N-96-01
EPA 550/9-81-423
II-A-172

June 1980

PB81-214 124

GUIDELINES FOR CONSIDERING NOISE IN LAND USE PLANNING AND CONTROL

Federal Interagency Committee on Urban Noise

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June 1980

Federal Interagency Committee on Urban Noise

FEDERAL
INTERAGENCY COMMITTEE
ON URBAN NOISE

To all local government officials and others interested in noise/land use concerns:

In his Environmental Message to Congress in August, 1979, President Carter announced a new Urban Noise Initiative to reduce urban noise. The Federal Interagency Committee on Urban Noise was thereby established to coordinate various programs, including an interagency program designed "to encourage noise sensitive development, such as housing, to be located away from major noise sources." As a first step in that program, the Committee is pleased to make available this document which presents a broad consolidation of Federal guidance on the incorporation of noise considerations in local development planning and site review operations. We hope that it will facilitate improved communication among all levels of government on noise compatible land use and that you will find it useful in addressing noise/land use concerns in your community.

Douglas Costle
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Neil Goldschmidt
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U.S. Department of Transportation

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U.S. Department of Housing
and Urban Development

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Assistant Secretary of Defense
(Manpower, Reserve Affairs & Logistics)
U.S. Department of Defense

Max Cleland
Administrator
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INTRODUCTION

In recent years noise has become a recognized factor in the community planning process. Some significant advancements are being made in the reduction of noise at its source; however, noise cannot be eliminated completely. Local, state, and Federal agencies, in recognition of this fact, have developed guidelines and procedures to deal with noise in the community land use planning process.

A number of Federal agencies have published policies and/or guidance on noise and land use. These agencies have done this for several different reasons: to carry out public law mandates to protect the public health and welfare and provide for environmental enhancement; to serve as the basis for grant approvals; and to integrate the consideration of noise into the overall comprehensive planning and interagency/intergovernmental coordination process.

Because the purposes and uses of these policy and guidance packages are often different, they can appear to be inconsistent and incomparable. This situation may have inhibited state and local planning and decision making with respect to noise and land use and, thus, inhibited consideration of noise in various Federal-grant-in-aid programs.

The purpose of this document is to put the various Federal agency policy and guidance packages into perspective. Although this document does not replace the individual Federal agency material, it can serve as the departure point for dealing with each agency's programs and facilitate the consideration of noise in all land use planning and interagency /intergovernmental coordination processes.

Although several of these Federal programs include noise standards or guidelines as part of their eligibility and performance criteria, the primary responsibility for integrating noise considerations into the planning process rests with local government which generally has exclusive control over actual land development. Noise, like soil conditions, physiographic features, seismic stablility, floodplains and other considerations, is a valid land use determinant. Scientific evidence clearly points to noise as not simply a nuisance but an important health and welfare concern.

The purpose of considering noise in the land use planning process is not to prevent development but rather to encourage development that is compatible with various noise levels. The objective is to guide noise sensitive land uses away from the noise and encourage non-sensitive land uses where there is noise. Where this is not possible, measures should be included in development projects to reduce the effects of the noise.

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Section 1 presents consolidated Federal agency land use compatibility guidelines. Section 2 overviews techniques by which the guidelines can be implemented. Section 3 briefly overviews the major Federal agency noise control policies and programs. The Appendices contain brief descriptions of environmental noise descriptors and annotated bibliographies of selected Federal documents.

Section 1. LAND USE COMPATIBILITY GUIDELINES

This section contains two tables. Table 1 classifies noise levels into a set of noise zones according to the most commonly used environmental noise descriptors. Noise zones are identified in order of increasing noise level by the letters "A" through "D". The descriptors are discussed in Appendix A. The Day-Night Average Sound Level (DNL)[1] descriptor can be used for all noise sources. The Equivalent Sound Level (L_{eq}) is included because some highway noise data can be expected to be in terms of an equivalent sound level for the highway "design hour" — see Table 1 for description of when L_{eq} (design hour) is equivalent to DNL for planning purposes. The L_{eq} descriptor itself is not unique to highways and can be applied to any noise source. The Noise Exposure Forecast (NEF) descriptor is used for aircraft noise only and is being superceded by DNL. The Community Noise Equivalent Level (CNEL) descriptor (for the state of California) uses values similar to DNL. Older descriptors unique to airport noise environments, such as the Composite Noise Rating (CNR), may be encountered. For general comparison purposes L_{dn} 65 = NEF 30 = CNR 100, L_{dn} 75 = NEF 40 = CNR 115.

Table 2 contains suggested land use compatibility guidelines. The table arrays land uses[2] on the left with the noise zones of Table 1 across the top. Land use compatibility is expressed as being "compatible", "incompatible" and "compatible with restrictions." The system as presented in the table is comprised of two digit categories identifying land use activity in the most generalized way (e.g. "10 Residential"). Within some of the two-digit categories here are sub-categories identifying activity in greater detail. Compatibility as expressed in this table represents a consolidation of existing Federal agency guidelines. This table serves as a point of departure in making several kinds of determinations, including whether various land uses should be allowed at particular sites based upon the noise levels at those sites. Detailed planning should be based on the procedures and specific general planning guidance found in appropriate Federal agency documents (Appendix B) as well as the needs, desires and site characteristics of the particular community. Another input to the

[1] Day-Night Average Sound Level is abbreviated as DNL and symbolized mathematically as L_{dn} (e.g., L_{dn} 65, L_{dn} 75, etc.).

[2] Land uses are here categorized according to the standard land use activity categories found in the *Standard Land Use Coding Manual*, Housing and Home Finance Agency (now Department of Housing and Urban Development) and Bureau of Public Roads (now Department of Transportation/Federal Highway Administration), 1965.

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planning process is the statement of public health and welfare goals in EPA's "Levels" Document. The levels can be used by individual communities to incorporate public health and welfare goals into the planning process. These levels do not *in themselves,* however, form the sole basis for appropriate land use actions because they do not consider cost, feasibility, the noise levels from any particular source, or the development needs of the community and do include an adequate margin of safety. They should be considered by all communities in their planning, including those who now enjoy quiet and wish to preserve it, as well as those which are relatively noisy and wish to mitigate the problem.

TABLE 1. NOISE ZONE CLASSIFICATION

Noise Zone	Noise Exposure Class	Noise Descriptor			HUD Noise Standards
		DNL[1] Day-Night Average Sound Level	L_{eq}(hour)[3] Equivalent Sound Level	NEF[4] Noise Exposure Forecast	
A	Minimal Exposure	Not Exceeding 55	Not Exceeding 55	Not Exceeding 20	"Acceptable"
B	Moderate Exposure	Above 55[2] But Not Exceeding 65	Above 55 But Not Exceeding 65	Above 25 But Not Exceeding 30	
C-1	Significant Exposure	Above 65 Not Exceeding 70	Above 65 Not Exceeding 70	Above 30 But Not Exceeding 35	"Normally Unacceptable"[5]
C-2		Above 70 But Not Exceeding 75	Above 70 But Not Exceeding 75	Above 35 But Not Exceeding 40	
D-1	Severe Exposure	Above 75 But Not Exceeding 80	Above 40 But Not Exceeding 80	Not Exceeding 45	"Unacceptable"
D-2		Above 80 But Not Exceeding 85	Above 80 But Not Exceeding 85	Above 45 But Not Exceeding 50	
D-3		Above 85	Above 85	Above 50	

[1]CNEL — Community Noise Equivalent Level (California only) uses the same values.

[2]HUD, DOT and EPA recognize L_{dn} = 55 dB as a goal for outdoors in residential areas in protecting the public health and welfare with an adequate margin of safety (Reference: EPA "Levels" Document.) However, it is not a *regulatory* goal. It 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.

[3]The Federal Highway Administration (FHWA) noise policy uses this descriptor as an alternative to L_{10} (noise level exceeded ten percent of the time) in connection with its policy for highway noise mitigation. The L_{eq} (design hour) is equivalent to DNL for planning purposes under the following conditions: 1) heavy trucks equal ten percent of total traffic flow in vehicles per 24 hours; 2) traffic between 10 p.m. and 7 a.m. does not exceed fifteen percent of the average daily traffic flow in vehicles per 24 hours. Under these conditions DNL equals L_{10} – 3 decibels.

[4]For use in airport environs only; is now being superceded by DNL.

[5]The HUD Noise Regulation allows a certain amount of flexibility for non-acoustic benefits in zone C-1. Attenuation requirements can be waived for projects meeting special requirements.

TABLE 2. SUGGESTED LAND USE COMPATIBILITY GUIDELINES

Land Use		Noise Zones/DNL Levels in L_{dn}						
SLUCM No.	Name	A 0-55	B 55-65	C-1 65-70	C-2 70-75	D-1 75-80	D-2 80-85	D-3 85+
10	**Residential**							
11	Household units.							
11.11	Single units — detached	Y	Y*	25[1]	30[1]	N	N	N
11.12	Single units — semidetached	Y	Y*	25[1]	30[1]	N	N	N
11.13	Single units — attached row	Y	Y*	25[1]	30[1]	N	N	N
11.21	Two units — side-by-side	Y	Y*	25[1]	30[1]	N	N	N
11.22	Two Units — one above the other	Y	Y*	25[1]	30[1]	N	N	N
11.31	Apartments — walk up	Y	Y*	25[1]	30[1]	N	N	N
11.32	Apartments — elevator	Y	Y*	25[1]	30[1]	N	N	N
12	Group quarters	Y	Y*	25[1]	30[1]	N	N	N
13	Residential hotels	Y	Y*	25[1]	30[1]	N	N	N
14	Mobile home parks or courts	Y	Y*	N	N	N	N	N
15	Transient lodgings	Y	Y*	25[1]	30[1]	35[1]	N	N
16	Other residential	Y	Y*	25[1]	30[1]	N	N	N
20	**Manufacturing**							
21	Food and kindred products — manufacturing	Y	Y	Y	Y[2]	Y[3]	Y[4]	N
22	Textile mill products — manufacturing	Y	Y	Y	Y[2]	Y[3]	Y[4]	N
23	Apparel and other finished products made from fabrics, leather, and similar materials — manufacturing	Y	Y	Y	Y[2]	Y[3]	Y[4]	N
24	Lumber and wood products (except furniture) — manufacturing	Y	Y	Y	Y[2]	Y[3]	Y[4]	N
25	Furniture and fixtures — manufacturing	Y	Y	Y	Y[2]	Y[3]	Y[4]	N
26	Paper and allied products — manufacturing	Y	Y	Y	Y[2]	Y[3]	Y[4]	N
27	Printing, publishing, and allied industries	Y	Y	Y	Y[2]	Y[3]	Y[4]	N
28	Chemicals and allied products — manufacturing	Y	Y	Y	Y[2]	Y[3]	Y[4]	N
29	Petroleum refining and related industries	Y	Y	Y	Y[2]	Y[3]	Y[4]	N

*The designation of these uses as "compatible" in this zone reflects individual Federal agencies' consideration of general cost and feasibility factors as well as past community experiences and program objectives. Localities, when evaluating the application of these guidelines to specific situations, may have different concerns or goals to consider. For an indication of possible community reaction in residential environments at various levels of cumulative noise, Table D-1 in Appendix D should be consulted.

