PRELIMINARY
NOISE ANALYSIS TECHNICAL REPORT

CENTERVILLE TURNPIKE WIDENING
PHASE III

CIP#: 2-419 & 7-027

PWCN#: 17-0018

UPC#: 109381

[August 2019]

EXECUTIVE SUMMARY

The Federal Highway Administration (FHWA) regulations for assessment and mitigation of highway traffic noise in the planning and design of federally aided highway projects are contained in Title 23 of the United States Code of Federal Regulations §772 (23 CFR 772). These regulations state that a "Type I" traffic noise analysis is required if through travel lanes or interchange ramps are added. This report details the noise analysis for the Centerville Turnpike Widening – Phase III, in Virginia Beach, Virginia. This noise analysis was conducted in accordance with FHWA and Virginia Department of Transportation (VDOT) noise assessment regulations and guidelines, in support of the Categorical Exclusion.

A preliminary noise evaluation was performed and a more detailed review will be completed during final design. As such, noise barriers that are found to be feasible and reasonable during the preliminary noise analysis may also not be found to be feasible and reasonable during the final design noise analysis. Conversely, noise barriers that were not considered feasible and reasonable may meet the established criteria and be recommended for construction.

This study details the noise impact and mitigation assessment for the Existing Conditions (2017) and for design year (2045) No-Build and Build Alternatives. The traffic data used in the noise analysis is based upon VDOT's environmental traffic data (ENTRADA) analysis program. The worst noise hour was derived through an analysis of all 24 AM and PM hours, which were then narrowed to the 8 AM, 10 AM, 11 AM and 5 PM hours by further analysis. Traffic volumes and speeds for those hours were modeled in FHWA's Traffic Noise Model (TNM), and the 8 AM hour was determined to produce the highest noise levels on both sides of the roadway for 2-way traffic.

Numerous noise sensitive land uses exist on both northbound and southbound sides of Centerville Turnpike in the Study Area. See **Table ES-1** for a summary of predicted worst-hour noise level ranges.

Table ES-1: Predicted Worst-Hour Noise Levels for Modeled Receptors

CNE ID[1]	Area Land Use and Description	Range of Predicted Worst-Hour L_{eq}[2] Exterior Noise Levels, dB(A)[3]		
		Existing 2017	No-Build 2045	Build 2045
01	Residences on Centerville Tpk, Livingston Oak Dr, Outerbridge Quay, Barbara Lee Ct and Jeri Ct	50-68	52-69	54-70
02	Residences on Centerville Tpk, Melody Ct and Hamer Ct	52-68	54-69	56-69
03	Residences on Mima Cir and Baren Ct	50-62	52-64	54-68
04	Infinity Apartment Homes at Centerville Crossing	51-63	53-65	53-65
05	Residences on Sun Valley Dr, Arapahoe Trail and Sundance Ct	52-62	53-64	55-70
06	Residences on Squaw Valley Trail, Wanda Cir and Steamboat Ct	54-63	55-64	57-70
07	Residences on Kempsville Crossing Ln	53-60	54-61	58-62
08	Residences, walking path and Centerville Park on John Brown Ln; residences on Arlington Arch Dr	54-66	56-67	58-71
09	Residences on Arlington Arch Ct	57-62	58-63	59-70
10	The Cascades Apartments and business park	63-66	64-67	65-69
11	Centerville Elementary School (exterior)	57-65	58-66	59-67
12	Colonial Baptist Church (exterior)	58	60	60
13	Resurrection United Methodist Church (exterior)	58	59	59

[1] *Common Noise Environment Identification Number*

[2] *Equivalent Sound Level*
[3] *A-weighted decibel*

Noise barrier analyses are warranted for all Common Noise Environments (CNEs) with noise impacts. Noise barriers were studied at CNE 01 (8 impacts), CNE 02 (7 impacts), CNE 03 (6 impacts), CNE 05 (12 impacts), CNE 06 (9 impacts), CNE 08 (10 impacts), CNE 09 (5 impacts), CNE 10 (4 impacts), CNE 11 (2 impacts). All noise barriers were assumed to be physically feasible, except at CNE 10, and were evaluated at heights of 15, 20, 25 and 30 feet to assess whether they meet acoustic feasibility, design goal, and reasonableness criteria.

Potential noise barriers were determined to be feasible and reasonable at all studied CNEs, except at CNE 10 where a noise barrier was deemed not feasible. Noise barriers that are shown to be feasible and reasonable in the preliminary design may not be feasible and reasonable in final design. All noise barriers would be further evaluated in final design to determine any engineering constraints associated with constructing the noise barrier. Additionally, VDOT guidelines recommend a variety of mitigation measures that should be considered in response to transportation-related noise impacts. While noise barriers and/or earth berms are generally the most effective form of noise mitigation, additional mitigation measures exist which have the potential to provide considerable noise reductions, under certain circumstances. Alternative measures would also be assessed based upon any new design information.

Table ES-2 summarizes each barrier's feasibility, acoustical design details, benefited receptors, length, height, surface area, surface area per benefited receptor, and cost-reasonableness, where applicable.

Table ES-2: Summary of Barrier Characteristics

Barrier ID	CNE ID	Barrier Length (Feet)	Barrier Height (Feet)	Surface Area (Square Feet)	Feasible?	Meets Design Goals?	Total Benefits	Barrier Square Feet per Benefited Receptor	Reason-able? (Square Feet per Benefit <1,600)
1P	01	692	15	10,380	Yes[1,2]	Yes	10	1,038	Yes
2P	02	594	15	8,910	Yes[1,2]	Yes	6	1,485	Yes
3P	03	628	15	9,420	Yes[1,2]	Yes	12	785	Yes
4P	05	1,009	15	15,135	Yes[1,2]	Yes	17	890	Yes
5P	06	850	15	12,750	Yes[1,2]	Yes	11	1,159	Yes
6P	08	650	15	9,750	Yes[1,2]	Yes	12	812	Yes
7P	09	328	15	4,920	Yes[1,2]	Yes	5	984	Yes
8P	11	196	15	2,940	Yes	Yes	2	1,470	Yes

[1] *Possible conflicts with existing overhead and underground utilities, poles and street lighting to be investigated further*
[2] *Limited space available for potential barrier adjacent to roadway; may require minor right-of-way acquisitions*

Any construction noise impacts that would occur as a result of roadway construction measures are anticipated to be temporary in nature and would cease upon completion of the project construction phase. A method of controlling construction noise is to establish the maximum level of noise that construction operations can generate. In view of this, VDOT has developed and FHWA has approved a specification that establishes construction noise limits.

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1. INTRODUCTION

This report documents the noise analysis conducted for existing (2017) and future (2045) conditions in the Centerville Turnpike Widening – Phase III Study Area to support the Categorical Exclusion (CE).

1.1 NOISE STUDY OVERVIEW

The Federal Highway Administration (FHWA) regulations for assessment and mitigation of highway traffic noise in the planning and design of federally aided highway projects are contained in Title 23 of the United States Code of Federal Regulations Part 772 (23 CFR §772). These regulations state that a "Type I" traffic noise impact analysis is required when through travel lanes or interchange ramps are added. This report details the noise impact analysis for the Centerville Turnpike Widening – Phase III in Virginia Beach, Virginia. This noise analysis was conducted in accordance with FHWA and Virginia Department of Transportation (VDOT) noise assessment regulations and guidelines.

This study details the noise impact assessment for the existing (2017) conditions and for the design year (2045) No-Build and proposed Build Alternative.

This report presents a description of noise terminology, the applicable standards and criteria, an evaluation of the existing noise conditions, a description of the computations of existing and future noise levels, a projection of future noise impact, and an evaluation of potential noise abatement measures. **Appendix A** provides a list of references, **Appendix B** presents the list of preparers, **Appendix C** presents all pertinent traffic data, **Appendix D** tabulates Traffic Noise Model (TNM) predicted noise level data, **Appendix E** tabulates noise monitoring field logs, **Appendix F** presents VDOT's Warranted, Feasible and Reasonable barrier worksheets, **Appendix G** presents VDOT project management response on alternative noise abatement measures (to be acquired), **Appendix H** provides site sketches, meter printouts, calibration and other pertinent correspondence, **Appendix I** presents all relevant TNM certifications, and **Appendix J** presents noise receptor location.

1.2 PROJECT DESCRIPTION

The City of Virginia Beach, in cooperation with VDOT and the FHWA, is preparing an EA for the Centerville Turnpike Widening – Phase III Project. Improvements are proposed for an approximate 1.2-mile section of Centerville Turnpike from Kempsville Road to the Chesapeake City line (**Figure 1**). The proposed action qualifies as a CE because it meets the criteria for a CE in CEQ regulations (40 CFR 1508.4) and existing accesses will only be modified (consolidated, right-in, right-out, raised median eliminates left turns) with no accesses eliminated. An approved CE under NEPA was completed for this project (References: 2040 Long Range Transportation Plan (LRTP), Amendments to the LRTP, the Final FY 2015-2018 TIP, FY 2018-2021 TIP, VDOT SYIP) with FHWA and VDOT oversight.

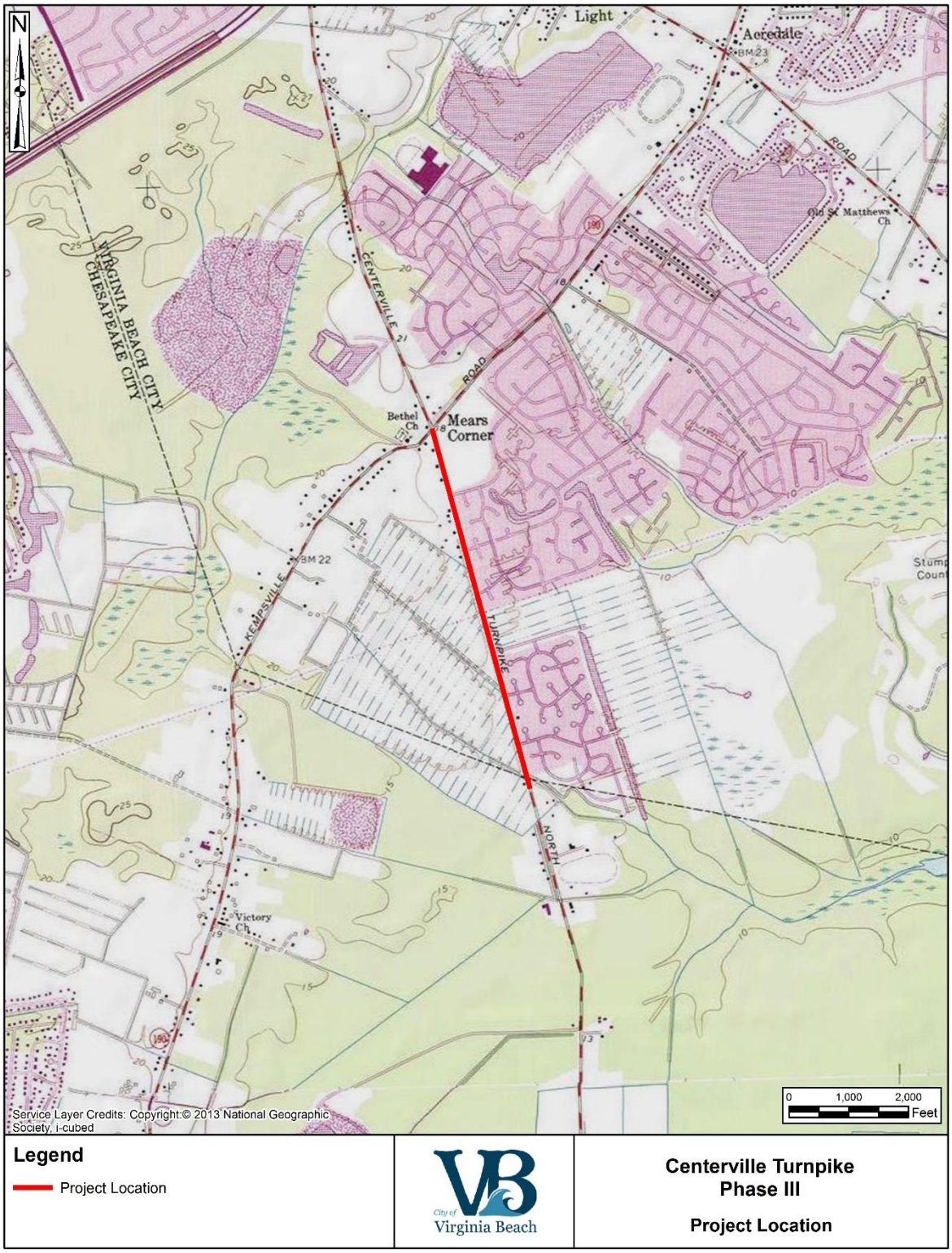
This project involves reconstruction with added capacity, widening of the 2-lane undivided open section roadway to 4-lane divided with raised median, sidewalk, curb and gutter, with underground stormwater conveyances and BMPs in a 99 ft R/W.

1.3 PURPOSE AND NEED

The Centerville Turnpike Widening – Phase III Project CE will address the following purpose and needs:

- Accommodate existing/forecasted travel demand, reconstruct roadway to meet current design standards to improve safety and turning movements, modify accesses to improve traffic flow/safety, improve bicycle/pedestrian multimodal options, and address drainage issues.

Figure 1: Project Location Map



1.4 ALTERNATIVES

1.4.1 No-Build Alternative

The No-Build Alternative includes continued road maintenance and repairs of existing transportation infrastructure within the Study Area. The No-Build Alternative serves as the baseline against which the potential environmental effects of the Build Alternative are compared.

1.4.2 Build Alternative

The Build Alternative calls for four lanes with a median from Kempsville Road to Lynnhaven Parkway where the roadway will begin to taper to two lanes tying into existing facilities south of the Parkway to about the City line. A bicycle lane on either side, an 8-foot asphalt sidewalk on the west side, and a 5-foot concrete sidewalk on the east side are proposed. Utilities are to be relocated within the right-of-way where feasible. The project includes modifying certain accesses to meet state access management standards. The project has the potential for noise barriers and limited new right-of-way. The drainage system along the study corridor directs stormwater to a major drain just south of the Virginia Beach/Chesapeake City Line that crosses under the Centerville Turnpike and heads east to Stumpy Lake. The project would convey drainage to this facility and improve it to accommodate new drainage volumes, in turn requiring regrading a short section of ditch and establishing a construction access area on the east side of Centerville Turnpike in the City of Chesapeake near the City line.

1.5 STUDY AREA – NOISE SENSITIVE LAND USES

Noise sensitive land uses in the project Study Area consist mainly of residential properties, including some upper floor balconies and ground level patios on the exterior of multi-family apartment buildings in the Study Area. Recreational areas are also included.

2. METHODOLOGY

2.1 FHWA AND VDOT REGULATIONS AND GUIDELINES

The noise analysis of the Centerville Turnpike Project was assessed in accordance with FHWA and VDOT noise assessment regulations and guidelines. The State Noise Abatement Policy was developed to implement the requirements of 23 Code of Federal Regulations (CFR)§772 Procedures for Abatement of Highway Traffic Noise and Construction Noise (July 13, 2011), FHWA's Highway Traffic Noise Analysis and Abatement Policy and Guidance (December 2011), and the noise related requirements of the National Environmental Policy Act of 1969. The current VDOT State Noise Abatement Policy became effective on July 13, 2011 and was last updated on July 15, 2015.

2.2 NOISE ABATEMENT CRITERIA AND SOUND LEVEL METRICS

To assess the degree of impact of highway traffic and noise on human activity, the FHWA established Noise Abatement Criteria (NAC) for different categories of land use (see **Table 2-1**). The NAC are given in terms of the hourly, A-weighted, equivalent sound level in decibels (dB(A)). The A-weighted sound level is a single number measure of sound intensity with weighted frequency characteristics that corresponds to human subjective response to noise. Most environmental noise (and the A-weighted sound level) fluctuates from moment to moment, and it is common practice to characterize the fluctuating level by a single number called the equivalent sound level (L_{eq}). The L_{eq} is the value or level of a steady, non-fluctuating sound that represents the same sound energy as the actual time-varying sound evaluated over the same time period. For traffic noise assessment, L_{eq} is typically evaluated over a one-hour period, and may be denoted as $L_{eq}(h)$.

