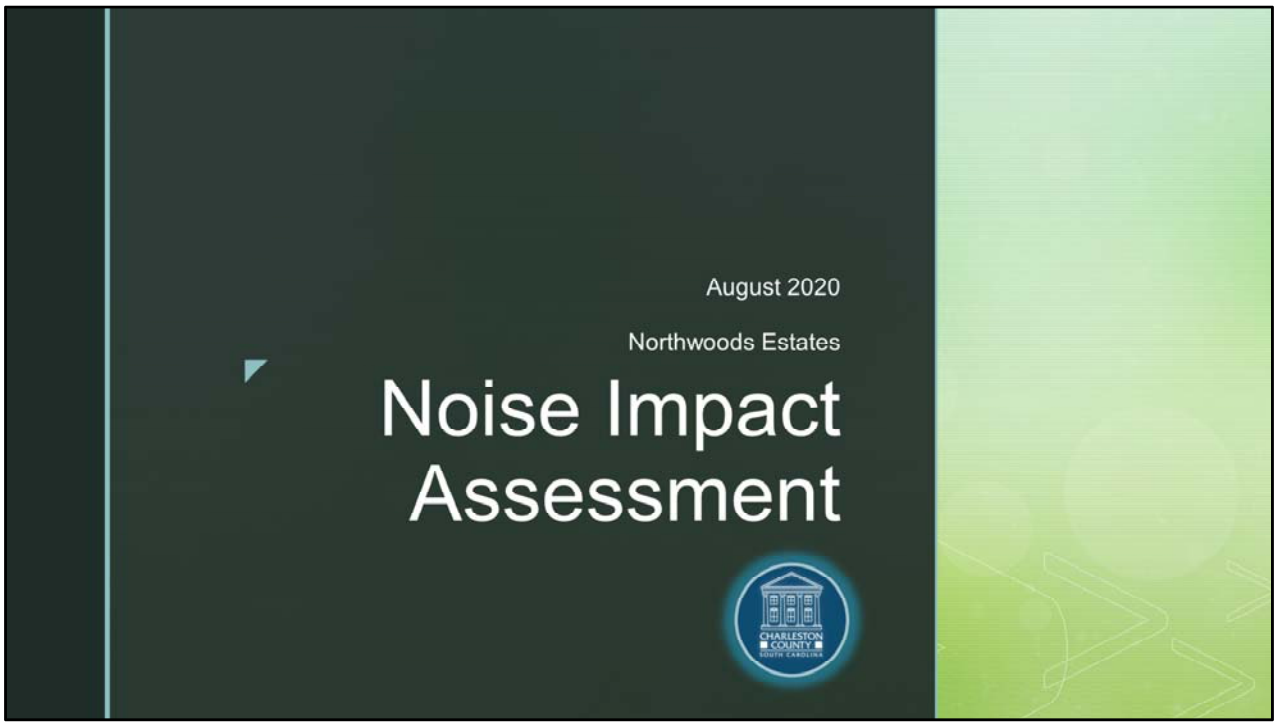
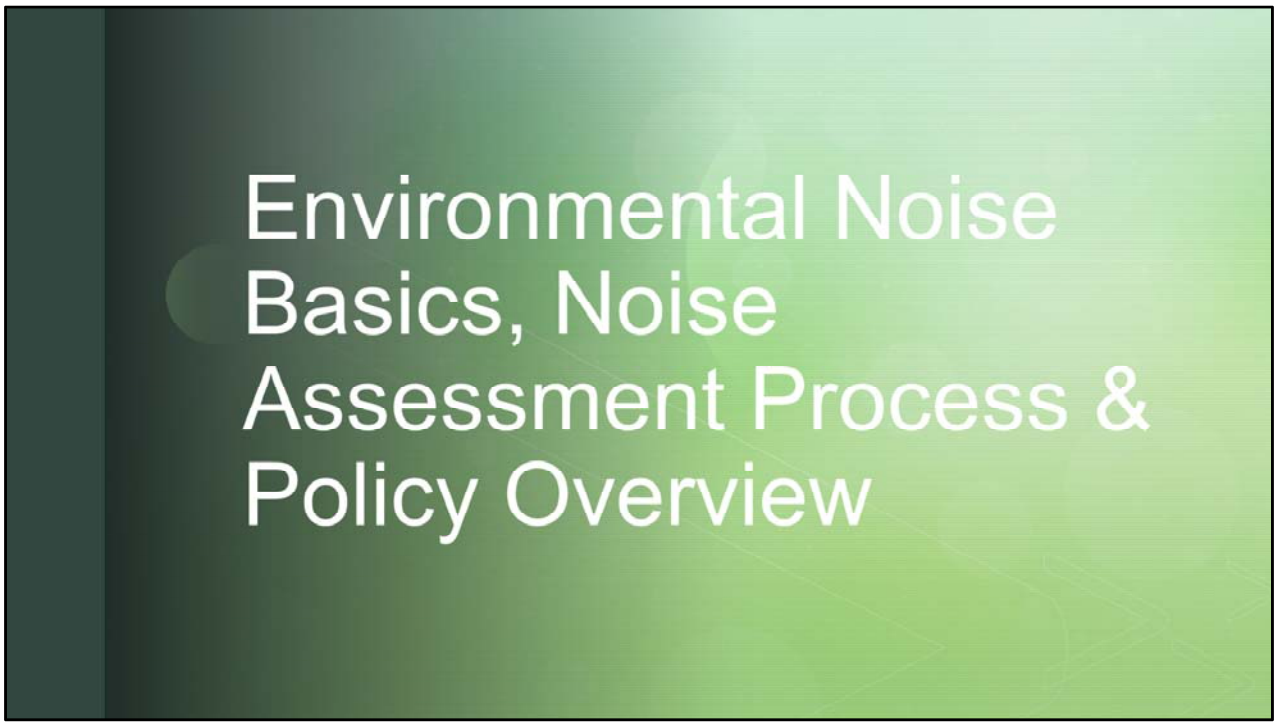
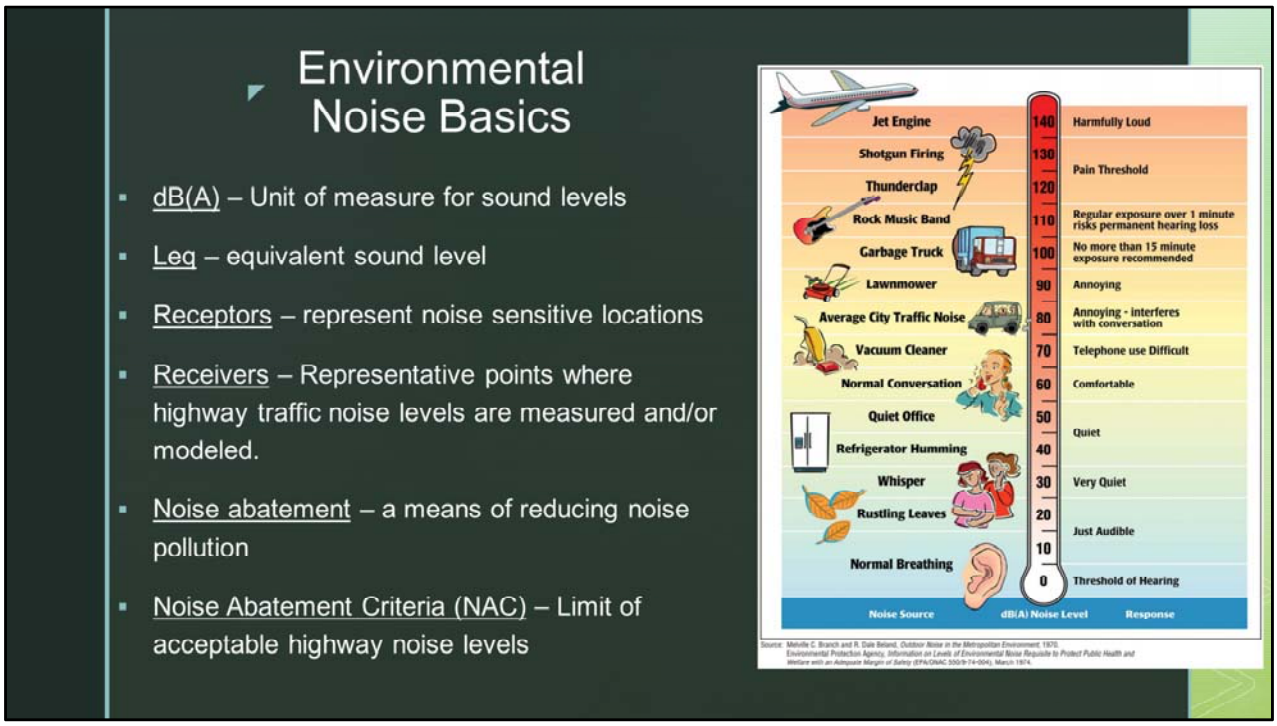


Welcome to the noise presentation for the Northwoods Estates community. The information to follow was originally intended to be presented as a community public meeting; however, due to public gathering restrictions in response to the current pandemic, this presentation is being presented in an online format.

The purpose of this noise presentation is to present the results of the noise impact assessment that was completed for the residents of Northwoods Estates community who are located adjacent to Interstate 26. Throughout the Palmetto Commerce Interchange public involvement process, Charleston County received numerous comments from residents of the Northwoods Estates community who are concerned with highway noise. As a result, this analysis was performed specifically for the Northwoods Estates Community to look at the existing and future noise levels.



Before we dive into the Northwoods Estates noise assessment, we will first provide basic information on terminology, the noise assessment process, and the policy that governs the decision-making process. This background information will be useful in understanding the Northwoods Estates noise study analysis and results.



First, we'll review a few environmental noise basics.

Noise levels are measured in A-weighted decibels, or dBA, and is the relative loudness of sounds in air perceived by the human ear. The figure on the right shows some common noises and their dBA. For example, a whisper is about 30 dBA while thunder is around 120 dBA.