NOTES FOR TABLE 2

1. a) Although local conditions may require residential use, it is discouraged in C-1 and strongly discouraged in C-2. The absence of viable alternative development options should be determined and an evaluation indicating that a demonstrated community need for residential use would not be met if development were prohibited in these zones should be conducted prior to approvals.

   b) Where the community determines that residential uses must be allowed, measures to achieve outdoor to indoor Noise Level Reduction (NLR) of at least 25 dB (Zone C-1) and 30 dB (Zone C-2) should be incorporated into building codes and be considered in individual approvals. Normal construction can be expected to provide a NLR of 20 dB, thus the reduction requirements are often stated as 5, 10 or 15 dB over standard construction and normally assume mechanical ventilation and closed windows year round. Additional consideration should be given to modifying NLR levels based on peak noise levels.

   c) NLR criteria will not eliminate outdoor noise problems. However, building location and site planning, design and use of berms and barriers can help mitigate outdoor noise exposure particularly from ground level sources. *Measures that reduce noise at a site should be used wherever practical in preference to measures which only protect interior spaces.*

2. Measures to achieve NLR of 25 must be incorporated into the design and construction of portions of these buildings where the public is received, office areas, noise sensitive areas or where the normal noise level is low.

3. Measures to achieve NLR of 30 must be incorporated into the design and construction of portions of these buildings where the public is received, office areas, noise sensitive areas or where the normal noise level is low.

4. Measures to achieve NLR of 35 must be incorporated into the design and construction of portions of these buildjngs where the public is received, office areas, noise sensitive areas or where the normal noise level is low.

KEY TO TABLE 2

SLUCM	Standard Land Use Coding Manual
Y (Yes)	Land Use and related structures compatible without restrictions.
N (No)	Land Use and related structures are not compatible and should be prohibited.
NLR (Noise Level Reduction)	Noise Level Reduction (outdoor to indoor) to be achieved through incorporation of noise attenuation into the design and construction of the structure.
Y^x (Yes with restrictions)	Land Use and related structures generally compatible; see notes 2 through 4.
25, 30, or 35	Land Use and related structures generally compatible; measures to achieve NLR of 25, 30 or 35 must be incorporated into design and construction of structure.
25*, 30* or 35*	Land Use generally compatible with NLR; however, measures to achieve an overall do not necessarily solve noise difficulties and additional evaluation is warranted.

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TABLE 2. SUGGESTED LAND USE COMPATIBILITY GUIDELINES (continued)

Land Use		Noise Zones/DNL Levels in L_{dn}						
SLUCM No.	Name	A 0-55	B 55-65	C-1 65-70	C-2 70-75	D-1 75-80	D-2 80-85	D-3 85+
30	**Manufacturing (cont'd)**							
31	Rubber and misc. plastic products — manufacturing	Y	Y	Y	Y[2]	Y[3]	Y[4]	N
32	Stone, clay and glass products — manufacturing	Y	Y	Y	Y[2]	Y[3]	Y[4]	N
33	Primary metal industries	Y	Y	Y	Y[2]	Y[3]	Y[4]	N
34	Fabricated metal products — manufacturing.	Y	Y	Y	Y[2]	Y[3]	Y[4]	N
35	Professional, scientific, and controlling instruments; photographic and optical goods; watches and clocks — manufacturing	Y	Y	Y	25	30	N	N
39	Miscellaneous manufacturing	Y	Y	Y	Y[2]	Y[3]	Y[4]	
40	**Transportation, communication and utilities**							
41	Railroad, rapid rail transit and street railway transportation	Y	Y	Y	Y[2]	Y[3]	Y[4]	Y
42	Motor vehicle transportation	Y	Y	Y	Y[2]	Y[3]	Y[4]	Y
43	Aircraft transportation	Y	Y	Y	Y[2]	Y[3]	Y[4]	Y
44	Marine craft transportation	Y	Y	Y	Y[2]	Y[3]	Y[4]	Y
45	Highway and street right-of-way	Y	Y	Y	Y[2]	Y[3]	Y[4]	Y
46	Automobile parking	Y	Y	Y	Y[2]	Y[3]	Y[4]	N
47	Communication	Y	Y	Y	25[5]	30[5]	N	N
48	Utilities	Y	Y	Y	Y[2]	Y[3]	Y[4]	Y
49	Other transportation, communication and utilities	Y	Y	Y	25[5]	30[5]	N	N
50	**Trade**							
51	Wholesale trade	Y	Y	Y	Y[2]	Y[3]	Y[4]	N
52	Retail trade — building materials, hardware and farm equipment	Y	Y	Y	Y[2]	Y[3]	Y[4]	N
53	Retail trade — general merchandise	Y	Y	Y	25	30	N	N
54	Retail trade — food	Y	Y	Y	25	30	N	N
55	Retail trade — automotive, marine craft, aircraft and accessories	Y	Y	Y	25	30	N	N
56	Retail trade — apparel and accessories	Y	Y	Y	25	30	N	N
57	Retail trade — furniture, home furnishings and equipment	Y	Y	Y	25	30	N	N
58	Retail trade — eating and drinking establishments	Y	Y	Y	25	30	N	N
59	Other retail trade	Y	Y	Y	25	30	N	N

NOTES FOR TABLE 2

2. Measures to achieve NLR of 25 must be incorporated into the design and construction of portions of these buildings where the public is received, office areas, noise sensitive areas or where the normal noise level is low.

3. Measures to achieve NLR of 30 must be incorporated into the design and construction of portions of these buildings where the public is received, office areas, noise sensitive areas or where the normal noise level is low.

4. Measures to achieve NLR of 35 must be incorporated into the design and construction of portions of these buildings where the public is received, office areas, noise sensitive areas or where the normal noise level is low.

5. If noise sensitive use indicated NLR; if not use is compatible.

KEY TO TABLE 2

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NLR (Noise Level Reduction)	Noise Level Reduction (outdoor to indoor) to be achieved through incorporation of noise attenuation into the design and construction of the structure.
Y^X (Yes with restrictions)	Land Use and related structures generally compatible; see notes 2 through 4.
25, 30, or 35	Land Use and related structures generally compatible; measures to achieve NLR of 25, 30 or 35 must be incorporated into design and construction of structure.
25*, 30* or 35*	Land Use generally compatible with NLR; however, measures to achieve an overall noise reduction do not necessarily solve noise difficulties and additional evaluation is warranted.

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TABLE 2. SUGGESTED LAND USE COMPATIBILITY GUIDELINES (continued)

Land Use		Noise Zones/DNL Levels in L_{dn}						
SLUCM No.	Name	A 0-55	B 55-65	C-1 65-70	C-2 70-75	D-1 75-80	D-2 80-85	D-3 85+
60	**Services**							
61	Finance, insurance and real estate services	Y	Y	Y	25	30	N	N
62	Personal services	Y	Y	Y	25	30	N	N
62.4	Cemeteries	Y	Y	Y	Y[2]	Y[3]	Y[4,11]	Y[6,11]
63	Business services	Y	Y	Y	25	30	N	N
64	Repair services	Y	Y	Y	Y[2]	Y[3]	Y[4]	N
65	Professional services	Y	Y	Y	25	30	N	N
65.1	Hospitals, nursing homes	Y	Y*	25*	30*	N	N	N
65.1	Other medical facilities	Y	Y	Y	25	30	N	N
66	Contract construction services	Y	Y	Y	25	30	N	N
67	Governmental services	Y	Y*	Y*	25*	30*	N	N
68	Educational services	Y	Y*	25*	30*	N	N	N
69	Miscellaneous services	Y	Y	Y	25	30	N	N
70	**Cultural, entertainment and recreational**							
71	Cultural activities (including churches)	Y	Y*	25*	30*	N	N	N
71.2	Nature exhibits	Y	Y*	Y*	N	N	N	N
72	Public assembly	Y	Y	Y	N	N	N	N
72.1	Auditoriums, concert halls	Y	Y	25	30	N	N	N
72.11	Outdoor music shells, amphitheaters	Y	Y*	N	N	N	N	N
72.2	Outdoor sports arenas, spectator sports	Y	Y	Y[7]	Y[7]	N	N	N
73	Amusements	Y	Y	Y	Y	N	N	N
74	Recreational activities (incl. golf courses, riding stables, water recreation)	Y	Y*	Y*	25*	30*	N	N
75	Resorts and group camps	Y	Y*	Y*	Y*	N	N	N
76	Parks	Y	Y*	Y*	Y*	N	N	N
79	Other cultural, entertainment and recreation	Y	Y*	Y*	Y*	N	N	N
80	**Resource production and extraction**							
81	Agriculture (except livestock)	Y	Y	Y[8]	Y[9]	Y[10]	Y[10,11]	Y[10,11]
81.5 to 81.7	Livestock farming and animal breeding	Y	Y	Y[8]	Y[9]	N	N	N
82	Agricultural related activities	Y	Y	Y[8]	Y[9]	Y[10]	Y[10,11]	Y[10,11]
83	Forestry activities and related services	Y	Y	Y[8]	Y[9]	Y[10]	Y[10,11]	Y[10,11]
84	Fishing activities and related services	Y	Y	Y	Y	Y	Y	Y
85	Mining activities and related services	Y	Y	Y	Y	Y	Y	Y
89	Other resource production and extraction	Y	Y	Y	Y	Y	Y	Y

*The designation of these uses as "compatible" in this zone reflects individual Federal agencies' consideration of cost and feasibility factors as well as program objectives. Localities, when evaluating the application of these guidelines to specific situations, may have different concerns or goals to consider. For an indication of possible community reaction in residential environments at various levels of cumulative noise, Table D-1 in Appendix D should be consulted.

NOTES FOR TABLE 2

2. Measures to achieve NLR of 25 must be incorporated into the design and construction of portions of these buildings where the public is received, office ares. noise sensitive areas or where the normal noise level is low.

