

Using 'Supplemental Metrics' to Address the Effects of Noise on People

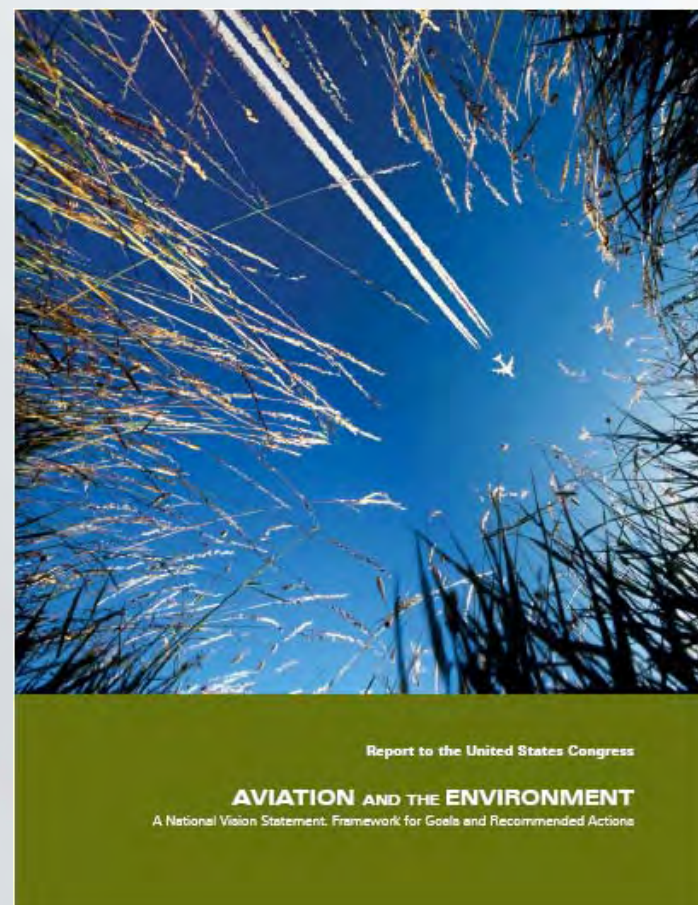
**Transportation Research Board
Annual Meeting
January 22, 2007**

**Mary Ellen Eagan
President
Harris Miller Miller & Hanson Inc.**

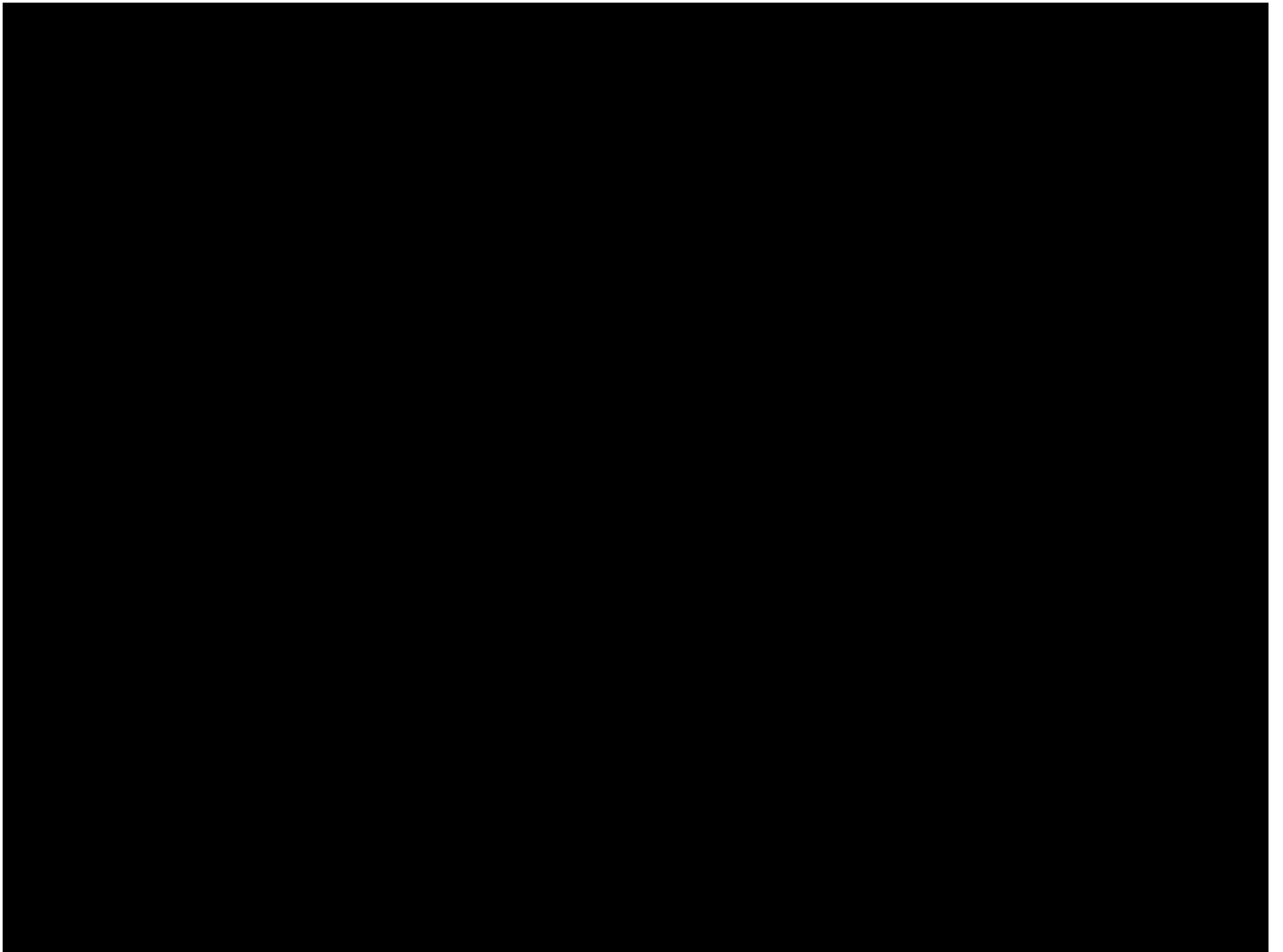
Report to Congress, December 2004

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- “Environmental impacts may be the ***fundamental constraint*** on air transportation growth in the 21st century.”
- “There has been a ***95% reduction*** in the number of people affected by aircraft noise ... The current situation is that aircraft noise is the ***single most significant local objection*** to airport expansion and construction.”
- “The nation should develop ***more effective metrics*** to assess and communicate aviation’s environmental effects.”



Source: Waitz et al., December, 2004



Background

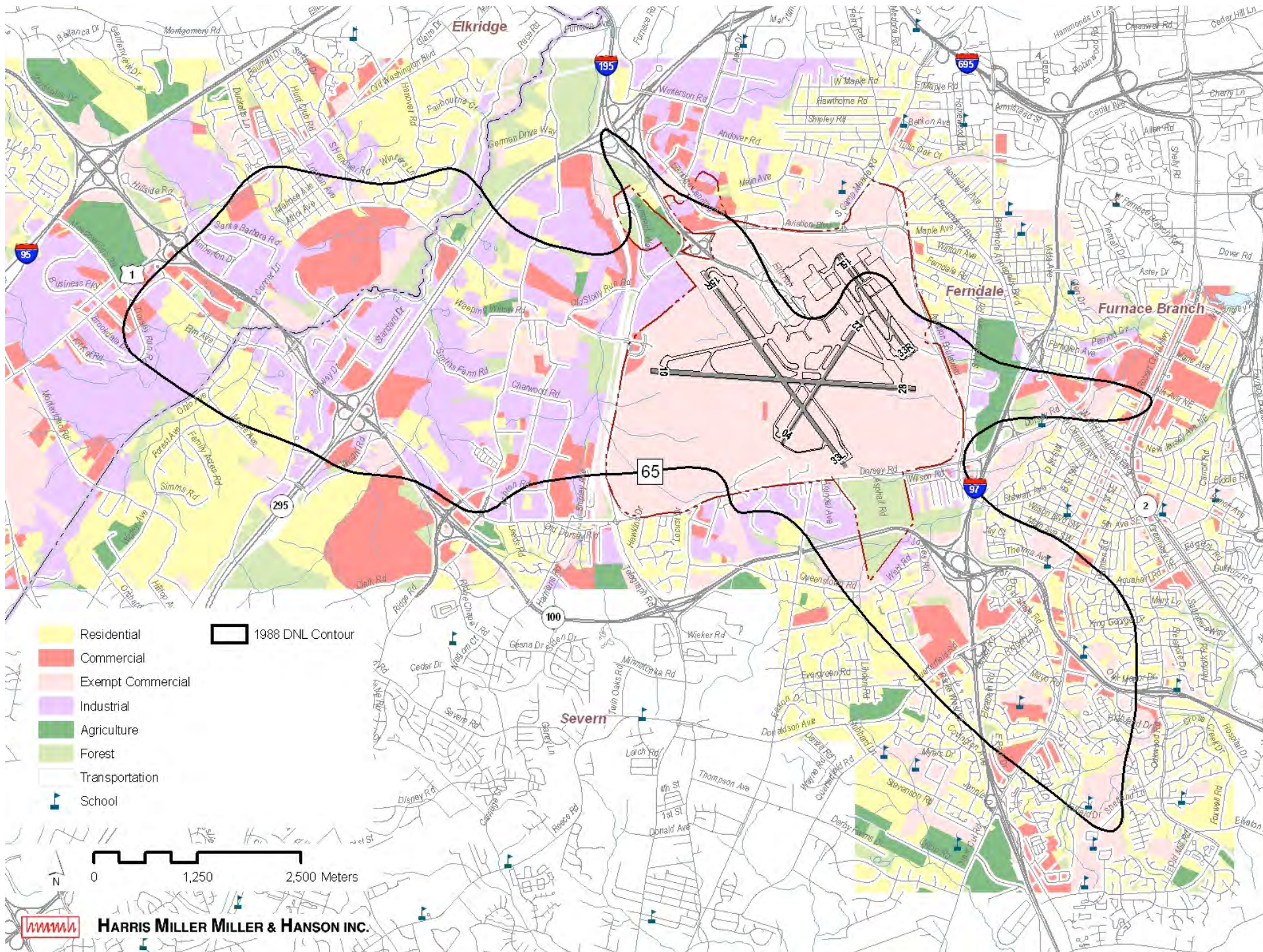
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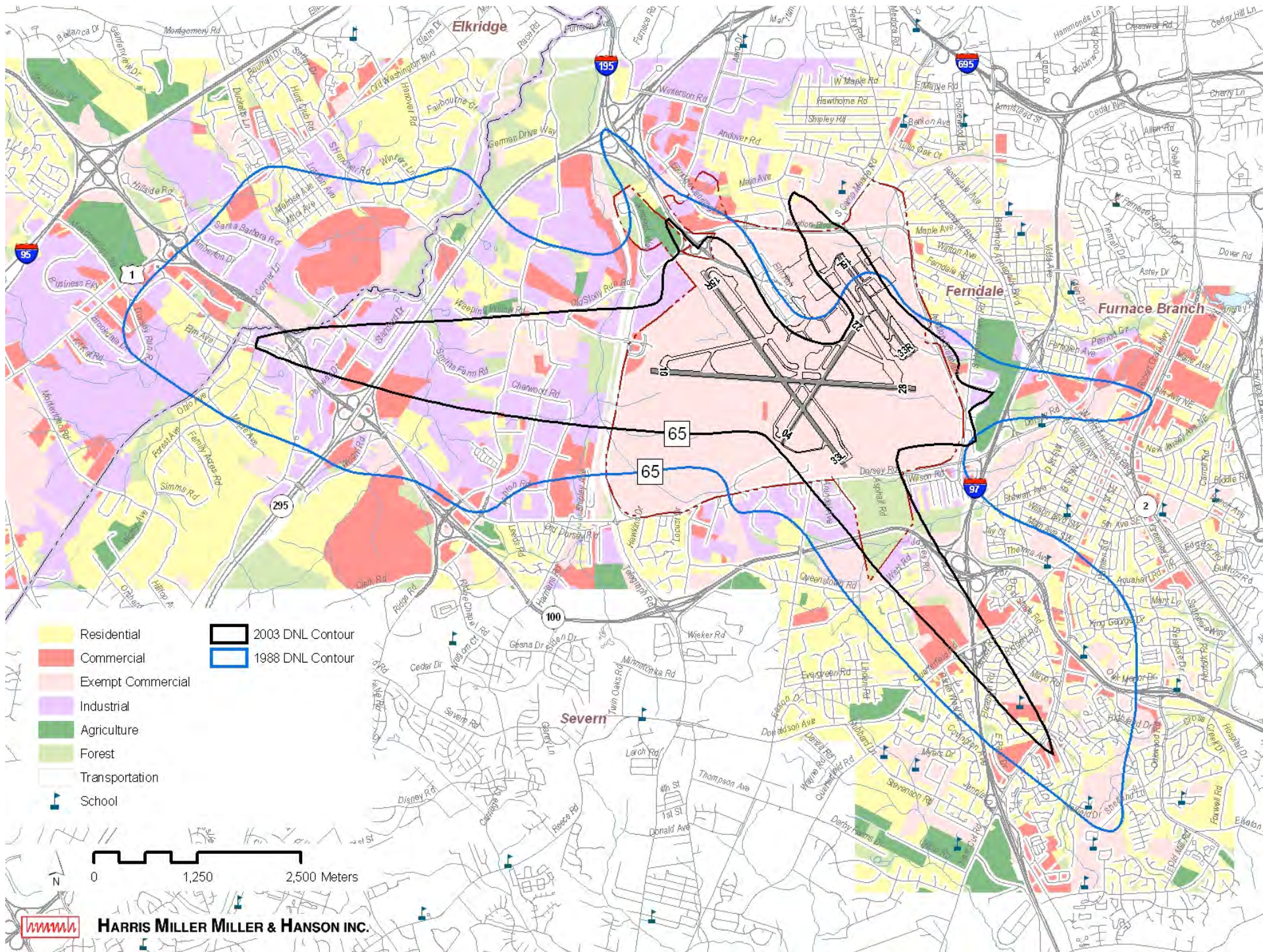
- **Decision-makers need to know how noise affects *the way people live***
- **Current FAA impact criteria (DNL 65) address land use compatibility planning**
- **What about other effects?**
 - Annoyance
 - Sleep disruption
 - Speech interference
 - Learning
 - Low frequency noise