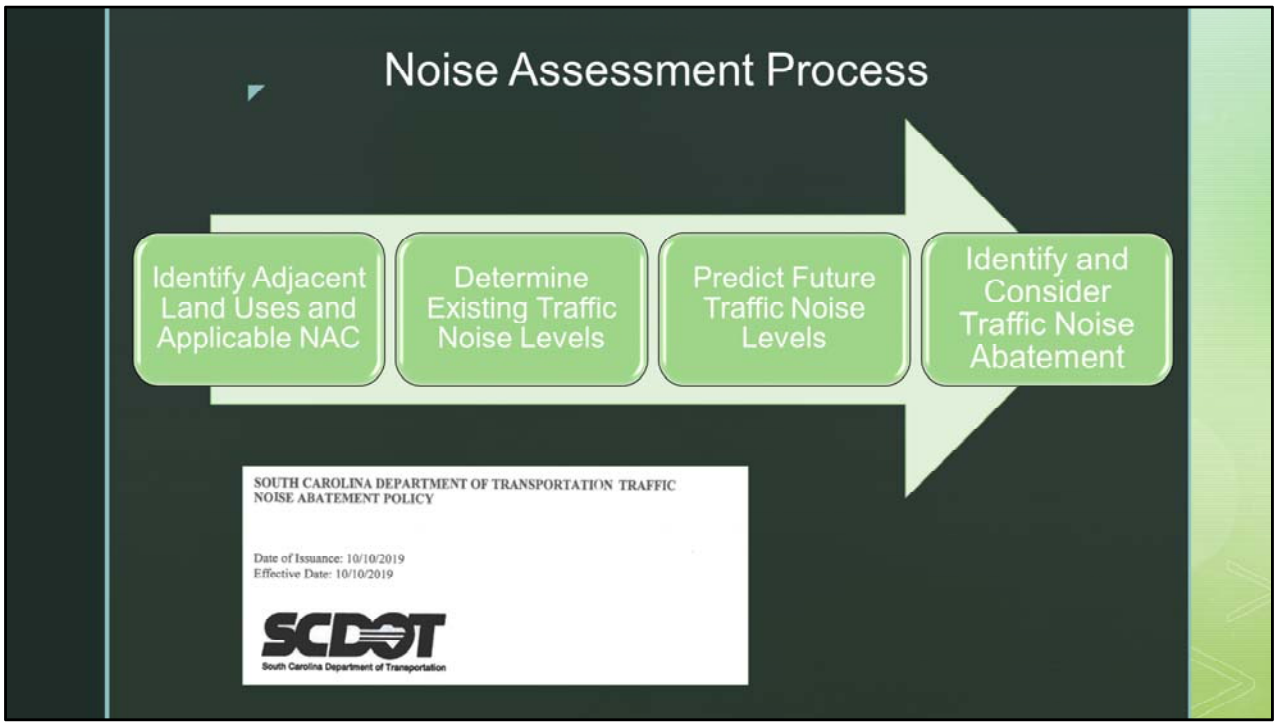
Because noise levels vary from moment to moment, Leq averages the louder and quieter measures of dBA over a time period, but gives much more weight to the louder measures of dBA.

Receptors represent noise-sensitive locations, such as a backyard or an outdoor seating area at a restaurant.

Receivers are representative points where traffic noise levels are measured and/or modeled. An individual receiver may represent multiple receptors. For example, an apartment complex may be modeled as one receiver within a model, but it represents multiple receptors (individual apartment units).

Noise abatement is a set of strategies or techniques to reduce noise impacts.

Noise abatement criteria (NAC) is the limit of acceptable noise levels for different land uses.



The process used for this noise analysis follows the South Carolina Department of Transportation's, or SCDOT's, Traffic Noise Abatement Policy and Guidelines. SCDOT developed the noise policy to meet Federal requirements.

https://www.scdot.org/business/pdf/EnvToolShed/TrafficNoise/SCDOT_Traffic_Noise_Policy_Rev_10Oct2019.pdf

The purpose of a traffic noise assessment is to determine the existing and future noise levels along a roadway, and then to evaluate whether noise abatement needs to be considered to help reduce noise impacts.

The first step in the noise assessment process is to identify the adjacent land uses within the study area. Noise Abatement Criteria, or NAC, have been established for sensitive land use areas of frequent human use such as residences, places of worship, schools, parks and medical facilities.

Noise Abatement Criteria

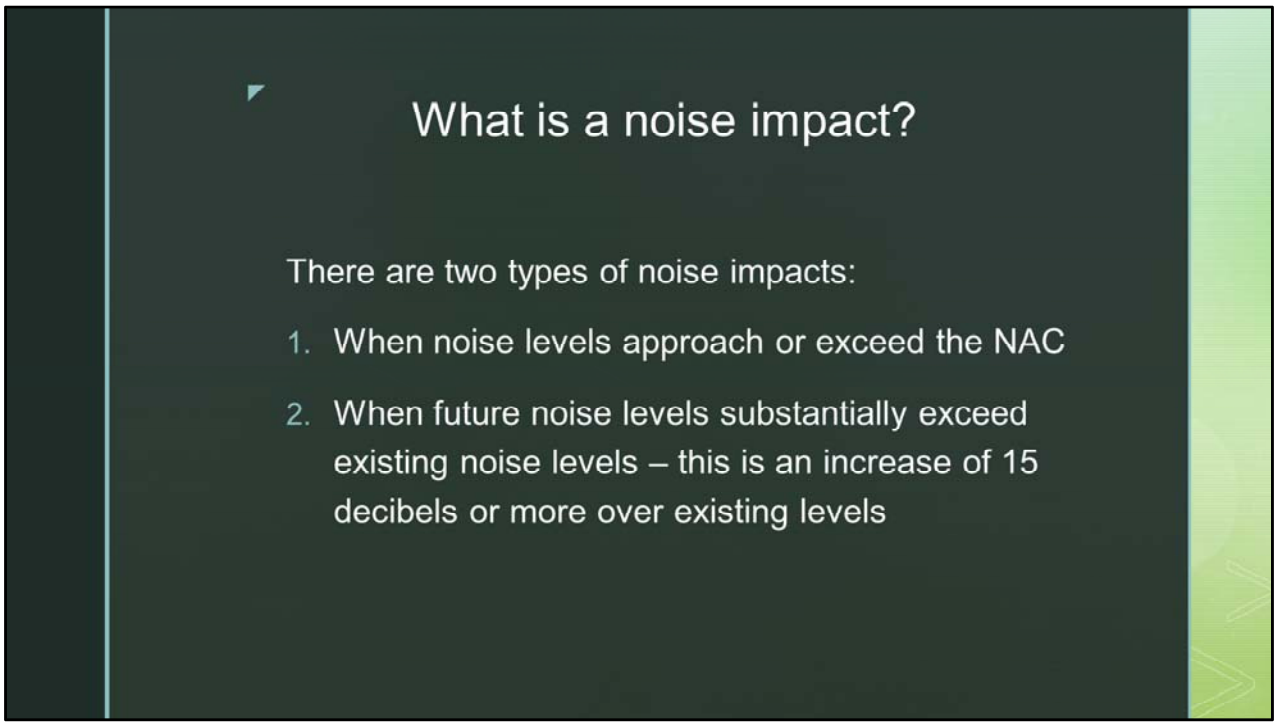
Activity Category	Activity Criteria [2] $L_{eq}(h)$	Evaluation Location	Activity Description
A	57	Exterior	Lands on which serenity and quiet are of extraordinary significance and serve an important public need and where the preservation of those qualities is essential if the area is to continue to serve its intended purpose.
B [3]	67	Exterior	Residential.
C [3]	67	Exterior	Active sports areas, amphitheaters, auditoriums, campgrounds, cemeteries, day care centers, hospitals, libraries, medical facilities, parks, picnic areas, places of worship, playgrounds, public meeting rooms, public or nonprofit institutional structures, radio studios, recording studios, recreational areas, Section 4(f) sites, schools, television studios, trails and trail crossings.
D	52	Interior	Auditoriums, day care centers, hospitals, libraries, medical facilities, places of worship, public meeting rooms, public or nonprofit institutional structures, radio studios, recording studios, schools and television studios.
E [3]	72	Exterior	Hotels, motels, offices, restaurants/bars and other developed lands , properties or activities not included in A-D or F.
F	------	------	Agriculture, airports, bus yards, emergency services, industrial, logging, maintenance facilities, manufacturing, mining, rail yards, retail facilities, shipyards, utilities (water resources, water treatment, electrical) and warehousing.
G	-------	-------	Undeveloped lands that are not permitted.

1 Either Leq(h) or L10(h) (but not both) may be used on a project
2 The Leq(h) or L10(h) Activity Criteria values are for impact determination only and are not design standards for noise abatement measures.
3 Includes undeveloped lands permitted for this activity category.

Each land use area is assigned an activity category and impact criteria. For example, activity category B is residential land use.

The impact criteria represents the limit of what is considered an acceptable noise level for each activity category.

The above table lists the activity categories based on land use, and provides the noise abatement criteria for each category. For example, the noise abatement criteria for Category B, Residential, is 67 Leq.