3. Measures to achieve NLR of 30 must be incorporated into the design and construction of portions of these buildings where the public is received, office areas, noise sensitive areas or where the normal noise level is low.

4. Measures to achieve NLR of 35 must be incorporated into the design and construction of portions of these buildings where the public is received, office areas, noise sensitive areas or where the normal noise level is low.

6. No buildings.

7. Land use compatible provided special sound reinforcement systems are installed.

8. Residential buildings require a NLR of 25.

9. Residential buildings require a NLR of 30.

10. Residential buildings not permitted.

11. Land use not recommended, but if community decides use is necessary, hearing protection devices should be worn by personnel.

KEY TO TABLE 2

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NLR (Noise Level Reduction)	Noise Level Reduction (outdoor to indoor) to be achieved through incorporation of noise attenuation into the design and construction of the structure.
Y^X (Yes with restrictions)	Land Use and related structures generally compatible; see notes 2 through 4.
25, 30, or 35	Land Use and related structures generally compatible; measures to achieve NLR of 25, 30 or 35 must be incorporated into design and construction of structure.
25*, 30* or 35*	Land Use generally compatible with NLR; however, measures to achieve an overall noise reduction do not necessarily solve noise difficulties and additional evaluation is warranted.

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Section 2. TECHNIQUES FOR DEALING WITH NOISE IN LAND USE PLANNING

There are many techniques that local governments can use to reduce the effect of noise on surrounding land uses. These techniques range from simply increasing public awareness of existing noise levels to the very drastic, but admittedly very effective step of public purchase of severely exposed land uses. The following table outlines some of these techniques. The table is not intended to be exhaustive. Rather it is presented simply to illustrate the range of techniques available to reduce the effect of noise on land uses.

The techniques are arrayed in order of increasing stringency and general effectiveness. The effectiveness of any given technique is, however, very much a function of the specific noise situation and the way in which the technique is applied. It should also be understood that often the most effective approach will be a *combination* of techniques such as enacting both zoning and building code requirements.

The table includes, for each technique, a brief general summary of current experience with the techniques. The column entitled "situation where most applicable" includes indications of inherent limitations to given techniques. The "comments" column is intended to provide general insights on how the techniques work.

TABLE 3. TECHNIQUES FOR DEALING WITH NOISE IN LAND USE PLANNING

TECHNIQUE	SITUATION WHERE MOST APPLICABLE	COMMENTS
I. Increasing Public Awareness		
a. Citizen Education	Anywhere	Can be an important factor in determining the marketability of homes and other land uses. Can have a direct effect on developers and builders. Use in combination with other actions.
b. Prior Notice of Noise Levels to Renters and Purchasers	Anywhere	Can be required by local ordinance. Enables renters and purchasers to choose environment with full information. May reduce or eliminate subsequent complaints or damage claims.
II. Coordination		
a. OMB Circular A-95 Process	Anywhere Federal and Federally assisted projects are proposed	Allows identification of noise problems in the review and comment of Federal and Federally assisted plans, programs and projects. Indirect control.
b. Environmental Assessment Process	Anywhere Environmental Impact Analyses are required.	Indirect Control. Increase awareness of noise. May discourage inappropriate projects. Mechanism to propose mitigation measures.
III. Providing Advisory Services		
a. Architectural or Planning Review	Where there is appropriate staff or funding.	Site-specific analysis for each case.
b. Design Assistance	Where there is appropriate staff or funding.	Allows inclusion of noise mitigation measures such as building attenuation, siting modification, berms, and barriers, etc.
c. Information Libraries	Anywhere	Passive advisory service.

Continued on following page

TABLE 3. TECHNIQUES FOR DEALING WITH NOISE IN LAND USE PLANNING (continued)

TECHNIQUE	SITUATION WHERE MOST APPLICABLE	COMMENTS
IV. Incorporating Noise Issues Into Comprehensive Planning Process	Where comprehensive planning process is established particularly where controls (zoning) must implement plan.	Works best when noise is considered a basic suitability factor along with others such as slope, soils conditions, etc. Should be addressed in all types of plans. May require enabling legislation.
V. Incorporating Noise Issues Into Environmental Management Programs	Where programs such as Areawide Waste Management, Air Quality, Coastal Zone Management, Prime and Unique Agricultural Lands and Floodplains and Wetlands are established.	These programs influence land use policy.
VI. Development Codes and Policies		
a. Subdivision Regulations and/or site plan approvals. Require Noise Reduction Considerations in site design (site orientation, buffers, barriers, etc.)	Where portions of development projects fall within noise exposure areas.	May not be applicable for airborne aircraft. May require enabling legislation.
b. Building codes. Require sound insulation, isolation, absorption in building construction	Where interior noise exposure can be reduced to acceptable levels and buildings should otherwise be prohibited.	Noise Level Reduction (NLR) up to 35 dB (15 dB above normal construction). Outdoor environment not protected. May require enabling legislation to use noise zones for building code restrictions. Difficult to apply retroactively. Local opposition to increased building costs possible Related to energy conservation. Requirements might also be incorporated into health and/or occupancy codes.

Continued on following page

TABLE 3. TECHNIQUES FOR DEALING WITH NOISE IN LAND USE PLANNING (continued)

TECHNIQUE	SITUATION WHERE MOST APPLICABLE	COMMENTS
VI. Development Codes and Policies — *continued*		
c. Special Permits and/or Special Planning Districts	Anywhere a permit granting system exists or can be started.	Site-specific analysis would be required for each case. May require enabling legislation.
d. Special Use Designations	Anywhere unique or special land characteristics exist (cultural or historic, scenic, wetlands, floodplains, prime agricultural lands, water supply sources).	Such areas may be noise exposed and those designations will normally assure noise compatibility. May require legislation.
e. Official Map	Anywhere streets exist or are planned.	Planned major streets should avoid noise sensitive areas and should encourage development in areas not exposed to noise.
f. Capital Improvements	Anywhere	Governmental constructed utilities, streets, and facilities should be sited to encourage compatible use and be in themselves compatible.
VII. Land Use Controls		
a. Zoning		
1. For compatible land uses	Anywhere	Should be based on a comprehensive plan. May require enabling legislation to use noise as a criterion. Not retroactive and can be removed upon short notice. Most effective for undeveloped areas.
2. To require buffer areas	Where noise source is at ground level.	Easy to implement in low density areas. Not effective for airborne aircraft. May require enabling legislation.
3. To require berms or barriers	Where noise source is at ground level.	Effective but care is needed to insure that it is aesthetically desirable. May require enabling legislation.

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TABLE 3. TECHNIQUES FOR DEALING WITH NOISE IN LAND USE PLANNING (continued)

TECHNIQUE	SITUATION WHERE MOST APPLICABLE	COMMENTS
VII. Land Use Controls — *continued*		
4. To allow cluster or planned unit development	For medium and large developments	Significant potential benefits. Builders can incorporate buffer areas without reducing number of units. May require enabling legislation.
VIII. Purchase Real Property Interests		
a. Fee Purchase		
1. For compatibility	Where noise levels are extreme	Attempts to contain worst noise effects within the right-of-way or site. May require enabling legislation.
2. For public use	Where public use is compatible and needed in that location.	Limited by need for compatible public uses.
b. Fee purchase and resale with development restrictions	Where other measures are impractical	Public authority may be reluctant. Local government may object to controls. Business may object to government becoming developer. Dependent on demand feasibility for compatible use. May require enabling legislation.
c. Easement (development rights) purchase	Where other measures are impractical	May be more practical than Fee Simple purchase. May require enabling legislation.
d. Agricultural Land Preservation District	Where land is suitable.	Requires appropriate legislation. Minimum site size of 50 acres is typical and usually allows a single farm residence. Presents possible bird strike hazards.
IX. Property Tax Incentives (open space, agricultural, etc.)	Where tax pressures exist on owners of undeveloped land.	Requires enabling legislation. Easy in many cases to implement. Cannot prevent incompatible development but can allow economically productive compatible land use.

Section 3. FEDERAL AGENCY PROGRAMS AND POLICIES

The purpose of this section is to briefly overview the noise policies and programs relating to land use of the following agencies:

- Department of Defense (DOD)
- Department of Housing and Urban Development (HUD)
- Environmental Protection Agency (EPA)
- Department of Transportation/Federal Aviation Administration (DOT/FAA)
- Department of Transportation/Federal Highway Administration (DOT/FHWA)
- Veterans Administration (VA)

The Federal noise policies and programs discussed in this section all share the common goal of protecting the public health and welfare with regard to noise. Most policies also state additional goals in recognition that noise is a specific constraint on particular agency missions. DOD, for example, states as a primary goal of its noise policy, the continuance of operational integrity at its airfields.

All of the policies address in varying degrees (and some not exclusively), transportation noise problems, particularly those of highways and airport systems. The policies concentrate on these noise sources not only because their noise problems are among the most pervasive, but because Federal agencies have assisted by providing billions of dollars for their construction and maintenance. Most, however, are actually owned and operated by local and State governments.

The major differences among the policies center upon the noise levels specified and the types of noise measures used or required. There are *four different types of noise levels* used in these policies:

- mitigation levels (e.g., FHWA design levels);
- levels required to protect the public health and welfare (e.g., EPA "levels" document);
- general planning (land use) levels (e.g., DOD);
- levels required for Federal assistance (e.g., HUD, VA) (these are similar to the general planning levels).

As Table 4 shows, a specific purpose is associated with each type of level. *Misuse of a particular type in any situation can produce erroneous results.*

Primarily because of differences in statutory authority, the noise policies differ in the kinds of noise actions and techniques emphasized. The FAA and EPA regulations, for example, stress source and operational controls for aircraft and highway vehicles while the FHWA policy, in the main, stresses noise mitigation (e.g., placement of noise barriers) at noise sensitive locations along highways. HUD and VA, on the other hand, require, in certain cases, that the receiver (e.g., residential development) be provided noise attenuation as a condition for mortgage insurance or assistance.

A brief overview of individual agency noise policies follows.

