.0	0.0
123	3600	90.0	0.0	10.0	1.0	1.0	35.0	100.0	0.0
124	7300	90.0	0.0	10.0	1.0	1.0	35.0	100.0	0.0
125	2800	90.0	0.0	10.0	1.0	1.0	40.0	100.0	0.0
126	5400	90.0	0.0	10.0	1.0	1.0	40.0	100.0	0.0
127	5237	92.0	0.0	8.0	1.0	1.0	55.0	100.0	0.0
128	5110	92.0	0.0	8.0	1.0	1.0	55.0	100.0	0.0
129	5237	92.0	0.0	8.0	1.0	1.0	55.0	100.0	0.0
130	15260	92.0	0.0	8.0	1.0	1.0	55.0	100.0	0.0
131	5190	93.0	0.0	7.0	1.0	1.0	45.0	100.0	0.0
132	6380	93.0	0.0	7.0	1.0	1.0	45.0	100.0	0.0
133	5190	93.0	0.0	7.0	1.0	1.0	45.0	100.0	0.0
134	27650	93.0	0.0	7.0	1.0	1.0	45.0	100.0	0.0
135	3800	93.0	0.0	7.0	1.0	1.0	45.0	100.0	0.0

FHWA Model RD-77-108: Brown-Buntin Associates, Inc.
Calveno Emission Curves Run Date: 05-15-1991
Project Number: 90-001 Run Time: 15:14:22
Year: 1991
Soft Site

INPUT DATA SUMMARY:

Segment	ADT	Day%	Eve%	Nite%	%MT	%HT	Speed	Distance	Offset
136	7410	93.0	0.0	7.0	1.0	1.0	45.0	100.0	0.0
137	4600	92.0	0.0	8.0	2.5	2.5	45.0	100.0	0.0
138	12100	92.0	0.0	8.0	2.5	2.5	45.0	100.0	0.0
139	4600	92.0	0.0	8.0	2.5	2.5	45.0	100.0	0.0
140	18180	92.0	0.0	8.0	2.5	2.5	45.0	100.0	0.0
141	4400	90.0	0.0	10.0	5.0	5.0	45.0	100.0	0.0
142	10000	90.0	0.0	10.0	5.0	5.0	45.0	100.0	0.0
143	5900	88.0	0.0	12.0	1.0	1.0	50.0	100.0	0.0
144	13000	88.0	0.0	12.0	1.0	1.0	50.0	100.0	0.0
145	11000	86.0	0.0	14.0	3.0	3.1	50.0	100.0	0.0
146	19500	86.0	0.0	14.0	3.0	3.1	50.0	100.0	0.0
147	2900	90.0	0.0	10.0	1.0	1.0	60.0	100.0	0.0
148	6000	90.0	0.0	10.0	1.0	1.0	60.0	100.0	0.0
149	2300	90.0	0.0	10.0	1.0	1.0	48.0	100.0	0.0
150	6500	90.0	0.0	10.0	1.0	1.0	48.0	100.0	0.0
151	2500	90.0	0.0	10.0	8.5	10.0	50.0	100.0	0.0
152	4000	90.0	0.0	10.0	8.5	10.0	50.0	100.0	0.0
153	3000	90.0	0.0	10.0	1.0	1.0	35.0	100.0	0.0
154	6000	90.0	0.0	10.0	1.0	1.0	35.0	100.0	0.0
155	6500	90.0	0.0	10.0	1.0	1.0	34.0	100.0	0.0
156	7000	90.0	0.0	10.0	1.0	1.0	34.0	100.0	0.0
157	5200	90.0	0.0	10.0	1.0	1.0	48.0	100.0	0.0
158	6000	90.0	0.0	10.0	1.0	1.0	48.0	100.0	0.0
159	23000	92.0	0.0	8.0	0.5	0.5	60.0	100.0	0.0
160	32000	92.0	0.0	8.0	0.5	0.5	60.0	100.0	0.0
161	14300	90.0	0.0	10.0	2.0	2.4	60.0	100.0	0.0
162	29000	90.0	0.0	10.0	2.0	2.4	60.0	100.0	0.0
163	11000	92.0	0.0	8.0	5.0	6.4	45.0	100.0	0.0
164	18000	92.0	0.0	8.0	5.0	6.4	45.0	100.0	0.0
165	2000	90.0	0.0	10.0	2.5	2.5	45.0	100.0	0.0
166	16000	90.0	0.0	10.0	2.5	2.5	45.0	100.0	0.0
167	5200	90.0	0.0	10.0	2.5	2.5	50.0	100.0	0.0
168	24000	90.0	0.0	10.0	2.5	2.5	50.0	100.0	0.0
169	3600	90.0	0.0	10.0	1.0	1.0	50.0	100.0	0.0
170	12000	90.0	0.0	10.0	1.0	1.0	50.0	100.0	0.0
171	5700	90.0	0.0	10.0	1.0	1.0	50.0	100.0	0.0
172	8100	90.0	0.0	10.0	1.0	1.0	50.0	100.0	0.0
173	3000	90.0	0.0	10.0	1.0	1.0	45.0	100.0	0.0
174	10000	90.0	0.0	10.0	1.0	1.0	45.0	100.0	0.0
175	4300	90.0	0.0	10.0	2.5	2.5	45.0	100.0	0.0
176	6500	90.0	0.0	10.0	2.5	2.5	45.0	100.0	0.0
177	3400	90.0	0.0	10.0	1.0	1.0	45.0	100.0	0.0
178	6800	90.0	0.0	10.0	1.0	1.0	45.0	100.0	0.0
179	3200	90.0	0.0	10.0	1.0	1.0	38.0	100.0	0.0
180	7800	90.0	0.0	10.0	1.0	1.0	38.0	100.0	0.0

