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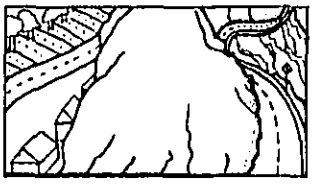
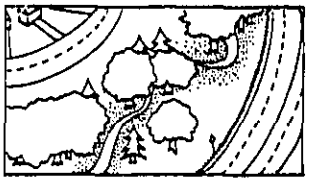
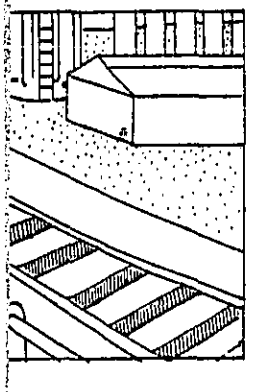
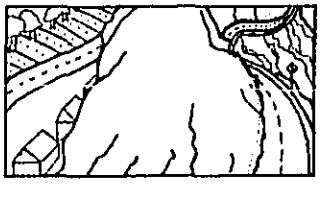


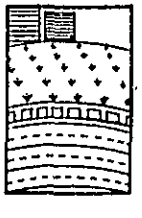
Quiet Communities:

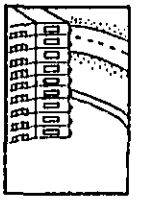
Minimizing the Effects of Noise through Land Use Controls

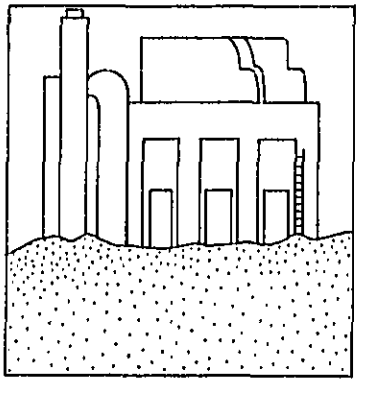


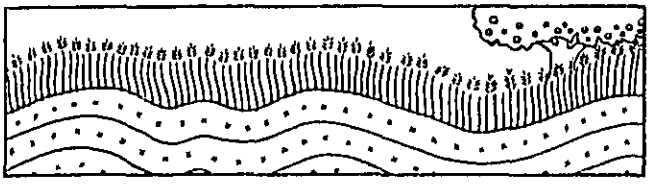


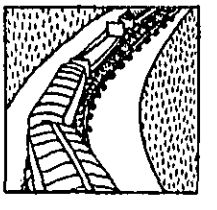












Quiet Communities:

Minimizing the Effects of Noise through Land Use Controls

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Table of Contents

Preface

ntil recently noise was not usually considered a factor in planning and regulating land use. A change in outlook is now occurring because of an increase in noise levels and an increase in the land area affected by noise.

Local governments now rely on land use regulations to protect people from threats to the public health, safety and welfare and to shape urban growth into a rational and efficient pattern of development.

Since noise is one threat to the public health, safety and welfare, land use controls are a valid means of combatting this problem.

This handbook is not designed as a general introduction to the problem of noise. Nor is it a compendium of all the techniques which could be used to control noise in your community. Rather, it focuses on land use plans and regulations as one way of controlling noise.

Executive Summary

ighway, railroad and airport noise are serious problems in many counties and cities and the potential for an increase in transportation noise is great.

There are three possible solutions to any noise problem: abate noise at the source, block the noise, or keep people away from the noise. This handbook explains techniques which fall into the last two categories.

The first step in noise control planning is to find out how severe the noise problem is. Use of prediction models is a common method of mapping noise levels along highways and railroads and around airports. The models are also useful in plotting projected noise levels near planned facilities such as a new or reconstructed highway, a new airport runway or a general aviation airport which will have increased commuter traffic or even air carrier service in the future.

Once you locate the noise or potential noise problem, you can plan future land use to keep noise-sensitive land uses—homes, schools and churches—away from high-noise areas. Wherever possible, the land in a high-noise area should be planned for noise-compatible (insensitive) uses such as factories, shopping centers or farmland.

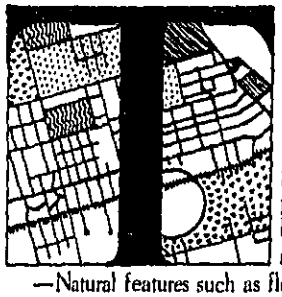
The land use plan can be implemented in several ways, the most important being an amendment to the zoning ordinance. Using the noise map in conjunction with the zoning map, you can either keep noise-sensitive uses out of the high-noise areas or, if land is scarce and demand is high, permit such uses if the noise is blocked by barriers or the occupants protected by acoustical insulation.

Where the noise level is very high, soundproofing the noise-sensitive uses may not be enough. You may have to purchase land or compensate the owner in some other way to keep the land in agriculture or open space use. This is a common approach used around airports and, although it is expensive, it is sometimes necessary.

Another important technique is to keep new roads and water and sewer lines out of the high-noise areas, thus limiting the pressure to develop this land for residential use.

The handbook suggests other techniques which could be used to deal with airport, highway, railroad, industrial and motorcycle noise. The appendices provide the tools you will need to implement the techniques: an explanation of how noise is measured and noise levels are predicted; recommended noise standards, to be used with land use controls, taken from existing ordinances and research documents; a discussion of legal problems you might encounter in implementing the land use controls; and a bibliography.

Comprehensive Land Use Planning



The purpose of comprehensive land use planning is to identify and designate compatible uses for land. How the land should best be used can be determined by a number of criteria including:

- —Natural features such as floodplain, steep slopes, wetland, mineral-bearing land or prime farmland;
- —Availability of or proximity to water and sewer lines, streets or highways, schools or parks;
- —Recent and projected commercial, industrial and residential growth;
- —Health, safety or welfare dangers—including noise, air or water pollution.

The comprehensive plan goes beyond merely designating compatible use. The plan (sometimes called a master or general plan) is a guide for local government showing the desired pattern and density of urban development and indicating areas for future public improvements, services and facilities. The plan often gives a timetable for future development and outlines the regulatory and administrative measures needed to implement the plan.

Planning for noise control can be handled as a part of the comprehensive planning process. However, since many plans were drawn up before noise was recognized as an existing or potential problem, most existing plans need to be amended to consider noise and noise control.

Comprehensive planning for noise control encompasses the following steps:

- —Problem identification and description;
- —Policy analysis and formulation;
- —Land use plan development;
- —Assessment of implementation techniques;
- —Choice of implementation techniques;
- —Implementation

Problem Identification and Description

The first step in the noise control planning process is to identify and describe the noise problem.

For transportation noise you can use a predictive model to estimate the noise levels and affected areas. Models ranging from simple to quite complex are available from the Environmental Protection Agency (EPA) and Department of Transportation (DOT). (See Appendix A.)

The model results will give you a map of transportation noise, much like a topographic map, except that the contour lines represent noise levels rather than elevation. (See back page.) On-site measurement is a valuable supplement to the model and necessary at places where you have received complaints or where the model gives unusually high or low estimates.

Industrial noise need not be mapped. A community noise ordinance can set limits to industrial noise measured at the industry's property line. So the industry has the responsibility of abating its own noise.

Transportation noise is not so easily handled. Local governments cannot regulate it with property line standards as they can with industrial noise, so the noise must be mapped and other noise control measures used.

The noise map is essential, not only to find out if you have a problem and what the severity of the problem is, but also as a part of your land use regulation. It is important to remember that the noise map may change over time as new technology and regulation decrease the transportation noise at the source, or variation in the number of vehicles or flights increases or decreases the noise levels.

Policy Formulation

The next step involves judgment. You must decide how serious the noise problems are and what your local government can reasonably expect to do about them. These are policy decisions.

The interrelated questions are what level of quiet you wish to achieve (policy decision), what you can achieve (technological and statutory limitations) and what you and your community can afford to achieve (economic limitations).

The three elements of noise—source, path, and receiver—make the problem complex and the solution difficult to implement because they may not all be completely within your control.

Local government can establish policy on source reduction and control by adopting the federal standards for new products and passing regulations to control misuse (e.g., faulty muffler) or to regulate place and hours of operation. But your standards may not be stricter than the federal standards.

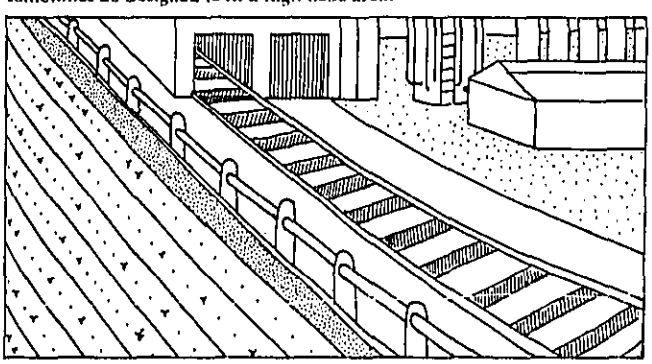
At the same time, local government should concentrate on the path and

receivers of noise. Land use controls are meant to either lengthen the path of the sound or permit only those uses compatible with noise. Other approaches, related to land use controls, are to block the path of sound by a barrier or insulate the receiver from the noise.