2.3 DEFINITION OF NOISE IMPACT

Traffic noise impacts occur if either of the following two conditions is met:

- The predicted traffic noise levels (future design year) approach or exceed the NAC, as shown in **Table 2-1**. The VDOT State Noise Abatement Policy defines an approach level to be used when determining a traffic noise impact. The "Approach" level has been defined by VDOT as 1 dB(A) less than the Noise Abatement Criteria for Activity Categories A to E. For example, for a category B receptor, 66 dB(A) would be approaching 67 dB(A) and would be considered an impact. If design year noise levels "approach or exceed" the NAC, then the activity is impacted and a series of abatement measures must be considered.
- The predicted traffic noise levels are substantially higher than the existing noise levels. A substantial noise increase has been defined by VDOT when the predicted (future design year) highway traffic noise levels exceed existing noise levels by 10 dB(A) or more for all noise sensitive exterior activity categories. For example, if a receptor's existing noise level is 50 dB(A), and if the future noise level is 60 dB(A), then it would be considered an impact. The noise levels of the substantial increase impact do not have to exceed the appropriate NAC. Receptors that satisfy this condition warrant consideration of highway traffic noise abatement.

If traffic noise impact is identified within the project corridor, then consideration of noise abatement measures is necessary. The final decision on whether to provide noise abatement along a project corridor will account for the feasibility of the design and overall cost weighted against the environmental benefit.

Table 2-1: FHWA Noise Abatement Criteria

Activity Category	$L_{eq}(h)$[1]	Description of Activity Category
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[2]	67 (Exterior)	Residential
C[2]	67 (Exterior)	Active sport 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, recreation 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	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

Activity Category	$L_{eq}(h)^1$	Description of Activity Category
G	–	Undeveloped lands that are not permitted (without building permits)

Source: 23 CFR §772.
[1] Hourly Equivalent A-weighted Sound Level (dB(A))
[2] Includes undeveloped lands permitted for this activity category

FHWA and VDOT policy also requires evaluations of undeveloped lands if they are considered "permitted", that is, when there is a definite commitment to develop land with an approved specific design of land use activities as evidenced by the issuance of at least one building permit.

The VDOT approach criteria for a Category D area is 51 dB(A). However, this equates to a different exterior impact criterion depending on the building type and window condition. **Table 2-2** below lists the building noise reduction factors used to estimate interior highway traffic noise impacts for Land Use Activity Category D areas.

Table 2-2: Reduction Factors for Estimating Category D Interior Impacts

Exterior Evaluation	Leq(h) [dB(A)]	86	76		71	61
Interior Evaluation	Building Type	Masonry		Light Frame		All
	Window Condition	Double Glazed	Single Glazed	Storm Window	Ordinary Sash (closed)	Open
	Noise Reduction Due to Structure Exterior (dB)	35	25		20	10
	Leq(h) [dB(A)]	(51)	(51)		(51)	(51)

- *Adapted from Table 6 of report FHWA-HEP-10-025, Highway Traffic Noise: Analysis and Abatement Guidance. FHWA. 2011*
- *The windows shall be considered open unless there is firm knowledge that the windows are in fact kept closed almost every day of the year.*

2.4 ANALYSIS PROCEDURE

When predicted design year Build Alternative noise levels approach or exceed the NAC during the loudest hour of the day or cause a substantial increase in existing noise, consideration of traffic noise reduction measures is necessary. If it is found that such mitigation measures would cause adverse social, economic, or environmental effects that outweigh the benefits received, they may be dismissed from consideration. For this study, noise levels throughout the Study Area were determined for existing (2017) conditions and for the design year (2045) No-Build and Build Alternatives.

All noise-sensitive land uses potentially affected by the project are near roads for which traffic data was developed as part of the environmental study. Therefore, all noise levels were computed from the appropriate worst-hour traffic data. The computation methods and computed noise levels appear in the following section.

2.5 TRAFFIC NOISE MODEL (TNM)

All traffic noise computations for this study were conducted using the latest version of the FHWA Traffic Noise Model (FHWA TNM 2.5). The FHWA TNM incorporates state-of-the-art sound emissions and sound propagation algorithms, based on well-established theory or on accepted international standards. The acoustical algorithms contained within the FHWA TNM have been validated with respect to carefully conducted noise measurement programs, and show excellent agreement in most cases for sites with and without noise barriers.

2.6 NOISE MODEL INPUTS

Available project engineering plans, topographic contours and building information were used to create a three-dimensional model in TNM of the geometry of the existing and future design roadway configurations and the surrounding terrain and buildings. The meridian source of the topographic survey is based on the City of Virginia Beach, Virginia Geodetic Control Network, Virginia State Plane Coordinate System, South Zone, NAD 1983 (1993 HARN).

The noise model also accounts for such factors as propagation over different types of ground (acoustically soft and hard ground), elevated roadway sections, significant shielding effects from local terrain and structures, distance from the road, traffic speed, and hourly traffic volumes including percentage of medium and heavy trucks. To fully characterize existing and future noise levels at all noise-sensitive land uses in the Study Area, many noise prediction receivers (also called “receptors” and “sites”) were added to the measurement sites in the TNM model. Some receptors were modeled to more precisely represent the multi-level condominium exterior uses directly adjacent to the proposed widening.

TNM run files are submitted with this report, with TNM printed data available upon request.

2.7 ADDITIONAL NOISE MODEL INPUT DATA

No additional noise model input data was used in this analysis.

3. EXISTING NOISE ENVIRONMENT

3.1 NOISE MONITORING

3.1.1 Noise Monitoring Methodology

A noise monitoring program was conducted along the Centerville Turnpike corridor, consistent with FHWA and VDOT recommended procedures to document existing ambient noise levels in noise-sensitive locations in the study corridor, and to provide a means for validation of the noise prediction model. Short-term (less than one hour) noise measurements were conducted at fourteen locations in the Study Area. Long-term monitoring of 24-hour duration was not performed with this project since it was unnecessary given the availability of detailed traffic analysis for AM and PM loudest-hour traffic volumes for Existing, and Build conditions.

3.1.2 Noise Monitoring Schedule

Short-term noise monitoring of 30-minute duration was conducted on March 6, 2018. The data collection procedure involved measurements of individual one-minute L_{eq} so that the minutes including noise events unrelated to traffic noise (such as aircraft operations) could later be separated or excluded, and the total measurement period L_{eq} could be determined both with and without the minutes that included these

events. By comparing the two totals, the significance of non-traffic events to the overall noise level can be determined for the measurement period. Traffic was counted manually during each measurement session in order to provide a basis for the model validation effort.

3.1.3 Noise Monitoring Instrumentation

Noise measurements were conducted with Rion NL-42 Type 2 sound level meters. The noise measurement instrumentation was field calibrated regularly during the measurement program, and has calibrations traceable to the National Institute of Standards and Technology, shown in **Appendix H**.

3.1.4 Noise Monitoring Locations

Measurement locations are shown in **Figures 2-1** through **2-2** in **Appendix J**, with short-term site numbers denoted with the prefix "M". Measurement locations and noise levels are shown in **Table 3-1**.

3.1.5 Noise Monitoring Documentation

Appendix E provides details of the data acquired during the noise measurement program, including noise monitor output and traffic counts, while **Appendix H** includes site sketches, photographs, and noise monitor specifications.

3.1.6 Noise Monitoring Results

Short-term noise monitoring is not a process to determine design year noise impacts or barrier locations. Short-term noise monitoring provides a level of consistency between what is present in real-world situations and how that is represented in the computer noise model. Short-term monitoring does not need to occur within every Common Noise Environment to validate the computer noise model.

The measured short-term noise levels appear in **Table 3-1** as equivalent sound levels (L_{eq}), along with site address and measurement date, start time and duration. The measured "Total" L_{eq} range from 51 dB(A) at the second-row residential location of 5304 Arapahoe Trail (Site M-05) to 62 dB(A) at the front row residential location near 8719 2009 Barbara Lee Court (Site M-01). The measurement results also show that the measured Total L_{eq} and the Traffic-Only L_{eq} are identical except at sites M-02, M-03, M-04, M-07 and M-10, where Traffic-only levels are 1 dB(A) lower, as a few minimal extraneous noise sources were observed.

Table 3-1: Short-Term Noise Measurement Results

Site[1]	Address	Date	Time Start	Duration (minutes)	Total L_{eq}[2], dB(A)[3]	Traffic Only L_{eq}, dB(A)
M-01	Near 2009 Barbara Lee Court	3/6/2018	12:45	30	62	62
M-02	2221 Centerville Turnpike	3/6/2018	12:45	30	61	60
M-03	5213 Mima Circle	3/6/2018	12:45	30	55	54
M-04	5309 Arapahoe Trail	3/6/2018	11:33	30	58	57
M-05	5304 Arapahoe Trail	3/6/2018	11:33	30	51	51
M-06	2013 Wanda Circle	3/6/2018	11:33	30	59	59
M-07	1913 Kempsville Crossing Lane	3/6/2018	10:05	30	52	51
M-08	1960 John Brown Lane	3/6/2018	10:05	30	55	55

Table 3-1: Short-Term Noise Measurement Results

Site[1]	Address	Date	Time Start	Duration (minutes)	Total L_{eq}[2], dB(A)[3]	Traffic Only L_{eq}, dB(A)
M-09	Near 1960 Arlington Arch Drive	3/6/2018	10:05	30	61	61
M-10	1965 Arlington Arch Drive	3/6/2018	10:05	30	52	51

[1] Site locations shown on maps in Figures 2-1 and 2-2. Detailed data presented in Appendix E.
[2]Equivalent Sound Level
[3]A-weighted decibel

3.1.7 Noise Model Validation

A validation of the noise modeling assumptions was conducted using the traffic counted on nearby roadways simultaneous with the noise measurement at each site, as input to the noise prediction model. These observed traffic counts are provided in the **Appendix E** field logs. Computed noise levels based on the counted traffic were compared to the measured noise levels to confirm the assumptions about aspects of the TNM model, such as the acoustical shielding provided by intervening terrain and existing noise barriers. The modeling assumptions were refined, as necessary, to obtain appropriate agreement between the computed and measured values. The validated modeling assumptions at the measurement sites and for the existing geometry were then extended to the design year alternative and applied at prediction locations where no measurements were made.

Predicted noise levels at all validation sites where traffic was counted and incorporated in the model were within the 3 dB(A) requirement. The overall average difference between measured and computed levels is +1.0 dB(A). The comparison of measured versus computed sound levels at each the measurement sites is shown in **Table 3-2**.

Table 3-2: Computed vs. Measured Sound Levels at Measurement Sites

Site No.	Address	Land Use	Measured L_{eq}[1] dB(A)[2] (Traffic-only)	Computed L_{eq} dB(A)	Difference
M-01	Near 2009 Barbara Lee Court	Residential	62	62.6	0.6
M-02	2221 Centerville Turnpike	Recreational	60.3	61.9	1.6
M-03	5213 Mima Circle	Residential	54.2	55.7	1.5
M-04	5309 Arapahoe Trail	Residential	57.3	59	1.7
M-05	5304 Arapahoe Trail	Residential	50.9	51.4	0.5
M-06	2013 Wanda Circle	Residential	58.8	58.3	-0.5
M-07	1913 Kempsville Crossing Lane	Residential	50.6	50.7	0.1
M-08	1960 John Brown Lane	Recreational	54.6	57	2.4

Table 3-2: Computed vs. Measured Sound Levels at Measurement Sites

Site No.	Address	Land Use	Measured L_{eq}[1] dB(A)[2] (Traffic-only)	Computed L_{eq} dB(A)	Difference
M-09	Near 1960 Arlington Arch Drive	Residential	60.8	62.8	2
M-10	1965 Arlington Arch Drive	Residential	51.4	51.9	0.5
Overall Average					**+1.0**

[1]*Equivalent Sound Level*
[2]*A-weighted decibel*

3.2 UNDEVELOPED LANDS AND PERMITTED DEVELOPMENTS

Highway traffic noise analyses are (and will be) performed for developed lands as well as undeveloped lands if they are considered "permitted." Undeveloped lands are deemed to be permitted when there is a definite commitment to develop land with an approved specific design of land use activities as evidenced by the issuance of at least one building permit.

In accordance with the VDOT Traffic Noise Policy, an undeveloped lot is considered to be planned, designed, and programmed if a building permit has been issued by the local authorities prior to the Date of Public Knowledge for the relevant project. The "Date of Public Knowledge" is the date that the final NEPA approval is made. The City has no obligation to provide noise mitigation for any undeveloped land that is permitted or constructed after this date.

Review of the City of Virginia Beach's Planning and Community Development database indicates no additional noise sensitive land uses being permitted within the project area at the time of this study.

3.3 COMMON NOISE ENVIRONMENT (CNE) DETERMINATION AND RECEPTOR CATEGORIZATION

Receptors are grouped into "Common Noise Environments" (CNEs) per current guidance from FHWA and VDOT. Each of these areas has similar sources of noise and similar land uses within it. For this section of the report, the ranges of noise levels and the projected noise impact are summarized by CNE.

CNE boundaries are identified in **Figures 2-1** and **2-2** for areas with noise-sensitive land use. Areas that do not have noise-sensitive land uses are not identified with CNE boundaries; such land use is Activity Category E, F, or G, that is commercial with no exterior activity areas, industrial, or undeveloped, respectively.

CNE 01 represents single family residences on Centerville Turnpike, Livingston Oak Drive, Outerbridge Quay, Barbara Lee Court and Jeri Court. This area is classified as Category B.

CNE 02 represents single family residences on Centerville Turnpike, Melody Court and Hamer Court. This area is classified as Category B.

CNE 03 represents single family residences on Mima Circle and Baren Court. This area is classified as Category B. An existing noise barrier protects residences adjacent to Lynnhaven Parkway.

CNE 04 represents multi-story residences at Infinity Apartment Homes at Centerville Crossing. This area is classified as Category B.

CNE 05 represents single family residences on Sun Valley Drive, Arapahoe Trail and Sundance Court. This area is classified as Category B.

CNE 06 represents single family residences on Squaw Valley Trail, Wanda Circle and Steamboat Court. This area is classified as Category B.

CNE 07 represents single family residences on Kempsville Crossing Lane. This area is classified as Category B.

CNE 08 represents single family residences, a walking path and Centerville Park on John Brown Lane, as well as single family residences on Arlington Arch Drive. This area is classified as Category B and C.

CNE 09 represents single family residences on Arlington Arch Court. This area is classified as Category B.

CNE 10 represents four 2nd- and 3rd story balconied residences, two outdoor dining areas, a playground, and dog park at The Cascades Apartments and business park. This area is classified as Category B and C.

CNE 11 represents Centerville Elementary School. This area is classified as Category C for the ball courts and Category D for interior use.

CNE 12 represents Colonial Baptist Church. This area is classified as Category D.

CNE 13 represents Resurrection United Methodist Church. This area is classified as Category D.

3.4 WORST NOISE HOUR

Worst noise hour determination is based upon VDOT's Environmental Traffic Data (ENTRADA) spreadsheets and comparison of TNM calculations for potential worst noise hours. Noise levels were predicted in each direction, including combined directions, for each "zone" (see Appendix D) of the project corridor. The analysis determined that the 8 AM, 10 AM, 11 AM, and 5 PM hours all possessed sufficient vehicle volumes, types and speeds to potentially represent the worst noise hour of the day in the design year. The 8 AM hour demonstrated the highest predicted noise levels for single and combined-directions for almost the entirety of the corridor, and thus was determined to represent the worst noise hour.

Traffic parameters associated with the 8 AM Worst Noise Hour were used for all roadways in this analysis. Long-term monitoring was not necessary to determine the Worst Noise Hour as all required traffic data was acquired and processed by RK&K before being incorporated into the noise analysis.

Appendix D provides tables of vehicle mixes, speeds and noise levels for each hour of the day, for existing and design-year conditions.

3.5 MODELED EXISTING ENVIRONMENT

The Existing noise environment was assessed for 2017; No-Build and Build noise environments were assessed for Design Year 2045.

The Existing condition includes a noise barrier that currently protects residences adjacent to Lynnhaven Parkway, in CNE 03. There are also many privacy fences between community developments and Centerville Turnpike, particularly on the northbound side of the highway. Some fences may be impacted by the proposed widening. Existing walls or privacy fences are generally 6 feet in height and offer little noise reduction, being constructed with wood slats and having gaps of varying degrees. These fences are not modeled as noise barriers in TNM.