FHWA Model RD-77-108: Brown-Buntin Associates, Inc.
Calveno Emission Curves   Run Date: 05-15-1991
Project Number: 90-001   Run Time: 15:14:24
Year: 1991
Soft Site

INPUT DATA SUMMARY:

Segment	ADT	Day%	Eve%	Nite%	%MT	%HT	Speed	Distance	Offset
181	3600	92.0	0.0	8.0	0.5	0.5	30.0	100.0	0.0
182	3600	92.0	0.0	8.0	0.5	0.5	30.0	100.0	0.0
183	10400	92.0	0.0	8.0	2.0	3.0	40.0	100.0	0.0
184	17000	92.0	0.0	8.0	2.0	3.0	40.0	100.0	0.0
185	29000	92.0	0.0	8.0	2.0	3.0	40.0	100.0	0.0
186	52000	92.0	0.0	8.0	2.0	3.0	40.0	100.0	0.0
187	21900	92.0	0.0	8.0	2.0	3.0	40.0	100.0	0.0
188	40000	92.0	0.0	8.0	2.0	3.0	40.0	100.0	0.0
189	4100	92.0	0.0	8.0	0.5	0.5	30.0	100.0	0.0
190	10000	92.0	0.0	8.0	0.5	0.5	30.0	100.0	0.0
191	16400	92.0	0.0	8.0	0.5	0.5	40.0	100.0	0.0
192	24000	92.0	0.0	8.0	0.5	0.5	40.0	100.0	0.0
193	12300	92.0	0.0	8.0	0.5	0.5	35.0	100.0	0.0
194	12000	92.0	0.0	8.0	0.5	0.5	35.0	100.0	0.0
195	2700	92.0	0.0	8.0	0.5	0.5	33.0	100.0	0.0
196	16000	92.0	0.0	8.0	0.5	0.5	33.0	100.0	0.0
197	11500	92.0	0.0	8.0	0.5	0.5	33.0	100.0	0.0
198	15000	92.0	0.0	8.0	0.5	0.5	33.0	100.0	0.0
199	2700	92.0	0.0	8.0	0.5	0.5	35.0	100.0	0.0
200	8000	92.0	0.0	8.0	0.5	0.5	35.0	100.0	0.0
201	8900	92.0	0.0	8.0	0.5	0.5	40.0	100.0	0.0
202	12000	92.0	0.0	8.0	0.5	0.5	40.0	100.0	0.0
203	11400	92.0	0.0	8.0	0.5	0.5	35.0	100.0	0.0
204	32000	92.0	0.0	8.0	0.5	0.5	35.0	100.0	0.0
205	11400	92.0	0.0	8.0	0.5	0.5	35.0	100.0	0.0
206	17000	92.0	0.0	8.0	0.5	0.5	35.0	100.0	0.0
207	12800	92.0	0.0	8.0	1.5	2.0	30.0	100.0	0.0
208	18000	92.0	0.0	8.0	1.5	2.0	30.0	100.0	0.0
209	15000	92.0	0.0	8.0	1.5	2.0	30.0	100.0	0.0
210	40000	92.0	0.0	8.0	1.5	2.0	30.0	100.0	0.0
211	15000	92.0	0.0	8.0	1.5	2.0	40.0	100.0	0.0
212	31000	92.0	0.0	8.0	1.5	2.0	40.0	100.0	0.0
213	12600	92.0	0.0	8.0	2.0	2.0	45.0	100.0	0.0
214	19000	92.0	0.0	8.0	2.0	2.0	45.0	100.0	0.0
215	18000	92.0	0.0	8.0	2.0	2.0	45.0	100.0	0.0
216	20000	92.0	0.0	8.0	2.0	2.0	45.0	100.0	0.0
217	21000	92.0	0.0	8.0	1.5	1.5	40.0	100.0	0.0
218	34000	92.0	0.0	8.0	1.5	1.5	40.0	100.0	0.0
219	4800	92.0	0.0	8.0	1.0	1.0	40.0	100.0	0.0
220	15000	92.0	0.0	8.0	1.0	1.0	40.0	100.0	0.0
221	18000	92.0	0.0	8.0	1.5	1.5	35.0	100.0	0.0
222	29000	92.0	0.0	8.0	1.5	1.5	35.0	100.0	0.0
223	23000	92.0	0.0	8.0	0.5	0.5	45.0	100.0	0.0
224	32000	92.0	0.0	8.0	0.5	0.5	45.0	100.0	0.0
225	33000	92.0	0.0	8.0	1.5	2.0	45.0	100.0	0.0

