7. NOISE ELEMENT

A. Introduction

The primary purpose of a general plan noise element is to clarify policies and standards by which the local government can limit the exposure of the community to excessive noise levels. Technical data relating to mobile and fixed sources is collected into a set of noise control policies and programs. The policies of the element are to be used as a basis for land use decisions.

The Mt. Shasta General Plan Noise Element is intended to be used to guide decisions concerning land use and the location of new roads and transit facilities, since these are common sources of excessive noise. Noise from existing land uses, including mining, agricultural, and industrial activities, must be closely analyzed to ensure compatibility, especially where residential and other sensitive receptors have encroached into areas previously occupied by these uses.

Noise sources in the Mt. Shasta Planning Area include traffic on major roadways and highways, railroad operations, and fixed noise sources. Noise modeling techniques and noise measurements were used to develop generalized "Ldn" (average day/night sound level) noise contours for the existing conditions of these sources. Noise contours are used as a guide for establishing a land use pattern that minimizes the exposure of residents to noise. 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 and will need to be adjusted for site-specific factors.

Acoustical Terminology and Noise Fundamentals

Discussion of noise issues requires the use of technical terminology. Following is a list of frequently used terms.

Acoustics The science of sound.

Ambient Noise The distinctive acoustical characteristics of a given area consisting of all noise sources audible at that location. In many cases, the term ambient is used to describe an existing or pre-project condition such as the setting in an environmental noise study.

Attenuation The reduction of noise.

A-Weighting A frequency-response adjustment of a sound level meter that conditions the output signal to approximate human response.

Decibel, or dB	The fundamental measurement unit of sound, defined as ten times the logarithm of the ratio of the sound pressure squared over the reference pressure squared.
CNEL	Community Noise Equivalent Level. Defined as the 24-hour average noise level with noise occurring during evening hours (7-10 p.m.) weighted by a factor of three and nighttime hours weighted by a factor of 10 prior to averaging.
Frequency	The measure of the rapidity of alterations of a periodic acoustic signal, expressed in cycles per second or Hertz.
Ldn	Day/Night Average Sound Level. Similar to CNEL, but with no evening weighting.
Leq	Equivalent or energy-averaged sound level.
Lmax	The highest root-mean-square (RMS) sound level measured over a given period of time.
Loudness	A subjective term for the sensation of the magnitude of sound.
Noise	Unwanted sound.

Noise is often described as unwanted sound. Sound is defined as any pressure variation in air that the human ear can detect. If the pressure variations occur frequently enough (at least 20 times per second), they can be heard and hence are called sound. The number of pressure variations per second is called the frequency of sound. Measurements of frequency are expressed as cycles per second, called Hertz (Hz).

Measuring sound directly in terms of pressure would require a very large and awkward range of numbers. To avoid this, the decibel scale was devised. The decibel scale uses the hearing threshold (20 micropascals), 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. 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 7-1 shows examples of noise levels for several common noise sources and environments.

The perceived loudness of sounds is dependent upon many factors including sound pressure level and frequency content. However, within the usual range of environmental noise levels, perception of loudness is relatively predictable and can be approximated by weighing the frequency response of a sound level meter by means of the standardized "A-weighting" network. There is a strong correlation between A-weighted sound levels (expressed as dBA) and community response to noise. For this reason, the A-weighted sound level has become the standard tool of environmental noise assessment. All noise levels reported in this document are in terms of A-weighted levels.

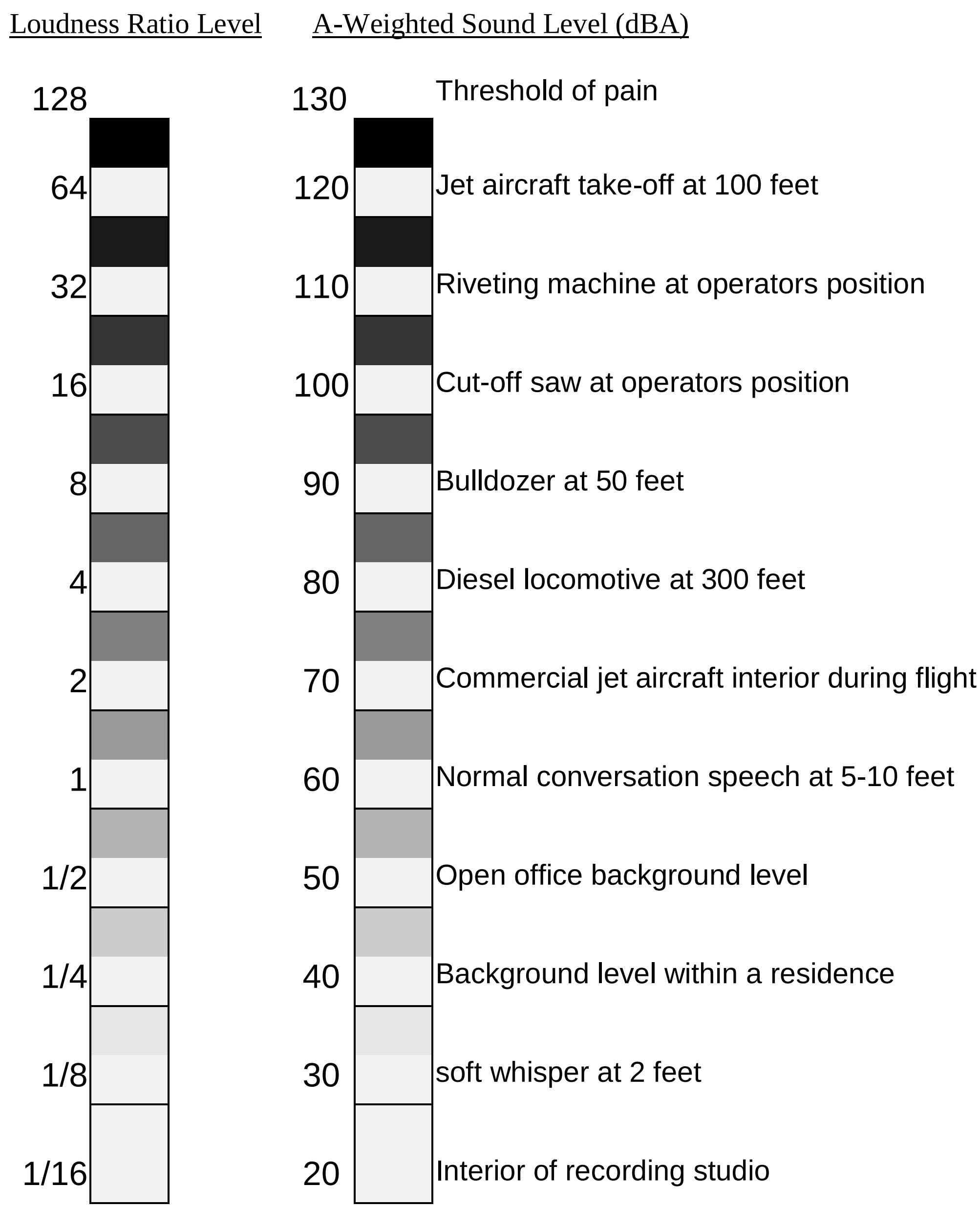
Community noise is commonly described in terms of the "ambient" noise level, which is defined as the all-encompassing noise level associated with a given noise environment. A common statistical tool to measure the ambient noise level is the average, or equivalent, sound level (Leq). This corresponds 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 Leq is the foundation of the composite noise descriptor, Ldn, and has very good correlation with community response to noise.

The Day-Night Average Level (Ldn) is based upon the average noise level over a 24-hour day, with a +10 decibel weighing applied to noise occurring during nighttime (10:00 p.m. to 7:00 a.m.) hours. The nighttime penalty is based upon the assumption that people react to nighttime noise exposures as though they were twice as loud as daytime exposures. Because Ldn represents a 24-hour average, it tends to disguise short-term variations in the noise environment.

Excessive noise in a community has often been cited as being a health problem, not necessarily in terms of actual physiological damages such as hearing impairment but in terms of inhibiting general well-being and contributing to undue stress and annoyance. The health effects of noise in a community arise from interference with human activities such as sleep, speech, recreation and tasks demanding concentration or coordination. When community noise interferes with human activities or contributes to stress, public annoyance with the noise source increases and the acceptability of the environment for people decreases. This decrease in acceptability and the threat to public well-being is the bases for land use planning policies that limit exposure to excessive community noise levels.

To control noise from fixed sources that have developed from processes other than zoning or land use planning, many jurisdictions have adopted community noise control ordinances. Such ordinances are intended to abate noise nuisances and to control noise from existing sources. They may also be used as performance standards to evaluate the creation of a potential nuisance, or potential encroachment of sensitive uses upon noise-producing facilities. Community noise control ordinances are generally designed to resolve noise problems on a short term basis (usually by means of hourly noise level criteria), rather than on the basis of 24-hour or annual cumulative noise exposures.

