PARSONS BRINCKERHOFF

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23 October 2015

Ms. Margaret T. White
Project Engineer
Office of the Town Engineer
71 Mt. Vernon Street
Winchester, MA 01890

RE: ***Winchester Cross Street Rail Delivery Noise Report***

Dear Ms. White,

Attached you will find Parsons Brinckerhoff's report summarizing our acoustical study involving railcar deliveries at night to the Tighe Group building in Winchester. A draft noise bylaw for the town to consider will be delivered separately.

With your assistance, we were able to have an initial public meeting on 9/21/15 in which we presented the purpose and methodology of our study to the community. We were also able to get feedback from attendees describing the kinds of noises that they found most disturbing at night. This led to our performing detailed noise measurements and observations of a railcar delivery the night of 10/6/15 to 10/7/15, as well as our performing long-term noise measurements in the Baldwin Street neighborhood during the week of 10/6/15 to 10/13/15.

In brief summary, noise associated with railcar deliveries at night to the Tighe Group building will be difficult to fully abate. Locomotives produce low frequency noise which has the ability to propagate great distances and easily penetrate typical residential structures. Several forms of potential noise control are described in the report including source controls, pathway controls and receiver controls. Of these options, the best in this case appears to be the **construction of a noise control shed over the Tighe rail spur in which the entire railcar delivery process could take place**.

Full details of the study's technical approach, measurement data, analysis, comparison to relevant noise guidelines, and recommendations for mitigation are described in the following report.

Professional Certification:
I hereby certify that this plan, specification, or report was prepared or reviewed by me and that I am a duly certified acoustical professional as recognized by the Institute for Noise Control Engineering (INCE).

Erich Thalheimer

Erich Thalheimer
Parsons Brinckerhoff, Inc.
Principal Noise & Vibration Engineer
INCE Board Certified No. 20104

Initial Public Meeting

An initial public meeting was held on 9/21/15 at Winchester Town Hall. Approximately twenty residents attended the meeting. Presentation material included an introduction and qualifications of the study's lead acoustical engineer, Mr. Erich Thalheimer, as well as a summary of the study's scope of work. The technical approach of the study was explained, and feedback from the public was encouraged. The main points of complaint heard from the public regarding railcar deliveries to the Tighe Group building at night included (1) locomotive idling noise, (2) banging noises as railcars are connected and disconnected, and (3) train horns. The typical hours of concern were described as from 1:00 AM to 4:00 AM on Sunday and Tuesday nights (i.e. Monday and Wednesday mornings).

Moreover, residents explained that railcar delivery noise was bothersome in communities other than just west of the tracks in the Baldwin Street neighborhood. Residents from Forest Street, east of the tracks, and from Irving Street and Spruce Street, both south of Cross Street, also expressed their objection to the railcar delivery noise. Consequently, the scope of the study was expanded to include these other neighborhoods.

It is anticipated that a final public meeting will be held sometime in November to present the results and findings of this study to the community.

Acoustical Terms

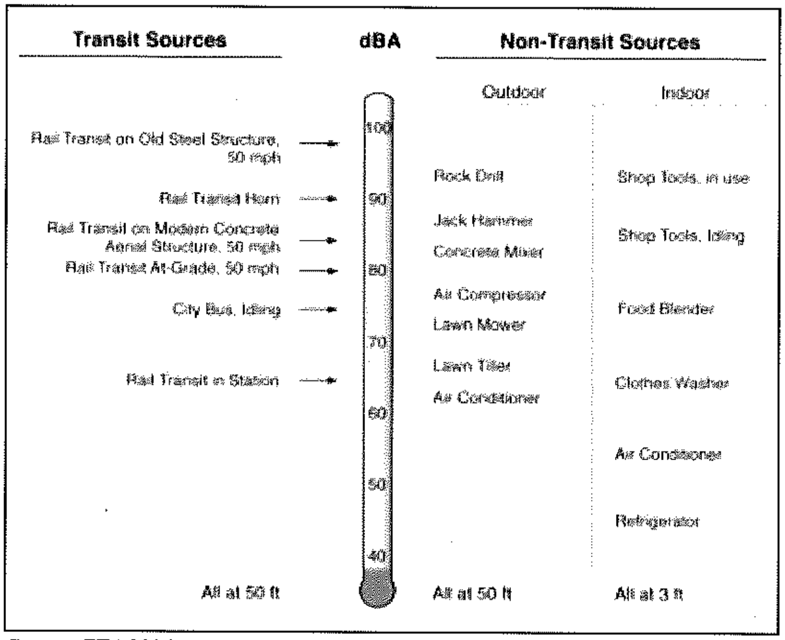
Noise is typically defined as unwanted or undesirable sound. Community noise is a result of everyday occurrences such as transportation systems, industrial processes, building air handling systems, power generation, wind, human activities, etc. Noise can be quantified in many different manners depending on its temporal (time), tonal (frequency), or magnitudinal (loudness) characteristics. In general, community noise assessments address relative changes in noise levels over time and relate those changes to effects on human beings.

Noise magnitude is expressed in units of decibels (dB) which is a logarithmic quantity comparing fluctuating air pressure to that of a standardized reference air pressure of 20 micro-pascals (i.e. dB re: 20 μPa). Noise level is expressed as a logarithmic quantity because humans are sensitive to relative changes in their noise environment. To illustrate, humans can barely perceive a change in noise levels of +/- 3 dB; can easily perceive a change of +/- 5 dB; and will generally perceive a change of +/- 10 dB as a doubling or halving in noise levels.

With respect to tonal content (frequency), a frequency weighting adjustment has been standardized to account for human auditory response over the audible frequency range of approximately 20 Hz to 20,000 Hz. Humans respond less sensitively to low frequency noise ranges, exhibit a maximum sensitivity to tones in mid-frequency ranges, and are somewhat less sensitive at higher frequency ranges. This frequency weighted adjustment is referred to as "A-weighting", with results expressed as A-weighted decibels, or dBA. Typical A-weighted decibel noise levels are shown in **Figure 1**.

