N O I S E   E L E M E N T

PAGE

INTRODUCTION

Next to air and water pollution noise is the third major pollutant. There has been ample scientific evidence which documents its detrimental effects on human health and well-being. Yet many persons are only now becoming aware of the extent of noise pollution as auto traffic increases, and the number of household appliances multiples. The purpose of the Noise Element is to establish policies which will, over time, reduce environmental noise to levels which are not harmful to health. The Element also has relationships to the overall Master Plan goals of preserving Berkeley's character-and promoting community safety.

Definition of Terms

In order to understand noise one must first have a clear understanding of the nature of sound. According to many acoustical engineers, sound may be defined as pressure variations in air or water which can be perceived by human hearing. Sound moves through the air somewhat like waves in the ocean. The waves are alternate rings of compressed and then rarefied air moving away from a central source at a constant speed. As each wave - first a compression, then a rarefaction - encounters an object, it exerts a force - a push, then a pull - on the object. This is why sound can break a glass or cause a window screen to vibrate.

Noise may be defined as sound which is objectionable and disturbing to some individual. The objectionable nature of sound could be caused by its pitch or its loudness. Pitch is the height or depth of a tone or sound, depending on the relative rapidity of the vibrations by which it is produced. High-pitched sounds, such as chalk scraping over a blackboard surface, are usually annoying to humans. Loudness is the intensity of sound waves combined with the reception characteristics of the ear. The intensity of a sound wave may be compared with the height of an ocean wave. In terms of sound's effect, intensity is how hard a sound wave hits an object.

In addition co the concepts of pitch and loudness, there are several noise measurement devices and scales which are used to describe the noise in a particular location. A decibel is a unit of measurement which indicates the relative intensity of a sound. The zero on the decibel scale is based on the lowest sound level that the healthy, unimpaired human ear can detect. Sound levels in decibels are calculated on a logarithmic basis. An increase of 10 decibels represents a ten-fold increase in acoustic energy, while 20 decibels is 100 times more intense (10 x 10), 30 decibels is 1,000 times more intense (10 x 10 x 10), etc. Therefore, one hundred decibels is 10 billion times as intense as one decibel.

The human ear also works logarithmically. Each decibel increase in sound level is perceived as approximately a doubling of loudness. The noise produced by a heavy truck (90 decibels) seems twice as loud as an alarm clock (80 decibels) (see Figure 1).

There are several methods of measuring sound. The most common in California are the A weighted sound level or dBA. This scale gives greater weight to the frequencies of sound to which the human ear is most sensitive, primarily the middle frequencies. The Community Noise Equivalent Level, CHEL, is a measure of the cumulative noise exposure in a community, with greater weights applied to evening and night-time periods. The Day-Night Average Sound Level, Ldn, is essentially the same as CNEL, with the exception that the evening time period is dropped and all occurrences during this 3-hour period are grouped into the day-time period.

Format of the Element

Recent state law changes have expanded the framework and content of noise elements to include a community noise exposure inventory, mitigating measures and possible solutions to existing and foreseeable noise problems. The noise element is also to show ho-,.~ it will be integrated into the city's zoning plan and tied to land use and circulation elements, and to the local noise ordinance.

This element will first discuss, in a general manner, the effects of noise on people, then the existing noise environment in Berkeley will be discussed. Policies will be presented which encourage solutions to noise problems and issues.

Like other Master Plan Elements, this element is not intended as a specific plan. Rather, the element should be looked at as a beginning point from which more detailed proposals may be developed. The element provides a framework for future decisions.

THE EFFECTS OF NOISE ON PEOPLE*

Sound is of great value to humankind. It warns Vs of danger and appropriately arouses and activates us. Sound gives us the advantage of speech and language which can calm, excite, or elicit joy or sorrow. But not all sound is desirable. Sounds that are valuable in one location may travel to places where they may not only serve no desirable purpose, but may interfere with and disrupt useful activities. Other sound are noises only at certain times, in certain places, to certain people. Obviously, there is a value judgment involved among people about what sound is unwanted. This section does not discuss S1ose values. Rather, it is the relationships between the properties of noise and its effects on people that are presented.

