Appendix G
Noise

This appendix describes the methods that the Surface Transportation Board's (Board) Office of Environmental Analysis (OEA) used to estimate and analyze the potential noise and vibration effects of the Southern and Northern Rail Alternatives.

G.1 Wayside Noise Models

Wayside noise refers to all noise generated by rail cars and locomotives other than horn noise. OEA used noise measurements from past noise studies (STB 1998a, 1998b) as the basis for the wayside noise level projections for the proposed rail line.

The equations for wayside noise modeling use the following parameters:

SEL_{cars} = Sound exposure level of railcars (A-weighted decibels [dBA])

L_{eqref} = Level equivalent of railcar

T_{passby} = Train passby time (seconds)

S = Train speed (miles per hour)

S_{ref} = Reference train speed

SEL = Sound exposure level

SEL_{locos} = Sound exposure level of locomotive

SEL_{ref} = Reference sound exposure level of locomotive

DNL = Day-night average noise level

N_{locos} = Number of locomotives

N_d = Number of trains during daytime

N_n = Number of trains during nighttime

D = Distance from tracks (feet)

The basic equation used for the wayside noise model is as follows:

$$SEL_{cars} = L_{eqref} + 10*\log(T_{passby}) + 30*\log(S/S_{ref})$$

For locomotives, which can be modeled as moving monopole point sources, the corresponding equation is as follows:

$$SEL_{locos} = SEL_{ref} + 10*\log(N_{locos}) – 10*\log(S/S_{ref})$$

The SEL is computed by logarithmically adding SEL_{locos} and SEL_{cars}.

$$DNL_{100'} = SEL + 10*\log(N_d + 10*N_n) – 49.4$$

$$DNL = DNL_{100'} + 15*\log(100/D)$$

The 10*log(x) term in the above equations can be used to determine the increase (or decrease) in train noise level associated with changes in traffic volumes, assuming that the other factors affecting noise (speed, train consist and length, time of day, and number of locomotives) are equivalent. The change in noise level (Delta; in dB) associated with two different traffic volumes would be as follows:

Delta = $10*\log(N_2/N_1)$

Where N1 and N2 are two different traffic volumes (in trains per day). For example, if rail traffic doubled, the increase in noise level would be 10*log(2/1) = 3 dB.

Table G-1 shows the reference wayside noise levels used in this analysis and **Figure G-1** shows the wayside noise frequency spectrum used in the calculations.

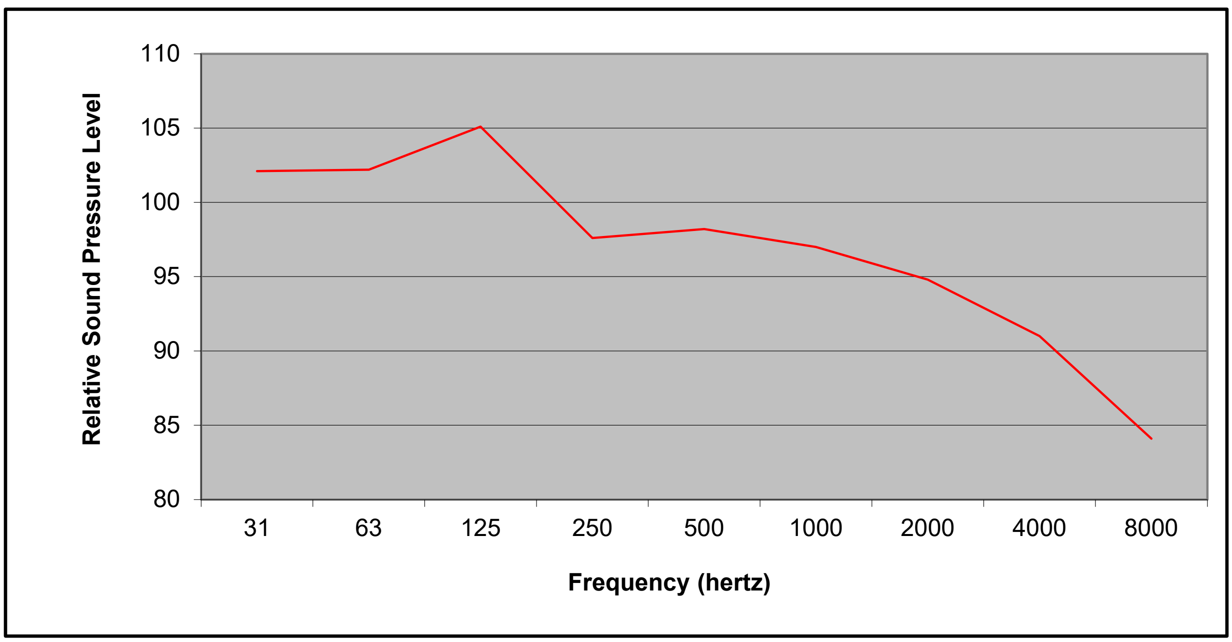
Table G-1. Reference Wayside Noise Levels

Description	Average Level (dBA)
Locomotive SEL (40 miles per hour at 100 feet)	95
Railcar L_{eq}	82

Source: STB 1998a, 1998b

Notes: dBA = A-weighted decibels; SEL = sound exposure level; L_{eq} = level equivalent

Figure G-1. Wayside Noise Spectrum



Source: STB 2002

G.2 Horn Noise Models

Freight train horn noise levels can vary for a variety of reasons, including the manner in which an engineer sounds the horn. Consequently, it is important to determine horn noise reference levels based on a large sample size. A substantial amount of horn noise data is available from the Federal Railroad Administration (FRA)'s Draft Environmental Impact Statement (EIS), *Proposed Rule for* *the Use of Locomotive Horns at Highway-Rail Grade Crossings*, hereafter referred to as the 1999 FRA Draft EIS (FRA 1999).

FRA data indicate that horn noise levels increase from the point at which the horn is sounded, at 0.25 miles from the grade crossing, to when it stops sounding at the grade crossing. In the first 0.125-mile segment, the energy average SEL measured at a distance of 100 feet from the tracks was found to be 107 dBA; in the second 0.125-mile segment, it was found to be 110 dBA. The 1999 FRA Draft EIS simplified the horn noise contour shape as a 5-sided polygon, although it is actually a teardrop shape. The Final Environmental Impact Statement, *Construction and Operation of a Rail Line from the Bayport Loop in Harris County* (STB 2003), discusses this subject in detail. OEA used the more accurate teardrop contour shape for that analysis. The attenuation, or drop-off rate, of horn noise is assumed to be 4.5 dBA per doubling of distance away from the tracks (FRA 1999).

Table G-2 lists the reference horn noise levels used in this analysis; **Figure G-2** shows the horn noise spectrum used in the calculations.

