Preliminary Noise Analysis
Draft Technical Report

Route 29/15/17 Interchange Project

Fauquier County

VDOT Project No. 0029-030-121, P101

UPC 77384

HMMH Report No. 306780.011
March 2017

Prepared for:
Virginia Department of Transportation
1401 East Broad St.
Richmond, VA 23219

Prepared by:

HMMH
77 South Bedford Street
Burlington, MA 01803
781.229.0707

EXECUTIVE SUMMARY

This report describes the details of a noise impact assessment and preliminary noise abatement evaluation performed for the Route 29/15/17 Interchange project in Fauquier County, Virginia. The noise analysis was conducted in accordance with Federal highway Administration (FHWA) and Virginia Department of Transportation (VDOT) noise assessment regulations and guidelines, both of which were revised and updated significantly in 2011. The FHWA regulations are set forth in 23 CFR Part 772. VDOT's revised policy was updated most recently on July 14, 2015.

The Route 29/15/17 Interchange project proposes to replace the existing at-grade intersection of Route 29/15/17, Route 29/15/17 Business and Route 880 (Lord Fairfax Drive) with a grade-separated facility to improve safety and capacity. The project is expected to improve traffic flow for commuters, as well as those traveling to the Fauquier County landfill and Lord Fairfax Community College. Route 29/15/17 currently carries an estimated 43,500 vehicles on a daily basis and is expected to carry 74,000 vehicles per day by 2040.

The study involved monitoring of existing noise conditions and modeling of existing (2016) and design year (2040) noise conditions in the study area with the FHWA-approved computerized Traffic Noise Model. Modeling accounted for the existing terrain and buildings, and for existing and proposed roadways with projected loudest-hour traffic, which was found to be the Saturday peak hour. Noise impact was assessed for the 2040 Build alternative and is summarized by FHWA land use activity category in the table below. Traffic noise projections are preliminary and will be reevaluated during the final design noise analysis.

The proposed Project is not related to the interstate system, nor does it result in a "constructive use" of a Section 4(f) property. Consequently, this preliminary noise study does not include an analysis of traffic noise levels for the design year No-build (2040) alternative, consistent with VDOT's State Noise Abatement Policy.

Noise Impact Summary

Alternative	Impact Type[1]	Number of Impacted Units by Land Use and FHWA Activity Category[2]				
		Residential Exterior (B)	Recreational Exterior (C)	Institutional Interior (D)	Commercial Exterior (E)	Total
Existing	NAC	2	n/a	n/a	n/a	2
Build	NAC	5	n/a	n/a	n/a	7
	Sub'l Inc.	1	n/a	n/a	n/a	
	Both	1	n/a	n/a	n/a	

Source: HMMH, 2017
Notes:
1.) "NAC" = Noise levels approach or exceed the FHWA Noise Abatement Criteria (NAC) for applicable Activity Category; "Sub'l Inc." = Design Year Build noise levels causes a substantial increase (10 decibels, or more) over existing noise levels; "Both" = Design Year Build noise levels approach or exceed the applicable NAC and cause a substantial increase (10 decibels, or more) over existing noise levels.
2.) The FHWA Activity Category is shown in parenthesis.

Noise abatement must be considered where noise impact is predicted to occur with the 2040 Build alternative. Noise abatement is evaluated to determine if it is warranted, feasible and reasonable. The

following table summarizes the total length, estimated cost and benefits that would be provided by the noise barriers that were evaluated in this study. Barrier B was found to be feasible and not reasonable, based on cost-effectiveness. There are potential utility conflicts associated with Barrier C; however, these conflicts would be further evaluated during the final design of the Project, if the noise barrier is shown to be warranted, feasible and reasonable at that time.

Noise abatement was found to be not feasible at one location along the project corridor where existing driveway access to Route 29/15/17 is to be maintained in the design year.