AUDITORY EFFECTS

Ear Damage

Exposure to intense noise can produce detrimental changes in the inner ear and seriously decrease the ability to hear. Some decreases are temporary for a few minutes or days after the termination of the noise while others may be permanent throughout life or chronic whenever the noise exposure occurs.

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*Most of this section is abstracted from two U.S. Environmental Protection Agency
Reports: Effect of Noise on People, Dec. 1971, and The Economic Impact of Noise

The outer ear, eardrum, and middle ear (Figure 2) are almost never damaged by exposure to intense noise. The primary site of auditory injury from excessive exposure to noise is the receptor organ of the inner ear - the organ of corti. Three tiny bones called ossicles transmit vibrations to a fluid contained in the cochlea. Within the cochlea are microscopic hair cells that move back and forth in response to the sound waves just as seaweed on the ocean floor undulates in response to wave action in the ocean. The energy impulses created by the movement of these crucial hair cells then go to the brain where they are interpreted as sound. Hair cells can be permanently damaged by too intensive sound waves.

Hearing Loss

The primary measure of hearing loss is the hearing threshold level or that level of a tone which can be detected by a person. The greater the hearing threshold level the greater the degree of hearing loss or partial deafness. In general, sound levels must exceed 60-80 decibels before a person will experience temporary threshold shifts, even for e3.-posures that last as long as 8-16 hours. However, people differ in their susceptibility to temporary threshold shifts. One person may be susceptible to noises of low pitch, another to noises of medium pitch, and another to noises of high pitch.

As exposures are repeated on a daily basis, the ear becomes less able to recover from the temporary threshold shift present at the end of each day if one works in a noise environment. However, a group of similarly exposed people will experience different threshold shifts: some will be larger than others. This reported observed difference is perhaps due to differences in susceptibility to noise, while some are due to actual differences in the noise levels encountered.

In addition to the hearing loss caused by constant exposure to noise, intense, impulsive, one-time exposure to noise, such as from a loud firecracker or the repeat from a fire arm, can 'cause both temporary and permanent hearing loss. Much of the hearing loss which occurs among youths is from this type of noise exposure (see Tables 1 and 2). The hearing loss which occurs as a person becomes older may be accelerated by the presence of noise.

Interference With Speech

In a highly technical society speech communication plays an extremely important role. Background noise can influence the accuracy, frequency, and quality of verbal exchange. Excessive background noise of over 60 decibels impairs conversation, formal education, occupation efficiency, family lifestyles, and the quality of leisure activities. Figure 3 shows how loud a person must speak to be heard with different background noise levels.

Table I

LIFETIME EXPOSURE TO NOISE (ILLUSTRATION)

	Childhood		Youth	Maturity
Cap Pistols				
Firearms	X	X		
Rock & Roll Music			X	
Transportation				
School Bus	X	X	X	
Automobile	X	X	X	
Train (subway, elevated)			X	X
Aircraft	X	X		
Household Appliances	X	X	X	
Construction Equipment	X	X	X	
"Community" (roadside, flight path)			X	X	X
Recreational Vehicles		X	X	

X =Exposure to noise source

Source: The Social *Impact of* Noise, U.S. Environmental Protection Agency, 1971

Table 2

HEARING LOSS – BY AGE

Age Range	Population Totals (in thousands)	Hearing Totals (thousands)	Loss of Noise-Associated Hearing loss (thousands)
0-5	17,000	850	?
5-10	20,000	1,000-1,400	*200
10-18	32,500	650- 975	**150
18-65	113,000	2,260	2,000 (Approx)
over 65	20,000	4,000	400-600
TOTALS	202,500	8,760-11,135	2,750-2,950

*Most common cause is explosions from *toy* caps (20% sensory-neural hearing loss).