Case Study: Baltimore-Washington International

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- Long history of noise abatement
- COMAR, 1974
- Development generally prohibited within Airport Noise Zone
- A 'Balanced Approach'
- Flight tracks and detailed land use data available



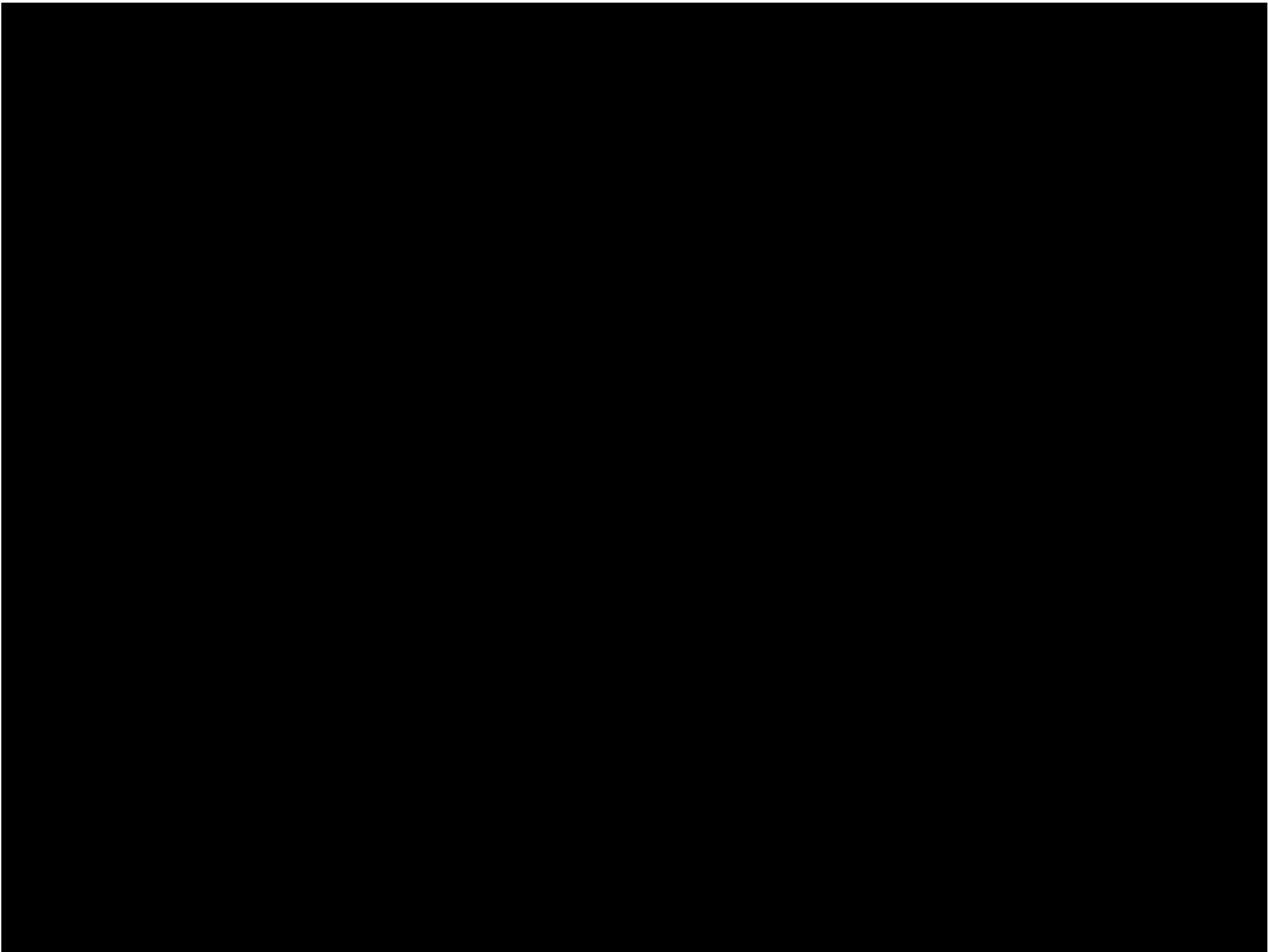


Is BWI's noise problem solved?

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Year	Daily Air Carrier Operations	Population inside DNL 65
1988	360	14,200
2003	579	1,314

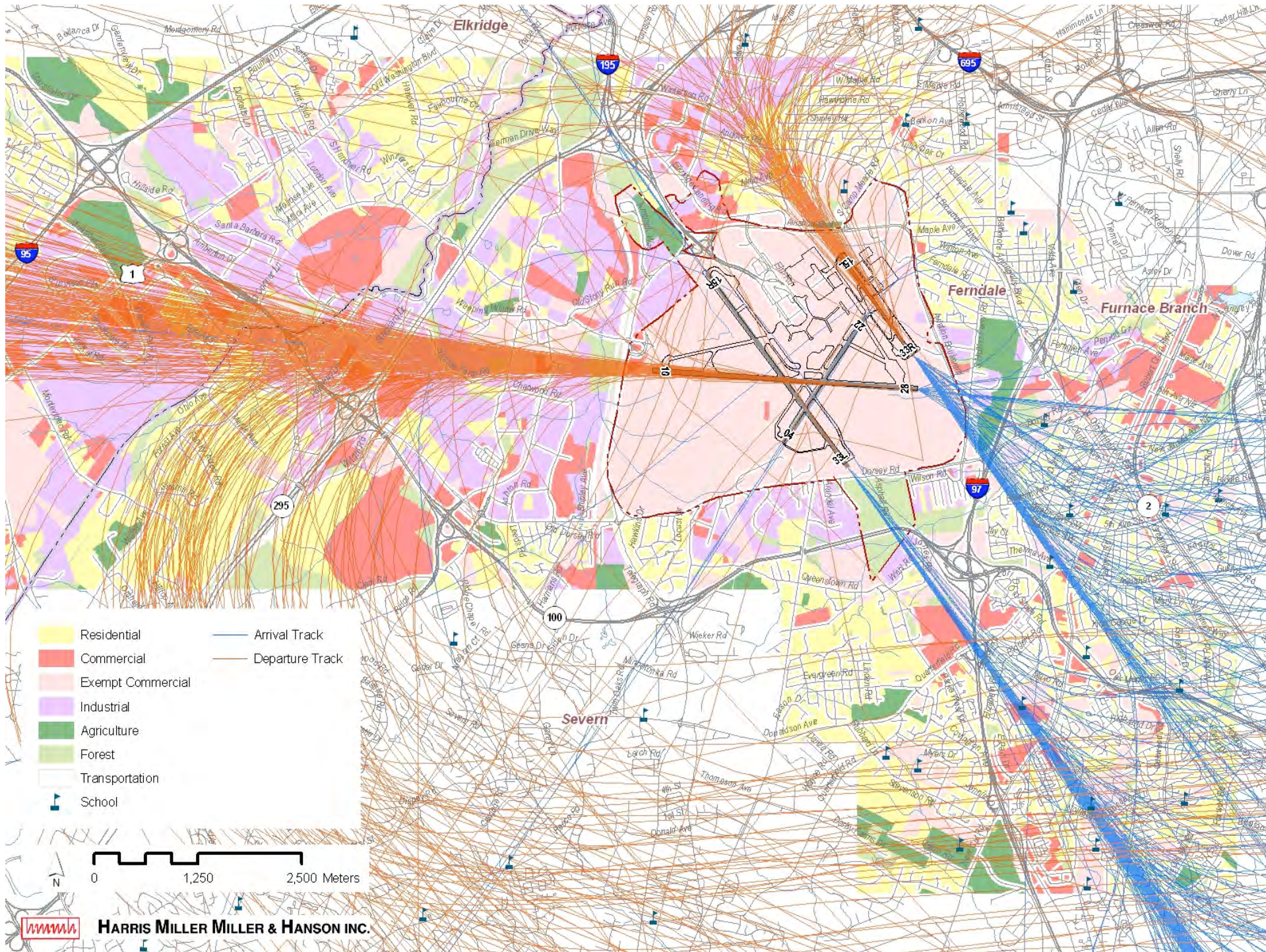
- **Air carrier activity increased 60%**
- **Impacted population reduced 90%**
- **Development pressures in formerly non-compatible areas**