Figure 7-I
Typical A-Weighted Sound Levels of Common Noise Sources



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, droning or high pitched sounds may be more annoying than the A weighted sound level alone suggests. Many noise standards apply a penalty, or correction, of 5 dBA to such sounds. The effects of unusual tonal content are generally more of a concern at nighttime when residents may notice the sound in contrast to low levels of 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 that 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 loss of "peace and quiet" is the inevitable result of land use or activity changes in such areas. Audibility of a new noise source and/or increases in noise levels within recognized acceptable limits are not usually considered to be significant noise impacts, but these concerns should be addressed and considered in planning and environmental review processes.

B. Fixed-Noise Sources

Three primary noise source categories are recognized in this Noise Element. They are: 1) Fixed-Noise Sources; 2) Roadway Noise; and 3) Railroad Noise.

The production of noise from stationary, or “fixed-noise” sources is often associated with industrial facilities. Noise exposures within industrial facilities are controlled by federal and state employee health and safety regulations (OSHA and Cal-OSHA). Exterior noise, however, is a concern that falls within the jurisdiction of local agencies.

Commercial businesses, recreational sites, public works operations and construction activity may also produce noise that affects adjacent sensitive land uses. These noise sources can be frequent or continuous and may be annoying to individuals who live in the vicinity. Noise generated from fixed noise sources may vary due to climatic conditions, time of day, and existing ambient noise levels.

From a land use planning perspective, fixed-source noise control issues focus upon two general goals: 1) the prevention of the introduction of new noise-producing uses in noise-sensitive areas; and 2) the prevention of the encroachment of noise sensitive uses upon existing noise-producing facilities. The first goal can be achieved by applying noise performance standards to proposed new noise-producing uses. The second goal can be met by preventing the encroachment of noise sensitive uses through zoning and special permit requirements, and by requiring that new noise-sensitive uses in proximity to noise-producing facilities include effective attenuation measures to ensure compliance with noise performance standards.

There are three primary areas within and near the City of Mt. Shasta that have light industrial and commercial uses. The three areas include: 1) the area adjacent to North Mt. Shasta Boulevard between its intersection with Chestnut Street and the Mt. Shasta City Park; 2) the south end of Ream Avenue located near the intersection of Ream Avenue and Court Street; and 3) the south side area adjacent to Mt. Shasta Boulevard. In addition, the Sousa Ready Mix facilities at the north end of the City have been identified as sources of fixed noise.

North Mt. Shasta Boulevard

The commercial area along North Mt. Shasta Boulevard generally north of Chestnut Street is comprised largely of heavier commercial land uses that include petroleum product sales, automotive service and repair, tire and automotive supply, and similar uses. Typical noise sources associated with these land uses include, but are not limited to, truck traffic, HVAC systems (i.e., heating, ventilation, and air conditioning systems), tire breakers, impact wrenches and compressors.

The majority of the businesses in this area operate during the daytime hours. The noise environment in this area is largely dominated by local roadway and railroad traffic. Typically, single event noise levels associated with truck movements range between 70 and 85 dB SEL at a distance of 75 feet. Data for maximum noise levels associated with air impact wrenches and tire breakers are approximately 89 dB and 105 dB, respectively, at a distance of 10 feet.

South Ream Commercial Area

The South Ream Avenue area is comprised primarily of trucking facilities. Noise sources associated with the operation of these facilities include truck traffic, HVAC systems and refrigeration trucks. These facilities typically operate during the daytime hours. However, the refrigeration trucks have compressors that may operate 24 hours per day and are often the subject of complaints. Sound level measurements of refrigeration trailer compressors have indicated continuous noise levels of 64 dB measured at a distance of 50 feet from the trailers.

South Commercial and Industrial Area

This mixed-use area is off and to the east of South Mt. Shasta Boulevard, generally between Bear Springs Road and Church Street. It includes the City's Public Works Yard, an automotive repair and body shop, a contractors yard, the recycling center operated by the Siskiyou Opportunity Center, and other commercial uses. Noise associated with the Public Works Yard is primarily related to the movement of heavy equipment. However, these activities are infrequent and intermittent.

The recycling center operated by the Siskiyou Opportunity Center is located at the corner of Mt. Shasta Boulevard and Bear Springs Road. Major noise sources associated with operation of the recycling center include the operation of equipment, the handling and loading of aluminum cans and glass, and the operation of saws for recycling lumber. The Opportunity Center has a building to house its recycling equipment and provide shielding of noise from the recycling operation.

Across Mt. Shasta Boulevard and Church Street from this area is the site known as the Roseburg Commerce Park. Future development of the Roseburg property is expected to be mixed-use with commercial, light industrial and residential uses. Mixed-use development of the property will require careful attention to related noise impact issues to ensure land use compatibility.

Sousa Ready Mix

The Sousa Ready Mix plant is located at 100 Upton Road, outside of the city limits on the west side of Interstate 5 between the highway and the Union Pacific Railroad tracks. Sousa Ready Mix provides sand, aggregate and ready-mix concrete products. The Upton facility contains the operation's concrete batch plant and crushing, screening and washing facilities. Typical noise sources associated with the plant operation that can be heard within the city limits include the sound of heavy trucks, front loaders, back-up warning devices, conveyor belt systems, air vibrators that shake material from hoppers into trucks, and the sound of sand and gravel on metal as trucks are being loaded. The noise environment in the area of the plant is dominated by the fairly constant noise of highway traffic on Interstate 5 and periodic noise from trains on the railroad.

The Spring Hill Mine, also owned by Sousa Ready Mix, is 98 acres in size, located at the northern-most portion of the City. The permit to mine the site was approved in 1980 when the site was located outside the city limits. The property was annexed to the City soon after the mining operation began. Excavated aggregate is hauled by dump truck from the mine on a private road to Abrams Lake Road and across Interstate 5 to the Upton site. Excavation of aggregate involves the use of a variety of heavy equipment including scrapers, loaders, dump trucks, dozers, and water trucks. Portable crushing and screening plants have been used at the mine to process aggregates. Most of the work at the mine is conducted during the summer months.

The operators of the aggregate mine have expressed concern that encroachment of residential and certain types of commercial uses near their facilities may increasingly impose constraints to the operation, largely because of the noise that is characteristic of the operation. The Mt. Shasta General Plan Open Space/Conservation Element, in addressing Mineral Resources, acknowledges the need to protect the economic viability of existing mining and material processing operations (e.g., Goal OC-6) and supports provisions by the City to avoid the development of "noise sensitive" uses (e.g., residences, hotels and motels) near such operations.

Parks and School Playing Fields

Parks and school playgrounds and playing fields, while being very different in character from industrial and heavy commercial uses, may also be considered to be fixed-noise sources. There are several park and school uses within the Mt. Shasta city limits. The level of noise generated by these uses depends on the age and number of people utilizing the respective facility at a given time, and the types of activities they are engaged in. School playing field activities tend to generate more noise than those of neighborhood parks, as the intensity of school playground usage tends to be much higher. At a distance of 100 feet from an elementary school playground being used by 100 students, average noise levels of 60 dB can be expected and maximum noise levels of 75 dB are common. At organized events such as high school football games with large crowds and public address systems, the level of noise generated is often significantly higher.

A particular issue concerning noise related to parks and recreation has been the Siskiyou Ice Rink, located at Shastice Park. The park and ice rink are managed by the Mt. Shasta Recreation and Parks District. The ice rink was built in the fall and winter of 1999/2000 and operated briefly in the late winter of 2000. The ice rink has been the subject of complaints and legal action from certain residents in the vicinity of the park concerning noise and indirect impacts claimed to be related to noise (e.g., affected property values). In fact, the ice rink did not operate in the year following first-phase construction due to legal action against it, but seasonal use of the rink was able to be resumed following further environmental impact studies, clarification of design plans and resolution of related issues. Along with the typical noise of a playground (human voices shouting, etc.), ice rinks generate additional noise from operation of chiller units and a "zamboni" vehicle used to resurface ice in the skating area. Music is also often played through outdoor speakers. Various environmental studies were completed for the facility including an Initial Study and Mitigated Negative Declaration in 2001. Design and other mitigation measures were incorporated into the ice rink facility to reduce the level of noise impact in the neighborhood.

C. Roadway Noise

Traffic noise levels for existing and future traffic volumes were calculated for the Planning Area. The Federal Highway Administration (FHWA) Highway Traffic Noise Prediction Model was used to develop Ldn contours for all state highways and major arterial roadways in the Mt. Shasta area. Distances from the centerlines of selected roadways to the 60 and 65 dB Ldn contours are summarized in **Table 7-1, Roadway Noise Contour Date**. **Figure 7-2** illustrates the projected locations of the 60 dB Ldn future roadway noise contours. "Existing" conditions are for the year 2006 and "Future" conditions are projected for the year 2026.

