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Legislative update on the FRA final rule on locomotive horn noise at grade crossings

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ABSTRACT

In 1994, the United States Congress passed the Swift Rail Development Act, which directed the Federal Railroad Administration (FRA) to issue a rule requiring all railroads operating in the United States to sound their horns at all grade crossings. The final rule was issued in 2005. The intent of Congress was to help limit the number of accidents involving trains at grade crossings with Quiet Zones, which local communities had enacted to reduce the noise impact from locomotive horns. In addition, a process was created to establish a standard national policy for communities to apply for and enact Quiet Zones. In addition to eliminating all existing Quiet Zones around the country, the rule also details a number of measures meant to provide relief to affected persons where the horns will be sounded, and also to the population as a whole living near all 159,000 public grade crossings around the country. This paper provides an update on the provisions of the final rule and the effects on the noise environment for communities near grade crossings.

1 INTRODUCTION

Locomotive horns have long been used as a safety measure at public grade crossings in the United States. Traditionally, horns have been sounded in a long, long, short, long pattern starting 400m (¼ mile) from crossings. Quiet Zones were established by local communities on an individual basis to reduce noise impacts and limit horn use at approximately 3,200 out of 159,000 public crossings in the U.S. However, there were no uniform limits or regulations related to Quiet Zones, allowing creation of Quiet Zones without any minimum safety standards.

Safety concerns at grade crossings with Quiet Zones became an issue in the early 1990's, primarily due to an increase in accidents related to the nighttime ban on the use of train horns along the Florida East Coast Railway in Florida. Statistics have shown that accident rates are 62% higher at grade crossings where horns are not blown. The Swift Rail Development Act was passed in 1994, and included a proposed rule to standardize Quiet Zones and pre-empt local ordinances regarding horn use at grade crossings.

On April 27, 2005 the Federal Railroad Administration (FRA) released 49 CFR Parts 222 and 229 "Use of Locomotive Horns at Highway-Rail Grade Crossings; Final Rule,"¹ referred to hereafter as "the rule". This document, released fourteen years after the first federal orders on horn use at grade crossings, requires railroads operating in the U.S. to sound their horns at all public grade crossings. In addition, provisions have been instituted to allow for Quiet Zones where locomotive horns are not sounded, and changes to horn blowing practices have been made to limit the amount of noise for the general public. This paper discusses the effects of the rule on the noise environment for communities near grade crossings and provides a summary of the provisions contained in the final rule for the creation of Quiet Zones and related safety measures.

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2 ENVIRONMENTAL IMPACT STATEMENT NOISE FINDINGS

As a part of the rule-making process, an Environmental Impact Statement (EIS)² was undertaken to determine the effects of eliminating Quiet Zones around the US. One of the primary concerns in the preparation of the EIS was the noise effects of the rule. The noise impact assessment process included the following steps:

- Development of a noise model based on empirical data to determine the effects of the reintroduced horns at the grade crossings. The model needed to be able to accurately determine the existing noise levels without the horns and project the future noise levels after the reintroduction of the horn noise. The Day-Night Sound Level (Ldn) was used to characterize existing and future noise levels. The parameters included in the noise model are included in Table 1.

Table 1: Horn Noise Model Inputs.

Train Parameters	Horn Parameters	Environmental Parameters
Train Speed	Location/Directivity	Shielding
Number of Trains (day/night)	Maximum Noise Level	Background Noise Level
Number of Locomotives	Duration	
Number of Cars	Sounding Pattern	

- Use of the noise impact criteria based on the increase in Ldn over the existing noise level contained in the FRA's High Speed Rail noise and vibration manual³ to determine the extent of impact at individual grade crossing. The existing noise was assumed to be dependent on the existing train traffic through the grade crossing, without the contribution of the horns, plus the background level. The increase in noise was based on the addition of the horn noise to the existing noise.
- Application of the results to a GIS database using census data to catalog the locations and numbers of people affected by the rule. The output consisted of a series of points at each grade crossing, defining polygons in each of the four quadrants of the grade crossing where both impact and severe impact were projected to occur, as shown in Figure 1.