Category C sports, recreation and trail areas in CNEs 08 and 11 are represented by arrays of receptors spaced at 100-foot intervals, in accordance with the methodology outlined in Appendix E of the VDOT Highway Traffic Noise Guidance Manual. For these areas, each receptor is counted the same as one residential receptor for the purposes of defining noise impacts and analyzing mitigation.

Noise levels that exceed the FHWA NAC are predicted in several CNEs for the Worst-Hour Existing condition, particularly those with front-row properties having direct exposure to the roadway. While some existing privacy fences offer limited protection from highway noise, they are also often flanked by noise transmitted through access gaps along the existing alignment. See **Table 3-3** for predicted Worst-Hour Existing noise level ranges, which also includes noise levels for Build and No-Build conditions. Design year noise levels are discussed in the next section.

Table 3-3: Predicted Worst-Hour Noise Levels for Modeled Receptors

CNE ID[1]	Area Land Use and Description	Range of Predicted Worst-Hour L_{eq}[2] Exterior Noise Levels, dB(A)[3]		
		Existing 2017	No-Build 2045	Build 2045
01	Residences on Centerville Tpk, Livingston Oak Dr, Outerbridge Quay, Barbara Lee Ct and Jeri Ct	50-68	52-69	54-70
02	Residences on Centerville Tpk, Melody Ct and Hamer Ct	52-68	54-69	56-69
03	Residences on Mima Cir and Baren Ct	50-62	52-64	54-68
04	Infinity Apartment Homes at Centerville Crossing	51-63	53-65	53-65
05	Residences on Sun Valley Dr, Arapahoe Trail and Sundance Ct	52-62	53-64	55-70
06	Residences on Squaw Valley Trail, Wanda Cir and Steamboat Ct	54-63	55-64	57-70
07	Residences on Kempsville Crossing Ln	53-60	54-61	58-62
08	Residences, walking path and Centerville Park on John Brown Ln; residences on Arlington Arch Dr	54-66	56-67	58-71
09	Residences on Arlington Arch Ct	57-62	58-63	59-70
10	The Cascades Apartments and business park	63-66	64-67	65-69
11	Centerville Elementary School (exterior)	57-65	58-66	59-67
12	Colonial Baptist Church (exterior)	58	60	60
13	Resurrection United Methodist Church (exterior)	58	59	59

[1] *Common Noise Environment Identification Number*
[2] *Equivalent Sound Level*
[3] *A-weighted decibel*

4. FUTURE NOISE ENVIRONMENT

4.1 MODELED FUTURE ENVIRONMENT

As with the Existing condition, noise impacts are predicted for the Worst-Hour Design Year conditions. No-Build noise levels are generally 1 to 2 dB(A) greater than Existing levels. Build noise levels are also generally slightly higher than No-Build levels, with levels approaching or exceeding the NAC - resulting in noise impacts. Build condition noise impacts are predicted for all CNEs except CNEs 04 and 07.

Build condition impacts are predicted to occur at both residential and recreational areas. The total number of predicted impacts is 63. Fifty-three (53) Category B residential impacts are predicted to occur in CNEs 01, 02, 03, 05, 06, 08, 09 and 10, with 10 Category C impacts predicted in CNEs 08, 10 and 11.

Three receptors were modeled for Category D interior analysis at institutional sites within CNEs 11, 12 and 13. Since all identified facilities have air conditioning and masonry construction, an outside-to-inside noise reduction value of 25 decibels is applied to exterior noise levels predicted by TNM. Since 51 dB(A) is the impact threshold for Category D use, an exterior noise level of 76 dB(A) would be required to impact the interior of the building. No Category D impacts are predicted for the entire project area. **Appendix D** includes interior and exterior noise level data.

See **Table 4-1** for a summary of predicted noise impacts.

The Build Alternative widening is not likely to physically impact existing privacy fences in the study area. However, potential noise barrier alignments could impact existing fences. In the absence of proposed sidewalks, modeled noise barriers are aligned generally 10 feet from the edge of roadway. However, in much of the corridor, in both northbound and southbound directions, new or realigned sidewalks are proposed – leaving less available space for noise barriers. In cases where privacy fences could be impacted, the benefits of a noise wall would likely surpass the utility of a privacy fence for residents.

Existing privacy fences are not assumed to provide adequate noise reduction due to their construction and varying degrees of gaps between slats and panels. Per Section 6.3.5 of the VDOT Noise Guidance Manual, the privacy fences are not modeled as noise barriers in TNM for the Build condition.

Table 4-1: Noise Impact by Common Noise Environment

CNE ID	Area Land Use and Description	Existing 2017[1]			No-Build 2045[1]			Build 2045		
		Cat. B	Cat. C	Cat. D	Cat. B	Cat. C	Cat. D	Cat. B	Cat. C	Cat. D
01	Residences on Centerville Tpk, Livingston Oak Dr, Outerbridge Quay, Barbara Lee Ct and Jeri Ct	1	0	0	2	0	0	8	0	0
02	Residences on Centerville Tpk, Melody Ct and Hamer Ct	1	0	0	1	0	0	7	0	0
03	Residences on Mima Cir and Baren Ct	0	0	0	0	0	0	6	0	0
04	Infinity Apartment Homes at Centerville Crossing	0	0	0	0	0	0	0	0	0
05	Residences on Sun Valley Dr, Arapahoe Trail and Sundance Ct	0	0	0	0	0	0	12	0	0
06	Residences on Squaw Valley Trail, Wanda Cir and Steamboat Ct	0	0	0	0	0	0	9	0	0
07	Residences on Kempsville Crossing Ln	0	0	0	0	0	0	0	0	0
08	Residences, walking path and Centerville Park on John Brown Ln; residences on Arlington Arch Dr	1	2	0	1	5	0	5	5	0
09	Residences on Arlington Arch Ct	0	0	0	0	0	0	5	0	0

CNE ID	Area Land Use and Description	Existing 2017[1]			No-Build 2045[1]			Build 2045		
		Cat. B	Cat. C	Cat. D	Cat. B	Cat. C	Cat. D	Cat. B	Cat. C	Cat. D
10	The Cascades Apartments and business park	0	2	0	0	2	0	1	3	0
11	Centerville Elementary School	0	0	0	0	2	0	0	2	0
12	Colonial Baptist Church	0	0	0	0	0	0	0	0	0
13	Resurrection United Methodist Church	0	0	0	0	0	0	0	0	0
Totals		**3**	**4**	**0**	**4**	**9**	**0**	**53**	**10**	**0**

[1] *For Existing and No-Build conditions, denotes the number of receptors that approach or exceed the FHWA NAC, rather than impacts as defined in Section 2.3. Determination of impact applies to the Build condition only.*

4.2 NOISE ABATEMENT DETERMINATION

4.2.1 Alternative Abatement Measures

VDOT guidelines recommend a variety of mitigation measures that should be considered in response to transportation-related noise impacts. While noise barriers and/or earth berms are generally the most effective form of noise mitigation, additional mitigation measures exist which have the potential to provide considerable noise reductions, under certain circumstances. Mitigation measures considered for this project include:

- Traffic management
- Alignment modifications
- Acoustical insulation of public use and non-profit facilities
- Buffer lands
- Construction of noise barriers
- Construction of earth berms

Additionally, the Noise Policy Code of Virginia (HB 2577, as amended by HB 2025) states: whenever the Commonwealth Transportation Board or the Department plan for or undertake any highway construction or improvement project and such project includes or may include the requirement for the mitigation of traffic noise impacts, first consideration should be given to the use of noise reducing design and low noise pavement materials and techniques in lieu of construction of noise walls or sound barriers. Vegetative screening, such as the planting of appropriate conifers, in such a design would be utilized to act as a visual screen if visual screening is required. Consideration will be given to these measures during the final design stage, where feasible. The response from project management is included in **Appendix G**.

Traffic Control Measures (TCM): Traffic control measures, such as speed limit restrictions, truck traffic restrictions, and other traffic control measures that may be considered for the reduction of noise emission levels are not practical for this project. These traffic control measures would be counterproductive to the project's objective of alleviating traffic and reducing congestion. Reducing speeds will not be an effective noise mitigation measure since a substantial decrease in speed is necessary to provide adequate noise reduction.

Alteration of Horizontal and Vertical Alignments: The alteration of the horizontal and vertical alignment has been considered to reduce or eliminate the impacts created by the proposed project. Shifting the horizontal alignment is not practical for this project. Even if possible, such shifts often create undesirable impacts such as right-of-way acquisition, temporary/permanent easements, and retaining walls. Shifting the roadway alignment away from the impacted residences often increases impacts to receptors located on the opposite side of the proposed roadway. For this project, the proposed widening mostly shifts traffic closer to land uses on the southbound side of the roadway, which is the side of the roadway least populated with residential properties.

Insulation: This noise abatement measure option applies only to public and institutional use buildings. Since no public use or institutional structures are anticipated to have interior noise levels exceeding FHWA's interior NAC, this noise abatement option would not be applied.

Acquisition of Buffering Land: The purchase of property for noise barrier construction or the creation of a "buffer zone" to reduce noise impacts is only considered for predominantly unimproved properties because the amount of property required for this option to be effective would create significant additional impacts (e.g., in terms of residential displacements), which were determined to outweigh the benefits of land acquisition.

Construction of Noise Barriers / Berms: Construction of noise barriers can be an effective way to reduce noise levels at areas of outdoor activity. Noise barriers can be wall structures, earth berms, or a combination of the two. The effectiveness of a noise barrier depends on the distance and elevation difference between roadway and receptor and the available placement location for a barrier. Gaps between overlapping noise barriers also decrease the effectiveness of the barrier, as opposed to a single connected barrier. The barrier's ability to attenuate noise decreases as the gap width increases.

Noise walls and earth berms are often implemented into the highway design in response to the identified noise impacts. The effectiveness of a freestanding (post and panel) noise barrier and an earth berm of equivalent height are relatively consistent; however, an earth berm is perceived as a more aesthetically pleasing option.

The use of earth berms is not always an option due to the excessive space they require adjacent to the roadway corridor. At a standard slope of 2:1, every one-foot in height would require four feet of horizontal width. This requirement becomes more complex in urban settings where residential properties often abut the proposed roadway corridor. In these situations, implementation of earth berms can require significant property acquisitions to accommodate noise mitigation. The cost associated with the acquisition of property to construct a berm can significantly increase the total costs to implement this form of noise mitigation.

Availability of fill material to construct the berm also needs to be considered. On proposed projects where proposed grading yields excess waste material, earth berms are often cost-effective mitigation options. On balance or borrow projects the implementation of earth berms is often an expensive solution due to the need to identify, acquire, and transport the material to the project site. Earth berms are not considered a viable mitigation option throughout the project area, and would not likely be evaluated in the final design stage.

As a general practice, noise barriers are most effective when placed at a relatively high point between the roadway and the impacted noise sensitive land use. To achieve the greatest benefit from a potential noise barrier, the goal of the barrier should focus on breaking the line-of-sight (to the greatest degree possible) from the roadway to the receptor. In roadway fill conditions, where the highway is above the natural

grade, noise barriers are typically most effective when placed on the edge of the roadway shoulder or on top of the fill slope. In roadway cut conditions, where the roadway is located below the natural grade, barriers are typically most effective when placed at the top of the cut slope. Engineering and safety issues have the potential to alter these typical barrier locations.

For this project, noise barriers are the only feasible mitigation option for impacted receptors.

4.2.2 Feasibility Criteria

All receptors that meet the warranted criterion must progress to the "feasible" phase. This phase of the noise abatement criteria requires that both of the following acoustical and engineering conditions be considered:

(1) At least a 5 dB(A) highway traffic noise reduction at impacted receptors. Per 23 CFR 772 FHWA requires the highway agency to determine the number of impacted receptors required to achieve at least 5 dB(A) of reduction. VDOT requires that fifty percent (50 percent) or more of the impacted receptors experience 5 dB(A) or more of insertion loss to be feasible, and

(2) The determination that it is possible to design and construct the noise abatement measure. The factors related to the design and construction include: safety, barrier height, topography, drainage, utilities, and maintenance of the abatement measure, maintenance access to adjacent properties, and general access to adjacent properties (i.e. arterial widening projects).

4.2.3 Reasonableness Criteria

All receptors that meet the feasibility criterion must progress to the "reasonableness" phase. This phase of the noise abatement criteria requires that all of the following conditions be considered:

- The viewpoints of the benefited receptors
- Cost effectiveness value
- Noise reduction design goal

Typically, the limiting factor related to barrier reasonableness is the cost effectiveness value, where the total surface area of the barrier is divided by the number of benefited receptors receiving at least a 5 dB(A) reduction in noise level. VDOT's approved cost is based on a maximum square footage of abatement per benefited receptor, a value of 1,600 square feet per benefited receptor.

For non-residential properties, such as parks and public use facilities, a special calculation is performed in order to quantify the type and duration of activity and compare to the cost effectiveness criterion. The determination is based on cost, severity of impact (both in terms of noise levels and the size of the impacted area and the activity it contains), and amount of noise reduction.

Noise Reduction Design Goals: The design goal is a reasonableness factor indicating a specific reduction in noise levels that VDOT uses to identify that a noise abatement measure effectively reduces noise. The design goal establishes a criterion, selected by VDOT, which noise abatement must achieve. VDOT's noise reduction design goal is defined as a 7 dB(A) of insertion loss for at least one impacted receptor, meaning that at least one impacted receptor is predicted to achieve a 7 dB(A) or greater noise reduction with the proposed barrier in place. The design goal is not the same as acoustic feasibility, which defines the minimum level of effectiveness for a noise abatement measure. Acoustic feasibility indicates that the noise abatement measure can, at a minimum, achieve a discernible reduction in noise levels.

Noise reduction is measured by comparing the future design year build condition pre-and post-barrier noise levels. This difference between unabated and abated noise levels is known as "insertion loss" (IL). It is important to optimize the noise barrier design to achieve the most effective noise barrier in terms of both noise reduction (insertion losses) and cost. Although at least a 5 dB(A) reduction is required to meet the feasibility criteria, the following tiered noise barrier abatement goals are used to govern barrier design and optimization.

- Reduction of future highway traffic noise by 7 dB(A) at one (1) or more of the impacted receptor sites (required criterion).
- Reduction of future highway traffic noise levels to the low-60-decibel range when practical (desirable).
- Reduction of future highway traffic noise levels to existing noise levels when practical (desirable).

Cost-Effectiveness: Typically, the limiting factor related to barrier reasonableness is the cost effectiveness value, where the total surface area of the barrier is divided by the number of benefited receptors receiving at least a 5-dBA reduction in noise level. VDOT's approved cost is based on a maximum square footage of abatement per benefited receptor, a value of 1,600 square feet per benefited receptor.

Where multi-family housing includes balconies at elevations that exceed a 30-ft high barrier or the topography causes receptors to be above the elevation of a 30-ft barrier, these receptors are not assessed for barrier benefits and are not included in the computation of the barrier's reasonableness.

For non-residential properties, such as parks and public use facilities, a special calculation is performed in order to quantify the type and duration of activity and compare to the cost effectiveness criterion. The determination is based on cost, severity of impact (both in terms of noise levels and the size of the impacted area and the activity it contains), and amount of noise reduction. This calculation was not applicable to this project.

The Viewpoints of the Benefited Receptors: VDOT shall solicit the viewpoints of all benefited receptors through certified mailings and obtain enough responses to document a decision as to whether or not there is a desire for the proposed noise abatement measure. Fifty percent or more of the respondents shall be required to favor the noise abatement measure in determining reasonableness. Community views in and of themselves are not sufficient for a barrier to be found reasonable if one or both of the other two reasonableness criteria are not satisfied.

4.2.4 Noise Barrier Evaluation

Noise barrier analyses are warranted for all Common Noise Environments (CNEs) with noise impacts, except at CNE 10 as discussed below. Noise barriers were studied at impacted CNEs 1, 2, 3, 5, 6, 8, 9 and 11. All noise barriers were assumed to be physically feasible and were evaluated at heights of 15, 20, 25 and 30 feet to assess whether they meet acoustic feasibility, design goal, and reasonableness criteria.