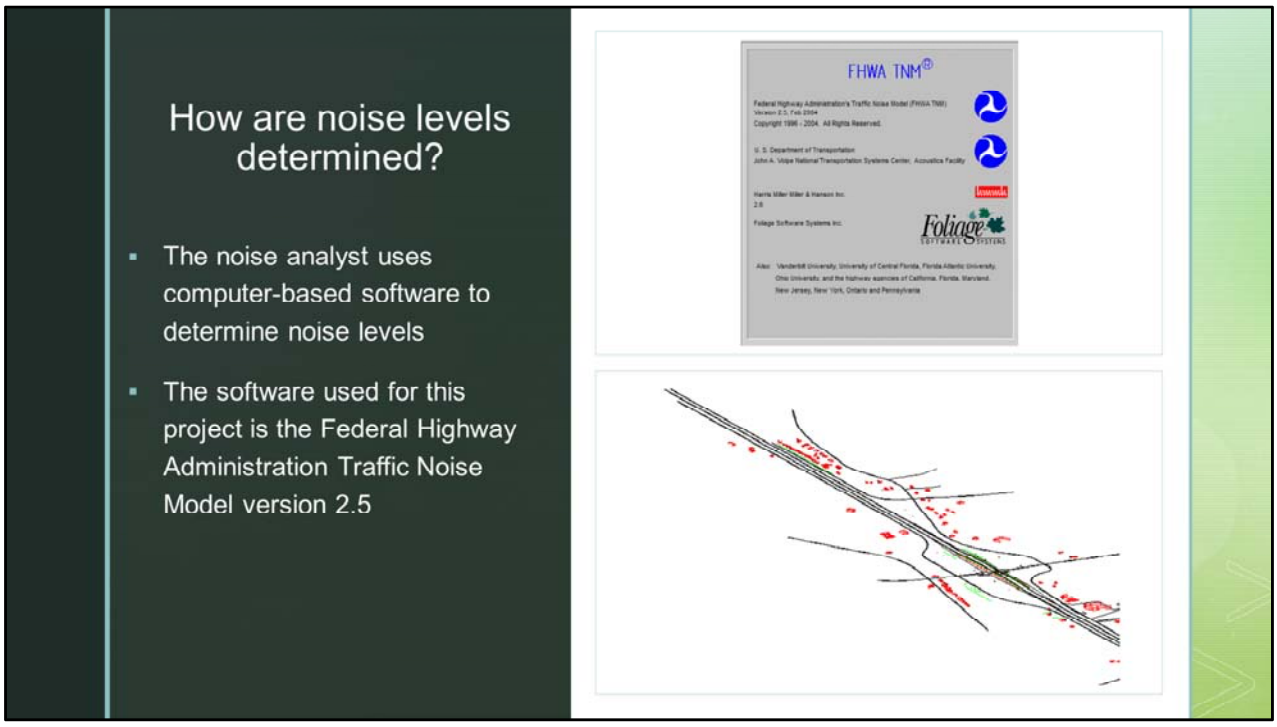


Noise abatement, such as noise walls, are only considered when there are noise impacts.

There are two types of noise impacts as defined by federal regulations:

1. When noise levels approach (within 1 dB) or exceed the Noise Abatement Criteria (NAC). So for Category B, residential, a receiver is considered “impacted” if future noise levels are 66 decibels or more.

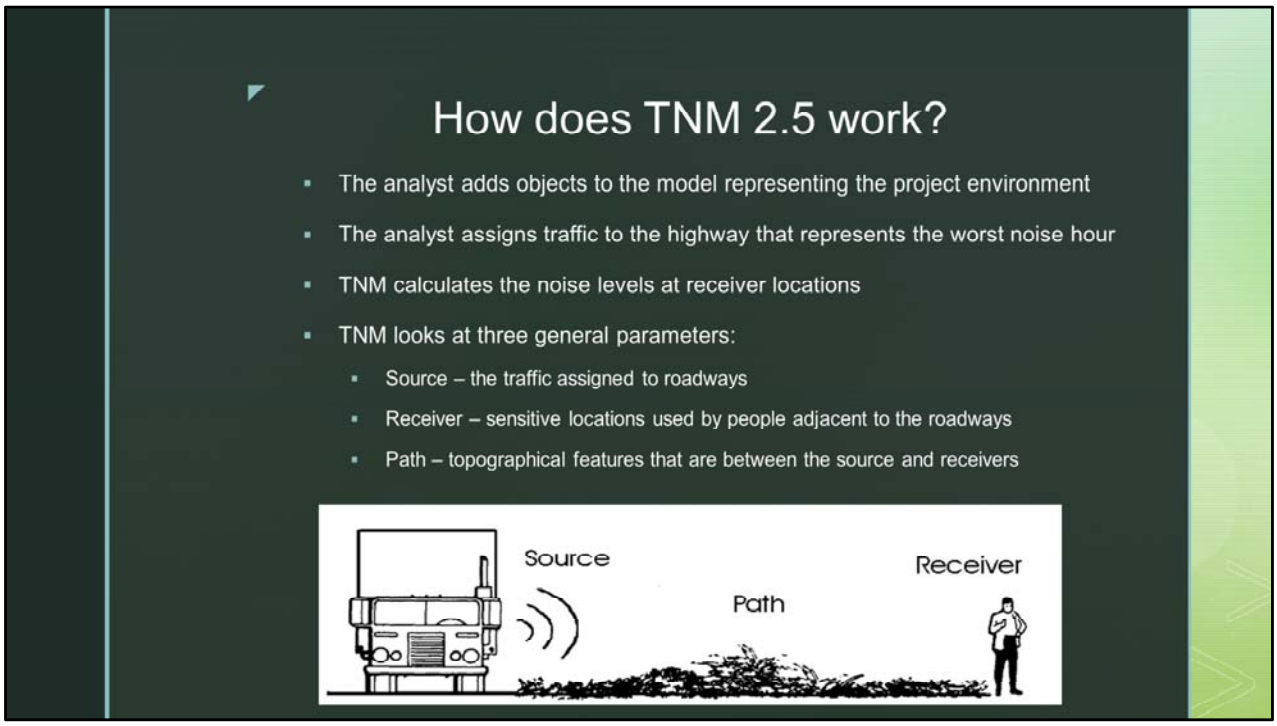
2. When future noise levels, usually 20 years in the future, are predicted to be 15 decibels or more above existing noise levels.



So how do we determine the existing and future noise levels?

Noise levels in an area of interest are determined using a computer-based software created by the Federal Highway Administration called Traffic Noise Model, or TNM, version 2.5 (TNM 2.5). The SCDOT noise policy requires the use of TNM 2.5 for analysis of highway traffic noise.

The images to the right show what a typical noise model may look like in the TNM 2.5 software.



Project-specific details are entered in the TNM 2.5 software to depict the roads, receivers, and topography. Other factors such as speed limit, traffic volume and type of traffic are also entered. The output of the model is a table that shows the noise level at each analyzed location, or receiver. The model is developed for both existing and future traffic conditions.

The traffic noise model is based on a source, path, receiver relationship. The source of the noise is the traffic on the road. The receiver is the analysis location, and the path is anything that is between the source and receiver. The model can account for rows of buildings, hills, dense vegetation, and changes in ground type, such as a pond or parking lot.

Model Validation

- The process involves:
  - Field noise measurements
  - Documentation of traffic volume, speeds and vehicle type during the measurement
  - Comparing the results of the model's calculated levels to the measured levels
  - The model is validated if these results are with 3 dB of each other

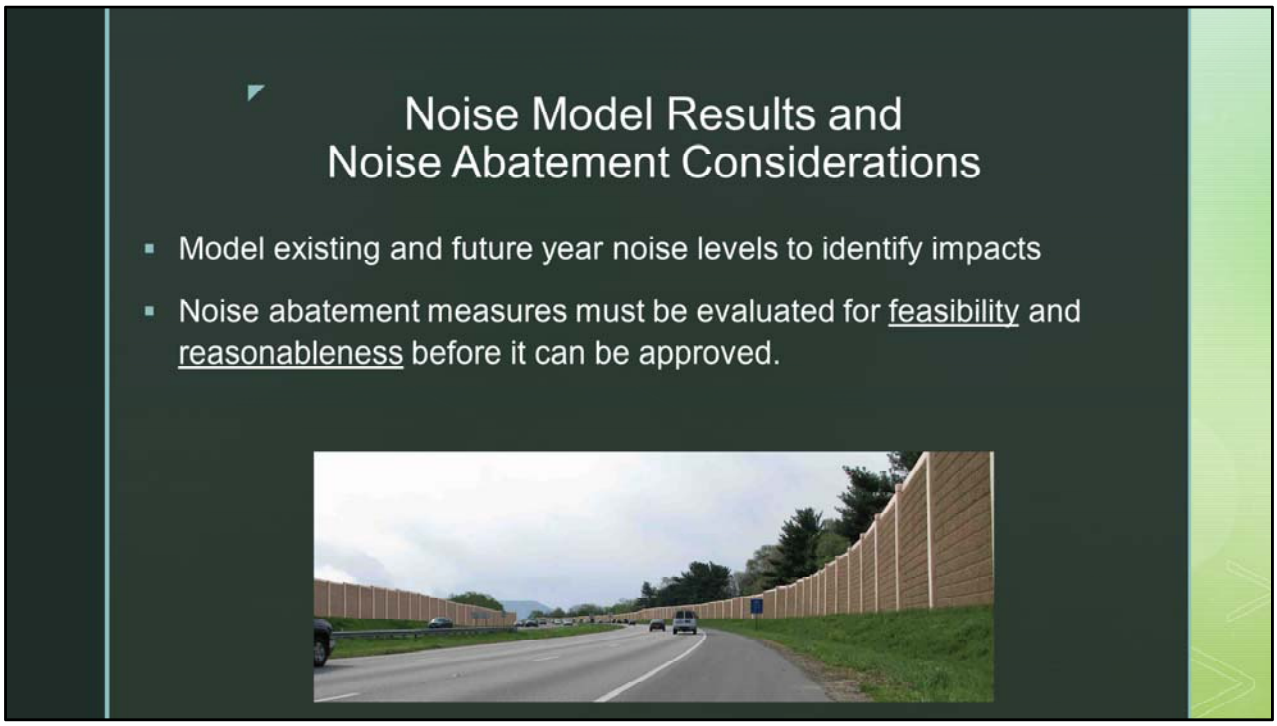
Table 3: Comparison of Measured Leq to TNM 2.5 Modeled Leq

Location	Measured Leq	Modeled Leq	Difference
Site #1 8684 Bentwood Drive	74.3	71.3	-3.0
Site #2 8318 Delhi Road	68.0	70.2	+2.2
Site #3 8139 Long Shadow Lane	71.3	70.6	-0.7
Site #4 7920 New Ryder Road	71.5	74.4	-2.9

When a model is created in TNM 2.5, it must first be validated to ensure that the model reflects the actual site conditions.