A major policy decision is what noise standards (levels) are appropriate for particular land uses. By setting standards you are deciding which land uses are incompatible with noise.

Because noise is a relative term, you must decide what is "noisy." You have to be realistic and take into account the existing ambient noise level of your community. Several sets of standards are attached to the handbook as Appendix B. These standards are meant to be used as guides.

In general, agriculture, mining, forestry and recreation, along with office, commercial or industrial buildings, are considered noise-compatible land uses. Residences, churches, schools, hospitals, nursing homes and outdoor amphitheaters are often considered noise-sensitive (incompatible) land uses. The best strategy is to keep these uses out of high-noise areas. By use of the techniques described later in the handbook, the sensitive land uses can sometimes be designed to fit a high-noise area.



Several federal noise compatibility standards have land use control implications. (See Appendix B.) The Department of Housing and Urban Development (HUD) standards are used by that agency to assess the suitability of a site for residential use. HUD can refuse federal housing assistance or mortgage insurance in high-noise areas. Many banks and mortgage companies voluntarily use the HUD standards to minimize their risk.

The Federal Highway Administration (FHWA) has a set of "design noise levels" (Appendix B) which are not intended to be land use standards although they have frequently been used as such. FHWA recommends noise levels lower than its "design levels" be used in land use planning.

Land Use Plan Development

After you have a clear idea of what the noise sources are, what areas they affect, and what your noise standards are, you can take the next step—evaluating your present land use patterns and future land use needs. At this stage you should not be concerned with individual lots or parcels of land, but focus on the larger picture of your entire jurisdiction. You should ascertain the amount of land available for new development and the projected growth in terms of residential, commercial and industrial land needed.

Deciding how much land is available for development takes you back to the standards. If you determined during policy formulation that only agricultural and open space uses are appropriate for your high-noise areas, then that land is not available for development.

Assuming your land use plan is already complete, you would see how much of the land you originally designated for development will remain suitable for development once you have considered noise.

Land exposed to moderate or high levels of noise should be used for the noise-compatible uses you have designated. And the land with little or no noise exposure is then used for residences and other noise-sensitive uses.

But if the projected demand for residences exceeds the amount of land in the low-noise area, you may have to consider using land in a moderate- or high-noise area. In this case the residences could be allowed only if the developer uses noise-mitigation measures (as described later in the handbook).

Once you know where you want new development (or redevelopment) to take place, the next step is planning the streets, highways, water and sewerage lines to serve the development. Looked at from another perspective, the public facilities can be used as "growth shapers," keeping development out of high-noise areas. (More on this later in the handbook.)

Planned highways, railroad lines or airport runways can themselves be sources of future noise. They should be located and designed to minimize noise exposure. Planners often find themselves in a dilemma when they try to increase density to carry out policies of saving land, energy and travel time. The prime sites for the increased density may also be high-noise areas. If the land is destined for noise-sensitive uses, noise-mitigation measures may be necessary.

Assess Implementation Techniques

The bulk of this handbook is devoted to this step. A wide range of land use control options is presented for your consideration. Each technique has certain strengths and weaknesses. Some techniques will be suited to your community and your plan and some will not.

Implementation Techniques

any of the implementation techniques described below are comprehensive land use regulations. They are used to handle a variety of problems, only one of which is noise. So, when considering any of these techniques, be sure to supplement this handbook with further ready and study. (See Bibliography, Appendix D.)

Choosing a particular technique depends on your local situation. Your choice may be limited by lack of state enabling legislation. Some of the techniques have been challenged in court with varying success. The legality of the technique may therefore vary from state to state. So it is important to check with your legal counsel before adopting any one of them.

Implementation techniques fall into two categories:

—Those which say you cannot use a given property for a particular use;

—Those which tell you how you must protect persons on the land, if you want to locate noise-sensitive activities in a high-noise area.

Zoning

The purpose of zoning is to prevent conflicts between land uses and to shape urban growth in a rational, efficient pattern, based on the comprehensive plan.

The authority for local governmental zoning comes from state enabling legislation and is based on the police power. Local government can regulate private property to protect the public health, welfare, safety and morals.

Zoning is the delineation of districts or zones where certain uses of land are allowed and others prohibited. A zoning ordinance may also regulate the density, setback from street, height or bulk of structures placed on the land.

Zoning can control noise in two ways:

—Zoning controls nontransportation sources (industry being the major source in this category) by delineating the residential, commercial and industrial districts which form the basis of a community noise ordinance;

—Zoning controls transportation noise by prohibiting or limiting land uses in high-noise areas near highways, railroads and airports.

Community noise ordinances are usually structured around noise limits (standards) for residential, commercial and industrial zoning districts. (Sample community noise standards are found in Appendix B.) Within any zoning district the noise level (measured at the property line) may not exceed the standard for that district.

Communities without zoning can also adopt a community noise ordinance. Here, the standards would not apply to zoning districts but to the existing uses of the land. An industry could then conceivably be required to lower its noise if an adjacent lot were used for residential and not industrial use. In this case a zoning ordinance would protect the interests of industry.

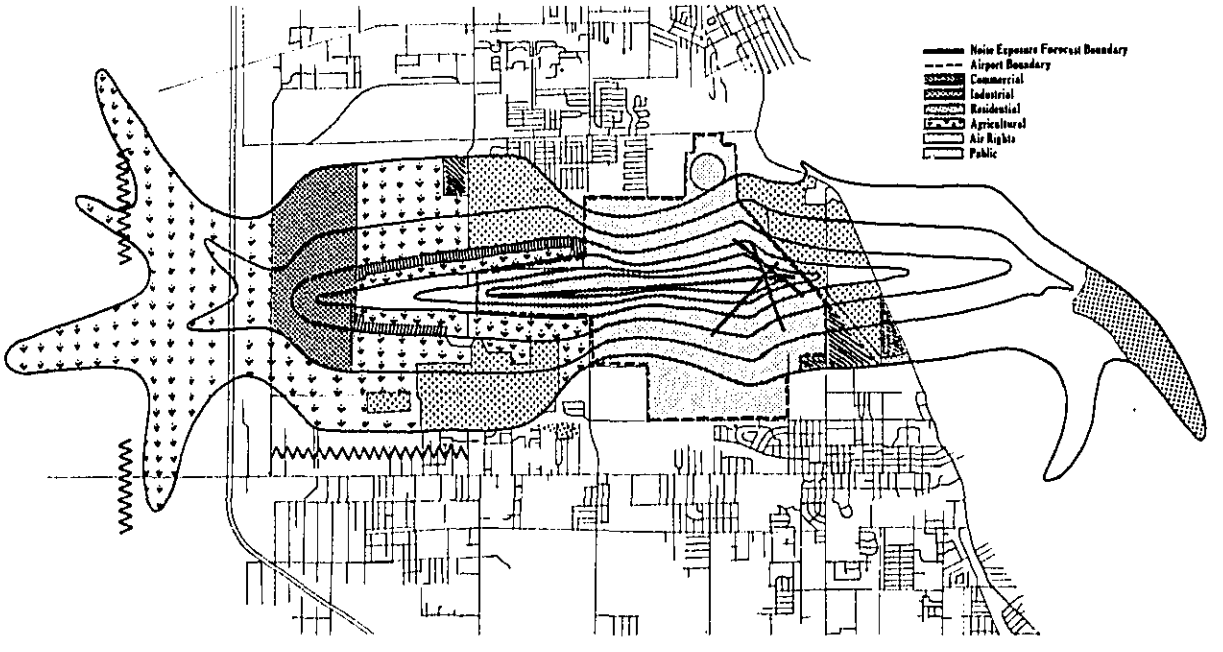
Another use of zoning is to regulate land use in areas affected by transportation noise. Zoning is an excellent technique for restricting high-noise areas to compatible uses.

The zoning map should reflect the recommendations of the land use plan. The land use plan is the legal backup and justification for the zoning ordinance. Land use plans are increasingly referred to by judges when deciding a zoning case. Based on the land use/noise compatibility decisions you made in the planning process, the zoning map should designate low-, moderate- and high-noise areas for land uses compatible with the different levels of noise. You could use the noise map as an overlay sheet over your current zoning map and thereby make the noise map an integral part of the zoning ordinance.

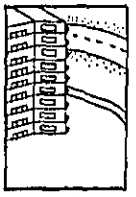
If the high-noise areas are designated for commercial or industrial use, the text of the zoning ordinance should specifically prohibit residential use in these commercial or industrial zones. Many zoning ordinances have a cumulative type of zoning whereby residential use is allowed by right in any zone.

The same point holds for districts zoned for agricultural use. A common approach is to permit low-density residential development along with farm and farm-related uses. Even with low-density, residences may still be adversely affected by airport noise.