FHWA Model RD-77-108: Brown-Buntin Associates, Inc.
Calveno Emission Curves   Run Date: 05-15-1991
Project Number: 90-001   Run Time: 15:15:22
Year: 1991
Soft Site

INPUT DATA SUMMARY:

Segment	ADT	Day%	Eve%	Nite%	%MT	%HT	Speed	Distance	Offset
226	51000	92.0	0.0	8.0	1.5	2.0	45.0	100.0	0.0
227	16200	92.0	0.0	8.0	1.0	1.0	30.0	100.0	0.0
228	23000	92.0	0.0	8.0	1.0	1.0	30.0	100.0	0.0
229	12900	92.0	0.0	8.0	0.5	0.5	35.0	100.0	0.0
230	20000	92.0	0.0	8.0	0.5	0.5	35.0	100.0	0.0
231	12700	92.0	0.0	8.0	1.5	1.5	30.0	100.0	0.0
232	14000	92.0	0.0	8.0	1.5	1.5	30.0	100.0	0.0
233	15100	92.0	0.0	8.0	2.0	2.0	30.0	100.0	0.0
234	23000	92.0	0.0	8.0	2.0	2.0	30.0	100.0	0.0
235	16800	89.0	0.0	11.0	1.5	0.7	35.0	100.0	0.0
236	28000	89.0	0.0	11.0	1.5	0.7	35.0	100.0	0.0
237	13500	92.0	0.0	8.0	0.5	0.5	40.0	100.0	0.0
238	27000	92.0	0.0	8.0	0.5	0.5	40.0	100.0	0.0
239	9700	92.0	0.0	8.0	0.5	0.5	35.0	100.0	0.0
240	19000	92.0	0.0	8.0	0.5	0.5	35.0	100.0	0.0
241	14000	92.0	0.0	8.0	0.5	0.5	40.0	100.0	0.0
242	23000	92.0	0.0	8.0	0.5	0.5	40.0	100.0	0.0
243	2000	90.0	0.0	10.0	2.5	2.5	45.0	100.0	0.0
244	16000	90.0	0.0	10.0	2.5	2.5	45.0	100.0	0.0
245	2900	92.0	0.0	8.0	0.5	0.5	30.0	100.0	0.0
246	5800	92.0	0.0	8.0	0.5	0.5	30.0	100.0	0.0
247	3600	92.0	0.0	8.0	0.5	0.5	30.0	100.0	0.0
248	4300	92.0	0.0	8.0	0.5	0.5	30.0	100.0	0.0
249	3000	92.0	0.0	8.0	0.5	0.5	30.0	100.0	0.0
250	4000	92.0	0.0	8.0	0.5	0.5	30.0	100.0	0.0
251	4100	92.0	0.0	8.0	0.5	0.5	35.0	100.0	0.0
252	32000	92.0	0.0	8.0	0.5	0.5	35.0	100.0	0.0
253	5900	93.0	0.0	7.0	1.0	1.0	40.0	100.0	0.0
254	17200	93.0	0.0	7.0	1.0	1.0	40.0	100.0	0.0
255	11100	93.0	0.0	7.0	2.0	2.0	35.0	100.0	0.0
256	32400	93.0	0.0	7.0	2.0	2.0	35.0	100.0	0.0
257	9200	93.0	0.0	7.0	1.0	1.0	35.0	100.0	0.0
258	26700	93.0	0.0	7.0	1.0	1.0	35.0	100.0	0.0
259	6600	93.0	0.0	7.0	1.0	1.0	35.0	100.0	0.0
260	19100	93.0	0.0	7.0	1.0	1.0	35.0	100.0	0.0
261	7900	93.0	0.0	7.0	1.0	1.0	25.0	100.0	0.0
262	22900	93.0	0.0	7.0	1.0	1.0	25.0	100.0	0.0
263	5900	93.0	0.0	7.0	1.0	1.0	25.0	100.0	0.0
264	17200	93.0	0.0	7.0	1.0	1.0	25.0	100.0	0.0
265	15100	93.0	0.0	7.0	1.0	1.0	25.0	100.0	0.0
266	43800	93.0	0.0	7.0	1.0	1.0	25.0	100.0	0.0
267	10500	93.0	0.0	7.0	1.0	1.0	25.0	100.0	0.0
268	30500	93.0	0.0	7.0	1.0	1.0	25.0	100.0	0.0
269	5200	93.0	0.0	7.0	1.0	1.0	25.0	100.0	0.0
270	15200	93.0	0.0	7.0	1.0	1.0	25.0	100.0	0.0

