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AIRPORT NOISE ABATEMENT PLANNING



U.S. Environmental Protection Agency
Washington, D.C. 20460

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A key strategy in the campaign against aviation noise is airport noise abatement planning. The U.S. Environmental Protection Agency, under the Congressional mandate of the 1972 Noise Control Act, has developed an airport noise abatement planning process which is a step by step approach to a quieter environment.

This pamphlet – for citizens and community leaders – provides an introduction to this planning process.

Is Aviation Noise Abatement Vital?

Why make the effort to reduce aviation noise?

To ask that question is to ask how much a community values its airport, or indeed whether it wants an airport at all.

Noise is clearly a threat to the health of communities which depend on their airports for jobs, growth and countless other economic and social benefits. Legitimate environmental concern about noise has led to delays and cancellations of plans to expand existing airports or build new airports. The community must decide how much it wants these benefits and whether it will make an effort to safeguard them.

Noise is indeed a part of aviation. Even a glider makes some noise. Airplanes also are subject to physical laws that restrict the manner in which they fly. Airplanes cannot make sharp turns in flight to avoid specific land areas. And safety is of course the prime concern in all aspects of aviation. In noise abatement, as in most other physical situations, there are practical limits to what can be accomplished.

Even with all the limits, much of the airplane noise impact on people living around airports today is unnecessary. This pamphlet shows there is no mystery about how to reduce aviation noise impact.

Part of the aviation noise impact is, of course, due to airplanes which operate near populated areas. However, another part of the same impact may be due to the poorly planned development of populated areas near airports.

We do know how to reduce the impact of aviation noise. We've simply not gotten together to do it. Confrontation over noise between the airport and the community leads nowhere but to stalemate and suit. The anger on both sides grows and problems remain. Cooperative effort by the community and the airport to explore the possibilities for noise abatement represents their best hope for co-existence and mutual prosperity.

The best time to do airport noise abatement planning is when there is no present noise problem at an airport and proper planning can prevent the creation of a problem as the airport grows. Some of our most serious airport noise situations today could have been prevented if noise problems had been considered *before* the airport expanded or residential development was allowed to encroach on the airport. Even in the case of these more seriously impacted airports, however, noise abatement planning can often help to reduce the extent of the existing noise problem.

Now is the time to begin.

DEVELOPING THE AIRPORT NOISE ABATEMENT PLAN

Who Will Lead?

We all have a shared and common responsibility to lead the efforts which are needed to reduce the impact of aviation noise on our communities and to insure the maintenance of our valuable air transportation system.

The technical lead in developing airport noise abatement plans should, however, logically be taken by the airport proprietor which is usually a state, county, city, or a port authority incorporated to operate transport facilities.

The courts have held generally that the airport proprietor is financially liable for loss of property values due to aircraft noise even though the proprietor cannot order aircraft to fly in a particular manner or even, in most cases, control the use of land near the airport.

The airport proprietor also is in a good position to bring together and to consult with all the public and private interests involved in noise abatement. These interests include airlines, airline pilots, aircraft manufacturers, local elected officials, land use planners and private citizens who live near the airport. Solutions to the aviation noise problem require the full participation of all these interested parties.

The Citizen's Right To Participate

Individual citizens or citizen groups who want to take part in airport noise abatement planning — or want to get the process started where none exists — may contact their elected officials, members of their port authority board of directors or airport management. These persons are sensitive to citizen concern about the aviation noise impact problem.

Affected citizens have the right to participate in the process of finding solutions to the aviation noise impact problem. Decisions about how airports and communities can best co-exist are not matters of technical judgment alone. They involve value judgments about the quality of life a community wants. Of course, it helps to research a problem before speaking out. Information and assistance may also be obtained from the headquarters or regional offices of the U.S. Environmental Protection Agency and the Federal Aviation Administration.

The Sound of Noise

Unpleasant, annoying or unwanted sound is defined as noise.

Whether a sound is noise or not may be a subjective decision depending on individual perception and even taste. A sound that is loud, harsh, inharmonious and painful to one person's ears may be music to another's. Unwanted sound is nevertheless a workable description of noise. The sounds of a powerful jet aircraft may evoke a sense of well being or pride in some people. However, to most people trying to relax, talk or even sleep, that same sound is noise.

The dB's of Noise Measurement

Sound is a form of energy which is transmitted through the air and received by our ears. How do we measure sound?

Technicians have found it convenient to use a logarithmic scale to describe the extremely wide range of energy levels which we perceive as sound. The logarithmic unit is expressed in decibels (dB).