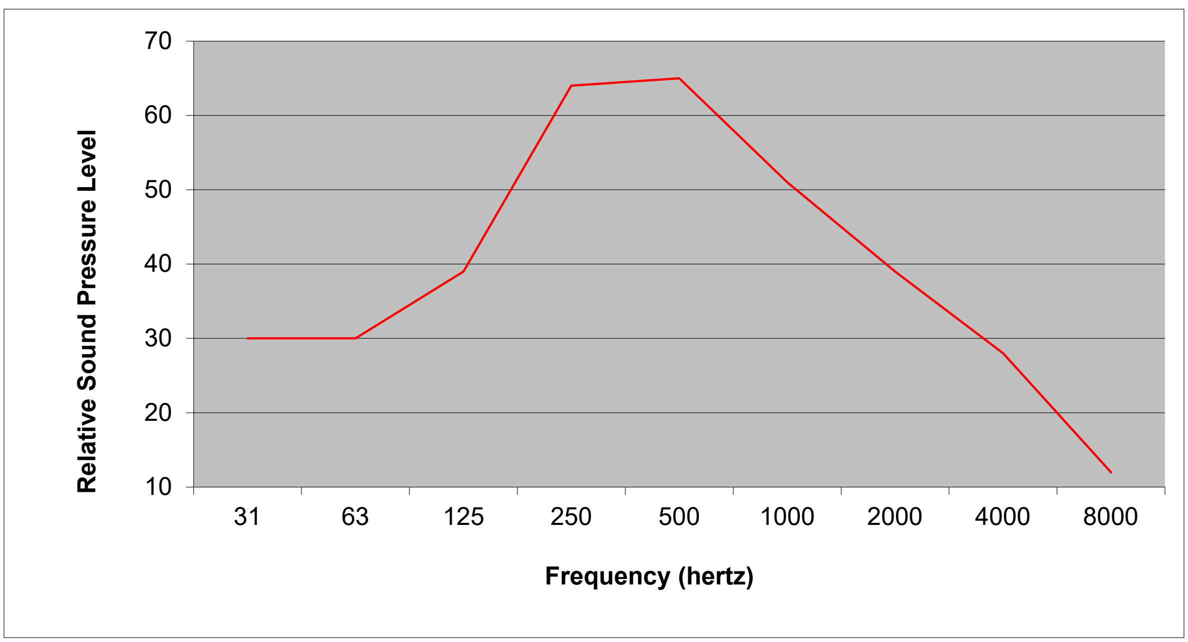
Table G-2. Reference Horn Noise Levels

Description	Average Level (dBA)
Horn SEL, 1st 0.25 mile	110
Horn SEL, 2nd 0.25 mile	107

Source: FRA 1999

Notes: dBA = A-weighted decibels; SEL = sound exposure level

Figure G-2. Horn Noise Spectrum (Leslie RS-3L Horn)



Source: STB 2003

G.3 Rail Line Operation Vibration Analysis Methods

OEA based its vibration assessment methods on Federal Transit Administration (FTA) methods (FTA 2006). Vibration level due to train passbys is approximately proportional to:

$V = 20*\log(speed/speed_{ref})$

Where:

V = Ground-borne vibration velocity

speed = Train speed

$speed_{ref}$ = Reference speed of the train relative to its corresponding vibration level

Published FTA ground-borne vibration levels are adjusted for train speed using the above equation and distance from the rail line to estimate vibration levels at specific receptor locations.

There are two ground-vibration impacts of general concern: annoyance to humans and damage to buildings. In special cases, activities that are highly sensitive to vibration, such as microelectronics fabrication facilities, are evaluated separately; this is not applicable to the present analysis. Two measurements correspond to human annoyance and building damage for evaluating ground vibration: peak particle velocity (PPV) and root-mean square (RMS) velocity. PPV is the maximum instantaneous positive or negative peak of the vibration signal, measured as a distance per time (such as millimeters or inches per second). This measurement has been used historically to evaluate shock-wave type vibrations from actions like blasting, pile driving, and mining activities, and their relationship to building damage. RMS velocity is an average, or smoothed, vibration amplitude, commonly measured over 1-second intervals. It is expressed on a logarithm scale in decibels (VdB) referenced to $0.000001*10^{-6}$ inch per second and is not to be confused with noise decibels. It is more suitable for addressing human annoyance and characterizing background vibration conditions because it better represents the response time of humans to ground vibration signals.

G.4 Noise Modeling Analysis

G.4.1 Ambient (Existing) Noise Modeling

Existing noise levels form the baseline for comparison against future noise levels. Existing noise levels can be measured and/or modeled. Measuring noise levels has certain advantages such as determining site-specific data, but long-term noise data collection is needed for transportation noise studies since annoyance criteria are usually expressed in terms of annual averages. In addition, in some cases, coverage of large geographic areas can be impractical because of the required large number of precision sound level meters. In this particular case, existing noise data was needed for the study area and for the extensive area adjacent to the existing UP mainline.

AADT traffic data and speed for major roadways such as U.S. 277 were modeled along with UP mainline train operational data. For areas further away from transportation noise sources, the following relationship developed by the Environmental Protection Agency (EPA) was used to estimate ambient noise levels.

$DNL = 22 + 10*\log(p)$

Where:

p = Population density in people per square mile

G.4.2 Southern Rail Alternative

G.4.2.1 Noise Barrier Performance Specifications

Surface Mass Density

For the Southern Rail Alternative, Green Eagle Railroad (GER) proposed 20-foot-high noise barriers on both sides of the tracks (October 17, 2024, letter to OEA) between the non-intrusive inspection (NII) facility and the western end of the Stormwater Channel Bridge. To provide sufficient mass density that would minimize noise going over the wall without compromising the noise-reduction effects of the wall itself, GER proposed to design the noise barrier to have a minimum Sound Transmission Loss (dB) according to the criteria in **Table G-3.**

Table G-3. Minimum Sound Transmission Loss for Noise Barrier

Frequency (Hz)	31.5	63	125	250	500	1,000	2,000	4,000	8,000	STC
Transmission Loss (dB)	15	19	23	27	31	35	39	43	47	35

In most noise barrier applications, any solid freestanding noise barrier that is 20 feet high would have sufficient mass for transmission loss to not be an issue. Noise barrier mass density is typically specified at 5 pounds per square foot. In this case, however, low frequency sound at 63 and 125 hertz (Hz) is involved here, not mid-frequency sound. Consequently, solid material of 10 pounds per square foot would be needed to achieve adequate[1] noise reduction within the 63 and 125 Hz band. However, a composite noise barrier material with an interior airspace/impedance change would also be able to provide enough attenuation. **Table G-3** shows the required transmission loss of the noise barrier to achieve a 0.6 dB or less degradation of performance at 63 Hz. This works out to be Sound Transmission Class (STC) 35. The more important values in this case are the low frequency values at 63 Hz and 125 Hz since STC primarily addresses mid frequency sound.

> **Transmission Loss (dB)** is a measurement of the reduction in sound level of a sound source as it passes through an acoustic barrier. It is the number of decibels that are reduced by the acoustical barrier or the wall and is measured at different frequencies.
>
> **Sound Transmission Class (STC)** is a rating of how well a partition attenuates sound. The STC rating very roughly reflects the decibel reduction of noise that a partition can provide. The STC is useful for evaluating speech sounds, but not music or machinery noise as these sources contain more low frequency energy than speech.

Absorptive Noise Barrier Face

Since the 20-foot-tall noise barriers that GER proposes to build would be relatively close together and also close to locomotives and rail cars, sound would reflect back and forth between these surfaces, effectively reducing the beneficial path-length-difference noise barrier performance. As a result, GER proposed to design the rail-side of the exterior surface of the noise barrier with environmentally protected sound absorption properties rated at a Noise Reduction Coefficient (NRC) of 0.9. This absorption treatment would help to reduce the performance degradation associated with parallel barriers.

> **Noise Reduction Coefficient (NRC)** is an average rating of how much sound an acoustic product can absorb. NRC varies from 0 to 1 with 1 being 100% absorptive.

[1] Adequate noise reduction means that the use of the barriers would avoid "severe" noise impacts per FTA classifications.