Summary of Noise Barriers Evaluated in this Study

Barrier ID	Number of Impacted Receptors	Impacted & Benefited Receptors	Non-Impacted & Benefited Receptors	Noise Barrier Parameters				Surface Area/ Benefited Receptor (SF/BR)[2]	Barrier Status[3]
				Length (feet)	Height (feet)	Surface Area (sq feet)	Cost at $42/sq feet[1]		
B	5	5	3	2,124	13	27,578	$1,158,276	3,447	F & NR
C	1	1	0	292	16	4,667	$196,014	4,667	F & NR[4]

Source: HMMH, 2017

Notes:

1.) This unit cost is a statewide average based on the three most recent years of historic data and only includes noise barrier material and installation costs.

2.) Where SF/BR exceeds VDOT's maximum of 1600, a noise barrier would not be considered cost-reasonable.

3.) Barrier Status: F & R = Feasible and Reasonable; F & NR = Feasible and Not Reasonable; NF = Not Feasible.

4.) Potential utility conflicts associated with Barrier C would be further evaluated during the final design of the Project, if the noise barrier is shown to be warranted, feasible and reasonable.

The Design Year Build alternative that was modeled for this preliminary noise study is based upon a design concept for a diamond interchange with signalized ramp terminals. Another design concept that is also under consideration by VDOT replaces the signalized ramp terminals with a roundabout. While the roundabout concept was not modeled for this study, it is expected to produce similar – or even lower – Design Year noise levels and noise impact than those produced by the diamond interchange concept. On the east side of Route 29/15/17 Bypass, the roundabout concept would locate proposed ramps and Lord Fairfax Road further from the residences on Turkey Run Drive. Although it is difficult to judge the magnitude of the difference in noise levels on the east side of the highway with the roundabout concept, the diamond interchange is nevertheless judged to be somewhat louder, thereby representing a worst case and lending a level of conservatism to this impact assessment. Note that a roundabout concept for the west side of the new interchange had not been reviewed for this noise study.

This report presents the results of a preliminary noise evaluation; a more detailed review will be completed during the final design of the Project. As such, noise barriers that are found to be feasible and reasonable during the preliminary noise analysis may 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.

Construction activity may cause intermittent fluctuations in noise levels. During the construction phase of the project, all reasonable measures will be taken to minimize noise impact from these activities.

TABLE OF CONTENTS

1 INTRODUCTION 1
1.2 Project Description 1
1.3 Study Area Description and Land Use 2
2 NOISE ABATEMENT CRITERIA AND DESIGN GOALS 4
2.1 Regulations and Guidelines 4
2.2 Noise Abatement Criteria 4
3 EXISTING NOISE CONDITIONS 6
3.1 Monitoring of Existing Noise Levels 6
3.2 Predicted Existing Noise Levels 7
3.3 Undeveloped Lands and Permitted Developments 7
4 TRAFFIC NOISE PREDICTION 9
4.1 Noise Prediction Model 9
4.2 Noise Model Validation 9
4.2.1 Validation results at Site M2 10
4.3 Traffic Data for Noise Prediction 11
4.4 Presentation of Results 12
5 NOISE IMPACT ASSESSMENT 14
6 NOISE ABATEMENT MEASURES 16
6.1 Alternative Noise Abatement Measures 16
6.1.1 Traffic Control Measures (TCM) 16
6.1.2 Alteration of Horizontal and Vertical Alignments 16
6.1.3 Acoustical Insulation 17
6.1.4 Acquisition of Buffer Land 17
6.1.5 Construction of Earth Berms 17
6.2 Noise Barriers 17
6.2.1 Feasibility and Reasonableness 18
6.2.2 Barriers Found Not Feasible 18
6.2.3 Summary of Potential Noise Barriers 19
7 CONSTRUCTION NOISE CONSIDERATION 21
8 INFORMATION FOR LOCAL GOVERNMENT OFFICIALS 22
8.1 Noise-Compatible Land-Use Planning 22