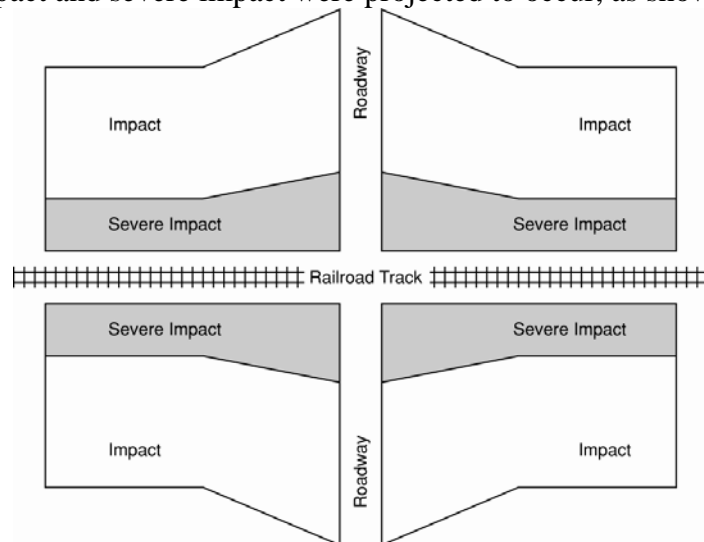


Figure 1: Horn noise model output to GIS database.

- Evaluation of mitigation options that would help to alleviate the noise impact of the rule. These mitigation options included implementing a maximum sound level (only a

minimum sound level previously), changing the directionality of horns, limiting the duration of horn blowing at crossings, and moving the location of horns on locomotives. Ultimately, the final rule incorporated a limit in the maximum noise level of horns, and a limit on the duration of horn blowing at grade crossings.

In addition to addressing noise impact at the existing Quiet Zones, an analysis was also conducted to determine ways to reduce noise from locomotive horns for people near all 159,000 public grade crossings in the United States. The analysis used the same noise model, assuming a standard grade crossing for the country, and calculated the number of impacts and severe impacts using the GIS database. The same mitigation options were applied to the entire country, with the result that there would be a significant reduction in noise for people near all crossings.

With the limit on the horn noise level and a limit on the duration of horn blowing, the FRA estimates that there will be 3.4 million fewer noise impacts with 1.9 million fewer severe impacts as defined by the FRA noise criteria. This represents a 38% reduction in noise impacts from locomotive horns nationwide.

3 FINAL RULE NOISE PROVISIONS

The most important noise provision in the new rule is the ability for communities to have a federally approved method of safely eliminating noise at grade crossings through the creation of Quiet Zones. The elimination of horn blowing at grade crossings represents a significant reduction in the noise from trains near grade crossings. The maximum noise level generated by horns can often be up to 20 dB greater than the noise generated by locomotives.

Based on the findings of the EIS, the rule sets a number of limits on noise levels nationwide, in order to reduce noise at grade crossings. In addition to the ability to implement Quiet Zones, which eliminate locomotive horns, the rule sets minimum and maximum noise levels for horns, sets limits to the duration of horn blowing, and changes the method for measuring noise levels from horns on locomotives. In addition, the rule allows for the use of wayside horns (horns mounted at the crossing, instead of on the locomotive) and sets rules for their implementation.

3.1 General Noise Provisions

Previous to the final rule, the FRA had set a minimum noise level of 96 dBA at 1.2m (4 ft) above the ground at 31m (100 ft) from the front of the locomotive for horns, in order to provide an acceptable warning to motorists. However, there was no maximum noise level specified, and horns were found to regularly exceed 114 dBA at 31m (100 ft) from the front of locomotives. The new rule sets a maximum noise level of 110 dBA at 31m (100 ft) in front of the locomotive for all horns. All locomotives built after June 24, 2005 will have to be tested to meet this limit and all locomotives built before June 24, 2005 will have to be tested by June 24, 2010.