The curve of a road, its steepness, and factors such as topography or a depressed road, and even buildup can affect how loud noise is perceived. The distances reported in **Table 7-1** are estimates of noise exposure along roadways in the City of Mt. Shasta based on samples and modeling. Traffic noise contours were not developed for every roadway in the planning area, only arterials and collectors.

A general plan provides broad guidance to address noise impacts. The intent of the generalized roadway noise contours listed in Table 7-1 and, concerning Interstate 5 and State Highway 89, shown graphically in Figure 7-2 is to illustrate the potential for conflicts between traffic noise levels and potential noise-sensitive receivers within the identified noise contours. The noise contours for Interstate 5 and Highway 89 portrayed in Figure 7-2 are projected for the year 2026. In areas where noise exposure may be significant, the effects of site-specific factors need to be evaluated and considered from more precise on-site noise measurements. For example, the 1993 General Plan recognized that, in some areas along Interstate 5, the actual noise levels associated with traffic on the highway ranged between 4.2 and 7.3 dB less than the noise levels predicted by the FHWA Model at certain measurement points. The actual measurements were influenced by the topography around the site. In some areas through the City, Interstate 5 is situated lower than the surrounding area and, therefore, adjacent properties may be shielded to some extent from traffic noise.

D. Railroad Noise

Railroad activity in the City of Mt. Shasta planning area includes freight and Amtrak activity on the Union Pacific Railroad (UPRR) tracks and occasional freight and excursion train activity on the tracks owned by the McCloud Railway Company. The UPRR line runs generally north/south through the planning area. Various land uses, including residential uses, are located adjacent to the railroad tracks. The McCloud Railway Company line extends east from its junction with the UPRR line to the town of McCloud.

Approximately 16 freight trains and two Amtrak trains operate daily on the UPRR tracks through the planning area. Freight train operations occur throughout the day and nighttime periods. The Amtrak trains come through the planning area primarily in the early morning hours.

The McCloud Railway Company averages approximately two trains a week in the City of Mt. Shasta.

The major noise sources associated with train operations in the City of Mt. Shasta are the locomotive engines and warning horns. There are a total of seven at-grade railroad crossings within the City of Mt. Shasta. Five are located along the Union Pacific line. Two crossings are on Nixon Street, and there are crossings at Alma Street, Lake Street and Ream Avenue. All five UPRR crossings are gated. There are two at-grade crossings for the McCloud Railway Company line: one for Everitt Memorial Highway and one for North Mt. Shasta Boulevard.

Table 7-1
Roadway Noise Contour Data

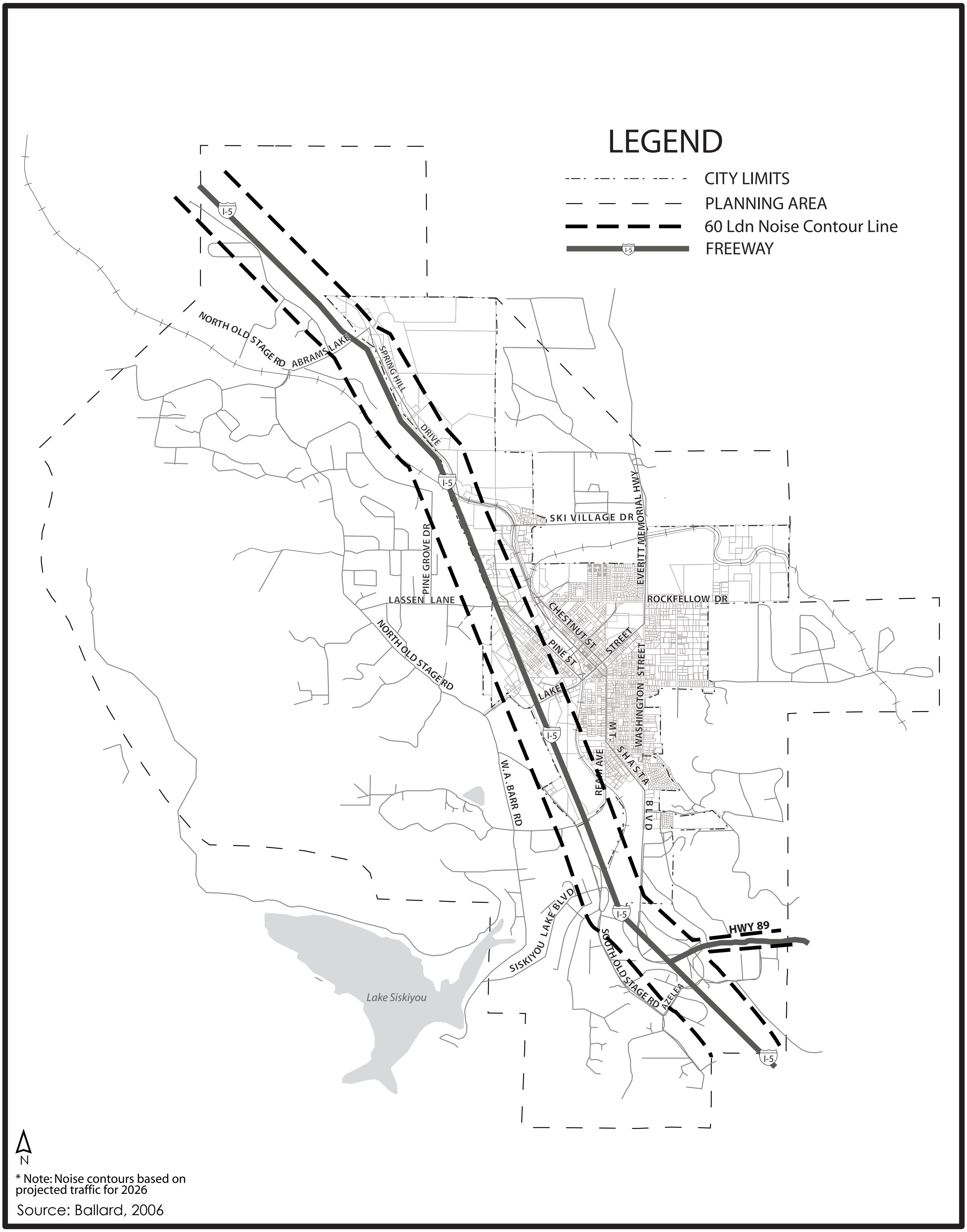
Seg. No.	Description	Existing*		Future*	
		60 dB	65 dB	60 dB	65 dB
Interstate 5:					
1	South of S.R. 89	990	459	1238	575
2	S.R. 89 to Lake Street	986	458	1234	573
3	Lake Street to N. Mt. Shasta Interchange	999	464	1250	580
4	N. Mt. Shasta Interchange to Abrams Lake Road	1037	481	1298	602
5	North of Abrams Lake Road	1021	474	1277	593
State Route 89:					
6	South of Interstate 5	263	122	330	153
Mt. Shasta Boulevard:					
7	Spring Hill Dr. to Nixon Road	63	29	87	40
8	Nixon Rd. to Alma Street	61	29	79	37
9	Alma St. to Lake Street	64	30	77	36
10	Lake St. to Chestnut Street	67	31	78	36
11	Chestnut St. to McCloud Avenue	78	36	94	44
12	McCloud Ave. to Old McCloud Road	71	33	84	39
13	South of Old McCloud Road	63	29	76	35
Alma Street:					
14	East of Pine Street	60	28	72	33
15	West of Pine Street	42	19	50	23
Pine Street:					
16	North of Alma Street	59	27	66	31
17	South of Alma Street	55	26	57	26
Morgan Way:					
18	South of W. Lake Street	36	17	42	20
W Lake Street:					
19	East of Morgan Way	81	38	90	42
20	West of Morgan Way	81	38	89	41
Rockfellow Drive:					
21	East of Everitt Memorial Hwy	25	12	31	14
22	West of Everitt Memorial Hwy	44	20	50	23
Everitt Memorial Hwy					

Table 7-1
Roadway Noise Contour Data

Seg. No.	*Description*	*Existing**		*Future**	
		60 dB	*65 dB*	*60 dB*	*65 dB*
23	North of Rockfellow Drive	57	27	70	32
N. Washington Dr.					
24	South of Rockfellow Drive	49	23	59	27
Ream Ave.					
25	East of Old Stage Coach Road	25	11	28	13
26	West of Old Stage Coach Road	14	7	14	7
Old Stage Coach Rd.					
27	North of Ream Avenue	21	10	25	11
28	South of Ream Avenue	24	11	30	14
Chestnut St.					
29	East of Mt. Shasta Boulevard	21	10	26	12
30	West of Mt. Shasta Boulevard	15	7	15	7
McCloud Ave.					
31	East of Mt. Shasta Boulevard	41	19	49	23
Old McCloud Rd.					
32	East of Mt. Shasta Boulevard	22	10	23	11
33	West of Mt. Shasta Boulevard	21	10	21	10

- Distance (in feet) from center of roadway to Ldn contours. "Existing" conditions are for the year 2006 and "Future" conditions are projected for the year 2026.