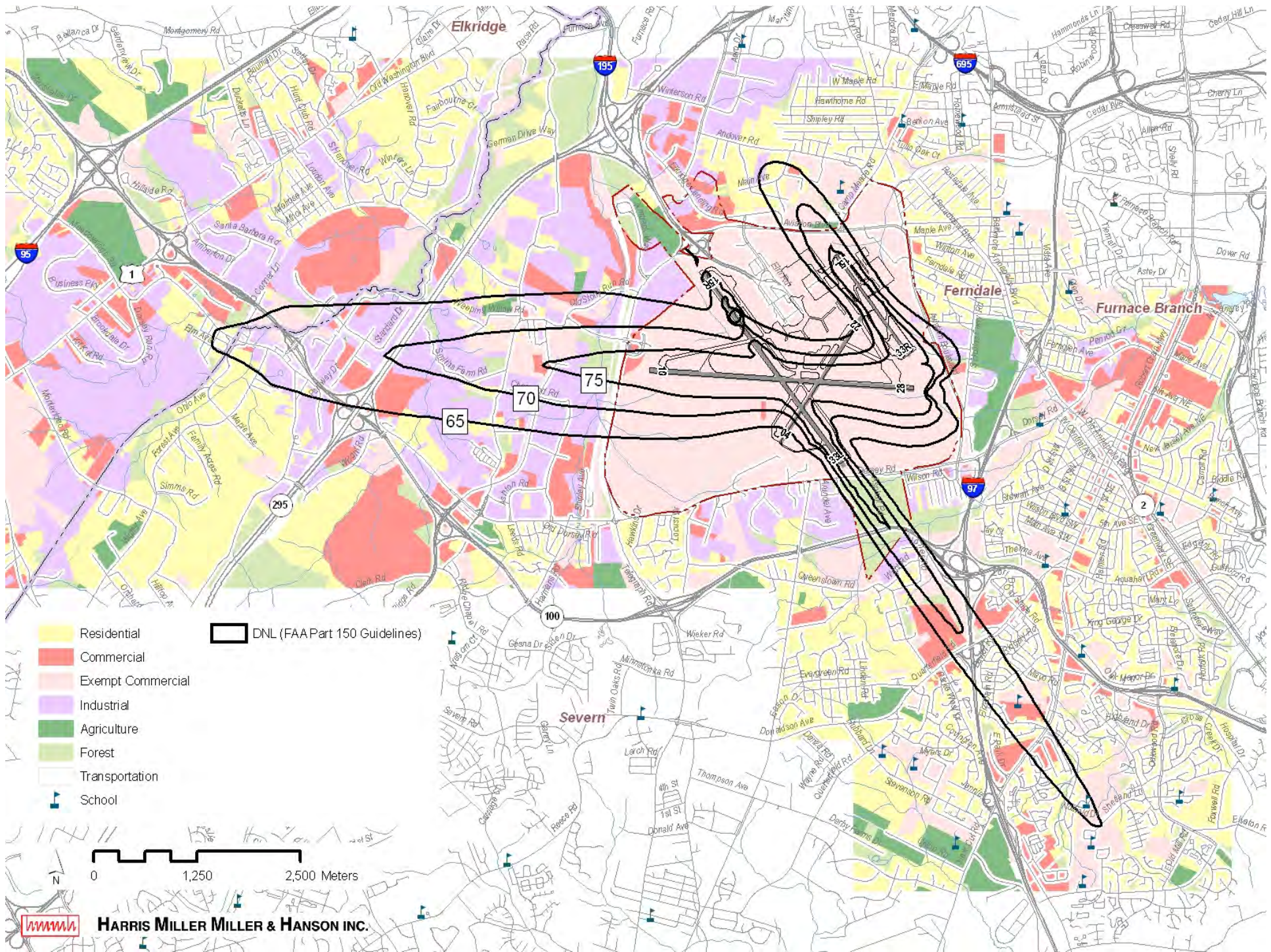


Use supplemental metrics to describe *effects*

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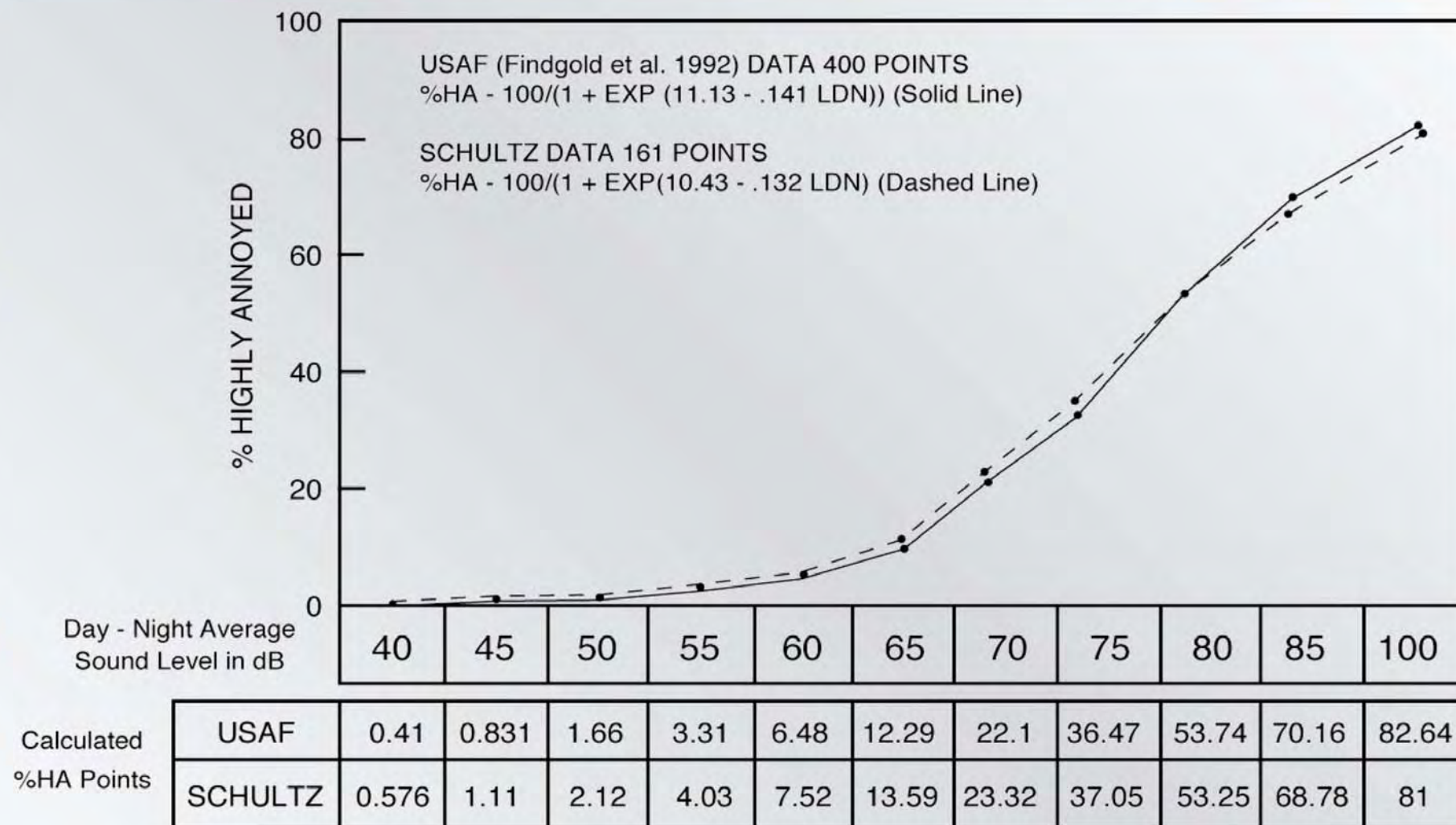
- | | |
|-------------------------------------|--|
| ■ Instead of <i>Metrics</i>, | Let's talk about <i>Effects</i> |
| ■ Instead of <i>CNEL</i> , | <i>Annoyance</i> |
| ■ Instead of <i>SEL</i> , | <i>Awakening</i> |
| ■ Instead of <i>N70</i> , | <i>Communication</i> |
| ■ Instead of <i>Leq</i> , | <i>Learning</i> |
| ■ Instead of <i>Lmax-C</i> , | <i>Rattle and Vibration</i> |





Annoyance: Familiar dose-response relationship

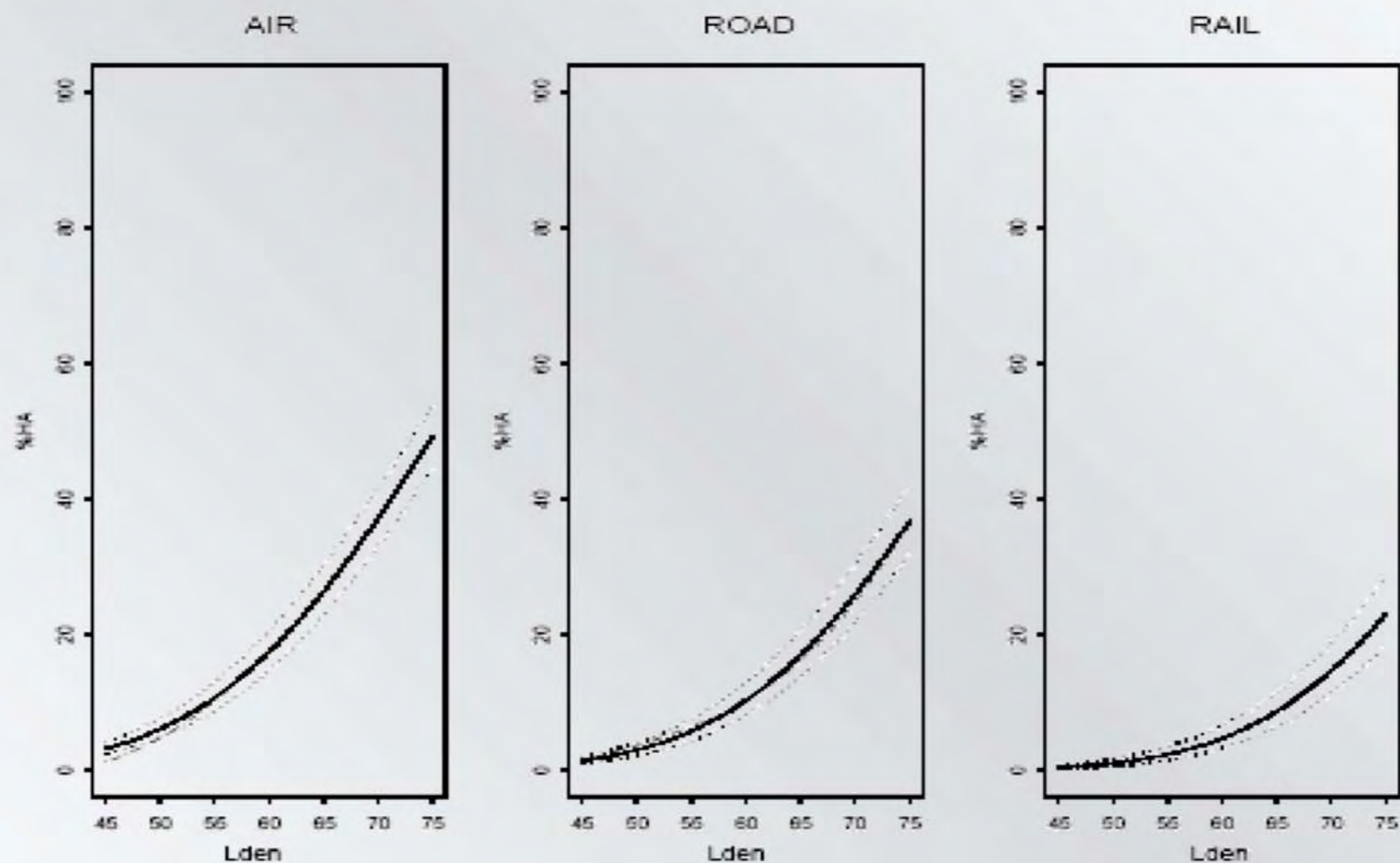
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Source: Finegold et al. 1992 and Schultz, 1978

Annoyance: recent analysis conducted in EU

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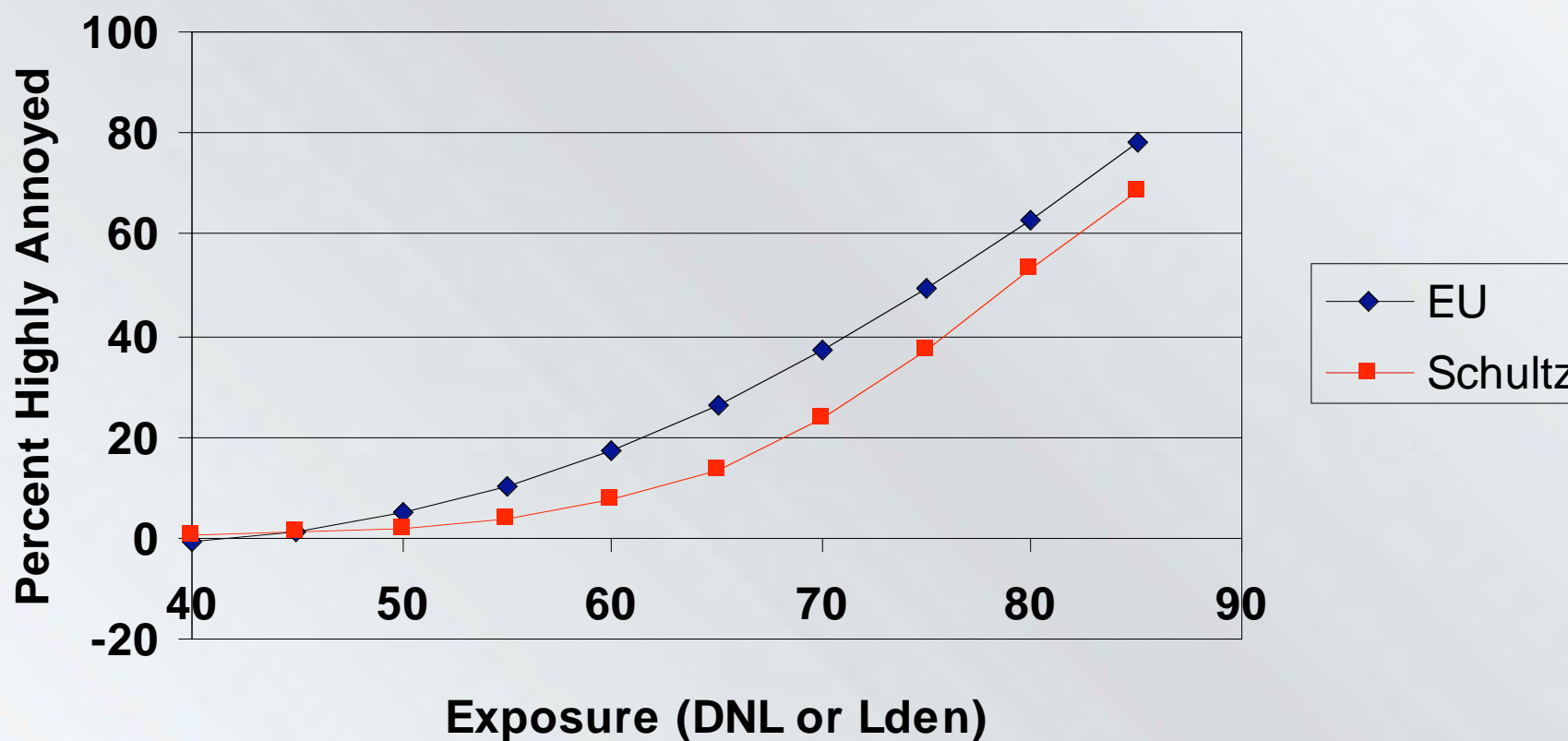