In addition to setting a maximum noise level and requiring that horn noise levels be measured for all locomotives, the rule also makes a small, but important, change in the way horn noise is measured for compliance with the minimum and maximum noise levels. For front or low mounted horns, the measurement procedure remains to measure at 1.2m (4 ft) above the ground at a distance of 31m (100 ft) from the front of the locomotive. However, for middle mounted horns, which are mounted further back on the locomotive, and are shielded to the front of the locomotive, the new rule states that the measurements should be conducted at 4.5m (15 ft) above the ground at a distance of 31m (100 ft) from the front of the locomotive. This change was made to limit the amount of shielding from the locomotive body, and potentially reduce the

noise level of horns that would have had to have been louder to meet the minimum noise level of 96 dBA at 31m (100 ft) at only 1.2m (4 ft) above the ground.

The other major change in noise limits is a limit on the amount of time a horn is sounded at grade crossings. The practice has been to start sounding the horn at 400m (1/4 mile) from the grade crossing, regardless of the speed of the train. The new rule mandates that train horns be sounded for 15-20 seconds before a grade crossing, and for trains traveling at greater than 72 km/hr (45 mph), horns should be sounded starting at 400m (1/4 mile) from the grade crossing. For trains traveling at less than 72 km/hr (45 mph) this significantly reduces the noise exposure for residents near all grade crossings, by limiting the amount of time the horns are sounded. In addition, for train operations at less than 24 km/hr (15 mph) horns do not have to be sounded if a flagger is used to warn motorists and pedestrians.

3.2 Wayside horns

An additional provision in the rule is related to the use of wayside horns. A wayside horn is mounted at the crossing, directed toward both the approaching traffic and any pedestrians. Instead of the horns on the approaching locomotive being sounded as the train approaches the crossing, the wayside horn is activated and sounded similar to a locomotive horn, but directed at traffic. The rule requires a wayside horn to:

- Be activated for at least 15 seconds prior to the train arrival.
- Have a minimum sound level of 92 dBA and a maximum sound level of 110 dBA at 31m (100 ft) from the centerline of the near track.
- Have a warning mechanism to indicate if the wayside horn is not working.
- Have flashing lights and gates at the crossing, at a minimum.

While a wayside horn is not “quiet” in sense of eliminating the horn noise in a Quiet Zone, there is a substantial reduction in noise near grade crossings, and noise exposure to residents near the grade crossing. Because the wayside horns are mounted at the crossing, and are highly directive, the noise levels at locations not directly adjacent to the roadway are significantly lower with a wayside horn as compared with a locomotive mounted horn.

A study conducted for the Alaska Railroad⁴ showed a significant reduction in noise levels near a grade crossing with a wayside horn. Noise measurements were conducted on a grid measuring 93m (300 ft) by 124m (400 ft) from the wayside horn during controlled operation of both a locomotive mounted horn which was sounded starting at 400m (1/4 mile) from the crossing and the wayside horn mounted at the crossing. Figure 2 shows a layout of the measurement locations in one quadrant near the grade crossing.

Figure 3 shows the time history of a wayside horn and locomotive horn as measured at a location 31m (100 ft) from both the tracks and the roadway. The characteristic long-long-short-long pattern can be seen for both horns (two cycles for the wayside horn and one for the locomotive horn). However, the maximum noise level generated by the locomotive horn is approximately 20 dB higher than the wayside horn at this location.

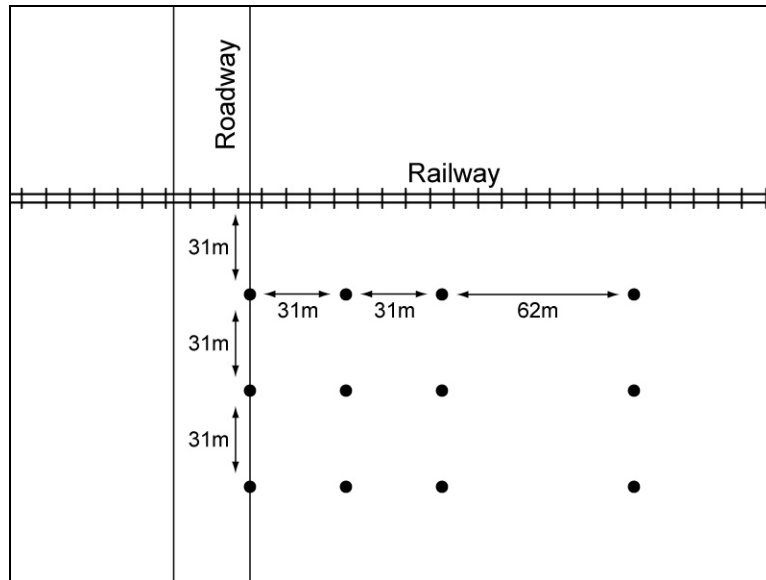


Figure 2: Measurement locations for wayside horn.