Source: FHWA-RD-77-108 with inputs from kdAnderson Transportation and Caltrans.



* Note: Noise contours based on projected traffic for 2026

Source: Ballard, 2006

Figure 7-2
Interstate 5 and State Route 89 Noise Contours

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Both McCloud Railway crossings are "passive" and are equipped with flashing lights and bells but no gates.

Noise from UPRR trains have an impact on the sound environment in the City of Mt. Shasta, especially in the vicinity of the tracks. When a train is passing, normal conversation can be difficult in buildings with open windows and without adequate noise insulation near the tracks. Noise level measurements have been conducted to determine the contribution of UPRR railroad operations to the noise environment. Noise levels were measured to determine typical sound exposure levels (SEL). The results of the railroad noise measurements for the UPRR line are shown in **Table 7-2.**

Table 7-2
Union Pacific Railroad Noise Measurement Results

Measurement Location	*# of Daily Trains*	*Noise Level (dB) @100 feet*	
		Mean SEL	*Lmax*
Near Intersection of I-5 and UPRR Tracks	18	102.5	75 - 110

Measurements taken August 14-15, 2006. Bollard Acoustical Consultants, Inc.

For the purposes of the General Plan Noise Element, it is useful to estimate the generalized distances of the 60 and 65 dB Ldn noise contours for each of the railroad tracks within the City. **Table 7-3** indicates the approximate width of the noise contours associated with the two railroad operations within the City. **Figure 7-3** illustrates the general 60 dB Ldn noise contours associated with the two railroad tracks.

Table 7-3
Approximate Distance to Railroad Noise Contours

Train	*Ldn dB, 100 feet from tracks*	*Distance to Ldn Contour (feet)*	
		60 dB	*65 dB*
Union Pacific Railroad	72.1	631	293
McCloud Railway Co.	51.9	30	14

Source: Bollard Acoustical Consultants, Inc., 2006, City of Mt. Shasta General Plan, 1993.

The Safety Element of this general plan discusses street-rail crossings from the perspective of public safety. The issue is also very much related to noise concerns because nearly all warning devices at the crossings involve loud warning signals. A warning provided by a train's horn is required as a train approaches both at-grade crossings with active warning devices and crossings with "passive" warning measures. The impacts of noise from train horns as trains approach street crossings has raised two particular issues concerning public safety and related noise impacts to neighborhoods around the crossings. These issues are 1) the alternative use of "wayside horns", and 2) the establishment of "quiet zones".

As noted in the Safety Element, locomotives typically sound their horns at least 15 seconds before the locomotive enters a public highway at-grade crossing. The intent is to sound the horn loud enough and timely for a vehicle on the street approaching the crossing to hear the horn. With the objective of the warning having a sound level of 95 dB(A) at the "motorist decision-making point" 50 feet in advance of the grade crossing, the Federal Railway Administration (FRA) has determined that 108 dB(A) is the optimal sound level for locomotive horns (Federal Railroad Administration, 2005). A horn sound level of 110 dB(A) is the maximum and 96 dB(A) is the minimum sound level. However, such a warning exposes a considerable segment of the local community near the tracks to the sound of the horn, in addition to motorists and pedestrians, as intended, who may be approaching the crossing.

Wayside horns have been proposed in some communities as one alternative to the use of locomotive horns at some crossings. A wayside horn is a stationary horn mounted at a grade crossing and is aimed up and down the street on which vehicles would be approaching the crossing. Wayside horns may be used in lieu of a locomotive horn at highway-rail grade crossings equipped with an active warning system consisting of, at a minimum, flashing lights and gates. The FRA has determined that a wayside horn set to 92 dB(A) (as measured 100 feet from the centerline of the railroad track) would provide an audible warning comparable to a properly sounded locomotive horn (FRA, 2005). In terms of noise impacts, the advantage of the wayside horn is that the warning is focused more directly toward the motorists and pedestrians approaching the crossing with less imposing noise impacts, as occurs with locomotive horns, on residential and commercial districts along the tracks near the crossing.

The second issue concerning public safety and noise related to railroad grade crossings is the issue of establishing "quiet zones". A quiet zone is a section of track approaching a railroad grade crossing in which trains do not need to and, in fact, are prohibited from sounding their horns. The train horns are rendered unnecessary only when other safety measures approved by the FRA provide an acceptable level of safety with the absence of locomotive horns. An FRA rule effective in June 2005 provides an opportunity for localities to establish quiet zones (i.e., *Final Rule on the Use of Locomotive Horns at Highway-Rail Grade Crossings).* To qualify for creation of a quiet zone, communities must equip proposed grade crossings with adequate safety measures to overcome the decrease in safety that would result from silencing the train horns. Quantifiable calculations must be made of the current "risk index" of the crossing with use of locomotive horns and the expected risk index without the horns but with supplementary safety measures.

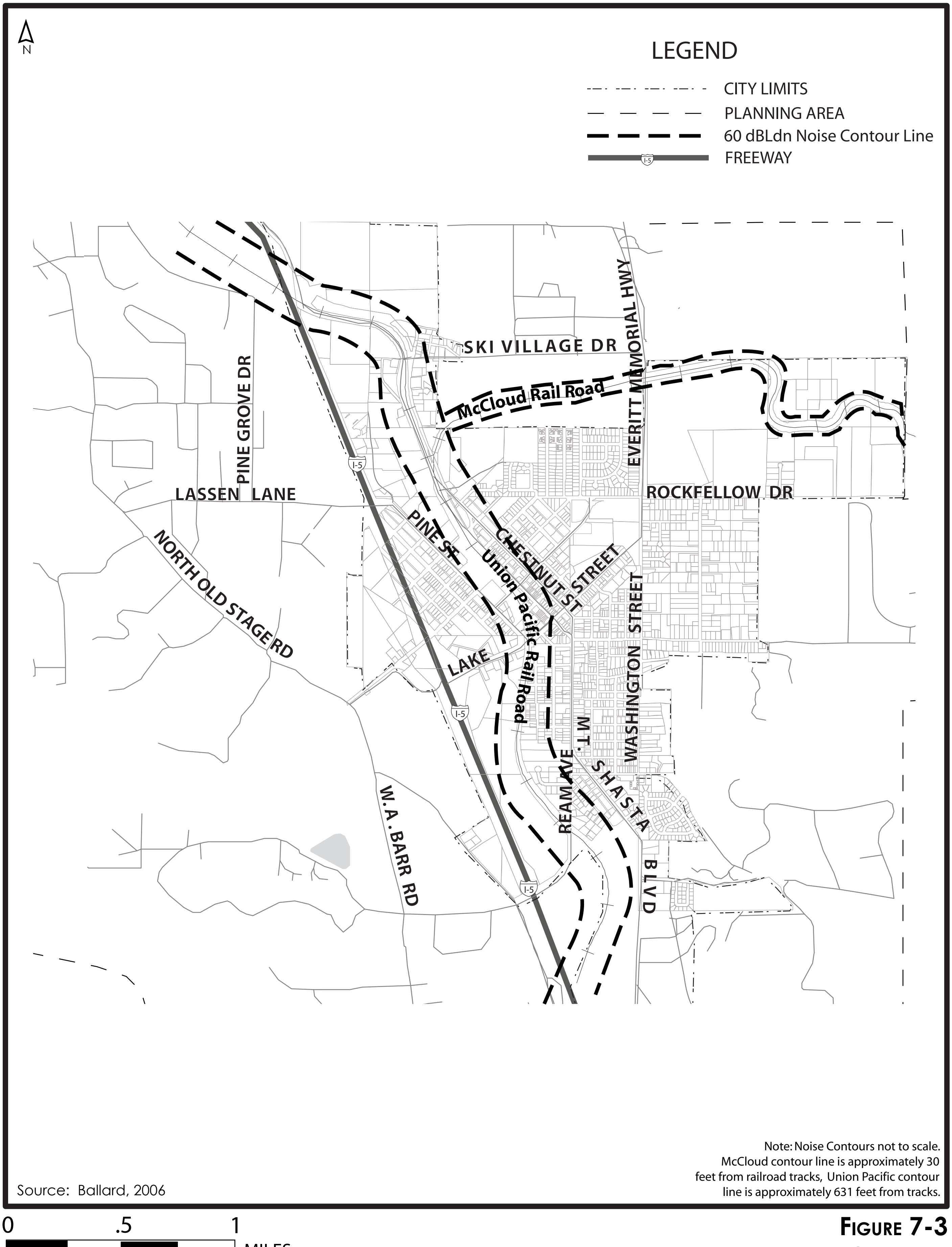

FIGURE 7-3
RAILROAD NOISE CONTOURS

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The FRA has outlined a list of Supplementary Safety Measures (SSMs) and Alternative Safety Measures (ASMs) that would be available to local jurisdictions that wish to reduce noise impacts in their communities. As provided in the Final Rule, communities have the sole discretion to designate a quiet zone if the recognized SSMs are used. Alternatively, a community may implement ASMs at some or all of the crossings within a quiet zone upon demonstrating the effectiveness of these measures to provide the acceptable level of public safety. The additional safety measures, which must meet federal specifications, usually must be constructed at the community's expense.