If the zoning ordinance prohibits residential use in a high noise area, or zones land for industrial use where there is little likelihood it is needed, the landowner may file suit on the grounds the regulation is too harsh. The "taking" issue, as it is widely referred to, is discussed in Appendix C.


Noise Exposure Forecast Boundary
Airport Boundary
Commercial
Industrial
Residential
Agricultural
Air Rights
Public

Special Permit

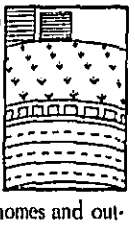


You can build flexibility into the zoning ordinance by allowing special permits (also called special exceptions or conditional use permits) for land uses which are generally prohibited in high noise areas. In order to gain permission, the developer must prepare the site and construct the building so the noise will not affect the users. In the text of the zoning ordinance, you should specify the noise limits (performance standards) for interior and exterior noise. (Where a building code is in force, techniques useful in meeting the interior standards could be explained in the code.)

You should use the standards you developed in the policy formulation of the planning process as the performance standards. For noise-sensitive uses where exterior use is not as important, large apartment buildings for example, you may want to set only interior standards.

A variety of techniques should be suggested as ways to control the noise to conform with the performance standards. The techniques (described in detail later in the handbook) deal with the design of the site and the building. A special permit could come in two stages: the first being a permit to begin construction. The second permit is given after a noise measurement is made to confirm that the noise level is at or lower than the performance standard.

Special Projects



The zoning ordinance should allow the developer to design a planned unit development where the buildings are clustered and the resulting open space is used as a buffer between the noise source and receivers. The typical approach allows construction on smaller lots than normally permitted but the total number of building units is not increased because the remaining land is kept as open space.

Regulation of the location of schools, hospitals, nursing homes and outdoor recreation areas, especially an amphitheater or other noise-sensitive use, is also a critically important responsibility for local government. Sometimes the location of these uses is decided outside the regular zoning process, presumably because they are public facilities. They should be treated the same as any private project.

In some communities where land is scarce, the space above highways and railroads looks increasingly attractive for new apartments or office buildings. The potential for noise and air pollution is obviously very great. Use of the air rights may be permitted under the special permit process. You could grant a permit if the developer met your interior noise standards.

Zoning is not an effective tool for correcting existing noise problems. It cannot require residents to move. But zoning could be used to encourage a

general change in the character of an area, from noise-incompatible to compatible use. This will be most effective when the area is already in transition.

Health Code

For local governments without zoning, the health code offers a way to protect people from noise. You could add the noise standards to your existing health code, applicable to all new residences built in your jurisdiction. The developer would then know that he must either build something other than residences or design them in such a way that the noise is controlled.

Along with the standard you should suggest noise-mitigation measures which are described later in the handbook.

The permit system would work along the lines of the special permit with a preliminary and final permit based on the developer's plans for mitigating the noise and his actual performance in meeting the standards.

Subdivision Regulations

Where the local government does not have a zoning ordinance, and where state enabling legislation allows, the noise performance standards (Appendix B) could be included in the subdivision regulations to control land use along highways and railroads. Since subdivision law pertains only to land and how it is developed (streets, drainage, water and sewerage), the interior noise standard is not applicable in this ordinance.

The developer could be required to submit preliminary and final plats for approval, with final approval tied to meeting the exterior noise standard.

The subdivision regulations could include a description of possible exterior mitigation measures. Because every piece of land is different in terms of noise exposure, topography, vegetation and so on, it is of doubtful value to require any particular design.

Where the local government has zoning, the strongest legal position is to have the noise standards in both ordinances.

Capital Improvements Program

Construction of new streets, water and sewerage lines to an area tends to spur residential development. Coordinating your capital improvements with your comprehensive plan would mean providing capital improvements to designated growth areas and not to areas affected by noise.

This technique is most useful in airport environs. If you have zoned the airport environs for no residential development, do not designate the area for future water or sewerage service and do not include it in a water or sanitary district or the landowner may legally insist on service in the future.

Programming capital improvements is not a substitute for zoning control. Rather it is a complementary technique. If your zoning map shows no residential development around the airport, but your improvements program shows service for the area, it would be difficult to refuse a rezoning request in the area.

Building Code

The building code itself is not a land use control technique. It can only regulate how new buildings are constructed. A good approach is to make sure the code requires conformance to your interior noise standards in the designated high-noise areas. The building code manual could explain various techniques for soundproofing walls, windows, doors and ceilings. The code should require an adequate ventilation system for buildings with sealed windows.

Disclosure of Noise Level

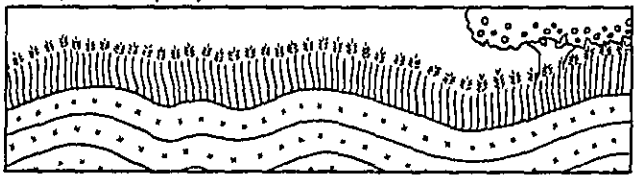
A useful technique for protecting prospective homeowners or renters is to require notice of the property's noise exposure in property deeds and rental leases. The notice should be in clear, simple language and be given good visibility in the deed or lease. All too frequently, people buy a home or rent an apartment on the weekend when noise levels are relatively low. The notice alerts the unsuspecting.

A possible drawback to this technique is the question of how many people will comprehend what the noise exposure (as measured in decibels) really means to them.

Public Acquisition of Land

The simplest, but most expensive, approach is to buy land in high-noise areas and thus keep the land free of any type of incompatible development. Taking land by eminent domain for noise control is fraught with legal and political hazards. Local governments may wish to buy the land and then sell it or lease it with deed or lease restrictions on future land use (no noise-sensitive uses allowed) or with the requirement that the building be insulated.

Or, the local government could purchase the development rights to the property, thus keeping the land free from development and in agricultural, forestry or other open space use.

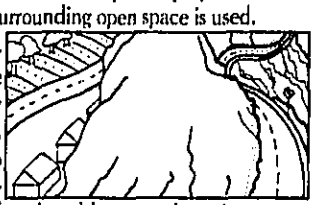


Physical Techniques

The following techniques are not in themselves land use control techniques. They are meant to complement the zoning and subdivision regulations. They are particularly appropriate for use with a special permit procedure. (See section on zoning ordinance.) Each site will need analysis to determine which technique or combination of techniques will give the most protection.

Site Planning

Site planning refers to the design of the development project—where the buildings are placed and how the surrounding open space is used.



—Placement of Buildings: The topography of the property may provide a building site behind a hill or in a low spot where noise is not as intense. Earthmoving is also a possibility to make an artificial hill or mound. Garages or maintenance buildings could be placed between the noise source and residences.

—Buffer Area: A simple technique is to leave distance between the noise source and receiver. The buffer can be kept as permanent open space or used for parking, agriculture or some recreation uses. The drawback to this technique is that land is expensive to purchase or keep in an undeveloped state.

One strategy is to recommend a buffer in a new residential subdivision or planned unit development. The buffer would remain as permanent open space, usually deeded to the public or to a homeowners' association as a park. As an incentive to provide the buffer, the developer is permitted to build on smaller lots than normally allowed.

Subdivisions with large lots (two to five acres) can avoid highway noise by setting homes away from the road. The exterior noise should not be measured at the property line; rather the measurement should be taken within a reasonable distance of the house.

Subdivisions could be laid out so the lots with frontage along a highway do not have direct access to the highway. The houses are set well back from the road with access to a parallel minor street. This technique provides a buffer as well as reduces access points to a major road, thereby minimizing traffic congestion and hazards.

Barriers

Noise barriers are placed between the noise source and receiver to block the noise. Barriers can be made of earth, concrete, wood, metal, plastic or stucco. Earthen barriers, referred to as berms, require a larger amount of land. Recent demonstration projects have shown that the cost of the barriers, approximately $500,000 per mile, is about the same regardless of material used. People seem to prefer wooden barriers for aesthetic reasons, although they do not have the durability of concrete or stucco. Use of barriers along highways can give a tunnel-like effect to which many motorists object.

Barriers must be designed with sufficient height to block the line-of-sight between noise source and receiver. This requirement makes them generally impractical for protecting high-rise buildings. A possible problem with barriers is the tendency for sound to bounce off the barrier and affect persons across the highway. Although berms deflect sound upwards because of their sloped design, they have the drawback of requiring maintenance.

Plantings of shrubs and evergreen trees can cut noise only a small amount, but they can offer aesthetic appeal and block sight of the noise source which is an important psychological benefit.

Architectural Design

You should recommend that in the design for new homes the noise-sensitive rooms not face the noise source. Windows that do face the noise should be small and well-sealed. Building a one-story building might avoid the problem by keeping below the noise, where a multistory building would receive unacceptable levels. Large buildings, particularly institutional buildings, may be designed around a central courtyard to provide quiet outdoor space.

Building Construction

The most effective construction technique to cut noise is insulation. Putting insulation material in the walls and ceiling and sealing cracks around windows and doors will reduce noise as well as reduce energy needs for heating and cooling.

