Why We Must Supplement DNL Noise Analysis

By

William Albee ~ Special Projects Director
Wyle Laboratories Acoustics Group

May 2002

Is the Day/Night Average Noise Level (DNL) metric truly as flawed as many citizens believe? Or does it serve its intended purpose of defining noncompatible land use areas and setting boundaries for noise mitigation measures quite well, but fail in communicating noise exposure to the average citizen? Perhaps what is needed is a better way to communicate noise exposure in terms that are more easily understood. Supplemental analysis, using noise metrics in addition to DNL, may be the answer!

This article examines these questions in the context of the origin of the DNL metric as the primary descriptor of community noise exposure, its role in the planning and administration of noise mitigation programs, and its shortcomings in describing noise impacts to the public. Better communication and understanding of noise exposure is not the end objective, but rather a means by which affected citizens, aviation officials and government authorities can come together at the local level to more effectively address their specific noise problems.

Go to any community meeting with airport noise on the agenda, and you will likely hear vigorous citizen complaints that DNL does not adequately communicate noise exposure to citizens who reside near airports or live under flight paths, particularly those who reside outside the airport's published DNL noise contours. You will likely hear the complaint that the Federal Government threshold for compatible land use, set at DNL 65 dB, is too high. When officials respond by defending DNL, citizens usually counter that they don't hear averages – they only hear individual aircraft. Most people find it very difficult to translate the individual noise events that add up over the typical day into an average noise level. This confusion leads to mistrust and the conclusion that DNL understates the noise that many citizens experience.

These views are legitimate and are strong indicators that aviation officials need to find better ways to communicate noise impacts; yet in the process, preserve the vital role DNL plays in administering Federally funded noise mitigation programs.

DNL Background

Before examining the application of various supplemental metrics to this problem, it is important to review the background and use of the DNL metric. The DNL 65 dB guideline was recommended in 1980 by the Federal Interagency Committee on Urban Noise (FICUN), and reaffirmed in 1992 by the Federal Interagency Committee on Noise (FICON).

The origin of DNL as the metric of choice for defining community noise exposure can be traced even further back in time. In 1974, EPA released a publication entitled *Information on Levels of Environmental Noise Requisite to Protect Public Health and Welfare With an Adequate Margin of Safety*, EPA Report No. 550/9-74-004, also known as the *Levels Document*. This document states: *"In order to describe the effects of environmental noise in a simple, uniform and appropriate way, the best descriptors are the long-term equivalent A-weighted sound level (L_{eq}) and a variation with a nighttime weighting, the day-night average sound level (L_{dn})."* It is important to point out the following disclaimer printed on the cover page of the document, which states: *"This document has been approved for general availability. It does not constitute a standard, specification, or regulation."*

When the DNL 65 dB threshold is discussed in public meetings, reference is often made to the DNL 55 dB noise level recommended by EPA in the Levels Document to limit outdoor activity interference and annoyance in residential areas. Many people believe that if Congress were to restore funding to the EPA Noise

Office, and vest the authority in that office to set Federal noise standards or guidelines, then the DNL 65 dB guideline would be lowered from 65 dB to 60 dB or perhaps 55 dB. However, this is not likely,

> *"These levels are not to be construed as standards as they do not take into account cost or feasibility...As specified in this document, it is EPA's judgment that the maintenance of levels of environmental noise at or below those specified above are requisite to protect the public from adverse health and welfare effects...The phrase health and welfare as used herein is defined as complete physical, mental and social well-being, and not merely the absence of disease and infirmity...Thus, as used in this document, the phrase health and welfare will necessarily apply to those levels of noise that have been shown to interfere with the ability to hear."*

considering EPA's qualifiers to their DNL 55 dB recommendation:

Obviously, EPA recognized that achieving an outdoor level of DNL 55 dB is an idealistic goal, stating that it was established without regard to cost or feasibility. Achieving that ideal goal would mean *"undue interference with activity and annoyance will not occur"* (in their terms). Given the current number of aircraft noise complaints from citizens exposed to levels below DNL 55 dB, it appears EPA was optimistic in declaring DNL 55 dB the noise level below which *"...annoyance will not occur."*

Congress responded to the growing aviation noise problem during the 1970s with the Aviation Safety and Noise Abatement Act (ASNA) of 1979, which required FAA to adopt a single noise metric to measure community noise exposure, and made Federal funding available to pay for noise mitigation. In choosing DNL as the single metric and DNL 65 dB as the guideline above, which noise sensitive land use is not compatible with aviation noise, the cognizant Federal agencies (including EPA) carefully considered cost and feasibility. When that guideline was set, Stage 1 and Stage 2 noise level airplanes comprised the majority of the commercial aircraft fleet, and several million persons were living inside DNL 65 dB noise contours around the nation's airports. Had EPA's ideal DNL 55 dB guideline been selected instead, the population residing in noncompatible areas at that time would likely have been more than 20 million people, and mitigation cost estimates would have been staggering beyond all reason.