8.2 VDOT's Noise Abatement Program 22

9 REFERENCES 23

APPENDIX A LIST OF PREPARERS A-1

APPENDIX B TRAFFIC DATA USED IN NOISE ANALYSIS B-1

APPENDIX C PREDICTED TRAFFIC NOISE LEVELS C-1

APPENDIX D NOISE MEASUREMENT DATA D-1

APPENDIX E PROPOSED ARRINGTON DEVELOPMENT - CONCEPT PLAN E-1

APPENDIX F RESPONSE FROM VDOT PROJECT MANAGEMENT ON ALTERNATIVE NOISE ABATEMENT MEASURES F-1

APPENDIX G WARRANTED, FEASIBLE AND REASONABLE WORKSHEETS G-1

LIST OF FIGURES

Figure 1 Study Area and Measurement Location Map 3
Figure 2 Location Map for Common Noise Environments, Receptors, Build Contours, and Barriers.. 13

LIST OF TABLES

Table 1 FHWA Noise Abatement Criteria 5
Table 2 Short-term Noise Monitoring Summary 7
Table 3 Computed vs. Measured Sound Levels at Measurement Sites 10
Table 4 Ranges of Predicted Exterior Noise Levels for the Worst Hour 12
Table 5 Noise Impact Summary 14
Table 6 Predicted Traffic Noise Impact by Common Noise Environment (CNE) 15
Table 7 Summary of Potential Noise Barriers 20
Table 8 2016 Existing Conditions: AM, PM, and Saturday Peak Hour Traffic Data B-2
Table 9 2040 Build Alternative: AM, PM, and Saturday Peak Hour Traffic Data B-3
Table 10 Comparison of TNM-Computed Traffic Noise Levels for AM, PM, and Saturday Peak Hours B-4
Table 11 Predicted Traffic Noise Levels C-2

1 INTRODUCTION

1.1 Background and Purpose

The Federal Highway Administration (FHWA) regulations for 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 there is the addition of through-traffic lanes or ramps in an interchange. The methods and procedures used in this preliminary noise impact evaluation are consistent with the latest noise assessment policies issued by FHWA and the Virginia Department of Transportation (VDOT); VDOT's Highway Traffic Noise Impact Analysis Guidance Manual was updated most recently on July 14, 2015.

This report presents a summary of the roadway improvements under study, 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 prediction of future noise impact, an evaluation of potential noise abatement measures, construction noise considerations, and information for local government officials. Appendix A presents the list of preparers, Appendix B tabulates the traffic data used in the noise modeling, Appendix C presents predicted noise levels, Appendix D presents all noise measurement data, Appendix E provides a response from the VDOT project management on alternative noise abatement measures, and Appendix F presents VDOT's Warranted, Feasible and Reasonable barrier worksheets.

1.2 Project Description

The Route 29/15/17 Interchange project in Fauquier County proposes to replace the existing at-grade intersection of Route 29/15/17, Route 29/15/17 Business and Route 880 (Lord Fairfax Drive) with a grade-separated facility to improve safety and capacity. The project is expected to improve traffic flow for commuters, as well as those traveling to the Fauquier County landfill and Lord Fairfax Community College. Route 29/15/17 currently carries an estimated 43,500 vehicles on a daily basis and is expected to carry 74,000 vehicles per day by 2040. The project corridor is approximately 2.1 miles in length and extends from 1.05 miles south to 1.05 miles north of Route 29/15/17 Business.[1]

The Design Year Build alternative that was modeled for this preliminary noise study is based upon a design concept for a diamond interchange with signalized ramp terminals. Another design concept that is also under consideration by VDOT replaces the signalized ramp terminals with a roundabout. While the roundabout concept was not modeled for this study, it is expected to produce similar – or even lower – Design Year noise levels and noise impact than those produced by the diamond interchange concept. On the east side of Route 29/15/17 Bypass, the roundabout concept would locate proposed ramps and Lord Fairfax Road further from the residences on Turkey Run Drive. Although it is difficult to judge the magnitude of the difference in noise levels on the east side of the highway with the roundabout concept, the diamond interchange is nevertheless judged to be somewhat louder, thereby representing a worst case and lending a level of conservatism to this impact assessment. Note that a roundabout concept for the west side of the new interchange had not been reviewed for this noise study.

