# A Methodology for Assessing Highway Traffic Noise Impacts in an Airport Environment

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ABSTRACT

A method used in predicting highway noise in conjunction with airport noise levels and assessing the total noise environment is presented. This method has been approved for use in Florida by the Federal Highway Administration. The method presented may not work for all similar situations; however, it does provide a starting point for innovations when manpower, monitoring equipment, and modeling programs are limited.

FHWA requires consideration of the impact of highway traffic-generated noise on land uses adjacent to a new or improved roadway. Of particular concern is the amplitude and duration of noise levels that research has shown to be either disturbing to normal functions associated with that land use or capable of producing adverse organic effects on the human aural system.

It makes little sense to seek reduction in or abatement of highway-generated noise levels for a particular receptor when other noise sources create levels as high or higher than those produced by automobiles and trucks on the roadway. Thus, it is important for the highway planner, engineer, or environmentalist to search out and identify all noise sources that affect the total noise environment of a particular land use and determine their composite and individual effects on the receptor.

## HIGHWAY NOISE IN AN AIRPORT ENVIRONMENT

The Third District of the Florida Department of Transportation initiated studies to determine the best way to increase the capacity of 12th Avenue in Pensacola (Figure 1). Forecasts of network computer models indicated significant increases in the future highway traffic demand and no workable alternatives to the upgrading of 12th Avenue were determined to be available. Therefore, the recommended improvement was to make the existing roadway multilane. An environmental analysis was prepared to identify and address probable environmental impacts on natural and man-made elements of lands adjacent to the existing facility. Noise levels were identified as a probable major consequence because of the developed nature of much of the acreage along the existing route and the need for additional rights-of-way (Figure 2).

Field investigations of the area to obtain noise measurements for validation of computer models before their use in preparation of future noise level projections met with immediate difficulties. Pensacola Regional Airport is located adjacent to a portion of the existing roadway. Noise levels generated by aircraft landing and taking off at this installation conflicted with collection of existing traffic noise measurements. It was found that field measurements had to represent a series of "windows" during the times between aircraft activity. After numerous samples, sufficient measurements of existing highway traffic noise were obtained to allow validation of the computer models. However, it was recognized that the difficulty experienced in collection of field measurements also indicated that noise levels generated by the airport operations play a significant role in the noise environment along this project.

It was realized that the airport had a significant impact on the noise environment and that it was necessary to obtain information concerning existing and future noise levels emanating from the airport and the relationship of these levels to the total noise environment. The Federal Aviation Administration (FAA) requires that airports receiving FAA monies prepare noise studies establishing noise impact zones of various magnitudes. The city of Pensacola's Planning Department had prepared an extensive document for the Pensacola Regional Airport. This document, Airport Noise Compatibility Program (1), establishes noise impact zones and detailed noise footprints based on the locations of the airport's runways, which runways were designated for primary use in landings and take-offs, and the types of aircraft using and expected to use the airport.

The airport noise study had been completed in late 1982 and the environmental study for the roadway improvement project was initiated in mid-1983. Therefore, the findings of the airport noise study were accepted as a given against which noise studies for the roadway could be compared and analyzed. (The noise study had been performed with assistance of the Florida Department of Transportation and had been accepted by the department and the FAA.)

Noise level predictions found in the airport noise study used the $L_{dn}$ descriptor. The $L_{dn}$ (day-night level) system is a classification methodology developed by the Environmental Protection Agency for the purpose of assessing noise impacts produced at any time of day. It is based upon the A-weighted sound pressure scale, which is weighted to compensate for the human ear's sensitivity to different sound pitches. Basically, the $L_{dn}$ value for a particular geographic point is the daily average A-weighted sound pressure level existing at that point with those noises occurring between 10 p.m. and 7 a.m. penalized by an additional 10 dBA (10 dB are added to measurements or projections for these hours). Because highway traffic noise levels are usually measured with the $L_{eq}$ descriptor, a direct comparison of the two noise sources did not appear

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PROPOSED 12TH. AVE.