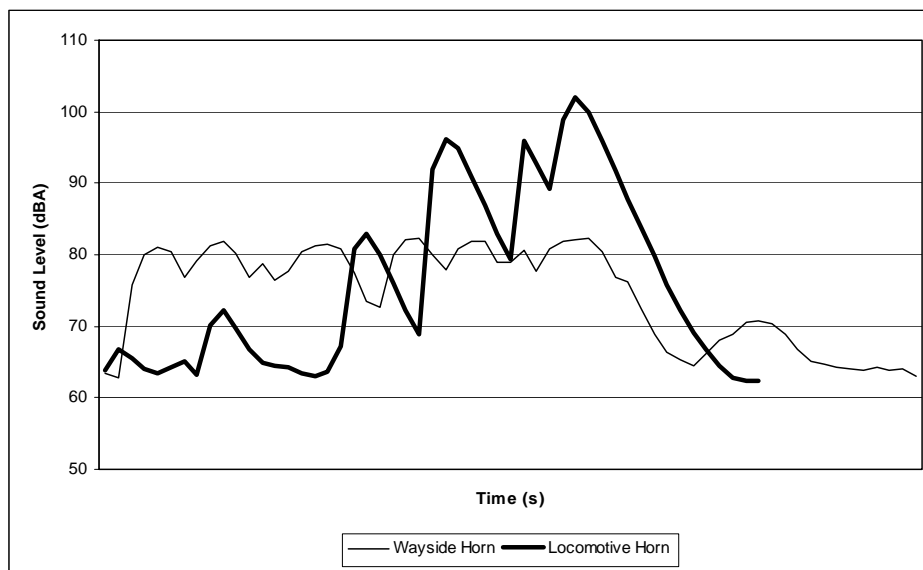


Figure 3: Time history comparison of locomotive mounted and wayside horn.

Tables 2 and 3 show the maximum noise levels from the wayside horn and locomotive horn, respectively, at each of the measurement positions. Table 4 shows the difference in noise level between the two types of horns. The higher levels in Table 4 represent a greater difference between the maximum noise levels generated by the wayside horn and the locomotive horn. Because of the directivity of the wayside horn, and because the locomotive horn is being sounded for 400m (1/4 mile) along the tracks, the largest differences can be found farther from the roadway, especially at locations close to the tracks. The wayside horn is directed down the road, and the noise levels to the side drop off quickly with increasing distance from the roadway, while the locomotive horn stays at a relatively constant noise level relative to the roadway at any specific distance from the tracks.

Table 2: Wayside Horn Maximum Noise Levels (dBA).

Distance from Wayside Horn	Distance from Roadway			
Distance from Tracks	0m	31m	62m	124m
31m	94	83	77	69
62m	91	84	78	72
93m	88	83	77	76

Table 3: Locomotive Horn Maximum Noise Levels (dBA).

Distance from Wayside Horn	Distance from Roadway			
Distance from Tracks	0m	31m	62m	124m
31m	106	104	106	104
62m	100	99	101	99
93m	100	100	100	98

Table 4: Comparison of Locomotive Horn and Wayside Horn Maximum Noise Levels (dB)*.

Distance from Wayside Horn	Distance from Roadway			
Distance from Tracks	0m	31m	62m	124m
31m	12	21	29	35
62m	9	15	23	27
93m	12	17	23	22

* The noise levels represent the reduction in noise level from the wayside horn compared to the locomotive horn.

4 FINAL RULE QUIET ZONE AND SAFETY PROVISIONS

In addition to the noise provisions, the rule provides a method for the creation of Quiet Zones, sets the qualifications for various types of Quiet Zones, establishes the method by which a Quiet Zone may be terminated, and specifies the acceptable safety measures to compensate for not sounding the horn at grade crossings. This section provides a simplified summary of the rule, in order to allow for a general understand of the provisions for the creation of Quiet Zones.