FHWA Model RD-77-108: Brown-Buntin Associates, Inc.
Calveno Emission Curves   Run Date: 05-15-1991
Project Number: 90-001   Run Time: 15:16:27
Year: 1991
Soft Site

INPUT DATA SUMMARY:

Segment	ADT	Day%	Eve%	Nite%	%MT	%HT	Speed	Distance	Offset
271	16400	93.0	0.0	7.0	2.0	2.0	40.0	100.0	0.0
272	47700	93.0	0.0	7.0	2.0	2.0	40.0	100.0	0.0
273	6300	93.0	0.0	7.0	1.0	1.0	30.0	100.0	0.0
274	18300	93.0	0.0	7.0	1.0	1.0	30.0	100.0	0.0
275	3000	93.0	0.0	7.0	1.0	1.0	45.0	100.0	0.0
276	8800	93.0	0.0	7.0	1.0	1.0	45.0	100.0	0.0
277	12686	90.0	0.0	10.0	1.0	1.0	35.0	100.0	0.0
278	18000	90.0	0.0	10.0	1.0	1.0	35.0	100.0	0.0
279	12980	90.0	0.0	10.0	1.0	1.0	30.0	100.0	0.0
280	19500	90.0	0.0	10.0	1.0	1.0	30.0	100.0	0.0
281	28167	90.0	0.0	10.0	1.0	1.0	30.0	100.0	0.0
282	42250	90.0	0.0	10.0	1.0	1.0	30.0	100.0	0.0
283	7000	90.0	0.0	10.0	5.0	1.6	35.0	100.0	0.0
284	8200	90.0	0.0	10.0	5.0	1.6	35.0	100.0	0.0
285	3700	90.0	0.0	10.0	1.9	0.1	35.0	100.0	0.0
286	6200	90.0	0.0	10.0	1.9	0.1	35.0	100.0	0.0
287	6100	90.0	0.0	10.0	1.9	0.1	35.0	100.0	0.0
288	7100	90.0	0.0	10.0	1.9	0.1	35.0	100.0	0.0
289	17000	90.0	0.0	10.0	1.3	2.6	45.0	100.0	0.0
290	22000	90.0	0.0	10.0	1.3	2.6	45.0	100.0	0.0
291	2320	90.0	0.0	10.0	0.1	0.1	35.0	100.0	0.0
292	5000	90.0	0.0	10.0	0.1	0.1	35.0	100.0	0.0
293	6400	90.0	0.0	10.0	1.3	2.6	45.0	100.0	0.0
294	7400	90.0	0.0	10.0	1.3	2.6	45.0	100.0	0.0
295	13400	90.0	0.0	10.0	2.0	2.0	35.0	100.0	0.0
296	73700	90.0	0.0	10.0	2.0	2.0	35.0	100.0	0.0
297	9500	90.0	0.0	10.0	2.0	2.0	35.0	100.0	0.0
298	41900	90.0	0.0	10.0	2.0	2.0	35.0	100.0	0.0
299	900	90.0	0.0	10.0	1.0	1.0	45.0	100.0	0.0
300	33800	90.0	0.0	10.0	1.0	1.0	45.0	100.0	0.0
301	15700	90.0	0.0	10.0	1.0	1.0	30.0	100.0	0.0
302	26500	90.0	0.0	10.0	1.0	1.0	30.0	100.0	0.0
303	5000	90.0	0.0	10.0	2.0	2.0	45.0	100.0	0.0
304	54700	90.0	0.0	10.0	2.0	2.0	45.0	100.0	0.0
305	2000	90.0	0.0	10.0	2.0	2.0	35.0	100.0	0.0
306	11000	90.0	0.0	10.0	2.0	2.0	35.0	100.0	0.0
307	3400	90.0	0.0	10.0	2.0	2.0	35.0	100.0	0.0
308	16700	90.0	0.0	10.0	2.0	2.0	35.0	100.0	0.0
309	6800	90.0	0.0	10.0	2.0	2.0	35.0	100.0	0.0
310	16900	90.0	0.0	10.0	2.0	2.0	35.0	100.0	0.0
311	2400	90.0	0.0	10.0	1.0	1.0	35.0	100.0	0.0
312	5400	90.0	0.0	10.0	1.0	1.0	35.0	100.0	0.0
313	3400	90.0	0.0	10.0	2.0	2.0	40.0	100.0	0.0
314	6500	90.0	0.0	10.0	2.0	2.0	40.0	100.0	0.0
315	5613	93.0	0.0	7.0	1.0	1.0	33.0	100.0	0.0