While impacts are predicted in CNE 10, a noise barrier is not considered feasible since it would need to be aligned along the edge of sidewalk due to limited right-of-way, which would eliminate several significant pedestrian access points to the playground, dog park, businesses and residences at The Cascades Apartments building at the corner of Centerville Turnpike and Lynnhaven Parkway. Therefore, mitigation for CNE 10 is not addressed in this section. Information on the noise levels associated with CNE 10 can be found in **Appendix D.**

Potential noise barriers were determined to be feasible and reasonable at all other impacted CNEs 1, 2, 3, 5, 6, 8, 9 and 11. Noise barriers that are shown to be feasible and reasonable in the preliminary design may not be feasible and reasonable in final design. All noise barriers would be further evaluated in final design to determine any engineering constraints associated with constructing the noise barrier.

Barrier 1P is a potential barrier for CNE 01 as shown in **Appendix J** Figure 2-1. Located along the northbound side of Centerville Turnpike, south of Livingston Oak Drive, the potential noise barrier would benefit 7 out of 8 impacted receptors and 3 non-impacted receptors on Barbara Lee Court and Jeri Court. Abatement for site R-02 is not feasible due to access constraints. The barrier would be 692 feet in length and 15 feet in height, with a surface area of 10,380 square feet. Barrier 1P is acoustically feasible because it would benefit at least 50 percent impacted receptors, and reasonable because it would meet the 7-dB(A) noise reduction design goal for at least one impacted receptor and has a surface area per benefited receptor value of 1,038, well below VDOT's maximum value of 1,600. It is possible that the potential noise barrier is not physically feasible due to conflicts with existing overhead power lines, utility poles and street lighting – as well as limited available right-of-way between the proposed improvements and residential properties. It is likely that the potential noise barrier would impact existing privacy fences in this CNE.

Barrier 2P is a potential barrier system consisting of two barriers for CNE 02 as shown in **Appendix J** Figure 2-1. Located along the northbound side of Centerville Turnpike, from north of Livingston Oak Drive to south of Woodhill Road, the potential barrier system would benefit 6 of 7 impacted receptors and 0 non-impacted receptors on Melody Court and Hamer Court. Abatement for site R-23 is not feasible due to access constraints. The barrier would be 594 feet in length and 15 feet in height, with a surface area of 8,910 square feet. Barrier 2P is acoustically feasible because it would benefit at least 50 percent impacted receptors, and reasonable because it would meet the 7-dB(A) noise reduction design goal for at least one impacted receptor and has a surface area per benefited receptor value of 1,485, which is below VDOT's maximum value of 1,600. If individual barrier segments north and south of receptor R-23 are evaluated independently, each still passes cost-reasonableness with SF/benefit values of 1,375 and 1,595, respectively. It is possible that the potential noise barrier is not physically feasible due to conflicts with existing overhead power lines, utility poles and street lighting – as well as limited available right-of-way between the proposed improvements and residential properties. It is likely that the potential noise barrier would impact existing privacy fences in this CNE.

Barrier 3P is a potential barrier for CNE 03 as shown in **Appendix J** Figure 2-1. Located along the northbound side of Centerville Turnpike, from north of Woodhill Road to south of Lynnhaven Parkway, the potential noise barrier would benefit 6 of 6 impacted receptors and 6 non-impacted receptors on Mima Circle and Baren Court Court. The barrier would be 628 feet in length and 15 feet in height, with a surface area of 9,420 square feet. Barrier 3P is feasible because it would benefit at least 50 percent of impacted receptors, and reasonable because it would meet the 7-dB(A) noise reduction design goal for at least one impacted receptor and has a surface area per benefited receptor value of 785, which is well below VDOT's maximum value of 1,600. It is possible that the potential noise barrier is not physically feasible due to conflicts with existing overhead power lines, utility poles and street lighting – as well as limited available right-of-way between the proposed improvements and residential properties. It is likely that the potential noise barrier would impact existing privacy fences in this CNE.

Barrier 4P is a potential barrier for CNE 05 as shown in **Appendix J** Figure 2-2. Located along the northbound side of Centerville Turnpike, from north of Infinity Lane to south of Hidden Valley Drive, this barrier would benefit 12 of 12 impacted receptors and 5 non-impacted receptors on Sun Valley Drive, Arapahoe Trail and Sundance Court. The barrier would be 1,009 feet in length and 15 feet in height, with a surface area of 15,135 square feet. Barrier 4P would be feasible because it would benefit at least 50

percent of impacted receptors, and reasonable because it would meet the 7-dB(A) noise reduction design goal for at least one impacted receptor and has a surface area per benefited receptor value of 890, well below VDOT's maximum value of 1,600. It is possible that the potential noise barrier is not physically feasible due to conflicts with existing overhead power lines, utility poles and street lighting – as well as limited available right-of-way between the proposed improvements and residential properties. It is likely that the potential noise barrier would impact existing privacy fences in this CNE.

Barrier 5P is a potential barrier for CNE 06 as shown in **Appendix J** Figure 2-2. Located along the northbound side of Centerville Turnpike, from north of Hidden Valley Drive to south of Old Ridge Road, this barrier would benefit 9 of 9 impacted receptors and 2 non-impacted receptors on Squaw Valley Trail, Wanda Circle and Steamboat Court. The barrier would be 850 feet in length and 15 feet in height, with a surface area of 12,750 square feet. Barrier 5P would be feasible because it would benefit at least 50 percent of impacted receptors, and reasonable because it would meet the 7-dB(A) noise reduction design goal for at least one impacted receptor and has a surface area per benefited receptor value of 1,159, below VDOT's maximum value of 1,600. It is possible that the potential noise barrier is not physically feasible due to conflicts with existing overhead power lines, utility poles and street lighting – as well as limited available right-of-way between the proposed improvements and residential properties. It is likely that the potential noise barrier would impact existing privacy fences in this CNE.

Barrier 6P is a potential barrier for CNE 08, as shown in **Appendix J** Figure 2-2. It is located along the southbound side of Centerville Turnpike, from south of the driveway for 1999 Centerville Turnpike, with a gap at the newly proposed Centerville Park access, to north of Glen View Drive. The potential barrier system would benefit 9 of 10 impacted receptors and 3 non-impacted receptors on Kempsville Crossing Lane, John Brown Lane, Arlington Arch Drive. Abatement for site R-101 is not feasible due to access constraints. The barrier would be 650 feet in length and 15 feet in height, with a surface area of 9,750 square feet. Barrier 6P would be feasible because it would benefit at least 50 percent of impacted receptors, and reasonable because it would meet the 7-dB(A) noise reduction design goal for at least one impacted receptor and has a surface area per benefited receptor value of 812, well below VDOT's maximum value of 1,600. It is possible that the potential noise barrier is not physically feasible in its southern portion due to very limited available right-of-way between the proposed improvements and residential properties. In this area, the potential noise barrier is aligned very close to the outside edge of sidewalk, and It is also highly likely that privacy fences would be impacted.

Barrier 7P is a potential barrier for CNE 09 as shown in **Appendix J** Figure 2-2. Located along the southbound side of Centerville Turnpike, from south of Glen View Drive to north of Amberbrooke Way, this barrier would benefit 5 of 5 impacted receptors and 0 non-impacted receptors on Arlington Arch Court. The barrier would be 328 feet in length and 15 feet in height, with a surface area of 4,920 square feet. Barrier 7P would be feasible because it would benefit at least 50 percent of impacted receptors, and reasonable because it would meet the 7-dB(A) noise reduction design goal for at least one impacted receptor and has a surface area per benefited receptor value of 984, below VDOT's maximum value of 1,600. It is possible that the potential noise barrier is not physically feasible due to very limited available right-of-way between the proposed improvements and residential properties. The potential noise barrier is aligned very close to the outside edge of sidewalk, and It is also likely that privacy fences would be impacted by the entirety of the barrier alignment.

Barrier 8P is a potential barrier for CNE 11 as shown in **Appendix J** Figure 2-1. Located along the southbound side of Centerville Turnpike, south of the Centerville Elementary School entrance, this barrier would benefit 2 of 2 impacted receptors and 0 non-impacted receptors at the Centerville Elementary School ball courts. The barrier would be 196 feet in length and 15 feet in height, with a surface area of

2,940 square feet. Barrier 8P would be feasible because it would benefit at least 50 percent of impacted receptors, and reasonable because it would meet the 7-dB(A) noise reduction design goal for at least one impacted receptor and has a surface area per benefited receptor value of 1,470, below VDOT's maximum value of 1,600.

See **Table 5-1** for a summary of barrier characteristics.

Table 5-1: Summary of Barrier Characteristics

Barrier ID	CNE ID	Barrier Length (Feet)	Barrier Height (Feet)	Surface Area (Square Feet)	Feasible?	Meets Design Goals?	Total Benefits	Barrier Square Feet per Benefited Receptor	Reason-able? (Square Feet per Benefit <1,600)
1P	01	692	15	10,380	Yes[1,2]	Yes	10	1,038	Yes
2P	02	594	15	8,910	Yes[1,2]	Yes	6	1,485	Yes
3P	03	628	15	9,420	Yes[1,2]	Yes	12	785	Yes
4P	05	1,009	15	15,135	Yes[1,2]	Yes	17	890	Yes
5P	06	850	15	12,750	Yes[1,2]	Yes	11	1,159	Yes
6P	08	650	15	9,750	Yes[1,2]	Yes	12	812	Yes
7P	09	328	15	4,920	Yes[1,2]	Yes	5	984	Yes
8P	11	196	15	2,940	Yes	Yes	2	1,470	Yes

[1] *Possible conflicts with existing overhead and underground utilities, poles and street lighting to be investigated further*

[2] *Limited space available for potential barrier adjacent to roadway; may require minor right-of-way acquisitions*

5. CONSTRUCTION NOISE

VDOT is also concerned with noise generated during the construction phase of the proposed project. The degree of construction noise impact would vary, as it is directly related to the types and number of equipment used and the proximity to the noise-sensitive land uses within the project area. Land uses that are sensitive to traffic noise, are also potentially considered to be sensitive to construction noise. Any construction noise impacts that would occur as a result of roadway construction measures are anticipated to be temporary in nature and would cease upon completion of the project construction phase. A method of controlling construction noise is to establish the maximum level of noise that construction operations can generate. In view of this, VDOT has developed and FHWA has approved a specification that establishes construction noise limits. This specification can be found in VDOT's 2016 Road and Bridge Specifications, Section 107.16(b.3), "Noise". The contractor would be required to conform to this specification to reduce the impact of construction noise on the surrounding community.

The specifications have been reproduced below:

- The Contractor's operations shall be performed so that exterior noise levels measured during a noise-sensitive activity shall not exceed 80 decibels. Such noise level measurements shall be taken at a point on the perimeter of the construction limit that is closest to the adjoining property on which a noise-sensitive activity is occurring. A noise-sensitive activity is any activity for which lowered noise levels are essential if the activity is to serve its intended purpose and not present an unreasonable public nuisance. Such activities include, but are not limited to, those associated

with residences, hospitals, nursing homes, churches, schools, libraries, parks, and recreational areas.

- The Department may monitor construction-related noise. If construction noise levels exceed 80 decibels during noise sensitive activities, the Contractor shall take corrective action before proceeding with operations. The Contractor shall be responsible for costs associated with the abatement of construction noise and the delay of operations attributable to noncompliance with these requirements.
- The Department may prohibit or restrict to certain portions of the project any work that produces objectionable noise between 10 PM and 6 AM. If other hours are established by local ordinance, the local ordinance shall govern.
- Equipment shall in no way be altered so as to result in noise levels that are greater than those produced by the original equipment.
- When feasible, the Contractor shall establish haul routes that direct his vehicles away from developed areas and ensure that noise from hauling operations is kept to a minimum.

These requirements shall not be applicable if the noise produced by sources other than the Contractor's operation at the point of reception is greater than the noise from the Contractor's operation at the same point.

6. PUBLIC INVOLVEMENT PROCESS

6.1 NOISE COMPATIBLE PLANNING

6.1.1 Noise-Compatible Land-Use Planning

FHWA and VDOT policies require that VDOT provides certain information to local officials within whose jurisdiction the highway project is located, to minimize future traffic noise impacts of Type I projects on currently undeveloped lands; Type I projects involve highway improvements with noise analysis. This information must include details on noise-compatible land-use planning and noise impact zones for undeveloped lands within the project corridor. The aforementioned details are provided below. Additional information about VDOT's noise abatement program has also been included in this section.

Sections 12.1 and 12.2 of VDOT's 2011 Highway Traffic Noise Impact Analysis Guidance Manual outline VDOT's approach to communication with local officials, and provides information and resources on highway noise and noise-compatible land-use planning. VDOT's intention is to assist local officials in planning the uses of undeveloped land adjacent to highways to minimize the potential impacts of highway traffic noise.

Entering the Quiet Zone is a brochure that provides general information and examples to elected officials, planners, developers, and the general public about the problem of traffic noise and effective responses to it. A link to this brochure on FHWA's website is provided:

http://www.fhwa.dot.gov/environment/noise/noise_compatible_planning/federal_approach/land_use/qz00.cfm

A wide variety of administrative strategies may be used to minimize or eliminate potential highway noise impacts, thereby preventing the need or desire for costly noise abatement structures such as noise barriers in future years. There are five broad categories of such strategies:

• Zoning,

- Other legal restrictions (subdivision control, building codes, health codes),
- Municipal ownership or control of the land,
- Financial incentives for compatible development, and
- Educational and advisory services.

The Audible Landscape: A Manual for Highway and Land Use is a very well-written and comprehensive guide addressing these noise-compatible land use planning strategies, with significant detailed information. This document is available through FHWA's Website, at

http://www.fhwa.dot.gov/environment/noise/noise_compatible_planning/federal_approach/audible_landscape/al00.cfm

6.1.2 Noise Impact Zones in Undeveloped Land along the Study Corridor

Also required under the revised 2011 FHWA and VDOT noise policies is information on the noise impact zones adjacent to project roadways in undeveloped lands. To determine these zones, noise levels are computed at various distances from the edge of the project roadways in each of the undeveloped areas of the project Study Area. Then, the distances from the edge of the roadway to the Noise Abatement Criteria sound levels are determined through interpolation. Distances vary in the project corridor due to changes in traffic volumes, or terrain features. Any noise sensitive sites within these zones should be considered noise impacted if no barrier is present to reduce sound levels. The distance from the edge of roadway to 71 dB(A) is predicted to be 30 feet; for 66 dB(A), the distance is 100 feet.

6.1.3 VDOT's Noise Abatement Program

Information on VDOT's noise abatement program is available on VDOT's Website, at: http://www.virginiadot.org/projects/pr-noise-walls-about.asp. The site provides information on VDOT's noise program and policies, noise walls, and a downloadable noise wall brochure.

6.2 VOTING PROCEDURES

For noise barriers determined to be feasible and reasonable, the affected public that will be benefited by the proposed mitigation will be given an opportunity to decide whether they are in favor of construction of the noise barrier. A final determination as to the construction of barriers will be made after the public hearing process. Before final decisions and approvals can be made to construct a noise barrier, a final design noise analysis will be performed. For barriers that are determined to be feasible and reasonable, input from the owners and residents of those receptor units that will be benefited by the proposed mitigation may vote by completing and returning the citizen survey that they receive in the mail. The initial citizen survey is sent out as certified mail so the disposition of the letters can be tracked. Of the votes tallied, 50 percent or more must be in favor of a proposed noise barrier in order for that barrier to be considered further. Upon completion of the citizen survey, the VDOT Noise Abatement staff will make recommendations to the Chief Engineer for approval. Approved barriers will be incorporated into the road project plans. A technical memorandum of the results of the public survey will be prepared and submitted to the FHWA.

APPENDIX A REFERENCES

23 CFR Part 772, as amended 75 FR 39820, July 13, 2010; Effective date July 13, 2011 – "Procedures for Abatement of Highway Traffic Noise and Construction Noise", Federal Highway Administration, U.S. Department of Transportation.
http://www.fhwa.dot.gov/environment/noise/regulations_and_guidance/

"Highway Traffic Noise: Analysis and Abatement Guidance", Federal Highway Administration, U.S. DOT, June 2010, revised January 2011.
http://www.fhwa.dot.gov/environment/noise/regulations_and_guidance/analysis_and_abatement_guidance/revguidance.pdf

"Highway Traffic Noise Impact Analysis Guidance Manual" (Version 8), Virginia Department of Transportation, July 2011, revised February 2018.
http://www.virginiadot.org/projects/resources/noisewalls/Highway_Traffic_Noise_Impact_Analysis_Guidance_Manual_v8.pdf

"State Noise Abatement Policy", Virginia Department of Transportation, effective July 13, 2011.
http://www.virginiadot.org/projects/resources/noisewalls/State_Noise_Abatement_Policy.pdf

APPENDIX B LIST OF PREPARERS / REVIEWERS

This appendix lists the preparers of this noise study report.

