CHAPTER TEN
NOISE

EXISTING NOISE ENVIRONMENT

GENERAL

Noise is often defined simply as unwanted sound, and thus is a subjective reaction to characteristics of a physical phenomenon. Researchers for many years have grappled with the problem of translating objective measurements of sound into directly correlated measures of public reaction to noise. The descriptors of community noise in current use are the results of these efforts, and represent simplified, practical measurement tools to gauge community response. Figure 10-1 provides examples of noise levels associated with common noise sources.

A common statistical tool to measure the ambient noise level is the average, or equivalent, sound level (L_{dn}[1]), which is the sound level corresponding to a steady-state A-weighted sound level in decibels (dB) 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 are in common use today: 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 a +10 decibel weighting applied to nighttime (10:00 p.m. to 7:00 a.m.) L_{eq} values. The nighttime penalty is based upon the assumption that people react to nighttime noise exposures as though they were subjectively twice as loud as daytime exposures. The CNEL (Community Noise Equivalent Level), like L_{dn}, is based upon 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 normally applied to airport/aircraft noise assessment. The L_{dn} descriptor 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 disguise short-term variations in the noise environment. Because they presume increased evening or nighttime sensitivity, these descriptors are best applied as criteria for land uses where nighttime noise exposures are critical to the acceptability of the noise environment, such as residential developments.

The State Office of Planning and Research Noise Element Guidelines require that major noise sources be identified and quantified by preparing generalized noise contours for current and projected conditions. Significant noise sources include traffic on major roadways and highways, railroad operations, airports, and representative industrial activities and fixed noise sources.

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[1] For an explanation of these terms, see Appendix A: "Acoustical Terminology"

Noise modeling techniques and noise measurements were used to develop generalized L_{dn}/CNEL or L_{eq} noise contours for the major roadways, railroads and fixed noise sources in the City of Grass Valley General Plan Planning Area for existing conditions.

Noise modeling techniques use source-specific data including average levels of activity, hours of operation, seasonal fluctuations, and average levels of noise from source operations. Modeling methods have been developed for a number of environmental noise sources including roadways, railroad line operations and industrial plants. Such methods produce reliable results as long as data inputs and assumptions are valid. The modeling methods used in this chapter closely follow recommendations made by the State Office of Noise Control, and were supplemented where appropriate by field-measured noise level data to account for local conditions. The noise exposure contours are based upon annual average conditions. Because local topography, vegetation or intervening structures may significantly affect noise exposure at a particular location, the noise contours should not be considered site-specific.

A community noise survey was conducted to describe existing noise levels in noise-sensitive areas within the City of Grass Valley Planning Area so that noise level performance standards could be developed to maintain an acceptable noise environment (see Figure 10-2).

EXISTING REGULATORY FRAMEWORK

The existing *General Plan Noise Element* is based upon recommendations by the California State Office of Noise Control as contained in the *Guidelines for the Preparation and Content of Noise Elements of the General Plan*.

The criteria in the Noise Element are established for determining potential noise conflicts between various land uses and noise sources. The standards are based upon the CNEL/L_{dn} descriptor. Figure 10-3 shows the land use compatibility chart contained in the existing Noise Element.

As described above, the CNEL and L_{dn} are 24-hour average noise level descriptors, which apply penalties to noise which occurs during the evening and nighttime hours. The CNEL and L_{dn} descriptors have been found to provide good correlation to the potential for annoyance from transportation-related noise sources (ie: roadways, airports, railroad operations). However, they do not provide a good correlation to the potential for annoyance from non-transportation or stationary noise sources such as industrial and commercial operations. This is due to the fact that many times stationary noise sources may operate between 8 and 10 hours per day, or will have noise sources such as loading docks, pressure relief valves or alarms which tend to be short duration noise events. When applying an L_{dn} or CNEL criterion, the noise levels associated with these types of short term operations will be averaged over a 24-hour period, thus underscoring the potential for annoyance.