As a variation of a "quiet zone", communities may create "partial quiet zones". Such zones restrict locomotive horns sounding between the hours of 10 p.m. and 7 a.m. Outside of that time period, trains would use their horns as otherwise required for public safety.

The Safety Element expresses goals for maintaining public safety, but it also states that the City should look into reducing the impacts of noise related to railroad crossings. The Safety Element includes **Goal SF-7**: "Maintain adequate levels of public safety at street-rail grade crossings while, when possible, reducing noise impacts involved with warning systems". It follows this goal with **Policy SF-7.1:** "The City will consider the feasibility and means for modifying warning and control systems at selected street-rail grade crossings to reduce related noise impacts, provided that adequate public safety is provided." The related implementation measure is **Implementation Measure SF-7.1(a)**: "The City will consider the feasibility of establishing "quiet zones" and/or the use of wayside horns to reduce train horn noise impacts pursuant to the criteria of the Federal Railroad Administration. Determination to proceed with implementation will be based on the expected adequacy of public safety and cost feasibility."

E. Other Noise Sources

Mercy Medical Center in Mt. Shasta maintains a helipad on the hospital grounds. The hospital, however, is not a base station for a helicopter stationed on site. The closest base station for a medical helicopter is at the Weed Airport. Therefore, flights to and from Mercy Medical Center are less frequent than they would be if the site was being used as a base station. Flights are generally limited to the delivery or transport of emergency patients. The helipad is also occasionally used by the California Highway Patrol and during mountain rescue operations. No particular concerns have been noted regarding noise generated by typical use of the medical center helipad. (Greg Lippert, Senior Director of Support Services, Mercy Medical Center, personal communication, May 11, 2006.)

Community Noise Survey:

To quantify existing noise levels in the quieter parts of the City of Mt. Shasta, a community noise survey was performed at six locations that are removed from major noise sources. Two of the six locations were monitored over a continuous 24-hour period, while the other six locations were each monitored for 15-minute periods during daytime hours. The community noise survey noise measurement locations are shown on **Figure 7-4**. The results of the community noise survey are provided in **Table 7-4** and are shown graphically on **Figures 7-5 and 7-6**.

Table 7-4
Community Noise Survey

Site	*Location*	*Measured Sound Level, dBA*	
		Average (Leq)	*Maximum (Lmax)*
A	808 Mormon Way	44(Day), 43 (Night)	60(Day), 75 (Night)
B	Crossing of I-5 and UPRR	68 (Day), 71(Night)	95(Day),108 (Night)
C	Everitt Memorial Hwy. and Stellar Way	47	61
D	McCloud Avenue and Eagle Nest Road	44	63
E	Wyehka Way	40	56
F	North end of Spring Hill Drive	45	56

Source: Bollard Acoustical Consultants, Inc., August 11, 2006. See Figure 7.4 for locations.

F. Criteria for Acceptable Noise Exposure

1. Background

The State Office of Planning and Research (OPR) Noise Element Guidelines include recommended exterior and interior noise level standards for local jurisdictions to identify and prevent the creation of incompatible land uses due to noise. The OPR guidelines contain a land use compatibility table that describes the compatibility of different land uses with a range of environmental noise levels in terms of Ldn. A noise environment of 60 dB Ldn or less is considered to be normally acceptable for residential uses according to those guidelines.

The U.S. Environmental Protection Agency (EPA) also offers guidelines for community noise exposure in the publication "Information on the Levels of Environmental Noise Requisite to Protect Public Health and Welfare with an Adequate Margin of Safety". These guidelines consider occupational noise exposure as well as noise exposure in the home. The "Levels Document" recognizes an exterior noise level of 55 dB Ldn as a goal to protect the public