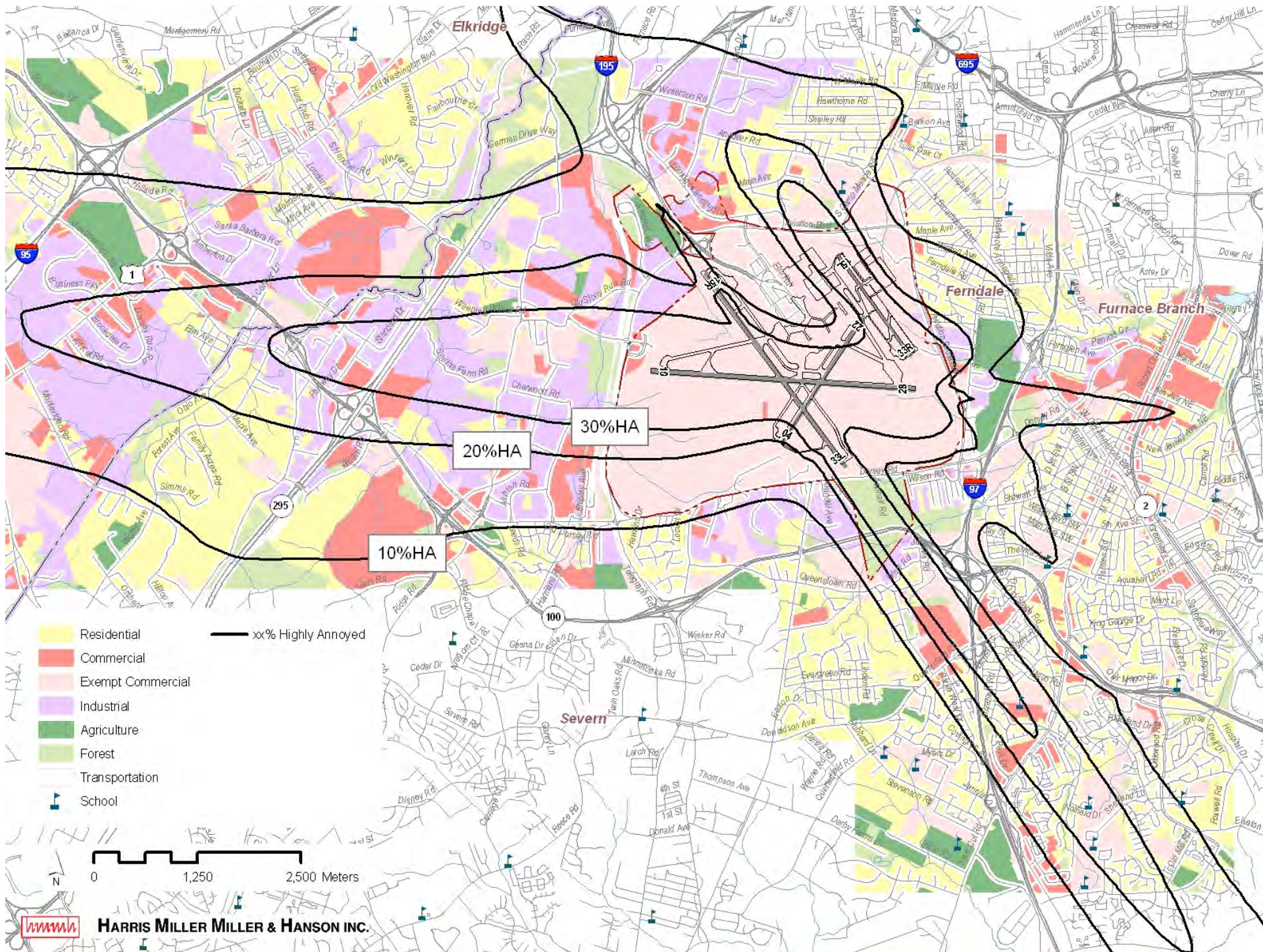
Source: *Position paper on dose-response relationships between transportation noise and annoyance*, European Commission Working Group 2, 2002.

Comparison of EU and Schultz annoyance curves

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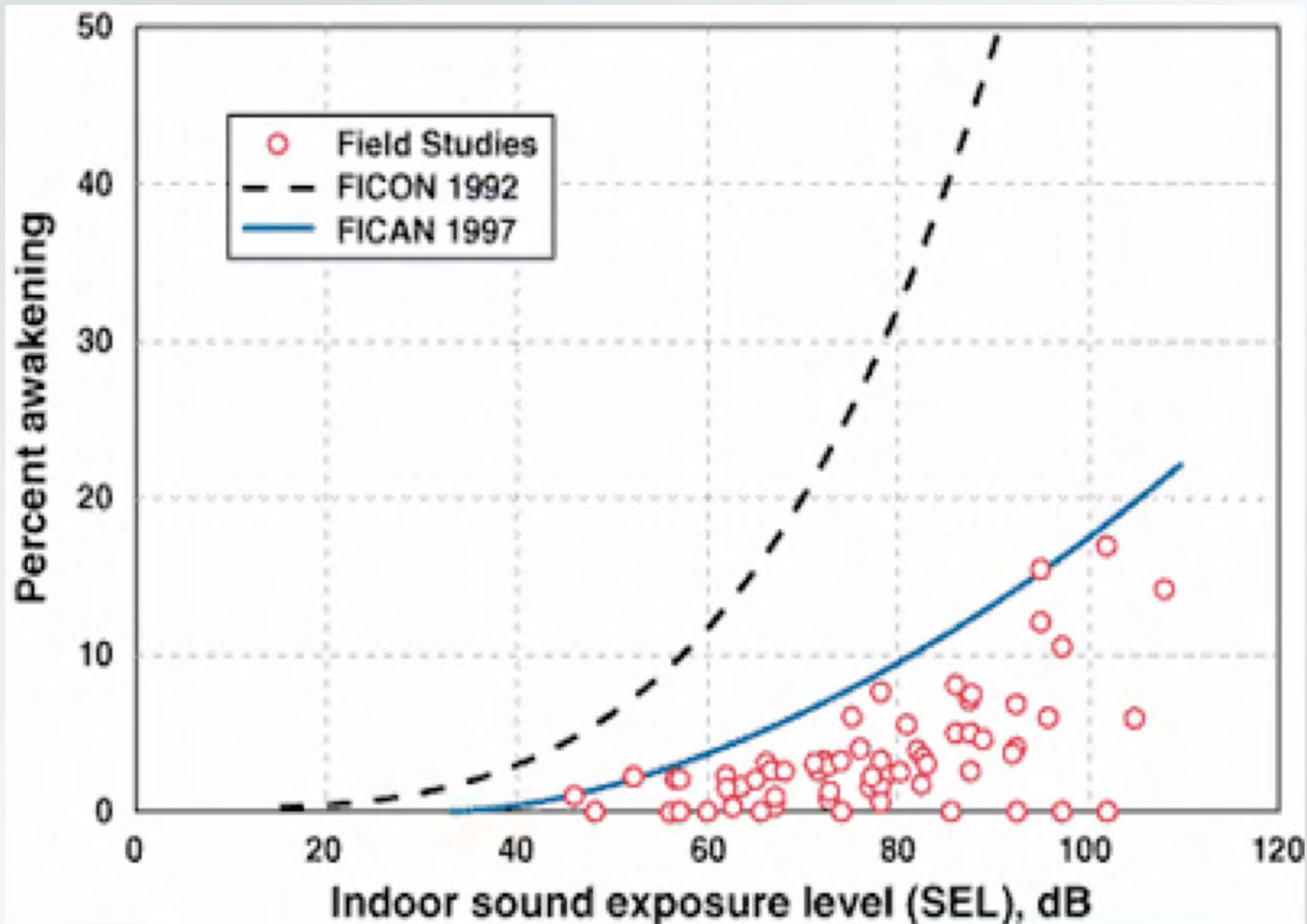
Annoyance dose-response





Sleep: Current guidance from 1997 FICAN curve

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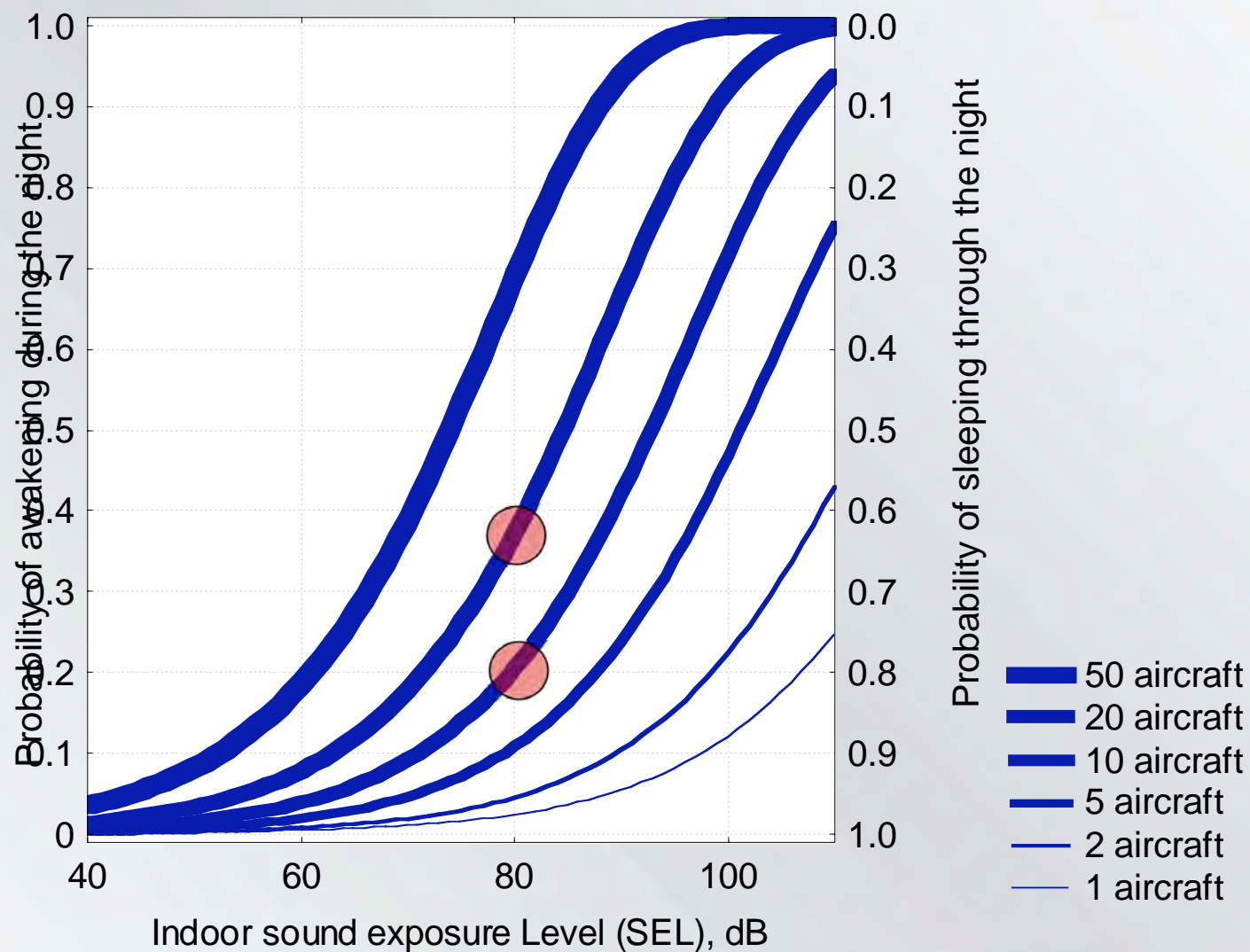
Percent awakening as probability

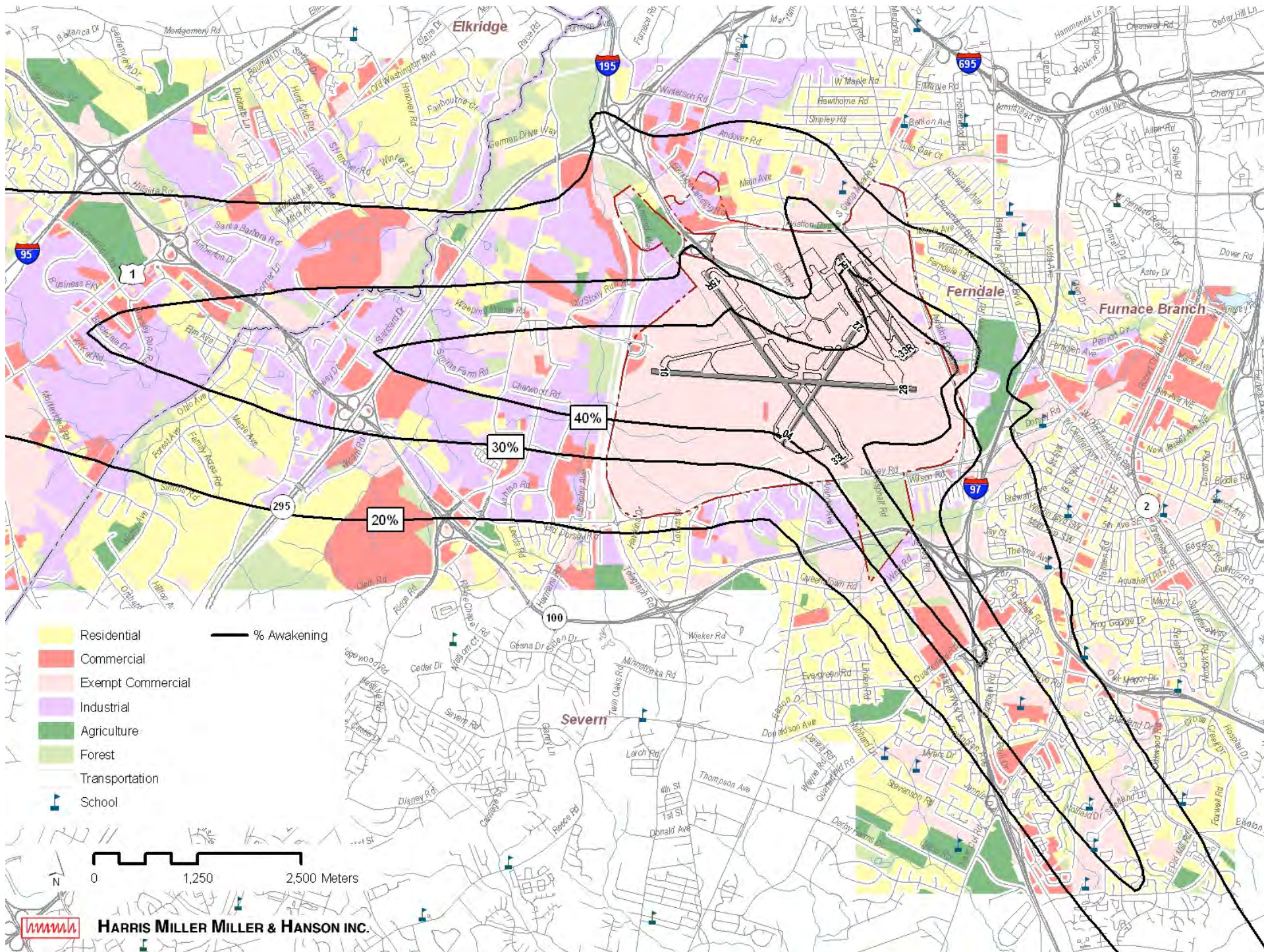
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- **“Percent awakening” is actually a probability**
 - If for some SEL, each person’s probability of awakening = 0.1, then 10% are expected to awake
- **One aircraft:**
 - 0.1 probability of awakening
 - 0.9 probability of not awakening
- **Two aircraft:**
 - “Sleeping through” means:
 - not awakening from the first, **AND**
 - not awakening from the second
 - Probability sleeping through = $(0.9)(0.9) = 0.81$
 - Probability awakening at least once = $1 - 0.81 = 0.19$