Model validation is the process of comparing actual measured noise levels with noise levels calculated in the TNM 2.5 model. In order to validate the model, noise measurements are taken at several locations along the existing roadway during free-flow traffic conditions. This is because free-flow traffic conditions where high traffic volumes are travelling at high speeds produces louder noise levels.

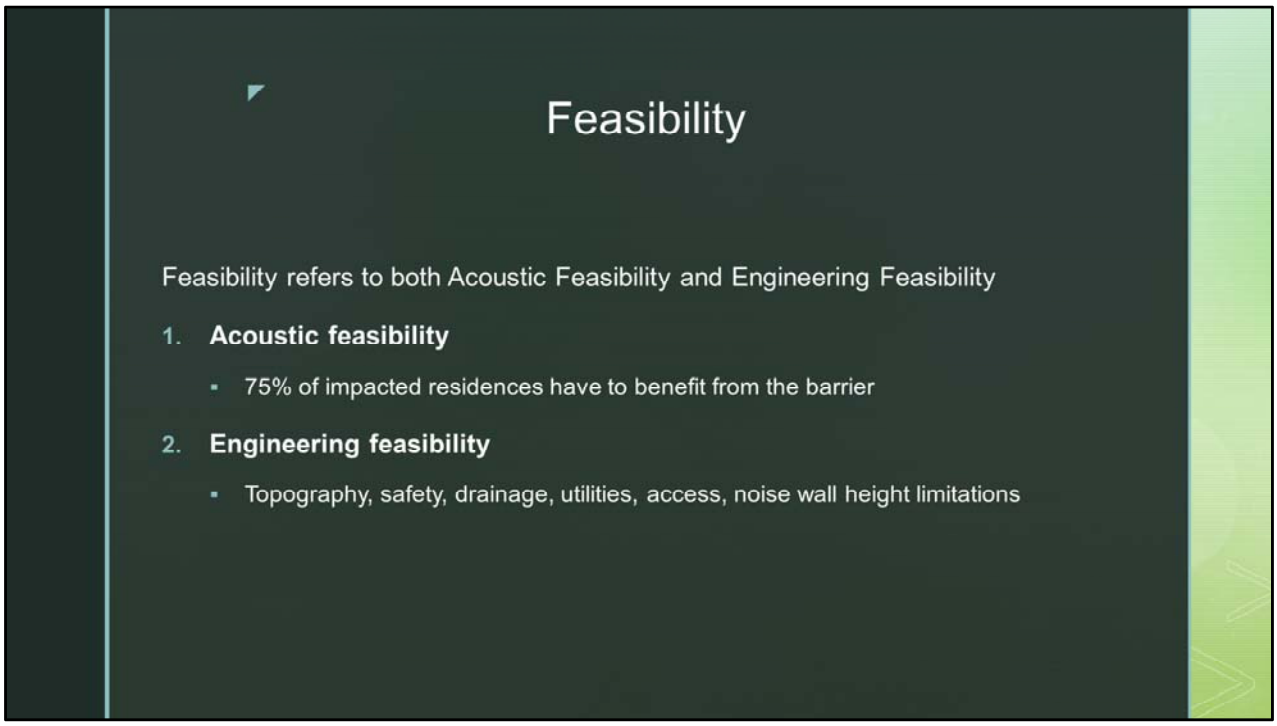
The noise measurements are then compared to the existing conditions model output data. If the noise measurements are within 3 dB of the model output, the model is considered to be valid.



The validated model is then used to calculate the existing condition (current year) and future year (20 years later) noise levels. If impacts to receivers are identified, noise abatement measures are considered.

Noise abatement measures, such as noise walls, must be evaluated for feasibility and reasonableness before it can be approved.

The feasibility and reasonableness criteria will be discussed in more detail on the following slides.

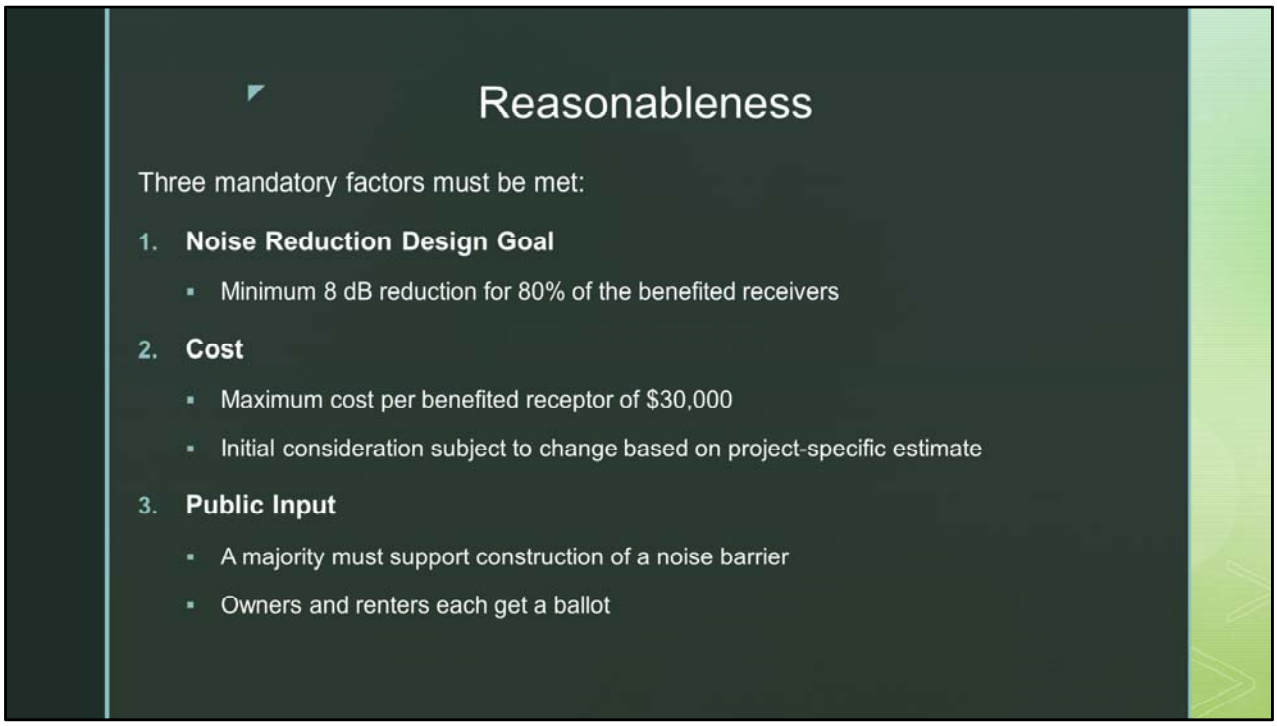


Feasibility refers to both Acoustic Feasibility and Engineering Feasibility.

1. In order to be considered acoustically feasible, at least 75% of the impacted residences must benefit from the noise barrier. A benefit is considered a noise level reduction of at least 5 decibels.

2. Engineering Feasibility looks at factors like topography, safety, drainage, utilities, access, and a 25’ height limitation for noise walls. Sometimes one or more of these factors can make a noise wall extremely difficult or impossible to construct.

If a barrier does not meet both acoustic and engineering feasibility requirements, the evaluation process stops and the noise barrier is considered not feasible to construct.



There are three mandatory factors that must be met for a noise abatement measure to be considered reasonable.

1. Noise reduction design goal – The first factor is that the barrier must provide at least an 8 decibel reduction for 80% of the benefited receivers.

   If the barrier wall does not meet the noise reduction design goal, the barrier wall is considered not reasonable to construct.

2. Cost – If the barrier wall meets the noise reduction design goal, we then consider cost-effectiveness. A preliminary construction cost estimate is prepared for the proposed noise barrier. The cost is based on a $35 per square foot cost which is dictated by SCDOT's Noise Abatement Policy. This total cost is then divided by the number of benefited receptors. If the cost per benefited receptor is less than $30,000 then a project-specific cost estimate should be prepared. This cost estimate takes into account the actual cost of the noise barrier construction including such factors as drainage and utility relocations, if needed.

   If the project specific cost estimate exceeds the maximum $30,000 cost per benefited receiver, the barrier wall is considered not reasonable to construct.

3. Public Input – If the barrier wall meets the first two reasonableness factors, the next step is to reach out to all the benefited receptors and document their position on whether they want or do not want the noise wall. Both owners and renters are able to provide their vote. At least 50% of the benefited receptors must vote in favor of the noise wall for it to be constructed.

In order for a noise barrier to be constructed, it must be considered both feasible and reasonable.