To analyze the noise impacts of the Southern Rail Alternative, OEA first analyzed a scenario in which the rail line would be elevated on an embankment, with no noise barriers. This modeling scenario determined what the noise effects on nearby receptors would be without noise barriers, and subsequently, confirmed the required height, lateral position, and length of noise barriers needed to adequately shield receptors. **Figure G-3** below shows the noise contours associated with this "no noise barrier" scenario; it assumes that GER would build the NII facility without noise abating walls.

The data in **Figure G-3** shows that without the proposed noise barriers, 53 residential receptors would be included in the 65 DNL contour with at least a 3 dBA increase; therefore, all 53 receptors would experience "severe" noise impacts based on FTA classifications.

OEA then modeled 20-foot-high noise barriers on both the north and south sides of the track as shown in **Figure G-4**. This scenario includes noise barriers on the U.S. 277 Bridge and the Barrera Street Bridge, as originally proposed by GER.

With 20-foot noise barriers as shown in **Figure G-4**, none of the 53 receptors that would be affected under the "no noise barrier" scenario would be exposed to 65 DNL or more. FTA impact classifications for these receptors would be either "none" or "moderate."

Table G-4 shows the results of this comparative analysis, including noise levels with and without the noise barriers, noise level increase above ambient, and barrier insertion loss, which is the noise level reduction provided by the barrier.[2] An insertion loss of 5 dBA or more is considered the minimum requirement, as less than that value might not be noticeable.

[2] The noise level with the proposed 20-foot noise barriers does not include ambient noise.

Figure G-3. Southern Rail Alternative Noise Contours Without Noise Barriers

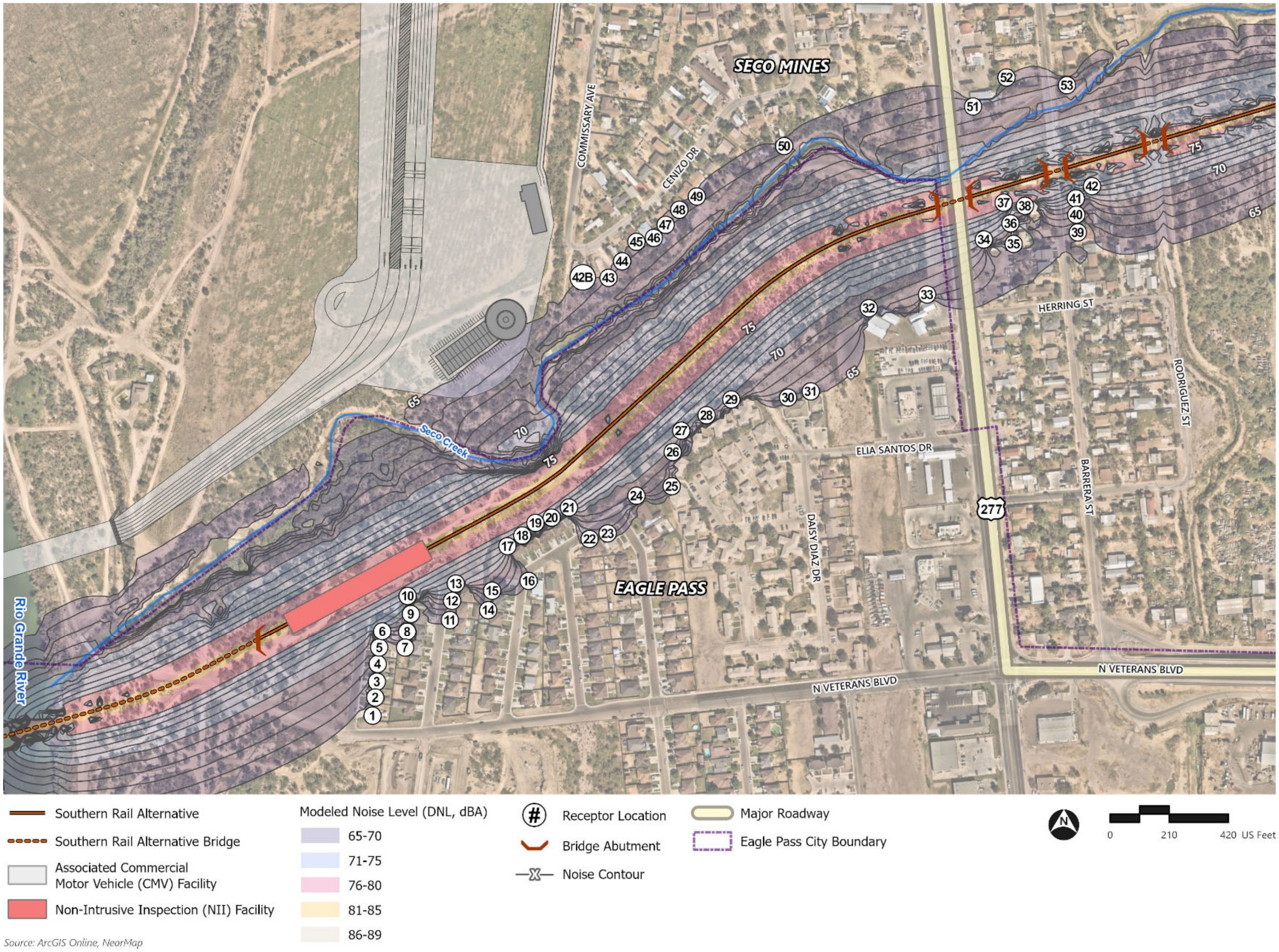
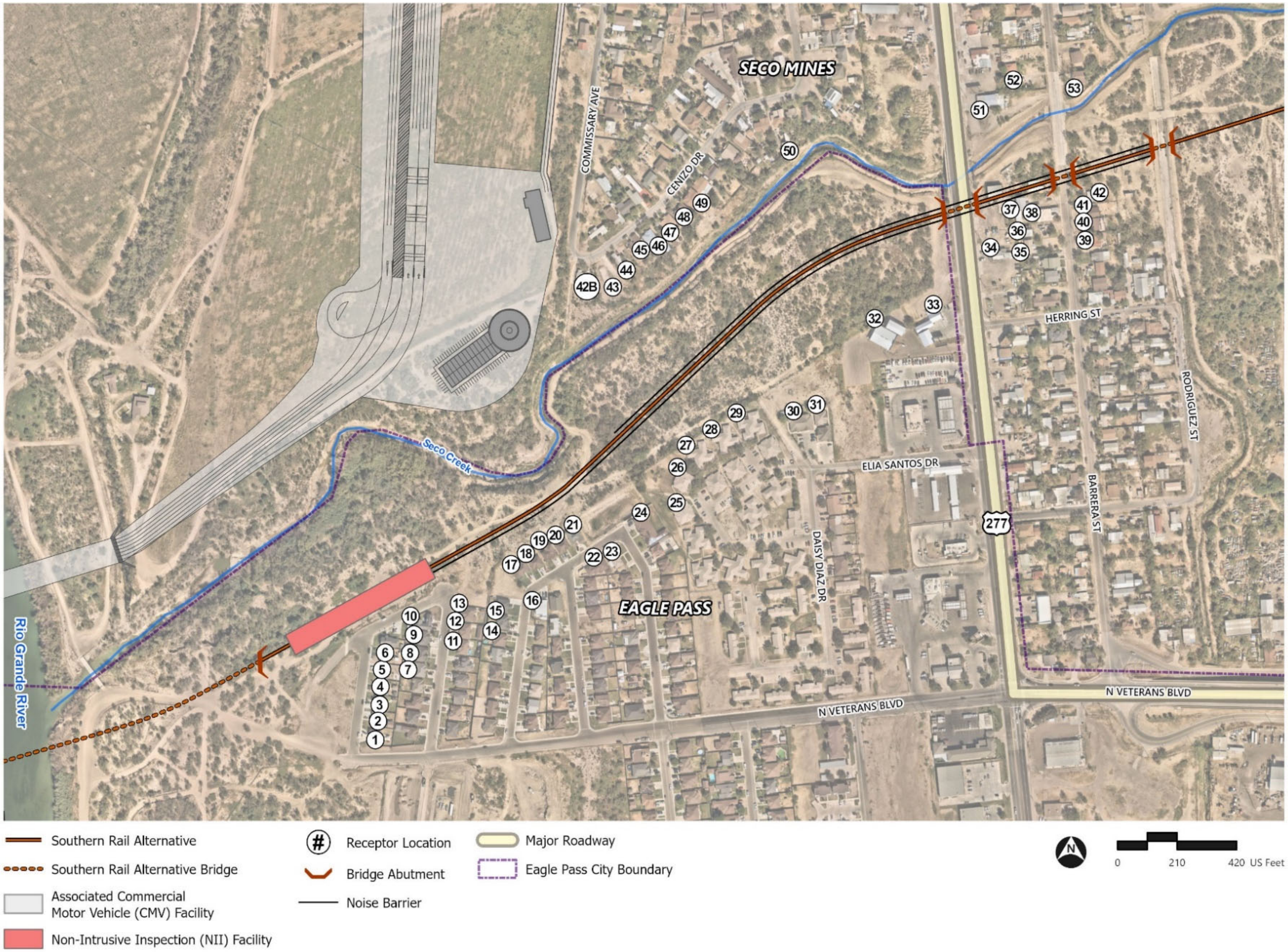