TABLE 4. FEDERAL AGENCY POLICY AND PROGRAM SUMMARY

AGENCY		1. DEPARTMENT OF DEFENSE (DOD)	2. DEPARTMENT OF HOUSING AND URBAN DEVELOPMENT (HUD)	3. ENVIRONMENTAL PROTECTION AGENCY (EPA)	4. DOT/FEDERAL AVIATION ADMINISTRATION (FAA)	5. DOT/FEDERAL HIGHWAY ADMINISTRATION (FHWA)	6. VETERAN'S ADMINISTRATION (VA)
Type of Program or Policy		Air Installations Compatible Use Zones (AICUZ) Program	HUD Noise Regulations	Health & Welfare Guidance	Aviation Noise Abatement Policy	Highway Noise Policy	VA Noise Policy
Key Documents		DOD Instruction 4165.57 (1977) Installation AICUZ Studies	24 CRF Part 51 Subpart B; Noise Assessment Guidelines (1980)	EPA "Levels" Document (1974)	DOT/FAA Aviation Noise Abatement Policy (1976) Advisory Circular: 150/5050-6 (1977)	FHPM 7-7-3 (1976)	Section VIII Appraisal of residential properties near Airports (1969)
Noise Levels	Title of Levels	Levels used as "reasonable" guidance to communities in planning	Levels which determine whether proposed sites are eligible for HUD insurance or assistance	Levels which are required to protect the public health and welfare with an adequate margin of safety	Levels used as "starting points" in determining noise/land use relationships	Design Noise Levels	Levels determining whether proposed sites are eligible for VA assistance
	Purpose of Levels	Guidance to communities for planning. Reflects cost, feasibility, past community experience, general program objectives and consideration of health and welfare goals.	See above. Levels can be used as general planning levels. Reflects cost, feasibility, general program objectives and consideration of health and welfare goals.	These levels identify in scientific terms the threshold of effect. While the levels have relevance for planning, they do not in themselves form the sole basis for appropriate land use actions because they do *not* consider cost, feasibility or the development needs of the community. The user should make such tradeoffs.	Guidance to communities for planning. Reflects safety, cost, feasibility, general program objectives and consideration of health and welfare goals.	These levels are used in determining where noise mitigation on a particular highway project is warranted. They do reflect cost and feasibility considerations. They are not appropriate land use criteria. Location Specific.	See above. Reflects cost, feasibility general program objectives and consideration of health and welfare goals.
	Source to which applied	Military Airfields	All sources	All sources	Civil Airports	Highways only	Airports only
	Noise Descriptors Used	DNL	DNL	DNL	DNL, (CNEL, California only)	L_{eq} or L_{10} for design hour	Various (including DNL)

Department of Defense (DOD)

Department of Defense policy for noise compatible land use guidance is called the Air Installation Compatible Use Zone (AICUZ). Each military service has an AICUZ program to investigate, describe, and study noise exposure and land use at all DOD air installations. AICUZ studies for each installation are prepared and given to the public and local, regional, state, and other federal agencies for use in their land use planning/control and intergovernmental programs and processes. Each study contains noise contours, accident potential zones, existing and future land use compatibilities and incompatibilities, land use planning/control recommendations.

Department of Defense Policy:

- Requires that all reasonable, economical, and practical measures will be taken to reduce and/or control the generation of noise from flying.
- Is to work toward achieving compatibility between air installations and neighboring civilian communities by means of a compatible land use planning and control process conducted by the local community.
- Requires working with local governments, local planning commissions, special purpose districts, regional planning agencies, state agencies, and state legislatures as well as other federal agencies.
- Includes technical assistance to local, regional, and state agencies to assist them in developing their land use planning and regulatory processes, to explain an AICUZ study and its implications, and generally to work toward compatible planning and development in the vicinity of military airfields.

Department of Housing and Urban Development (HUD)

The major purpose of the Department of Housing and Urban Development's (HUD) noise regulations (24 CFR Part 51 Subpart B) is to insure that activities assisted or insured by the Department achieve the goal of a suitable living environment. HUD also supports other agencies efforts in noise control.

The regulations generally apply to all HUD actions and provide minimum national standards to protect citizens against excessive noise in their communities and places of residence. The basic policy is that HUD assistance for construction of new noise sensitive uses is prohibited generally for projects with Unacceptable noise exposures and is discouraged for projects with Normally Unacceptable noise exposure. Unacceptable noise exposure is defined as a noise level above 75 dB (Day-night average sound level (DNL) in decibels). A Normally Unacceptable level is one above 65 dB but not exceeding 75 dB. These noise levels are to be based on noise from all sources, highway, railroad and aircraft.

Attenuation measures are normally required before projects in the Normally Unacceptable zone can be approved. Attenuation measures that reduce the external noise at a site are preferred, whenever practicable, over measures which only provide attenuation for interior spaces. HUD's noise regulations also apply to modernization and rehabilitation. For major or substantial rehabilitation projects in the Normally Unacceptable and Unacceptable

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noise zones HUD actively will seek to have noise attenuation features incorporated into the project. In the Unacceptable noise zones, HUD will strongly encourage conversion of noise exposed sites to more compatible land uses.

HUD also requires that Comprehensive Planning Assistance grantees give adequate consideration to noise as an integral part of the urban environment with particular emphasis being placed on the importance of compatible land use planning in relation to airports, highways and other sources of high noise. Recipients of community development block grants under Title I of the Housing and Community Development Act of 1974 must also take into consideration the noise criteria and standards in the environmental assessment process.

Environmental Protection Agency (EPA)

The EPA's Noise program is designed to provide leadership to the national noise abatement effort. The key statutory mandates under which EPA operates are the Noise Control Act of 1972 (PL92-574) and the Quiet Communities Act of 1978 (95-609).

Until recently, EPA's Program has concentrated its efforts in setting noise source emission standards for various products, including transportation vehicles, construction equipment and consumer products. EPA also proposes aircraft/airport regulations to the FAA following a special procedure specified in the Noise Control Act of 1972.

Key to these efforts have been EPA reports defining scientifically the relationships between noise level and human response. The EPA "Levels" Document established threshold levels of impact which, if met, would protect the public "with an adequate margin of safety". As noted in Table 4, while these levels have relevance for planning, they, in themselves, are *not* necessarily appropriate land use planning criteria because they do not consider cost, feasibility, or the development needs of the community.

The emphasis of EPA's program today is on assisting cities, States and others to develop and carry out effective noise programs through various approaches, including noise and land use. In addition to a new grants program under the Quiet Communities Act, EPA has initiated such technical assistance programs as The Quiet Communities Program (QCP) and Each Community Helps Others (ECHO). The QCP is a program focusing EPA guidance and fiscal resources on target communities to achieve total community involvement and action. The ECHO program provides technical assistance to local communities on specific noise problems consulting services from officials of communities who have successfully overcome similar problems. Various other programs emphasizing provision of information on noise to various publics are also being developed and carried out.

Department of Transportation/Federal Aviation Administration (DOT/FAA)

The Federal Aviation Administration's noise program is guided by the 1976 Aviation Noise Abatement Policy and the Aviation Safety and Noise Abatement Act of 1979. The policy defines the responsibilities of the FAA, airport proprietors and users, and land use planning and control authorities in achieving and maintaining airport noise compatibility. The FAA uses two major approaches to implement this policy. The first is aimed at reducing

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the noise of the individual aircraft. This includes a program to retrofit engines or equipment on noisy aircraft or to replace them with newer, quieter aircraft. It also includes the development of operational procedures which can reduce the aircraft's noise impacts.

The other major approach to noise compatibility is through planning and development activities at airports under the Airport and Airway Development Act of 1970 (as amended). Airport Noise Control and Land Use Compatibility (ANCLUC) planning studies integrate the master planning study activities, the environmental considerations, and the airport-land use compatibility planning activities at an airport. The objective is to achieve maximum noise and environmental compatibility within the constraints of safety, service, and economic viability. The plan may contain operational controls as well as physical improvements for the airport. It will also recommend, based upon a comprehensive study effort, land uses and strategies for land use control for areas around the airport impacted by noise. FAA's advisory circular, Airport-Land Use Compatibility Planning (AC 150/5050-6), serves as the basic guidance for the land use compatibility portion of an ANCLUC study.

The Aviation Safety and Noise Abatement Act of 1979 strengthens the FAA's noise policy by providing assistance to airport operators to prepare and carry out noise compatibility programs and providing incentives for replacing noisy aircraft with new technology aircraft. In compliance with this Act, the FAA will develop and promulgate an amendment to Part 150 of the Federal Aviation Regulations which will standardize airport noise abatement plans and provide for their review, specify standard noise metrics for use in airport noise assessments, and identify compatible land uses.

Department of Transportation/Federal Highway Administration (DOT/FHWA)

As a result of the Federal Aid Highway Act of 1970[1], the Federal Highway Administration (FHWA) is concerned with traffic and construction noise associated with Federal aid highways. Since 1972, FHWA has had a noise policy applicable to new highway construction. The focus of the policy is to elevate the consideration of noise exposure in Federal-Aid highway location and design decisions by requiring substantive study of future noise exposure in conjunction with standards featuring highway design noise levels. (These levels have a very specific purpose which is explained in Table 4. Since 1976, FHWA's policy has also provided for noise mitigation on existing Federal aid highways. The principal noise mitigation measure has been placement of barriers at noise sensitive locations.

FHWA also recognizes and supports other approaches to highway noise control. Although in the source control area FHWA's authority is limited to implementing interstate motor carrier noise standards issued by EPA, it supports legislation to reduce the noise levels of motor vehicles. In the land use area its authority (like that of the other Federal agencies discussed here) is limited to providing information and guidance.[2]

The FHWA noise policy applies to the Federal Highway program which (unique among the policies discussed here) is a state administrated program receiving Federal assistance. The noise policy is actually carried out as part of the overall environmental assessment process required by the National Environmental Policy Act. For each new highway, FHWA

[1]Act amended in 1973 and 1976.

[2]FHWA's key document in this area is *The Audible Landscape* (1974).

requires that state highway agencies furnish localities information on noise and land use. Furthermore, FHWA will normally not approve funds for barrier construction for areas which have become sensitive after May 24, 1976, unless localities have instituted land use controls over the remaining undeveloped lands adjacent to the highways.

Veterans Administration (VA)

The Veterans Administration (VA) policy for consideration of noise and land use planning is contained in separate statements. One statement is for the VA's Loan Guaranty Program and the other is for both the Department of Medicine and Surgery (DM&S) and the Department of Memorial Affairs (DMA).

The VA Loan Guaranty noise policy governs VA decisions as to whether residential sites in airport environs are "acceptable" for loan guaranty programs to eligible veterans and active duty personnel.

The VA Loan Guaranty noise policy features a set of three noise zones. In the case of new construction, all new developments located in the two higher zones generally are not eligible for VA assistance. There is flexibility in that if a local officer recommends acceptance, the VA Central Office will consider the case in light of geographic factors and proposed attenuation features,[1] as well as marketability. In the middle zone, it, therefore, may be possible to develop properties which will be acceptable for VA loans.