NOISE IMPACT ASSESSMENT

Palmetto Commerce Interchange Project
Charleston County, South Carolina

Prepared For:

Charleston County

Prepared By:

Three Oaks Engineering, Inc.
1230 Sumter Street, Suite 400
Columbia, SC 29201

May 2019

NOISE IMPACT ASSESSMENT

Northwoods Estates
Charleston County, South Carolina

Prepared For:

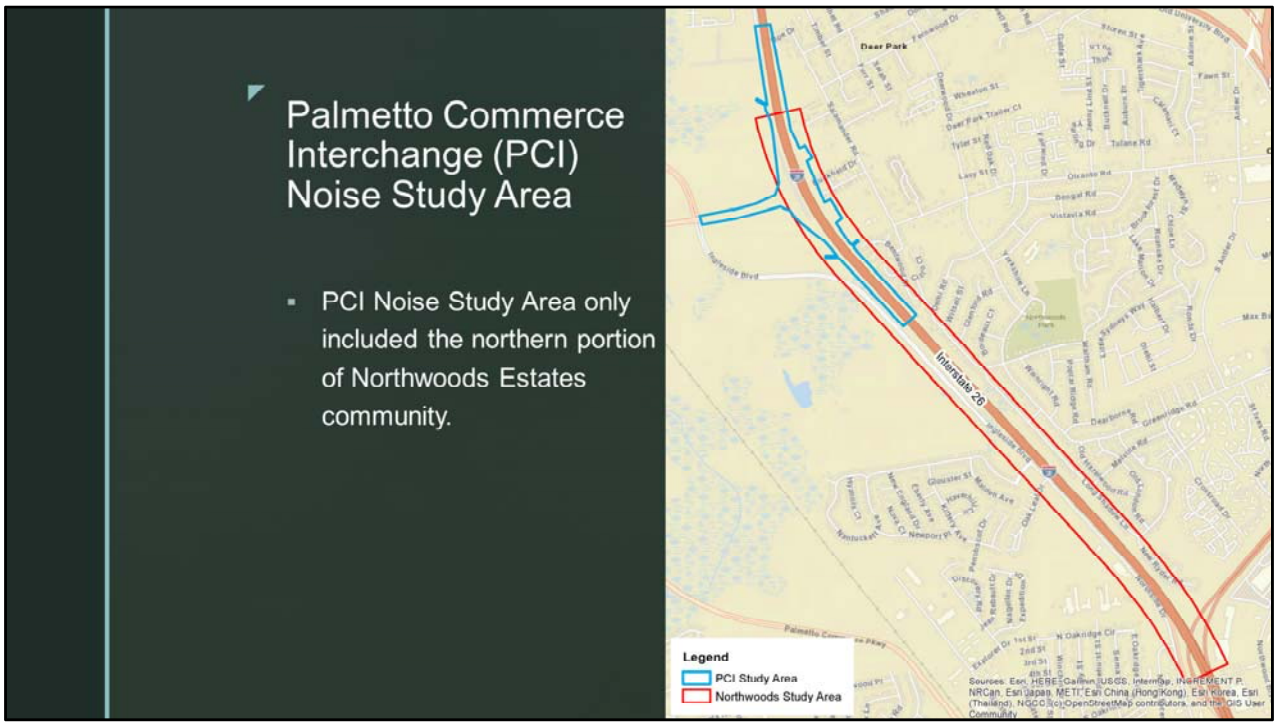
Charleston County

Prepared By:

Three Oaks Engineering, Inc.
1022 State Street, Building #2
Cayce, SC 29033

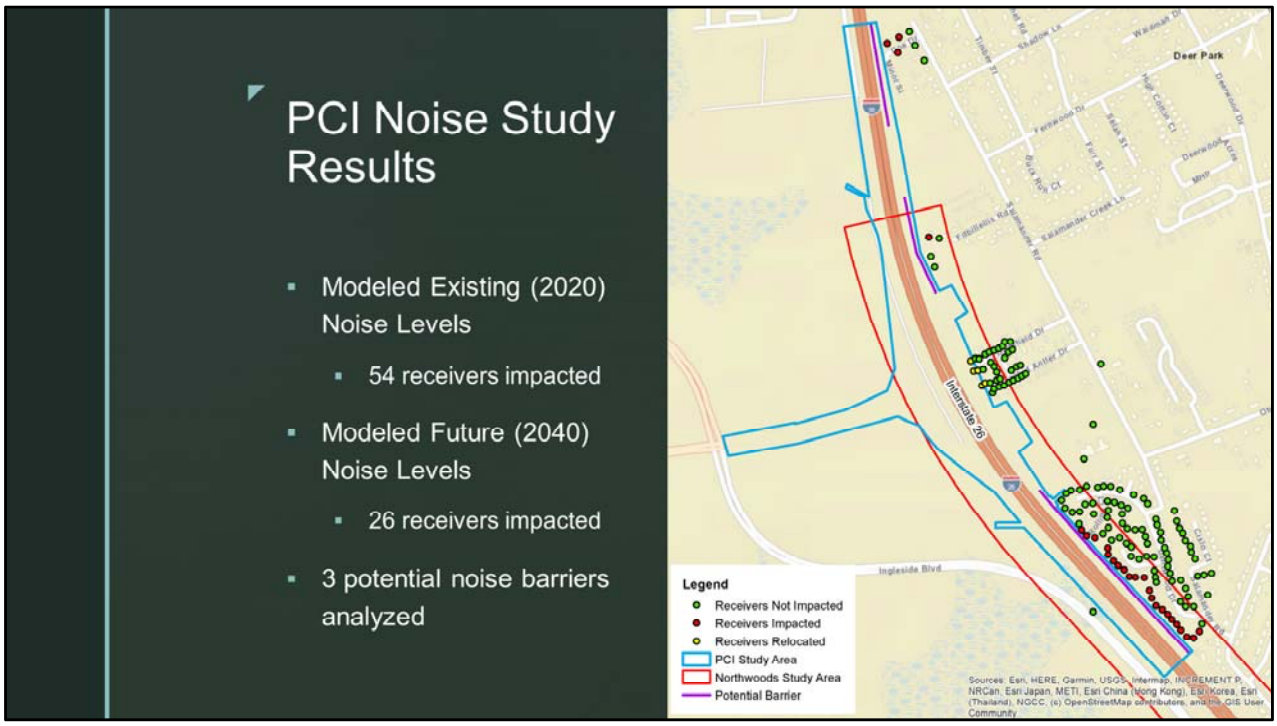
August 2020

Now that you know the basics of highway traffic noise, let's briefly discuss the Noise Impact Assessment that was prepared for the Palmetto Commerce Interchange project, and then discuss the Northwoods Estates Noise Impact Assessment.



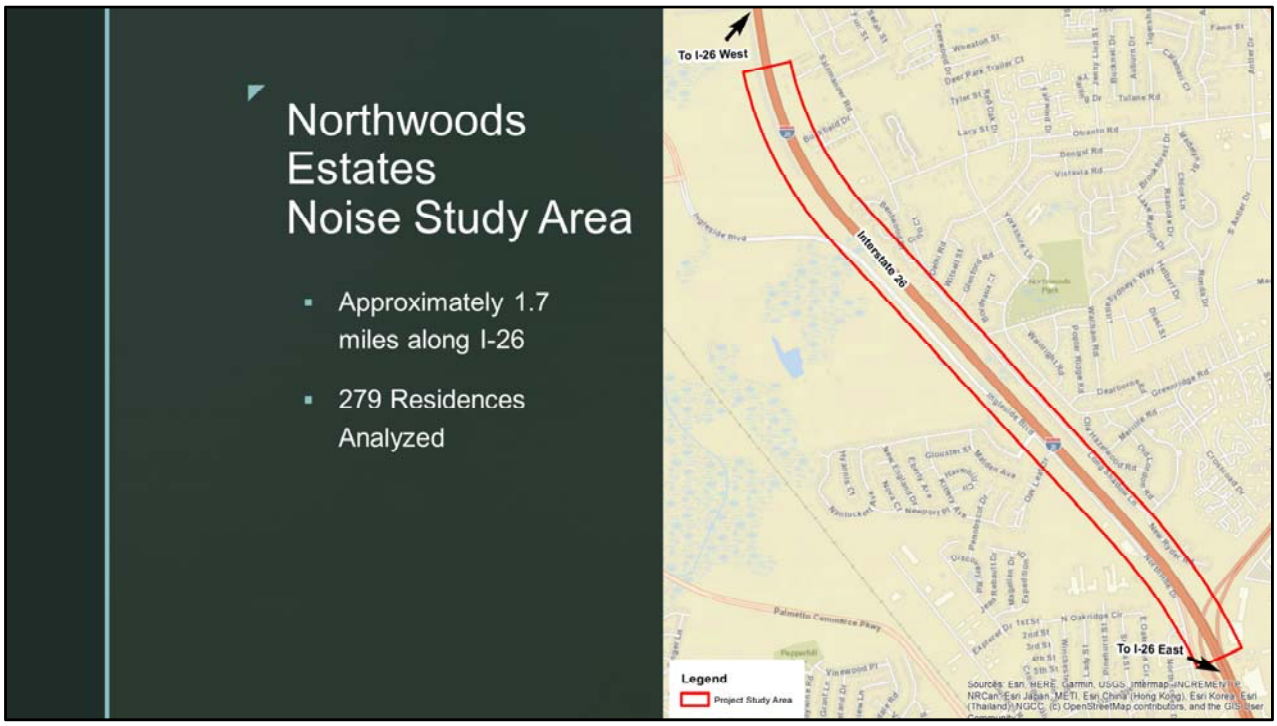
As part of the Palmetto Commerce Interchange (PCI) project, a noise study was completed in May 2019. The PCI study area only included noise impacts caused by the new interchange project.

This graphic shows the PCI noise study area (in blue) in comparison to the Northwoods Estates noise study area (in red).



In comparing the existing (2020) noise levels to the future (2040) noise levels, the PCI noise study concluded that construction of the interchange will actually decrease the number of impacted receivers from 54 impacted receivers to 26 impacted receivers. This is because the project includes building on and off ramps for the interchange at a much higher elevation than the existing roadway, which will act as a shield from the interstate noise.

Overall, there were still 26 receivers that would be impacted in the PCI noise study area in 2040 (impacted receivers shown in red on graphic). The project team analyzed three potential noise barriers to lessen the noise impacts for these receivers; however, none of the barrier walls were found to be feasible and reasonable to construct. As a result, the PCI project does not include the installation of a noise wall.



Due to a number of noise concerns voiced from residents of Northwoods Estates, Charleston County agreed to perform a separate noise study to include the entire Northwoods Estates subdivision adjacent to Interstate 26. The purpose of the study is to evaluate future noise levels and impacts to Northwoods Estates residences using future (2040) projected traffic along I-26.