Awakening curves for multiple events

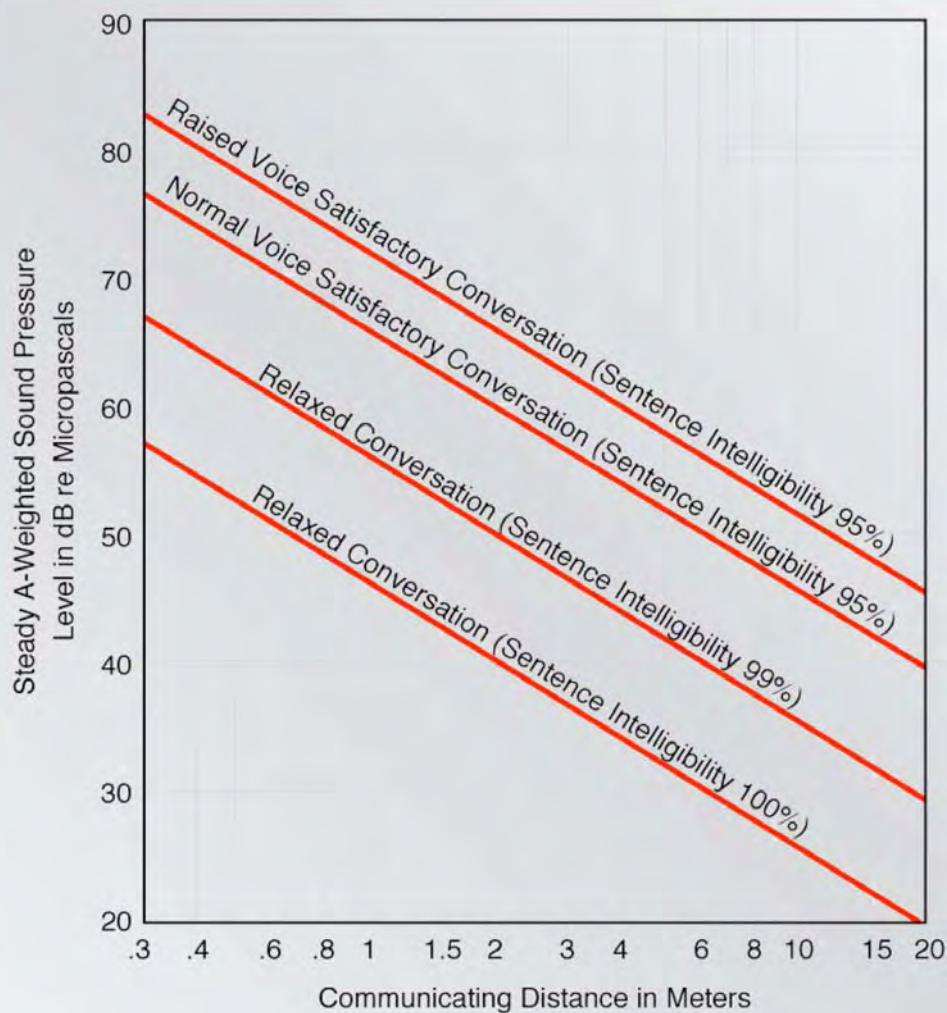
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Speech Interference & Communication

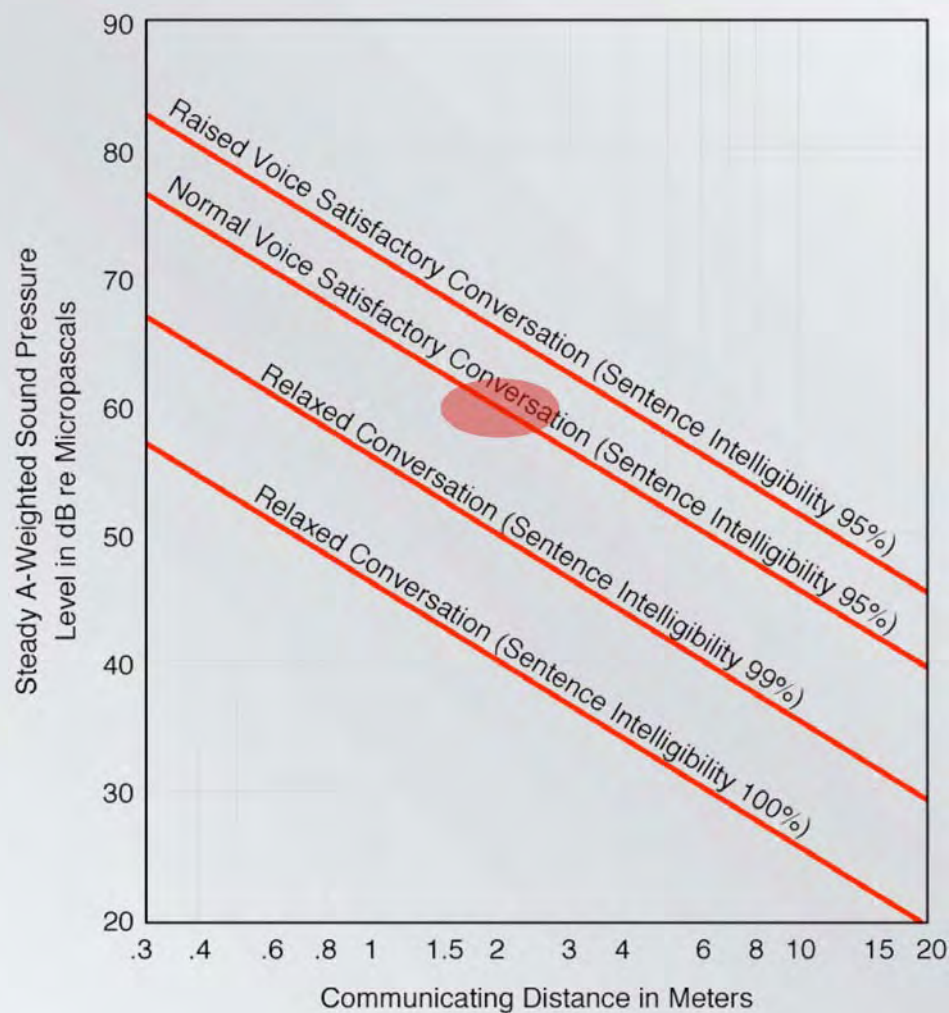
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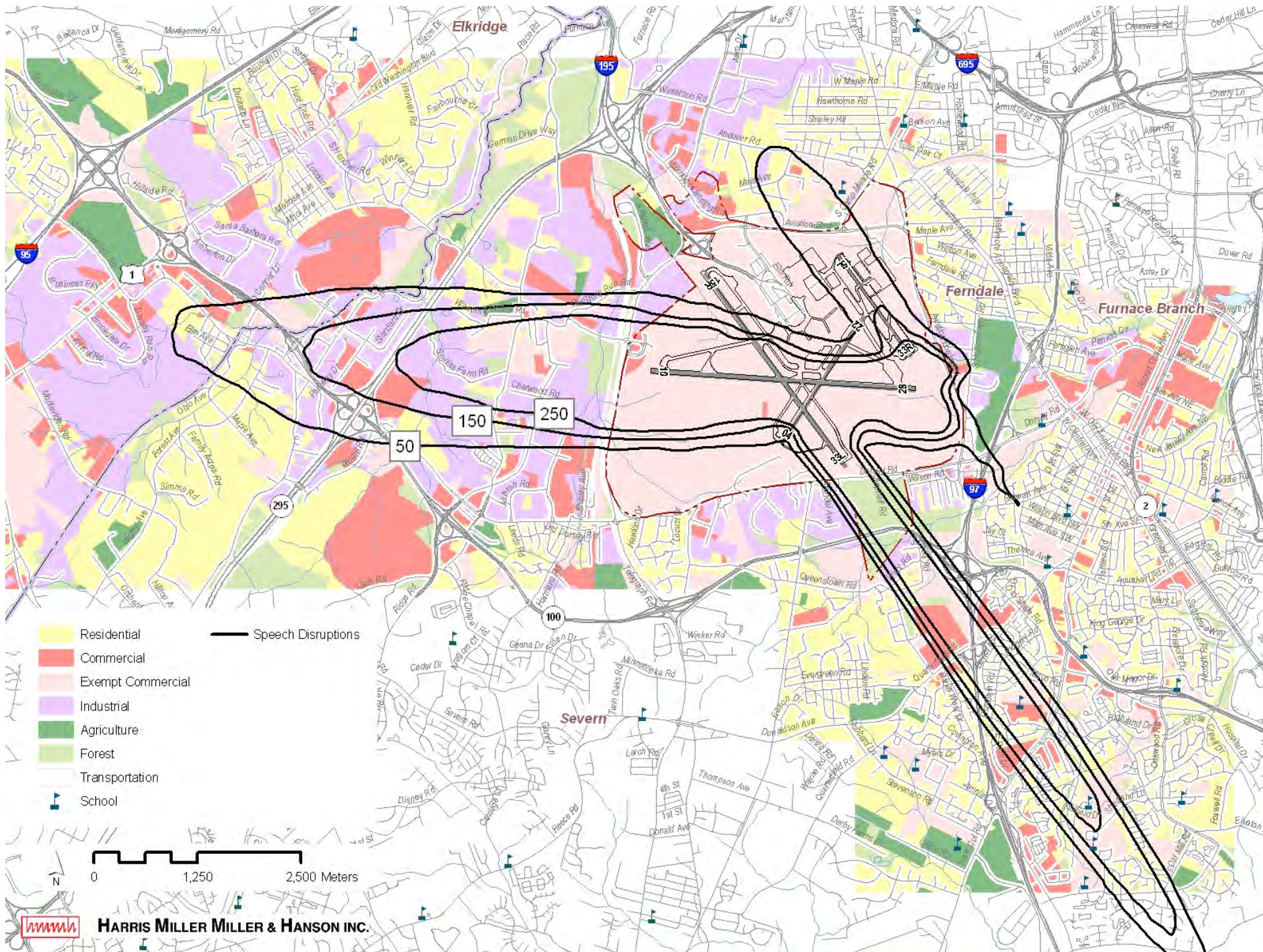
Source: US EPA, *Information on Levels of Noise Requisite to Protect the Public Health and Welfare with an Adequate Margin of Safety*, March 1974.