4.1 Definitions

To help facilitate the understanding of the very complex provisions contained within the rule, a set of definitions is first provided to understand some of the terminology discussed in the subsections that follow. Some of the terms defined in the rule and discussed below include:

- Supplementary Safety Measures (SSMs) – Systems or procedures established under the rule which are considered effective substitutes for sounding of the locomotive horns.
- Alternative Safety Measures (ASMs) – Systems or procedures, other than SSMs, established under the rule which are considered to be an effective substitute for sounding of the locomotive horns.
- Nationwide Significant Risk Threshold (NSRT) – A number reflecting a measure of risk, calculated on a nationwide basis, which reflects the average risk at grade crossings with flashing light and gates where horns are sounded. A risk level above this number represents a significant risk.
- Crossing Corridor Risk Index (CCRI) – A number reflecting the risk to the public at crossings along a rail corridor, representing the average risk at each crossing within the corridor.

- Risk Index With Horns (RIWH) – A measure of the risk to the public when horns are sounded in a Quiet Zone.
- Quiet Zone Risk Index (QZRI) – A measure of the risk which reflects the CCRI for a Quiet Zone, after an adjustment for the increased risk due to the lack of horns in the Quiet Zone and the reduced risk due to any SSMs or ASMs.
- Quiet Zone Calculator – A tool available on the FRA website to calculate the QZRI for a Quiet Zone. The main calculator inputs include any warning or safety devices, number of trains and automobiles per day, the number of tracks and highway lanes, and the number of accidents at crossings.

4.2 General Provisions

The new rule regulates the sounding of locomotive horns at grade crossings. In addition to the noise provisions, the rule also sets forth provisions for Quiet Zones that pre-empt all local and state regulations related to Quiet Zones, but allows some decisions by state agencies in the types and methods of improvements at grade crossings. The rule essentially eliminates all existing Quiet Zones, unless certain criteria are met. Horns are still allowed to be sounded in Quiet Zones in emergencies or in the case of equipment malfunction.

A Quiet Zone must have a minimum length of 800m (1/2 mile), and can consist of multiple contiguous grade crossings. All grade crossings in a Quiet Zone must have active warning devices – flashing lights and gates at a minimum. If the grade crossing is also a pedestrian crossing, warning bells must also be included. All grade crossings within the Quiet Zone must also have a sign that states that horns are not sounded at the crossing.

The rule sets certain risk levels in determining a Quiet Zone. For a Quiet Zone (which can be one crossing or multiple consecutive crossings in a corridor) the corridor must have a Quiet Zone Risk Index (QZRI) at or below the Nationwide Significant Risk Threshold (NSRT) or Risk Index With Horns (RIWH). The rule also sets forth certain safety measures that compensate for the absence of audible warning by horns at crossings.

4.3 Types of Quiet Zones

The final rule divides the Quiet Zones into several types, depending on the year created, the type of Quiet Zone and the location of the Quiet Zone. For each of the three types defined below, the rule also defines partial Quiet Zones as locations where the horns are silenced during the evening and/or nighttime hours. The three main types of Quiet Zones include:

- Pre-Rule Quiet Zones – Quiet Zones established before October 9, 1996 by local authorities. Pre-Rule Quiet Zones have until 2008 and 2011 to meet some of the general provisions, such as warning signs about horns not being sounded.
- Intermediate Quiet Zones – Quiet Zones established between October 9, 1996 and December 18, 2003 by local authorities. Intermediate zones are valid until June 24, 2006, and then become equivalent to New Quiet Zones.
- New Quiet Zones – Quiet Zones established under the new rules.

In addition to the Quiet Zones identified and classified by the rule, the existing Pre-Rule Quiet Zones and Intermediate Quiet Zones in the greater Chicago area are treated as a separate class of crossings. Because over half of all Quiet Zones enacted prior to December 18, 2003 are in the Chicago area, and because of intense local concern, these crossings are not covered by the provisions in this rule if they were in effect before December 18, 2003. Any New Quiet Zones enacted in the Chicago area are subject to the rule, and there will be a further evaluation of the Chicago area at a later date, with an addendum or revision to the rule to include these crossings.