However, A-weighted decibels do not describe well the annoyance potential associated with low frequency noise. Large sources such as locomotives can produce significant low frequency noise which can excite structures and be perceived as vibration. Being low frequency, the noise has the ability to propagate great distances and easily penetrate typical residential structures. The structure's walls can then reradiate the noise, and even amplify it, within the structure. This effect is known as structure-borne noise.

Figure 1. Typical A-weighted Noise Levels



Source: FTA 2006

Numerous metrics and indices have been developed to quantify the temporal characteristics (changes over time) of community noise. The following noise metrics are typically used in community noise assessments:

- ***Lmax**, or Maximum Sound Level,* is the maximum sound level experienced during a period of time. The Lmax is useful for describing the "loudest" noise event over time, and is expressed in dBA. The Lmax level is highly dependent on the root-mean-square (RMS) time response setting of a measurement instrument. For train passby events an RMS time response of 'fast' (0.125 sec) is appropriate.

- ***Leq**, or Equivalent Sound Level,* is the energy-averaged noise level that represents the same (equivalent) acoustical energy that was contained in the fluctuating noise over a period time. The Leq is useful for describing the "average" noise level over time, and is expressed in dBA.

- ***Ln**, or Percentile Level,* is a statistical representation of changing noise levels indicating that over a given time period the fluctuating noise level was equal to, or greater than, the stated level for "n" percent of the time. For example, the L10, L33, L50, and L90 represent the noise levels exceeded 10, 33, 50, and 90 percent of the time. The L10 is often used to identify intrusive noise levels from transportation or construction sources, while the L90 is considered to represent relatively steady, background noise levels. Ln percentile levels are expressed in dBA.

- ***Ldn**, or Day-Night Sound Level,* represents an energy-average noise level evaluated over 24 hours in which a 10 dBA "penalty" is added to the Leq noise level for each of the nine nighttime hours (10:00 PM to 7:00 AM). The penalty is applied to account for people's increased sensitivity to nighttime noise intrusions during quiet activities such as sleeping, and the typical reduction in ambient noise levels during nighttime hours which may allow offending noise sources to be more noticeable. The Ldn is expressed in dBA.

Train Noise Measurements

Detailed noise measurements and observations of train activities were performed the night of 10/6/15 to 10/7/15. In addition, unattended long-term noise measurements in the Baldwin Street neighborhood were performed during the week of 10/6/15 to 10/13/15.

Detailed observed measurements were performed at the Tighe Group property using a CEL Instruments Model 593 Sound Level Analyzer that complies with ANSI Standard S1.4 for Type 1 accuracy. The CEL 593 was programmed to measure sound levels in third-octave bands from 16 Hz to 20,000 Hz using an RMS 'fast' time response. Long-term noise levels in the community were measured using Larson Davis Model 720 Noise Monitors that comply with ANSI Standard S1.4 for Type 2 accuracy. The LD 720 monitors were configured to measure Lmax, Leq, L1, L10, L50 and L90 noise levels in A-weighted decibels (dBA) in 1-minute and 1-hour intervals using an RMS 'fast' time response. All the noise monitoring devices used in this study were calibrated in the field with a Bruel & Kjaer Model 4231 Acoustical Calibrator that complies with ANSI Standard S1.40 for Class 1 accuracy.

The observation session involved performing detailed noise measurements in 1-minute intervals at two locations; one adjacent to the Tighe Group's property to serve as a control monitor (i.e. clearly identifying train-related activity), and the other at the head of Baldwin Street to monitor noise levels in the community, as shown in **Figure 2**. During the night of 10/6/15 to 10/7/15 there were fourteen train events observed between the hours of 9:00 PM to 4:00 AM. This included ten MBTA commuter trains, one Amtrak Downeaster train, two freight train passbys, *and one freight train delivery to the Tighe Group building that occurred from 12:39 to 1:12 AM.* The resulting Lmax levels of the two long-term noise monitors are shown in **Figure 3** for the night of observed train activity.