Part 150 Mitigation Measures and the Federal Guideline for Noise Compatibility

FAA implemented the noise provisions of ASNA in Federal Aviation Regulation, Part 150, and Noise Compatibility Planning. Under that program, billions of Federal dollars have been spent to acquire land and sound insulate homes inside DNL 65 dB contours at participating airports. With the transition to the current all Stage 3 noise level commercial aircraft fleet, the noise contours have been considerably reduced in size. Yet, thousands of people who reside within DNL 65 dB or higher noise contours are still waiting for mitigation (a significant number of those will wait many more years for their turn). For example, the sound insulation program at Chicago's Midway airport is near completion only within the DNL 80 dB contour and that program is just beginning between the DNL 75 and 80 dB contours. As additional airports participate in the Part 150 program, even more persons residing inside DNL 65 dB contours will be lining up for Federally funded mitigation.

Virtually every airport master plan projects annual growth in operations for as far as can reasonably be projected into the future. Now that the Stage 3 transition is complete, this growth trend is predicted to far outstrip further shrinkage of noise contours from quieter aircraft, meaning noise contours will grow around many, if not most airports for the foreseeable future. Transition to Stage 4 noise levels alone will not keep pace, and considerable area recently removed from DNL 65 dB contours via the Stage 3 transition sadly is in grave danger of being lost to this trend. A precious national resource (reduced noise contours) that cost a small fortune in new airplanes will be squandered if local officials fail to act very soon!

At the current rate of Federal noise program funding (even though in the hundreds of millions of dollars each year) it will take many more years to address all of the currently existing noncompatible land uses around our airports. So the key question is *what would be the effect of reducing the Federal noise compatibility guideline from DNL 65 dB to a lower threshold, such as 60 dB?*

The answer is that millions of persons would immediately find themselves residing in newly designated noncompatible areas, and many of these areas were designated as compatible when they were developed under the current DNL 65 dB guideline. Federal funding to address these newly designated noncompatible areas would be decades away, assuming that areas impacted at DNL 65 dB and higher would be fully addressed first, and also assuming Congress does not significantly increase funding. Had a lower Federal guideline been initially set, such as DNL 60 dB, there would now be far less development between DNL 60 and 65 dB contours, but that opportunity has long since passed.

The logical conclusion is that reducing the guideline threshold before substantially all existing residences within the DNL 65 dB contours are sound insulated or acquired would greatly expand the problem and contribute little or nothing to the solution. The efforts that various stakeholders have been directing toward lowering the Federal guideline might better serve the cause if they are redirected toward persuading Congress to significantly increase noise mitigation funding. While a change in the Federal guideline may not be advisable in the near term, it might be logical and feasible to change it in the future when most of the sound insulation programs around the nation's airports are completed. The good news is that individual communities do not have to wait for a change in the Federal guideline to take action.

The best course of action for individual communities is to use their zoning authority to establish noise standards that reflect the will of their citizens and are affordable to implement. If local officials fail to act soon to protect the areas that have recently been removed from their DNL 65 dB contours as a result of the transition to an all Stage 3 fleet, development will follow shrinking noise contours and this one-time opportunity will be lost.

A good example of responsible local action is Cleveland, where officials recently set the local aviation noise standard at DNL 60 dB, and the recent Part 150 update included a measure, approved by the FAA, to use Passenger Facility Charges to fund the sound insulation program out to the DNL 60 dB contour. Minneapolis is currently updating its Part 150 with the same measure. Communities need not wait for a change in the Federal guideline to take comparable action. Orlando is another excellent example of a city that has effectively protected its airport; by implementing a strong noise overlay zoning code that includes noise disclosure within the DNL 55 dB contour. Similar action by many other cities will speed the day when a change in the Federal guideline becomes practical.

DNL has functioned very well for over 20 years as the primary planning and decision tool for administration of Federally funded airport noise mitigation programs, and as the FICON pointed out in its 1992 report, "*...no other metrics are of sufficient scientific standing to replace DNL.*"

Supplemental Metrics

The FICON report went on to recommend the use of supplemental metrics "*...to best determine noise impacts at specific noise-sensitive locations*," and further stated:

