Analysis of Safety at Quiet Zones

2014 Global Level Crossing Safety & Trespass Prevention Symposium
Urbana, IL
Who We Are

The Federal Railroad Administration (FRA) enables the safe, reliable, and efficient movement of people and goods for a strong America, now and in the future.

- Safety is our number one priority
- We are laying a foundation for higher performing rail
- Promulgating and enforcing rail safety regulations
- Investing in America’s rail corridors
- Research and development to advance rail safety
Our Success and Accomplishments

Rail has never been safer.

FRA is committed to continuous safety improvement:
• Maintaining onsite inspections identifying safety violations;
• Development rules, regulations and guidance; and
• Workforce training

FRA is the Chief Safety Regulator for all Passenger and Freight Railroads Nationwide
• FRA employs nearly 900 people
• With eight regional offices strategically located across the Nation
• Dedicated to our vision: RAIL - Moving America Forward
F E D E R A L  R A I L R O A D  A D M I N I S T R A T I O N

Laying a foundation for higher performing rail

Our Multi-Billion Dollars Portfolio Includes:
• Amtrak Operating and Capital Programs - $7 billion
• High Speed and Intercity Passenger Rail (HSIPR) Grants - $10.1 billion
• Research and Development - $30 million
• Railroad Rehabilitation and Improvement Financing (RRIF) Program – $1.7 billion
• Transportation Investment Generating Economic Recovery (TIGER) Programs - $423 million
• Rail Line Relocation Grants - $86 million
• Disaster Assistance Grants - $18 million
Analysis of Safety at Quiet Zones
Background

• Most states had laws that require trains to provide an audible warning while approaching public crossings

• Some states permitted whistle bans under state law or home rule

• This rule was required by statute in order to provide a National policy for train horn use
Florida Experience

Collisions at Crossings During 10 PM to 6AM Whistle Bans
Florida East Coast Railroad

Year

Collisions - Cumulative Total

0 50 100 150 200 250


Whistle Bans Began
Florida Experience

Collisions at Crossings During 10 PM to 6AM Whistle Bans
Florida East Coast Railroad

Collisions - Cumulative Total

Year

Whistle Bans Canceled

Whistle Bans Began
Florida Experience

Collisions at Crossings During 10 PM to 6AM Whistle Bans
Florida East Coast Railroad

- Whistle Bans Canceled
- Whistle Bans Began

Year

Collisions - Cumulative Total

0 50 100 150 200 250

80 81 82 83 84 85 86 87 88 89 90 91 92 93
National Safety Impact

• Florida - nighttime ban
  – 195% increase in collisions
• 1st Nationwide Study
  – +84% average increase in collisions
• Nationwide Study - revised
  – +62% at crossings with gates
• Rule
  – +66.8% at crossings with gates
Study

- Considered quiet zones established between May 2005 and April 2011
- 203 quiet zones
  - 81 pre-rule
  - 121 new
  - 1 wayside horn
- 903 crossings
Hypothesis

There will be no statistical difference between the number of incidents that occurred before the quiet zone was established and the number of incidents that occurred after the quiet zone was established.
Statistical Analysis

- Statistical analysis was conducted on all quiet zones based on
  - Year of quiet zone establishment
  - Quiet Zone Type (New, Pre Rule)
  - Basis for establishment or BAS Section.
Data Collection

- **CCM QZ database**
  - Date of establishment
  - Pre-rule or new
  - Basis of establishment

- **Railroad Accident Incident Reporting System**
  - Grade crossing collision reports
Data

• Study included only the quiet zones that had been established for at least one year.
• 202 quiet zones were observed with establishment dates from May 2005 through April 2011.
  – 81 Pre-Rule
  – 121 New
Eliminated Data

• A minimum of 12 months of observable data both prior to and following the implementation of the quiet zone was required to avoid biased estimates that could occur because of seasonal factors.

• 2 quiet zones did not contain proper NOE’s and therefore were not included in the study.

• The remaining 203 quiet zones being observed were established between May 2005 and April 2011.