ROADWAYS

The Federal Highway Administration (FHWA) Highway Traffic Noise Prediction Model (FHWA-RD-77-108) was used to develop CNEL contours for all highways and major roadways in the City of Grass Valley Planning Area. The FHWA Model is the analytical method presently favored for traffic noise prediction by most state and local agencies, including Caltrans. The current version of the model is based upon the CALVENO noise emission factors for automobiles, medium trucks, and heavy trucks, with consideration given to vehicle volume, speed, roadway configuration, distance to the receiver and the acoustical characteristics of the site. The FHWA Model predicts hourly L_{eq} values for free-flowing traffic conditions, and is generally considered to be accurate within 1.5 dB. To predict CNEL 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.

Traffic data representing annual average traffic volumes for existing conditions were obtained from Caltrans for the State highways within the City of Grass Valley, and from the General Plan traffic consultant for local roadways. Day/evening/night traffic distribution for State Routes (SR) 49, 20, and 174 were based upon 24-hour noise measurement data. Truck mix data for the State highways were also based upon Caltrans data. Using these data and the FHWA methodology, traffic noise levels as defined by CNEL were calculated for existing traffic volumes for the State highways and local roadways. Distances from the center lines of each of the roadway segments to the 60 and 65 dB CNEL contours are summarized in Table 10-1.

In some cases, the actual distances to noise level contours may vary from the distances predicted by the FHWA model. Factors such as roadway curvature, roadway grade, shielding from local topography or structures, elevated roadways, or elevated receivers may affect actual sound propagation. Therefore the distances reported in Table 10-1 are generally considered to be conservative estimates of noise exposure along roadways in the City of Grass Valley.

Significant variations in topography occur in the Grass Valley area. In many cases, the existing topography which occurs adjacent to the major roadways affects sound propagation due to roadway traffic. The effects of factors such as topography, roadway curvature, grade, etc. can be determined from site-specific traffic noise measurements. The noise measurement results can be compared to the FHWA model results by entering the observed traffic volumes, speed and distance as inputs to the FHWA model. The differences between the measured and predicted noise levels can be used to adjust the FHWA model and more precisely determine the locations of the traffic noise contours.

TABLE 10-1
EXISTING TRAFFIC NOISE CONTOUR DATA

Segment	Description	CNEL At 100 Feet*	Distance to Traffic CNEL Contour*	
			60 dB	65 dB
State Route 49				
1	Begin Freeway to Grass Val. Int.	69.7	444	206
2	Grass Val. Int. To S.R. 20	71.1	554	257
3	S.R. 20 to N. Auburn Street	71.6	593	275
4	N. Auburn Street to S.R. 174	72.5	684	318
5	S.R. 174 to Bennett Street	72.5	684	318
6	Bennett Street to Idaho Maryland	72.6	697	324
7	Idaho Maryland to Brunswick Road	71.8	613	284
8	Brunswick Road to Banner Ridge	71.7	599	278
State Route 20				
9	West Boundary to Mill Street	67.6	321	149
10	Mill Street to S.R. 49	68.0	340	158
State Route 174				
11	Brunswick Road to Empire Mine Road	59.6	94	44
12	Empire Mine Road to Race Street	56.9	62	29
13	Race Street to Ophir Road	56.7	60	28
14	Ophir Road to S.R. 49	57.4	69	32
Alta Street				
15	West Main to Alta Vista	54.9	46	21
16	Alta Vista to Ridge Road	54.1	40	19
South Auburn Street				
17	Mohawk Street to School Alley	57.6	69	32
18	School Alley to Whiting Street	57.0	63	29
19	Whiting Street to Mc Knight Way	57.2	65	30
Banner Lava Cap				
20	Entire Length	54.6	44	20
Brighton Street				
21	Mc Courtney to Chapel	54.5	43	20
Brunswick Road				
22	49/20 O.C. to Idaho Maryland	62.8	155	72
23	Idaho Maryland to Loma Rica Drive	60.3	104	48
24	Loma Rica Drive to Bennett Street	60.3	104	48
Dorsey Drive				