Figure 2. Project Area and Noise Monitor Locations

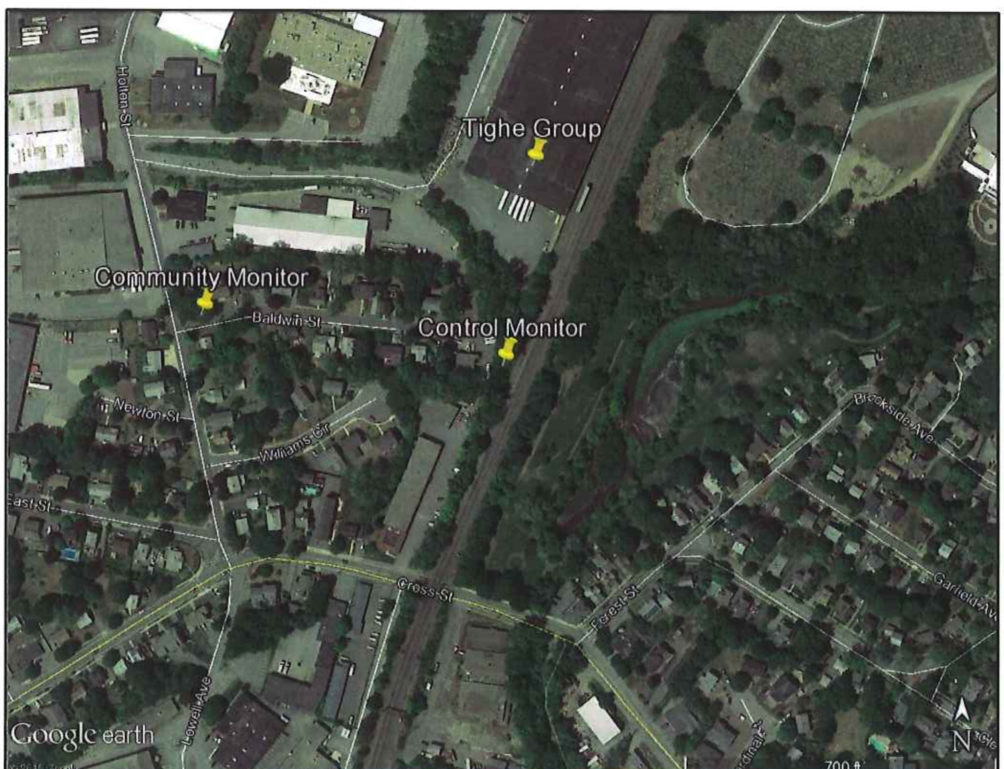
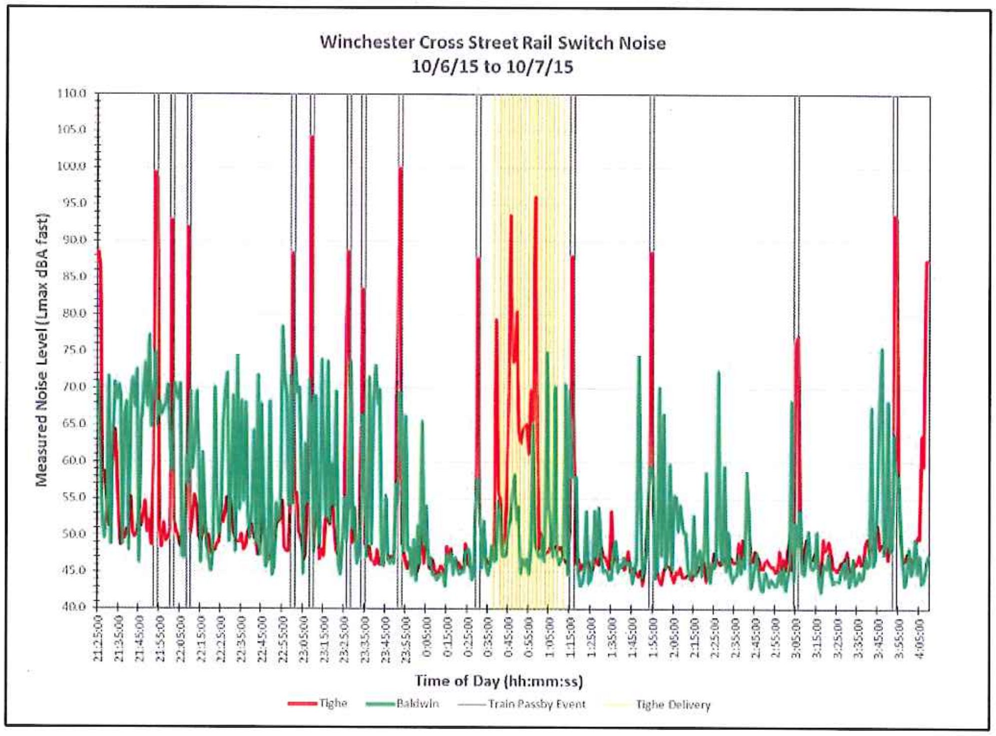


Figure 3. 1-minute Interval Lmax Noise Levels
Control Monitor vs. Community Monitor



From the data in **Figure 3** is can be deduced that noise levels during train events at the head of Baldwin Street (in green) were about 24 decibels quieter than the noise levels measured at the control monitor's location on the Tighe Group property (in red). The community monitor was approximately 740 feet from the centerline of the tracks and the control monitor was about 50 feet away. Based on these distances, it would be expected that train noise levels would decrease by 23 decibels due solely to distance attenuation, so the remaining decibel of loss can be attributed to ground absorption and interference from trees. Of course, noise levels at any particular residence or location would vary based on their distance from the tracks and exposure to other localized noise sources.

Based on noise data collected the night of observed train events, the average noise level in the community generated by MBTA, Amtrak and freight train *passby events* are approximately 66-69 dBA Lmax and 55-58 dBA Leq; making train passbys one of the louder noise sources in the community though not necessarily the loudest events. Other noise sources are also audible in the community such as local traffic including heavy trucks, distance traffic, aircraft and helicopter overflights, rooftop HVAC units and insect noise. In comparison, background noise levels measured in the absence of any train activity ranged from 39 to 46 dBA Leq.

Figures 4 and 5 show the measured Lmax and Leq hourly noise levels for the remainder of the week. From the data in **Figure 5** the Ldn level for the community was determined to be 63 dBA Ldn *without the effects of railcar delivery noise to the Tighe Group building.*

Figure 4. 1-hour Interval Lmax Noise Levels Control Monitor vs. Community Monitor