• Chicago exempt crossings not included
Incident Data

• 2 groups of incident data:
  – Incidents which occurred during the year period $N$ before the quiet zone
    • $N$ is the number of full observable years before (and after) the establishment of the quiet zone.
  – Incidents that occurred during the year period $N$ after the quiet zone
  – Data outside of this criterion were eliminated; consequently, incidents which occurred either before or after the full 12 month period (in a 1 year study) were eliminated.
Analysis Methodology

• A paired t-test is a statistical method used to compare two population means where observations in one population can be paired with observations in the other population.

• Specifically, incident data for a time interval of 1, 2, 3, 4, 5, 6 or 7 year(s) before the quiet zone was established was compared to incident data during a time interval of 1, 2, 3, 4, 5, 6 or 7 year(s) after the quiet zone was established.

• A comparison of the means of each of sample was used to analyze incidents that occurred during these specific time frames.
Hypothesis

The null hypothesis is that there will be no statistical difference between the number of incidents that occurred before the quiet zone was established and the number of incidents that occurred after the quiet zone was established (due to the installation of SSMs or ASMs which compensate for the increased risk attributable to the lack of the horn).
Null Hypothesis

• If the $t$-test value is 0.05 or less, the difference is statistically significant
• Null hypothesis is false
# QZs Grouped By Years

<table>
<thead>
<tr>
<th>Group</th>
<th>Established Between</th>
<th>Consecutive months of data</th>
<th># of QZs in group</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>May-05</td>
<td>84</td>
<td>82</td>
</tr>
<tr>
<td>1A</td>
<td>May-05</td>
<td>84</td>
<td>73</td>
</tr>
<tr>
<td>2</td>
<td>May-06</td>
<td>72</td>
<td>21</td>
</tr>
<tr>
<td>3</td>
<td>May-07</td>
<td>60</td>
<td>28</td>
</tr>
<tr>
<td>4</td>
<td>May-08</td>
<td>48</td>
<td>26</td>
</tr>
<tr>
<td>5</td>
<td>May-09</td>
<td>36</td>
<td>25</td>
</tr>
<tr>
<td>6</td>
<td>May-10</td>
<td>24</td>
<td>31</td>
</tr>
<tr>
<td>7</td>
<td>May-11</td>
<td>Not Included</td>
<td></td>
</tr>
</tbody>
</table>
## Collision Data

<table>
<thead>
<tr>
<th>Group</th>
<th>Observation</th>
<th>Incidents Before NOE</th>
<th>Incidents After NOE</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>82</td>
<td>202</td>
<td>178</td>
</tr>
<tr>
<td>1A</td>
<td>73</td>
<td>188</td>
<td>167</td>
</tr>
<tr>
<td>2</td>
<td>21</td>
<td>39</td>
<td>35</td>
</tr>
<tr>
<td>3</td>
<td>28</td>
<td>40</td>
<td>40</td>
</tr>
<tr>
<td>4</td>
<td>26</td>
<td>27</td>
<td>24</td>
</tr>
<tr>
<td>5</td>
<td>25</td>
<td>18</td>
<td>14</td>
</tr>
<tr>
<td>6</td>
<td>31</td>
<td>11</td>
<td>22</td>
</tr>
<tr>
<td>TOTAL</td>
<td>213</td>
<td>337</td>
<td>313</td>
</tr>
</tbody>
</table>
## Analysis

<table>
<thead>
<tr>
<th>Group</th>
<th>Established Between</th>
<th>$P(T&lt;=t)$ two-tail</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>May-05  April-06</td>
<td>0.302766172</td>
</tr>
<tr>
<td>1A</td>
<td>May-05  April-06</td>
<td>0.343798355</td>
</tr>
<tr>
<td>2</td>
<td>May-06  April-07</td>
<td>0.618187035</td>
</tr>
<tr>
<td>3</td>
<td>May-07  April-08</td>
<td>1.00</td>
</tr>
<tr>
<td>4</td>
<td>May-08  April-09</td>
<td>0.822847496</td>
</tr>
<tr>
<td>5</td>
<td>May-09  April-10</td>
<td>0.294672782</td>
</tr>
<tr>
<td>6</td>
<td>May-10  April-11</td>
<td>0.025108245</td>
</tr>
<tr>
<td>7</td>
<td>May-11  Present</td>
<td></td>
</tr>
</tbody>
</table>
# Quiet Zone Type