Double-glazed windows, with panes of different thicknesses, solid core doors, acoustical ceiling tiles, rugs and draperies will all help relieve the occupants from the noise. The transmission of sound can also be reduced by increasing the thickness or density of the wall and staggering the studs, so a stud is attached to only one panel.

Special Noise Problems

This section will focus on the critical noise problems for local government and suggest which techniques are appropriate. Again a warning is due—before deciding on any technique make sure you have the authority to adopt and enforce the technique.

Airport Noise

The noise control and land use planning process needs some modification to account for airport noise. To be effective the planning effort should include all affected local governments and the airport operator. The process is further complicated by the role of the Federal Aviation Administration (FAA) which is responsible for regulating aircraft noise at the source and for flight operations.

The FAA has set forth a schedule for noise abatement so that the airlines bring all new and existing aircraft into compliance with their noise standards by 1985. As airlines buy new jets or retrofit existing jet engines, the aircraft single event noise levels will drop. The noise exposure area could diminish, except where there is an increase in traffic.

The location of industries or other compatible uses in high-noise areas poses no problem. However, much more land exists in the high-noise area than can ever be used by commerce or industry. And there is strong development pressure from landowners, developers, builders and people anxious to live in a low-density residential environment. Unfortunately, many of the prospective homeowners are either unaware of the noise problem or underrate its effects before locating near an airport.

Some noise control techniques the airport operator should consider are:

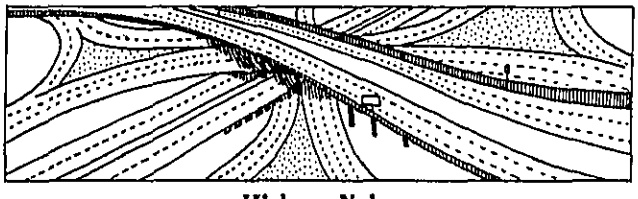
- —Acquiring land to be used as an open space buffer or to be leased or sold for noise-compatible use, e.g., industry, air freight warehouse, agriculture, golf course.
- —Providing purchase guarantees to existing homeowners in high-noise areas. Homes could then be soundproofed and resold, or moved to a low-noise area, or demolished. Such a program would also involve resident relocation costs.
- —Soundproofing existing homes and other noise-sensitive uses in a moderate-noise area on a cost-sharing basis.
- —Building noise barriers.
- —Constructing new runways to shift noise away from residences.
- —On-the-ground aircraft operations.
- —Preferential runways and approach and departure flight patterns.
- —In-the-air aircraft operational procedures.
- —Landing fees pegged to time of day or type of aircraft.
- —Airport restrictions based on time of day or numbers or noise of aircraft.

Some of the above techniques must be approved by the FAA because of possible interference with interstate commerce or safety standards. And the operator should consult with local government to ensure that efforts are complementary.

Local governments should consider the following techniques (in cooperation with the airport operator):

- —Zoning the high-noise areas (not acquired by eminent domain or controlled by easement) for industrial, commercial or open space use—no residential or other noise-sensitive uses allowed. Zoning moderate-noise areas for noise-compatible uses or residential use by special permit according to your noise standards. Restricting the height of buildings and other structures in the flight path. Considering compensation to landowners who must keep their land undeveloped and to landowners affected by the height limitations, compensation to cease when the noise is reduced to an acceptable level or if the flight path is changed.

—A noise alert in property deed or rental lease to give a prospective resident due notice.
—Not programming water or sewerage lines, streets or other improvements which would stimulate residential development in the noise area.
—Close cooperation among local government, the airport operator and state and federal agencies. Make sure airport master plan and local comprehensive land use plan and zoning map are complementary.
—Involve residents of airport environs, landowners and environmental and civic groups in the planning and implementation of the noise control program.



Highway Noise

As with airport noise, local government can best control highway noise by concentrating on the path and the receiver of noise. As for source reductions, the EPA has promulgated regulations for new trucks and published preliminary regulations for new buses and motorcycles, requiring a staged reduction of noise emissions over several years. Tire noise and automobile noise are currently under study.

The Federal Highway Administration (FHWA) requires assessment of expected noise levels for new highways or major reconstructions and assessment of mitigation measures. The final noise level should be less than the FHWA design level (Appendix B). The problem is that the design noise level for residences (70 dBA) is higher than most noise standards for residential use set by local governments.

The solution is either barriers, land use controls or traffic management to keep the noise from becoming a problem. Barriers have become increasingly popular among state highway departments as a noise control technique. States are using barriers on new and existing roads. Even though they are expensive, land developers can also use barriers to protect new residences from noise where the state is not planning to or has not built barriers.

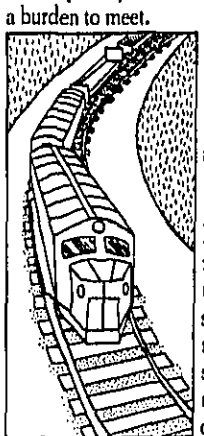
Another approach is traffic management, including rerouting truck traffic away from noise-sensitive land uses, lowering speed limits or instituting time-of-day restrictions. Implementing traffic management techniques on state roads may require consultation or approval of your state transportation department.

The zoning ordinance is an effective technique to control development in a noise area where you have vacant land. Low-density zoning may work where an adequate buffer and other mitigation techniques are used. But when no residential development is suitable, zoning for open space is appropriate and some form of compensation may be necessary (Appendix C). If you permit residential development along a highway, you should require conformance to the performance standards you set for the special permit procedure.

Railroad Noise

Railroad noise is not a major problem for most communities. However, railroad noise seriously affects some older communities, especially in mining areas or where railyards are located. In 1975 the EPA promulgated regulations for interstate railroad locomotives and freight cars. The railroads must meet "best-maintenance practice" standards for in-use locomotives and cars; these standards are now in effect.

By the end of 1979, all new locomotives must be equipped with mufflers to meet stricter noise emissions standards. The 1975 regulations, however, did not apply to stationary railroad equipment. Subsequently, the railroads association sued EPA to require the federal government to set such standards. The new regulations are expected in the near future. These would preempt state and local regulations, which the association considers a burden to meet.

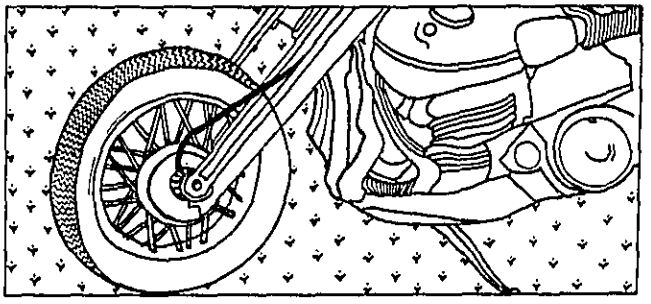


Fortunately, the land along railroads in urban areas is generally used for industrial purposes because of needed access for freight pickup and delivery. Residences along railroads are usually old and new construction in these areas is rare.

Because most urban land along railroads is already developed, land use controls are not very effective. However, where vacant land exists it should be zoned for industrial use. The industrial zoning district should not permit residential or other noise-sensitive use. Outside urban areas, vacant land along railroads may be under development pressure. You should map the noise in these areas, based on railroad conformance to federal source emission standards.

The general procedure of zoning vacant land for noise-compatible uses, with provision for special permits, is applicable to railroad noise areas. The special permit, with its performance standards, may also be necessary in built-up areas for proposed redevelopment projects in high-noise areas.

Housing rehabilitation is generally not regulated by a zoning ordinance, because there is no change in land use. But any government housing assistance programs should include a recognition of where the noise areas are and recommend incorporating noise-mitigation measures into the rehabilitation program.



Motorcycle Noise

The EPA is in the process of drafting final regulations to quiet motorcycles. The preliminary regulations set separate standards for street and off-the-road vehicles. Once the EPA regulations for motorcycles are finalized, you should incorporate the standards into your community noise ordinance. You have the responsibility of enforcing the noise standards by making sure the mufflers are not taken off or tampered with.

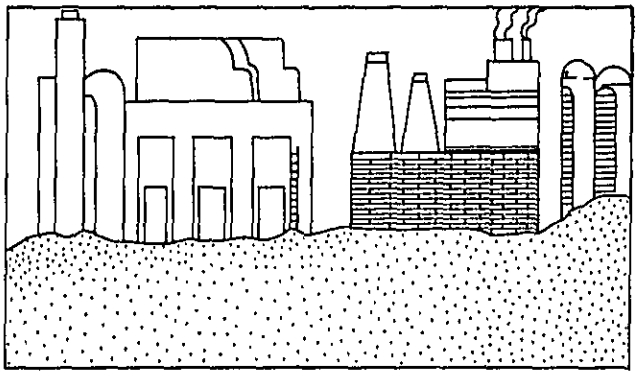
Off-the-road motorcycles need special consideration in land use planning and control. When you set aside land for recreational use, identify certain areas for motorcycle trails. The trails could perhaps be used for snowmobiles in the winter. Having trails set aside for motorcycles and snowmobiles will be an incentive to keep the vehicles off the streets and out of vacant lots or backyards. Off-the-road motorcyles used on private property can be regulated by the property line standards in your community noise ordinance.