Speech Interference & Communication

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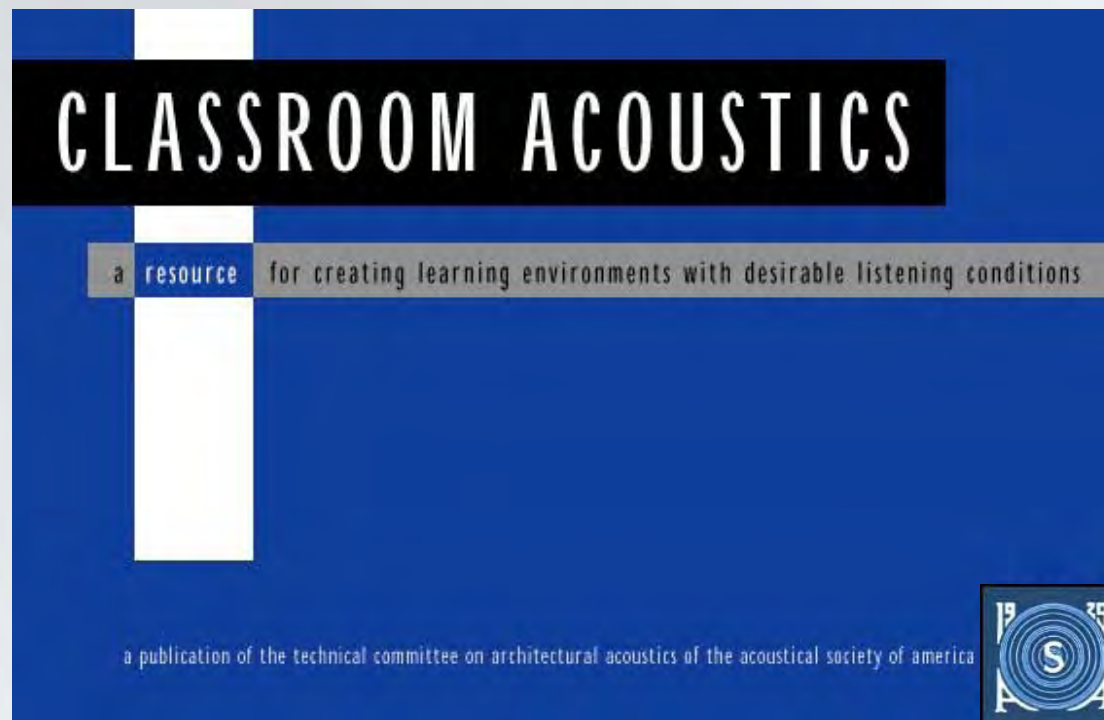


Source: US EPA, *Information on Levels of Noise Requisite to Protect the Public Health and Welfare with an Adequate Margin of Safety*, March 1974.



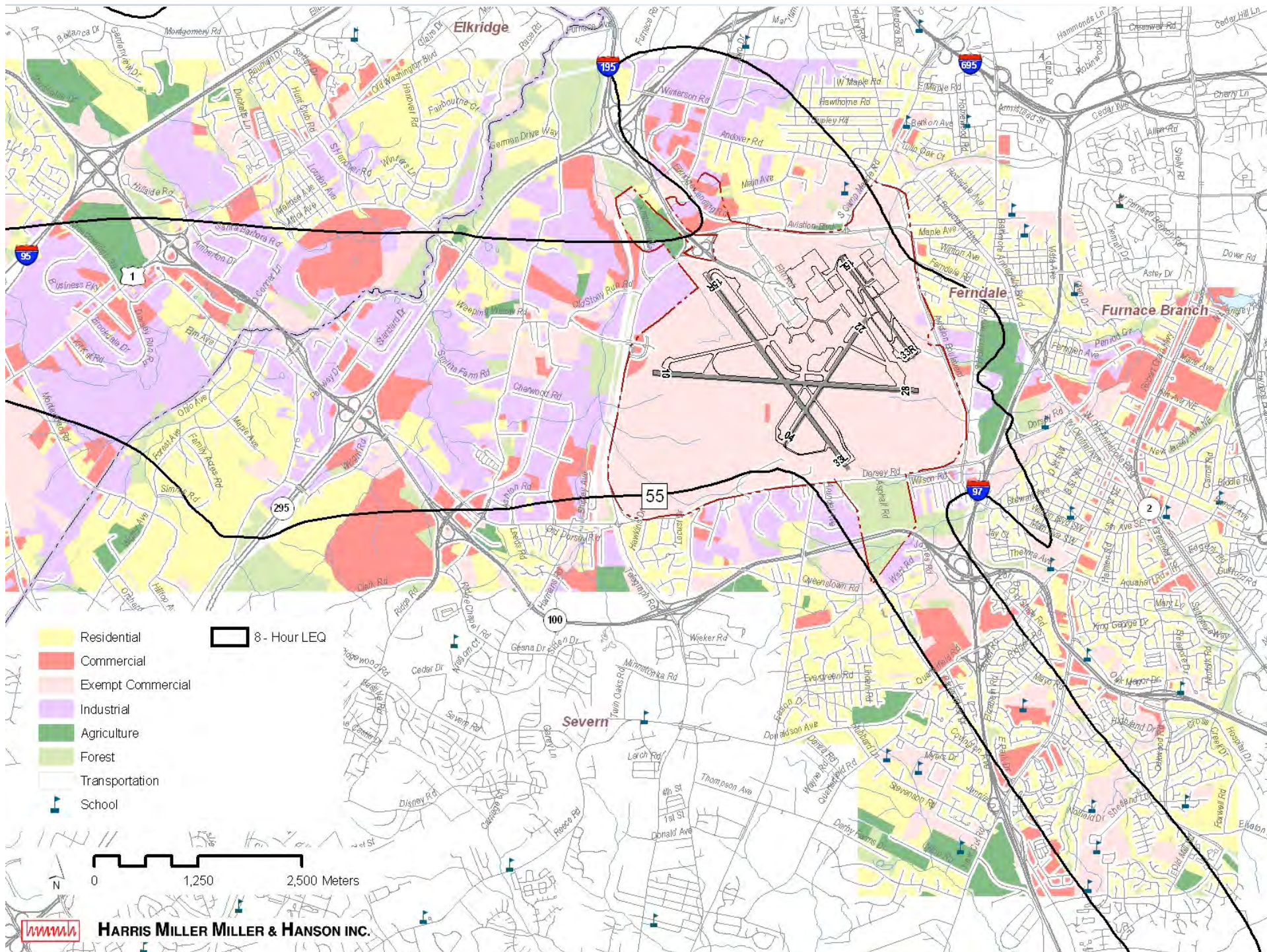
Impacts on Learning

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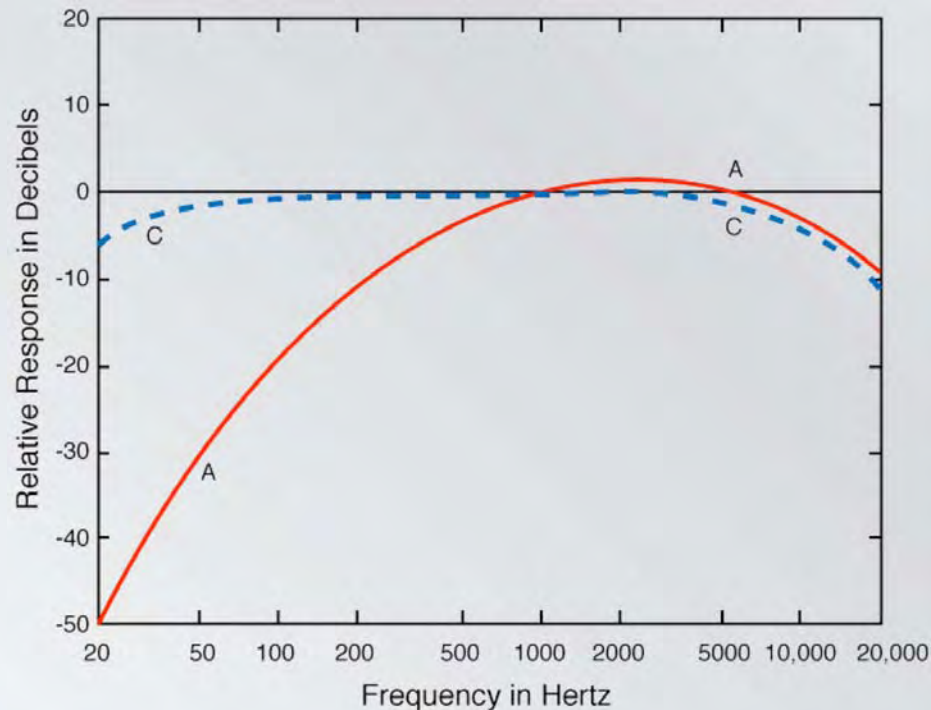
**ANSI Standard for Classroom Acoustics
recommends interior noise level of 40 dBA**

Source: ANSI/ASA S12.60-2002, *Acoustical Performance Criteria, Design Requirements, and Guidelines for Schools*



Low frequency noise

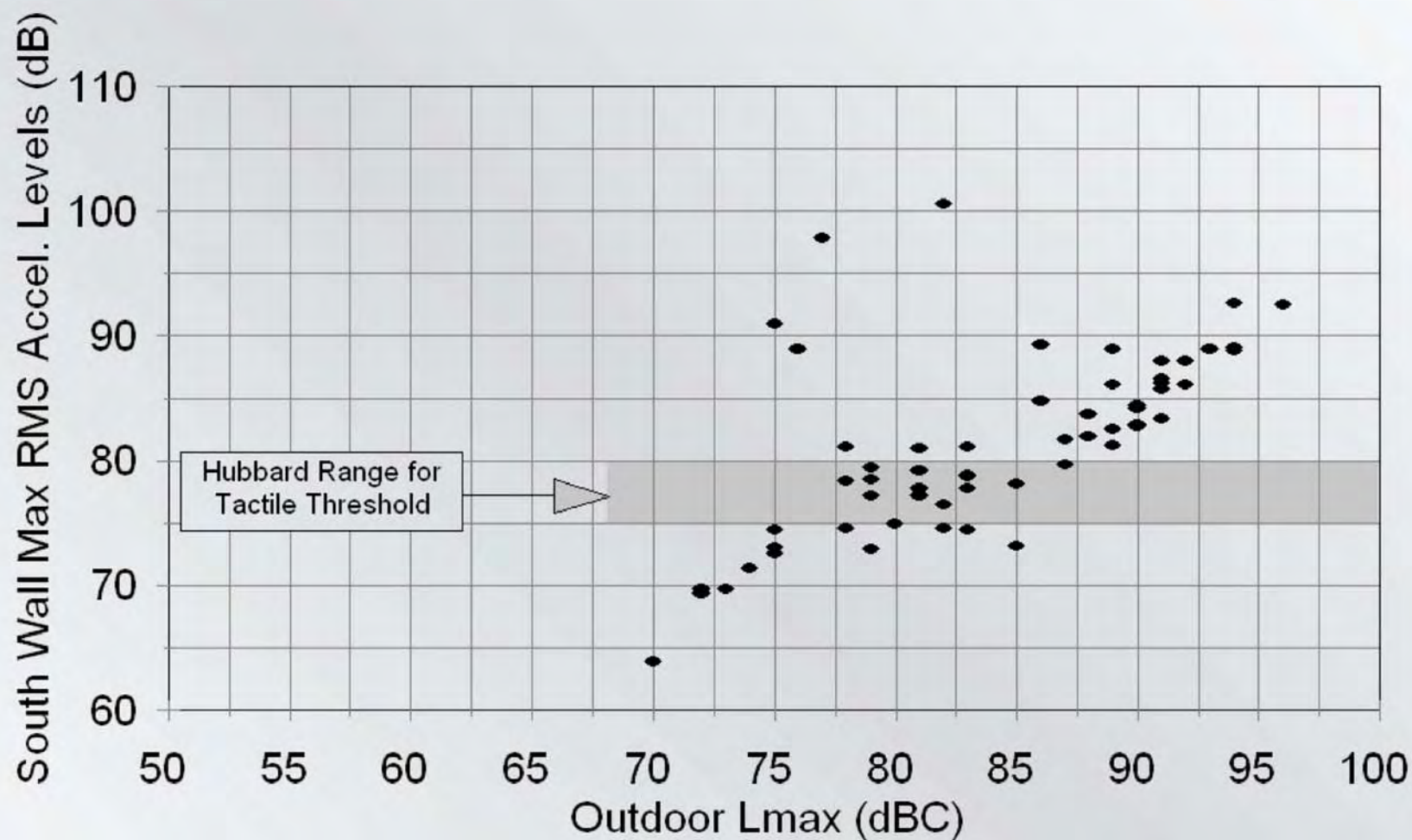
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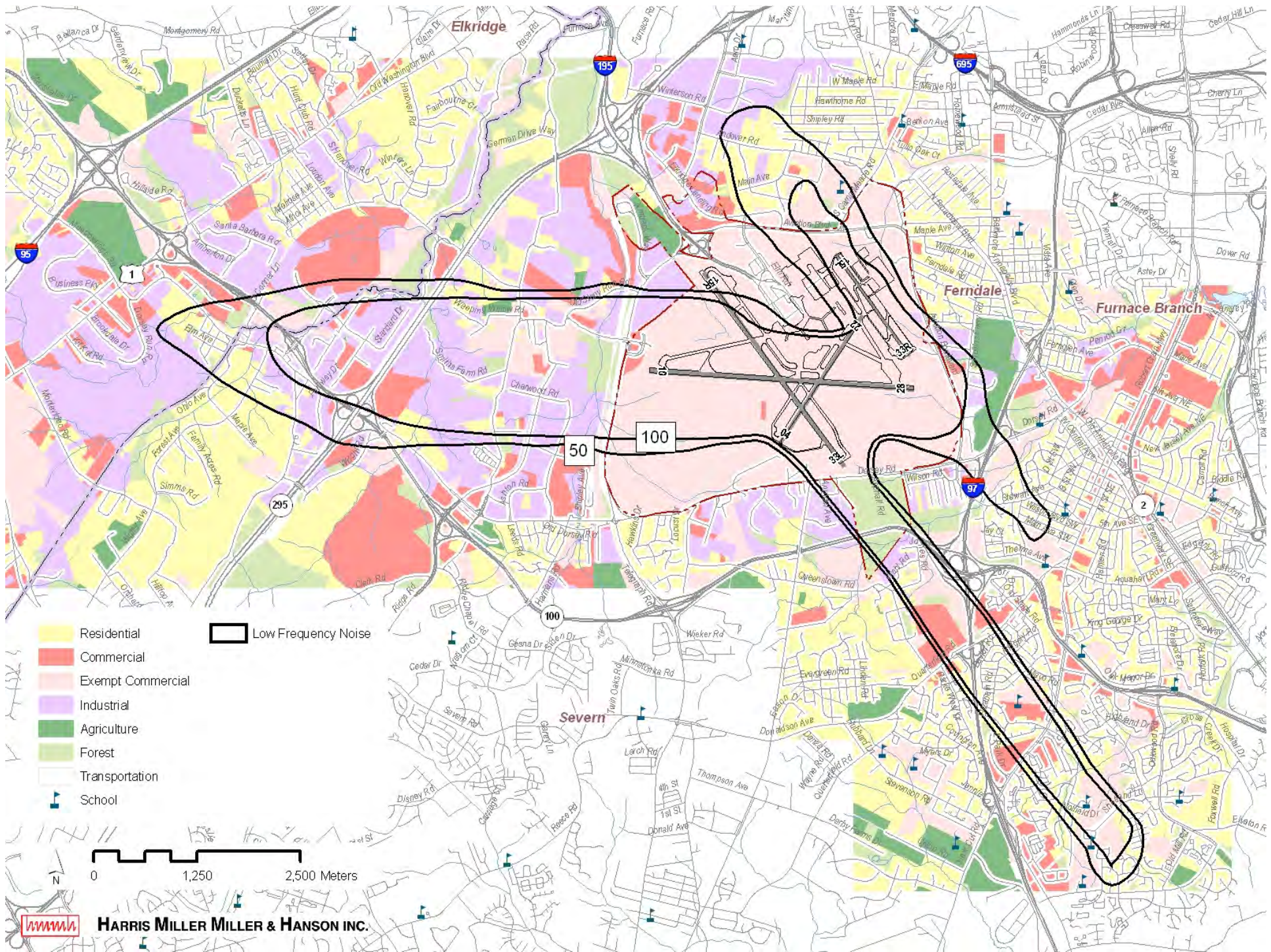
- **Primarily a problem near start-of-takeoff, sideline**
- **Results in noise-induced vibration, rattle**
- **Use C-weighting to address low frequency bands**