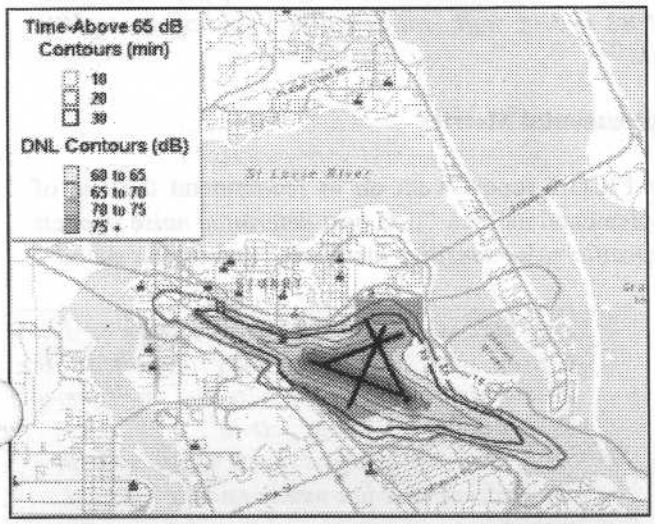
> - *The purpose of a supplemental analysis is to convey with more specificity and detail the potential effect of changes to the environment as a result of a Federal action.*
> - *Any additional analysis needs to inform both the Federal decision-maker and the affected public*

There are several noise metrics that can be used individually or in combination to describe exposure, which are far easier for the public to understand than the DNL metric. They include, but are not limited to:

- Sound Exposure Level (SEL), which is a measure of duration and magnitude of a single noise event in A-weighted decibels;
- Equivalent Sound Level (Leq), which is the average noise level over a specified time period, such as school hours;
- Time Above (TA), which is the amount of time that a noise event exceeds a maximum decibel level (L_{max}) threshold; and,
- Number of Events (N-Level), which is the number of noise events above a maximum decibel level threshold during a specified period of time.

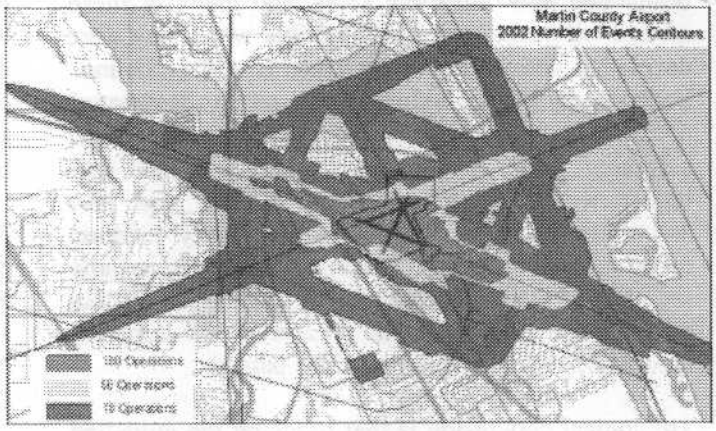
Two supplemental metrics that clearly convey cumulative noise exposure in terms the public readily

nderstands are the TA and N-Level metrics, with results presented graphically as contours overlaid on a local area map. A TA analysis is expressed as the number of minutes in a certain time-period (typically the average annual day), that noise created by aircraft operations exceeds a specified A-weighted decibel level. The TA metric can be applied to any period of time, such as local school hours. The results of TA analysis are displayed as an overlay of contour lines on the same background map as the DNL noise contours, and may be shown with or without the DNL contours.



The general aviation airport example above shows DNL contours out to DNL 60 dB overlaid with TA contours of 10, 20 and 30 minutes above 65 dB for the average annual day. The threshold of 65 dB L_{max} was selected in this case, because it is the approximate level for noise to interfere with conversation in an outdoor environment, but any threshold may be selected.

The N-Level metric shows the average number of events above a specified maximum decibel level for a given period of time (such as the average annual day). N-Level contours show the geographic distribution of the average number of events above a certain noise level for a given period of time, such as the average annual day. The results of N-Level analysis are generally displayed as map contours with each contour line showing the average number of expected events above the specified decibel level during the selected time period. The number of events in areas between the contour lines would fall somewhere in the range between the two contour lines.



The general aviation airport example above shows contours for 10, 50, and 100 events above 65 dB L_{max} for the average annual day. In this case, it was necessary to show the 10 events contour in order to close all of the contours along the touch and go pattern flight tracks for each runway. The threshold levels selected for which contours to show is highly flexible, and is typically selected at the discretion of airport and community officials, along with input from other stakeholders, to meet specific study objectives.

When TA and N-level contours are presented along with DNL contours, the public receives not only the average airport noise level, but the amount of time airplane noise exceeds the specified level and the number of times each day that noise exceeds the specified level. When these metrics are presented along with DNL, a complete picture of airport noise exposure in the community emerges, painted in clear terms. The threshold maximum noise levels selected for TA and N-level analysis will determine the extent of the area included in the resulting contours. Thus, these metrics enable the selection of thresholds that can extend the analysis far beyond the traditional DNL contours. For example, N-level analysis is an excellent tool to develop preferential flight paths in both the near and far proximity of an airport. The TA and N-level analyses can also show the potential benefits of employing noise abatement arrival and departure procedures on a particular runway far more definitively than DNL. Thus, when these metrics along with DNL are employed, local officials are far more informed in their decisions regarding land use and zoning in airport environs.