Industrial Noise

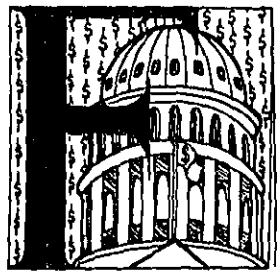
Your zoning ordinance should not allow residents to locate in areas designated for industrial use. You would want to do this not only to keep residences out of noise areas, but to make sure you have prime industrial sites set aside for future industrial and economic growth.

The industrial noise which affects the community most often comes not from stationary machinery but from the cars and trucks going and coming from the plant. Even with federal source controls for vehicles, some noise will still remain. For this reason you should have industrial zoning districts located away from residential areas.

To protect nonindustrial land uses adjacent to the industrial district, you should set noise standards for your zoning districts and put these into your community noise ordinance. The standards regulate noise, not at the source but at the property line (Appendix B). Without a zoning ordinance you can still regulate industrial noise through the community noise ordinance. The property line standards will not be set for zoning districts but for individual properties based on current use.



Implementation



Federal funds are available for land use planning from the Department of Housing and Urban Development ("701" funds), from the Federal Aviation Administration (airport noise control and land use compatibility planning grant program), and from the Environmental Protection Agency through the Quiet Communities Program.

After you have reviewed the techniques, you should select one or more which fit your needs and state and local laws. You may find that a technique is applicable in one situation and not another. And there are costs associated with each technique which you should consider.

Costs

The costs of land acquisition, noise barrier construction, and soundproofing buildings are very high. The Department of Transportation has limited funds available for these projects. Other federal funds are available for these projects to protect existing noise-sensitive uses.

Federal funds, however, are not available for new residences or public buildings. This is one reason why land use controls are so important. If people plan to live in high-noise areas, they must pay the additional costs for barriers, soundproofing or land buffers. States are becoming increasingly interested in building noise barriers along major highways. Barriers are considered more cost-effective than land acquisition or soundproofing.

The Airport and Airway Development Act Amendments of 1976 noted land acquisition as an important noise control technique, eligible for airport trust funds. Barriers are most effective for on-the-ground noise control but offer no protection for the vast majority of people affected by aircraft noise.

Insulation is currently being installed in airport environs only on an experimental basis, with successful results on public buildings. Several foreign national governments have already committed sizable funds to soundproofing homes and public buildings.

The estimated cost of soundproofing varies, depending on the amount of reduction desired and whether it is done during or after construction of the building. Soundproofing just windows and doors can reduce noise substantially. Additional measures are not generally cost-effective. With soundproofing, the building receives the additional benefit of needing less energy for heating and cooling. The energy savings exceed the energy costs of providing year-round mechanical ventilation.

Where the noise level is extremely high, purchase of existing residences may be necessary. In this case you should figure moving and other relocation costs in estimating program expense. Compensation payment to landowners who are not allowed to develop their land, situated in high-noise areas, is discussed in Appendix C.

Public Support

Planning and implementing a noise control program demands public support. Many of the decisions you will have to make will be controversial. If you fail to act, citizens will complain about the noise and lack of commitment on the part of local officials. If you make the tough decisions, landowners and prospective homeowners will object to "more government regulations" and "no-growth policies."

An educational and citizen involvement program should be blended with the planning and regulation program. As citizens understand the noise problem and what techniques are available to local government, your job becomes a lot easier.

Appendix A:
Noise Metrics and Prediction Methodologies

Noise Metrics

The job of noise control is made more difficult by the variety of noise metrics. Definitions of terms and noise metrics are presented below, excerpted from *Airport-Land Use Compatibility Planning*, a document prepared by the Federal Aviation Administration.

Glossary of Noise Terms

Decibel (dB). A numerical expression of the relative loudness or level of a sound, i.e., the sound pressure level.

A-Weighted Sound Level (dBA). The human ear is more sensitive to sound energy at high frequencies than at low frequencies. Also, the ear's sensitivity to sound of different frequencies changes with the level of the sound. The A-weighted sound level is the actual measured sound level weighted to match the sensitivities of the human ear. This may also be written dB(A).

Noise Metric. Noise metrics are the different measures by which a given noise may be expressed, for example, Noise Exposure Forecast or Day-Night Average Sound Level.

Equivalent Sound Level (Leq)

Leq is an energy summation of the aggregate noise environment as measured in A-weighted sound level. Contour values range from less than 50 Leq for lightly impacted areas to more than 70 for heavily impacted areas. It includes no time-of-day correction.

Day-Night Average Sound Level (Ldn).

Ldn was developed in 1973-1974 for the Environmental Protection Agency. It is the energy-averaged equivalent level (Leq) for 24 hours, adjusted to include a 10 dB penalty for noise exposures during night-time hours (10 p.m. to 7 a.m.). It is a measurable quantity and can be measured directly using portable monitoring equipment. Contour values usually range from less than 55 Ldn for lightly impacted areas to more than 75 Ldn for heavily impacted areas.

Community Noise Equivalent Level (CNEL).

The CNEL was developed for the state of California. It is quite similar to the Ldn, 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 night-time hours (10:00 p.m. to 7:00 a.m.). Contour

values usually range from less than 55 CNEL for lightly impacted areas to more than 75 CNEL for heavily impacted areas. CNEL, like Ldn, is a measurable quantity and can be measured directly.

Noise Exposure Forecast (NEF).

The NEF was developed in 1967. It takes into account the time-of-day plus the additional exposure factors of the duration of aircraft flyovers and of discrete (pure) tones such as turbine "whine." The NEF is a complex procedure, usually requiring the use of a computer for noise contour development. Contours derived via this method usually range from less than 20 NEF for lightly impacted areas to more than 40 NEF for heavily impacted areas. The NEF is a calculated noise exposure value and cannot be directly measured.

Prediction Methodologies

Highway Noise.

FHWA's *Noise Prediction Model* (Report No. FHWA-RD-77-108) presents the latest method for estimating highway noise. It explains the theory behind the model and gives three levels of solution ranging from simple pencil-and-paper calculations through handheld calculation programs to a computer program.

Your state highway department should have a copy of the manual and may have experience in using the prediction model. You may also request a copy from the Office of Engineering, Federal Highway Administration, HNG-20, Washington, D.C. 20590.

Airport Noise.

Calculation of Day-Night Levels (Ldn) Resulting from Civil Aircraft Operations EPA 550/9-77-450, including addendum 1, describes how to perform "desk calculations" of noise from civil aircraft operations to determine noise impact around airports. You may obtain a copy from the Office of Noise Abatement and Control, U.S. Environmental Protection Agency, Washington, D.C. 20460.

If you have a problem with military aircraft noise, contact EPA for this document: *Department of Defense: Air Installations Compatible Use Zones (AICUZ) Program* (EPA 550/9-77-353).

Railroad Noise.

You can receive assistance from EPA to predict and map railroad noise, although no document is currently available for distribution.

Appendix B: Noise Standards

This appendix offers three types of noise standards: community noise standards, land use standards, and standards used by federal agencies.

Community Noise Standards

The community noise standards are linked with broad receiving land use categories: residential, commercial and industrial. Each category includes all the zoning districts you consider related to that use. For example, the industrial category could include agricultural and forest districts as well as industrial districts.

Therefore, you must decide how to aggregate your zoning districts into several categories. And you must set noise standards (limits) for that category.

The standards are property line standards. This means the noise measures at the property line must not exceed the standard for that category. Where no zoning ordinance exists, the standards may apply to the actual use of the property rather than to a zoning district.

Following are excerpts from three community noise ordinances which show the property line noise standards for those communities.

San Diego County, California
Ordinance No. 4387

Zone Ambient Noise Level Limits

	Zone	Time	Sound Level (A-Weighted) Decibels
Residential	R-1, R-1-A,	7 a.m. to 7 p.m.	50
	E-1-A, R-1-B, R-1(15)	7 p.m. to 10 p.m.	45
	LC, LC-A, T-Temporary,	10 p.m. to 7 a.m.	40
	R-2 and R-2-A		
	R-3, R-4, R-5, R-P,	7 a.m. to 7 p.m.	60
	PRD, and all other resi-	7 p.m. to 10 p.m.	55
	dential and estate zones	10 p.m. to 7 a.m.	50
Commercial	All Commercial zones	7 a.m. to 7 p.m.	60
		7 p.m. to 10 p.m.	55
		10 p.m. to 7 a.m.	55
Industrial	M, M-1, M-2	Anytime	70
	M-3 and all other Industrial and Agricultural Zones, including E-2-B	Anytime	57

The time duration allowance set forth in the table below shall apply to these noise level limits.