In all cases (existing as well as proposed properties) for sites located in the two higher zones, VA requires that a statement from each veteran purchaser be obtained indicating awareness that (a) the property being purchased is located in an area adjacent to an airport, and (b) the aircraft noise factor may affect normal liveability, value and saleability of the property.

The VA's Loan Guaranty Service conducts its business with veteran purchasers, lenders, builders and other sellers who are interested in VA's guaranty of the loan to an individual veteran purchaser. The Loan Guaranty Service rarely has any direct interaction with local authorities.

The policy for land acquisition and maintenance adhered to by DM&S and DMA considers noise in the environmental planning of all acquisition and construction programs. All new VA Medical Centers, domiciliaries, and other medical facilities are compatible or have been designed with noise attenuation features allowing them to be compatible with zones as defined in Table 2. All new VA National Cemetery Construction has generally been limited to Noise Zones A & B as described on Table 2 because of the nature of outdoor services. Guidelines for planning state facilities which are eligible for grant funds from DM&S or DMA programs are slightly relaxed leaving latitude to local conditions in planning requirements.

[1] Such as soundproofing, year round air conditioning and other treatment.

Appendix A

EXPLANATION OF ENVIRONMENTAL NOISE DESCRIPTORS

This appendix discusses various descriptors that Federal agencies have used to assess environmental noise. These descriptors can be categorized as to whether they are applicable to 1) all sources or 2) airport only.

1) *Applicable to all sources*

A. *Day Night Average Sound Level (DNL; scientific notation L_{dn})*

Day-Night average sound level[1], abbreviated as DNL and symbolized as L_{dn}, is the 24 hour average sound level, in decibels, for the period from midnight to midnight, obtained after addition of 10 decibels to sound levels in the night from midnight to 7 a.m. and from 10 p.m. to midnight. DNL is a measureable quantity and can be measured directly at a specific location, using portable monitoring equipment[2]. (When it is measured it is not necessary that the measurement begin at midnight.)

B. *Equivalent sound level (L_{eq})*

L_{eq} is the average sound level[1], in decibels, for any time period under consideration. If averaged over a 24 hour period, the only difference between it and DNL would be the 10 decibel night time weighting used in DNL.

In connection with its highway noise standards featuring design noise levels, FHWA uses an L_{eq} for the highway "design hour" as an alternative to the L_{10} descriptor. (The design hour is normally the 30th highest traffic volume occurring during the year.) Noise levels are predicted for the design year, which is normally 20 years from construction of the highway, and the noisiest hour of the day (usually the design hour). As indicated in Table II-1, under typical conditions the L_{eq} (design hour) approximately equals DNL.

---

[1]Average sound level — the level, in decibels, of the mean-square A-weighted sound pressure during a stated time period, with reference to the square of the standard reference sound pressure of 20 micropascals.

[2]It is important to note that L_{dn} contours derived from the use of noise prediction models do *not* necessarily reflect precise noise levels at specific locations. Typically, computer based airport noise prediction models forecast yearly average values for L_{dn}.

C. L_{10}

While this descriptor applies to any noise source, FHWA is the only Federal agency using it (as an alternative to L_{eq}). L_{10} is defined as the sound level that is exceeded 10 percent of the time for the period under consideration, which, in the case of FHWA, is the design hour. DNL under typical conditions approximately equals L_{10} – 3 decibels.

D. *Community Noise Equivalent Level (CNEL)*

The CNEL, developed for the State of California, is almost identical to the DNL, except that it introduces an intermediate weighting for the early evening hours between 7:00 p.m. and 10:00 p.m. in addition to the weighting for the nighttime hours (10:00 p.m. to 7:00 a.m.). CNEL, like DNL, is a measurable quantity and can be measured directly. DNL is approximately equal to CNEL in almost all situations.

2) *Measures applying to airport sources only*

A. *Noise Exposure Forecast (NEF)*

The NEF was developed in 1967 as a refinement of the composite noise rating (CNR). It takes into account the factors considered by the CNR plus the additional exposure factors of the duration of aircraft flyovers and of discrete (pure) tones such as turbine "whine". The NEF cannot be directly measured and requires a computer for noise contour development. DNL approximately equals NEF + 35.

REFERENCES FOR APPENDIX A

1. *Information on Levels of Environmental Noise Requisite to Protect Public Health and Welfare with an Adequate Margin of Safety; Environmental Protection Agency;* Report No. 550/9-74-004; March 1974 (document for sale by U.S. Government Printing Office, Stock No. 055-000-00120-1, $2.10).
   This document gives the technical basis for the L_{dn} and L_{eq} noise descriptors.
2. *Federal-Aid Highway Program Manual 7-7-3,* Federal Highway Administration, May 14, 1976, Washington, D.C.
   This document describes FHWA's design noise levels which are expressed in L_{eq} and L_{10}.
3. *The Adopted Noise Regulations for California Airports,* Title 4, Register 70, No. 48-11-28-70, Subchapter 6, Noise Standards (distributed by Documents Section, State of California, P.O. Box 20191, Sacramento, California 95820).
   Describes CNEL.
4. *Noise Exposure Forecast: Evolution, Evaluation, Extensions, and Land Use Interpretations;* W.J. Galloway and D.E. Bishop; Bolt, Beranek, and Newman, Inc.; Report No. FAA-No.-70-9; August 1970 (available through the National Technical Information Service, Springfield, Virginia 22151, No. AD 717-131, $5.25).

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5. *Procedures for Developing Noise Exposure Forecast Areas for Aircraft Flight Operations;* D.E. Bishop and R.D. Horonjeff; Bolt, Beranek and Newman, Inc.; Report No. DS-67-10; August 1967 (available through the National Technical Information Service, Springfield, Virginia 22151, No. AD 660-706, $5.25).

   These documents are basic references for the Noise Exposure Forecast.

6. *Land Use Planning Relating to Aircraft Noise;* W.J. Galloway and A.C. Pietrasanta; Bolt, Beranek, and Newman, Inc.; Technical Report No. 821; October 1964 (available through the National Technical Information Service, Springfield, Virginia 22151, No. AD-615-015, $5.25).

   This document describes the CNR methodology (which is no longer in general use).

Appendix B

ANNOTATED BIBLIOGRAPHY OF FEDERAL DOCUMENTS RELATED TO NOISE AND LAND USE ACTIVITIES

The purpose of this bibliography is to provide aid to all persons involved in noise and land use planning and decision making, including planners, elected officials, facility and land managers, the private development community and the general public.

This bibliography discusses only Federal agency publications which are relevant to noise and land use activities. A much more extensive list would result were Federal publications included which cover other noise subject areas of interest to State and local agencies (e.g., highway noise mitigation, construction noise, aircraft source regulation, etc.).

The bibliography is organized into two parts. The first part covers Federal noise regulations, guidance tools and manuals and special studies. The second part discusses relevant Congressional statutes.

Noise/Land Use Bibliography — Part I

DEPARTMENT OF DEFENSE (DOD)

1. "Air Installations Compatible Use Zones," Department of Defense Instruction 4165.57, 8 November 1977.

   This regulation sets forth the broad requirements for the Air Installations Compatible Use Zones (AICUZ) program while leaving implementation to individual military services.

2. "Intergovernmental Coordination of Defense Land and Facility Plans and Projects," Department of Defense Directive 4165.61, 16 December 1976.

   This directive gives DOD's intergovernmental coordination policy.

3. "Planning in the Noise Environment," Air Force Manual 19-10, TM-5-803-2 (Army), and NAVFAC P-970 (Navy), 15 June 1978.

   This is a noise description, reduction and planning handbook; includes noise and land use guidelines.

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4. *"USAF Air Installation Compatible Use Zone (AICUZ) Policy,"* June 1979.

   This document contains the U.S. Air Force AICUZ policy.

5. USAF Air Installation Compatible Use Zone (AICUZ) Handbook (Environmental Planning Bulletin 10) 2 Volumes, June 1979.

   This contains the procedures and guidelines for preparing AICUZ studies.

6. "Interagency/Intergovernmental Coordination of Land, Facility and Environmental Plans, and Programs." Air Force Regulation 19-9, 1980.

   This is the USAF's AICUZ and interagency/intergovernmental coordination policy.

7. "Air Force Handbook for Installation Coordination with Civilian Agencies: (Interim Environmental Planning Bulletin 14), two volumes, January 1978.

   This contains USAF's procedures for intergovernmental coordination at the local, regional and State levels.

8. "Air Force Handbook for Federal Agency Coordination" (Interim Environmental Planning Bulletin 15), January 1978.

   This contains procedures for Federal agency coordination; includes Federal agency directory.

9. "Intergovernmental Coordination of Department of the Navy Land Facility Plans, Projects, and Program," OPNAVINST 11010.35, 1979, U.S. Navy.

   This contains Navy intergovernmental coordination policy and procedures.

10. "Air Installation Compatible Use Zone Program (AICUZ)," OPNAVINST 11010.36, 1979, U.S. Navy.

    This contains Navy policy, procedures and guidelines for carrying out the AICUZ program at Navy and Marine Corps installations.

11. "Air Force Directory of State Environmental Planning Agencies," October 1977.

    Lists approximately 1300 State agencies.

12. "Air Installation Compatible Use Zone Studies," U.S. Air Force and U.S. Navy.

    These studies are published for each air installation.

ENVIRONMENTAL PROTECTION AGENCY (EPA)

1. *Information on Levels of Environmental Noise Requisite to Protect Public Health and Welfare with an Adequate Margin of Safety,* Environmental Protection Agency, Washington, D.C. (EPA 550/9-74-004), March 1974.

   This document is a scientific statement of threshold protective levels of noise without consideration of cost or feasibility or the needs of the community in any specific condition.

2. *Public Health and Welfare Criteria for Noise,* Report No. 550/9-73-002, Environmental Protection Agency, Washington, D.C., July 1973.

   This document contains published descriptive data on the effects of noise which might be expected from various levels and exposure situations.

3. *Model Community Noise Control Ordinance.* Environmental Protection Agency, September 1975.

   This model is intended as a basic tool for use by communities of various sizes in the development of noise control ordinances, (which can include land use provisions) tailored to their specific local conditions and goals.

4. *State and Municipal Noise Control Activities, 1973-74.* Environmental Protection Agency, Washington, D.C., January 1976.

   This report presents an assessment of the status of State and local noise control efforts and is intended as a reference guide for public administrators.

5. *Federal Noise Program Report Series: Volume I, Department of Defense: Air Installations Compatible Use Zones (AICUZ) Program,* Environmental Protection Agency, Washington, D.C., April 1977. (EPA 550/9-77-353).