Figure G-4. Southern Rail Alternative Noise Contours with 20-foot Noise Barriers, Including on Bridges



Source: ArcGIS Online, NearMap

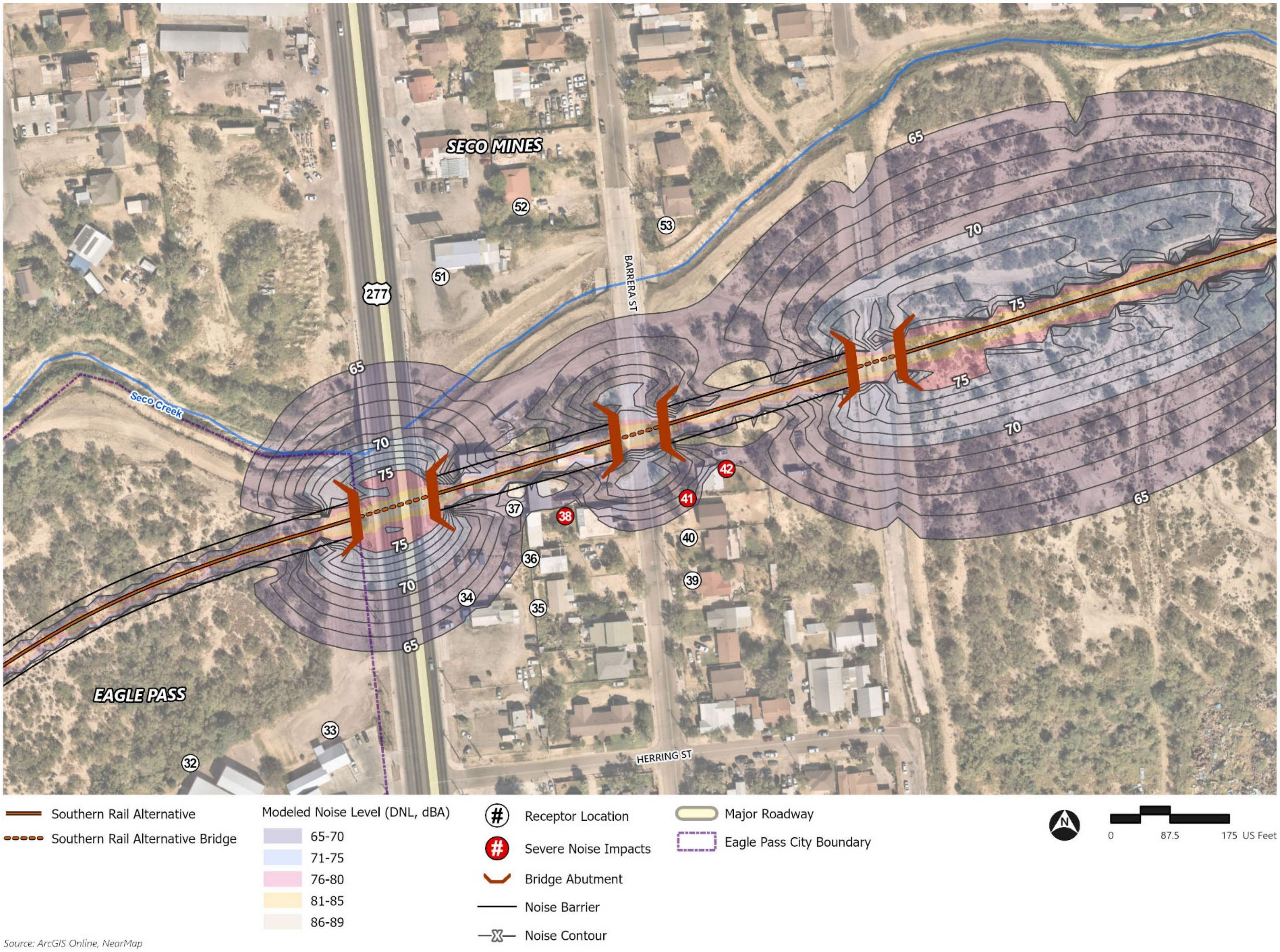
Table G-4. Southern Rail Alternative Noise Levels with and Without Proposed Noise Barriers

Receptor	Existing Ambient Noise Level DNL (dBA)	Noise Level, No Barrier DNL (dBA)	Noise Level Increase DNL (dBA)	FTA Impact	Noise Level, with 20-Foot Barrier DNL (dBA)	Noise Level Reduction, with 20-Foot Barrier (dBA)
1	53.8	65.1	11.6	Severe	53.1	12
2	53.8	65.9	12.4	Severe	53.7	12.2
3	53.8	66.5	12.9	Severe	54.3	12.2
4	53.8	67.7	14.1	Severe	55.3	12.4
5	53.8	69	15.3	Severe	56.2	12.8
6	54	71.8	17.9	Severe	58.8	13
7	53.7	65.7	12.3	Severe	52.1	13.6
8	53.7	67.8	14.3	Severe	53.8	14
9	53.7	68.3	14.7	Severe	55.4	12.9
10	54	73.2	19.3	Severe	59.5	13.7
11	53.7	65.3	11.9	Severe	51.8	13.5
12	53.8	68	14.4	Severe	53.7	14.3
13	54	71.2	17.3	Severe	57.5	13.7
14	53.8	65.2	11.7	Severe	52.5	12.7
15	54.2	67.7	13.7	Severe	54.5	13.2
16	54.1	65.1	11.3	Severe	54.1	11
17	54	72.7	18.8	Severe	59.9	12.8
18	54	72.6	18.7	Severe	58.9	13.7
19	54.2	74.1	19.9	Severe	60.8	13.3
20	54.1	72.8	18.8	Severe	58.6	14.2
21	54.4	73.2	18.9	Severe	59.8	13.4
22	54.2	66	12.1	Severe	54.2	11.8
23	54.2	66.3	12.4	Severe	52.4	13.9
24	54.4	68.7	14.5	Severe	54.5	14.2
25	54	66.1	12.4	Severe	52.4	13.7
26	54.1	69.5	15.5	Severe	56.2	13.3
27	54.6	70.9	16.4	Severe	57.5	13.4
28	54.7	70.2	15.6	Severe	57	13.2
29	55.2	69.7	14.7	Severe	56.5	13.2
30	55.5	66	10.9	Severe	51.8	14.2
31	56.5	65.7	9.7	Severe	51.5	14.2
32	57.7	68.6	11.2	Severe	55.1	13.5
33	64.1	67.7	5.2	Severe	53.8	13.9
34	66.5	70.6	5.5	Severe	55.9	14.7
35	60.9	67.6	7.5	Severe	52.4	15.2
36	61.7	69.2	8.2	Severe	54.5	14.7