Allowances for Sound Levels Lasting Less than an Hour

Duration	Allowance Decibels
Up to 30 minutes per hour (50 %)	+3
Up to 15 minutes per hour (25%)	+6
Up to 10 minutes per hour (16%)	+8
Up to 5 minutes per hour (8%)	+11
Up to 2 minutes per hour (3%)	+15

Permissible construction noise level limits shall be governed by Section 36.410 of this chapter.

Montgomery County, Maryland
Noise Ordinance (February 11, 1976)

Policy: To reduce the outdoor ambient noise level so as to promote public health, safety, welfare, and the peace and quiet of the inhabitants, and to facilitate the enjoyment of the county's natural attractions and resources.

Penalty: Misdemeanor. Maximum of $1,000 fine.

Enforcement: By the director of the Department of Environmental Protection or his designee. A written notice may be served upon an alleged violator requiring corrective action to be taken. Any person may commence a civil action on his own behalf against an alleged violator.

Specific Prohibitions: 1) Maximum permissible sound levels shall be reduced by 5 dB(A) for sound of periodic or impulsive character or an audible tone such as a whine, hum, or screech.

2) The playing of radios, phonographs, loudspeakers, or other noise producing machines or devices upon private property or upon public streets, thoroughfares or other public property shall not exceed sound limits established in this chapter.

3) Unlawful for any person to sell anything by outcry between 9:00 p.m. and 8:00 a.m.

4) Unlawful to use a drum or musical instrument in the street or thoroughfares between 9:00 p.m. and 8:00 a.m.

5) Unlawful for any person owning, harboring, keeping, or in charge of any animal or fowl to allow it to cause noise exceeding the sound limits.

Quiet Zone: The County Executive may designate any geographical area of the County as a Noise-Sensitive Area in which noise producing activities may be prohibited.

Maximum Permissible Sound Pressure Levels: 1) At any point on the property line:

i) 62 dB(A) commercial or industrial zone;

ii) 55 dB(A) residential zone;

2) Maximum permissible sound levels measured at property line or 50 feet from source whichever is greater, for construction, repair, or demolition shall not exceed the sum of 20 dB(A) and maximum permissible levels from 7:00 a.m. to 9:00 p.m.

Variance & Exemptions: 1) The Director of DEP can authorize temporary exemptions from maximum permissible sound levels for a reasonable period of time.

2) Exemption for performance of emergency work.

3) Warning devices necessary for public safety such as police, fire and ambulance sirens and train horns.

4) Any agricultural use as defined in Section 31B-2(b) of this chapter.

5) Lawn care, maintenance of house and automobile, etc. are permitted between 9:00 a.m. and 9:00 p.m. even though noise levels are over 55 dB(A).

King County, Washington
Ordinance No. 2909

District of Sound Source	District of Receiving Property Within King County			
	Rural	Residential	Commercial	Industrial
Rural	49 dB(A)	52 dB(A)	55 dB(A)	57 dB(A)
Residential	52 dB(A)	55 dB(A)	57 dB(A)	60 dB(A)
Commercial	55 dB(A)	57 dB(A)	60 dB(A)	65 dB(A)
Industrial	57 dB(A)	60 dB(A)	65 dB(A)	70 dB(A)

Section 303. Modifications to Maximum Permissible Sound Levels. The maximum permissible sound levels established by this chapter shall be reduced or increased by the sum of the following:

a) Between the hours of 10:00 p.m. and 7:00 a.m. during weekdays, and between the hours of 10:00 p.m. and 9:00 a.m. on weekends, the levels established by Section 302 of this chapter are reduced by 10 dB(A) where the receiving property lies within a rural or residential district of King County.

b) For any source of sound which is periodic, which has a pure tone component, or which is impulsive and is not measured with an impulse sound level meter, the levels established by this chapter shall be reduced by 5 dB(A).

c) For any source of sound which is of short duration, the levels established by this chapter are increased by:
   1) 5 db(A) for a total of 15 minutes in any one-hour period; or
   2) 10 dB(A) for a total of 5 minutes in any one-hour period; or
   3) 15 dB(A) for a total of 1.5 minutes in any one-hour period.

Land Use Planning Standards

The following exterior noise standards are recommended by the Federal Aviation Administration, Federal Highway Administration and the Department of Housing and Urban Development for use by local government. They are not required standards for local government; they are suggested standards.

Chart II aggregates the many land uses listed in Chart I into four zones (A through D), arranged by increasing noise levels. Zone A has minimal noise exposure and is suitable for noise-sensitive land uses, whereas Zone D has severe noise exposure and is suitable mainly for industry.

These standards can be a help in deciding on performance standards for your land use ordinances. You could allow a land use best suited for Zone A (low noise area) to locate in a noisier area if the developer could meet the Zone A standards through noise mitigation measures.

LAND USE GUIDANCE CHART I

Slucm No.[1]	Land Use	Lug Zone[2]
10	**Residential**	**A-B**
11	Household units.	
11,11	Single units—detached.	A
11,12	Single units—semiattached.	A
11,13	Single units—attached row.	B
11,21	Two units—side-by-side.	A
11,22	Two units—one above the other.	A
11,31	Apartments—walk up.	B
11,32	Apartments—elevator.	B-C
12	Group quarters.	A-B
13	Residential hotels.	B
14	Mobile home parks or courts.	A
15	Transient lodgings.	C
19	Other residential.	A-C
20	**Manufacturing.**[3]	**C-D**
21	Food and kindred products—manufacturing.	C-D
22	Textile mill products—manufacturing.	C-D
23	Apparel and other finished products made from fabrics, leather and similar materials—manufacturing.	C-D
24	Lumber and wood products (except furniture)—manufacturing.	C-D
25	Furniture and fixtures—manufacturing.	C-D
26	Paper and allied products—manufacturing.	C-D
27	Printing, publishing, and allied industries.	C-D
28	Chemicals and allied products—manufacturing.	C-D
29	Petroleum refining and related industries.[4]	C-D
30	**Manufacturing** (continued).[3]	
31	Rubber and miscellaneous plastic products—manufacturing.	C-D
32	Stone, clay, and glass products—manufacturing.	C-D
33	Primary metal industries.	D
34	Fabricated metal products—manufacturing.	D
35	Professional, scientific, and controlling instruments; photographic and optical goods; watches and clocks—manufacturing.	B
39	Miscellaneous manufacturing.	C-D
40	**Transportation, communication, and utilities.**	
41	Railroad, rapid rail transit, and street railway transportation.	D
42	Motor vehicle transportation.	D
43	Aircraft transportation.	D
44	Marine craft transportation.	D
45	Highway and street right-of-way.	D
46	Automobile parking.	D
48	Communication	A-D
48	Utilities.	D
49	Other transportation, communication, and utilities.	A-D
50	**Trade.**[5]	
51	Wholesale Trade.	C-D
52	Retail trade—building materials, hardware, and farm equipment.	C
53	Retail trade—general merchandise.	C
54	Retail trade—food.	C
55	Retail trade—automotive, marine craft, aircraft, and accessories.	C
56	Retail trade—apparel and accessories.	C
57	Retail trade—furniture, home furnishings, and equipment.	C
59	Retail trade—eating and drinking. Other retail trade.	C-D
60	**Services.**[5]	
61	Finance, insurance, and real estate services.	B
62	Personal services.	B
63	Business services.	B
64	Repair services.	C
65	Professional services.	B-C
66	Contract construction services.	C
67	Governmental services.	B
68	Educational services.	A-B
69	Miscellaneous services.	A-C
70	**Cultural, entertainment, and recreational.**	
71	Cultural activities and nature exhibitions.	A
72	Public assembly.	A
73	Amusements.	C
74	Recreational activities.[6]	B-C
75	Resorts and group camps.	A
76	Parks.	A-C
79	Other cultural, entertainment, and recreational.[10]	A-B
80	**Resource production and extraction.**	
81	Agriculture.	C-D
82	Agricultural related activities.	C-D
83	Forestry activities and related services.	D
84	Fishing activities and related services.	D
85	Mining activities and related services.	D
89	Other resource production and extraction.	C-D
90	**Undeveloped land and water areas.**	
91	Undeveloped and unused land area (excluding noncommercial forest development).	D
92	Noncommercial forest development	D
93	Water areas.	A-D
94	Vacant floor area.	A-D
95	Under construction.	A-D
99	Other undeveloped land and water areas.	A-D

Source: Federal Aviation Administration. *Airport-Land Use Compatibility Planning.* 1977.

[1] SLUCM: Standard Land Use Coding Manual.
[2] Refer to land use guidance chart II.
[3] Zone "C" suggested maximum except where exceeded by self-generated noise.
[4] Zone "D" for noise purposes; observe normal hazard precautions.
[5] If activity is not substantial, air-conditioned building, go to next higher zone.
[6] Requirements likely to vary—individual appraisal recommended.