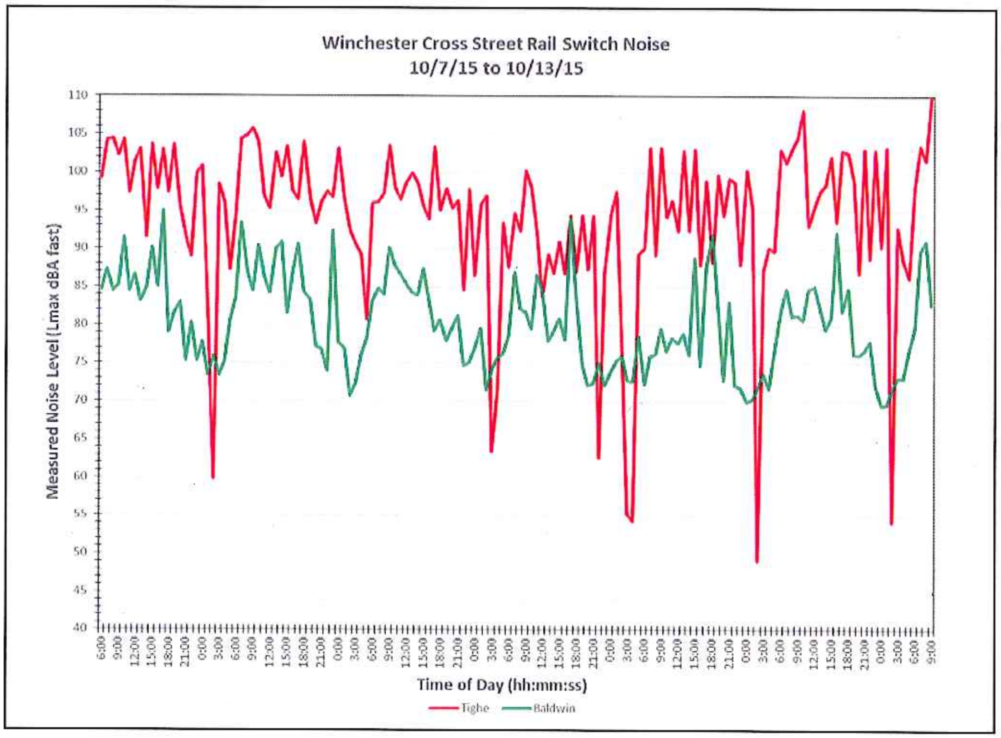
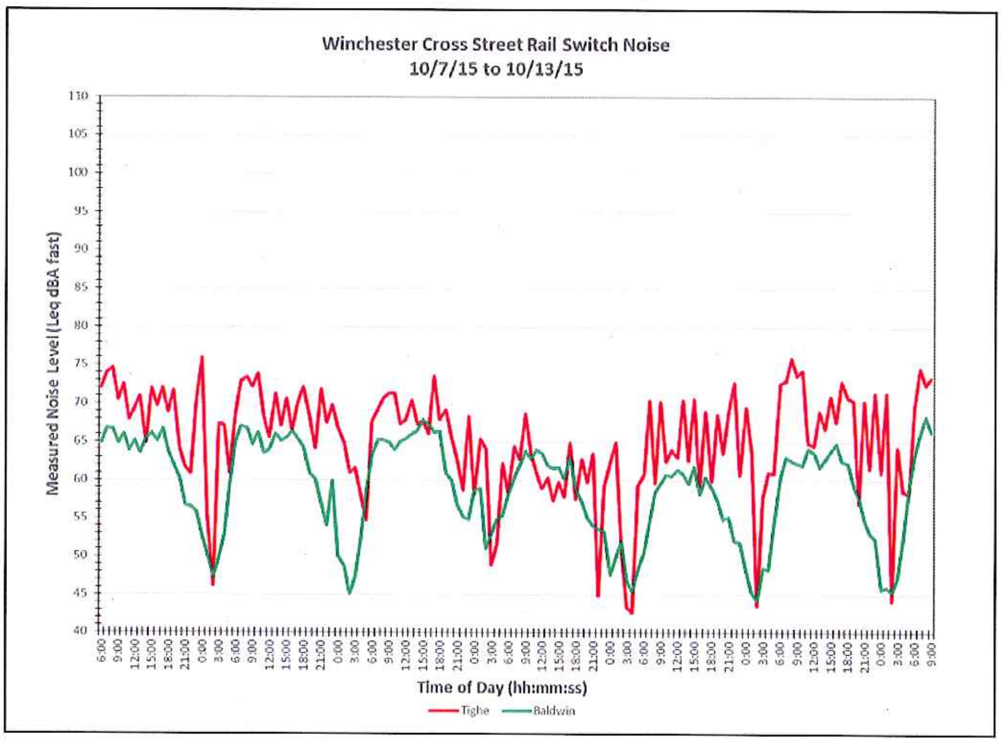


Figure 5. 1-hour Interval Leq Noise Levels Control Monitor vs. Community Monitor



Tighe Railcar Delivery Noise

As mentioned above, a railcar delivery to the Tighe Group building was observed as it occurred from 12:39 to 1:12 AM the morning of 10/7/15. The delivery involved a single locomotive and a single railcar which was backed into place and parked alongside the Tighe Group building, as shown in **Photo 1**. The locomotive was the dominant noise source during railcar delivery. Other noises included disconnection of the railcar and the spur switch being opened and closed manually. The locomotive then departed southbound without removing any of the other railcars which were already behind the building. Notably, there were no train horn soundings throughout the entire night.

Photo 1. Railcar Delivery to Tighe Group

Noise levels and third-octave band spectra were measured during the railcar delivery event using a CEL 593 Sound Level Analyzer. As shown in **Figure 6**, the freight locomotive produced significant low frequency noise in the 50 Hz and 80 Hz third-octave bands as it was idling and moving very slowly during the delivery. These low frequencies would have the ability to propagate in all directions and excite nearby structures to vibrate.

In comparison, other trains passing through the area at higher speeds did not produce the same degree of low frequency noise. As shown in **Figure 7**, MBTA commuter, Amtrak Downeaster and freight trains passing through the area on the main tracks produced the majority of their noise in the mid-frequency bands ranging from about 400 Hz to 4,000 Hz.

It is important to note that the noise spectra shown in both **Figures 6 and 7** have been normalized to an equivalent distance of 50 feet from the microphone for comparison. Consequently, it is clear that the maximum noise levels produced during the railcar delivery event at the Tighe Group building were significantly quieter on a broadband A-weighted basis than the Lmax levels of other trains passing through the area. However, the additional low frequency noise produced by the delivery locomotive, combined with the extended time it takes to complete a delivery, have the potential to cause greater annoyance in the community.