Firearms and toy caps (based on approximately 20% sensory-neural),

Source: Tfie *Social Impact of* Noise, U.S. Environmental Protection Agency, 1971

PSYCHOLOGICAL AND SOCIOLOGICAL EFFECTS

Noise not only has direct effects on auditory functions, but also produces other more general behavioral effects. Many of the psychological and sociological effects of noise can be traced to the role of hearing in humankind's evolutionary development. This section will discuss such non-medical effects on people as sleep disturbance, annoyance, stress, and general psychological/ sociological effects of noise.

Sleep Disturbance

Noise can interfere with sleep by either awakening a person or causing a shift from a deep sleep level*to a shallower level. Brief sounds of sufficient intensity and fluctuating noise levels above 35-45 decibels have been shown to alter the sleep pattern to lighter sleep. Research indicates that when people are exposed to a great deal of noise they will complain of sleep loss and suffer a reduction of their feeling of well being. Figure 4 shows the results of a Canadian study of noise-induced sleep disturbance.

An experiment with the effects of traffic noise on sleeping patterns revealed some interesting results. The sounds were actually recorded in a bedroom near a busy street. One set of measurements was taken from 10 p.m. and midnight and another was between midnight and 4 a.m. The average sound was 70 decibels for the high-density early traffic, and only 61 decibels for the low-density traffic. The interesting fact was that the low-density traffic pattern was more disruptive of sleep than was the high-density pattern.

Whether such sleep disturbance constitutes a health hazard is debatable. While good sleep is necessary for physical and mental health, normal persons who lose sleep compensate by spending more time in deep sleep, and by napping. It may be very difficult to deprive a normal person of sufficient sleep to produce adverse health effects.

Annoyance/Community-Response

Annoyance is a response to noise by certain persons. Highly annoyed persons are likely to believe that those responsible for the noise are not concerned about those being exposed to the noise, and they are also likely to believe that the source of noise is not of great importance to the economic and social success of the community.

Annoyance is probably a good measure of the potential for complaint and community action. Whether complaints or anti-noise actions actually develop will depend on social and political factors. Each individual's degree of annoyance cannot be accurately predicted. Those who complain about noise cannot be identified as having a special set of psychological and sociological characteristics. Complaints about noise are less tied to the physical characteristics of noise than to the circumstances surrounding the noise generation, such as from aircraft.

Stress

At noise levels of 85 decibels or more human_stress reactions can be expected. Many physical changes such as dilating pupils, rising blood pressure, and acid secretion in the stomach occur during exposure to sounds of moderate volume and duration. Most of these changes are only temporary, but with constant exposure may become permanent, contributing to ulcers and heartburn.

While noise alone probably does not produce mental illness, constant exposure to noise makes people nervous, irritable, and generally unsettled. A 1969 London study of persons living near Heathrow Airport in comparison with persons living in a quieter environment found a significantly higher rate of admission to mental hospitals for them. In addition, another study of steel-workers found that those working in a noisy environment were more aggressive, distrustful, and irritable than*workers in a quieter environment. Table 3 shows equivalent sound levels in decibels occurring inside various places.

THE ECONOMIC IMPACT OF NOISE

A 1971 study regarding the economic impact of noise could only definitively assess the economic costs of aircraft noise. Costs were found to occur in the of property easements, litigation, loss of industrial and residential property value, and insulation of the receiver (home or business) or the source (aircraft). Benefits from the abatement of aircraft noise are received by residential and industrial property owners as well as by airport operators and airlines. However, the article is careful to point out that since air travel is a major transportation mode necessary for a region's economic health, costly noise restrictions might retard economic development of that region.

The study found it difficult to assess the cost of noise within the home or from nearby freeways and streets because of a lack of verifiable data. The study does note that as trends in the growth of noise generators and in urban/ suburban population concentrations continue, noise could become a more serious problem, nationwide, in the future. In some respects this increased emphasis on noise problems has already begun in California through the requirement of a noise element in a city's General Plan.

THE EXISTING NOISE ENVIRONMENT

This section will discuss the existing noise environment in Berkeley in terms of sources of Berkeley noise and existing and projected noise impacted areas. Possible mitigating measures for noise control, including ties with the Land Use and Circulation Elements, will be proposed as well as standards and criteria for noise abatement.