LAND USE GUIDANCE CHART II

Land Use Guidance Zones (Lug)	Noise Exposure Class	Noise Estimating Methodologies Ldn Day-Night Avg. Sound Level	NEF Noise Exposure Forecast	Hud Noise Assessment Guidelines
A	Minimal Exposure	0 to 55	0 to 20	Clearly Acceptable
B	Moderate Exposure	55 to 65	20 to 30	Normally Acceptable
C	Significant Exposure	65 to 75	30 to 40	Normally Unacceptable
D	Severe Exposure	75 & Higher	40 & Higher	Clearly Unacceptable

Source: Federal Aviation Administration. *Airport-Land Use Compatibility Planning*, 1977.

Federal Noise Standards

Several federal agencies have developed land use standards and are actively involved in working with local governments to control noise. Of greatest importance to local government are the Department of Housing and Urban Development (HUD) standards and the Federal Highway Administration (FHWA) "design levels." These are not merely recommendations; they are federal policy.

The HUD standards are essentially a land use policy. HUD will not provide financial assistance or loan guarantees for new housing or substantial rehabilitation where their exterior or interior standards are exceeded. Although HUD assists or guarantees only 5 to 10 percent of the national housing market, many mortgage bankers use the HUD standards to limit their risk. Other federal agencies and some local governments have incorporated the HUD standards in their noise control programs.

The FHWA design noise levels are not, strictly speaking, noise standards. These "levels" represent a balancing of what would be desirable from a public health and welfare perspective and what is practical based on our present transportation system and the vehicles which operate upon it.

The levels may be exceeded where the economic or social costs of meeting the levels are too high. Even when the levels are met, the FHWA recommends land use planning and controls to limit incompatible land uses adjacent to the highway. The levels are not land use standards and should not be used as such.

HUD INTERIOR NOISE STANDARDS[a]

Area	HUD Standard	Approximate L Value
Sleeping quarters	—Does not exceed 55dB(A) for more than 60 minutes in any 24-hour period, and	—$L_4 \leq 55$
	—Does not exceed 45dB(A) for more than 30 minutes during night time sleeping hours from 11 p.m. to 7 a.m., and	—L 6.25 (night) ≤ 45
	—Does not exceed 45dB(A) for more than an accumulation of 8 hours in any 24-hour day.	—$L_{33} \leq 45$
Other interior areas	HUD personnel discretion	

[a] To be met regardless of whether noise originates from exterior noise sources or interior building sources such as heating, plumbing, and air conditioning. The means required for achieving the standards will depend on, among other things, the external noise levels, the equipment and layout used in the building, and the noise attenuation characteristics of the buildings, floors, and walls. These standards assume open windows unless other provision is made for adequate ventilation.

Source: U.S. Environmental Protection Agency, *Department of Housing and Urban Development: Noise Abatement and Control Policy*, 1977.

HUD EXTERIOR NOISE STANDARDS [a]

Site Acceptability Category	General External Exposure Standards		Airport Standards		Administrative Procedures
	HUD Standards	Approximate L Value	HUD Standards	Approximate Ldn Value	
Unacceptable	—Exceeds 80dB(A) 60 minutes per 24 hours	$L_4 > 80$dB	NEF>40[b]	Ldn>75dB	Exceptions are strongly discouraged and require a 102(2)c environmental statement and the Secretary's approval.
	—Exceeds 75dB(A) 8 hours per 24 hours	$L_{33} > 75$dB	CNR>115		
Discretionary—Normally Unacceptable	—Exceeds 65dB(A) 8 hours per 24 hours —Loud repetitive sounds	$L_{33} > 65$dB	NEF 30-40 CNR 100-115	Ldn=65-75dB	Approvals require noise attenuation measures, the Regional Administrator's concurrence and an Environmental Impact Statement. In cases where a project "infills" existing development internal memoranda modify this provision to provide for a special environmental clearance.
Discretionary—Normally Acceptable	—Does not exceed 65dB(A) more than 8 hours per 24 hours	$L_{33} \leq 65$dB	NEF<30 CNR<100	Ldn<65dB	Ordinary Administrative procedures apply
Normally Acceptable	—Does not exceed 45dB(A) more than 30 minutes per 24 hours	$L_2 \leq 45$dB			

[a] Measurements and projections of noise exposures are to be made at appropriate heights above site boundaries.
[b] The Composite Noise Rating (CNR) and Noise Exposure Forecast (NEF) are cumulative noise descriptors which were developed *exclusively* for use in airport environments. CNR and NEF are roughly translatable into Ldn, the noise descriptor having applicability to all noise sources which EPA has recommended be utilized by federal agencies.

Source: U.S. Environmental Protection Agency, *Department of Housing and Urban Development: Noise Abatement and Control Policy*, 1977.

FEDERAL HIGHWAY ADMINISTRATION
DESIGN NOISE LEVEL/ACTIVITY RELATIONSHIPS

Activity Category	Design Noise Levels[1] (dBA)		Description of Activity Category
	$L_{eq}(h)$*	$L_{10}(h)$**	
A[2]	57 (Exterior)	60 (Exterior)	Tracts of land on which serenity and quiet are of extraordinary significance and serve an important public need and where the preservation of those qualities is essential if the area is to continue to serve its intended purpose. Such areas could include amphitheaters, particular parks or portions of parks, open spaces, or historic districts which are dedicated or recognized by appropriate local officials for activities requiring special qualities of serenity and quiet.
B[2]	57 (Exterior)	70 (Exterior)	Picnic areas, recreation areas, playgrounds, active sports areas, and parks which are not included in Category A and residences, motels, hotels, public meeting rooms, schools, churches, libraries, and hospitals.
C	72 (Exterior)	75 (Exterior)	Developed lands, properties or activities not included in Categories A and B above.
D	—	—	For requirements on undeveloped lands, see paragraph 11.a and 11.c.
E	52 (Interior)	55 (Interior)	Residences, motels, hotels, public meeting rooms, schools, churches, libraries, hospitals, and auditoriums.

[1] Either L_{eq} or L_{10} design noise levels may be used.
[2] Parks in Categories A and B include all such lands (public or private) which are actually used as parks as well as those public lands officially set aside or designated by a governmental agency as parks on the date of public knowledge of the proposed highway project.
* Hourly Equivalent A-Weighted Sound Level.
** The A-Weighted Sound Level equalled or exceeded 10% of the time for the period under consideration (in this case one hour).

Source: *Federal-Aid Highway Program Manual,* Volume 7, Chapter 7, Section 3.

Appendix C: Compensable Zoning

Zoning, an extension of the police power, is limited by constitutional guarantees that private property may not be taken for public use without just compensation. The question which has plagued zoning since its inception, circa 1916, is when does the regulation of land become a "taking."

This issue is important in controlling urban development in undeveloped high-noise areas—for example, if you decide to zone land in a high-noise area for agricultural or open space use with even low-density residential use prohibited. Or if you decide to zone a large amount of land for commercial or industrial use, beyond the demand you foresee for those uses. The landowners may claim their land was taken for public use without compensation, because they are not allowed what they consider "reasonable" use of their land.

Judicial decisions. The courts have come down on both sides of the issue. The courts have used several tests to determine whether property has been taken by regulation: physical encroachment, public benefits at excessive private expense, substantial diminution of value, and no remaining reasonable use.

The judicial decisions on this issue vary greatly by state. The states of California, Oregon and Massachusetts allow strict regulation of private property. For example, the Oregon court upheld a Portland rezoning from low-density residential to agricultural and forest uses. The court decided these were substantial beneficial uses.[1] The California Supreme Court upheld a rezoning which diminished the value of a piece of property from $375,000 to $75,000.[2] Where local governments have intended to protect floodplains and wetlands, the courts in Wisconsin and Massachusetts have upheld regulations which prohibit all urban development.[3] The courts in these states are moving away from the traditional tests of "taking" as listed above.

On the other side of the issue, the Supreme Courts in Indiana, Idaho, New Jersey and Washington struck down land use regulations around airports which limited building heights and urban development as taking without compensation.[4] However, the Florida Supreme Court upheld a similar regulation.[5]

When the court finds a regulation a "taking," the regulation is either declared void in its entirety or as it applies to that particular piece of property. You must then either develop a new regulation or keep the regulation and find a way to compensate the landowners for the loss in value due to regulation.

The strategies used by local government to maintain the regulation include purchase of the property or purchase of the development rights to the property. Or the owner is offered property tax reductions in return for not developing the land.

Several judges have succinctly stated the rationale for compensation: "[T]o afford relief to the land owner in cases in which it is unfair to ask him to bear a burden which should be assumed by society."[6] And, "[T]o distribute throughout the community the loss inflicted upon the individual by the making of public improvements."[7]

A recent case in Palo Alto, Calif. suggests a new direction in judicial decision-making.[8] The city had planned to purchase sizable acreage in the foothills nearby for public park and open space uses but found its funds lacking. After a subsequent rezoning of the area to open space use, a property owner sued on the grounds of a "taking."