TABLE 10-1
EXISTING TRAFFIC NOISE CONTOUR DATA

Segment	Description	CNEL At 100 Feet*	Distance to Traffic CNEL Contour*	
			60 dB	65 dB
25	Ridge Road to E. Main Street	53.7	38	18
26	E. Main Street to Segworth	56.1	55	25
Empire Street				
27	49/20 O.C. to Le Duc Street	55.6	51	24
28	Le Duc Street to Kate Hayes Street	55.0	46	21
29	Kate Hayes Street to Grass Valley Limit	54.9	45	21
Freeman Lane				
30	Mc Knight Way to Taylorville Road	57.8	71	33
Hughes Road				
31	East Main Street to Ridge Road	57.6	69	32
Idaho Maryland Road				
32	Brunswick Road to 49/20 O.C.	54.2	41	19
La Barr Meadows				
33	Entire Length	58.7	82	38
Loma Rica Road				
34	Entire Length	57.0	63	29
Mc Courtney Road				
35	Entire Length	58.0	74	34
West Mc Knight Way				
36	Taylorville Road to Freeman	58.1	75	35
Mill Street				
37	Main Street to Neal Street	56.0	54	25
38	Neal Street to Rhode Island Street	56.3	57	26
Neal Street				
39	East of Church Street	55.9	53	25

Ridge Road				
40 41	Ridge Estates Road to Hughes Road Hughes Road to Alta Street	55.7 57.6	52 69	24 32
Sutton Way				
42 43	South of Brunswick North of Brunswick	58.2 60.0	76 100	35 47
Taylorville Road				
44 45	Freeman lane to Mc Knight Way Mc Knight Way to Mill Street	52.7 57.3	33 67	15 31

Source: Brown-Buntin Associates, 1998.

Table 10-2 has been prepared to serve as a guide when applying the traffic noise exposure contour information presented in this section to areas with varying topography. The table is used by adding the correction factor to the noise level predicted at a given distance. It should be noted that the adjustment factors presented in this table are intended to provide conservative (worst-case) results, and that complex situations should be evaluated by an acoustical consultant where the potential for significant noise impact exists.

TABLE 10-2
TRAFFIC NOISE ADJUSTMENTS FOR VARIOUS TOPOGRAPHIC CONDITIONS

	Distance from Center of Roadway (Feet)		
Topographic Situation	<200	200 - 400	>400
Hillside overlooks roadway with full view of traffic	-0-	+1 dB	+3 dB
Roadway Elevated (>15')	-5 dB	-2 dB	-0-
Roadway in cut/below embankment	-5 dB	-5 dB	-5 dB
Dense vegetation (100 feet or more)	-5 dB	-5 dB	-5 dB

Source: Brown Buntin Associates, 1998.

Traffic noise contours were not developed for all segments of local roadways in the City of Grass Valley. However, Figure 10-4, prepared using the FHWA Model, may be used to estimate the distance to the CNEL contours for projected volumes of arterial traffic. For arterial traffic, the predicted distance to the 60 dB CNEL contour is determined by the Average Daily Traffic Volume (ADT) and the posted speed limit. CNEL contours derived from Figure 10-4 are only indicators of potential noise conflicts, requiring more detailed analysis to determine traffic noise levels at any given location.

AIRCRAFT NOISE LEVELS

The Nevada County Airpark is located east of Grass Valley. The facility is a base for local personal and recreational flyers. The Airpark also serves as a transportation facility for business/corporate aviation and aerial fire-fighting operations. Based upon the July 1990 *Nevada County Airpark Master Plan* prepared by Hodges and Shutt, there were 160 based aircraft with 75,000 operations per year in 1989. Future upgrades of the facility are recommended in the Master Plan, and the 20-year forecast projects an increase in operations to 116,000 per year. Figure 10-5 shows the existing (1989) CNEL contours for the Nevada County Airpark, which are contained in the Master Plan.