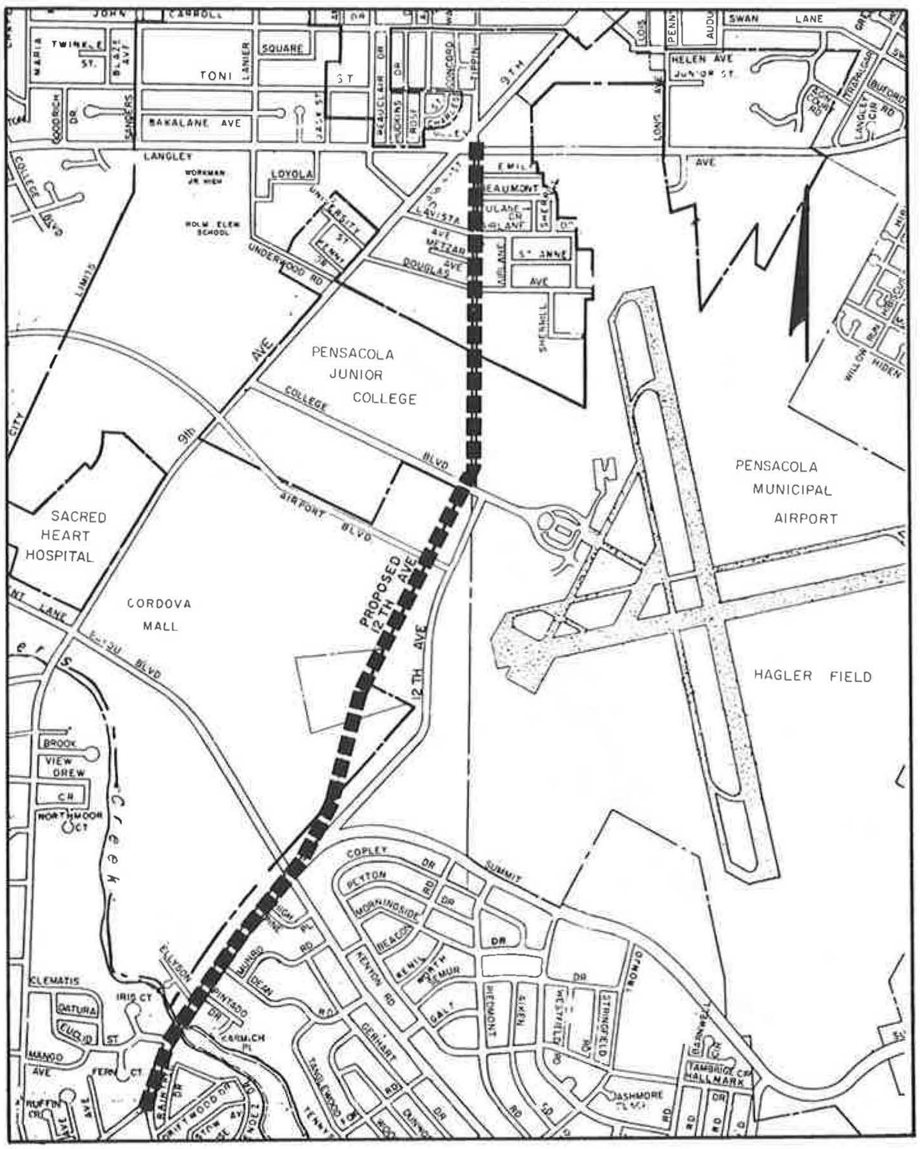


**FIGURE 1** Project location map.

possible. $L_{eq}$ is defined as "the equivalent steady-state sound level which in a stated period of time contains the same acoustic energy as the time-varying sound level during the same period" (2).

Because sufficient time, manpower, and equipment were lacking to conduct a 24-hr noise study in the field to determine the $L_{dn}$ and because the difficulty of doing so in the airport environment was recognized, an alternative method had to be devised to allow an $L_{eq}$ versus $L_{dn}$ comparison. This led to the development of a methodology that, although conservative, allowed for this comparison without the extensive use of either manpower or equipment.