Since decibels are logarithmic units, sound levels cannot be added by ordinary arithmetic. For example, if one jet produces a sound level of 90 dB when it passes overhead, two simultaneous jet flyovers would not produce 180 dB. Two jets, each with a sound level of 90 dB, would have a combined level of 93 dB. Other sound levels combine similarly as shown on the chart below.

Decibel Addition Rules for Combining Sound Levels

When two decibel values differ by:	Add the following amount to the higher value:
0 or 1 dB	3 dB
2 or 3 dB	2 dB
4 to 9 dB	1 dB
10 dB or more	0 dB

"A" Weighting For The Human Ear

The human ear responds more sensitively to some frequencies than to others. Sound measurement devices have been designed to account for the characteristics of the ear through the use of special electrical weighting networks. The most commonly used network — the A-weighted one — approximates the manner in which the human ear responds to sound. This unit of measurement is commonly referred to as decibels measured on the A-scale or dB(A).

The A-weighted levels of common environmental noises are:

Sound Levels dB(A)	Sound Sources
130	Air raid siren
110	Rock music
100	727 on takeoff, at 1/4 statute mile
90	Busy street corner
80	Garbage disposal
70	Vacuum cleaner
60	Ordinary conversation
30	Watch ticking
10	Rustle of leaves

The above examples all reflect decibel levels generated by specific single noise events. In reality, one's noise exposure during any day is a composite of many different exposures.

The cumulative exposure measure recommended by EPA for all community noise studies and planning is the Day-Night Average Sound Level (L_{dn}).

L_{dn} is the 24-hour average sound level expressed in dB(A), with a 10 decibel penalty applied to noise events from 10 p.m. to 7 a.m. The penalty for nighttime noise events accounts for the increased sensitivity of most people to noise in the quiet nighttime hours. "L" in the expression stands for average noise level, "d" for day and "n" for night with a 10 dB penalty added.

THE AIRPORT NOISE ANALYSIS METHOD: STEP BY STEP

Determining the location and severity of aviation noise problems around an airport is the first step in the process of planning for noise abatement.

EPA has developed a straight forward method of analyzing the noise situation around an airport. It is called the Airport Noise Evaluation Process (ANEP), and is based upon use of Day-Night Average Sound Level (L_{dn}). The EPA methodology is based upon the simple proposition that aviation noise abatement can only reduce that portion of the noise level in a community which is produced by aircraft. That is to say, one must first determine if the community noise problem is mainly due to aircraft, partly due to aircraft, or hardly due to aircraft.

Before using the ANEP methodology, it is important to understand the different kinds of noise that play a role in determining the contribution of aircraft noise to the total noise level in a particular area.

Indigenous Noise

Indigenous sound levels are the day-night average levels generated by activities and sources common to residential neighborhoods, but not including noise from major highways, airplanes, trains and industries. Indigenous noise is mainly due to all types of motor vehicles operating in the community, on the local streets.

Background Noise

When indigenous noise is added to the noise from major highways, trains and industries, the total is called Background Noise.

Aviation Noise

Aviation noise is that caused by airplanes operating on an airport and in the airspace around it.

Total Noise

The total noise level, in decibels, is the logarithmic sum (remember decibel addition rules for combining sound levels) of community background and aircraft noise levels. For example, if the background level is 65 dB and the aircraft level 72 dB, the total level is 73 dB. The spread between levels here is 7 dB, which requires the addition of 1 dB to the higher value.

Incremental Aircraft Impact

Incremental aircraft noise is the arithmetic difference between the total sound level and the community background level. For instance, with a total sound level of 77 dB and a background level of 69 dB, the incremental aircraft impact is 8 dB.

With this understanding of the several different kinds of noise that exist in a community, the planner can move ahead to the Airport Noise Evaluation Process.

THE AIRPORT NOISE EVALUATION PROCESS

The Airport Noise Evaluation Process is the EPA's method to determine what part of the total noise level in an area is due to aircraft operations. The process can be used to describe the existing situation to determine a "baseline" and then it can also be used to describe proposed airport operations and community developments. A comparison of any future case with the baseline indicates the noise impact reduction benefits of the proposal.

In the Airport Noise Evaluation Process, a picture of the total community noise level is built up from aircraft noise levels and community background levels.