Figure 6. Rail Delivery Locomotive Spectrum

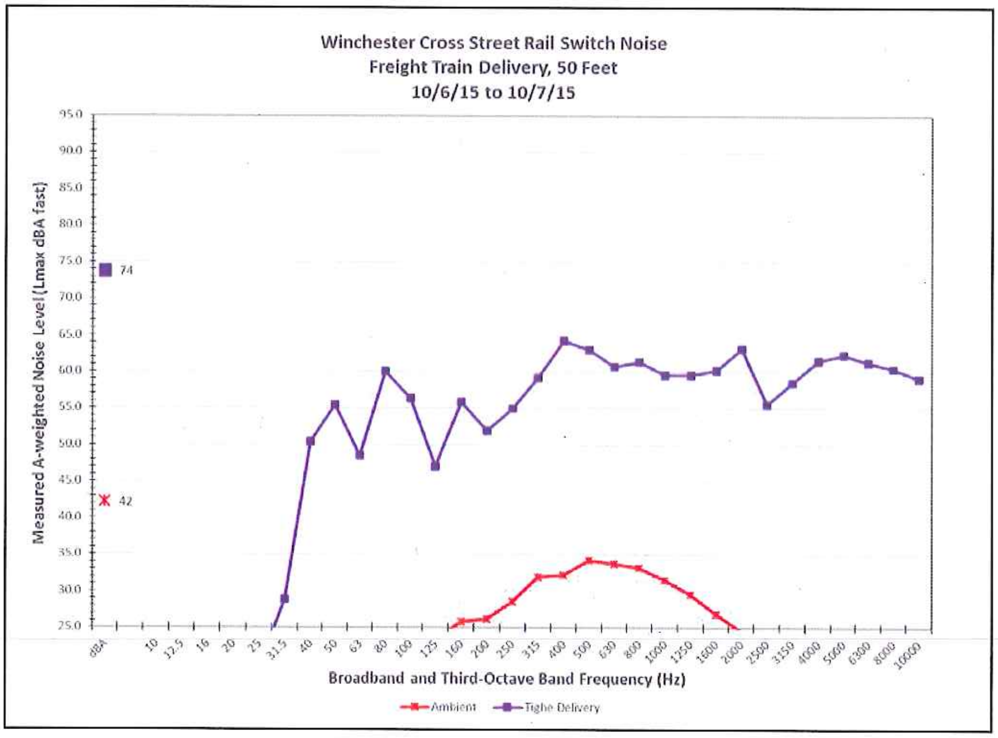
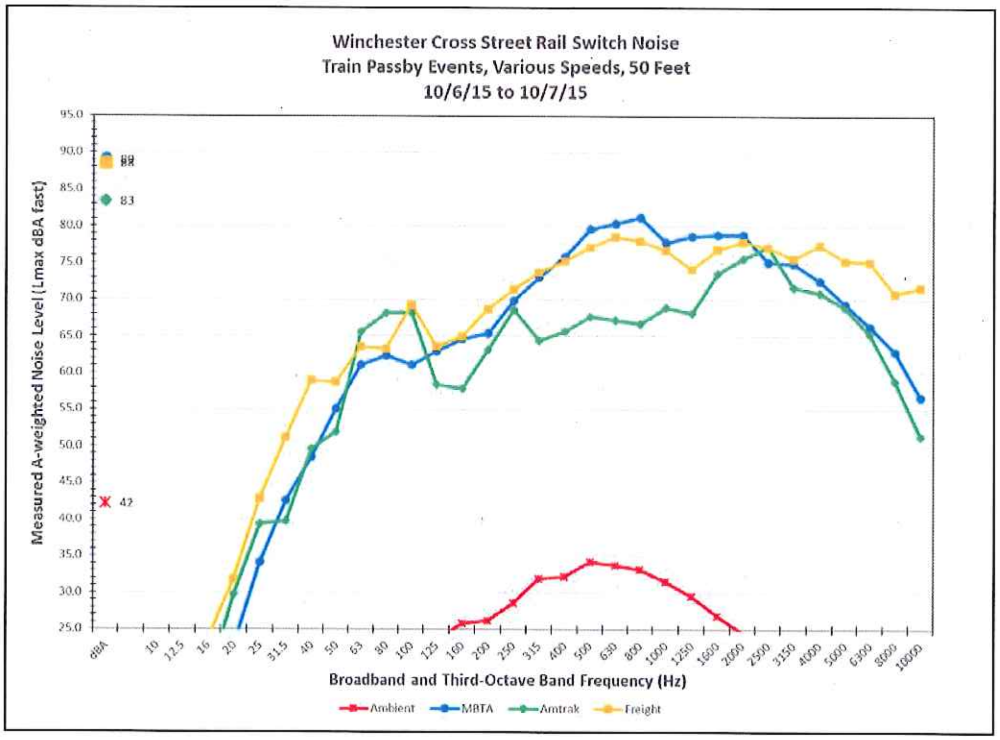


Figure 7. Train Passby Events Spectra



Regulatory Setting

Nighttime railcar deliveries to the Tighe Group building in Winchester are most likely not subject to any noise code or restrictions. Federal rail noise guidelines would not apply because the deliveries are not a "project" funded by FRA or FTA. The State's noise regulation, 310 CMR 7.10, as enforced through Mass. DEP, would not apply because the regulation is intended for stationary noise sources and exempts transportation sources such as highways and railroads. No noise bylaw is currently in place in the Town of Winchester.

That said, an evaluation of the noise levels generated by the nighttime railcar deliveries was performed with respect to FRA/FTA and Mass. DEP noise guidelines. This evaluation was done in order to put the severity of the nighttime delivery noise in some perspective. *This evaluation is not intended to find or establish fault requiring mitigative actions be taken by the noise producer(s).*

FRA/FTA Noise Criteria

The Federal Railroad Administration (FRA) and Federal Transit Administration (FTA) specify identical criteria to define community noise impact based on sensitive land-use categories and relative changes in noise exposure caused by a project. FRA/FTA noise criteria compare future rail project noise with a receptor's existing noise exposure. FRA/FTA noise criteria limits incorporate both absolute criteria, which consider activity interference caused by the rail project alone, and relative criteria, which consider annoyance due to the change in the noise environment caused by the project. Although the impact criteria allow higher levels of project noise in areas with high levels of existing noise, smaller relative increases in total noise exposure are allowed in such areas.