Preparers with Rummel, Klepper & Kahl, LLP are as follows:

- James Long III – Project Manager
- Kevin Hughes – Design Manager
- George Tye – Acoustic Engineer
- Stuart Samberg – Traffic Analysis
- Susan Miller – Project Planner
- Alan Grubb – CADD Coordinator
- Ross Hudnall – VDOT reviewer

APPENDIX C TRAFFIC DATA

This appendix compiles the traffic data used in the noise analysis modeling. Hourly-hour vehicle volumes, truck percentages, and speeds were developed by Rummel, Klepper & Kahl, LLP in coordination with data provided by the Virginia Department of Transportation.

APPENDIX D TNM PREDICTED NOISE LEVEL DATA

This appendix includes data predicted by TNM for Existing, No-Build and Build conditions.

CNE	NAC	Receptor	Existing 2017	No-Build 2045	Build 2045	Build 2045 with Potential Barrier	IL	Impacted and Benefited?	Not Impacted and Benefited?
01	B	R-01	60	62	63	63	0		
01	B	R-02	68	69	70	70	0		
01	B	R-03	53	55	58	54	4		
01	B	R-04	58	60	66	56	10	Yes	
01	B	R-05	58	60	66	54	12	Yes	
01	B	R-06	59	60	66	53	13	Yes	
01	B	R-07	50	52	56	46	9		Yes
01	B	R-08	50	52	54	47	7		Yes
01	B	R-09	58	60	66	53	13	Yes	
01	B	R-10	58	60	66	53	13	Yes	
01	B	R-11	58	60	66	53	13	Yes	
01	B	R-12	52	53	57	51	6		Yes
01	B	R-13	65	66	67	55	12	Yes	
01	B	R-14	57	58	60	57	2		
01	B	R-15	53	55	56	55	2		
02	B	R-16	62	63	69	56	13	Yes	
02	B	R-17	62	63	69	56	13	Yes	
02	B	R-18	61	63	68	58	10	Yes	
02	B	R-19	60	62	64	60	4		
02	B	R-20	52	54	56	52	3		
02	B	R-21	52	54	57	54	2		
02	B	R-22	54	55	58	56	2		
02	B	R-23	68	69	69	69	0		
02	B	R-24	61	62	67	61	6	Yes	
02	B	R-25	61	63	68	58	10	Yes	
02	B	R-26	61	62	69	60	8	Yes	
02	B	R-27	58	59	63	59	4		
02	B	R-28	53	54	56	53	3		
02	B	R-29	53	54	56	54	3		
02	B	R-30	55	56	57	55	2		
03	B	R-31	62	64	68	61	7	Yes	
03	B	R-32	61	62	68	58	10	Yes	
03	B	R-33	60	62	67	56	12	Yes	
03	B	R-34	60	62	67	55	12	Yes	
03	B	R-35	53	54	58	49	9		Yes
03	B	R-36	51	53	55	52	3		
03	B	R-37	52	54	56	54	2		
03	B	R-38	54	55	57	55	2		
03	B	R-39	55	56	58	49	6		Yes
03	B	R-40	58	59	61	51	8		Yes
03	B	R-41	61	62	67	54	14	Yes	
03	B	R-42	60	62	67	54	13	Yes	
03	B	R-43	58	60	65	54	11		Yes
03	B	R-44	52	53	57	48	9		Yes
03	B	R-45	51	53	55	49	5		Yes
04	B	R-46a	60	62	63				
04	B	R-46b	62	64	64				

CNE	NAC	Receptor	Existing 2017	No-Build 2045	Build 2045	Build 2045 with Potential Barrier	IL	Impacted and Benefited?	Not Impacted and Benefited?
04	B	R-46c	63	64	65				
04	B	R-47a	61	62	63				
04	B	R-47b	63	64	65				
04	B	R-47c	63	65	65				
04	B	R-48a	51	53	53				
04	B	R-48b	53	55	55				
04	B	R-48c	55	56	57				
04	B	R-48d	57	58	59				
04	B	R-49a	54	55	57				
04	B	R-49b	55	57	59				
04	B	R-49c	57	58	60				
04	B	R-49d	58	59	60				
04	B	R-129	52	54	56				
04	B	R-130	52	53	55				
05	B	R-50	61	62	69	57	12	Yes	
05	B	R-51	61	63	68	56	13	Yes	
05	B	R-52	61	63	68	57	11	Yes	
05	B	R-53	61	63	68	60	8	Yes	
05	B	R-54	57	59	62	59	3		
05	B	R-55	52	53	55	52	4		
05	B	R-56	52	53	55	51	4		
05	B	R-57	53	54	57	52	5		Yes
05	B	R-58	62	64	70	56	14	Yes	
05	B	R-59	62	64	70	56	13	Yes	
05	B	R-60	59	61	67	56	12	Yes	
05	B	R-61	53	55	58	53	6		Yes
05	B	R-62	53	54	58	53	6		Yes
05	B	R-63	61	62	68	62	6	Yes	
05	B	R-64	60	61	67	59	8	Yes	
05	B	R-65	59	60	67	58	9	Yes	
05	B	R-66	62	63	69	57	12	Yes	
05	B	R-67	59	61	67	56	11	Yes	
05	B	R-68	53	55	59	53	6		Yes
05	B	R-69	53	54	58	53	5		Yes
05	B	R-70	53	55	58	54	4		
05	B	R-71	54	56	58	55	3		
05	B	R-72	57	58	59	57	2		
06	B	R-73	63	64	70	55	15	Yes	
06	B	R-74	63	64	70	56	14	Yes	
06	B	R-75	58	59	65	54	11		Yes
06	B	R-76	55	56	59	56	3		
06	B	R-77	57	58	59	58	2		
06	B	R-78	59	60	67	55	12	Yes	
06	B	R-79	62	63	70	56	14	Yes	
06	B	R-80	61	63	69	56	14	Yes	
06	B	R-81	58	60	67	55	12	Yes	
06	B	R-82	63	64	69	55	15	Yes	
06	B	R-83	62	64	69	55	14	Yes	
06	B	R-84	60	61	68	55	13	Yes	
06	B	R-85	57	59	64	53	11		Yes
06	B	R-86	54	55	57	53	4		

CNE	NAC	Receptor	Existing 2017	No-Build 2045	Build 2045	Build 2045 with Potential Barrier	IL	Impacted and Benefited?	Not Impacted and Benefited?
06	B	R-87	56	57	58	56	2		
06	B	R-88	57	59	59	58	1		
07	B	R-89	59	61	61				
07	B	R-90	60	61	62				
07	B	R-91	60	61	61				
07	B	R-92	53	54	58				
08	B	R-93	60	61	61				
08	B	R-94	60	62	62				
08	B	R-95	61	63	64				
08	B	R-96	57	58	59	55	4		
08	C	R-97	66	67	69	57	12	Yes	
08	C	R-98	66	67	69	56	13	Yes	
08	C	R-99	65	66	68	56	12	Yes	
08	C	R-100	65	66	68	58	10	Yes	
08	C	R-101	66	67	69				
08	C	R-102	63	64	65				
08	C	R-103	61	62	63				
08	C	R-104	60	62	63	55	8		Yes
08	C	R-105	60	61	62	55	7		Yes
08	C	R-106	59	60	61	57	4		
08	B	R-107	56	58	65	56	9		Yes
08	B	R-108	59	60	67	58	10	Yes	
08	B	R-109	61	62	69	58	11	Yes	
08	B	R-110	62	64	71	57	13	Yes	
08	B	R-111	61	62	71	57	15	Yes	
08	B	R-112	66	67	70	65	5	Yes	
08	B	R-113	54	56	58	56	2		
08	B	R-114	56	57	59	57	2		
08	B	R-115	56	58	60	59	1		
09	B	R-116	61	62	69	54	15	Yes	
09	B	R-117	62	63	70	55	15	Yes	
09	B	R-118	61	63	70	55	15	Yes	
09	B	R-119	60	62	70	55	15	Yes	
09	B	R-120	60	62	69	60	9	Yes	
09	B	R-121	59	61	64	61	3		
09	B	R-122	58	59	59	58	1		
09	B	R-123	57	58	59	57	1		
10	C	R-131	63	65	66				
10	C	R-132	66	67	69				
10	C	R-133	66	67	69				
10	B	R-134a	63	64	66				
10	B	R-134b	63	64	65				
10	B	R-135a	63	64	65				
10	B	R-135b	63	64	65				
11	C	R-124	65	66	67	59	8	Yes	
11	C	R-125	64	66	67	59	8	Yes	
11	C	R-126	60	61	62	59	3		
11	C	R-127	60	61	62	59	3		
11	C	R-128	57	58	59	58	1		
11	D	R-136	59/34[1]	60/35[1]	61/36[1]				
12	D	R-137	58/33[1]	60/35[1]	60/35[1]				

CNE	NAC	Receptor	Existing 2017	No-Build 2045	Build 2045	Build 2045 with Potential Barrier	IL	Impacted and Benefited?	Not Impacted and Benefited?
13	D	R-138	58/33[1]	59/34[1]	59/34[1]				

[1] *Denotes predicted exterior/interior noise levels at Category D institutional receptors*

APPENDIX E NOISE MONITORING FIELD LOGS

This appendix includes data acquired during the noise monitoring measurement program, including noise monitor output and traffic counts resulting from video recording.

Site	Date & Time	Duration	Leq dB(A)
M-01	3/6/2018 12:45	0:01:00	54.4
M-01	3/6/2018 12:46	0:01:00	62.3
M-01	3/6/2018 12:47	0:01:00	64.3
M-01	3/6/2018 12:48	0:01:00	63
M-01	3/6/2018 12:49	0:01:00	64.2
M-01	3/6/2018 12:50	0:01:00	62.3
M-01	3/6/2018 12:51	0:01:00	61.1
M-01	3/6/2018 12:52	0:01:00	63
M-01	3/6/2018 12:53	0:01:00	63
M-01	3/6/2018 12:54	0:01:00	63.8
M-01	3/6/2018 12:55	0:01:00	59.7
M-01	3/6/2018 12:56	0:01:00	61.5
M-01	3/6/2018 12:57	0:01:00	63.7
M-01	3/6/2018 12:58	0:01:00	63.9
M-01	3/6/2018 12:59	0:01:00	64.2
M-01	3/6/2018 13:00	0:01:00	59.9
M-01	3/6/2018 13:01	0:01:00	61.7
M-01	3/6/2018 13:02	0:01:00	64.8
M-01	3/6/2018 13:03	0:01:00	62.9
M-01	3/6/2018 13:04	0:01:00	56.7
M-01	3/6/2018 13:05	0:01:00	59.3
M-01	3/6/2018 13:06	0:01:00	56.8
M-01	3/6/2018 13:07	0:01:00	58
M-01	3/6/2018 13:08	0:01:00	61.3
M-01	3/6/2018 13:09	0:01:00	62.9
M-01	3/6/2018 13:10	0:01:00	57.9
M-01	3/6/2018 13:11	0:01:00	57.7
M-01	3/6/2018 13:12	0:01:00	62.4
M-01	3/6/2018 13:13	0:01:00	60.9
M-01	3/6/2018 13:14	0:01:00	62.8
M-02	3/6/2018 12:45	0:01:00	59.1
M-02	3/6/2018 12:46	0:01:00	60.3
M-02	3/6/2018 12:47	0:01:00	60.9
M-02	3/6/2018 12:48	0:01:00	62.6
M-02	3/6/2018 12:49	0:01:00	62.5
M-02	3/6/2018 12:50	0:01:00	62.7
M-02	3/6/2018 12:51	0:01:00	59.8
M-02	3/6/2018 12:52	0:01:00	62.7
M-02	3/6/2018 12:53	0:01:00	54.5
M-02	3/6/2018 12:54	0:01:00	63.5
M-02	3/6/2018 12:55	0:01:00	59.7
M-02	3/6/2018 12:56	0:01:00	61.6

Site	Date & Time	Duration	Leq dB(A)
M-02	3/6/2018 12:57	0:01:00	59.2
M-02	3/6/2018 12:58	0:01:00	61.5
M-02	3/6/2018 12:59	0:01:00	62.8
M-02	3/6/2018 13:00	0:01:00	61.7
M-02	3/6/2018 13:01	0:01:00	61.7
M-02	3/6/2018 13:02	0:01:00	56.7
M-02	3/6/2018 13:03	0:01:00	65
M-02	3/6/2018 13:04	0:01:00	55.4
M-02	3/6/2018 13:05	0:01:00	54.7
M-02	3/6/2018 13:06	0:01:00	59
M-02	3/6/2018 13:07	0:01:00	54.1
M-02	3/6/2018 13:08	0:01:00	57.7
M-02	3/6/2018 13:09	0:01:00	65.9
M-02	3/6/2018 13:10	0:01:00	55.3
M-02	3/6/2018 13:11	0:01:00	60.7
M-02	3/6/2018 13:12	0:01:00	56.6
M-02	3/6/2018 13:13	0:01:00	62.7
M-02	3/6/2018 13:14	0:01:00	54.9
M-03	3/6/2018 12:45	0:01:00	50.8
M-03	3/6/2018 12:46	0:01:00	55.6
M-03	3/6/2018 12:47	0:01:00	52.8
M-03	3/6/2018 12:48	0:01:00	57.8
M-03	3/6/2018 12:49	0:01:00	52.4
M-03	3/6/2018 12:50	0:01:00	55
M-03	3/6/2018 12:51	0:01:00	54.7
M-03	3/6/2018 12:52	0:01:00	54.9
M-03	3/6/2018 12:53	0:01:00	56.2
M-03	3/6/2018 12:54	0:01:00	54.5
M-03	3/6/2018 12:55	0:01:00	51.4
M-03	3/6/2018 12:56	0:01:00	55.8
M-03	3/6/2018 12:57	0:01:00	52.7
M-03	3/6/2018 12:58	0:01:00	56.1
M-03	3/6/2018 12:59	0:01:00	53
M-03	3/6/2018 13:00	0:01:00	56.3
M-03	3/6/2018 13:01	0:01:00	53.2
M-03	3/6/2018 13:02	0:01:00	54.6
M-03	3/6/2018 13:03	0:01:00	55.1
M-03	3/6/2018 13:04	0:01:00	50.9
M-03	3/6/2018 13:05	0:01:00	51.2
M-03	3/6/2018 13:06	0:01:00	50.2
M-03	3/6/2018 13:07	0:01:00	50.7
M-03	3/6/2018 13:08	0:01:00	63.3
M-03	3/6/2018 13:09	0:01:00	52.1
M-03	3/6/2018 13:10	0:01:00	54.1
M-03	3/6/2018 13:11	0:01:00	51.8
M-03	3/6/2018 13:12	0:01:00	53.5
M-03	3/6/2018 13:13	0:01:00	55.4