The first step was to determine the traffic characteristics of 12th Avenue in the vicinity of the airport. This was done by using a traffic counter set to provide an hourly readout of traffic volumes. The results of this effort can be found in Table 1. It becomes readily apparent from examining these counts that there are significant differences in traffic volumes utilizing the roadway during the nighttime penalty hours as opposed to the daytime hours. This difference became the basis for the development of the methodology described.

With the traffic data gathered by the counter, it was decided that field traffic noise measurements would be conducted from 4:00 to 5:00 p.m. Because this was the peak traffic hour, the hourly $L_{eq}(h)$ should represent the worst-case condition. This measurement was used as an upper limit to the 24-hr $L_{dn}$. The $L_{dn}$ will in fact be the same as the peak-hour $L_{eq}$ if (a) the hourly $L_{eq}$ for each daytime hour is the same as the peak-hour $L_{eq}$, and (b) the hourly $L_{eq}$ for each nighttime hour is 10 dB less than the peak-hour $L_{eq}$. The first assumption is obviously conservative, because all other daytime hourly $L_{eq}$'s are less than the peak-hour $L_{eq}$. The second assumption requires more consideration.

A simple estimate of the hourly $L_{eq}$ during the nighttime hours can be made by considering the difference in traffic volume between the peak hour and the nighttime hours. As can be seen in Table 1, the average nighttime traffic volume is less than 1/12 of the peak-hour traffic volume. Because a noise