FRA/FTA's noise criteria define two threshold levels of impact, *moderate impact* and *severe impact*, based on a receptor's existing noise exposure and land-use category.

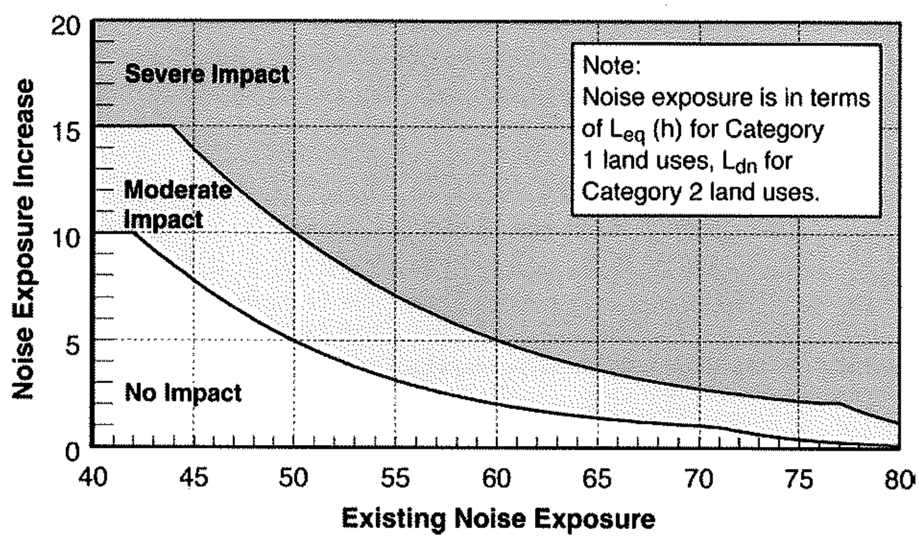
- **Severe Impact:** Project-generated noise in the severe impact range can be expected to cause a significant percentage of people to be highly annoyed by the new noise and represents the most compelling need for mitigation.
- **Moderate Impact:** In the moderate range of noise impact, the change in the cumulative noise level is noticeable to most people but may not be sufficient to cause strong, adverse reactions from the community. Other project-specific factors must be considered to determine the magnitude of the impact and the need for mitigation. These factors include the existing noise level, the predicted level of increase over existing noise levels, the types and numbers of noise-sensitive land-uses affected, the noise sensitivity of the properties, community views, and the cost of mitigating noise to more acceptable levels.

FRA/FTA noise impact criteria are also dependent on the land-use category of the receptor. Category 1 land-use includes tracts of land where quiet is an essential element in their intended purpose, such as outdoor concert pavilions, recording studios, concert halls, and historical sites with significant outdoor land-use. Category 2 land-use includes residences and buildings where people normally sleep. This category includes homes, hospitals, and hotels where nighttime sensitivity to noise is assumed to be of utmost importance. Category 3 land use includes institutional properties with primarily daytime and evening use, such as medical offices, churches, schools, libraries, and theaters. Places with meditation or study associated with cemeteries, museums, monuments, and recreational facilities are also included in this category. Most general purpose businesses and commercial buildings are not included in any category.

The relevant noise metric when evaluating Category 2 receptors is the Ldn due to the receptor's sensitivity to nighttime noise intrusion. Category 1 and 3 receptors are analyzed using the Leq for the loudest hour of rail-related activity during hours of receptor noise sensitivity. All noise levels measured or predicted using the FRA/FTA procedure are expressed in A-weighted decibels (dBA) and are applied and evaluated on the exterior of the receptor at a position closest to or facing the project.

The noise criteria approach used by FRA/FTA for identifying community noise impact is shown graphically in **Figure 8**. *Given the measured existing noise exposure in the Baldwin Street neighborhood of 63 dBA Ldn (without railcar deliveries), the noise limit for moderate and severe impacts would be 65 dBA Ldn and 67 dBA Ldn, respectively. The additional noise produced by railcar deliveries to the Tighe Group building is not significant enough to increase the Ldn levels. Consequently, there would be no noise impact to the community in accordance with FRA/FTA guidelines.*

Figure 8. FRA/FTA Noise Impact Criteria



Mass. DEP Noise Regulation

Noise levels generated by commercial businesses in Massachusetts are regulated in 310 CMR 7.10 and its interpretation by the Massachusetts Department of Environmental Protection (Mass. DEP). The regulation defines acceptable noise emissions for new stationary sources as a function of existing ambient noise levels.

The Mass. DEP noise criteria state that broadband A-weighted (dBA) noise levels associated with new operating equipment cannot exceed the lowest ambient noise conditions by more than 10 decibels. Mass. DEP defines ambient noise as the quietest background noise present 90% of the time (i.e. the L90 statistical level expressed in dBA) during the source's operating hours. Mass. DEP noise criteria also attempt to avoid the creation of annoying pure tone conditions which are defined as occurring when the noise level in any single octave band exceeds the levels in the adjacent octave bands by more than 3 decibels. These noise criteria are evaluated at the property lines and exterior facades of nearby inhabited buildings.

While not specifically defined in the Mass. DEP policy, it is commonly accepted that stationary noise sources should be measured in terms of their continuous noise emissions (i.e. the Equivalent Sound Level, Leq, in dBA) and evaluated for compliance against the quietest ambient levels (i.e. L90 in dBA) during a period of at least one hour.