Table 3

EQUIVALENT SOUND LEVELS IN DECIBELS NORMALLY OCCURRING INSIDE VARIOUS PLACES

SPACE	Leq(+)
Small Store (1-5 clerks)	60
Large Store (more than 5 clerks)	65
Small Office (1-2 desks)	58
Medium Office (3-10 desks)	63
Large Office (more than 10 desks)	67
Miscellaneous Business	63
Residences	
Typical movement of people-no TV or radio	40-45
Speech at 10 feet, normal voice	55
TV listening at 10 feet , no other activity	55-60
Stereo music	50-70

(+)These measurements were taken over durations typical of the operation of these facilities.

Source: Environmental Protection Agency, 1974.

SOURCES OF BERKELEY NOISE

There are several sources of noise in Berkeley. Roughly, they can be divided into three categories: transportation, industry, and the routine activity of people and things.

Transportation Modes

Noise generated by transportation modes is one of the major causes of noise and complaints about noise in Berkeley. The Southern Pacific Railway along Third Street is a major source of noise in West Berkeley. The most prevalent source of transportation noise emanates from motor vehicles. This noise is generated by the vehicles themselves and by the interaction of the vehicles and their environment. The principal noises of motor vehicles stem from the exhaust, the engine intake, valving and gearing, the fan, and aerodynamic noise generated by passage of vehicles through the atmosphere.

The Berkeley Police Department maintains records concerning the number of citations issued dealing with Section 27150 of the Vehicle Code - the noisy muffler law. The Department's records show that 16 citations were issued during 1974, 5 citations during 1975, and 10 citations for the first five months of 1976 regarding noise mufflers.

Industry

Industrial noise and the noise created by transportation associated with industry can effect both the workers in the various plants as well as the nearby residential and commercial land uses, as has been shown in the previous section of this element. The type of industry which Berkeley contains does not emit a great deal of outside noise. Most noise from Berkeley industrial concerns emanates from outdoor industrial activities. These activities include storage operations and scrap yards.

Routine Activity of People and Things

This category includes such ordinary and diverse things as building air conditioners, especially high efficiency cooling towers on commercial and industrial buildings, leisure time activities, such as home workshop tools, television sets, and power mowers, barking dogs, arguments, and parties, are all sources of noise complaints.

While the Police Department does not maintain separate records for noise complaints, such statistics are grouped with ordinance violations such as abandoned property and abandoned animals. Of the complaints filed during 1975 for this category, approximately 24% or 2,784 can be considered as noise complaints according to the Police Department. This figure is 945 more complaints than in 1974 when 1,839 were filed.

Noise-Sensitive Areas

Noise-sensitive are as are residential areas2 parks, schools, hospitals, and rest homes and mental care facilities. Most of Berkeley is noise-sensitive.

Present Noise Environment

A total of 42, 24-hour measurements were taken in September 1975 by the McDonnell/Douglas Corporation using the B&K Digital Data Recorder. Measurements were taken while the Berkeley Unified School District was on strike and before U.C. classes resumed. A rate of one sample every three (3) seconds was used to record the environmental noise. The data from these locations were reduced on the B&K 321 Digital Data System, from which hourly equivalent sound values were retrieved.
These hourly values were then used to calculate the day-night average sound level (Ldn) value for each of the 42 measurement locations. These locations are presented in Table 4.

Based on these Ldn values, the Present Noise Contour Map (Figure 6) was drawn. The contour lines are presented in terms of Ldn in increments of Ldn 5. Included on the map are the actual measurement locations along with the calculated Ldn value.

Present Noise impacted Areas

Using the Present Noise Contour Map, the criteria used to determine the present impacted areas are as follows:

Sensitive Areas - Schools, Parks, Hospitals and Residential. These areas are impacted if they are enveloped by noise environment or Ldn 65 or greater;

Non-Sensitive Areas - Commercial and industrial. These areas are impacted it they are enveloped by a noise environment of Ldn 75 or greater.