   This report describes the features and problems of DOD's AICUZ program.

6. *Federal Noise Program Report Series: Volume II, Department of Housing and Urban Development: Noise Abatement and Control Policy,* Environmental Protection Agency, Washington, D.C., April 1977.

   This report discusses the features and problems associated with HUD's Noise Policy.

7. *Federal Noise Program Report Series: Volume III, Department of Transportation, Federal Highway Administration: Noise Policy and Related Environmental Procedures,* Environmental Protection Agency, Washington, D.C., July 1977. (EPA 550/9-77-357).

   This report describes the features and problems associated with FHWA's noise policy and related environmental procedures.

8. *Calculation of Day-Night Levels L_{dn} Resulting from Civil Aircraft Operations.* Environmental Protection Agency, Washington, D.C., January 1977.

   This report gives manual techniques for predicting aircraft noise levels in the environs of specific airports.

GENERAL SERVICES ADMINISTRATION (GSA)

1. *Compatible Land Uses at Federal Airfields.* Federal Management Circular 75-2: General Services Administration, 1975.

   This circular prescribes the Executive Branch's general policy with respect to achieving compatible land uses on either public or privately owned property at or in the vicinity of Federal airfields.

DEPARTMENT OF HOUSING AND URBAN DEVELOPMENT (HUD)

1. *"Environmental Criteria and Standards, Noise Abatement and Control, 24 CFR, Part 51, Subpart B,"* U.S. Department of Housing and Urban Development, July 12, 1979.

   This is the basic noise policy with quantitative noise standards and implementation procedures.

2. *Noise Assessment Guidelines.* W.J. Galloway and T.J. Schultz, Bolt, Beranek and Newman, Inc., prepared for the U.S. Department of Housing and Urban Development, 1980.

   These are guidelines for use in implementing the HUD noise regulation. They provide a tool for persons without acoustical training to perform preliminary estimates of the noise exposure at a site in relation to the HUD standards.

3. *HUD Noise Assessment Guidelines Technical Background.* W.J. Galloway and T.J. Schultz, Bolt, Beranek and Newman, Inc., prepared for the U.S. Department of Housing and Urban Development, 1980.

   This report discusses the need for noise abatement, the various techniques for measuring and describing noise and human responses to it. It gives technical background information for the development of site noise assessment techniques.

4. *Aircraft Noise Impact, Planning Guidelines for Local Agencies.* R. Dale Beland, Wilsey and Ham, Inc., prepared for the U.S. Department of Housing and Urban Development, 1972.

   This manual, based upon information developed in joint HUD-DOT studies and other case studies of aircraft noise abatement, provides a tool for local planners, local governments and others in developing a comprehensive aircraft abatement program through land use planning. GPO order number 2308-00214, NTIS order number PB213-020. Some of the technical data is a bit dated, but in general, still very useful.

5. Metropolitan Aircraft Noise Abatement Policy Studies, U.S. Department of Housing and Urban Development, 1971.
   a. MANAPS — O'Hare International Airport, Chicago, Ill., 1971.
   b. MANAPS — Cape Kennedy Regional Airport, East Central Florida Planning Council, 1971.
   c. MANAPS — J.F. Kennedy International Airport, N.Y., Tri-state Transportation Commission, 1971.
   d. MANAPS — Bradley International Airport, Windsor Locks, Conn., Capitol Regional Planning Agency, 1971.

6. *Noise in Urban and Suburban Areas: Results of Field Studies.* Bolt, Beranek and Newman, prepared for the U.S. Department of Housing and Urban Development, 1967. National Technical Information Service order number PB210-849.

   This study identifies significant noise sources, other than aircraft, known to create disturbances within the home. It analyzes the results of a social survey made to determine community responses to traffic noise.

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DEPARTMENT OF TRANSPORTATION/Federal Aviation Administration (DOT/FAA)

1. *"Aviation Noise Abatement Policy,"* DOT/FAA, November 1976.

   This discusses actions the Administrator of FAA and Secretary of DOT believe should be taken to reduce aviation noise impact on the people who live in areas surrounding airports. It defines the roles and responsibilities of airport operators, aircraft operators, affected communities and the FAA for noise compatibility.

2. *Airport-Land Use Compatibility Planning,* FAA Advisory Circular 150/5050-6, 1977.

   This is FAA's guidance for compatible land use planning in the vicinity of both new and existing airports. It provides ideas and techniques for planning as well as guidance which may be used in developing noise control plans as encouraged by the DOT/FAA Noise Abatement Policy of 1976.

3. *Airport Noise Control and Land Use Compatibility (ANCLUC) Planning under the Planning Grant Program,* FAA Order 5900.4, 1977.

   This document provides programming and planning guidance for ANCLUC planning.

4. *Noise Control Plans,* FAA Order 1050.11, 1977.

   This document provides FAA policy and procedures for airport noise control plans.

5. *Citizen Participation in Airport Planning,* FAA Advisory Circular 150/5050-4, 1975.

   This circular provides guidances for citizen involvement in airport planning.

6. *Policies and Procedures for Considering Environmental Impacts,* FAA Order 1050.1C, 1979.

   This order covers FAA procedures for environmental assessments for all FAA project actions.

7. *Airport Environmental Handbook,* FAA Order 5050.4, 1980.

   This order covers procedures for airport actions.

8. *Impact of Noise on People,* Federal Aviation Administration, Washington, D.C., 1977.

   This document summarizes known information concerning public health and welfare effects and reactions.

9. *Five Year Environmental Plan 1978-1982,* Federal Aviation Administration.

10. *Airport Development Aid Program Handbook,* FAA Order 5100.36, 1979.

11. *Certified Airplane Noise Levels,* FAA Advisory Circular 36-1B, December 1977.

    This circular provides noise level data for airplanes certified under FAR Part 36 since its publication on November 18, 1969.

12. *Estimated Airplane Noise Levels in A-Weighted Decibels,* AC 36-3A, June 11, 1980.

This circular provides listings of both certificated and uncertificated aircraft noise levels in A-weighted decibels, both ranked in descending order and listed by aircraft manufacturer. These values are intended to provide a consistent basis for comparison of noise levels of major aircraft models rather than of individual aircraft. Ranking of aircraft noise levels that occur under uniform Federal Aviation Regulation Part 36 certification conditions provides the best information currently available on the relative noisiness of civil aircraft over a wide variety of conditions.

13. *Integrated Noise Model, Version 1, January 1978.* Federal Aviation Administration.

This report discusses the model and its uses.

14. *FAA INM Basic User's Guide, Version 2, 1979.* Federal Aviation Administration.

This report contains the procedures for use of the Integrated Noise Model. (INM)

15. *INM Installation Manual, 1978.* Federal Aviation Administration.

This report contains instructions for installing the INM program.

16. *Report to Congress, Study, Feasibility, Practicability and Cost of Soundproofing of Hospitals, and Public Health Facilities Near Airports.* Federal Aviation Administration, July 1977.

This study, required by Section 26(3), Appendix B of the Airport and Airway Development Act Amendments of 1976 (P.C. 94-353), concludes that soundproofing of schools, hospitals, and public health facilities located near airports is a feasible and practicable means for alleviating aircraft noise impact.

17. *Planning for the Airport and its Environs: The Sea-Tac Success Story.* Federal Aviation Administration, Washington, D.C., April 1978.

This is a case study of airport planning in the environs of Sea-Tac Airport, Washington. It constitutes guidance for other communities upset with airport noise incompatibility problems.

18. *Community Involvement Manual,* FAA-EE-79-06, 1979.

This report gives additional guidance for conducting citizen participation activities.

19. *Developing Noise Exposure Contours for Federal Aviation Airports.* DOT-FA-75WA-3710, NTIS No. ADA 023429. December 1975.

This report presents a "desk top" method for developing noise contours for airports other than air carrier airports.

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DEPARTMENT OF TRANSPORTATION/Federal Highway Administration (DOT/FHWA)

1. *"A Statement of National Highway Transportation Policy,"* page 21, paragraph 2, Federal Highway Administration, December 1976, Washington, D.C.

   This document sets forth FHWA's policy on highway traffic noise. Noise control mitigation, land use and source control are discussed.

2. *"Federal-Aid Highway Program Manual 7-7-3,"* Federal Highway Administration, Washington, D.C., May 14, 1976.

   This document contains FHWA's noise standards for highways and requirements for Federal participation in highway noise mitigation.

3. *"The Audible Landscape: A Manual for Highway Noise and Land Use,"* Federal Highway Administration, Washington, D.C., November 1974, (Reprinted — August 1976).

   This document discusses various land use control techniques which communities can use in highway environs.

4. *Determination of Reference Energy Mean Emission Levels,* FHWA-OEP/HEV-78-1. Reagan, Jerry A., prepared for the Federal Highway Administration, Washington, D.C., July 1978.

   This report provides guidance for measurement of noise emission levels of motor vehicles and for using this measured data to compute reference energy mean emission levels.

5. *Highway Noise Barrier Selection, Design and Construction Experiences, Implementation Package 76-8,* Federal Highway Administration, Region 10. Snow, C.H., prepared for U.S. Department of Transportation, FHWA, Offices of Research and Development, Office of Engineering, Office of Environmental Policy, Washington, D.C., October 1976.

6. *Insulation of Buildings Against Highway Noise,* Davy, Bruce A. and Skale, Steven R., Wyle Research. Prepared for U.S. Department of Transportation, Federal Highway Administration, Office of Development, FHWA-TS-77-202. Washington, D.C., 1977.

   This manual provides highway engineers tools to assess the noise insulation requirements of buildings, to determine the effectiveness of existing buildings in insulation of interior space against highway traffic noise, and to evaluate the effectiveness of proposed modifications.

7. *A Guide to Visual Quality in Noise Barrier Design, Implementation Package 77-12.* Blum, Randolph F., The Organization for Environmental Growth, Inc., Prepared for the U.S. Department of Transportation, Office of Research and Development. Washington, D.C., July 1978.

   This report deals with the esthetic considerations of noise barrier design.

8. *Background Report on Outdoor-Indoor Noise Reduction Calculation Procedures Employing the Exterior Wall Noise Rating (EWNR) Method.* Mange, Gary E.; Skale, Steven R.; and Sutherland, Louis C., Wyle Research. Prepared for the U.S. Department of Transportation, Federal Highway Administration, Office of Development, Report No. FHWA-TS-77-220, Washington, D.C., March 1978.

   This is a background report on the procedures for evaluating outdoor-indoor noise reduction of structure in terms of the single number metric Exterior Wall Noise Rating (EWNR).