Mass. DEP noise criteria are intended to limit continuous noise sources. They are not well suited nor applicable to regulate louder event-type noises such as truck and train passbys, construction activities, or impulsive noises. *That said, given the quietest measured background noise level in the Baldwin Street neighborhood of 41 dBA L90, the noise limit for impacts would be 51 dBA. The noise level of the railcar delivery process projected to a distance of 740 feet into the community would be 50 dBA, which would just comply with the Mass. DEP noise limit. However, residents living closer to the tracks (within 680 feet) could experience delivery train noise levels in excess of 51 dBA and would therefore be considered impacted.*

Noise Control Options

The generation and propagation of noise is a physical phenomenon which can therefore be controlled. In general, control options can be applied to the noise source, the pathway, or the receiver. The degree of noise reduction achieved is a function of the effectiveness of the controls, proper installation of the controls, the frequency range requiring attenuation, and the perception of the receivers.

In this case there will be challenges due to the low frequency noise produced by locomotives making railcar deliveries at night to the Tighe Group building. Low frequency noise is difficult to control due to its long wavelengths and omni-directional propagation patterns. Nevertheless, noise control options do exist for this project, as described below. However, it is important to note again that there are no enforceable regulatory violations in this case, so noise mitigation measures are not compulsory.

Source Controls

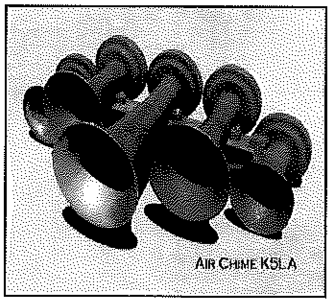
Noise controls applied at the source are usually the most effective option because they prevent unwanted noise from being generated in the first place.

One possibility is to restrict (agree, require) the use of only quieter electric locomotives to service the Tighe Group building at night. However, this is likely an unrealistic idea because various freight companies might be involved, and implementation would be unenforceable.

Another possible means of source control are time restrictions. Clearly, railcar deliveries at night are much more aggravating to the community than deliveries during daytime hours would be. However, freight carriers and the MBTA would prefer freight activities be conducted during off-perk (non-revenue) hours which is typically from about 1:00 AM to 5:00 AM. During these times there is less train congestion on the two main line tracks.

There has been discussion amongst community members regarding the State's 5-minute idle time regulation as described in MGL Ch. 90, Section 16A. However, the law clearly exempts "vehicles engaged in the delivery or acceptance of goods, wares, or merchandise for which engine assisted power is necessary and substitute alternate means cannot be made available". Moreover, enforcing such an idle time restriction in the middle of the night would be very difficult to accomplish.

Train Horns



Horns are a necessary and proven-effective warning device used on trains of all types in service in the United States. Amtrak uses a Nathan 5 Air Chime K5LA horn mounted on the top-middle of the locomotive. All five "bells" face forward and produce a B major 6th chord (220 to 554 Hertz) measuring 104 dBA at a reference distance of 100 feet. The K5LA five-chime assembly's musical chord helps the horn to be heard and lessens complaints. However, to serve its intended purpose the horn must be quite loud relative to surrounding background noise conditions.

The use and loudness of train horns are dictated in the United States by 49 CFR Parts 222 and 229, as administered by the FRA. Train horns must produce a minimum of 96 dBA at a distance of 100 feet, but should not exceed 110 dBA at 100 feet. Train horns are required to be sounded ¼ mile ahead of a street crossing as the train is approaching. The approach distance can be even greater if the train is moving at higher speeds. The warning should consist of two-long – one-short – one-long horn blows. The horn is also used at the locomotive engineer's discretion and judgment in the event pedestrians, vehicles or obstacles are on the tracks.

That said, there are no requirements for the freight trains to be sounding their horns as they make deliveries at night to the Tighe Group building. Horns are not required when exiting or merging back onto the main line from a side spur. If horns are being sounded during a delivery to the Tighe Group building then it is being done at the discretion of the engineer; typically in the case of when construction crews are working on the tracks.

Lastly, horn-free "Quiet Zones" would not apply in this case. Horn-free zones are only intended at roadway grade crossings, not at side spur delivery areas. FRA/FTA must be persuaded to consider establishing a horn-free zone through the proposed use of acceptable and effective Supplemental Safety Measures (SSM) at candidate grade crossings. SSMs typically include physical safety measures such as four-quadrant gate systems and warning lights. The local jurisdiction's highway department must also agree to the SSM options.

<u>Pathway Controls</u>

Noise can be effectively blocked or diverted by obstacles placed along the propagation pathway, i.e. a noise barrier. To be effective, the barrier must be long and tall enough to completely block the line-of-sight between the noise source and the receivers, must be free of any holes or gaps, and must be placed either close to the noise source or to the receiver.

Noise barriers can be built of any solid mass construction material providing a surface density of at least 4 lbs/SF. Common noise barrier materials include wooden timbers, concrete, brick, steel or plastic panels, and earthen berms. If designed and built properly, a noise barrier can provide up to 15 decibels of noise reduction. However, the amount of noise reduction is greatest for receivers close to the barrier and is lessened with distance from the barrier. Also, noise barriers are more effective at mid- and high-frequency than they are a low frequency.

Single Noise Barrier

In this case a single noise barrier could be considered for construction along the western side of the Tighe Group rail spur, as shown in **Figure 8**. The barrier would need to be approximately 600 feet long in order to cover the entire spur and could tie into the Tighe Group's building. For conceptual purposes an initial barrier height of 18 feet can be considered. Such a barrier would provide noise relief to the neighborhood west of the tracks (i.e. Baldwin Street, Williams Street, Newton Street), but at the risk of elevating noise levels east of the tracks (i.e. Forest Street, Brookside Avenue) due to noise reflecting off the barrier. A means of minimizing the reflected noise contribution is to line the source side of the barrier with a sound absorptive material such as Pyrok (or equivalent). At an estimated unit cost of $40/SF (including Pyrok), this barrier could cost $432,000 to install.