Receptor	Existing Ambient Noise Level DNL (dBA)	Noise Level, No Barrier DNL (dBA)	Noise Level Increase DNL (dBA)	FTA Impact	Noise Level, with 20-Foot Barrier DNL (dBA)	Noise Level Reduction, with 20-Foot Barrier (dBA)
37	62.8	76.5	13.9	Severe	60.3	16.2
38	58.4	72.1	13.9	Severe	55.2	16.9
39	57.8	66.4	9.2	Severe	53.7	12.7
40	58.1	66.4	8.9	Severe	53.2	13.2
41	58.2	70.9	12.9	Severe	56.7	14.2
42	58.1	74.2	16.2	Severe	61.1	13.1
43	55.3	66	11.1	Severe	60.4	5.6
44	55.3	65.8	10.9	Severe	59.6	6.2
45	54.8	65.4	11.0	Severe	58.3	7.1
46	55.6	65.9	10.7	Severe	58.3	7.6
47	55.6	65.6	10.4	Severe	57.4	8.2
48	55.8	65.6	10.2	Severe	57.5	8.1
49	52.1	65.6	13.7	Severe	57.2	8.4
50	57.3	65.7	9.0	Severe	55.9	9.8
51	65	67	4.1	Severe	57.7	9.3
52	58.1	65	7.7	Severe	57.6	7.4
53	58	67.2	9.7	Severe	61.2	6

In October 2024, GER sent OEA a letter stating that it intended to install 20-foot-high noise barriers on both sides of the tracks between the NII facility and the western end of the Stormwater Channel Bridge, but to not include barriers on the Barrera Street Bridge and the U.S. 277 Bridge. GER also stated that a comprehensive review and structural analysis indicated that installing noise barriers on the bridges would present significant challenges (October 17, 2024, letter to OEA). OEA then analyzed the noise effects of GER's revised design, which is shown in **Figure G-5**.

Figure G-5. Southern Rail Alternative Noise Contours with GER's Proposed Noise Barrier Design



OEA's analysis of GER's revised design showed that with gaps in the noise barriers on the U.S. 277 Bridge and the Barrera Street Bridge, operation of the Southern Rail Alternative would cause "severe" noise impacts under FTA classification on three receptors in the vicinity of Barrera Street: receptors 38, 41, and 42.

G.4.2.2 Determining Feasibility and Reasonableness of Noise Barriers on Elevated Structures

As noted above, in a letter to OEA dated October 17, 2024, GER stated that a comprehensive review and structural analysis indicated that installing noise barriers on bridges would present significant challenges. Specifically, GER stated:

> *Following a comprehensive review and structural analysis, GER has determined that the inclusion of the sound barriers over bridges (for example, spanning Del Rio Blvd. and Barrera St.) would present significant challenges in meeting the required performance standards for those bridges. The primary concerns are the added weight and wind loads imposed by the sound barriers, which would exert considerable strain on the structural components of the bridges and would make the engineering particularly challenging and potentially cost prohibitive.*

OEA then requested that GER provide information supporting their concerns about installing noise barriers on bridges in an information request dated October 22, 2024. By letter to OEA dated October 30, 2024, GER stated that:

> *Placing noise barriers along bridge sections introduces additional structural challenges in anchoring and supporting the weight and wind forces associated with the noise barrier panels. To distribute the flexural stress and provide additional support to the noise barriers, it was determined that the two opposing noise barriers to either side of the proposed rail line would need to be connected at the top to provide the necessary stability. As a result, this need to stabilize the noise barrier panels requires increasing the height of the noise barriers from GERs typical design of 20 feet to 23 feet in order to comply with minimum over-rail clearance requirements established by the American Railway Engineering and Maintenance-of-Way Association (AREMA).*

OEA thoroughly reviewed the information provided by GER and found that GER's preliminary assessment did not adequately support GER's concerns about installing noise barriers on bridges. OEA determined that the height of 23 feet and the weight of 45 pounds per square foot for the noise barriers specified by GER in its October 30, 2024, letter are overly high assumptions because any additional height needed for structural reasons may be provided by the bridge structure rather than taller noise barriers. Based on design assumptions provided by GER, using a noise barrier with an interior impedance change that meets the specifications in **Table G-5** would satisfy the necessary reduction of sound going through the wall. OEA then researched whether installing noise barriers on rail bridges was feasible. OEA found examples of roadway bridges with effective noise barriers. See pictures in **Figure G-6 and Figure G-7**. Several companies manufacture effective noise barriers, which are in use on bridges in numerous locations. OEA did not find specific examples of noise barriers on freight rail bridges but did find examples for passenger rail bridges, which is structurally the same as freight. OEA also did not see the need to consider "wind on live load" as GER did (i.e., wind on trains). OEA reasoned that this would be double counting because the noise walls should shield the live load from wind.

OEA also assessed what the additional cost of installing noise barriers on bridges on the Southern Rail Alternative. Based on a rough-order-of magnitude (ROM) estimate, OEA estimated that, for the Southern Rail Alternative, extending the barriers across the bridges would add approximately $700,000, or 7 percent, to the cost of GER's proposed noise barriers (approximately $9.7 million).[3] See **Attachment A** for more detailed calculations, including assumed unit costs for noise barrier at grade ($85 per square foot, including materials and construction) and on structure ($75 per square foot, including materials and construction). The cost of building noise barriers on the bridges under the Southern Rail Alternative would represent approximately 0.18 percent of the $394 million construction cost estimate for the New Rail Bridge and proposed line on both the U.S. and Mexican sides of the project (Presidential Permit Application, October 17, 2023). GER and PVH estimated that the construction cost estimate for the proposed line and the Commercial Motor Vehicle (CMV) Facility combined would be $648.5 million.

After reviewing all the relevant information to date, OEA preliminarily concludes that it would be reasonable and feasible to require GER to install noise barriers on both sides of the proposed U.S. 277 and Barrera Street Bridges (**MM-Noise-01a**). If the Board authorizes the Southern Rail Alternative and imposes this measure, the Southern Rail Alternative would have no "severe" noise impacts.

G.4.3 Northern Rail Alternative

OEA analyzed the noise impacts for the Northern Rail Alternative in the same manner as those of the Southern Rail Alternative. OEA first analyzed noise impacts assuming no noise barriers. This modeling scenario determined the noise effects on nearby receptors without noise barriers, and subsequently confirmed GER's proposed height, lateral position, and length of noise barriers needed to adequately shield receptors. **Figure G-8** shows the noise contours associated with the "no noise barrier" scenario; it assumes that GER would build the NII facility without noise abating walls.