<table>
<thead>
<tr>
<th>Quiet Zone Type</th>
<th>QZ Count</th>
<th>Pre Ax</th>
<th>Post Ax</th>
</tr>
</thead>
<tbody>
<tr>
<td>New</td>
<td>122</td>
<td>138</td>
<td>133</td>
</tr>
<tr>
<td>Pre Rule</td>
<td>81</td>
<td>199</td>
<td>178</td>
</tr>
<tr>
<td>Wayside Horns</td>
<td>1</td>
<td>4</td>
<td>0</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>204</strong></td>
<td><strong>341</strong></td>
<td><strong>311</strong></td>
</tr>
</tbody>
</table>
### Analysis by Type

<table>
<thead>
<tr>
<th>Quiet Zone Type</th>
<th>$P(T\leq t)$ two-tail</th>
<th>Is $P$-value $&gt; \alpha = .05$?</th>
</tr>
</thead>
<tbody>
<tr>
<td>New (§ 222.39)</td>
<td>0.790213291</td>
<td>Yes, FAIL TO REJECT</td>
</tr>
<tr>
<td>Pre Rule (§ 222.41)</td>
<td>0.350349621</td>
<td>Yes, FAIL TO REJECT</td>
</tr>
</tbody>
</table>
Basis of Establishment

• No statistically significant difference in the number of accidents before and after the establishment of Quiet Zones observed in the BAS Sections as highlighted in green on the next slide.

• Not enough data in other BAS Sections for analysis
<table>
<thead>
<tr>
<th>BAS Section</th>
<th>Description</th>
<th>QZs</th>
<th>Pre Acc</th>
<th>Post Acc</th>
</tr>
</thead>
<tbody>
<tr>
<td>222.39(a)(1)</td>
<td>SSM at each Crossing</td>
<td>43</td>
<td>38</td>
<td>29</td>
</tr>
<tr>
<td>222.39(a)(2)(i)</td>
<td>QZRI &lt;= NSRT, no SSMs</td>
<td>5</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>222.39(a)(2)(ii)</td>
<td>QZRI &lt;= NSRT, with SSMs</td>
<td>4</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>222.39(a)(3)</td>
<td>QZRI &lt;= RIWH with SSMs</td>
<td>48</td>
<td>75</td>
<td>85</td>
</tr>
<tr>
<td>222.39(b)</td>
<td>Public Authority Application</td>
<td>1</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>222.39(b)(4)(i)(A)</td>
<td>App QZRI&lt;= RIWH</td>
<td>20</td>
<td>20</td>
<td>16</td>
</tr>
<tr>
<td>222.39(b)(4)(i)(B)</td>
<td>App QZRI&lt;= NSRT</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>222.41(a)(1)(i)</td>
<td>SSM at each Crossing</td>
<td>2</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>222.41(a)(1)(ii)</td>
<td>QZRI &lt;= NSRT</td>
<td>40</td>
<td>107</td>
<td>96</td>
</tr>
<tr>
<td>222.41(a)(1)(iii)</td>
<td>NSRT&lt;= QZRI&lt;= 2 x NSRT, no relevant collisions</td>
<td>16</td>
<td>24</td>
<td>25</td>
</tr>
<tr>
<td>222.41(a)(1)(iv)</td>
<td>QZRI &lt;= RIWH</td>
<td>4</td>
<td>15</td>
<td>24</td>
</tr>
<tr>
<td>222.41(b)(1)(i)</td>
<td>Partial QZ, SSM at each Crossing</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>
Conclusions

• No significant difference in collisions before and after the establishment of quiet zones
  – Overall
  – Pre-rule or New
  – By year except for the latest year – unexplained and will need further analysis.
Questions?

Thank you to Marquese Lewis.

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