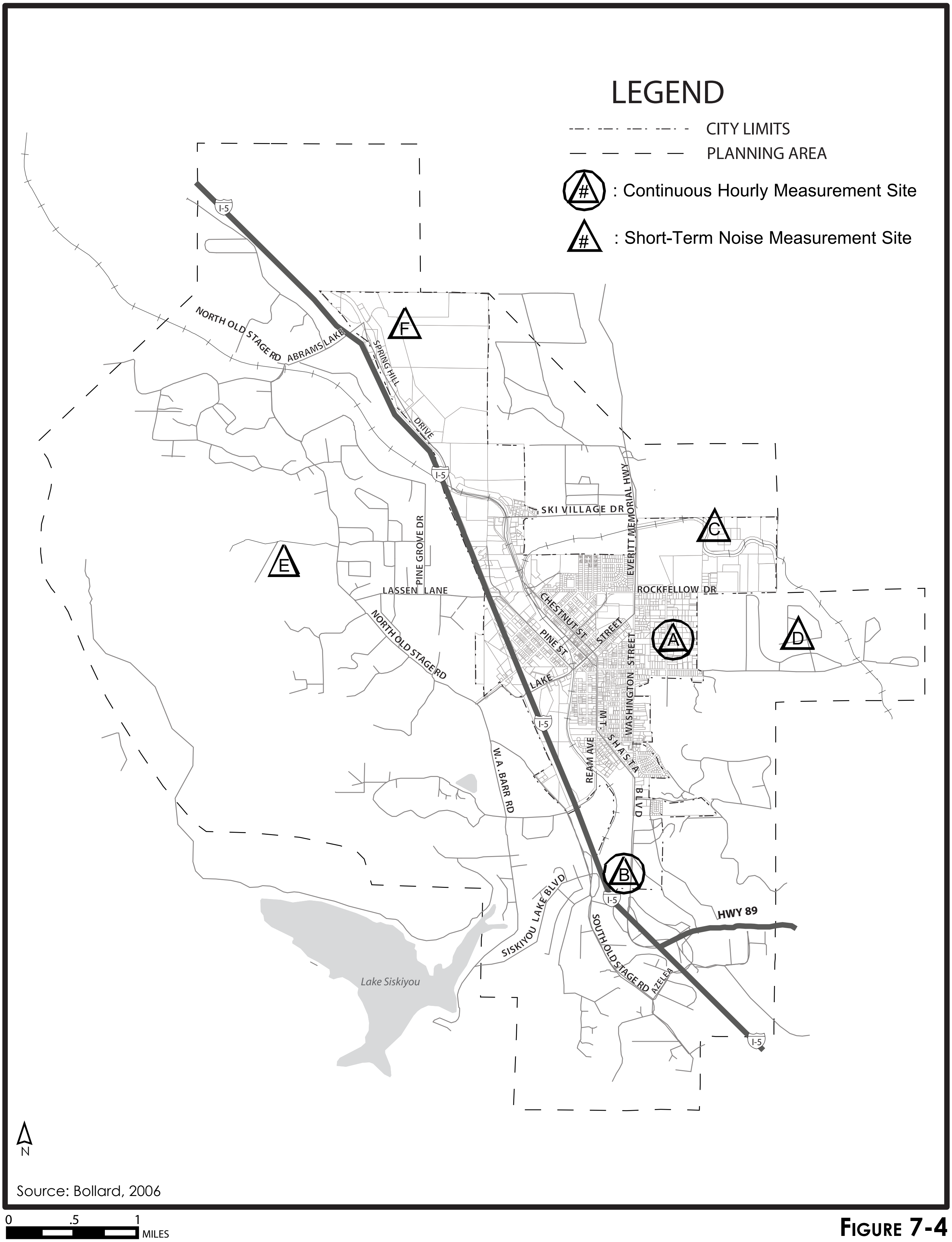

Figure 7-4
Community Noise Survey Sites

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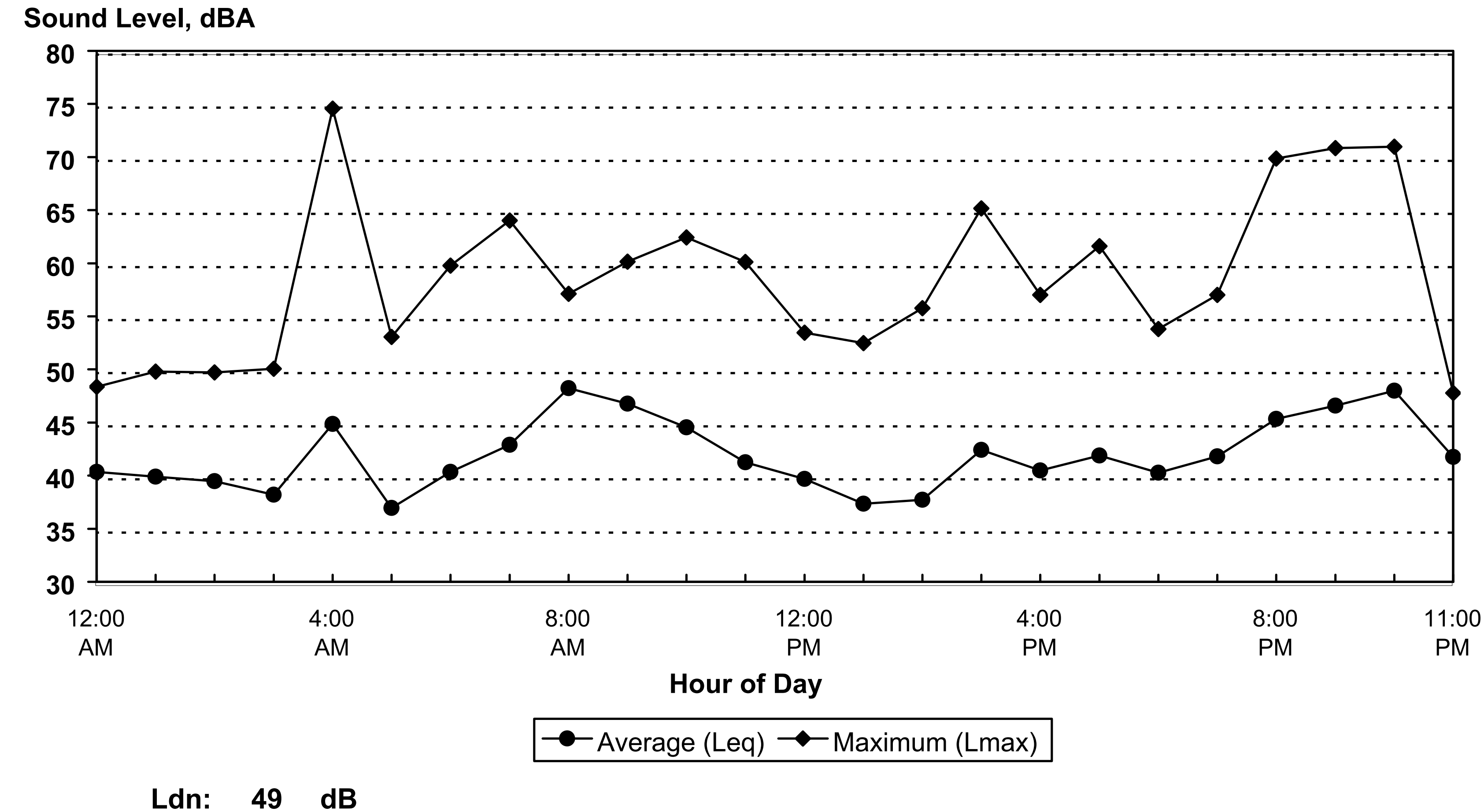
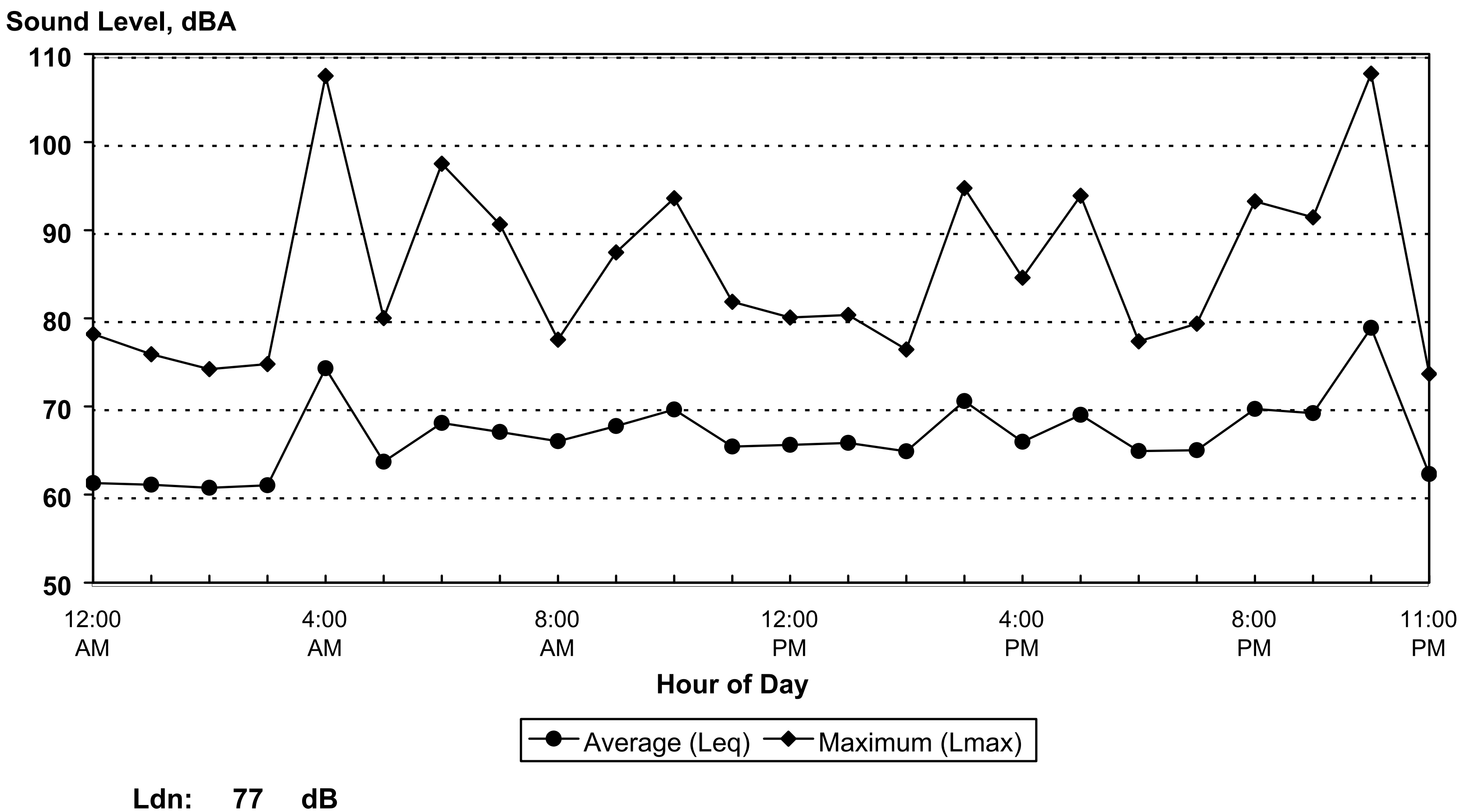


Source: Bollard, 2006

FIGURE 7-5
24HR CONTINUOUS NOISE MONITORING
AT 808 MORMON WAY
FRIDAY, AUGUST 11, 2006

PMC



Source: Bollard, 2006

FIGURE 7-6
24 HR CONTINUOUS NOISE MONITORING
AT I-5 AND UNION PACIFIC RAILROAD, NORTH OF SR 89
FRIDAY, AUGUST 11, 2006

from hearing loss, activity interference, sleep disturbance and annoyance. EPA notes, however, that this level is not a regulatory goal, 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. EPA and other federal agencies have suggested land use compatibility guidelines indicating that residential noise exposures of 55 to 65 dB Ldn are acceptable.

The U.S. Environmental Protection Agency has also prepared a "Model Community Noise Control Ordinance", using Leq as the means of defining allowable residential noise level limits. The EPA model contains no specific recommendations for local noise level standards, but reports a range of Leq values as adopted by various local jurisdictions. The mean daytime residential noise standard reported by the EPA is 57 dBA (Leq), and the mean nighttime residential noise standard is 52 dBA (Leq).

Other state laws and regulations regarding noise control are directed towards aircraft, motor vehicles and noise in general. The California Vehicle Code sets noise emission standards for new vehicles including autos, trucks, motorcycles and off-road vehicles. Performance standards also apply to all vehicles operated on public streets and roadways. Section 216 of the California Streets and Highways Code regulates traffic noise received at schools near freeways.

2. General Plan Objectives and Programs: Noise

Goal NZ-1: Protect City residents from the harmful and annoying effects of exposure to excessive noise.