FAA Position on Supplemental Analysis

A big question is what position does the FAA take on supplemental analysis? Some FAA officials with noise program responsibilities have stated personal opinions that supplemental metrics are better than DNL for communicating noise impacts to individual citizens. An FAA official recently made that statement during his presentation at the annual Airport Noise Symposium in San Diego.

While FAA has not issued a definitive written policy on the matter, the 1992 FICON report, in which FAA participated, clearly supports the use of supplemental metrics. The Federal Interagency Committee on Aviation Noise (FICAN) was formed as a standing technical aviation noise committee in the early 1990s as recommended in the FICON report. In February 2001, the FICAN held a public forum on the use and application of noise metrics to supplement DNL analyses, and published their findings in February 2002 as follows: *"FICAN finds that Supplemental metrics provide valuable information that is not easily captured by DNL. Supplemental metrics are particularly useful for assessing the effects of aircraft noise on interference with activities such as sleep and speech. In these cases, the use of metrics such as single exposure metrics can provide a more meaningful estimate of interference than a single DNL estimate."*

In July 2001, FAA published for public comment a proposed policy document entitled *Aviation Noise Abatement Policy 2000,* which reflects their future vision for addressing noise issues, and strongly indicates their intention to focus more attention on noise outside DNL 65 dB contours. In that document, one of FAA's stated goals is to: *"Design air traffic routes and procedures to minimize noise impacts in areas beyond the jurisdiction of airport proprietors, consistent with local consensus and the efficient use of airspace."* One of the proposed policies states: *"As requested, the FAA will assist State and local governments in establishing policies and practices to minimize noise sensitive land uses around airports, including locally determined buffers outside areas of significant noise exposure."*

To successfully implement this policy and achieve its goal, FAA must employ noise metrics that will clearly show the impacts of noise well beyond DNL 65 dB contours. FAA officials have historically encouraged the use of supplemental analysis in Environmental Assessments and in Environmental Impact Statements, but have not issued a specific policy statement on use of these metrics in Part 150 studies. In recent meetings with the author, key FAA Headquarters officials stated that when airport officials include sufficient justification in their noise study grant applications, identifying specific metrics and how they will be applied, they can approve the supplemental analysis. They further qualified their position, stating they are not supportive of any open-ended policy that would fund supplemental analyses that are not specifically justified.

Recognizing the value of supplemental metrics in communicating noise exposure to the average citizen, several airports have moved forward and are currently including TA and N-Level analysis in their Part 150 updates. Many other airport and local government representatives are also considering inclusion of supplemental analyses in their future Master Plan and Part 150 updates.

The primary vehicle available to effectively achieve FAA's proposed goal and policy stated above is the Part 150 program. Identification of and agreement on preferred flight tracks in a Part 150, as envisioned in FAA's proposed noise policy, requires noise analysis far beyond the DNL 55 contour. The parameters of the TA and N-Level metrics can be set to effectively perform this analysis, even in remote areas that are many miles from an airport where DNL is not well suited (it is generally accepted that DNL analysis degrades in accuracy at levels below 65 dB and is rarely used below 55 dB).

In the opinion of the author, the FAA should strongly endorse the use of appropriate supplemental metrics in the Part 150 program. After all, it is the program specifically designed for use by airports and communities to reach local consensus on noise mitigation measures, including preferred air traffic routes, and to formally communicate the will of the stakeholders to the FAA.

Summing Up

The FAA's proposed noise policy, the 1992 FICON Report, and the recent FICAN findings all provide strong support for the use of additional noise metrics to supplement DNL analysis. Widespread use of appropriate supplemental metrics in airport noise studies would greatly improve public understanding of noise exposure and impacts, because the average citizen with little knowledge of acoustics can easily understands them. By combining Time-Above and Number of Events with other noise metrics and DNL analysis, the responsible officials could produce noise studies that are more comprehensive far more acceptable and credible with the public.

Go Do The Right Thing

In the author's view, decision makers need to consider an appropriate mix of DNL and supplemental noise analyses in their future airport noise studies that will:

1. Best describe noise exposure in terms the general public can easily understand,
2. Facilitate a better public participation process for considering alternatives that leads to consensus, and
3. Enable decision makers to select and implement the most effective noise abatement and mitigation measures.

Note: Mr. Albee recently retired from the FAA where he spent 9 years as Manager, Policy and Regulatory Division in the Office of Environment and Energy. He also served as FAA's first Aviation Noise Ombudsman.