FIXED NOISE SOURCES

The production of noise is a result of many industrial processes, even when the best available noise control technology is applied. Noise exposures within industrial facilities are controlled by Federal and State employee health and safety regulations (OSHA and Cal-OSHA), but exterior noise levels may exceed locally acceptable standards. Commercial, recreational and public service facility activities can also produce noise which affects adjacent sensitive land uses. These noise sources can be continuous and may contain tonal components which may be annoying to individuals who live in the nearby vicinity. In addition, noise generation from fixed noise sources may vary based upon climatic conditions, time of day and existing ambient noise levels.

From a land use planning perspective, fixed-source noise control issues focus upon two goals: to prevent the introduction of new noise-producing uses in noise-sensitive areas, and to prevent encroachment of noise sensitive uses upon existing noise-producing facilities. The first goal can be achieved by applying noise level performance standards to proposed new noise-producing uses. The second goal can be met by requiring that new noise-sensitive uses in near proximity to noise-producing facilities include mitigation measures to ensure compliance with noise performance standards.

Fixed noise sources which are typically of concern include but are not limited to the following:

HVAC Systems	Cooling Towers/Evaporative Condensers
Pump Stations	Lift Stations
Emergency Generators	Boilers
Steam Valves	Steam Turbines
Generators	Fans
Air Compressors	Heavy Equipment
Conveyor Systems	Transformers
Pile Drivers	Grinders
Drill Rigs	Gas or Diesel Motors
Welders	Cutting Equipment
Outdoor Speakers	Blowers
Chippers	Cutting Equipment
Loading Docks	Amplified music and voice

The types of uses which may typically produce the noise sources described above include, but are not limited to: wood processing facilities, pump stations, industrial facilities, trucking operations, tire shops, auto maintenance shops, metal fabricating shops, shopping centers, drive-up windows, car washes, loading docks, public works projects, batch plants, bottling and canning plants, recycling centers, electric generating stations, race tracks, landfills, sand and gravel operations, and athletic fields.

Discussions with the City of Grass Valley planning staff indicate that noise complaints within the City of Grass Valley have generally been confined to three types of noise sources. The noise sources which have generated noise complaints include car washes, delivery trucks and construction activities.

CHEVRON CAR WASH

The one specific noise source which the City staff identified as eliciting noise complaints included the Chevron Station car wash which is located at East Main Street and Idaho Maryland Mine Road. The car wash operates 24-hours per day, and has been a source of noise complaints from residences in close proximity. Primarily during the nighttime period when noise due to roadway traffic along SR 49 is low, the noise levels due to car wash operations become more apparent and noticeable.

Noise level measurements were conducted of car wash operations on August 13, 1998. The noise level measurements were conducted from a distance of 50 feet from the entrance to the car wash. Major noise sources associated with the car wash included the automatic wash and dry cycles. The blowers associated with the drying cycle of the car wash are the dominant noise source. Noise levels associated with operation were approximately 78 dB L_{max} and 89 dB SEL for each wash and dry cycle. Assuming that a maximum of 8 operations (4 wash only cycles and 4 wash & dry cycles) occur during a busy hour indicates that the distances to the 50 and 55 dB L_{eq} noise level contours are approximately 160 and 90 feet respectively from the entrance/exit of the car wash.

NORTH STAR QUARRY

The North Star Quarry is located east of SR 49 on Idaho-Maryland Mine Road. The North Star Quarry is a rock and gravel mining operation. Noise sources associated with the operation include truck traffic to and from the site, excavation of resource material with a CAT D-8 dozer, loading of aggregate material with CAT 966 & 988 wheel loaders, and processing equipment which include a jaw crusher, roll crusher and deck screen.