[1] http://www.virginiadot.org/projects/culpeper/warrentonintersection.asp

1.3 Study Area Description and Land Use

Noise sensitive land uses in the project study area include single-family residences along Route 29/15/17 Business, on Turkey Run Drive, on Travelers Way, and along Route 29/15/17 south of the proposed interchange. Following VDOT and FHWA policies and procedures, the receptors used in the model to represent exterior activity areas at noise-sensitive land uses were grouped into Common Noise Environments (CNEs). Receptors in a CNE are exposed to similar noise sources and levels and generally occur between secondary noise sources, such as cross-streets. The modeled receptors for the Project were grouped into the following CNEs:

- CNE A is located along the east side of Route 29/15/17 Business, just north of the proposed interchange, and consists of two single-family homes.
- CNE B is located on the east side of Route 29/15/17 Bypass, from the approximate location of the proposed interchange to the northern project limit, and consists of 15 single-family homes on Turkey Run Drive.
- CNE C is located on the east side of Route 29/15/17, just south of the proposed interchange, and consists of four single-family homes on Travelers Way.
- CNE D is located on the west side of Route 29/15/17, within 500 feet of the southern project limit, and consists of one single-family home.

Figure 1 shows the location of the study area and the noise monitoring locations, which are discussed in detail in Section 3.1

▲M# Measurement Site

Study Area

VDOT Virginia Department of Transportation

Figure 1
Study Area Location Map

Route 15/17/29 Interchange Project
Warrenton and Fauquier County

UPC No. 77384

0 4,000 8,000 Feet

2 NOISE ABATEMENT CRITERIA AND DESIGN GOALS

2.1 Regulations and Guidelines

The potential noise impact of the Route 29/15/17 Interchange project was assessed in accordance with FHWA and VDOT noise assessment regulations and guidelines. The FHWA regulations are set forth in 23 CFR Part 772. On July 13, 2010, FHWA published revised noise regulations which became effective on July 13, 2011. FHWA has also published a guidance document to support the new regulations. VDOT prepared revisions to its noise policy in accordance with FHWA's requirements and revised policy. VDOT's revised policy has received approval from FHWA, and was last updated on July 14, 2015.

2.2 Noise Abatement Criteria

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 activity (see Table 1). The NAC are given in terms of the hourly, A-weighted, equivalent sound level in decibels (dBA). The A-weighted sound level is commonly used when measuring environmental noise to provide a single number descriptor that correlates with human subjective response to noise because the sensitivity of human hearing varies with frequency. The A-weighted sound level is widely accepted by acousticians as a proper unit for describing environmental 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 $L_{eq}(h)$.

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

1. The predicted traffic noise levels (future design year) approach or exceed the NAC, as shown in Table 1.

2. The predicted traffic noise levels (future design year) cause a substantial increase

In this study, only residential areas (Activity Category B) were evaluated for impact. Recreational areas (Activity Category C) and institutional interior spaces (Activity Category D) are not present within the study area boundary. For Category B noise impact would occur when predicted exterior noise levels, approach or exceed 67 dBA in terms of $L_{eq}(h)$ during the loudest hour of the day. VDOT defines the word "approach" in "approach or exceed" as within 1 decibel. Therefore, the threshold for noise impact is where exterior noise levels are within 1 decibel of 67 dBA $L_{eq}(h)$, or 66 dBA.

Noise impact also would occur wherever project noise causes a substantial increase over existing noise levels. VDOT defines a substantial increase as an increase of 10 decibels or more above existing noise levels for all noise-sensitive exterior activity categories. For example, if a receptor's existing noise level is 50 dBA, an impact due to a substantial increase would occur if the design year noise level is 60 dBA as a result of the project. The design year project noise level need not exceed the applicable NAC for a substantial increase to occur.