The Northwoods Estates noise study area extends approximately 1.7 miles in length along I-26, starting about 1.3 miles south of I-26/US 78 interchange and ending at the US 52 Connector. A total of 279 houses were analyzed for existing and future noise impacts. The study area includes residences along Bentwood Drive, Rollins Court, Brigham Drive, Delhi Road, Long Shadow Lane, and New Ryder Road. Land uses in the study area are all residential which has a Noise Abatement Criteria (NAC) of 67 decibels.

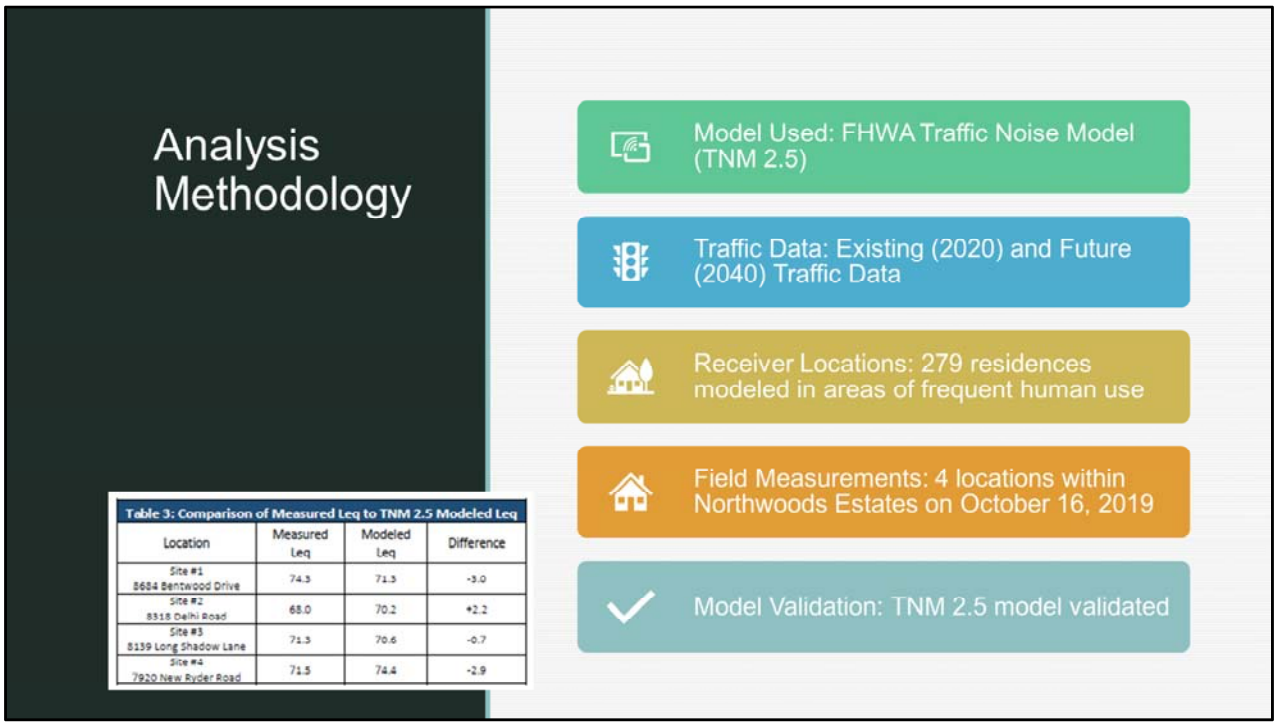


Table 3: Comparison of Measured Leq to TNM 2.5 Modeled Leq

Location	Measured Leq	Modeled Leq	Difference
Site #1 8684 Bentwood Drive	74.3	71.3	-3.0
Site #2 8318 Delhi Road	68.0	70.2	+2.2
Site #3 8139 Long Shadow Lane	71.3	70.6	-0.7
Site #4 7920 New Ryder Road	71.5	74.4	-2.9

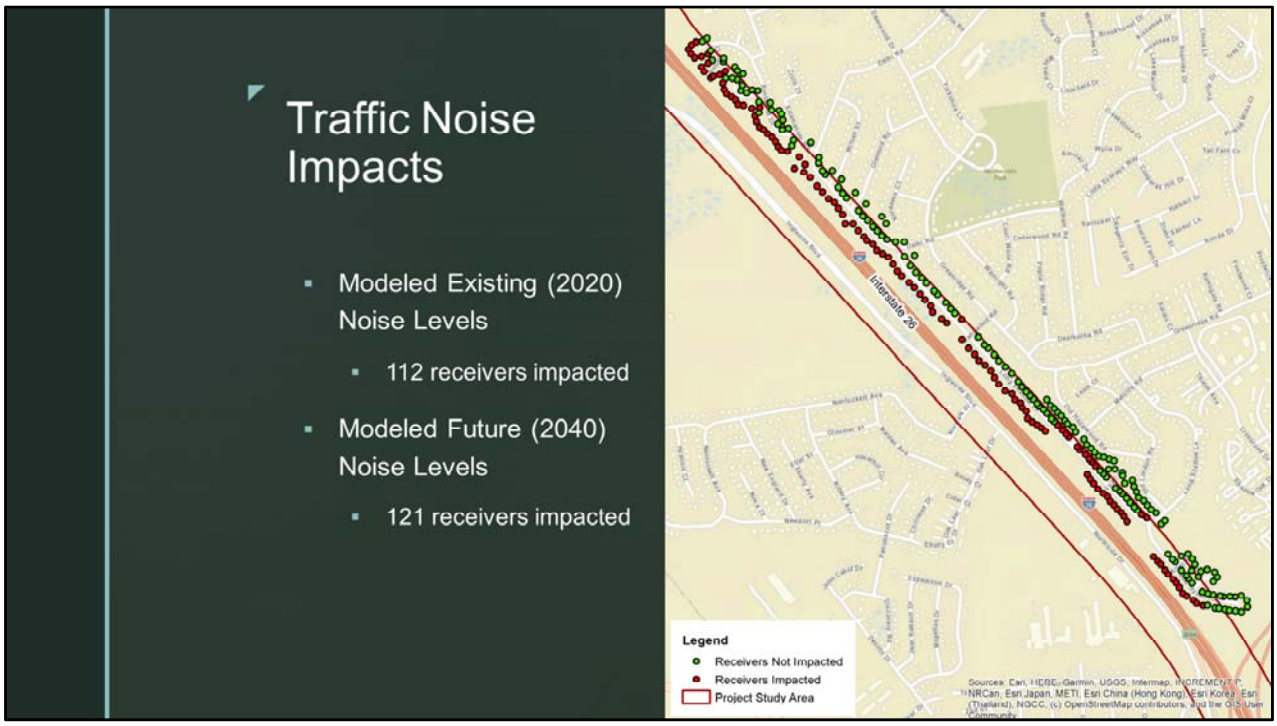
The Federal Highway Administration's (FHWA's) Traffic Noise Model (TNM 2.5) was used to derive existing and future noise levels.

Existing (2020) and future (2040) traffic data were used for the noise analysis.

Sensitive receivers in areas of frequent human use were first identified using aerial photography and street views from Google Maps, which were then field verified. The receivers were 279 residences of Northwoods Estates community located along Interstate 26. This information was then input to the TNM 2.5 software for modeling.

In order to verify that the noise model is an accurate representation of field conditions, ambient noise field measurements were taken at 4 locations within the Northwoods Estates community to compare with the model. The field measurements were taken on Wednesday, October 16, at: 8687 Bentwood Drive, 8318 Delhi Road, 8139 Long Shadow Lane, and 7920 New Ryder Road.

The field measurements were then compared to the existing conditions model results. The field measurements were within 3 decibels of the model results, so the model is validated. The model is then used to calculate the existing (2020) and future year (2040) noise levels to identify the impacted receivers.



Today, there are 112 receivers that have noise levels that approach (within 1 dBA) or exceed the Noise Abatement Criteria (NAC) for residential land use.

For the future noise levels, there are 121 receivers that would have noise levels that approach (within 1 dBA) or exceed the NAC for residential land use, shown in the figure to the right.

As a result, noise abatement measures to reduce noise impacts were considered.

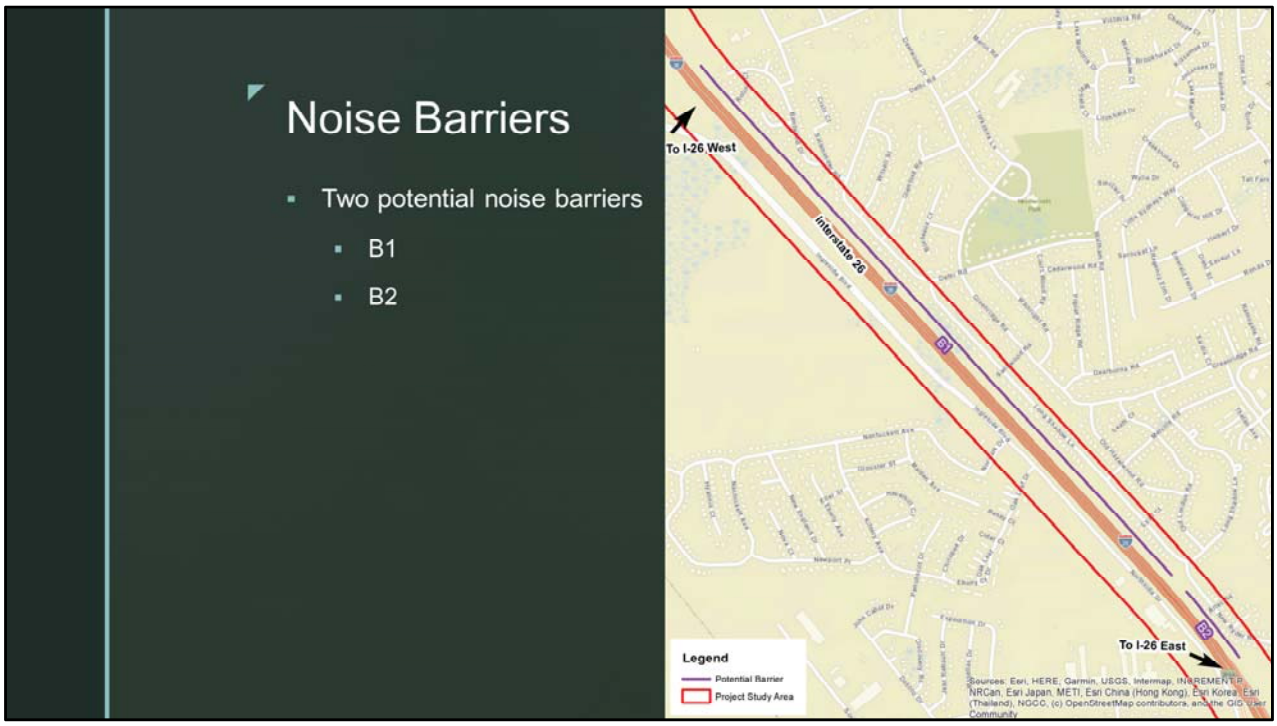
The following noise abatement measures were considered and evaluated as a means to reduce or eliminate traffic noise impacts:

1. **Acquisition of real property to provide a buffer zone between traffic and the impacted receivers** – The purchase of land along I-26 to lessen the noise levels along Northwoods Estates would require the costly and disruptive relocation of homeowners. This is better suited for undeveloped properties.

2. **Traffic Management** – Signing this section of I-26 to restrict larger or louder vehicles from using certain travel lanes would prevent the interstate's intended purpose for the movement of people, goods, and services.

3. **Alteration of Horizontal and Vertical Alignments** – Realigning the interstate, either horizontally or vertically, would require disruptive relocations for Northwoods Estates and/or the communities on the opposite side of the interstate.

4. **Noise Barriers** – Noise barriers, such as earthen berms and noise walls, were considered for Northwoods Estates. Earthen berms were eliminated as an option as it would require removal of the existing tree buffer along the interstate, and right-of-way acquisition, to accommodate the earthen berm.



Two noise wall barriers were modeled and evaluated for **feasibility** and **reasonableness**. The noise wall locations are shown and labeled B1 and B2 on the graphic.

Noise Barrier Evaluation – Barrier 1

Table 5.1: Barrier 1

Evaluation Summary

Wall Length (ft) = 7,609

Total # of Impacts = 108

Wall Height (feet)	Total Area (sq. ft.)	Cost per Square Foot $	Total Wall Cost $	Acoustically Feasible? (Y/N)	Engineering Feasibility? (Y/N)	Overall Feasible? (Y/N)	Meets Noise Reduction Goal? (Y/N)	Number of Benefitted Receivers	Cost per Benefitted Receiver $	Is Barrier Cost Effective? (Y/N)	Overall Reasonable? (Y/N)	Conclusion
25	188,974	35	6,614,090	Y	Y	Y	Y	185	35,751.84	N	N	Feasible, but not reasonable
20	151,179	35	5,291,265	Y	Y	Y	Y	177	29,894.15	Y	Y	Feasible and reasonable
20	151,179	67.05	10,136,552	Y	Y	Y	Y	177	57,268.66	N	N	Feasible, but not reasonable
15	113,384	35	3,968,440	Y	Y	Y	Y	130	30,526.46	N	N	Feasible, but not reasonable

**The Evaluation Summary is based on the SCDOT Traffic Noise Abatement Policy.

Barrier wall B1 was modeled to reduce noise impacts to residences along Bentwood Drive, Rollins Court, Brigham Drive, Delhi Road, and Long Shadow Lane.

The barrier was modeled at 7,559 feet in length and was evaluated at 3 fixed heights of 25 feet, 20 feet, and 15 feet.

Feasibility

- For all 3 barrier wall height scenarios (25 feet, 20 feet, 15 feet), barrier wall B1 meets the criteria for both acoustic feasibility and engineering feasibility
- Since both acoustic and engineering feasibility criteria are met with barrier wall B1, the evaluation continues for reasonableness.

Reasonableness

- Noise Reduction Design Goal
    - Barrier wall B1 of all wall height scenarios (25', 20', 15') meet the noise reduction design goal; therefore, evaluation continues for cost effectiveness.
- Cost-effectiveness – cost estimates were prepared for each of the 3 barrier wall height scenarios based on a $35/square foot prescribed cost. This prescribed cost is based on SCDOT's Noise Abatement Policy. As a reminder, the maximum allowable cost is $30,000 per benefitted receptor.

- Barrier wall B1 with 15’ wall height exceeds the allowable $30,000 cost per benefitted receptor; therefore, the evaluation stops and the barrier wall is considered not reasonable to construct.
- Barrier wall B1 with 20’ wall height is within the allowable $30,000 cost per benefitted receptor; therefore, evaluation continues. The following slide describes the continuation of this evaluation.
- Barrier wall B1 with 25’ wall height exceeds the allowable $30,000 cost per benefitted receptor; therefore, the evaluation stops and the barrier wall is considered not reasonable to construct.

Out of the 3 barrier wall heights analyzed, only barrier wall B1 with a wall height of 20’ meets the initial cost-effectiveness criteria. The project team then prepared a project-specific cost estimate which is described on the following slide.

Noise Barrier Evaluation – Barrier 1 Continued

Table 5.1: Barrier 1

Evaluation Summary

Wall Length (ft) = 7,609

Total # of Impacts = 108

Wall Height (feet)	Total Area (sq. ft.)	Cost per Square Foot $	Total Wall Cost $	Acoustically Feasible? (Y/N)	Engineering Feasibility? (Y/N)	Overall Feasible? (Y/N)	Meets Noise Reduction Goal? (Y/N)	Number of Benefitted Receivers	Cost per Benefitted Receiver $	Is Barrier Cost Effective? (Y/N)	Overall Reasonable? (Y/N)	Conclusion
20	151,179	35	5,291,265	Y	Y	Y	Y	177	29,894.15	Y	Y	Feasible and reasonable
20	151,179	67.05	10,136,552	Y	Y	Y	Y	177	57,268.66	N	N	Feasible, but not reasonable

**The Evaluation Summary is based on the SCDOT Traffic Noise Abatement Policy.

Since barrier wall B1 at a height of 20' meets the SCDOT reasonableness criteria for cost-effectiveness based on the $35/square foot prescribed cost, evaluation continues.

The next step was to complete a project-specific cost estimate for barrier wall B1. As a reminder, SCDOT's Noise Abatement Policy states that *"During the detailed noise abatement evaluation, a more project-specific construction cost should be applied at a cost per square foot basis."*

The Charleston lowcountry area has stringent design requirements due to our geographical susceptibility to earthquakes and hurricanes. This results in costly structural foundations for the noise wall. In addition, the noise wall would cross an existing stream so construction would impact wetlands and require culvert pipe extensions. These project-specific factors are not taken into consideration with the $35 per square foot prescribed cost that is used in the initial cost-effectiveness evaluations. See Page 33 (Appendix C) of the Northwoods Estates Noise Impact Assessment for the project-specific cost estimate that was prepared for barrier wall B1.

The detailed project-specific cost estimate for barrier wall B1 resulted in a cost of $67.05/square foot, and at $57,268 exceeds the $30,000 allowable cost per benefitted receptor; therefore, the evaluation stops and the barrier wall is considered not reasonable

to construct.

Noise Barrier Evaluation – Barrier 2

Table 5.2: Barrier 2

Evaluation Summary

Wall Length (ft) = 918

Total # of Impacts = 13

Wall Height (feet)	Total Area (sq. ft.)	Cost per Square Foot $	Total Wall Cost $	Acoustically Feasible? (Y/N)	Engineering Feasibility? (Y/N)	Overall Feasible? (Y/N)	Meets Noise Reduction Goal? (Y/N)	Number of Benefitted Receivers	Cost per Benefitted Receiver $	Is Barrier Cost Effective? (Y/N)	Overall Reasonable? (Y/N)	Conclusion
25	22,952	35	803,320	Y	Y	Y	Y	16	50,207.50	N	N	Feasible, but not reasonable
20	18,362	35	642,670	Y	Y	Y	Y	15	42,844.66	N	N	Feasible, but not reasonable
15	13,771	35	481,985	Y	Y	Y	Y	13	37,075.77	N	N	Feasible, but not reasonable
12	11,017	35	385,595	Y	Y	Y	Y	12	32,132.92	N	N	Feasible, but not reasonable
10	9,181	35	-	Y	Y	Y	N	-	-	-	N	Feasible, but not reasonable

**The Evaluation Summary is based on the SCDOT Traffic Noise Abatement Policy.

Barrier wall B2 was modeled to reduce noise impacts to residences along New Ryder Road.

The barrier was modeled at 918 feet in length and was evaluated at 5 fixed heights of 25 feet, 20 feet, 15 feet, 12 feet, and 10 feet.