Based on criteria developed by the Environmental Agency the Department of Housing and Urban Development, the California Department of Housing and Community Development, and the U. S. Department of Health, Education and Welfare, Berkeley should adopt noise standards for noise sensitivity land use classifications. The criteria developed by the EPA are issued as information only, not as standards, and are the levels deemed "requisite to protect health and welfare with an adequate margin of safety . The EPA cautions that the criteria "do not take into account cost or feasibility," and that "States and localities will approach this information according to individual needs and situations.

Most of Berkeley is impacted by noise. There are few areas in the city which do not exceed 65 Ldn. However, since the measurements are conducted on a citywide basis, specific measurements should be taken for any new construction or existing problems.

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TABLE 4

SITE NO.	DATE (1975)	LOCATION OF MEASUREMENT	SITE ADJUSTED Ldn VALUE
1	9/8 - 9/9	San Pablo Ave. near Cedar St.	74
2	9/8- 9/9	University Ave. between 9th & 10th Streets	77
3	9/8 - 9/9	Peralta St. & Hopkins St.	62
4	9/8- 9/9	Gilman St. between Curtis St. & Nielson St.	71
5	9/8- 9/9	Sacramento St. between Virginia St. & Delaware St.	66
6	9/8- 9/9	Cedar St. & Grant St.	62
7	9/9- 9/10	Grove St. between Allston Way & Bancroft Way	71
8	9/9- 9/10	Dwight Way & Mi 1 vi a St.	69
9	9/9- 9/10	College St. & Forest Ave.	70
10	9/9- 9/10	Telegraph Ave. & Russell St.	70
11	9/9- 9/10	Ashby Ave. & Ellsworth St .	71
12	9/9- 9/10	Shattuck Ave. between Delaware St. & Francisco St.	70
13	9/10 - 9/11	Oxford St. between Allston Way & Kittredge St.	71
14	9/10 - 9/11	Shattuck Ave. & Adeline St.	70
15	9/10 - 9/11	Garber St. & Piedmont Ave.	62
16	9/10 - 9/11	Derby St. & Claremont Blvd.	71
17	9/10 - 9/11	Ellsworth St. between Stuart St. & Ward St.	59
I8	9/10 - 9/11	Milvia St. between Francisco St. & Delaware St.	68
19	9/11 - 9/12	Action St. between Parker St. & Carleton St.	64
20	9/11 - 9/12	Eastshore Rd. & Page St.	81
21	9/11 - 9/12	Cedar St. between 2nd St. & 4th St.	82
22	9/11 - 9/12	8th St 62. between Page St. & Jones St.	

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TABLE 4 (Continued)

SITE NO.	DATE	LOCATION OF MEASUREMENT SITE	ADJUSTED Ldn VALUE
23	9/11 - 9/12	6th St. & Carmelia St.	69
24	9/11 - 9/12	Virginia St. & Cornell St.	61
25	9/12 - 9/13	Mabel St. & Oregon St.	67
26	9/12 - 9/13	Roosevelt St. & Channing Way	58
27	9/12 - 9/13	McGee Ave. & Russell St.	63
28	9/12 - 9/13	Ellis St. & Prince St.	62
29	9/12 - 9/13	Fairview St. & California St.	64
30	9/12 - 9/13	Monterey Ave. & Colusa Ave.	63
31	9/13 - 9/14	La Loma Ave. between Buena Vista Way & La Vereda Rd.	67
32	9/13 - 9/14	Eunice St. & Euclid Ave.	67
33	9/13 - 9/14	Spruce St. & Marin Ave.	68
34	9/13 - 9/14	Grizzly Peak Rd. & Shasta Rd.	67
35	9/13 - 9/14	Grizzly Peak Rd. & Keeler Ave.	59
36	9/13 - 9/14	The Arlington Ave. & Thousand Oaks Blvd.	67
37	9/15 - 9/16	Heinz St. & 8th St.	70
38	9/15 - 9/16	7th St. & Parker St.	70
39	9/15 - 9/16	Virginia St. & Scenic Ave.	63
40	9/15 - 9/16	Hearst Ave. between Scenic Ave. & Arch St.	70
41	9/15 - 9/l6	Claremont Blvd. & Webster St.	67
42	9/15 - 9/16	Tunnel Rd. between Oakridge & The Uplands	75