Brown-Buntin Associates, Inc conducted an analysis of noise impacts associated with the operations of the North Star Quarry in June 1992. The analysis indicated that the distance to the 50 and 55 dB hourly L_{eq} noise level contours is approximately 900 feet and 500 feet respectively from the center of the excavation area. The distance to the 60 dB L_{dn} noise level contour is approximately 160 feet from the center of the excavation area. Review of current operations at the quarry indicate that they have not changed significantly from the operations used in the analysis which was conducted in 1992.

TRUCK DELIVERY AND LOADING DOCK NOISE

Loading dock and truck delivery operations generally occur at most commercial and industrial type uses. The types of uses include, but are not limited to, supermarkets, hardware supply stores and "big box" stores such as K-Mart, Target, Costco, etc.

Noise level measurement data collected for various loading docks within the Sacramento and Visalia areas indicate that typical busy loading docks with semi truck arrivals and departures, unloading activities, semi truck passbys on the service roads, and step-side type delivery trucks will produce an average hourly noise level of 60 dB L_{eq}, and a maximum noise level of approximately 82 dB at a distance of 50 feet from the loading dock. Generally, the maximum noise levels are due to heavy truck passbys on the service road and the sudden discharge of air from the air brakes. Overall hourly average noise levels are due to all activities including arrivals and departures of trucks, revving of engines, and activities on the loading docks.

Residential uses located adjacent to loading docks can be exposed to noise levels which may be considered annoying. Loading docks generally experience use between 3 and 4 hours out of a day. When using a 60 dB L_{dn} noise level standard, the noise from loading docks would not be considered to be a major noise source, with the 60 dB L_{dn} contour located approximately 20 feet from the loading dock or service road. However, the 50 dB hourly L_{eq} noise level contour is located approximately 150 feet from the loading dock.

CONSTRUCTION NOISE

During the construction phases of any large commercial, industrial or municipal project, noise from construction activities can dominate the noise environment in the immediate area. Activities involved in construction will generate noise levels, as indicated in Table 10-3, ranging from 70 to 90 dB at a distance of 50 feet. Construction activities can be temporary in nature, but can also be long-term.

Construction typically occurs during normal working hours, although due to climatic conditions or impending changes in the season, extended working hours from early morning to late in the evening also can occur. Construction noise impacts could be significant, as nighttime operations or use of unusually noisy equipment could result in annoyance or sleep disruption for nearby residences.

TABLE 10-3 CONSTRUCTION EQUIPMENT NOISE	
Type of Equipment	Maximum Level, dBA at 50 feet
Scrapers	88
Bulldozers	87
Heavy Trucks	88
Backhoe	85
Pneumatic Tools	85

Source: *Environmental Noise Pollution*, Patrick R. Cunniff, 1977.

It is difficult to determine the location of a noise contour associated with construction activities due to the variations in types of equipment, number of pieces of equipment and the hours of operation. Therefore, the noise levels shown in Table 10-3 only indicate the maximum noise levels.

COMMUNITY NOISE SURVEY

A community noise survey was conducted to document noise exposure in areas of the City containing noise sensitive land uses. For that purpose, noise sensitive land uses in the City of Grass Valley Planning Area were considered to include residential areas, parks and schools. Noise monitoring sites were selected to be representative of typical residential conditions in the City. Short-term noise monitoring was conducted at three sites on August 12, 1998. Each site was monitored three different times during the day and night so that valid estimates of CNEL could be prepared. Three continuous hourly noise monitoring sites were established in the City of Grass Valley as part of the General Plan Update to record day-night statistical noise level trends. The noise level measurements were conducted between August 13 and August 17, 1998. The data collected included the L_{eq}, the maximum level during the measurement period (L_{max}) and other statistical descriptors. Noise monitoring sites, measured noise levels, and the measured and estimated CNEL values at each site are summarized in Table 10-4.

Community noise monitoring systems were calibrated with acoustical calibrators in the field prior to use. The systems comply with all pertinent requirements of the American National Standards Institute (ANSI) for Type I sound level meters.