C-weighting measurements vs. vibration criteria

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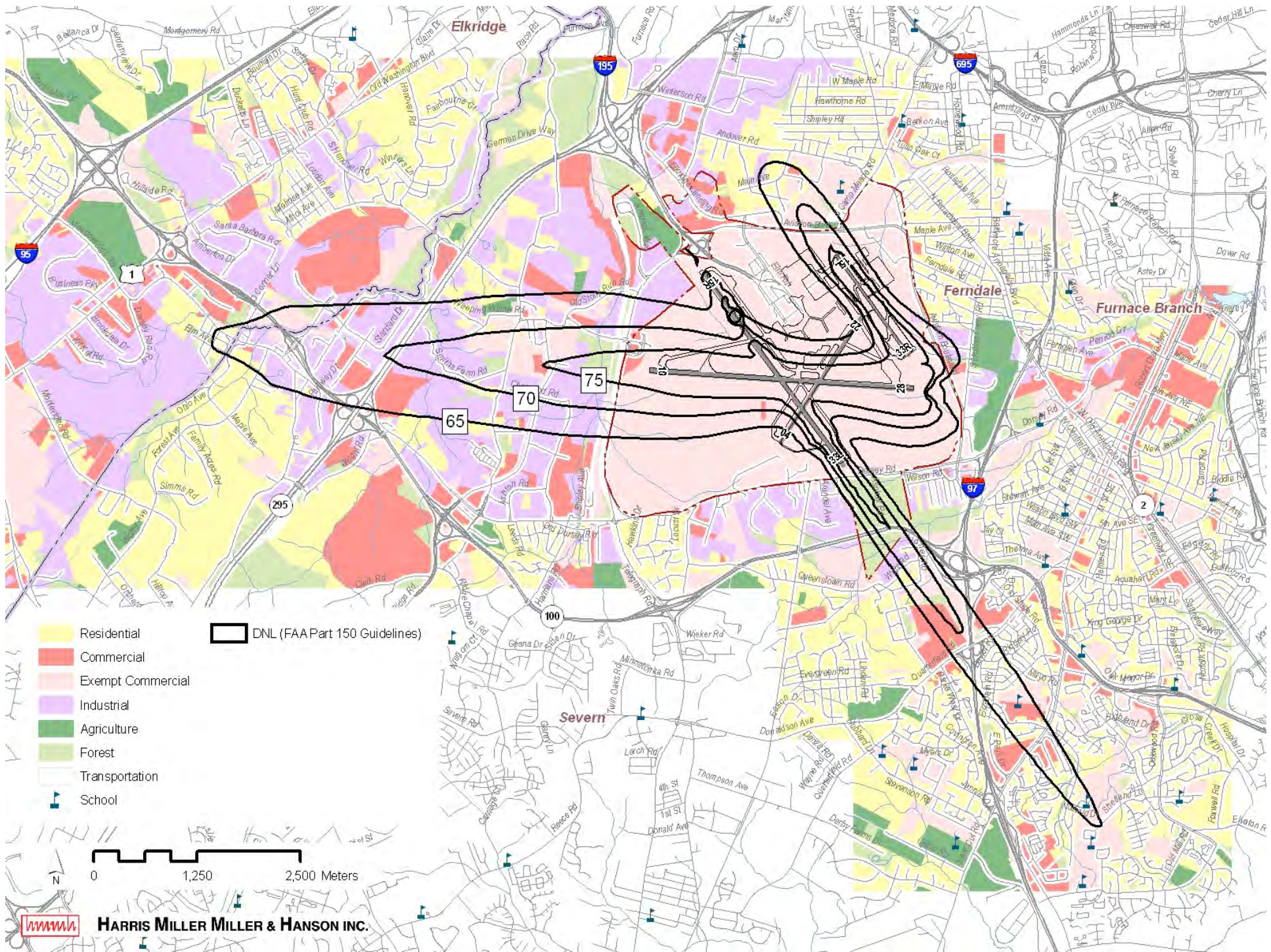
Source: Miller et al., *Low-frequency Noise From Aircraft Start Of Takeoff*, Internoise 98