Aircraft Noise Levels

Aircraft noise levels, at any point on the ground, are predicted in terms of the Day-Night Average Sound Level for all of the aircraft which use the airport. The EPA has developed a handbook for aircraft noise prediction which describes the information which you must gather about the airport, includes all of the aircraft sound level values, and shows how to combine the information to produce aviation noise predictions. This handbook, *Calculation of Day-Night Levels (L_{dn}) Resulting from Civil Aircraft Operations*, EPA 550/9-77-450 is available through:

United States Environmental Protection Agency
Office of Noise Control Programs (AW-471)
Washington, D.C. 20460

Community Background Levels

Community background levels are also predicted in terms of the Day-Night Average Sound Level and the EPA has developed a handbook for estimating community levels, *Community Noise Level Estimation*, which is available at the address noted above.

Community noise levels are developed from readily available planning-type information such as residential population in census tracts, developed and undeveloped land areas, proximity to highways, etc.

Incremental Aircraft Impact

Using the EPA's handbooks on aircraft noise prediction and community noise estimation, aircraft and community levels can be developed for all of the land area which surrounds the airport. For each such land area, the aircraft and community levels can

be added (remembering the rule for logarithmic addition) to determine the total noise level and the community level can be subtracted from the total to determine the Incremental Aircraft Impact. For example, if the aircraft level is 65 dB and the community level is also 65 dB, the total level is 68 dB and the Incremental Aircraft Impact is 3 dB (68 dB less 65 dB). When this process is utilized for all of the land areas around the airport the result is a "picture" of where the aircraft noise impact is located and how many people are impacted at each level of aircraft noise increment.

The Airport Noise Evaluation Process provides an overall display of an airport's noise problem. The planner learns from the process how much airplane noise is reaching how many people.

Now the planner must consider different ideas and options for noise abatement using the same evaluation process.

Broadly speaking, these options fall into three categories:

- Reduce the noise at the source -- the airplane engine and airframe.
- Reduce the noise of aircraft and airport operations.
- Control the uses of land around the airport to prevent or remove noise sensitive developments.

The United States has more than 450 major airports serving an American fleet of some 2200 large jets and thousands of other aircraft, including those of foreign nations. Each of these airports is different -- in location, size, mission, runway layout and pattern of surrounding land uses. Therefore, each airport may have its own peculiar noise problem, requiring solutions that must be tailored to the specific site.

Airport noise abatement planning is simply a systematic evaluation and selection of those options for abatement that will work best at a given airport. Each abatement option can be tested for its potential by using the Airport Noise Evaluation Process. First, the planner works with the current operations for a picture of the noise problem as it now exists. Then, he applies the process to each idea for noise reduction to see whether it will improve the picture. This is a way, in effect, of changing how the airport is operated, but only on paper. The process is relatively inexpensive, rational, and understandable to both technician and layman alike.

SOME OF THE OPTIONS FOR NOISE ABATEMENT

As we have said before, there is no mystery about what can be done to reduce aviation noise impact. A great many options are available. Since each airport is a unique case, options should be evaluated in the context of the particular airport. Just because a specific option was effective at Airport A does not mean that it will be equally effective at Airport B.

Each noise abatement option may require different organizations for approval and implementation. For example, any option which may affect safety will require approval from the FAA. Some are more expensive and more difficult to implement. Some of the potentially effective noise abatement options are the following:

- Actions that the airport proprietor can implement directly:
 - (1) location of engine run-up areas;
 - (2) time when engine run-up for maintenance can be done;
 - (3) establishment of landing fees based on aircraft noise emission characteristics or time of day.
- Actions that the airport proprietor can implement directly if he has authority, or propose to other appropriate local authorities:
 - (1) plan and control of land use adjacent to the airport by zoning or other appropriate land use controls, such as utility expenditures and the issuance of building permits;
 - (2) enact building codes which require housing and public buildings in the vicinity of airports to be appropriately insulated; and
 - (3) require appropriate notice of airport noise to the purchasers of real estate and prospective residents in areas near airports.
- Actions that the airport proprietor can implement directly in conjunction with other appropriate local authorities and with financial assistance from the FAA, where appropriate:
 - (1) acquire land to insure its use for purposes compatible with airport operations;