Policy NZ-1.1: Enforce standards for noise exposure from proposed and existing non-transportation noise sources. The General Plan Noise Standards for the City of Mt. Shasta for new uses affected by non-transportation noise sources are shown on Table 7-5. The standards of Table 7-5 shall be applied to both new noise-sensitive land uses and new noise-generating uses, with the responsibility for noise attenuation placed on the new use. For example, if a developer proposes construction of a new apartment complex near an existing industry, the developer would be responsible for including appropriate noise attenuation in the project design to achieve compliance with the standards of Table 7-5 at the new apartments. Conversely, if a new industry was proposed near an existing apartment complex, the industry would be responsible for including appropriate noise attenuation in the project design to achieve compliance with the Table 7-5 standards at the existing apartment building.

Implementation Measures:

NZ-1.1(a): Enact a noise control ordinance.

NZ-1.1(b): When noise levels due to non-transportation noise sources exceed acceptable noise level standards as indicated in Table 7-5, noise mitigation measures shall be required to comply with the standards.

NZ-1.1(c): Noise created by new proposed non-transportation noise sources shall not exceed the noise level standards indicated in Table 7-5 at the property line.

Policy NZ-1.2: Review impacts more closely when a project is potentially a high noise generator.

Implementation Measure:

NZ-1.2(a): Proposed non-residential land uses that are likely to produce noise levels exceeding the acceptable noise standards at existing or planned noise-sensitive uses shall require an acoustical analysis as part of the application review process to ensure that methods of achieving noise standards are included in project design.

Policy NZ-1.3: Emergency service and agriculture uses shall be allowed to continue or be initiated even if noise standards are exceeded.

Implementation Measure:

NZ-1.3(a): Noise sources associated with agricultural operations (on lands zoned for such uses) or emergency equipment are exempt from noise standards.

Policy NZ-1.4: Enforce General Plan noise standards for noise exposure from proposed and existing transportation noise sources. The General Plan Noise Standards for the City of Mt. Shasta for new uses affected by transportation noise sources are shown on Table 7-6. Where the noise level standards of Table 7-6 are expected to be exceeded at proposed new uses that would be affected by traffic or railroad noise, appropriate noise mitigation measures shall be included in the project design to reduce projected noise levels to comply with the standards of Table 7-6.

Implementation Measures:

NZ-1.4(a): Evaluate transportation noise sources of proposed projects according to the noise level standards shown in Table 7-6.

NZ-1.4(b): Using acceptable acoustical engineering and construction standards, incorporate design features to reduce traffic noise to achieve the noise standards shown in Table 7-6.

NZ-1.4(c): Noise created by new transportation noise sources, including roadway improvements, shall be mitigated to comply with the noise level standards shown in Table 7-6.

NZ-1.4(d): Actively enforce the California Vehicle Code sections relating to adequate vehicle mufflers and modified exhaust systems.

Policy NZ-1.5: Actively work to reduce noise generated by City equipment.

Implementation Measure:

NZ-1.5(a): When purchasing new equipment, the City shall acquire equipment and vehicles that comply with noise level performance standards based upon the best feasible noise reduction technology.

Policy NZ-1.6: The City Development Code shall include procedures to ensure that required noise review and mitigation measures are implemented in the project review and building permit processes.

Implementation Measure:

NZ-1.6(a): Proposed noise-sensitive land uses in areas exposed to existing or projected exterior noise levels, which exceed acceptable noise standards, shall require an acoustical analysis as part of the environmental review process so that noise mitigation may be included in the project design. When an acoustical analysis is required by the City to assess compliance with the City's Noise Element standards, the analysis shall follow the guidelines of Table 7-7.

Policy NZ-1.7: Noise attenuation measures required to achieve acceptable noise standards shall emphasize site planning and project design.

Implementation Measures:

NZ-1.7(a): Use creative concepts and accepted acoustical engineering standards to achieve acceptable noise standards.

NZ-1.7(b): The use of noise barriers, such as soundwalls, shall be considered a supplemental means of achieving the noise standards after all practical design-related noise mitigation measures have been integrated into the project. When soundwalls and noise barriers are proposed, the City will consider the visual impacts in addition to their effectiveness in attenuating noise.

Policy NZ-1.8: Monitor compliance with noise standards.

Implementation Measures:

NZ-1.8(a): Develop and employ procedures to monitor compliance with the standards of the Noise Element after completion of projects where noise mitigation measures were required.

NZ-1.8(b): Building design shall be reviewed to enforce the State Noise Insulation Standards (California Code of Regulations, Title 24) and Chapter 35 of the Uniform Building Code (UBC).

NZ-1.8(c): Noise associated with construction activity between the hours of 7 a.m. and 5 p.m. shall be exempt from the standards cited in Table 7-5. Construction activity outside of this period may exceed the cited standards if an exemption is granted by the City to cover special circumstances.

Table 7-5
Noise Standards for New Uses Affected by Non-Transportation Noise

New Land Use	*Outdoor Activity Area - Leq*		*Interior – Leq*	*Notes*
	Daytime	*Nighttime*	*Day & Night*	
All Residential	50	45	35	1, 2, 7
Transient Lodging	55	---	40	3
Hospitals & Nursing Homes	50	45	35	4
Theaters & Auditoriums	---	---	35	
Churches, Meeting Halls, Schools, Libraries, etc.	55	---	40	
Office Buildings	55	---	45	5, 6
Commercial Buildings	55	---	45	5, 6
Playgrounds, Parks, etc.	65	65	---	6
Industry	65	65	50	5

Notes:

1. Outdoor activity areas for single-family residential uses are defined as back yards. For large parcels or residences with no clearly defined outdoor activity area, the standard shall be applicable within a 100 foot radius of the residence.

2. For multi-family residential uses, the exterior noise level standard shall be applied at the common outdoor recreation area, such as at pools, play areas or tennis courts.

3. Outdoor activity areas of transient lodging facilities include swimming pool and picnic areas, and are not commonly used during nighttime hours.

4. Hospitals are often noise-generating uses. The exterior noise level standards for hospitals are applicable only at clearly identified areas designated for outdoor relaxation by either hospital staff or patients.

5. Only the exterior spaces of these uses designated for employee or customer relaxation have any degree of sensitivity to noise.

6. The outdoor activity areas of office, commercial and park uses are not typically utilized during nighttime hours.

7. It may not be possible to achieve compliance with this standard at residential uses located immediately adjacent to loading dock areas of commercial uses while trucks are unloading. The daytime and nighttime noise level standards applicable to loading docks shall be 55 and 50 dB Leq, respectively.

General: The Table 5 standards shall be reduced by 5 dB for sounds consisting primarily of speech or music, and for recurring impulsive sounds. If the existing ambient noise level exceeds the standards of Table 7-5, then the noise level standards shall be increased at 5 dB increments to encompass the ambient.

Table 7-6
Noise Standards for New Uses Affected by Traffic and Railroad Noise

New Land Use	*Outdoor Activity Area - Ldn*	*Interior - Ldn/Peak Hour Leq*[1]	*Notes*
All Residential	60-65	45	2, 3, 4
Transient Lodging	65	45	5
Hospitals & Nursing Homes	60	45	6
Theaters & Auditoriums	---	35	
Churches, Meeting Halls, Schools, Libraries, etc.	60	40	
Office Buildings	65	45	7
Commercial Buildings	65	50	7
Playgrounds, Parks, etc.	70	---	
Industry	65	50	7

Notes:

1. For traffic noise within the City, Ldn and peak-hour Leq values are estimated to be approximately similar. Interior noise level standards are applied within noise-sensitive areas of the various land uses, with windows and doors in the closed positions.

2. Outdoor activity areas for single-family residential uses are defined as back yards. For large parcels or residences with no clearly defined outdoor activity area, the standard shall be applicable within a 100-foot radius of the residence.

3. For multi-family residential uses, the exterior noise level standard shall be applied at the common outdoor recreation area, such as at pools, play areas or tennis courts.

4. Where it is not possible to reduce noise in outdoor activity areas to 60 dB Ldn or less using a practical application of the best-available noise reduction measures, an exterior noise level of up to 65 dB Ldn may be allowed provided that available exterior noise level reduction measures have been implemented and interior noise levels are in compliance with this table.

5. Outdoor activity areas of transient lodging facilities include swimming pool and picnic areas.

6. Hospitals are often noise-generating uses. The exterior noise level standards for hospitals are applicable only at clearly identified areas designated for outdoor relaxation by either hospital staff or patients.

7. Only the exterior spaces of these uses designated for employee or customer relaxation have any degree of sensitivity to noise.

Table 7-7
Acoustical Analysis Standards

An acoustical analysis prepared pursuant to this Noise Element shall:

A. Be the responsibility of the applicant.

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

C. Include representative noise level measurements with sufficient sampling periods and locations to adequately describe local conditions and the predominant noise sources.