Site	Date & Time	Duration	Leq dB(A)
M-03	3/6/2018 13:14	0:01:00	55.6
M-04	3/6/2018 11:33	0:01:00	64.1
M-04	3/6/2018 11:34	0:01:00	62.3
M-04	3/6/2018 11:35	0:01:00	54.9
M-04	3/6/2018 11:36	0:01:00	52.4
M-04	3/6/2018 11:37	0:01:00	58.6
M-04	3/6/2018 11:38	0:01:00	53.6
M-04	3/6/2018 11:39	0:01:00	55
M-04	3/6/2018 11:40	0:01:00	56.1
M-04	3/6/2018 11:41	0:01:00	61.1
M-04	3/6/2018 11:42	0:01:00	53.1
M-04	3/6/2018 11:43	0:01:00	54
M-04	3/6/2018 11:44	0:01:00	53.6
M-04	3/6/2018 11:45	0:01:00	57.9
M-04	3/6/2018 11:46	0:01:00	54.9
M-04	3/6/2018 11:47	0:01:00	62.2
M-04	3/6/2018 11:48	0:01:00	61.9
M-04	3/6/2018 11:49	0:01:00	55.9
M-04	3/6/2018 11:50	0:01:00	58.8
M-04	3/6/2018 11:51	0:01:00	57
M-04	3/6/2018 11:52	0:01:00	57.1
M-04	3/6/2018 11:53	0:01:00	59
M-04	3/6/2018 11:54	0:01:00	51.7
M-04	3/6/2018 11:55	0:01:00	65.4
M-04	3/6/2018 11:56	0:01:00	51.4
M-04	3/6/2018 11:57	0:01:00	58.1
M-04	3/6/2018 11:58	0:01:00	51.2
M-04	3/6/2018 11:59	0:01:00	58.4
M-04	3/6/2018 12:00	0:01:00	53.7
M-04	3/6/2018 12:01	0:01:00	50.7
M-04	3/6/2018 12:02	0:01:00	52.6
M-05	3/6/2018 11:33	0:01:00	53.5
M-05	3/6/2018 11:34	0:01:00	52.3
M-05	3/6/2018 11:35	0:01:00	47.5
M-05	3/6/2018 11:36	0:01:00	47.3
M-05	3/6/2018 11:37	0:01:00	49.9
M-05	3/6/2018 11:38	0:01:00	47.8
M-05	3/6/2018 11:39	0:01:00	46.8
M-05	3/6/2018 11:40	0:01:00	48.4
M-05	3/6/2018 11:41	0:01:00	51.1
M-05	3/6/2018 11:42	0:01:00	46.3
M-05	3/6/2018 11:43	0:01:00	49.4
M-05	3/6/2018 11:44	0:01:00	49.2
M-05	3/6/2018 11:45	0:01:00	50.9
M-05	3/6/2018 11:46	0:01:00	54
M-05	3/6/2018 11:47	0:01:00	55.8
M-05	3/6/2018 11:48	0:01:00	56.3

Site	Date & Time	Duration	Leq dB(A)
M-05	3/6/2018 11:49	0:01:00	51
M-05	3/6/2018 11:50	0:01:00	50.6
M-05	3/6/2018 11:51	0:01:00	48.7
M-05	3/6/2018 11:52	0:01:00	52.4
M-05	3/6/2018 11:53	0:01:00	50.6
M-05	3/6/2018 11:54	0:01:00	50.2
M-05	3/6/2018 11:55	0:01:00	53.3
M-05	3/6/2018 11:56	0:01:00	44
M-05	3/6/2018 11:57	0:01:00	48.9
M-05	3/6/2018 11:58	0:01:00	47.3
M-05	3/6/2018 11:59	0:01:00	48.8
M-05	3/6/2018 12:00	0:01:00	46.2
M-05	3/6/2018 12:01	0:01:00	50
M-05	3/6/2018 12:02	0:01:00	48
M-06	3/6/2018 11:33	0:01:00	63.3
M-06	3/6/2018 11:34	0:01:00	59.3
M-06	3/6/2018 11:35	0:01:00	58
M-06	3/6/2018 11:36	0:01:00	57.4
M-06	3/6/2018 11:37	0:01:00	59
M-06	3/6/2018 11:38	0:01:00	55.8
M-06	3/6/2018 11:39	0:01:00	57.2
M-06	3/6/2018 11:40	0:01:00	56.3
M-06	3/6/2018 11:41	0:01:00	62.9
M-06	3/6/2018 11:42	0:01:00	55.1
M-06	3/6/2018 11:43	0:01:00	56.9
M-06	3/6/2018 11:44	0:01:00	58.4
M-06	3/6/2018 11:45	0:01:00	58.1
M-06	3/6/2018 11:46	0:01:00	55.9
M-06	3/6/2018 11:47	0:01:00	62.4
M-06	3/6/2018 11:48	0:01:00	58.8
M-06	3/6/2018 11:49	0:01:00	60.8
M-06	3/6/2018 11:50	0:01:00	60.2
M-06	3/6/2018 11:51	0:01:00	58
M-06	3/6/2018 11:52	0:01:00	59.2
M-06	3/6/2018 11:53	0:01:00	55.7
M-06	3/6/2018 11:54	0:01:00	59.2
M-06	3/6/2018 11:55	0:01:00	63.9
M-06	3/6/2018 11:56	0:01:00	59.3
M-06	3/6/2018 11:57	0:01:00	58.2
M-06	3/6/2018 11:58	0:01:00	57
M-06	3/6/2018 11:59	0:01:00	58.8
M-06	3/6/2018 12:00	0:01:00	57.2
M-06	3/6/2018 12:01	0:01:00	52.2
M-06	3/6/2018 12:02	0:01:00	57.5
M-07	3/6/2018 10:05	0:01:00	51.3
M-07	3/6/2018 10:06	0:01:00	50.9
M-07	3/6/2018 10:07	0:01:00	49.8

Site	Date & Time	Duration	Leq dB(A)
M-07	3/6/2018 10:08	0:01:00	49.6
M-07	3/6/2018 10:09	0:01:00	48.9
M-07	3/6/2018 10:10	0:01:00	51.7
M-07	3/6/2018 10:11	0:01:00	48.6
M-07	3/6/2018 10:12	0:01:00	50
M-07	3/6/2018 10:13	0:01:00	49.4
M-07	3/6/2018 10:14	0:01:00	48.9
M-07	3/6/2018 10:15	0:01:00	54.6
M-07	3/6/2018 10:16	0:01:00	50.8
M-07	3/6/2018 10:17	0:01:00	52.7
M-07	3/6/2018 10:18	0:01:00	48.9
M-07	3/6/2018 10:19	0:01:00	49.2
M-07	3/6/2018 10:20	0:01:00	51.7
M-07	3/6/2018 10:21	0:01:00	49.8
M-07	3/6/2018 10:22	0:01:00	49
M-07	3/6/2018 10:23	0:01:00	49
M-07	3/6/2018 10:24	0:01:00	48.6
M-07	3/6/2018 10:25	0:01:00	48.8
M-07	3/6/2018 10:26	0:01:00	49.6
M-07	3/6/2018 10:27	0:01:00	55.4
M-07	3/6/2018 10:28	0:01:00	48.7
M-07	3/6/2018 10:29	0:01:00	49.2
M-07	3/6/2018 10:30	0:01:00	57.4
M-07	3/6/2018 10:31	0:01:00	57.3
M-07	3/6/2018 10:32	0:01:00	52.6
M-07	3/6/2018 10:33	0:01:00	49.3
M-07	3/6/2018 10:34	0:01:00	47.5
M-08	3/6/2018 10:05	0:01:00	54.6
M-08	3/6/2018 10:06	0:01:00	57.8
M-08	3/6/2018 10:07	0:01:00	52.9
M-08	3/6/2018 10:08	0:01:00	49.8
M-08	3/6/2018 10:09	0:01:00	53.4
M-08	3/6/2018 10:10	0:01:00	55.5
M-08	3/6/2018 10:11	0:01:00	53.3
M-08	3/6/2018 10:12	0:01:00	52.6
M-08	3/6/2018 10:13	0:01:00	56.9
M-08	3/6/2018 10:14	0:01:00	49.7
M-08	3/6/2018 10:15	0:01:00	58.5
M-08	3/6/2018 10:16	0:01:00	54.8
M-08	3/6/2018 10:17	0:01:00	56.6
M-08	3/6/2018 10:18	0:01:00	57.7
M-08	3/6/2018 10:19	0:01:00	52.3
M-08	3/6/2018 10:20	0:01:00	54.6
M-08	3/6/2018 10:21	0:01:00	56.8
M-08	3/6/2018 10:22	0:01:00	51.8
M-08	3/6/2018 10:23	0:01:00	55.5
M-08	3/6/2018 10:24	0:01:00	51.8

Site	Date & Time	Duration	Leq dB(A)
M-08	3/6/2018 10:25	0:01:00	56.8
M-08	3/6/2018 10:26	0:01:00	53.3
M-08	3/6/2018 10:27	0:01:00	54.3
M-08	3/6/2018 10:28	0:01:00	53.4
M-08	3/6/2018 10:29	0:01:00	55
M-08	3/6/2018 10:30	0:01:00	52.4
M-08	3/6/2018 10:31	0:01:00	54.2
M-08	3/6/2018 10:32	0:01:00	47.6
M-08	3/6/2018 10:33	0:01:00	54.4
M-08	3/6/2018 10:34	0:01:00	48.3
M-09	3/6/2018 10:05	0:01:00	64.9
M-09	3/6/2018 10:06	0:01:00	59.3
M-09	3/6/2018 10:07	0:01:00	56.3
M-09	3/6/2018 10:08	0:01:00	60.3
M-09	3/6/2018 10:09	0:01:00	62.3
M-09	3/6/2018 10:10	0:01:00	60.2
M-09	3/6/2018 10:11	0:01:00	59.2
M-09	3/6/2018 10:12	0:01:00	63.1
M-09	3/6/2018 10:13	0:01:00	56.2
M-09	3/6/2018 10:14	0:01:00	64.2
M-09	3/6/2018 10:15	0:01:00	60.7
M-09	3/6/2018 10:16	0:01:00	61.6
M-09	3/6/2018 10:17	0:01:00	64.7
M-09	3/6/2018 10:18	0:01:00	57.4
M-09	3/6/2018 10:19	0:01:00	61.8
M-09	3/6/2018 10:20	0:01:00	63.8
M-09	3/6/2018 10:21	0:01:00	57.4
M-09	3/6/2018 10:22	0:01:00	61.7
M-09	3/6/2018 10:23	0:01:00	58.4
M-09	3/6/2018 10:24	0:01:00	63.1
M-09	3/6/2018 10:25	0:01:00	60
M-09	3/6/2018 10:26	0:01:00	59.2
M-09	3/6/2018 10:27	0:01:00	57.1
M-09	3/6/2018 10:28	0:01:00	61.9
M-09	3/6/2018 10:29	0:01:00	58.7
M-09	3/6/2018 10:30	0:01:00	61
M-09	3/6/2018 10:31	0:01:00	53.6
M-09	3/6/2018 10:32	0:01:00	60.8
M-09	3/6/2018 10:33	0:01:00	54.7
M-09	3/6/2018 10:34	0:01:00	61.2
M-10	3/6/2018 10:05	0:01:00	51.2
M-10	3/6/2018 10:06	0:01:00	45.6
M-10	3/6/2018 10:07	0:01:00	53.9
M-10	3/6/2018 10:08	0:01:00	58.3
M-10	3/6/2018 10:09	0:01:00	46.4
M-10	3/6/2018 10:10	0:01:00	57.3
M-10	3/6/2018 10:11	0:01:00	46.1

Site	Date & Time	Duration	Leq dB(A)
M-10	3/6/2018 10:12	0:01:00	49.7
M-10	3/6/2018 10:13	0:01:00	48.7
M-10	3/6/2018 10:14	0:01:00	51.3
M-10	3/6/2018 10:15	0:01:00	54.5
M-10	3/6/2018 10:16	0:01:00	52.8
M-10	3/6/2018 10:17	0:01:00	53.2
M-10	3/6/2018 10:18	0:01:00	44.1
M-10	3/6/2018 10:19	0:01:00	50.5
M-10	3/6/2018 10:20	0:01:00	48
M-10	3/6/2018 10:21	0:01:00	47.7
M-10	3/6/2018 10:22	0:01:00	46.3
M-10	3/6/2018 10:23	0:01:00	48.4
M-10	3/6/2018 10:24	0:01:00	45.2
M-10	3/6/2018 10:25	0:01:00	55.2
M-10	3/6/2018 10:26	0:01:00	46.2
M-10	3/6/2018 10:27	0:01:00	58.6
M-10	3/6/2018 10:28	0:01:00	49.3
M-10	3/6/2018 10:29	0:01:00	45.1
M-10	3/6/2018 10:30	0:01:00	46
M-10	3/6/2018 10:31	0:01:00	52.9
M-10	3/6/2018 10:32	0:01:00	44.8
M-10	3/6/2018 10:33	0:01:00	48.4
M-10	3/6/2018 10:34	0:01:00	45.3

Traffic was counted manually, on site, during short-term noise monitoring on March 6, 2018, with the results shown below.

Traffic Measurement Session	Roadway	Cars	Medium Trucks	Heavy Trucks	Buses	Motorcycles
10:05 – 10:34	Centerville Tpk NB	171	11	13	0	0
10:05 – 10:34	Centerville Tpk SB	132	7	6	0	0
11:33 – 12:02	Centerville Tpk NB	183	3	9	2	1
11:33 – 12:02	Centerville Tpk SB	199	10	12	1	1
12:45 – 13:14	Centerville Tpk NB	81	7	7	0	0
12:45 – 13:14	Centerville Tpk SB	102	8	6	0	0

APPENDIX F WARRANTED, FEASIBLE AND REASONABLE WORKSHEETS

Warranted, Feasible, and Reasonable Worksheet

Note: the answers provided in the worksheet may differ between preliminary and final design. This worksheet is available in a protected digital format upon request.

Date:	June 18, 2018
Project No. and UPC:	CIP# 2-419, 7-027; PWCN# 17-0018; UPC# 109381
County:	None (Independent city)
Facility:	Centerville Turnpike
Barrier System ID:	1P
Noise Abatement Category(s)	B
Community Name and/or CNE#	CNE 01

Design phase: [X] Preliminary Design [ ] Final Design

Warranted

1. Community Documentation (if applicable)
   a. Date community was permitted. (Per 23CFR 772 this is the date the building permit was issued). — TBD
   b. Date of approval for the Categorical Exclusion (CE), Record of Decision (ROD), or Finding of No Significant Impact (FONSI): — N/A
   c. Does the date in 1.a precede the date in 1.b? If yes, proceed to Warranted Item 2. If no, consideration of noise abatement is not warranted. Proceed to "Decision" block and answer "no" to warranted question. As the reason for this decision, state that "Community was permitted after the date of approval of CE, ROD, or FONSI, as appropriate." — [X] Yes [ ] No

2. Criteria requiring consideration of noise abatement
   a. Project causes design year noise levels to approach or exceed the Noise Abatement Criteria? — [X] Yes [ ] No
   b. Project causes a substantial noise increase of 10 dBA or more? — [ ] Yes [X] No

Feasibility

1. Impacted receptor units
   a. Number of impacted receptor units: — 8
   b. Number of impacted receptor units receiving 5 dBA or more insertion loss (IL): — 7
   c. Percentage of impacted receptor units receiving 5 dB(A) or more IL — 87.5%
   d. Is the percentage 50 or greater? — [X] Yes [ ] No

2	Will placement of the noise barrier cause engineering or safety conflicts, e.g. drainage or site distance issues?	☐ Yes	☐ No
3	Will placement of the noise barrier restrict access to vehicular or pedestrian travel?	☐ Yes	☒ No
4	Will placement of the noise barrier conflict with existing utility locations?	☐ Yes	☐ No

Reasonableness

1. Cost-Benefit Factors

a. Surface Area (Total square foot) of the proposed noise barrier. (ft^2)	10,380
b. Impacted noise sensitive receptor(s) receiving 5 dB(A) IL or more.	7
c. Non-impacted noise sensitive receptor(s) receiving 5 dB(A) IL or more.	3
d. Total number of benefited receptors.	10
e. Surface Area per benefited receptor unit. (ft^2/BR)	1,038
f. Is (1e) less than or equal to the maximum square feet per benefited receptor (MaxSF/BR) value of 1600?	Yes
g. Does the barrier provide an IL of at least 7 dB(A) for at least one impacted receptor in the design year?	Yes

2. Community Desires Related to the Barrier
   a. Do at least 50 percent of the benefited receptor unit owner(s) and renters desire the noise barrier? If yes, continue to "decision" block. If no, the barrier can be considered not to be reasonable. Proceed to "decision" block and answer "no" to reasonableness question. As the reason for this decision, state that "The majority of the impacted receptor unit owners do not desire the barrier." ☐ Yes ☐ No

3. Additional Noise Barrier Details

a. Length of the proposed noise barrier	692
b Height range of the proposed noise barrier	15
c. Average height of the proposed noise barrier	15
d Cost per square foot. ($/$ft^2$)	$42
e. Total Barrier Cost ($)	$435,960
f. Additional comments (if applicable)	
g. Barrier material	☐ Absorptive ☐ Reflective

Decision

Is the Noise Barrier(s) WARRANTED?	☒ Yes	☐ No
Is the Noise Barrier(s) FEASIBLE?	☐ Yes	☐ No
Is the Noise Barrier(s) REASONABLE?	☐ Yes	☐ No

Additional Reasons for Decision:
Reasonableness pending community decision.
Feasibility pending further examination of utilities, drainage and right-of-way.