9. *Fundamentals and Abatement of Highway Traffic Noise.* Anderson, G.S.; Miller, L.N.; and Shadley, Fr. R., Bolt, Beranek and Newman, Inc. Prepared for U.S. Department of Transportation, FHWA, PB-222-703/1. Washington, D.C., June 1973.

10. *FHWA Highway Traffic Noise Prediction Model.* Barry, T. and J. Reagan, FHWA-RD-77-108, Federal Highway Administration, Washington, D.C., December 1978.

    This draft report describes FHWA traffic noise model. A predicted sound level can be calculated through a series of manual adjustments to the reference energy mean emission level.

VETERANS ADMINISTRATION (VA)

1. Veterans Administration, "*Section VIII Appraisal of Residential Properties Near Airports, 1969.*

   This contains the VA noise policy.

Noise/Land Use Bibliography — Part II

KEY CONGRESSIONAL STATUTES RELEVANT TO NOISE AND LAND USE

- Aviation Safety and Noise Abatement Act of 1979.

  This Act directs the Secretary of Transportation to take specific actions with respect to airport noise reduction.

- Quiet Communities Act of 1978.

  This Act directs the Environmental Protection Agency to assist States and Communities in carrying out their own noise control programs through the administration of a nationwide Quiet Communities Program.

- Federal Aid Highway Act of 1970, and 1973 and 1976 amendments.

  This series of legislation contains provisions directing the Federal Highway Administration to take specific actions with respect to highway noise, including the development and carrying out of noise standards for new highway construction and providing funding for noise mitigation on existing highways.

- Airport and Airways Development Act of 1970 and 1976 amendments.

  This legislation provides the Federal Aviation Administration's Grants Programs for airport planning and development including noise compatibility planning and sharing in the costs of certain airport noise abatement measures and activities.

- Noise Control Act of 1972.

  This Act requires all Federal agencies to carry out their programs in a manner so as to promote an environment free from noise that jeopardizes the health and welfare of the American public, and directs the Environmental Protection Agency to undertake certain noise abatement activities, including setting noise standards and furnishing technical assistance to State and local governments.

- National Environmental Policy Act of 1969.

  This Act requires that for all proposed Federal actions significantly affecting the quality of the environment, Federal agencies should prepare an environmental impact statement concerning the proposed action.

- Federal Aviation Act of 1968 and 1972 amendments.

  This law constitutes the basic authority for Federal regulation of Aircraft noise.

- The Department of Housing and Urban Development Act of 1965.

  This law provides that the Department of Housing and Urban Development may make such rules as may be necessary to carry out its duties and sets forth, as a matter of national purpose, the sound development of the Nation's communities.

Appendix C

ANNOTATED BIBLIOGRAPHY OF FEDERAL MANUALS AND OTHER DOCUMENTS RELATED TO NOISE ATTENUATION IN BUILDINGS

DEPARTMENT OF COMMERCE/National Bureau of Standards (DOC/NBS)

1. *Quieting: A Practical Guide to Noise Control.* Berendt, Raymond D., Corliss, Edith L.R. and Ojalvo, Morris, S., U.S. Department of Commerce, July 1976.

   This guide offers to the general lay reader practical solutions to various noise problems including recommendations for techniques for quiet in existing homes as well as for choosing a quiet home or apartment.

2. *Design Guide for Reducing Transportation Noise in and Around Buildings.* Pallett, David S., Wehrli, R., Kilmer, Roger D., and Quindry, Thomas L., U.S. Department of Commerce/National Bureau of Standards, April, 1978.

   This design guide presents a unified procedure for the selection of noise criteria in and around buildings, for the prediction of exterior and interior noise levels arising as a consequence of transportation systems operations, and for the evaluation of the adequacy of building designs with regard to environmental noise. Noise criteria levels are suggested in terms of equivalent sound levels (L_{eq}). Simplified predictive methods enable the estimation of noise levels from highways, railways, and aircraft. The sound isolation provided by the building shell is estimated by means of a new single-figure rating system. Finally, the manual suggests design manipulations which may make possible the improvement of the acoustic conditions in and around buildings.

3. *Acoustical and Thermal Performance of Exterior Residential Walls, Doors and Windows.* Sabine, H.J., Lacher, M.B., Flynn, D.R., and Quindry, T.L., U.S. Department of Commerce, November 1975.

   This manual is intended to assist in achieving improved design when both noise and energy conservation are to be considered. It describes the results of laboratory tests (109 acoustical, 48 thermal) conducted on typical residential exterior wall constructions and compares them with literature data on similar constructions.

4. *Noise Criteria of Buildings: A Critical Review.* Yaniv, Simone I. and Flynn, D.R., U.S. Department of Commerce, January, 1978.

   This report reviews existing criteria that could be applied to rating the noise environment in dwellings, and to rating noise isolation from outside to inside a dwelling. It concludes that the central problem is to select appropriate criteria for rating the interior noise environment. Once this is done, criteria for noise isolation can be derived directly and these in turn can be used to derive performance requirements for building elements, such as partitions and exterior walls.

DEPARTMENT OF DEFENSE (DOD)

1. *"Air Installation Compatible Use Zone Studies,"* U.S. Air Force and U.S. Navy.

   A standard appendix in each study gives recommendations for design and construction techniques for primarily residential construction to achieve various levels of noise reduction corresponding to the land use guidance contained in the main document.

2. *"Planning in the Noise Environment,"* Air Force Manual 19-10, TM-5-803-2 (Army), and NAVFAC P-970 Navy), 15 June 1978.

   This manual is a tool for installation planners to assist them in developing acceptable noise environments on military installations; contains some information on building acoustics.

3. TM-5-805-15, *U.S. Army Technical Manual on Architectural Acoustics.*

   This manual contains design information to provide occupant with satisfactory acoustical conditions within and protection from noise that may be injurious to health or welfare. Provides recommended techniques for reducing unwanted sounds.

4. *Facility Acoustic Parameters' Catalog.* Naval Environmental Support Service (AESO 330-76-02), January 1977.

   This provides a fundamental knowledge of architectural acoustics. Provides techniques for determination of Sound Transmission Class (STC) and composite transmission loss and for relating noise reduction to STC. Provides absorption and transmission loss data.

5. *Noise Reduction Technology Catalog.* Naval Environmental Support Service, AESO Report 330-70-01, January 1977.

   This report provides a fundamental acquaintance with the properties of noise and various techniques applicable to noise control. Provides absorption and transmission loss data for common building materials.

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DEPARTMENT OF HOUSING AND URBAN DEVELOPMENT (HUD)

1. *A Guide to Airborne, Impact, and Structure Borne Noise-control in Multi-family Dwellings.* Berendt, Raymond D., Winzer, George E., and Burroughs, prepared for U.S. Department of Housing and Urban Development, September 1961. NTIS order number PB210-849.

   This Guide incorporates a broad range of criteria appropriate for isolating airborne, impact, and structure-borne noise associated with residential construction. Sound classifications represented in the most common types of building construction are identified.

DEPARTMENT OF TRANSPORTATION/Federal Aviation Administration (DOT/FAA)

1. *"The Feasibility, Practicability and Cost of the Soundproofing of Schools, Hospitals, and Public Health Facilities Near Airports,"* Federal Aviation Administration, 1977.

   This study, required by Section 26(3), Appendix B of the Airport and Airway Development Act Amendments of 1976 (P.C. 94-353), concludes that soundproofing of schools, hospitals, and public health facilities near airports is a feasible and practicable means for alleviating aircraft noise impact.

DEPARTMENT OF TRANSPORTATION/Federal Highway Administration (DOT/FHWA)

1. *Insulation of Buildings Against Highway Noise.* Davy, Bruce A. and Skale, Steven R., Wyle Research, prepared for U.S. Department of Transportation, Federal Highway Administration, Office of Development, FHWA-TS-77-202. Washington, D.C., 1977.

   This manual provides highway engineers with the necessary tools to assess the noise insulation requirements of buildings, to determine the effectiveness of existing buildings in insulating interior space against highway traffic noise, and to evaluate the effectiveness of proposed modifications.

2. *Background Report on Outdoor-Indoor Noise Reduction Calculation Procedures Employing the Exterior Wall Noise Rating (EWNR) Method.* Mange, Gary E.; Skale, Steven R.; and Sutherland, Louis C., Wyle Research. Prepared for U.S. Department of Transportation, Federal Highway Administration, Office of Development, Report No. FHWA-TS-77-220, Washington, D.C., March 1978.

   This is a background report on the procedure for evaluating outdoor-indoor noise reduction of structure in terms of the single number metric Exterior Wall Noise Rating (EWNR), first reviews the basis of previous single number ratings emphasizing the Sound Transmission Class (STC). It is shown that the latter was initially designed to try to account for the relative loudness of interior noises in typical residences as heard by adjoining neighbors on the other side of a common party wall.

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In a similar, but quite independent manner, the EWNR metric was developed so that the A-weighted indoor noise level, due to highway noise sources outdoors, could be roughly estimated directly from the value of EWNR and the A-weighted outdoor noise level. The basis for this is defined, first in terms of the basic theory for noise reduction from outdoors to indoors at one frequency. The result is then summed over all frequencies to give the overall effective noise reduction. The EWNR single number rating replaces this complex summation and, as shown by recently conducted field tests, provides a valid method with an accuracy of about ±3 dB for predicting levels inside buildings due to outdoor transportation noise sources.

This background report also briefly reviews the basis for the tables of EWNR values and tables of various EWNR adjustment factors used to evaluate the composite noise reduction of A-weighted noise levels for a wide range of practical residential structural assemblies which may include walls, windows, doors, roofs, and ceilings.

3. *Guide to the Soundproofing of Existing Homes Against Exterior Noise.* Wyle Research, prepared for city of Los Angeles Department of Airports (1970). Reprinted with permission by Federal Highway Administration, Office of Development, 1977.

   This manual is for the designer in selecting and conceptualizing various methods of soundproofing existing homes. This guide presents the various successful methods used in a 1970 pilot project to increase the noise reduction capabilities of existing houses for the Los Angeles Department of Airports. Three categories of modification from minor to extensive are covered. The guide also provides a basic understanding of the elements of noise control and the systematic method of soundproofing houses. This guide expands the repertory of methods and techniques of reducing the impact of highway traffic noise on its neighbors.

DEPARTMENT OF AGRICULTURE (DOA)

1. Jones, R.E., "Effects; of Flankling and Test Environment on Lab Field Correlation of Airborne Sound Insulation," *Journal of the Acoustical Society of America,* 57(5), 1975, 1138-1149.