Figure 8. Single Noise Barrier Concept

Parallel Noise Barriers

A potential enhancement to the idea of a single noise barrier would be to construct two noise barriers parallel to each other on both sides of the Tighe rail spur. Parallel barriers would reduce noise propagating both west and east of the tracks, but not as effectively as a single barrier. This is because noise will reflect back and forth between the parallel barriers and escape over the top, thus degrading the potential noise reduction performance of each barrier. Again, to minimize this effect the source sides of the barriers could be lined with an acoustical absorption material. The cost estimate for two 600 foot x 18 foot parallel noise barriers complete with Pyrok surfaces would be $864,000.

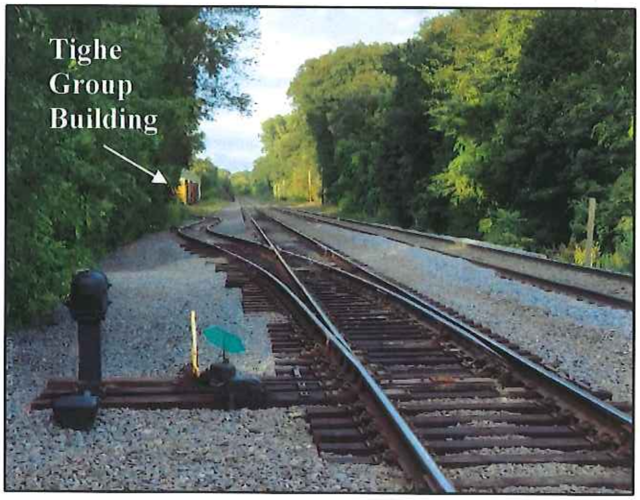
Enclosed Train Shed

Taking the idea of parallel barriers even further, the delivery train could be completely enclosed inside a 600 foot long acoustical shed. Conceptually, a shed is simply parallel barriers covered by a roof. The advantages of a shed are significant from a noise control perspective. Noise from the entire delivery process – i.e. the locomotive, railcar connections, rail switch noises, etc. – would be contained within the shed. A well designed and constructed acoustical shed could reduce delivery train noise by 10 to 15 decibels.

The shed would have to be built of a sufficiently massive material to effectively contain low frequency noise, and be lined with an acoustical absorption material such as Pyrok. The shed would form a confined space, so rooftop ventilation fans would needed in several locations. Lighting would also need to be provided inside the shed. The Town of Winchester would need to consider that such a shed could pose a risk as an "attractive nuisance" for loitering and crime.

There would be a multitude of design, construction and safety considerations to contend with in building an acoustical train shed. The area in question can be seen on the left side of **Photo 2**. A train shed would be the most effective means of reducing railcar delivery noise for all affected communities to the west, east and south of the Tighe Group building. A rough cost estimate to construct such a shed would be $1,500,000.

Photo 2. Tighe Group Rail Delivery Spur



Lastly, there is ample precedence for these types of acoustical train sheds. One is currently being constructed in Brunswick, Maine, to service the Amtrak Downeaster train. However, it is much more than just a shed; it is a staffed maintenance and repair facility as well. Other examples include the WMATA line in West Falls Church, Virginia, and the CTA Purple Line in Wilmette, Illinois.

<u>Receiver Controls</u>

Though typically not the first preference, on occasion noise control options can be applied to directly affect the receivers. This option can become attractive when there are only a few residences in need of noise reduction. Typically, public agencies will not fund receiver noise controls due to difficulties in establishing a fair and unbiased eligibility policy. However, many public and private projects have resorted to receiver noise control measures when source and/or pathways control options are either infeasible or not sufficient.

One form of receiver noise control that does get implemented frequently is to enhance the soundproofing capabilities of people's homes. This is often done around airports and where construction projects might take years to complete. Residential soundproofing consists of augmenting or replacing window and doors, installing AC systems, and reinforcing a "room of preference" (such as bedroom) with additional gypboard walls and ceilings. When done correctly, noise levels inside the home can be reduced by 10 decibels relative to the unmitigated condition. Of course, soundproofing the houses only reduces noise infiltrating into the homes; it does nothing to reduce outdoor noise. From residential soundproofing programs implemented by FAA and FHWA, the cost to soundproof a single-family home would be approximately $30,000.

Very rarely, and never with public money, monetary compensation can be offered to the aggrieved public in return for their signing waivers to stop complaining about the noise. This form of receiver noise control is jokingly referred to as "hush money", but there are times when it is the only pragmatic solution. Specific details and dollar amounts are usually kept confidential.

Conclusions

An acoustical study was conducted in October 2015 to measure, evaluate and recommend mitigation options to abate freight train noise associated with railcar deliveries to the Tighe Group building at night. An initial public meeting was held on 9/21/15 to present the purpose and methodology of the study and to get feedback from attendees describing the kinds of noises that they found most disturbing at night. Detailed noise measurements and observations of a railcar delivery were performed the night of 10/6/15 to 10/7/15, and long-term noise measurements were performed in the Baldwin Street neighborhood during the week of 10/6/15 to 10/13/15.

Measured noise levels were evaluated against FRA/FTA and Mass. DEP noise criteria for perspective, and several forms of noise control options were presented addressing noise at its source, along the pathway, and at receivers' locations. Railcar delivery noise at night to the Tighe Group building will be difficult to fully abate. Locomotives produce low frequency noise which has the ability to propagate great distances and easily penetrate typical residential structures. However, of the various forms of noise control discussed in this study, the best option would be to construct a noise control shed over the Tighe rail spur to enclose the entire railcar delivery process.

The cost and complexity of any form of noise control can be daunting. However, if done correctly noise from the railcar deliveries can be successfully attenuated. The idea of "cost sharing" should be considered where there are several parties involved in this case, namely the MBTA, Pan Am, the Tighe Group, the Town of Winchester, and the benefiting residents.

It is important to note that this study was a conceptual feasibility study. Each of the noise control options presented in this study would require much greater assessment and analysis before it could be considered for implementation. Parsons Brinckerhoff remains available to further assist the Town of Winchester in these regards whenever desired.