Possible Noise Mitigating Measures

As a 1970 report on noise problems points out, there must be a noise source and a noise receiver and between them a path of noise transmission. The report then lists four basic procedures that may be taken to reduce noise inflicted on receivers, three* of which are applicable to Berkeley:

1. Control the noise at its source.

2. Interrupt the noise path.

3. Enclose the noise receiver.

Of these three measures the primary avenue open to Berkeley through its police power is to control noise at its source. As a minimum this includes low noise specifications for new city-owned vehicles, and noise emission limits on public work projects. Public buildings should also be sufficiently insulated so that they may carry out their intended functions.

Aside from controlling noise emanating from publicly owned vehicles and buildings, cities can establish standards and criteria for interior and exterior noise. Such standards are typically developed for and contained in noise ordinances and the building code. The state regulates both interior and exterior noise levels for residential buildings. The United States Environmental Protection Agency has prepared a model noise ordinance which may be adapted for use by Berkeley. This ordinance encourages a municipality to select its own standards for noise attenuation, recognizing noise as essentially a local issue.

Obviously, legislation in the form of noise and zoning ordinances and building code amendments are not enough to mitigate against the adverse effect of noise. For example, physical barriers could be constructed to insulate nearby land uses from the effects of freeway noise. Careful placement of new residential structures along certain major streets, as proposed in the Land Use Element, should consider the effects of traffic generated noise as shown in Figure 11. State law now requires special noise insulation of new multi-unit dwellings constructed within the 60 dB noise exposure range. As state guidelines point out, this requirement may influence the location and cost of this housing type since major Berkeley arterials are within this noise category. An active public awareness program which explain-s the deleterious effects of excessive noise on the physical and psychological condition of people could also be conducted. Noise information generated from monitoring noise conditions should be integrated into the Zoning Ordinance pursuant to state guidelines as shown in Figure 12.

*The fourth method involves protection from aircraft noise.

POLICY RECOMMENDATIONS

POLICY 6.00

Establish standards for interior and exterior noise levels in accordance with the California Administrative Code and incorporate these standards into appropriate local ordinances.

POLICY 6.01

Include land use compatibility for noise environments in administration of the existing Zoning Ordinance by establishing normally acceptable, conditionally acceptable, normally unacceptable, and clearly unacceptable noise levels for land use categories as given in state noise guidelines in Figure 12.

POLICY 6.02

Actively seek the assistance of the California Department of Transportation in providing visually pleasing sound attenuation devices for the Eastshore Freeway (State Route 17), the Grove-Shafter Freeway (State Route 24), Ashby/Tunnel Road (State Route 13), and schedule the necessary share of local funding in the Capital Improvement Program (see Open Space Element).

POLICY 6.03

Promote increased public awareness concerning the deleterious effects of-excessive noise on humans.

POLICY 6.04

Support federal and state legislation to lower allowable noise levels on all motor vehicles.

POLICY 6.05

Allocate greater enforcement effort to existing noise ordinances and sections of the Vehicle Code pertaining to noise.

POLICY 6.06

Establish noise emission limits for city public works projects.

TABLE3

RECOMMENDED MAXIMUM AVERAGE OUTDOOR NOISE LEVELS

To prevent hearing damage	80 Decibels, Ldn*
For conversation	63
For sleeping	60
To prevent annoyance	60

***Day-night average sound level.**

COMPATIBLE LAND USES IN AIRPORT NOISE ZONES

The U.S. Department of Housing and Urban Development (HUD) has commissioned the preparation of guidelines for the compatibility of different land uses in noise zones around airports. These guidelines were prepared by the firm of Wilsey and Ham and are based on noise sensitivity factors for each type of land use.* The sensitivity factors are:

1. Speech communication needs,

2. Subjective judgements of noise acceptability and relative noisiness by people living near airports,

3. Need for freedom from noise intrusions, and

4. Sleep sensitivity criteria.

Wilsey and Ham prepared a list of human activities, and based on research which has been done on the effects of noise on these activities, analyzed the degree of impact-of different airport noise levels on each activity. The results of this analysis is shown in Figure 5. Next, land use categories were matched with the human activities which take place in each and the relative importance of each activity to each land use type was determined. This is shown in Figure 6.