Without noise barriers, the Northern Rail Alternative 65 DNL contour would include 32 receptors experiencing a 3 dBA increase or more. All these receptors except for one fall into the "severe" impact FTA classification. Receptor 51 would experience moderate noise impacts because it is close to U.S. 277, where ambient levels are higher. However, receptor 51 is a commercial facility and not subject to residential noise impact thresholds.

OEA then modeled continuous, 20-foot-high noise barriers on both the north and south sides of the track between the western end of the Stormwater Channel Bridge through a point past the residential developments west of U.S. 277 and south of Seco Creek, as shown in **Figure G-9**. With such noise barriers, no receptors would be included within the 65 DNL contour along the Northern Rail Alternative. Therefore, there would be no "severe" noise impacts.

Table G-5 shows Northern Rail Alternative noise levels with and without continuous noise barriers, noise level increase above ambient from the proposed line, FTA impact classification, and noise level loss with noise barriers.[4] This analysis assumes noise barriers on each side of the tracks with no gaps on bridge structures, as shown in **Figure G-9**.

[3] A ROM estimate is based on high-level objectives and provides a high-level view of a project costs. Most ROM estimates have a wide range of variance.

[4] The noise levels with the proposed 20-foot noise barriers do not include ambient noise levels.

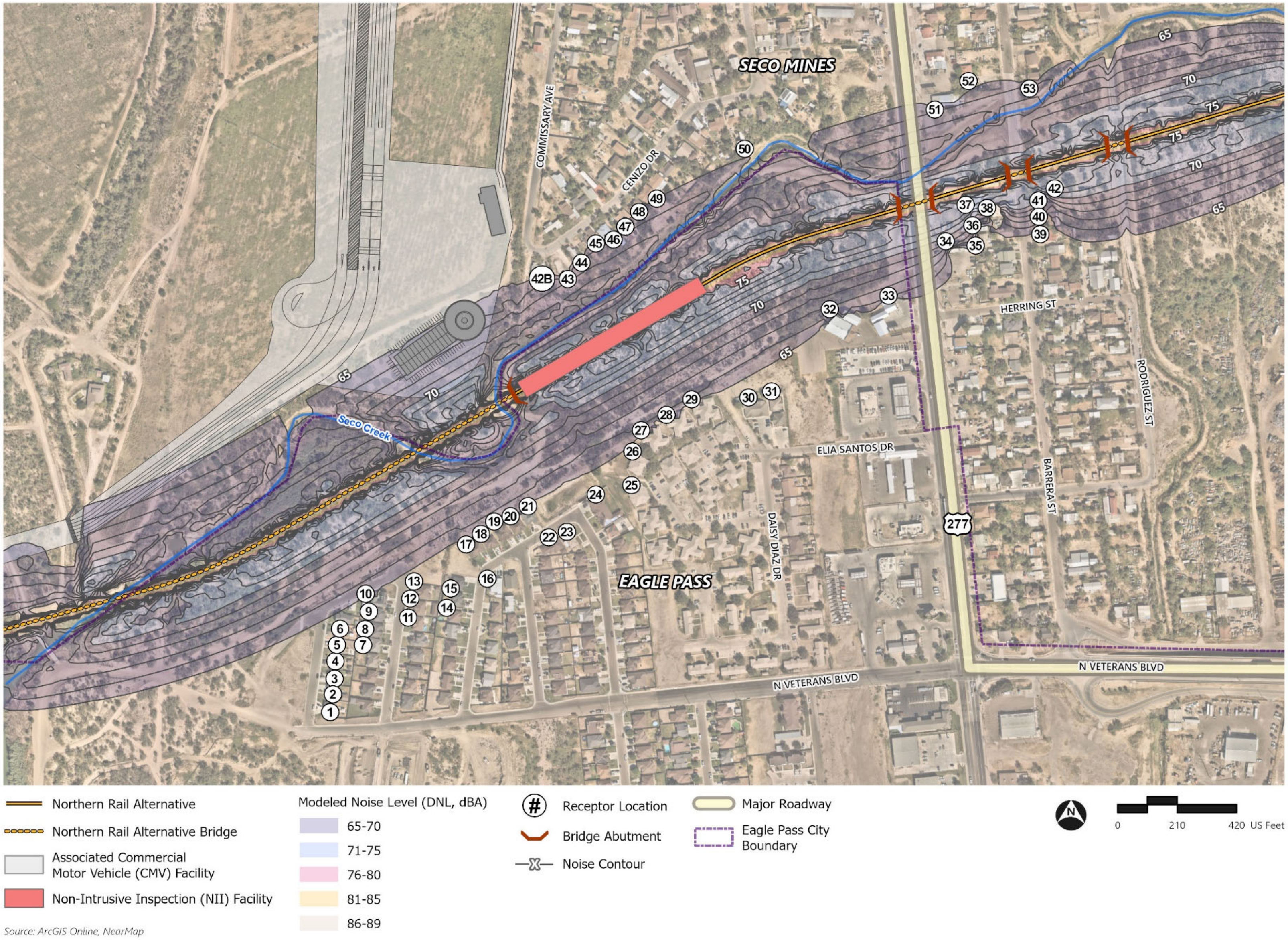
Figure G-6. Noise Barrier on Bridge (Example 1)

Stratford, Connecticut

Figure G-7. Noise Barrier on Bridge (Example 2)