D. Estimate existing and projected noise levels in terms of the City's standards and compare those levels to the adopted policies of the Noise Element.

E. Recommend appropriate mitigation to achieve compliance with the adopted policies and standards of the Noise Element. Where the noise source in question consists of intermittent single events, the report must address the effects of maximum noise levels in sleeping rooms in terms of possible sleep disturbance.

F. Estimate interior and exterior noise exposure after the prescribed mitigation measures have been implemented.

G. Describe a post-project assessment program that could be used to evaluate the effectiveness of the proposed mitigation measures.

3. Noise Mitigation Options

In considering proposals for projects that involve the generation of excessive noise, or the exposure of noise-sensitive uses in areas subject to high noise levels, mitigation measures are often needed to achieve desirable noise level standards. Noise problems can usually be considered as being composed of three basic elements: the noise source, a transmission path, and a receiver. The appropriate acoustical treatment for a given project should consider the nature of the noise source and the sensitivity of the receiver. The problem should be defined in terms of appropriate criteria (Ldn, Leq, or Lmax), the location of a sensitive receiver (inside or outside), and when the problem occurs (daytime or nighttime). Noise control techniques can then be selected to provide an acceptable noise environment for the receiving property while remaining consistent with local aesthetic standards and practical structural and economic limits. Fundamental noise control techniques and mitigation options are discussed below:

Use of Setbacks

Noise exposure may be reduced by increasing the distance between the noise source and receiving use. Setback areas can take the form of open space, frontage roads, recreational areas, storage yards, etc. The available noise attenuation from this technique is limited by the characteristics of the noise source, but is generally about 4 to 6 dB per doubling of distance from the source.

Use of Barriers

Shielding by barriers can be obtained by placing walls, berms or other structures, such as buildings, between the noise source and the receiver. The effectiveness of a barrier depends upon blocking line-of-sight between the source and receiver, and is improved with increasing the distance the sound must travel to pass over the barrier as compared to a straight line from source to receiver. The difference between the distance over a barrier and a straight line between source and receiver is called the "path length difference," and is the basis for calculating barrier noise reduction.

Barrier effectiveness depends upon the relative heights of the source, barrier and receiver. In general, barriers are most effective when placed close to either the receiver or the source. An intermediate barrier location yields a smaller path-length-difference for a given increase in barrier height than does a location closer to either source or receiver.

For maximum effectiveness, barriers must be continuous and relatively airtight along their length and height. To ensure that sound transmission through the barrier is insignificant, barrier mass should be about 4 lbs./square foot, although a lesser mass may be acceptable if the barrier material provides sufficient transmission loss. Satisfaction of the above criteria requires substantial and well-fitted barrier materials, placed to intercept line of sight to all significant noise sources. Earth, in the form of berms or the face of a depressed area, is also an effective barrier material.

The attenuation provided by a barrier depends upon the frequency content of the source. Generally, higher frequencies are attenuated (reduced) more readily than lower frequencies. This results because a given barrier height is relatively large compared to the shorter wavelengths of high frequency sounds, while relatively small compared to the longer wavelengths of the frequency sounds. The effective center frequency for traffic noise is usually considered to be 550 Hz. Railroad engines, cars and horns emit noise with differing frequency content, so the effectiveness of a barrier will vary for each of these sources. Frequency analyses are necessary to properly calculate barrier effectiveness for noise from sources other than highway traffic.

There are practical limits to the noise reduction provided by barriers. For highway traffic noise, a 5 to 10 dB noise reduction may often be reasonably attained. A 15 dB noise reduction is sometimes possible, but a 20 dB noise reduction is extremely difficult to achieve. Barriers usually are provided in the form of walls, berms, or berm/wall combinations. The use of an earth berm in lieu of a solid wall may provide up to 3 dB additional attenuation over that attained by a solid wall alone, due to the absorption provided by the earth. Berm/wall combinations offer slightly better acoustical performance than solid walls, and are often preferred for aesthetic reasons.

Site Design

Buildings can be placed on a project site to shield other structures or areas, to remove them from noise-impacted areas, and to prevent an increase in noise level caused by reflections. The use of one building to shield another can significantly reduce overall project 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 noise reduction measures 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.

Another option in site design is the placement of relatively insensitive land uses, such as commercial or storage areas, between the noise source and a more sensitive portion of the project. Examples include development of commercial buildings along a busy arterial to block noise affecting a residential area, or providing recreational vehicle storage or travel trailer parking along the noise-impacted edge of a mobile home park. 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.

Site design should also guard against the creation of reflecting surfaces that may increase onsite 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. The open end of "U"-shaped buildings should point away from noise sources for the same reason. Landscaping walls or noise barriers located within a development may inadvertently reflect noise back to a noise-sensitive area unless carefully located. Avoidance of these problems while attaining an aesthetic site design requires close coordination between local agencies, the project engineer and architect, and the noise consultant.

Building Design

When structures have been located to provide maximum noise reduction by barriers or site design, noise reduction measures may still be required to achieve an acceptable interior noise environment. The cost of such measures may be reduced by placement of interior dwelling unit features. For example, bedrooms, living rooms, family rooms and other noise-sensitive portions of a dwelling can be located on the side of the unit farthest from the noise source.

Bathrooms, closets, stairwells and food preparation areas are relatively insensitive to exterior noise sources, and can be placed on the noisy side of a unit. When such techniques are employed, noise reduction requirements for the building facade can be significantly reduced, although the architect must take care to isolate the noise impacted areas by the use of partitions or doors. In some cases, external building facades can influence reflected noise levels affecting adjacent buildings. This is primarily a problem where high-rise buildings are proposed. The effect is most evident in urban areas where an "urban canyon" may be created. Bell-shaped or irregular building facades and attention to the orientation of the building can reduce this effect.

Noise Reduction by Building Facades

When interior noise levels are of concern in a noisy environment, noise reduction may be obtained through acoustical design of building facades. Standard residential construction practices provide 10-15 dB noise reduction for building facades with open windows, and approximately 25 dB noise reduction when windows are closed. Thus a 25 dB exterior-to-interior noise reduction can be obtained by the requirement that building design include adequate ventilation systems. This allows windows on a noise-impacted facade to remain closed under any weather condition.

Where greater noise reduction is required, acoustical treatment of the building facade is necessary. Reduction of relative window area is the most effective control technique, followed by providing acoustical glazing (thicker glass or increased air space between panes) in low air infiltration rate frames, use of fixed (non-movable) acoustical glazing or the elimination of windows. Exterior roll-up shades over windows may also be used to reduce noise.

Noise transmitted through walls can be reduced by increasing wall mass (using stucco or brick in lieu of wood siding), isolating wall members by the use of double or staggered stud walls, or mounting interior walls on resilient channels. Noise control for exterior doorways is provided by reducing door area, using solid-core doors, and by acoustically sealing door perimeters with suitable gaskets. Roof treatments may include the use of plywood sheathing under roofing materials.

Whichever noise control techniques are employed, it is essential that attention be given to installation of weather stripping and caulking of joints. Openings for attic or subfloor ventilation may also require acoustical treatment.

Design of acoustical treatment for building facades should be based upon analysis of the level and frequency content of the noise source. The transmission loss of each building component should be defined and the composite noise reduction for the complete facade calculated to account for absorption in the receiving room. A one-third octave band analysis is a definitive method of calculating the A-weighted noise reduction of a facade.

A common measure of transmission loss is the "Sound Transmission Class" (STC). STC ratings are not directly comparable to A-weighted noise reduction and must be corrected for the spectral content of the noise source. Requirements for transmission loss analyses are outlined by Title 24 of the California Code of Regulations.

Use of Vegetation

Trees and other vegetation are often thought to provide significant noise attenuation. However, approximately 100 feet of dense foliage (so that no visual path extends through the foliage) is required to achieve even a 5 dB attenuation of traffic noise. Thus, 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, increasing ground absorption of sound and thus increasing the attenuation of sound with distance. Planting of trees and shrubs is also of aesthetic and psychological value and may reduce adverse public reaction to a noise source by removing the source from view, even though noise levels will be largely unaffected. It should be noted, however, that trees planted on the top of a noise control berm can actually slightly degrade the acoustical performance of the barrier. This effect can occur when high frequency sounds are diffracted (bent) by foliage and directed downward over a barrier.

In summary, the effects of vegetation upon noise transmission are minor and are primarily limited to increased absorption of high frequency sounds and to providing aesthetic benefits that may reduce adverse public reaction to the noise source.

REFERENCES:

California, State of. Governor's Office of Planning and Research. *General Plan Guidelines*, 2003.

City of Mt. Shasta, *General Plan Noise Element*, 1993.

Federal Railroad Administration, *Final Rule on the Use of Locomotive Horns at Highway-Rail Grade Crossings*, Federal Register, Vol. 70, No. 80, April 27, 2005.

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