Traffic Noise Modeling

Preliminary Development & Final Design
How do the results compare?

Karel L. Cubick
Noise Analyst
ms consultants, inc.

I-77 Case Study
Canton, Ohio

- Existing interstate highway with 2 lanes each direction
- Adding 1 median lane in each direction within existing ROW
- Study area = 10 miles in length (4 projects)
- Engineer’s Total Cost Estimate (Project 2) $ 22 M
  Barriers $ 4.3M (20%)

- Single and multi-family homes
- Park, school, motels, churches, commercial development
- No existing noise barriers, numerous complaints from residents
Preliminary Development Noise Analysis
(Environmental)
Data Utilized

• Roadway
  – County planimetric maps (hardcopy with elevation data & no centerlines)
  – XYZ manually determined with grid paper

• Traffic
  – *IR 77 Area Development Study* predicted future traffic volumes
  – ADT only, DHV and % Trucks assumed

• Receivers
  – as shown on planimetric maps

• Assumptions
  – *analysis would likely result in recommendation for barrier construction*
  – 1998 Study Stamina 2.0/Optima

Planimetric Map
Final Design Noise Analysis
(Construction Plans)

Data Utilized

- Roadway
  - Lane group centerlines from design plan CAD files
- Traffic
  - Project design designation (DHV, % Trucks, Design Speed)
- Receivers
  - Scanned planimetric maps & digital airphotos referenced into CAD files
- Barriers
  - Locations determined in conjunction with design team (cross-sections)
  - Edge of shoulder with snow storage area
  - L/A Line in place of fence
  - 2002 Study TNM

Preliminary Development
(Environmental)

Analysis Results

- Noise Levels
  - Predicted within 3dB of monitored
- Impacts
  - DY levels exceed FHWA NAC
### Preliminary Development

(Environmental)

#### Analysis Results

- **Mitigation**
  - 12-16’ barrier > 5dB IL for 38th Street East Barrier

- **Cost Effectiveness**
  - 38th < $ 25,000 receptor
  - 50th > $ 25,000 receptor

- **Environmental Commitment**
  - Cost effective barriers be investigated in final design
  - *must be in design scope*
  - *don't underestimate effort*

### Final Design

(Construction Plans)

#### Analysis Results

- **Noise Levels**
  - Predicted > Existing

- **Impacts**
  - Exceed FHWA NAC

- **Mitigation**
  - 12-14’ Barrier
  - Exceeds goal (6 dB) at first row impacted receivers

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### Table 3: NOISE BARRIER SUMMARY

<table>
<thead>
<tr>
<th>Location</th>
<th>Barrier</th>
<th>Number of Estimated Cost per Receiver</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Woodridge</td>
<td>12-16’</td>
<td>&gt; 5dB IL</td>
</tr>
<tr>
<td>38th Street</td>
<td>20’</td>
<td>5,000 receptor</td>
</tr>
<tr>
<td>38th Street</td>
<td>12-16’</td>
<td>5,000 receptor</td>
</tr>
<tr>
<td>Orondeau</td>
<td>38’</td>
<td>5,000 receptor</td>
</tr>
<tr>
<td>50th Street</td>
<td>12-16’</td>
<td>5,000 receptor</td>
</tr>
<tr>
<td>60th Street</td>
<td>25’</td>
<td>5,000 receptor</td>
</tr>
<tr>
<td>Broadmoor</td>
<td>66’</td>
<td>5,000 receptor</td>
</tr>
<tr>
<td>Convenience</td>
<td>18’</td>
<td>5,000 receptor</td>
</tr>
<tr>
<td>Whipple</td>
<td>20’</td>
<td>5,000 receptor</td>
</tr>
</tbody>
</table>

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### Table 4: NOISE LEVELS SUMMARY

<table>
<thead>
<tr>
<th>Location</th>
<th>Barrier</th>
<th>Noise Level</th>
<th>Impact</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Predicted</td>
<td>Existing</td>
</tr>
<tr>
<td></td>
<td></td>
<td>&gt;</td>
<td></td>
</tr>
</tbody>
</table>

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Average noise levels before and after construction of barriers are calculated using the formula:

\[
\text{Average Noise Level} = \frac{\text{Sum of Individual Noise Levels}}{\text{Number of Receivers}}
\]
Final Design
(Construction Plans)
Analysis Results

- Cost Effectiveness
  - $ 25/ sq ft  double sided sound absorptive barrier material
  - Total Cost  $ 1,442,400
  - Cost per DU = $ 11,262

Did the environmental level analysis accurately predict design level modeling results?

<table>
<thead>
<tr>
<th></th>
<th>Preliminary Development</th>
<th>Final Design</th>
</tr>
</thead>
<tbody>
<tr>
<td>Noise Model</td>
<td>Stamina 2.0/Optima</td>
<td>TNM 1.0b</td>
</tr>
<tr>
<td>No Barrier Noise Level *</td>
<td>72.5 dB</td>
<td>71.4 dB</td>
</tr>
<tr>
<td>Barrier Height</td>
<td>12-16’</td>
<td>8-14’</td>
</tr>
<tr>
<td>Barrier Effectiveness* (IL)</td>
<td>9.3 dB</td>
<td>8.3 dB</td>
</tr>
<tr>
<td>Barrier Location</td>
<td>Shoulder</td>
<td>Shoulder with snow storage</td>
</tr>
<tr>
<td>Number of DU</td>
<td>119</td>
<td>128</td>
</tr>
<tr>
<td>Cost per DU</td>
<td>$ 13,182</td>
<td>$ 11,262</td>
</tr>
</tbody>
</table>

* Burrsire pool receiver
I-77 Study
Areas for Improvement

• “No New ROW” = no mapping or survey beyond L/A fence, all receiver info from non-project sources

• “No New ROW” = no adjacent property owner mailing list, a public involvement challenge

• Design Year Traffic data = Predicted truck volume may be low
  – Design Designation (2024) = 10%
  – Field Observed (2002) = 14%

I-77 Study
Lessons Learned

• Assumption that barriers would be part of final design = detailed environmental noise study, not last minute decisions

• Detailed environmental study allowed time for aesthetic considerations and public involvement during final design

• Close coordination between Noise Analysts, Highway Design Team, DOT, Local Officials, and the Public - ESSENTIAL

• Can do / must do attitude of entire team!
I-77 Noise Barrier

US 42 Noise Barrier