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Factors that Determine the Reduction in

Property Values Caused by Traffic Noise

Environmental noise caused by traffic can reduce property

values. Planners, policymakers, and legislators must look at

noise damage costs caused by motor vehicles when considering

transportation options. Daniel Haling and Harry Cohen

provided a method to estimate this type of noise impact in

"Residential Noise Damage Costs Caused by Motor Vehicles"

(Transportation Research Record 1559).

**BACKGROUND**

The majority of sounds detected by human hearing are within

the range of 0 to 140 decibels (dB). The noise created by traffic

normally resides in the range of 50 to 95 dB. The effects of

transportation noise are routinely measured using an Aweighted

decibel scale (designated dBA), which is useful for

measuring the noise impact of a single occurrence but not the

impact of continuous noise. A frequently used measurement for

continuous noise is the equivalent sound level (Leq), known

also as the energy mean sound level. Leq includes both the

intensity and length of all sounds occurring during a given

period; it indicates "the average acoustic intensity over time and

is the equivalent noise energy level of a steady, unvarying tone."

The Environmental Protection Agency has developed a

measurement for a community's exposure to noise (the average

energy sound level) for a 24-hour period from midnight to

midnight. The measure of this day-night sound level, designated

DNL or Ldn, is commonly used to evaluate noise impacts on

communities and residential areas.

**NOISE PREDICTION MODEL / NOISE DAMAGE COST**

**STUDIES**

The most common model for estimating vehicle traffic noise

levels is the Federal Highway Administration's (FHWA's)

STAMINA 2.0/OPTIMA. Derived from long-standing research

by the FHWA and the National Cooperative Highway Research

Program (NCHRP), the FHWA model "is a two-level coordinate

system-based program, based on energy-equivalent sound

levels."

Studies in the 1970s "estimated that background noise in a

typical urban neighborhood was roughly 55 Ldn and that

housing prices decreased by 0.2 to 0.6 percent for every one

unit increase in Ldn." A major study of noise costs conducted

for the 1982 Federal Cost Allocation Study "assumed a 0.4

percent decrease in the value of a housing unit for each dBA

(Leq) increase over a threshold value of 55 dBA."

**NOISE COST CALCULATIONS**

Calculating the impact of transportation noise on residential

property values requires constructing a model for estimating the

value of property that includes an estimate of traffic noise cost.

One method for calculating noise impact cost is based on an

estimating procedure developed in 1981 and used in the 1982

Federal Highway Cost Allocation Study. This procedure takes

into consideration reduced residential property values caused by

noise from vehicles. It operates on the theories that people will

pay to avoid high noise levels and that housing values reflect

location relative to a noisy roadway.

The procedure for estimating noise damage uses three main

components: (1) the number of housing units affected, (2) the

noise level in decibels above an established noise threshold, and

(3) the average change in property values per decibel that can

be attributed to the roadway. The number of housing units

affected varies by location. The noise emission level of vehicles

changes depending on the type of vehicle, its speed, its

operating weight, and the volume of traffic on the roadway. The

third component of the calculation is constant for all housing

units, based on a survey of studies on residential property

values affected by noise. Using these values, the noise damage

caused by each vehicle-kilometer can be calculated--subject to

the type of vehicle, its speed, the volume of traffic on the

roadway, and the type of housing development surrounding the

roadway.

**TRANSPORTATION NOISE LEVEL**

Calculating the noise damage cost of a single vehicle requires

estimating the noise emission of that vehicle, as well as the

noise emission of all vehicles on that segment of road. Noise

emission level estimates of single vehicles are based on two

emission equations developed by the FHWA--the first for large

trucks and the second for passenger cars and light trucks. Truck

noise levels, which are significantly different from those

generated by passenger cars, are converted into noise passenger car

equivalents (NPCEs) using factors developed through a

vehicle emission equation and a total noise level equation.

By combining transportation noise levels across vehicle

classes, a composite noise emission level for the roadway is

produced. (It should be noted that decibels add logarithmically

rather than algebraically.)

The number of housing units affected by transportation noise

depends on the density of the housing population and how close

the housing unit is to the roadway. Noise distance ranges are

estimated for each of the land development types shown in

Table 1 below. The distance ranges are an estimated number of

feet within which houses are subject to a given noise level

range. Three noise levels are established at 55-65 dBA, 65-75

dBA, and greater than 75 dBA. The noise distance ranges are

labeled A, B, and C, where C is closest to the roadway and

assumed to begin at 9.14 m (30 ft), with no housing units

located closer than that to the roadway.

After noise distance ranges are estimated, housing densities

are needed to calculate the total number of housing units

affected. Based on the 1981 noise cost study, Table 1 illustrates

the housing densities per acre by land development type and

noise distance range. As noted earlier, previous noise impact

studies estimated that housing units lose 0.4 percent of their

value for every decibel above the threshold level. The most

recent survey of housing values (1993) showed a median house

value of $86,529. Using this value annualized at a 10 percent

discount rate and multiplied by the 0.4 value loss, the noise

damage cost is found to be $34.61 per decibel per housing unit.

**NOISE DAMAGE COSTS PER VEHICLE MILE**

Noise damage costs can be calculated per vehicle-mile for

each land development type, traffic volume range, and vehicle

speed. Noise damage costs reflect the number of housing units

the vehicle affects and the number of decibels the vehicle adds

to the existing traffic noise.

Table 2 shows the noise damage cost per NPCE-mile for each

land type and traffic speed, based on average annual daily

traffic (AADT). The table shows that, in all land-development

categories, noise damage costs increase as traffic speeds

increase. Similar results occur in urban areas devoted to

residential use; as traffic speed increases, the damage costs per

NPCE mile increase. However, as traffic volumes increase, the

noise damage contributed by a single vehicle decreases. For

example, at a traffic speed of 55 mph, the noise damage costs

decrease from 0.25 cents per NPCE mile to 0.16 cents as traffic

increases from 10,000- to 200,000-NPCE AADT.

Table 2: Noise Damage Costs per NPCE-Mile

Noise damage costs can also be estimated for a variety of

truck types and operating weights. Costs will vary depending on

the land development type. For example, a five-axle semitrailer

operating at 65,000 pounds and traveling in an urban business

district will cause 5.74 cents of noise damage per vehicle mile.

In an urban fringe area, the cost will increase to 11.48 cents per

vehicle mile.

**CONCLUSIONS**

Motor vehicle types, traffic volumes, and land development

types surrounding roadways all play significant roles in

estimating residential noise damage costs. Those responsible for

transportation planning and policymaking should be aware of

the variations in these costs and the three primary factors that

define them.