The community noise survey results indicate that typical noise levels in noise sensitive areas of the City of Grass Valley Planning Area are in the range of 46.9 dB to 68.9 dB CNEL. Traffic on State and local roadways, industrial activities, aircraft overflights and neighborhood activities are the controlling factors for background noise levels in the majority of the Planning Area. In general, most areas of the City of Grass Valley which contain noise sensitive uses are moderately quiet to noisy, and are representative of an urban environment. Some residential areas have outdoor activity areas directly exposed to major noise sources such as State Route 49 and existing industrial areas. Noise exposure at some of those residences may be considered in excess of generally acceptable noise exposure criteria.

The L_{eq} values in Table 10-4 represent the average measured noise levels during the sample periods. The L_{eq} values were the basis of the estimated CNEL values. The L_{max} values show the maximum noise levels observed during the samples. The L_{50} and L_{90} values represent the noise levels exceeded 50 percent and 90 percent of the time during the sample period.

The continuous monitoring data are shown graphically and are contained within Appendix A. The graphs show that ambient noise levels generally reach a minimum during the hours of 12:00 a.m. to 5:00 a.m., increasing during the daytime hours as a function of increased traffic and other human activities

TABLE 10-4
SUMMARY OF MEASURED NOISE LEVELS AND ESTIMATED DAY-NIGHT AVERAGE LEVELS (L_{dn}) IN AREAS CONTAINING NOISE SENSITIVE LAND USES

Site	Location	Time Period	Sound level, dB				
			L_{eq}	L_{50}	L_{90}	L_{max}	Estimated CNEL
1	Memorial Park at Oak Street	**8/12/98**					**55.6**
		11:00 a.m.	51.2	50	46	60.2	
		7:25 p.m.	50.0	49	47	57.5	
		10:20p.m.	48.4	45	43	56.4	
2	Condon Park	**8/12/98**					**51.5**
		11:30 a.m.	48.5	47	44	54.9	
		8:10 p.m.	47.5	47	44	56.0	
		11:15 p.m.	43.5	41	40	49.5	
3	Sierra College at Robert Ross Way	**8/12/98**					**46.9**
		12:30 p.m.	42.8	43	41	51.2	
		8:45 p.m.	42.3	41	40	50.1	
		11:50 p.m.	39.4	38	36	44.7	
4*	Corner of Broadview & Hill	**8/13-14/98**					**48.3**
		Ld	44.6			67.9	
		Le	43.0			62.9	
		Ln	40.9			57.1	
		8/15/98					**51.2**
		Ld	48.2			69.8	
		Le	46.1			65.7	
		Ln	43.4			60.0	
5*	312 Marshall	**8/13-14/98**					**68.9**
		Ld	66.8			76.7	

TABLE 10-4
SUMMARY OF MEASURED NOISE LEVELS AND ESTIMATED DAY-NIGHT AVERAGE LEVELS (L_{dn}) IN AREAS CONTAINING NOISE SENSITIVE LAND USES

Site	Location	Time Period	Sound level, dB				
			L_{eq}	L_{50}	L_{90}	L_{max}	Estimated CNEL
		Le	64.4			72.6	
		Ln	60.6			71.9	
		8/15/98					**68.6**
		Ld	66.5			85.7	
		Le	64.7			78.3	
		Ln	60.1			73.7	
6*	888 Freeman	**8/13-14/98**					**51.4**
		Ld	45.2			63.3	
		Le	45.1			69.0	
		Ln	44.6			53.3	
		8/15/98					**54.9**
		Ld	45.5			65.8	
		Le	45.8			57.1	
		Ln	45.1			59.9	

* = Continuous Monitoring Site
Ld = Measured noise level during daytime hours (7:00 a.m. – 7:00 p.m.)
Le = Measured noise level during the evening hours (7:00 p.m. – 10:00 p.m.)
Ln = Measured noise level during nighttime hours (10:00 p.m. – 7:00 a.m.)

Source: Brown-Buntin Associates, 1998