4.4 Applying for and Establishing Quiet Zones

The rule sets forth common guidelines for establishing a Quiet Zone. Generally a Quiet Zone is initiated by a public authority with jurisdiction over the crossing or crossings, but two parties – the railroad(s) and public authority must work together jointly to create a Quiet Zone. For all types of Quiet Zones, notifications must be provided to all railroads operating in the Quiet Zone announcing the creation of a Quiet Zone or the continuation of a Pre-Rule Quiet Zone. Adding a crossing to a Pre-Rule Quiet Zone (lengthening) negates all grandfathering clauses, and the Quiet Zone must immediately comply with the rules for New Quiet Zones. In addition, updates must be provided on a regular basis to FRA for all types of Quiet Zones to ensure that they are still meeting the requirements.

4.4.1 New Quiet Zones Not Requiring FRA Approval

The FRA has established guidelines under which a New Quiet Zone does not need FRA approval. In order for this to occur, one of the following conditions must be met:

- The Quiet Zone must include one or more SSMs at each crossing.
- The QZRI is at or below NSRT already without any additional SSMs or if the added SSMs bring the QZRI below the NSRT.
- SSMs reduce the QZRI below the RIWH.

4.4.2 New Quiet Zones Requiring FRA Approval

For New Quiet Zones that do not meet any of the above conditions, but incorporate some measures, the public authority must document and describe what will be done to reduce the QZRI below either the RIWH or the NSRT. There must also be a comment period for these types of New Quiet Zones. For new crossings, the public authority must also provide projections of traffic data for 5 years (cars and trains) and provide a comment period.

4.4.3 Pre-Rule Quiet Zones

The FRA recognizes the uniqueness of Pre-Rule Quiet Zones and allows them to gain automatic approval if they are in compliance with the minimum rules (flashing lights and gates) and all notices and if one of the following conditions is met:

- SSMs at all crossings
- QZRI is below NSRT
- QXRI is above NSRT but less than 2x NSRT and no collisions occurred at any crossing within the zone for 5 years before April 27, 2005
- QXRI is below RIWH

Pre-rule zones have 5 years from June 24, 2005 to meet the above rules. If the QZRI falls below the NSRT within 3 years of June 24, 2005, the zone may stay in effect. This may continue for 3 more years beyond the 5 years if a plan is in place for implementing Quiet Zones in the state and improvements have been started at Quiet Zones within the state.

4.5 Termination of Quiet Zones

Because the foundation of the rule is based on both a nationwide assessment of risk and an assessment of risk within the Quiet Zone, there are provisions for termination of Quiet Zones under certain conditions. The conditions are different for New Quiet Zones and Intermediate Quiet Zones (which become New Quiet Zones after June 24, 2006) and Pre-Rule Quiet Zones. In addition to the conditions described below for both types of crossings, a Quiet Zone may be reviewed and terminated by the FRA or by the public authority responsible for the Quiet Zone at

their discretion, provided the appropriate notifications and appeals are followed. On an annual basis, the FRA calculates the NSRT for use in determining risk at Quiet Zones.

4.5.1 New Quiet Zones and Intermediate Quiet Zones

For New and Intermediate Quiet Zones with approved SSMs at every crossing within the Quiet Zone, as long as the QZRI is below the RIWH, the FRA does not conduct an annual review of the crossing. However, for Quiet Zones where there is not an SSM at every crossing, the FRA will calculate the QZRI for the Quiet Zone and compare that number with the NSRT. If the QZRI is above the NSRT, the Quiet Zone will terminate in six months, unless the following occurs:

- The authority provides a written commitment to lower the risk in the Quiet Zone to a level at or below the NSRT or RIWH, with specific steps outlined, within 6 months of notification by the FRA.
- The authority completes the appropriate SSMs or ASMs within three years to reduce the QZRI below either the NSRT or RIWH and is approved by the FRA.