Feasibility

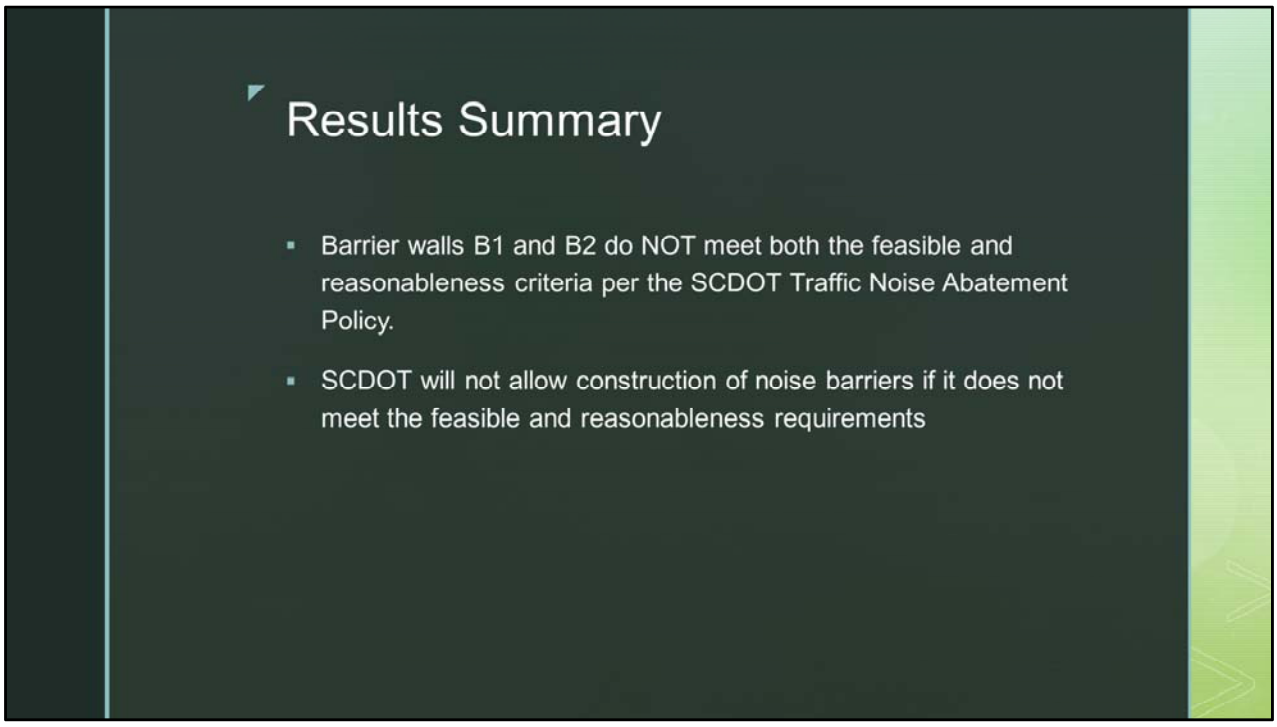
- For all 5 barrier wall height scenarios (25 feet, 20 feet, 15 feet, 12 feet, 10 feet), barrier wall B2 meets the criteria for both acoustic feasibility and engineering feasibility
- Since both acoustic and engineering feasibility criteria are met, the evaluation continues for reasonableness

Reasonableness

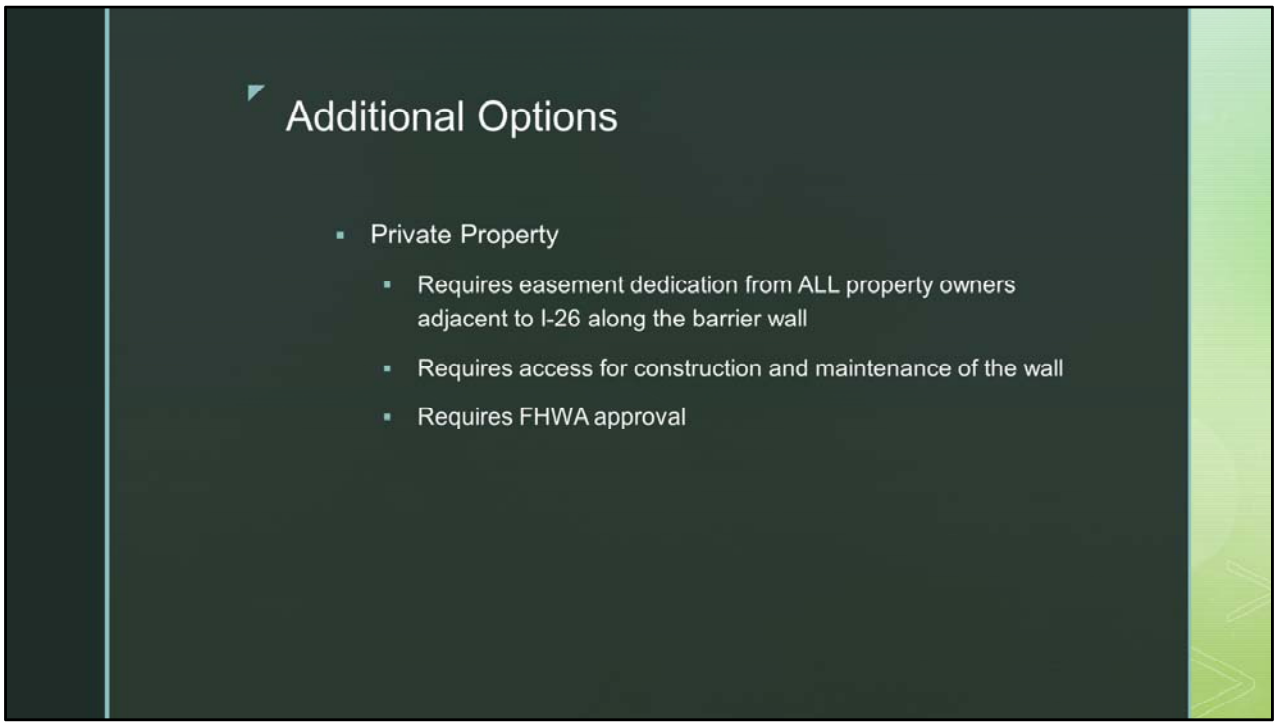
- Noise Reduction Design Goal
    - Barrier wall B2 with wall heights of 25', 20', 15', and 12' meets the noise reduction design goal; therefore, evaluation continues for cost effectiveness
    - Barrier wall B2 with 10' wall height does not meet the noise reduction design goal; therefore, the evaluation stops and the barrier wall of 10' wall height is considered not reasonable to construct.
- Cost-effectiveness – cost estimates were prepared for the 4 barrier wall height scenarios that meet the noise reduction design goal. The cost estimates were based on a

$35/square foot cost as prescribed by SCDOT's Noise Abatement Policy.

- Barrier wall B2 with wall heights of 25', 20', 15' and 12' all exceed the allowable $30,000 cost per benefitted receptor; therefore, the evaluation stops and the barrier walls are considered not reasonable to construct.

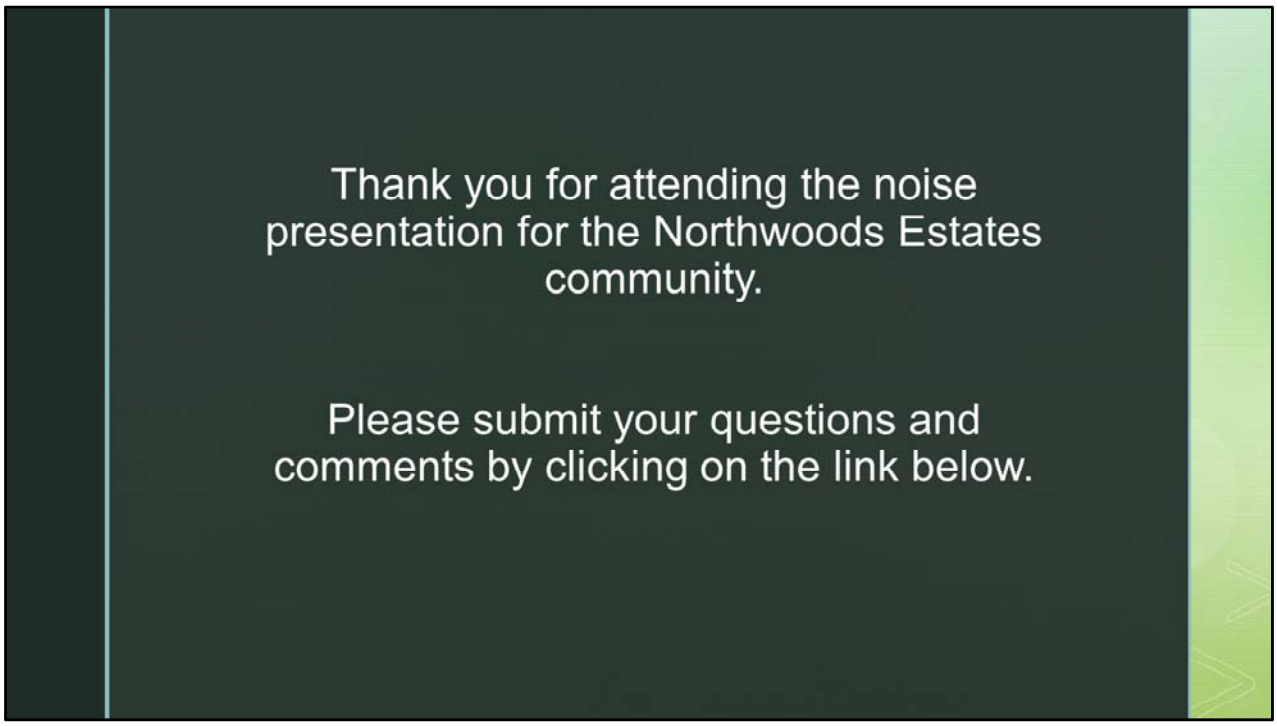


Barrier walls B1 and B2 do NOT meet both the feasible and reasonableness criteria per the SCDOT Traffic Noise Abatement Policy; therefore, SCDOT will not allow for construction of a barrier wall within the I-26 right-of-way.



An additional option considered is constructing a noise wall on private property. This would require easement dedication from all property owners adjacent to I-26 along the barrier wall. It would also require additional right-of-way or easement within the I-26 right-of-way to allow access for construction and maintenance of the wall which would require Federal Highway Administration (FHWA) approval.

This option was not pursued due to the extensive property impacts and funding constraints.



Thank you for attending the Noise Presentation for the Northwoods Estates community.

Submit your questions and/or comments here:
https://palmettocommerceinterchange.com/contact-us.