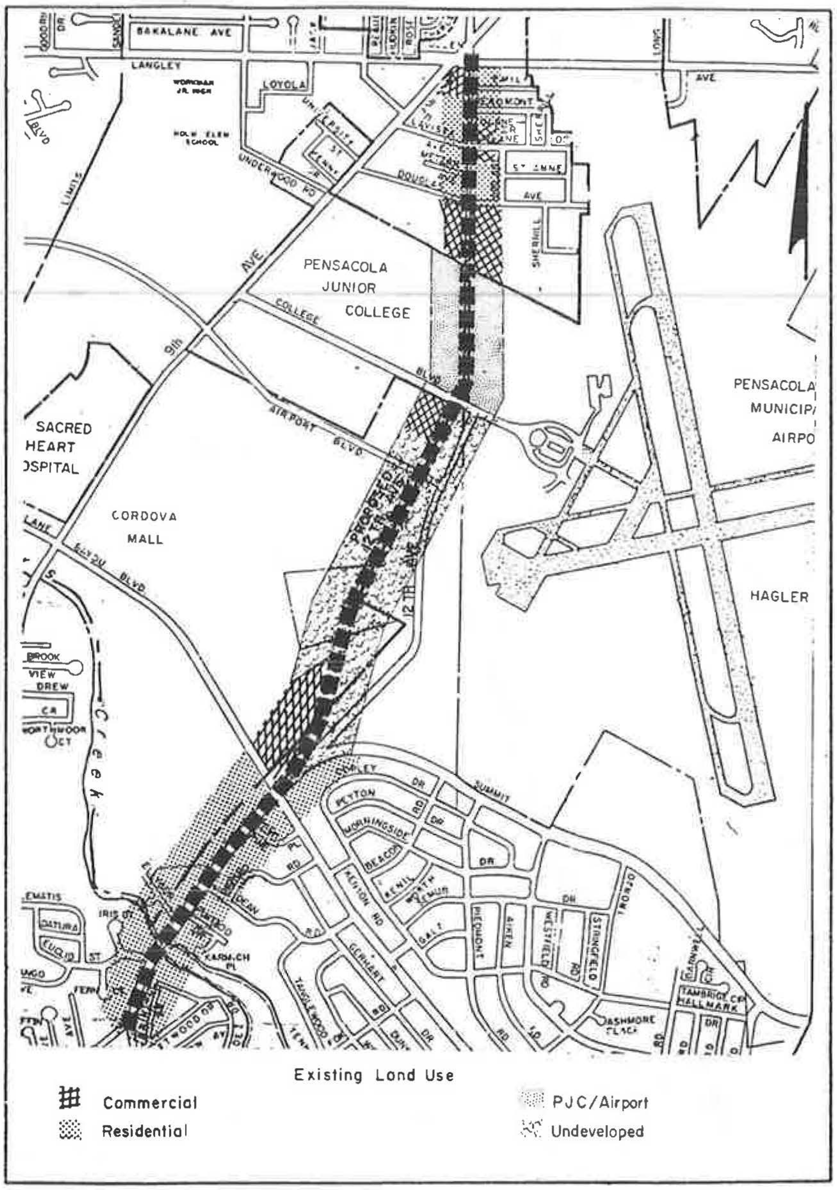


**FIGURE 2 Existing land use map.**

**TABLE 1 Traffic Counts for 12th Avenue (24 hr)**

| Daytime | Measured Traffic Volume | Nighttime | Measured Traffic Volume |
|---|---|---|---|
| 7-8 a.m. | 1,318 | 10-11 p.m. | 349 |
| 8-9 a.m. | 1,219 | 11-12 a.m. | 194 |
| 9-10 a.m. | 1,131 | 12-1 a.m. | 116 |
| 10-11 a.m. | 1,022 | 1-2 a.m. | 31 |
| 11-12 p.m. | 1,225 | 2-3 a.m. | 36 |
| 12-1 p.m. | 1,220 | 3-4 a.m. | 32 |
| 1-2 p.m. | 1,178 | 4-5 a.m. | 31 |
| 2-3 p.m. | 1,458 | 5-6 a.m. | 127 |
| 3-4 p.m. | 1,513 | 6-7 a.m. | 401 |
| 4-5 p.m. | 1,761 | | |
| 5-6 p.m. | 1,600 | | |
| 6-7 p.m. | 1,128 | | |
| 7-8 p.m. | 841 | | |
| 8-9 p.m. | 618 | | |
| 9-10 p.m. | 570 | | |
| Total | 17,802 | | 1,317 |
| Avg | 1,187 | | 146 |
| Peak hour | 1,761 | | 401 |

level decreases by 10 dB if its source strength decreases by a factor of 10, the average hourly $L_{eq}$ during the night in this case is more than 10 dB below the peak-hour $L_{eq}$ and the second assumption is also conservative.

Because both assumptions are conservative, one can say with confidence that the $L_{dn}$ is less than the peak-hour $L_{eq}$. Use of this approach to determine future traffic noise levels and the need for abatement efforts proved to be valuable because of the lack of automated noise-sampling equipment that could be used for total traffic cycles. This method also eliminated the need for additional manpower to conduct the 24-hr tests. This was extremely important because the manpower was not readily available and there was a tight time frame for project completion.

Comparison of $L_{dn}$'s for highway and airport noise indicated that the amplitude of highway traffic noise was less than that generated by aircraft for most of the length of the proposed project periods.

Where traffic noise was found to be predominant, it was analyzed and addressed according to procedures in the Federal-Aid Highway Program Manual (2).

Alternative methods to achieve similar results were also developed after the hectic push to complete the project had subsided. One of the methods uses a computer prediction of the daytime peak-hour $L_{eq}$ and a similar prediction of the nighttime peak-hour $L_{eq}$. If the difference between the two levels is equal to or greater than the 10-dB penalty, the $L_{dn}$ can be assumed to be less than the daytime peak-hour $L_{eq}$.

A second method would employ the computer prediction of the hourly $L_{eq}$ for each daytime and nighttime hour. This would allow for the addition of the 10-dB penalty to each nighttime hour and then the 24-hourly predictions could be averaged to determine the $L_{dn}$. This would allow for a direct comparison of the contribution of noise from both highway and airport sources.

## SUMMARY AND CONCLUSIONS

The methodology described used an existing noise study prepared for the airport to help establish and evaluate the total future noise environment along the highway project. Use of the airport noise study and this procedure also eliminated the need for additional noise sampling equipment and manpower to obtain field data throughout the 24-hr period.

This methodology was approved by the Florida FHWA office for this particular project. Approval for similar applications will have to be sought on a project-by-project basis. Before this approach is used for a unique noise situation, approval from the local FHWA office must be obtained.

## ACKNOWLEDGMENTS

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## REFERENCES

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