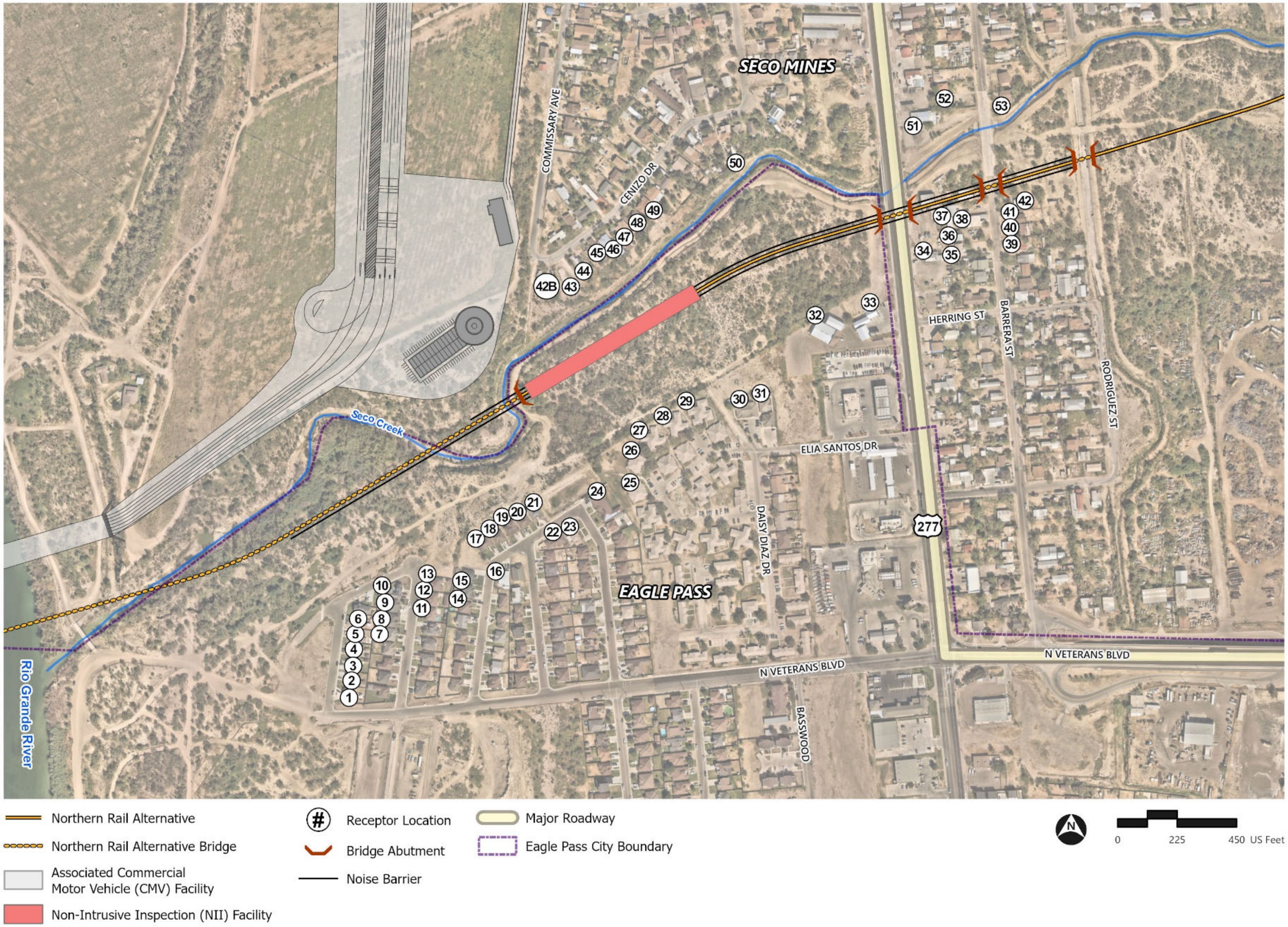
Newton, Massachusetts

Figure G-8. Northern Rail Alternative Noise Contours Without Noise Barriers



Source: ArcGIS Online, NearMap

Figure G-9. Northern Rail Alternative Noise Contours with Continuous Noise Barriers



Source: ArcGIS Online, NearMap

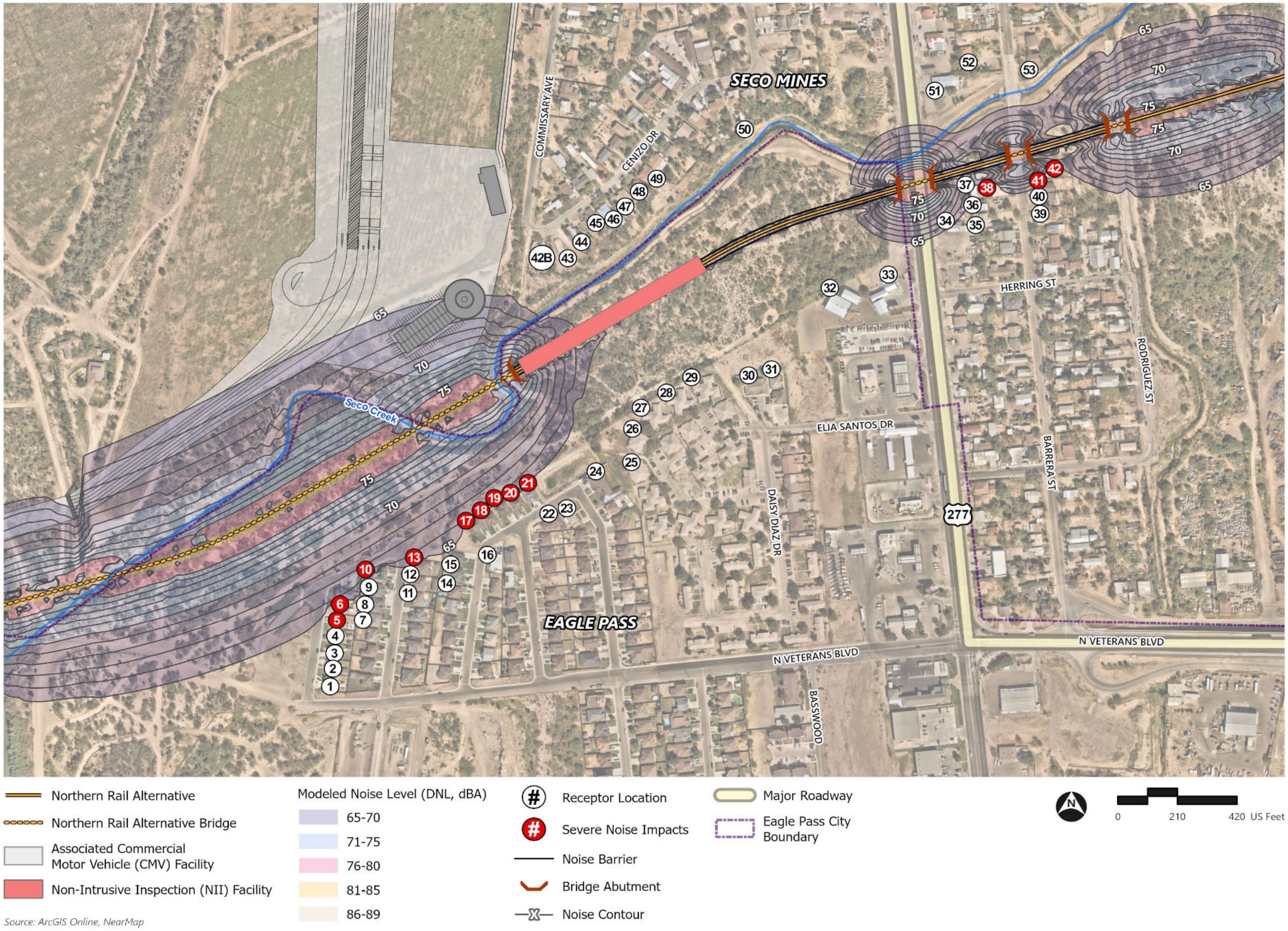
Table G-5. Northern Rail Alternative Noise Levels with and without Proposed Noise Barriers

Receptor	Existing Ambient Noise Level DNL (dBA)	Noise Level, No Barrier DNL (dBA)	Noise Level Increase DNL (dBA)	FTA Impact	Noise Level, with 20-Foot Barrier DNL (dBA)	Noise Level Reduction, with 20-Foot Barrier (dBA)
1	53.8(	60.1	7.2	Moderate	51.4	8.7
2	53.8	60.7	7.7	Moderate	51.9	8.8
3	53.8	61.2	8.1	Severe	52.3	8.9
4	53.8	62	8.8	Severe	53	9.0
5	53.8	62.8	9.5	Severe	53.6	9.2
6	54	64.7	11.1	Severe	56	8.7
7	53.7	60.3	7.5	Moderate	51.2	9.1
8	53.7	62.1	9.0	Severe	53.1	9.0
9	53.7	61.8	8.7	Severe	53.1	8.7
10	54	65.2	11.5	Severe	56.6	8.6
11	53.7	59.6	6.9	Moderate	50.7	8.9
12	53.8	62	8.8	Severe	52.5	9.5
13	54	64.3	10.7	Severe	55.7	8.6
14	53.8	60.1	7.2	Moderate	50.8	9.3
15	54.2	62.3	8.7	Severe	53.2	9.1
16	54.1	60	6.9	Moderate	53.2	6.8
17	54	64.9	11.2	Severe	56.8	8.1
18	54	64.8	11.1	Severe	56.3	8.5
19	54.2	65.5	11.6	Severe	57.3	8.2
20	54.1	65.1	11.3	Severe	56.7	8.4
21	54.4	65.2	11.1	Severe	57.1	8.1
22	54.2	60.8	7.5	Moderate	52.7	8.1
23	54.2	61.5	8.0	Severe	52.9	8.6
24	54.4	63.5	9.6	Severe	54.8	8.7
25	54	61.6	8.3	Severe	53.3	8.3
26	54.1	64.4	10.7	Severe	55.7	8.7
27	54.6	65.7	11.4	Severe	57.1	8.6
28	54.7	65.8	11.4	Severe	57.2	8.6
29	55.2	65.8	11.0	Severe	57.3	8.5
30	55.5	63.5	8.6	Severe	54.9	8.6
31	56.5	63.4	7.7	Severe	54.8	8.6
32	57.7	66.9	9.7	Severe	57.8	9.1
33	64.1	66.2	4.2	Severe	56.9	9.3
34	66.5	69.4	4.7	Severe	59.2	10.2
35	60.9	66.4	6.6	Severe	56.2	10.2
36	61.7	68	7.2	Severe	57.9	10.1
37	62.8	72.8	10.4	Severe	62.9	9.9