The California Court of Appeals ruled that the owner had stated a cause of action in inverse condemnation for the downzoning of his property. The court distinguished this case from the downzoning noted earlier (footnote 2) on the grounds that the Palo Alto "taking" was much harsher. It is interesting that the court held that invalidation of the new zoning regulation was an improper remedy. The only remedy was inverse condemnation and just compensation.

Whether you determine you must pay compensation because the court requires it or choose to pay compensation because you consider compensation the correct policy decision, several options are available.

[1] *Joyce v. City of Portland,* 546 P. 2d. 1100.

[2] *HFH Ltd. v. Superior Court of Los Angeles County,* 542 P. 2d. 237.

[3] Floodplain regulations upheld: *Turner v. County of Del Norte,* 101 California Reporter 93 and *Turnpike Realty Co. v. Town of Dedham,* 284 N.E. 2d. 891. Wetland regulation upheld: *Just v. Marinette County,* 201 N.W. 2d. 761.

[4] *Indiana Toll Road Commission v. Jankovich,* 193 N.E. 2d. 240; *Roark v. City of Caldwell,* 394 P. 2d. 641; *Yara Engineering Corp. v. City of Newark,* 40 A. 2d. 559; *Ackerman v. Port of Seattle,* 348 P. 2d. 664.

[5] *Warning v. Peterson,* 137 So. 2d. 268.

[6] *Bacich v. Board of Control,* 144 P. 2d. 823.

[7] *Clement v. State Reclamation Board,* 220 P. 2d. 897.

[8] *Eldridge v. City of Palo Alto,* 129 Cal. Rptr. 575 (1976).

Two New Models. Before the landmark case of *Euclid v. Ambler*,[9] where a rezoning causing substantial diminution in property value was upheld, several jurisdictions had used compensable regulation.[10] Two new models under study at present are transferable development rights (TDR) and zoning by special assessment financed eminent domain (ZSAFED.)[11]

Both models are meant to compensate the landowner for the onerous burden placed on him or her to further public progress. In the case of high-noise areas, this means keeping all noise-sensitive development out of these areas and compensating the owners for a diminished right to develop their land.

Under the TDR approach, the development rights to property in the area to remain undeveloped—in this case the high-noise areas—are allowed to be transferred and used in designated growth areas as a density bonus. Several local governments are currently experimenting with this approach.

The ZSAFED approach is designed to pay compensation (damages) for harsh regulation (wipeout) and finance the scheme by capturing land value increases (windfall) caused by zoning permission to develop for intensive use. This approach is not now in use by any local government.

Most localities have experience with special assessment districts for water, sewerage or road projects whereby the landowners who benefit pay for the improvements. With ZSAFED, the concept is expanded to include owners affected adversely as well as beneficially by zoning-related property value changes.

The scheme is appropriate for protecting high-noise areas around airports and along highways and railroads. Owners of land designated by zoning for no development would receive damages, paid in annual installments, based on the loss of value due to the regulation. Owners of land designated for development would pay the local government the increase in value due to the permission to develop the land.

Since the government does not own the development rights, it does not have to sell them back to the owner if the zoning is later changed. In the case of noise, the zoning could conceivably change if the noise-exposure area is reduced by reduction of noise at the source. If the strict regulation is lifted and the land is permitted to be developed, the tax collector simply raises the assessment based on the new market value.

The negative impact (decreased land values) of zoning in noise areas would generally fall on those owning land in the high-noise areas where residential development is not compatible with the noise or where income-producing compatible uses, mainly commercial and industrial, are

not needed. Increased value would accrue to land designated for commercial and industrial uses which you deem compatible with noise.

A good case can be made to pay less than 100 percent of the increase or decrease in land value due to zoning. Several studies suggest a range between 50 and 80 percent.[12] The intention is to moderate windfalls and wipeouts, not eliminate them. The profit motive would remain as a stimulus for private action.

The ZSAFED scheme raises many administrative problems such as how large to make the special district and, where the district crosses jurisdictional boundaries, how to coordinate all the local governments involved.

The ZSAFED scheme is not meant to compensate people who are now living in the noise area. Some other system would be needed to provide this type of compensation. Setting up such a system is beyond the scope of this study.

[9] *Village of Euclid v. Ambler Realty Co.*, 272 U.S. 365 (1926).

[10] *In re Kansas City Ordinance* No. 39946, 252 S.W. 404 (1923); *City of Kansas City v. Kindle*, 446 S.W. 2d. 807 (1969); State ex rel *Twin City Bldg. and Inv. Co. v. Houghton*, 176 N.W. 159 (1920).

[11] Donald Hagman and Dean Misczynski, *Windfalls For Wipeouts*, American Society of Planning Officials, Chicago, 1978. (Includes a discussion of both TDR and ZSAFED).

[12] Hagman, *Windfalls For Wipeouts*, p. 525, and Urban Systems Research Inc., "A Comprehensive Policy to Ameliorate Adverse Impacts of Transportation Facilities," for U.S. Department of Transportation, May 1975, p. 67.

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[4] U.S. Federal Aviation Administration, *Planning for the Airport and Its Environs: The Sea-Tac Success Story* (Port of Seattle and King County), 1978, 95 pp.

[5] U.S. Department of Housing and Urban Development, *Aircraft Noise Impact; Planning Guidelines for Local Agencies*, 1972, 275 pp.

[2] U.S. Environmental Protection Agency, *Department of Defense: Air Installations Compatible Use Zones Program (AICUZ)*, 1977, 58 pp.

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[2] U.S. Environmental Protection Agency, *Model Noise Control Ordinance*, 1975, 24 pp.

[1] California Department of Health, *Model Community Noise Control Ordinance*, 1977, 57 pp.

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[5] U.S. Department of Housing and Urban Development, *Noise Assessment Guidelines*, 1971, 20 pp.

Sources:

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[2] Office of Noise Abatement and Control, Environmental Protection Agency, Washington, D.C. 20460.

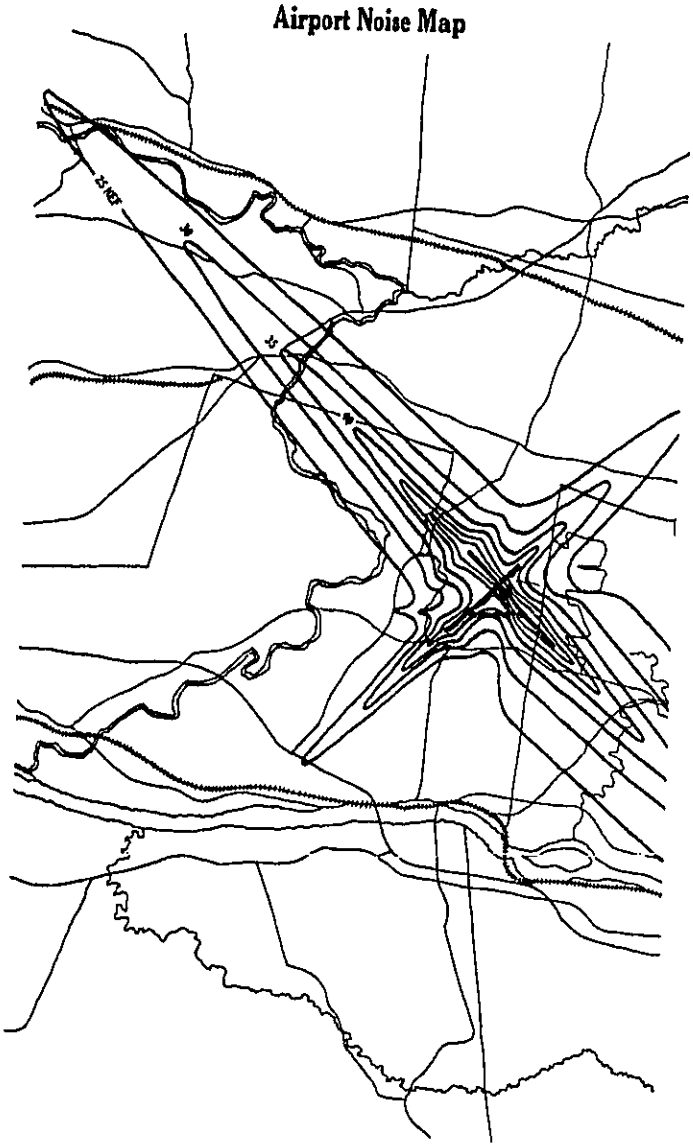
[3] Office of Environmental Policy, Federal Highway Administration, U.S. Department of Transportation, Washington, D.C. 20590.

[4] Office of Environmental Quality, Federal Aviation Administration, U.S. Department of Transportation, Washington, D.C. 20591.

[5] Office of Environmental Quality, Department of Housing and Urban Development, Washington, D.C. 20410.

[6] Center for Urban Policy Research, Rutgers University, Building 4051, Kilmer Campus, New Brunswick, N.J. 09803.

Airport Noise Map



Highway Noise Map