FHWA Model RD-77-108: Brown-Buntin Associates, Inc.
Calveno Emission Curves Run Date: 05-15-1991
Project Number: 90-001 Run Time: 15:17:32
Year: 1991
Soft Site

INPUT DATA SUMMARY:

Segment	ADT	Day%	Eve%	Nite%	%MT	%HT	Speed	Distance	Offset
316	8000	93.0	0.0	7.0	1.0	1.0	33.0	100.0	0.0
317	3641	90.0	0.0	10.0	1.0	1.0	42.0	100.0	0.0
318	5200	90.0	0.0	10.0	1.0	1.0	42.0	100.0	0.0
319	31971	94.0	0.0	6.0	1.0	1.0	31.0	100.0	0.0
320	45400	94.0	0.0	6.0	1.0	1.0	31.0	100.0	0.0
321	11610	90.0	0.0	10.0	1.0	1.0	34.0	100.0	0.0
322	16500	90.0	0.0	10.0	1.0	1.0	34.0	100.0	0.0
323	10899	90.0	0.0	10.0	1.0	1.0	30.0	100.0	0.0
324	15500	90.0	0.0	10.0	1.0	1.0	30.0	100.0	0.0
325	10855	90.0	0.0	10.0	1.0	1.0	34.0	100.0	0.0
326	15500	90.0	0.0	10.0	1.0	1.0	34.0	100.0	0.0
327	7833	90.0	0.0	10.0	1.0	1.0	33.0	100.0	0.0
328	11200	90.0	0.0	10.0	1.0	1.0	33.0	100.0	0.0
329	12618	95.0	0.0	5.0	1.0	1.0	32.0	100.0	0.0
330	18000	95.0	0.0	5.0	1.0	1.0	32.0	100.0	0.0
331	7747	90.0	0.0	10.0	1.0	1.0	34.0	100.0	0.0
332	11000	90.0	0.0	10.0	1.0	1.0	34.0	100.0	0.0
333	6314	90.0	0.0	10.0	1.0	1.0	35.0	100.0	0.0
334	9000	90.0	0.0	10.0	1.0	1.0	35.0	100.0	0.0
335	9300	90.0	0.0	10.0	2.5	2.5	45.0	100.0	0.0
336	18000	90.0	0.0	10.0	2.5	2.5	45.0	100.0	0.0
337	9300	90.0	0.0	10.0	2.5	2.5	45.0	100.0	0.0
338	18000	90.0	0.0	10.0	2.5	2.5	45.0	100.0	0.0
339	9250	90.0	0.0	10.0	1.0	1.0	45.0	100.0	0.0
340	12900	90.0	0.0	10.0	1.0	1.0	45.0	100.0	0.0
341	3500	90.0	0.0	10.0	1.0	1.0	45.0	100.0	0.0
342	5000	90.0	0.0	10.0	1.0	1.0	45.0	100.0	0.0
343	6380	90.0	0.0	10.0	1.0	1.0	45.0	100.0	0.0
344	9800	90.0	0.0	10.0	1.0	1.0	45.0	100.0	0.0
345	4440	90.0	0.0	10.0	1.8	5.4	35.0	100.0	0.0
346	6660	90.0	0.0	10.0	1.8	5.4	35.0	100.0	0.0