Finally the guidelines were compiled by assigning noise sensitivity weights to each land use based on the sensitivity of the human activities which are associated with each land use category. The guidelines are shown in Figure 7. The land use categories in Figure 7 vary in noise sensitivity from residential , which is rated 1, to public right-of-way, which is rated 5. The acceptability categories (clearly acceptable, normally acceptable, normally unacceptable, and clearly unacceptable) indicate the suitability for new construction or development for each land use. These guidelines are intended as refinements to the less precise guidelines which were promulgated by HUD in August, 1971 in HUD Circular 1 3390.2.

"Aircraft NoiseImpact,PlanningGuidelines for Local Agencies, U.S. Department of Housing and Urban Development November, 1972.

An examination of the numerical values obtained by using two periods versus three periods per day shows that for any reasonable distribution of environmental noise levels, the two-period day and the three-period day are essentially identical; i.e., the 24-hourequivalent sound levels are equal wit]-in a few tenths of a decibel. Therefore, the simpler two-period day is used in this document, with daytime extending from 7a.m. to 10 p.m. and nighttime extending from 10 p.m. to 7 a.m. The symbol for the 15-hour daytime
equivalent sound level is Ld, the symbol for the 9-hour nighttime equivalent sound level is Ln, and the day-night weighted measure is symbolized as Ldn.

The Ldn is defined as the A-weighted average sound level in decibels (re 20 micropascals) during a 24-hour period with a 10 dB weighting applied to nighttime sound levels. Examples of the outdoor present day (1973) day-night noise level at typical locations are given in Figure 1.

3. Leq for the 24-hour average sound level to which an individual is exposed (Leq{24}):This situation is related to the cumulative noise exposure experienced by an individual irrespective of where, or under what situation, this exposure is received. The long term health and welfare effects of noise on an individual are related to the cumulative noise exposure he receives ever a lifetime.

Relatively little is *known concerning* the total effect of such lifetime exposures, but dose-effect relations have been studied for two selected situations:

a.The average long-term exposure to noise primarily in residential areas leading0 2
to Purmoyance reactions and complaints.

b.The long term effects of occupational noise on hearing, with the daily exposure dose based on an eight-ht-hour work day.

An ideal approach to identifying environmental noise levels in terms of their effect on public health and welfare would be to start by identifying the maximum noise not to be exceeded by individuals. However, the noise dose that an individual receives is a function of lifestyle. For example, exposure patterns of office workers, factory workers, housewives and school children are quite different. Within each group the exposures will vary widely as a function of the working, recreational, and sleeping patterns of the individual. Thus, two individuals working in the same office will probably accumulate different total noise doses if they use different modes of transportation, live in different areas, and have different TV habits. Examples of these variations in noise dose for several typical life styles are provided in Appendix B. However, detailed statistical information on the distribution of actual noise doses and the relationship of these doses to long-term health and welfare effects is still missing. Therefore, a realistic approach to this problem is to identify appropriate noise levels for.

Appendix F

CLASSIFICATIONS OF ONGOING NOISE EXPOSURE

Type of Exposure	Typical Examples
Steady-State	Weaving room noise; sound of a waterfall; shipboard noise; interior of a vehicle or aircraft noise; turbine noise; hum of electrical sub-station.
Fluctuating Noise	Many kinds of processing or manufacturing noise. Traffic noise; airport noise; many kinds of recreational noise (e.g., vehicle racing; powered lawn mowing; radio and TV).
Intermittent Noise	Many kinds of industrial noise (especially in construction work, ship building, forestry, aircraft maintenance, etc.); Many kinds of recreational noise (e.g.. rock concerts, chains awing); light traffic noise; occasional aircraft flyover noise; many kinds of domestic noise(e.g., use of electrical appliances in the home); school noise.

Source: U.S. Environmental Protection Agency