Receptor	Existing Ambient Noise Level DNL (dBA)	Noise Level, No Barrier DNL (dBA)	Noise Level Increase DNL (dBA)	FTA Impact	Noise Level, with 20-Foot Barrier DNL (dBA)	Noise Level Reduction, with 20-Foot Barrier (dBA)
38	58.4	70.1	12.0	Severe	57.6	12.5
39	57.8	65.3	8.2	Severe	56	9.3
40	58.1	65.4	8.0	Severe	55.5	9.9
41	58.2	69.7	11.8	Severe	58.2	11.5
42	58.1	72.7	14.7	Severe	62.3	10.4
42B	55.3	66.8	11.8	Severe	58.8	8.0
43	55.3	65.2	10.3	Severe	60.6	4.6
44	55.3	66.3	11.3	Severe	59.9	6.4
45	54.8	65.4	11.0	Severe	57.9	7.5
46	55.6	66	10.8	Severe	59.4	6.6
47	55.6	65.2	10.1	Severe	57.6	7.6
48	55.8	65.2	9.9	Severe	58.3	6.9
49	52.1	65	13.1	Severe	58.3	6.7
50	57.3	64.5	8.0	Severe	57.5	7.0
51	65	65.8	3.4	Moderate	58.5	7.3
52	58.1	64	6.9	Severe	55.2	8.8
53	58	66.3	8.9	Severe	57.9	8.4

As discussed above, GER is not currently proposing to install noise barriers across bridge structures. For the Northern Rail Alternative, this would include the Barrera Street Bridge, the U.S. 277 Bridge, and the New Rail Bridge west of the NII facility. The noise contours associated with GER's current design for the Northern Rail Alternative are shown in **Figure G-10**.

Figure G-10. Northern Rail Alternative Noise Contours with GER's Proposed Noise Barrier Design



Under the Northern Rail Alternative with gaps in the noise barriers at the three bridges, a total of 12 receptors would be severely affected: nine receptors at the southwest end of the proposed line (receptors 5, 6, 10, 13, 17, 18, 19, 20) and three receptors in the vicinity of Barrera Street (receptors 38, 41, and 42) would be exposed to 65 DNL with at least a 3 dBA increase and experience a "severe" impact under FTA classification.

G.4.3.1 Noise Barrier Performance Specifications

The noise barrier specifications would be the same as for the Southern Rail Alternative.

G.4.3.2 Determining Feasibility and Reasonableness of Noise Barriers on Elevated Structures

As discussed above, OEA researched whether installing noise barriers on rail bridges was reasonable and feasible. OEA also assessed what the additional cost of installing noise barriers on bridges under the Northern Rail Alternative. Based on a ROM estimate, OEA estimated that, for the Northern Rail Alternative, extending the barriers across the Barrera Street Bridge, the U.S. 277 Bridge, and along the south side of the New Rail Bridge west of the NII facility to a point past the nearby residential development would add approximately $2.4 million, or just under 50 percent, to the cost of GER's proposed noise barriers (approximately $5 million). See **Attachment A** for more detailed calculations. The cost of building noise barriers on the bridges under the Northern Rail Alternative would represent approximately 0.63 percent of PVH's $394 million construction cost estimate for the New Rail Bridge and proposed line on both the U.S. and Mexican sides of the project as stated in the Presidential Permit for the Puerto Verde Global Trade Bridge (PVH 2023). GER and PVH estimated that the construction cost estimate for the proposed line and the CMV Facility combined would be $648.5 million.

After reviewing all the relevant information to date, OEA preliminarily concludes that it would be reasonable and feasible to require GER to install noise barriers on both sides of the proposed U.S. 277 and Barrera Street Bridges and along the south side of the New Rail Bridge to a point past the nearby residential development (**MM-Noise-01b**). If the Board authorizes the Northern Rail Alternative and imposes this measure, the Northern Rail Alternative would have no "severe" noise impacts.

ATTACHMENT A

Rough-Order-of-Magnitude Estimates for Noise Barriers

Southern Rail Alternative

Noise Barrier Type	ROM Unit Cost (2025 Dollars per Square Foot)	Total Area of Noise Barrier (Square Feet)	ROM Estimated Cost
Along Embankment at Grade with Track (as Proposed)	$85.00	113,880	$9,679,800
On-Bridge (MM-NOISE-001a)	$75.00	9,280	$696,000
		Continuous Noise Barriers Total Cost	$10,375,800
		Cost of On-Bridge Noise Barriers as % of Cost of Noise Barriers as Proposed	7.19%
		Cost of On-Bridge Noise Barriers as % of Cost of Continuous Noise Barrier	6.71%
		Total Estimated Cost of Proposed Line	$394,000,000
		Cost of On-Bridge Noise Barriers as % of Total Estimated Cost of Proposed Line	**0.18%**

Northern Rail Alternative

Noise Barrier Type	ROM Unit Cost (2025 Dollars per Square Foot)	Total Area of Noise Barrier (Square Feet)	ROM Estimated Cost
Along Embankment at Grade with Track (as Proposed)	$85.00	58,420	$4,965,700
On-Bridge (MM-NOISE-001b)	$75.00	32,860	$2,464,500
		Continuous Noise Barriers Total Cost	$7,430,200
		Cost of On-Bridge Noise Barriers as %of Cost of Noise Barriers as Proposed	49.63%
		On-Bridge Noise Barriers as % of Cost of Continuous Noise Barrier	33.17%
		Total Estimated Cost of Proposed Line	$394,000,000
		Cost of On-Bridge Noise Barriers as % of Total Estimated Cost of Proposed Line	**0.63%**

Length and Area of Noise Barriers - Southern Rail Alternative

	Barrier Length (Feet)	Barrier Height (Feet)	Area of Noise Barriers (Square Feet)
At-Grade (North and South of the Tracks)	5,694	20	113,880
US-277 Bridge (Both Sides of Bridge)	282	20	5,640
Barrera Street Bridge (Both Sides of Bridge)	182	20	3,640

Length and Area of Noise Barriers - Northern Rail Alternative

Bridge	Barrier Length (Feet)	Barrier Height (ft)	Area of Noise Barrier (Square Feet)
At-Grade (North and South of the Tracks)	2,921	20	58,420
North side of New Rail Bridge	192	20	3,840
South Side of New Rail Bridge	987	20	19,740
US-277 Bridge (Both Sides of Bridge)	282	20	5,640
Barrera Street Bridge (Both Sides of Bridge)	182	20	3,640