2. Jones, R.E., "Field Sound Insulation Evaluation for Two Auxiliary Walls," USDA Forest Service Research Paper No. FPL-244, Forest Products Laboratory, Madison, WI, 1975.

3. Jones, R.E., "How to Accurately Predict the Sound Insulation of Partitions," *Sound and Vibration* 10(6), pp. 14-25, 1976: Errata *Sound and Vibration* 10(11), 1976, p. 15.

4. Jones, R.E., "Insulation Evaluation of Load Bearing Sandwich Panels for Housing," Forest Products Laboratory, Madison, WI., 1975 NTIS No. PB 244-152/AS.

5. Jones, R.E., "Laboratory-Field Correlation for Airborne Sound Transmission Through Party Walls," USDA Forest Service Research paper No. FPL-240, Forest Products Laboratory, Madison, WI., 1975.

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6. Jones, R.E., "Sound Insulation Evaluation of Several Single-Row-of-Wood Stud Party Walls Under Laboratory and Field Conditions, USDA Forest Service Research paper No. FPL-241, Forest Products Laboratory, Madison, WI., 1975.

7. Jones, R.E., "Sound Insulation of High Performance Wood Frame Party Partitions Under Laboratory and Field Conditions," USDA Forest Service Research paper No. FPL-309, Forest Products Laboratory, Madison, WI., April 1978.

Appendix D

EFFECTS OF NOISE ON PEOPLE

Environmental noise affects health and welfare in many ways. Table D-1 describes some aspects of the effect of noise on people in residential areas to varying levels of cumulative exposure. As stated in the main portion of this document, it can be used as an important input to the local land use decision making process. For a further discussion of the effects of noise consult the bibliography on the following page.

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TABLE D-1. EFFECTS OF NOISE ON PEOPLE
(Residential Land Uses Only)

Effects[1] / Day-Night Average Sound Level in Decibels	Hearing Loss	Speech Interference		Annoyance[2]	Average Community Reaction[4]	General Community Attitude Towards Area
		Indoor	Outdoor			
	Qualitative Description	% Sentence Intelligibility	Distance in Meters for 95% Sentence Intelligibility	% of Population Highly Annoyed[3]		
75 and above	May Begin to Occur	98%	0.5	37%	Very Severe	Noise is likely to be the most important of all adverse aspects of the community environment.
70	Will Not Likely Occur	99%	0.9	25%	Severe	Noise is one of the most important adverse aspects of the community environment.
65	Will Not Occur	100%	1.5	15%	Significant	Noise is one of the important adverse aspects of the community environment.
60	Will Not Occur	100%	2.0	9%	Moderate to Slight	Noise may be considered an adverse aspect of the community environment.
55 and below	Will Not Occur	100%	3.5	4%		Noise considered no more important than various other environmental factors.

1. "Speech Interference" data are drawn from the following tables in EPA's "Levels Document": Table 3, Fig. D-1, Fig. D-2, Fig. D-3. All other data from National Academy of Science 1977 report "Guidelines for Preparing Environmental Impact Statements on Noise, Report of Working Group 69 on Evaluation of Environmental Impact of Noise."
2. Depends on attitudes and other factors.
3. The percentages of people reporting annoyance to lesser extents are higher in each case. An unknown small percentage of people will report being "highly annoyed" even in the quietest surroundings. One reason is the difficulty all people have in integrating annoyance over a very long time.
4. Attitudes or other non-acoustic factors can modify this. Noise at low levels can still be an important problem, particularly when it intrudes into a quiet environment.

NOTE: Research implicates noise as a factor producing stress-related health effects such as heart disease, high-blood pressure and stroke, ulcers and other digestive disorders. The relationships between noise and these effects, however, have not as yet been quantified.

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HEALTH EFFECTS BIBLIOGRAPHY

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2. Bugliarello, George, *Noise Pollution: A Review of Its Techno-Sociological and Health Aspects,* (Biotechnology Program: Carnegie-Mellon University, Feb., 1968), p. 52.

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7. Welch, B.L. and Welch, A.S., *Physiological Effects of Noise,* New York: Plenum Press, 1970, p. 57.

8. *Information on Levels of Environmental Noise Requisite to Protect Public Health and Welfare with an Adequate Margin of Safety,* (EPA 550/9-74-004), Mar. 1974.

9. *Some Considerations in Choosing an Occupational Noise Exposure Regulation,* prepared for the U.S. Environmental Protection Agency by MIT Center for Policy Alternatives, (EPA 550/9-76-007), pp. 2-40, 2-41, and 118.

10. *Report to the President and Congress on Noise,* Report of the Administrator of EPA in compliance with Title IV of the Public Law 91-6004: The Clean Air Act Amendments of 1970 (Washington, D.C.; U.S. EPA, Feb., 1972), pp. 1-42.

11. Cohen, Alexander, "Effects of Noise on Psychological State", *Proceedings of the Conference on Noise As a Public Health Hazard,* ASHA, No. 4, Feb. 1969, p. 84.

12. Tanaka, Y., and T. Arayama, in *Practica: Oto-Phino-Laryngo-Logica,* 31, (1969), p. 269.

13. Scibetta, J.J., and M.G. Rosen, in *American Journal Obstet. & Gynec.,* 33 (1969), p. 830.

14. Statement by A. Stanley Weltman in Public Hearing on Physiological and Psychological Effects on Noise, Boston (Oct. 23-9, 1971), p. 123.

15. Ando, Y., and H. Hattori, "Effects of Noise on Human Placental Lacotgen (NPL), Levels in Maternal Plasma", *British Journal of Obstetrics and Gynec.*, 84 (Feb. 1977), p. 115.

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17. Cohen, S., D.C. Glass and J.E. Singer, "Apartment Noise, Auditory Discrimination, and Reading Ability in Children", *Journal of Exp. and Social Psychology*, 9, No. 5, (1973), pp. 407-422.

18. The Superintendent of Schools of Inglewood, CA, before Congressional Subcommittee, in *The Social Impact of Noise*, EPA report, (Dec. 1971), p. 20.

19. *Public Health and Welfare Criteria for Noise*, (EPA 550/9-73-002), 1973, pp. 8-20, 6-7.

20. Miller, "Effects of Noise on People," *Journal of the Acoustical Society of America*, 56, No. 3, (Sept. 1974), pp. 757. 743.

21. Federal Railroad Administration, Advanced Notice of Proposed Rulemaking, "Protection of Railroad Maintenance-of-Ways-and-Structure Employees", *Federal Register*, Vol. 40, No. 76, April 18, 1975, pp. 17265-6.

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Appendix E

FEDERAL AGENCY POINTS OF CONTACTS FOR ADDITIONAL INFORMATION

DEPARTMENT OF DEFENSE (DoD)

1. Office of the Secretary of Defense

   A. Deputy Assistant Secretary of Defense
   (Energy, Environment and Safety)
   Pentagon, Room 3E784
   Washington, D.C. 20301 (202) 695-0221

   B. Deputy Assistant Secretary of Defense
   (Installations and Housing)
   Pentagon, Room 3E760
   Washington, D.C. 20301 (202) 695-7804

2. United States Army

   A. U.S. Army Environmental Hygiene Agency
   Bioacoustics Division
   Aberdeen Proving Ground, Maryland 21010

   B. Headquarters, Department of the Army
   DAEN-Z-CE
   Washington, D.C. 21010

   C. Headquarters, Department of the Army
   DAEN-MPE-I
   Washington, D.C. 20314

   D. Commander/Director
   CERL
   P.O. Box 4005
   Champaign, Illinois 61820

DEPARTMENT OF DEFENSE (DoD) (continued)

3. United States Navy

   A. General:

   Office of Chief of Naval Operations (OP-04E)
   Department of the Navy
   Washington, D.C. 20350 (202) 325-0090

   B. Specific for Individual Installations
   Commanding Officer of Installation involved

4. United States Air Force

   A. General:

   Environmental Division (AF/LEEV)
   Directorate of Engineering and Services
   Headquarters U.S. Air Force
   Washington, D.C. 20330

   B. General — Standard Federal Regions I-IV:

   Environmental Planning Division (AFRCE/ROV)
   USAF Regional Civil Engineer/Eastern Region
   526 Title Building
   Atlanta, GA 30303

   C. General — Standard Federal Regions V-VIII:

   Environmental Planning Division (AFRCE/ROV)
   USAF Regional Civil Engineer/Central Region
   Main Tower Building
   1200 Main Street
   Dallas, TX 75202

   D. General — Standard Federal Regions IX-X:

   Environmental Planning Division
   USAF Regional Civil Engineer/Western Region
   630 Sansome Street
   San Francisco, CA 94111

   E. Specific for Individual Installations:

   Environmental Planning Section (DEEV)
   Base Civil Engineer

DEPARTMENT OF HOUSING AND URBAN DEVELOPMENT (HUD)

A. General:

Director
Environmental Planning Division
Office of Environmental Quality
451 7th Street, S.W.
Washington, D.C. 20410 (202) 755-8909

B. Specific for Individual Projects:

Environmental Clearance Officers in HUD Regional and Area Offices

ENVIRONMENTAL PROTECTION AGENCY (EPA)

A. Headquarters

Office of Noise Abatement and Control
Washington, D.C. 20460 (703) 557-7634

B. Regions

Region I
JFK Building
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Region II
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Atlanta, GA 30308 (404) 881-4861

Region V
230 South Dearborn St.
Chicago, IL 60604 (312) 353-2202

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First International Bldg.
1201 Elm Street
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Region VII
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Kansas City, MO 64106 (816) 374-3307

ENVIRONMENTAL PROTECTION AGENCY (EPA) (continued)

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DEPARTMENT OF TRANSPORTATION/Federal Aviation Administration (DOT/FAA)

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B. Ofice of Airport Planning and Programming (APP-600)
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A. Headquarters
Office of Environmental Policy
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Region V 18209 Dixie Highway Homewood, IL 60430	(312) 799-6300 FTS 370-9112
Region VI 819 Taylor Street Fort Worth, TX 76102	(817) 334-3221 FTS 334-3433
Region VII 6301 Rockholl Road P.O. Box 19715 Kansas City, MO 64131	(816) 926-7421 FTS 926-7421
Region VIII 555 Zang Street P.O. Box 24256 Denver, CO 80225	(303) 234-4051 FTS 234-4051
Region IX 2 Embarcadero Center P.O. Box 7616 Suite 530 San Francisco, CA 94111	(415) 556-3850 FTS 556-3366
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