Warranted, Feasible, and Reasonable Worksheet

Note: the answers provided in the worksheet may differ between preliminary and final design. This worksheet is available in a protected digital format upon request.

Date:	June 18, 2018
Project No. and UPC:	CIP# 2-419, 7-027; PWCN# 17-0018; UPC# 109381
County:	None (Independent city)
Facility:	Centerville Turnpike
Barrier System ID:	2P
Noise Abatement Category(s)	B
Community Name and/or CNE#	CNE 02

Design phase: [X] Preliminary Design [ ] Final Design

Warranted

1. Community Documentation (if applicable)
   a. Date community was permitted. (Per 23CFR 772 this is the date the building permit was issued). — TBD
   b. Date of approval for the Categorical Exclusion (CE), Record of Decision (ROD), or Finding of No Significant Impact (FONSI): — N/A
   c. Does the date in 1.a precede the date in 1.b? If yes, proceed to Warranted Item 2. If no, consideration of noise abatement is not warranted. Proceed to "Decision" block and answer "no" to warranted question. As the reason for this decision, state that "Community was permitted after the date of approval of CE, ROD, or FONSI, as appropriate." — [X] Yes [ ] No

2. Criteria requiring consideration of noise abatement
   a. Project causes design year noise levels to approach or exceed the Noise Abatement Criteria? — [X] Yes [ ] No
   b. Project causes a substantial noise increase of 10 dBA or more? — [ ] Yes [X] No

Feasibility

1. Impacted receptor units
   a. Number of impacted receptor units: — 7
   b. Number of impacted receptor units receiving 5 dBA or more insertion loss (IL): — 6
   c. Percentage of impacted receptor units receiving 5 dB(A) or more IL — 86%
   d. Is the percentage 50 or greater? — [X] Yes [ ] No

2	Will placement of the noise barrier cause engineering or safety conflicts, e.g. drainage or site distance issues?	☐ Yes	☐ No
3	Will placement of the noise barrier restrict access to vehicular or pedestrian travel?	☐ Yes	☒ No
4	Will placement of the noise barrier conflict with existing utility locations?	☐ Yes	☐ No

Reasonableness

1. Cost-Benefit Factors

a. Surface Area (Total square foot) of the proposed noise barrier. (ft^2)	8,910
b. Impacted noise sensitive receptor(s) receiving 5 dB(A) IL or more.	6
c. Non-impacted noise sensitive receptor(s) receiving 5 dB(A) IL or more.	0
d. Total number of benefited receptors.	6
e. Surface Area per benefited receptor unit. (ft^2/BR)	1,485
f. Is (1e) less than or equal to the maximum square feet per benefited receptor (MaxSF/BR) value of 1600?	Yes
g. Does the barrier provide an IL of at least 7 dB(A) for at least one impacted receptor in the design year?	Yes

2. Community Desires Related to the Barrier
   a. Do at least 50 percent of the benefited receptor unit owner(s) and renters desire the noise barrier? If yes, continue to "decision" block. If no, the barrier can be considered not to be reasonable. Proceed to "decision" block and answer "no" to reasonableness question. As the reason for this decision, state that "The majority of the impacted receptor unit owners do not desire the barrier." ☐ Yes ☐ No

3. Additional Noise Barrier Details

a. Length of the proposed noise barrier	594
b Height range of the proposed noise barrier	15
c. Average height of the proposed noise barrier	15
d Cost per square foot. ($/$ft^2$)	$42
e. Total Barrier Cost ($)	$374,220
f. Additional comments (if applicable)	
g. Barrier material	☐ Absorptive ☐ Reflective

Decision

Is the Noise Barrier(s) WARRANTED?	☒ Yes	☐ No
Is the Noise Barrier(s) FEASIBLE?	☐ Yes	☐ No
Is the Noise Barrier(s) REASONABLE?	☐ Yes	☐ No

Additional Reasons for Decision:
Reasonableness pending community decision.
Feasibility pending further examination of utilities, drainage and right-of-way.

Warranted, Feasible, and Reasonable Worksheet

Note: the answers provided in the worksheet may differ between preliminary and final design. This worksheet is available in a protected digital format upon request.

Date:	June 18, 2018
Project No. and UPC:	CIP# 2-419, 7-027; PWCN# 17-0018; UPC# 109381
County:	None (Independent city)
Facility:	Centerville Turnpike
Barrier System ID:	3P
Noise Abatement Category(s)	B
Community Name and/or CNE#	CNE 03

Design phase: [X] Preliminary Design [ ] Final Design

Warranted

1. Community Documentation (if applicable)
   a. Date community was permitted. (Per 23CFR 772 this is the date the building permit was issued). — TBD
   b. Date of approval for the Categorical Exclusion (CE), Record of Decision (ROD), or Finding of No Significant Impact (FONSI): — N/A
   c. Does the date in 1.a precede the date in 1.b? If yes, proceed to Warranted Item 2. If no, consideration of noise abatement is not warranted. Proceed to "Decision" block and answer "no" to warranted question. As the reason for this decision, state that "Community was permitted after the date of approval of CE, ROD, or FONSI, as appropriate." — [X] Yes [ ] No

2. Criteria requiring consideration of noise abatement
   a. Project causes design year noise levels to approach or exceed the Noise Abatement Criteria? — [X] Yes [ ] No
   b. Project causes a substantial noise increase of 10 dBA or more? — [ ] Yes [X] No

Feasibility

1. Impacted receptor units
   a. Number of impacted receptor units: — 6
   b. Number of impacted receptor units receiving 5 dBA or more insertion loss (IL): — 6
   c. Percentage of impacted receptor units receiving 5 dB(A) or more IL — 100%
   d. Is the percentage 50 or greater? — [X] Yes [ ] No

2	Will placement of the noise barrier cause engineering or safety conflicts, e.g. drainage or site distance issues?	☐ Yes	☐ No
3	Will placement of the noise barrier restrict access to vehicular or pedestrian travel?	☐ Yes	☒ No
4	Will placement of the noise barrier conflict with existing utility locations?	☐ Yes	☐ No

Reasonableness

1. Cost-Benefit Factors

a. Surface Area (Total square foot) of the proposed noise barrier. (ft^2)	9,420
b. Impacted noise sensitive receptor(s) receiving 5 dB(A) IL or more.	6
c. Non-impacted noise sensitive receptor(s) receiving 5 dB(A) IL or more.	6
d. Total number of benefited receptors.	12
e. Surface Area per benefited receptor unit. (ft^2/BR)	785
f. Is (1e) less than or equal to the maximum square feet per benefited receptor (MaxSF/BR) value of 1600?	YES
g. Does the barrier provide an IL of at least 7 dB(A) for at least one impacted receptor in the design year?	YES

2. Community Desires Related to the Barrier
   a. Do at least 50 percent of the benefited receptor unit owner(s) and renters desire the noise barrier? If yes, continue to "decision" block. If no, the barrier can be considered not to be reasonable. Proceed to "decision" block and answer "no" to reasonableness question. As the reason for this decision, state that "The majority of the impacted receptor unit owners do not desire the barrier." ☐ Yes ☐ No

3. Additional Noise Barrier Details

a. Length of the proposed noise barrier	628
b Height range of the proposed noise barrier	15
c. Average height of the proposed noise barrier	15
d Cost per square foot. ($/$ft^2$)	$42
e. Total Barrier Cost ($)	$395,640
f. Additional comments (if applicable)	
g. Barrier material	☐ Absorptive ☐ Reflective

Decision

Is the Noise Barrier(s) WARRANTED?	☒ Yes	☐ No
Is the Noise Barrier(s) FEASIBLE?	☐ Yes	☐ No
Is the Noise Barrier(s) REASONABLE?	☐ Yes	☐ No

Additional Reasons for Decision:
Reasonableness pending community decision.
Feasibility pending further examination of utilities, drainage and right-of-way.

Warranted, Feasible, and Reasonable Worksheet

Note: the answers provided in the worksheet may differ between preliminary and final design. This worksheet is available in a protected digital format upon request.

Date:	June 18, 2018
Project No. and UPC:	CIP# 2-419, 7-027; PWCN# 17-0018; UPC# 109381
County:	None (Independent city)
Facility:	Centerville Turnpike
Barrier System ID:	4P
Noise Abatement Category(s)	B
Community Name and/or CNE#	CNE 05

Design phase: [X] Preliminary Design [ ] Final Design

Warranted

1. Community Documentation (if applicable)
   a. Date community was permitted. (Per 23CFR 772 this is the date the building permit was issued). — TBD
   b. Date of approval for the Categorical Exclusion (CE), Record of Decision (ROD), or Finding of No Significant Impact (FONSI): — N/A
   c. Does the date in 1.a precede the date in 1.b? If yes, proceed to Warranted Item 2. If no, consideration of noise abatement is not warranted. Proceed to "Decision" block and answer "no" to warranted question. As the reason for this decision, state that "Community was permitted after the date of approval of CE, ROD, or FONSI, as appropriate." — [X] Yes [ ] No

2. Criteria requiring consideration of noise abatement
   a. Project causes design year noise levels to approach or exceed the Noise Abatement Criteria? — [X] Yes [ ] No
   b. Project causes a substantial noise increase of 10 dBA or more? — [ ] Yes [X] No

Feasibility

1. Impacted receptor units
   a. Number of impacted receptor units: — 12
   b. Number of impacted receptor units receiving 5 dBA or more insertion loss (IL): — 12
   c. Percentage of impacted receptor units receiving 5 dB(A) or more IL — 100%
   d. Is the percentage 50 or greater? — [X] Yes [ ] No

2	Will placement of the noise barrier cause engineering or safety conflicts, e.g. drainage or site distance issues?	☐ Yes	☐ No
3	Will placement of the noise barrier restrict access to vehicular or pedestrian travel?	☐ Yes	☒ No
4	Will placement of the noise barrier conflict with existing utility locations?	☐ Yes	☐ No

Reasonableness

1. Cost-Benefit Factors

a. Surface Area (Total square foot) of the proposed noise barrier. (ft^2)	15,135
b. Impacted noise sensitive receptor(s) receiving 5 dB(A) IL or more.	12
c. Non-impacted noise sensitive receptor(s) receiving 5 dB(A) IL or more.	5
d. Total number of benefited receptors.	17
e. Surface Area per benefited receptor unit. (ft^2/BR)	890
f. Is (1e) less than or equal to the maximum square feet per benefited receptor (MaxSF/BR) value of 1600?	YES
g. Does the barrier provide an IL of at least 7 dB(A) for at least one impacted receptor in the design year?	YES

2. Community Desires Related to the Barrier
   a. Do at least 50 percent of the benefited receptor unit owner(s) and renters desire the noise barrier? If yes, continue to "decision" block. If no, the barrier can be considered not to be reasonable. Proceed to "decision" block and answer "no" to reasonableness question. As the reason for this decision, state that "The majority of the impacted receptor unit owners do not desire the barrier." ☐ Yes ☐ No

3. Additional Noise Barrier Details

a. Length of the proposed noise barrier	1,009
b Height range of the proposed noise barrier	15
c. Average height of the proposed noise barrier	15
d Cost per square foot. ($/$ft^2$)	$42
e. Total Barrier Cost ($)	$635,670
f. Additional comments (if applicable)	
g. Barrier material	☐ Absorptive ☐ Reflective

Decision

Is the Noise Barrier(s) WARRANTED?	☒ Yes	☐ No
Is the Noise Barrier(s) FEASIBLE?	☐ Yes	☐ No
Is the Noise Barrier(s) REASONABLE?	☐ Yes	☐ No

Additional Reasons for Decision:
Reasonableness pending community decision.
Feasibility pending further examination of utilities, drainage and right-of-way.

Warranted, Feasible, and Reasonable Worksheet

Note: the answers provided in the worksheet may differ between preliminary and final design. This worksheet is available in a protected digital format upon request.

Date:	June 18, 2018
Project No. and UPC:	CIP# 2-419, 7-027; PWCN# 17-0018; UPC# 109381
County:	None (Independent city)
Facility:	Centerville Turnpike
Barrier System ID:	5P
Noise Abatement Category(s)	B
Community Name and/or CNE#	CNE 06

Design phase: [X] Preliminary Design [ ] Final Design

Warranted

1. Community Documentation (if applicable)
   a. Date community was permitted. (Per 23CFR 772 this is the date the building permit was issued). — TBD
   b. Date of approval for the Categorical Exclusion (CE), Record of Decision (ROD), or Finding of No Significant Impact (FONSI): — N/A
   c. Does the date in 1.a precede the date in 1.b? If yes, proceed to Warranted Item 2. If no, consideration of noise abatement is not warranted. Proceed to "Decision" block and answer "no" to warranted question. As the reason for this decision, state that "Community was permitted after the date of approval of CE, ROD, or FONSI, as appropriate." — [X] Yes [ ] No

2. Criteria requiring consideration of noise abatement
   a. Project causes design year noise levels to approach or exceed the Noise Abatement Criteria? — [X] Yes [ ] No
   b. Project causes a substantial noise increase of 10 dBA or more? — [ ] Yes [X] No

Feasibility

1. Impacted receptor units
   a. Number of impacted receptor units: — 9
   b. Number of impacted receptor units receiving 5 dBA or more insertion loss (IL): — 9
   c. Percentage of impacted receptor units receiving 5 dB(A) or more IL — 100%
   d. Is the percentage 50 or greater? — [X] Yes [ ] No

2	Will placement of the noise barrier cause engineering or safety conflicts, e.g. drainage or site distance issues?	☐ Yes	☐ No
3	Will placement of the noise barrier restrict access to vehicular or pedestrian travel?	☐ Yes	☒ No
4	Will placement of the noise barrier conflict with existing utility locations?	☐ Yes	☐ No

Reasonableness

1. Cost-Benefit Factors

a. Surface Area (Total square foot) of the proposed noise barrier. (ft^2)	12,750
b. Impacted noise sensitive receptor(s) receiving 5 dB(A) IL or more.	9
c. Non-impacted noise sensitive receptor(s) receiving 5 dB(A) IL or more.	2
d. Total number of benefited receptors.	11
e. Surface Area per benefited receptor unit. (ft^2/BR)	1,159
f. Is (1e) less than or equal to the maximum square feet per benefited receptor (MaxSF/BR) value of 1600?	YES
g. Does the barrier provide an IL of at least 7 dB(A) for at least one impacted receptor in the design year?	YES

2. Community Desires Related to the Barrier
   a. Do at least 50 percent of the benefited receptor unit owner(s) and renters desire the noise barrier? If yes, continue to "decision" block. If no, the barrier can be considered not to be reasonable. Proceed to "decision" block and answer "no" to reasonableness question. As the reason for this decision, state that "The majority of the impacted receptor unit owners do not desire the barrier." ☐ Yes ☐ No

3. Additional Noise Barrier Details

a. Length of the proposed noise barrier	850
b Height range of the proposed noise barrier	15
c. Average height of the proposed noise barrier	15
d Cost per square foot. ($/$ft^2$)	$42
e. Total Barrier Cost ($)	$535,500
f. Additional comments (if applicable)	
g. Barrier material	☐ Absorptive ☐ Reflective

Decision

Is the Noise Barrier(s) WARRANTED?	☒ Yes	☐ No
Is the Noise Barrier(s) FEASIBLE?	☐ Yes	☐ No
Is the Noise Barrier(s) REASONABLE?	☐ Yes	☐ No

Additional Reasons for Decision:
Reasonableness pending community decision.
Feasibility pending further examination of utilities, drainage and right-of-way.

Warranted, Feasible, and Reasonable Worksheet

Note: the answers provided in the worksheet may differ between preliminary and final design. This worksheet is available in a protected digital format upon request.