4.5.2 Pre-Rule Quiet Zones

For Pre-Rule Quiet Zones, the process is slightly different than for the other Quiet Zones. If there is an SSM at every crossing in the Quiet Zone, the FRA will not conduct an annual review. For a Pre-Rule Quiet Zone where there are not SSMs at every crossing:

- If the QZRI was initially below the NRST and the QZRI stays below the NRST, the Quiet Zone will stay in effect.
- If the QZRI is above the NRST, but less than twice the NSRT and there have been no collisions within the last five years, the Quiet Zone will stay in effect.

If the QZRI is more than twice the NSRT or above the NRST but less than twice the NRST and there has been an accident within 5 years, the process for termination of a Pre-Rule Quiet Zone is the same as for a New Quiet Zone, as described above.

4.6 Supplementary Safety Measures and Alternative Safety Measures

The rule sets forth certain measures shown in Table 5 that replace the safety provided by the sounding of the horn. These methods do not include standard warning devices, such as crossbucks, flashing lights, gates that do not block travel completely or traffic signals. In addition to the measures listed in the rule, there is also a provision for creating and certifying new types of SSMs and ASMs. For ASMs, their effectiveness must be calculated against a baseline in order to be accepted by FRA.

Table 5: Supplementary and Alternative Safety Measures.

Supplementary Safety Measures	Alternative Safety Measures
4-quadrant gates with or without presence detection	Modified SSMs (do not meet all SSM requirements)
Median barriers with gates	Non-Engineering ASMs
One-way street with gates	Shorter channels
Closing grade crossings	Photo enforcement
Grade separation	Education and awareness
	Programmatic enforcement
Temporary Closure (only for partial Quiet Zones)	Engineering ASMs
	Other improvements to reduce risk at crossings

5 UNRESOLVED LEGAL AND ENVIRONMENTAL ISSUES

5.1 Legal Liability

The liability issues of a potential accident involving a Quiet Zone created under this rule have not been fully resolved. The FRA's feeling is that this rule will not shift liability away from the railroads to a public authority that enacts Quiet Zone. The FRA's intent under the rule is to remove the failure to sound the horn at grade crossings located within Quiet Zones as a potential cause for legal action. However, until this is challenged in a legal case involving an accident at a crossing within a Quiet Zone, the legal aspects of this rule are still unclear.

5.2 Environmental Mitigation

The use of Quiet Zones represents a powerful noise mitigation measure for both freight trains and passenger trains. In the US, horn noise is the dominant noise source at locations within 400m (1/4 mile) of grade crossings. Elimination of horns would result in substantial reduction in noise levels and levels of impact and severe impact as defined by FRA and FTA (Federal Transit Administration). However, because Quiet Zones can be terminated, it is not clear how this will ultimately play out as a mitigation measure. While the FTA has accepted Quiet Zones as a potential mitigation measure in their new guidance⁵, mitigation measures are generally required to be permanent (e.g. noise barriers), and not something that can be altered or removed (e.g. speed reductions to limit noise).

6 SUMMARY

This rule provides a comprehensive set of regulations and requirements to allow communities to substantially reduce noise at grade crossings while having a framework to maintain or improve safety. In addition to the ability to create Quiet Zones and eliminate horn sounding altogether, the rule also provides for specific limits on locomotive horn noise designed to reduce the impact at all public grade crossings around the country.

7 REFERENCES

- [1] *49 CFR Parts 222 and 229 Use of Locomotive Horns at Highway-Rail Grade Crossings; Final Rule.* Federal Register – United States Department of Transportation, Federal Railroad Administration, Washington D.C., April 27, 2005.
- [2] *Final Environmental Impact Statement Interim Final Rule for the Use of Locomotive Horns at Highway-Rail Grade Crossings.* United States Department of Transportation, Federal Railroad Administration Office of Railroad Development, Washington D.C., December 5, 2003.
- [3] *High-Speed Ground Transportation Noise and Vibration Impact Assessment.* United States Department of Transportation, Federal Railroad Administration, Washington D.C., October 2005.
- [4] Lance D. Meister, "Results of Wayside vs. Locomotive Horn Noise Testing." Harris Miller Miller & Hanson Inc report #300370, August 7, 2004.
- [5] *Transit Noise and Vibration Impact Assessment.* United States Department of Transportation, Federal Transit Administration Office of Planning and Environment Report # FTA-VA-90-1003-06, Washington D.C., May 2006.