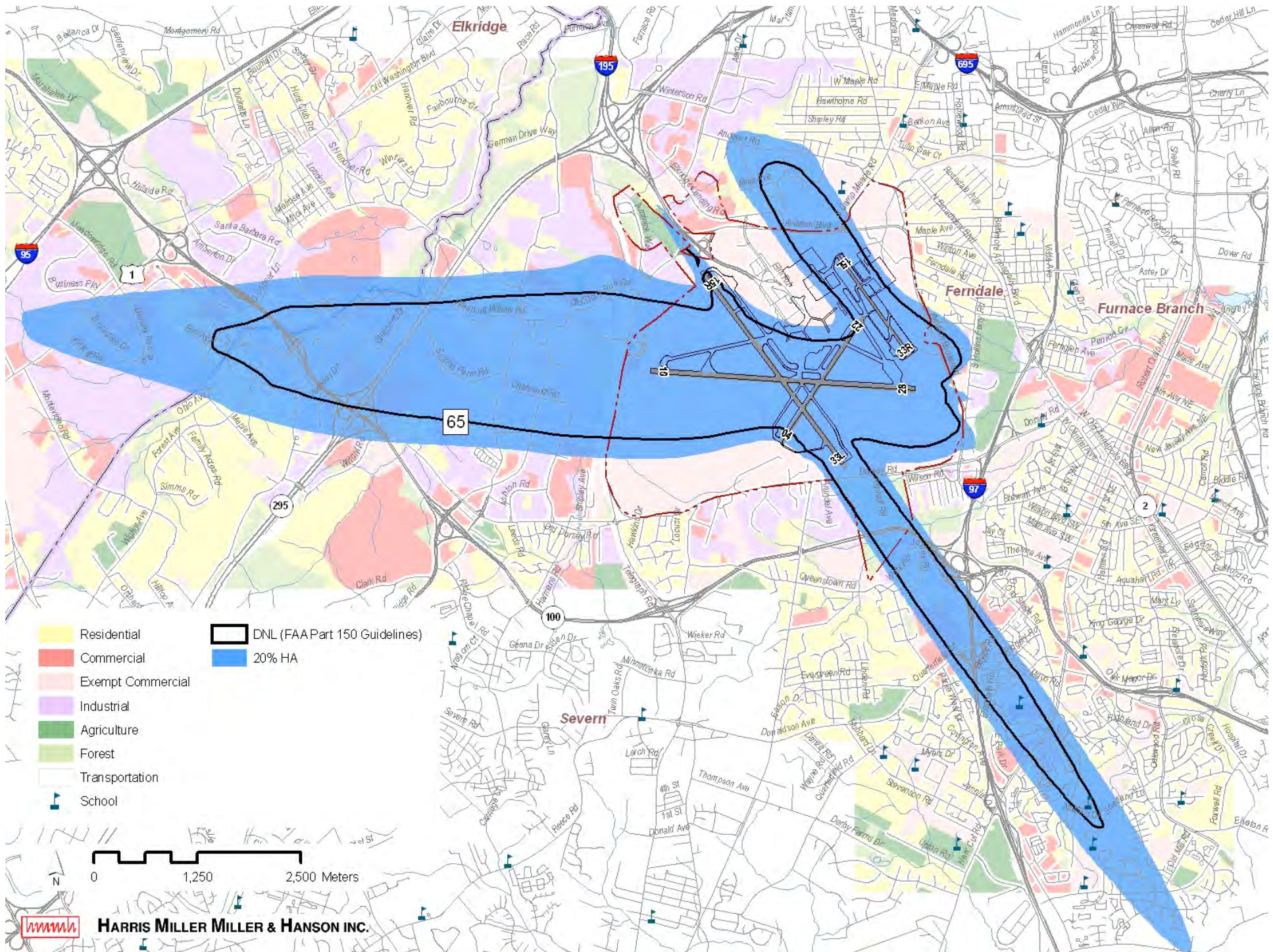


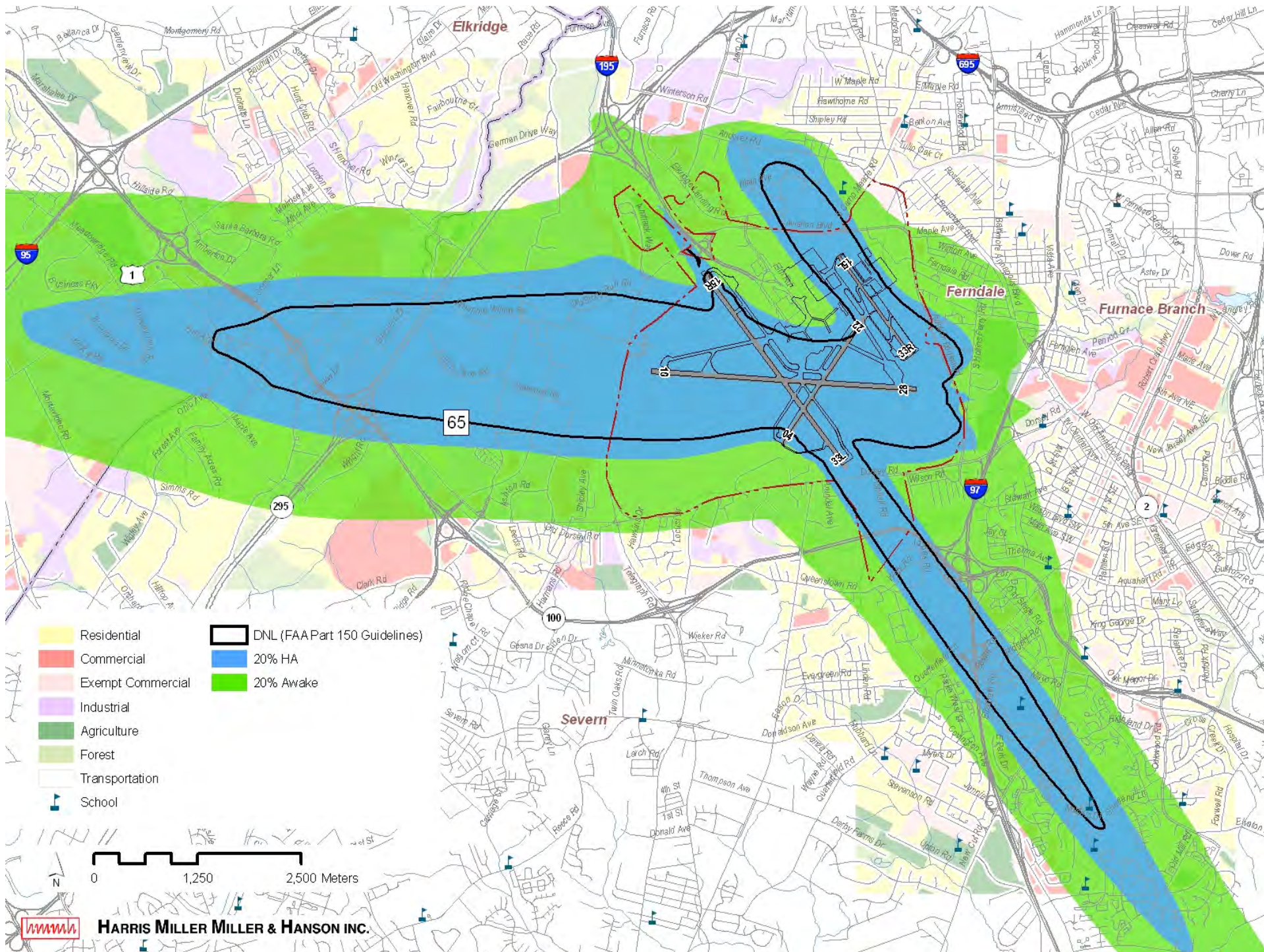
Putting it all together

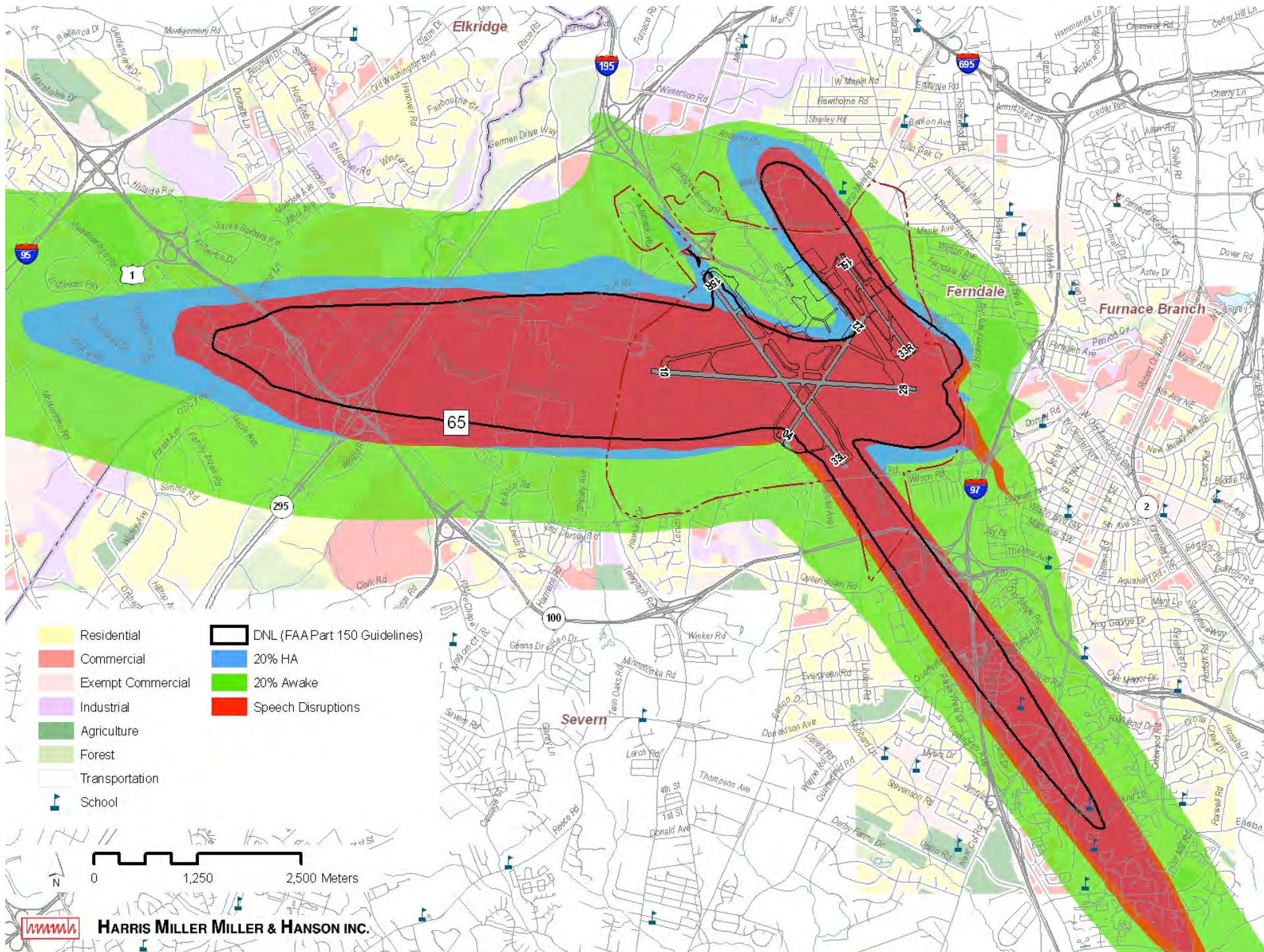
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- **What if we showed all of these effects?**

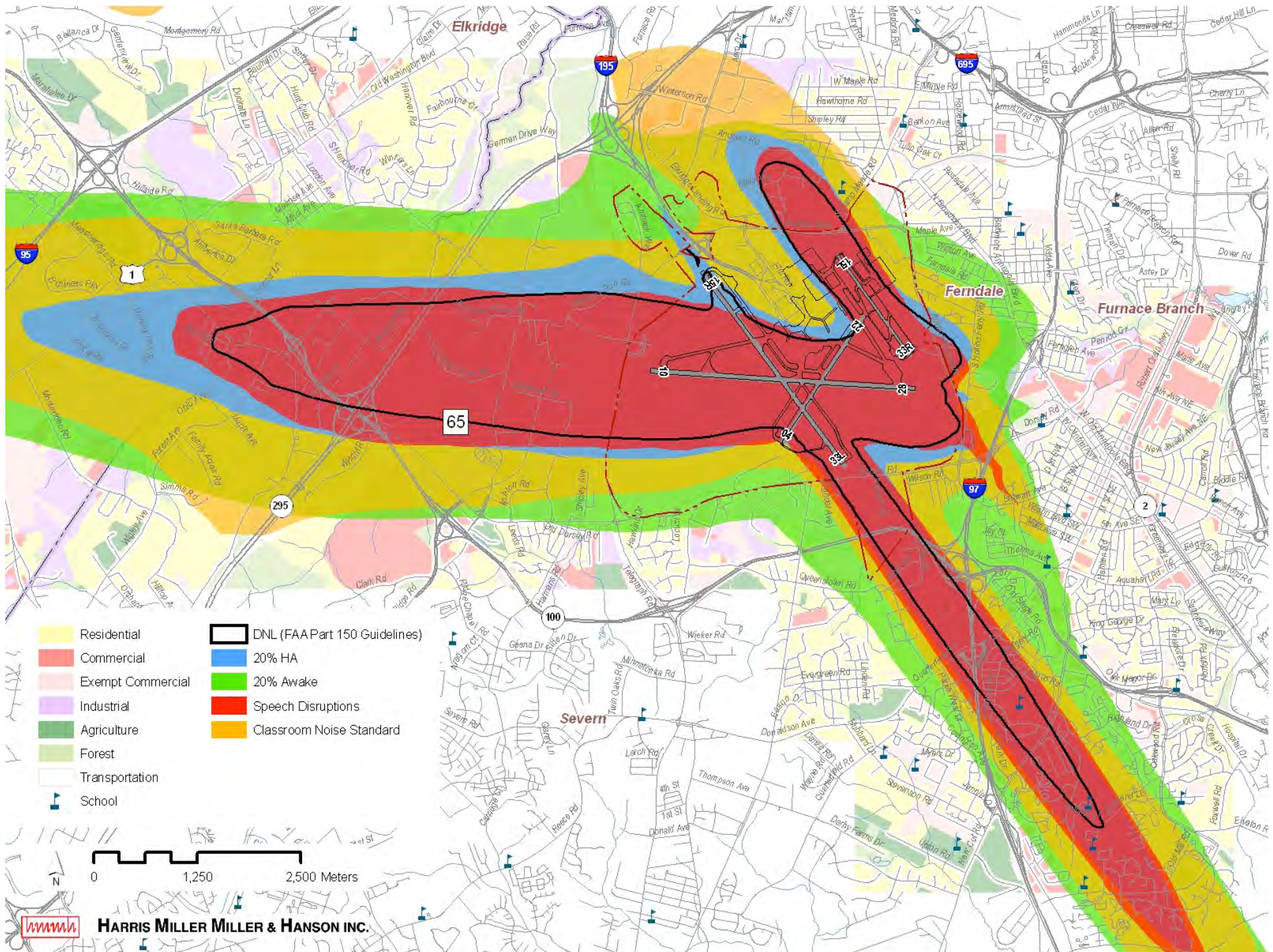


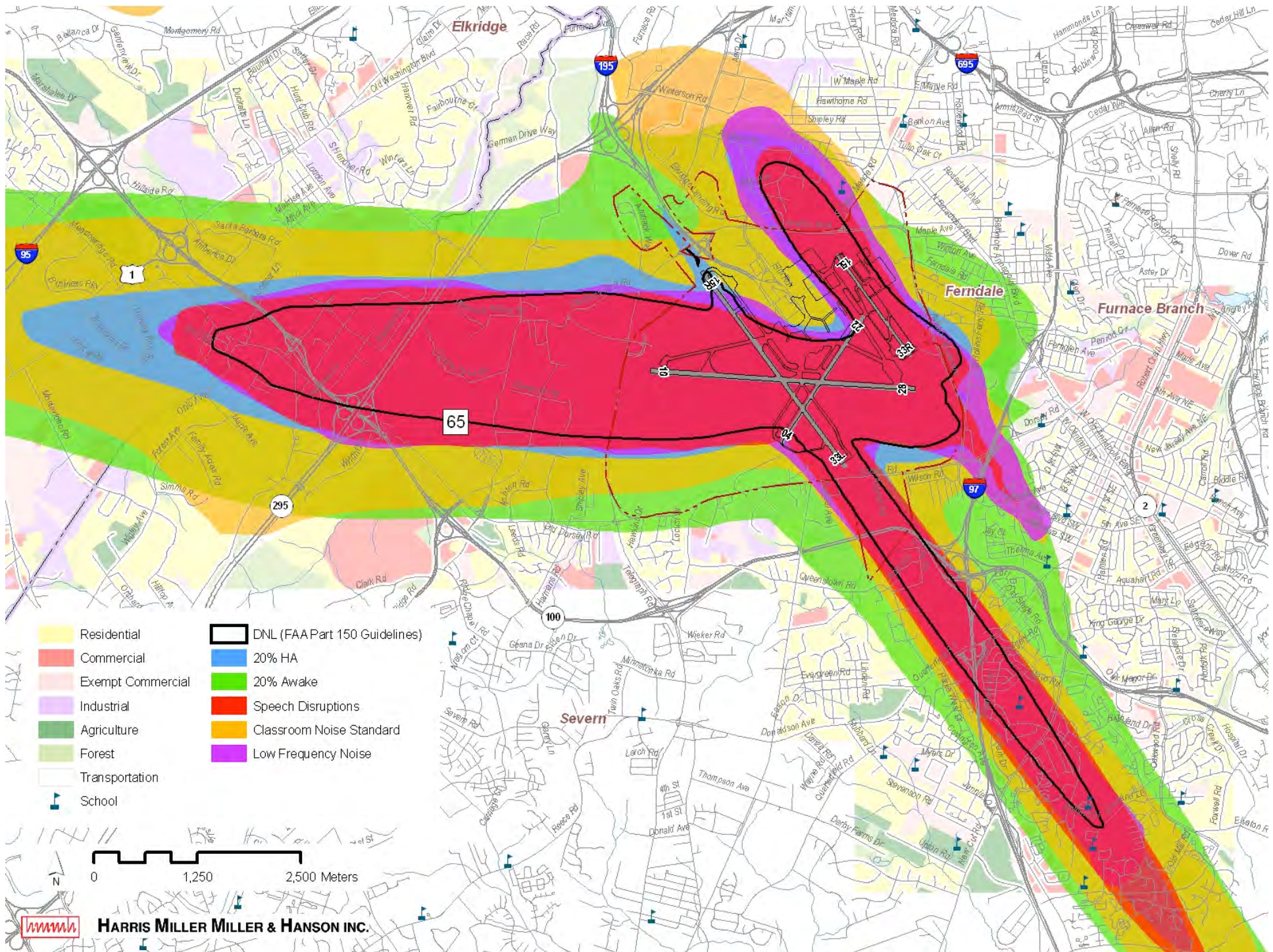






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Summary

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- The effects of aviation will continue to be a constraint to aviation growth unless we start communicating in a way that reflects the way people live.