Date:	June 18, 2018
Project No. and UPC:	CIP# 2-419, 7-027; PWCN# 17-0018; UPC# 109381
County:	None (Independent city)
Facility:	Centerville Turnpike
Barrier System ID:	6P
Noise Abatement Category(s)	B
Community Name and/or CNE#	CNE 08

Design phase: [X] Preliminary Design [ ] Final Design

Warranted

1. Community Documentation (if applicable)
   a. Date community was permitted. (Per 23CFR 772 this is the date the building permit was issued). — TBD
   b. Date of approval for the Categorical Exclusion (CE), Record of Decision (ROD), or Finding of No Significant Impact (FONSI): — N/A
   c. Does the date in 1.a precede the date in 1.b? If yes, proceed to Warranted Item 2. If no, consideration of noise abatement is not warranted. Proceed to "Decision" block and answer "no" to warranted question. As the reason for this decision, state that "Community was permitted after the date of approval of CE, ROD, or FONSI, as appropriate." — [X] Yes [ ] No

2. Criteria requiring consideration of noise abatement
   a. Project causes design year noise levels to approach or exceed the Noise Abatement Criteria? — [X] Yes [ ] No
   b. Project causes a substantial noise increase of 10 dBA or more? — [ ] Yes [X] No

Feasibility

1. Impacted receptor units
   a. Number of impacted receptor units: — 10
   b. Number of impacted receptor units receiving 5 dBA or more insertion loss (IL): — 9
   c. Percentage of impacted receptor units receiving 5 dB(A) or more IL — 90%
   d. Is the percentage 50 or greater? — [X] Yes [ ] No

2	Will placement of the noise barrier cause engineering or safety conflicts, e.g. drainage or site distance issues?	☐ Yes	☐ No
3	Will placement of the noise barrier restrict access to vehicular or pedestrian travel?	☐ Yes	☒ No
4	Will placement of the noise barrier conflict with existing utility locations?	☐ Yes	☐ No

Reasonableness

1. Cost-Benefit Factors

a. Surface Area (Total square foot) of the proposed noise barrier. (ft^2)	9,750
b. Impacted noise sensitive receptor(s) receiving 5 dB(A) IL or more.	9
c. Non-impacted noise sensitive receptor(s) receiving 5 dB(A) IL or more.	3
d. Total number of benefited receptors.	12
e. Surface Area per benefited receptor unit. (ft^2/BR)	812
f. Is (1e) less than or equal to the maximum square feet per benefited receptor (MaxSF/BR) value of 1600?	YES
g. Does the barrier provide an IL of at least 7 dB(A) for at least one impacted receptor in the design year?	YES

2. Community Desires Related to the Barrier
   a. Do at least 50 percent of the benefited receptor unit owner(s) and renters desire the noise barrier? If yes, continue to "decision" block. If no, the barrier can be considered not to be reasonable. Proceed to "decision" block and answer "no" to reasonableness question. As the reason for this decision, state that "The majority of the impacted receptor unit owners do not desire the barrier." ☐ Yes ☐ No

3. Additional Noise Barrier Details

a. Length of the proposed noise barrier	650
b Height range of the proposed noise barrier	15
c. Average height of the proposed noise barrier	15
d Cost per square foot. ($/$ft^2$)	$42
e. Total Barrier Cost ($)	$409,500
f. Additional comments (if applicable)	
g. Barrier material	☐ Absorptive ☐ Reflective

Decision

Is the Noise Barrier(s) WARRANTED?	☒ Yes	☐ No
Is the Noise Barrier(s) FEASIBLE?	☐ Yes	☐ No
Is the Noise Barrier(s) REASONABLE?	☐ Yes	☐ No

Additional Reasons for Decision:
Reasonableness pending community decision.
Feasibility pending further examination of utilities, drainage and right-of-way.

Warranted, Feasible, and Reasonable Worksheet

Note: the answers provided in the worksheet may differ between preliminary and final design. This worksheet is available in a protected digital format upon request.

Date:	June 18, 2018
Project No. and UPC:	CIP# 2-419, 7-027; PWCN# 17-0018; UPC# 109381
County:	None (Independent city)
Facility:	Centerville Turnpike
Barrier System ID:	7P
Noise Abatement Category(s)	B
Community Name and/or CNE#	CNE 09

Design phase: [X] Preliminary Design [ ] Final Design

Warranted

1. Community Documentation (if applicable)
   a. Date community was permitted. (Per 23CFR 772 this is the date the building permit was issued). — TBD
   b. Date of approval for the Categorical Exclusion (CE), Record of Decision (ROD), or Finding of No Significant Impact (FONSI): — N/A
   c. Does the date in 1.a precede the date in 1.b? If yes, proceed to Warranted Item 2. If no, consideration of noise abatement is not warranted. Proceed to "Decision" block and answer "no" to warranted question. As the reason for this decision, state that "Community was permitted after the date of approval of CE, ROD, or FONSI, as appropriate." — [X] Yes [ ] No

2. Criteria requiring consideration of noise abatement
   a. Project causes design year noise levels to approach or exceed the Noise Abatement Criteria? — [X] Yes [ ] No
   b. Project causes a substantial noise increase of 10 dBA or more? — [ ] Yes [X] No

Feasibility

1. Impacted receptor units
   a. Number of impacted receptor units: — 5
   b. Number of impacted receptor units receiving 5 dBA or more insertion loss (IL): — 5
   c. Percentage of impacted receptor units receiving 5 dB(A) or more IL — 100%
   d. Is the percentage 50 or greater? — [X] Yes [ ] No

2	Will placement of the noise barrier cause engineering or safety conflicts, e.g. drainage or site distance issues?	☐ Yes	☐ No
3	Will placement of the noise barrier restrict access to vehicular or pedestrian travel?	☐ Yes	☒ No
4	Will placement of the noise barrier conflict with existing utility locations?	☐ Yes	☐ No

Reasonableness

1. Cost-Benefit Factors

a. Surface Area (Total square foot) of the proposed noise barrier. (ft^2)	4,920
b. Impacted noise sensitive receptor(s) receiving 5 dB(A) IL or more.	5
c. Non-impacted noise sensitive receptor(s) receiving 5 dB(A) IL or more.	0
d. Total number of benefited receptors.	5
e. Surface Area per benefited receptor unit. (ft^2/BR)	984
f. Is (1e) less than or equal to the maximum square feet per benefited receptor (MaxSF/BR) value of 1600?	YES
g. Does the barrier provide an IL of at least 7 dB(A) for at least one impacted receptor in the design year?	YES

2. Community Desires Related to the Barrier
   a. Do at least 50 percent of the benefited receptor unit owner(s) and renters desire the noise barrier? If yes, continue to "decision" block. If no, the barrier can be considered not to be reasonable. Proceed to "decision" block and answer "no" to reasonableness question. As the reason for this decision, state that "The majority of the impacted receptor unit owners do not desire the barrier." ☐ Yes ☐ No

3. Additional Noise Barrier Details

a. Length of the proposed noise barrier	328
b Height range of the proposed noise barrier	15
c. Average height of the proposed noise barrier	15
d Cost per square foot. ($/$ft^2$)	$42
e. Total Barrier Cost ($)	$206,640
f. Additional comments (if applicable)	
g. Barrier material	☐ Absorptive ☐ Reflective

Decision

Is the Noise Barrier(s) WARRANTED?	☒ Yes	☐ No
Is the Noise Barrier(s) FEASIBLE?	☐ Yes	☐ No
Is the Noise Barrier(s) REASONABLE?	☐ Yes	☐ No

Additional Reasons for Decision:
Reasonableness pending community decision.
Feasibility pending further examination of utilities, drainage and right-of-way.

Warranted, Feasible, and Reasonable Worksheet

Note: the answers provided in the worksheet may differ between preliminary and final design. This worksheet is available in a protected digital format upon request.

Date:	June 18, 2018
Project No. and UPC:	CIP# 2-419, 7-027; PWCN# 17-0018; UPC# 109381
County:	None (Independent city)
Facility:	Centerville Turnpike
Barrier System ID:	8P
Noise Abatement Category(s)	C
Community Name and/or CNE#	CNE 11

Design phase: [X] Preliminary Design [ ] Final Design

Warranted

1. Community Documentation (if applicable)
   a. Date community was permitted. (Per 23CFR 772 this is the date the building permit was issued). — TBD
   b. Date of approval for the Categorical Exclusion (CE), Record of Decision (ROD), or Finding of No Significant Impact (FONSI): — N/A
   c. Does the date in 1.a precede the date in 1.b? If yes, proceed to Warranted Item 2. If no, consideration of noise abatement is not warranted. Proceed to "Decision" block and answer "no" to warranted question. As the reason for this decision, state that "Community was permitted after the date of approval of CE, ROD, or FONSI, as appropriate." — [X] Yes [ ] No

2. Criteria requiring consideration of noise abatement
   a. Project causes design year noise levels to approach or exceed the Noise Abatement Criteria? — [X] Yes [ ] No
   b. Project causes a substantial noise increase of 10 dBA or more? — [ ] Yes [X] No

Feasibility

1. Impacted receptor units
   a. Number of impacted receptor units: — 2
   b. Number of impacted receptor units receiving 5 dBA or more insertion loss (IL): — 2
   c. Percentage of impacted receptor units receiving 5 dB(A) or more IL — 100%
   d. Is the percentage 50 or greater? — [X] Yes [ ] No

2	Will placement of the noise barrier cause engineering or safety conflicts, e.g. drainage or site distance issues?	☐ Yes	☐ No
3	Will placement of the noise barrier restrict access to vehicular or pedestrian travel?	☐ Yes	☒ No
4	Will placement of the noise barrier conflict with existing utility locations?	☐ Yes	☐ No

Reasonableness

1. Cost-Benefit Factors

a. Surface Area (Total square foot) of the proposed noise barrier. (ft^2)	2,940
b. Impacted noise sensitive receptor(s) receiving 5 dB(A) IL or more.	2
c. Non-impacted noise sensitive receptor(s) receiving 5 dB(A) IL or more.	0
d. Total number of benefited receptors.	2
e. Surface Area per benefited receptor unit. (ft^2/BR)	1,470
f. Is (1e) less than or equal to the maximum square feet per benefited receptor (MaxSF/BR) value of 1600?	YES
g. Does the barrier provide an IL of at least 7 dB(A) for at least one impacted receptor in the design year?	YES

2. Community Desires Related to the Barrier
   a. Do at least 50 percent of the benefited receptor unit owner(s) and renters desire the noise barrier? If yes, continue to "decision" block. If no, the barrier can be considered not to be reasonable. Proceed to "decision" block and answer "no" to reasonableness question. As the reason for this decision, state that "The majority of the impacted receptor unit owners do not desire the barrier." ☐ Yes ☐ No

3. Additional Noise Barrier Details

a. Length of the proposed noise barrier	196
b Height range of the proposed noise barrier	15
c. Average height of the proposed noise barrier	15
d Cost per square foot. ($/$ft^2$)	$42
e. Total Barrier Cost ($)	$123,480
f. Additional comments (if applicable)	
g. Barrier material	☐ Absorptive ☐ Reflective

Decision

Is the Noise Barrier(s) WARRANTED?	☒ Yes	☐ No
Is the Noise Barrier(s) FEASIBLE?	☐ Yes	☐ No
Is the Noise Barrier(s) REASONABLE?	☐ Yes	☐ No

Additional Reasons for Decision:
Reasonableness pending school decision.
Feasibility pending further examination of utilities, drainage and right-of-way.

APPENDIX G RESPONSE FROM PROJECT MANAGER ON ALTERNATIVE NOISE ABATEMENT MEASURES

This appendix will include a memo and survey sent to the City of Virginia Beach Department of Public Works project manager about the potential for use of alternative noise abatement measures, pursuant to Virginia House Bill 2577.

APPENDIX H SITE SKETCHES, METER PRINTOUTS, CALIBRATION AND OTHER PERTINENT CORRESPONDENCE

Site M-01, Photograph #1

Site M-01, Photograph #2

Site M-02, Photograph #1

Site M-02, Photograph #2

Site M-03, Photograph #1

Site M-03, Photograph #2

Site M-04, Photograph #1

Site M-04, Photograph #2

Site M-05, Photograph #1

Site M-05, Photograph #2

Site M-06, Photograph #1

Site M-06, Photograph #2

Site M-07, Photograph #1

Site M-07, Photograph #2

Site M-08, Photograph #1

Site M-08, Photograph #2

Site M-09, Photograph #1

Site M-09, Photograph #2

Site M-10, Photograph #1

Site M-10, Photograph #2

RION CO., LTD.

3-20-41 Higashimotomachi Kokubunji Tokyo 185-8533
Phone:042(359)7888, Facsimile:042(359)7442

Certificate of Calibration

Name : **Sound Level Meter, Class 2**

Model : **NL-42** **S/No.** : **00560088**

Date of Calibration : **June, 22, 2016**

We hereby certify that the above product was tested and calibrated according to the prescribed Rion procedures, and that it fulfills specification requirements.
The measuring equipment and reference devices used for testing and calibrating this unit are managed under the Rion traceability system and are traceable according to official Japanese standards and official standards of countries belonging to the International Committee of Weights and Measures.

RION CO., LTD.

K. Ikeda

Manager, Quality Control Department

RION CO., LTD.

3-20-41 Higashimotomachi Kokubunji Tokyo 185-8533
Phone:042(359)7888, Facsimile:042(359)7442

Certificate of Calibration

Name : **Sound Level Meter, Class 2**

Model : **NL-42** **S/No.** : **00560089**

Date of Calibration : **June, 22, 2016**

We hereby certify that the above product was tested and calibrated according to the prescribed Rion procedures, and that it fulfills specification requirements.
The measuring equipment and reference devices used for testing and calibrating this unit are managed under the Rion traceability system and are traceable according to official Japanese standards and official standards of countries belonging to the International Committee of Weights and Measures.

RION CO., LTD.

K. Ikeda

Manager, Quality Control Department

RION CO., LTD.

3-20-41 Higashimotomachi Kokubunji Tokyo 185-8533
Phone:042(359)7888, Facsimile:042(359)7442

Certificate of Calibration

Name : **Sound Level Meter, Class 2**

Model : **NL-42** **S/No.** : **00560090**

Date of Calibration : **June, 22, 2016**

We hereby certify that the above product was tested and calibrated according to the prescribed Rion procedures, and that it fulfills specification requirements.
The measuring equipment and reference devices used for testing and calibrating this unit are managed under the Rion traceability system and are traceable according to official Japanese standards and official standards of countries belonging to the International Committee of Weights and Measures.

RION CO., LTD.

K. Ikeda

Manager, Quality Control Department

RION CO., LTD.

3-20-41 Higashimotomachi Kokubunji Tokyo 185-8533
Phone:042(359)7888, Facsimile:042(359)7442

Certificate of Calibration

Name : **Sound Level Meter, Class 2**

Model : **NL-42** **S/No.** : **00560164**

Date of Calibration : **June, 22, 2016**

We hereby certify that the above product was tested and calibrated according to the prescribed Rion procedures, and that it fulfills specification requirements.
The measuring equipment and reference devices used for testing and calibrating this unit are managed under the Rion traceability system and are traceable according to official Japanese standards and official standards of countries belonging to the International Committee of Weights and Measures.

RION CO., LTD.

K. Ikeda

Manager, Quality Control Department

RION CO., LTD.

3-20-41 Higashimotomachi Kokubunji Tokyo 185-8533
Phone:042(359)7888, Facsimile:042(359)7442

Certificate of Calibration

Name : **Sound Calibrator**

Model : **NC-74** **S/No.** : **34367623**

Date of Calibration : **March, 17, 2016**

We hereby certify that the above product was tested and calibrated according to the prescribed Rion procedures, and that it fulfills specification requirements.
The measuring equipment and reference devices used for testing and calibrating this unit are managed under the Rion traceability system and are traceable according to official Japanese standards and official standards of countries belonging to the International Committee of Weights and Measures.

RION CO., LTD.

K. Ohata

Manager, Quality Control Department

APPENDIX I TNM CERTIFICATES

FHWA TNM 2.5 Certification of George Tye is provided.

Certificate of Continuing Education

This is to certify that

George Tye

has satisfactorily completed 32 hours of training on

FHWA TRAFFIC NOISE MODEL 2.5

conducted by

Bowlby & Associates, Inc.

Franklin, TN
October 30 - November 2, 2012

William Bowlby, Ph.D., P.E.
Bowlby & Associates, Inc.

Darlene Reiter, Ph.D., P.E.
Bowlby & Associates, Inc.

APPENDIX J NOISE ANALYSIS MAPS