- (2) acquire interests in land, such as easements or air rights, to insure its use for purposes compatible with airport operations;
 - (3) acquire noise suppressing equipment, construction of physical barriers, and landscape for the purpose of reducing the impact of aircraft noise; and
 - (4) undertake airport development, such as new runways or extended runways, that would shift noise away from populated areas or reduce the noise impact over presently impacted areas.
- Actions that the airport proprietor can propose to FAA for implementation at a specific airport as operational noise control procedures:
 - (1) a preferential runway use system;
 - (2) preferential approach and departure flight tracks;
 - (3) a priority runway use system;
 - (4) a rotational runway use system;
 - (5) flight operational procedures such as thrust reduction or maximum climb on takeoff;
 - (6) higher glide slope angles and glide slope intercept altitudes on approach; and
 - (7) displaced runway threshold.
 - Actions an airport proprietor can establish, after providing an opportunity to airport users, the general public and to FAA to review and advise:
 - (1) restrictions on the use of or operations at the airport in a particular time period or by aircraft type, such as:
 - (a) limiting the number of operations per day or year;
 - (b) prohibiting operations at certain hours — curfews;
 - (c) prohibiting operation by a particular type or class of aircraft; and
 - (2) any combination of the above.

- Actions an airport proprietor can propose to an airline:

- (1) Shifting operations to neighboring airports.
- (2) Rescheduling of operations by aircraft type or time of day.

The noise abatement options described here are not theoretical — they are practical, effective, and they have been used at specific airports and in specific combinations. What must be done is to determine which of the options is most effective at your airport and then, through a cooperative effort, put those options to work. This has been done at some airports and it has been effective. For example, at Wold-Chamberlain International Airport, Minneapolis, Minnesota, there are restrictions on engine run-ups, limitations on night flights, and new noise abatement approach and departure procedures. At Seattle International Airport, there is a noise abatement plan which includes the outright purchase of highly impacted property, resale guarantee on other properties, and acoustic insulation of many other homes.

LET'S GET ON WITH THE JOB

Airplanes will always make noise. No ideal solutions to the problem are known, particularly where airports already are surrounded by hundreds of thousands of people. But the impact of noise on airport neighbors can be reduced. That much is apparent.

If the airport and the community cooperate in developing and implementing a noise abatement program and a community compatible land use program they can live together with a degree of harmony. The airport can grow to meet air transport needs of the community. The community can continue to develop and enjoy the economic and other benefits that increased air traffic represents — in greater peace and quiet.

It is likely that elements of any noise abatement plan will require approval of the FAA, especially when they involve aircraft operations. If the community and the airport join together to present an agreed upon plan to the FAA, the odds of getting plan approval are that much greater. This is the time for the community to get together, perhaps as a citizens advisory committee, to work with the airport so that the job can get done. The climate for positive action has never been better.

Let's get on with the job.

NOTE: EPA's film *Jet Roar* is available free of charge for showing to any audiences interested in obtaining a better understanding of the aviation noise problem, its solutions, and what the communities are doing to deal with the problem. To obtain the film contact any office of Modern Talking Picture Service Inc. or write to the EPA Regional Noise Representative listed for your area.

EPA REGIONAL NOISE REPRESENTATIVES

EPA Region	States	Address	Noise Representatives
I	Maine, N.H., Vt., Mass., R.I., Conn.	JFK Building Room 2113 Boston, Mass. 02203	Mr. Al Hicks (617/223-5708)
II	N.Y., N.J., P.R., V.I.	26 Federal Plaza Room 907G New York, N.Y. 10007	Mr. Tom O'Hare (212/264-1000)
III	Pa., Md., Del., W. Va., Va., D.C.	Curtis Building Room 225 6th & Walnut Sts. Philadelphia, Pa. 19106	Mr. Patrick Anderson (215/597-9118)
IV	N.C., S.C., Tenn., Ky., Miss., Ga., Fla., Al.	354 Courtland St., N.E. Atlanta, Ga. 30308	Dr. Kent Williams (404/881-4861)
V	Wisc., Ill., Mich., Ohio, Ind., Mn.	230 S. Dearborn Chicago, Ill. 60604	Mr. Horst Witschonke (312/353-2205)
VI	N. Mex., Okla., Ark., La., Tex.	1600 Patterson St. Room 1107 Dallas, Texas 75201	Mr. Mike Mendias (214/749-3837)
VII	Nebr., Kans., Iowa Mo.	1735 Baltimore St. Kansas City, Mo. 64108	Mr. Vincent Smith (816/374-3307)
VIII	Mont., N. Dak., S. Dak., Wyo., Utah, Colo.	1860 Lincoln St. Suite 900 Denver, Colo. 80203	Mr. Robert Simmons (303/337-2221)
IX	Calif., Nev., Ariz., Hawaii	100 California St. San Francisco, Calif. 94111	Dr. Richard Procunier (415/556-4606)
X	Wash., Oreg., Idaho Alaska	1200 Sixth Avenue Room 11C Seattle, Wash. 98101	Ms. Deborah Yamamoto (206/442-1253)