Table 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[2]	72 (Exterior)	Hotels, motels, offices, restaurants/bars, and other developed lands, properties or activities not included in A-D or F
F	–	Agriculture, airports, bus yards, emergency services, industrial, logging, maintenance facilities, manufacturing, mining, rail yards, retail facilities, shipyards, utilities (water resources, water treatment, electrical), and warehousing
G	–	Undeveloped lands that are not permitted (without building permits)

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

When the predicted design-year Build case 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 warranted and necessary. If it is found that such mitigation measures will 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 (2016) conditions and the design-year (2040) Build alternative.

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 loudest-hour traffic data. The prediction methods and predicted noise levels appear in Section 4.

3 EXISTING NOISE CONDITIONS

This section of the report describes the noise monitoring program and the investigation of undeveloped lands and permitted developments.

3.1 Monitoring of Existing Noise Levels

A noise monitoring program was conducted within the Route 29/15/17 Interchange project study area, consistent with FHWA and VDOT recommended procedures. The objectives of the monitoring program were to document existing ambient noise levels in noise-sensitive locations and to provide a means for validation of the traffic noise prediction model.

Noise monitoring was conducted at four short-term (30 minutes in duration) sites on January 5, 2017. Measurement sites were generally located in areas with the highest noise exposures, adjacent to first-row properties. Traffic classification counts on the roadways nearest each measurement site were conducted simultaneously with each noise measurement. The short-term measurements characterized existing noise levels in the study area but were not necessarily conducted during the loudest hour of the day. They included contributions from sources other than traffic, such as aircraft. Figure 1 shows the locations of the noise measurement sites within the project study area. The short-term noise monitoring locations are shown in the study area graphic, and labeled with the prefix "M."

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 CNE to validate the computer noise model.

Short-term noise measurements were conducted using an HMMH-owned Larson-Davis 824 (ANSI Type I, "Precision") integrating sound level meter. HMMH's noise measurement instruments are calibrated annually at a certification laboratory, with calibrations traceable to the National Institute of Standards and Technology. During the monitoring program, the sound level meters were calibrated in the field using a handheld acoustic calibrator at the beginning and end of each measurement period.

The short-term data collection procedure involved measurement of one-second equivalent sound levels (L_{eq}s) over a period of 30 minutes. Continuous logging of events was conducted during the monitoring, so that intervals that included events not representative of the ambient noise environment or not traffic-related could be excluded later. For each 30-minute period, a "Total L_{eq}" (includes non-contaminated sound level contributions from every 1-second interval) and a "Traffic-only L_{eq}" (excludes those intervals that contained noise events unrelated to roadway noise) were determined. By comparing the two totals, the significance of non-traffic events (such as aircraft operations) to the overall noise level can be determined for the measurement period.

The measured noise levels appear in Table 2 as equivalent sound levels (L_{eq}). As described above, the L_{eq} is a sound-energy average of the fluctuating sound level (in A-weighted decibels, dBA) measured over a specified period of time. Table 2 provides the site address, as well as the date, start time, and duration of each measurement. Measured noise levels are presented both in terms of the "Total L_{eq}" and the "Traffic-only L_{eq}".

As shown in Table 2, the Total L_{eq} ranged from a low of 58 dBA at 6860 Traveler's Way (Site M3) to a high of 74 dBA at 8598 James Madison Highway (Site M4). At each measurement site the value of the Traffic-only L_{eq} is the same as the measured Total L_{eq}, which is an indication that roadway

traffic was the dominant source of noise in spite of the presence of other sporadic and occasional noise events in the community.

Traffic on Route 29/15/17, Route 29/15/17 Business, Route 29/15/17 Bypass, and Lord Fairfax Road was the dominant source of noise. Other sources of noise in the existing environment included, but were not limited to aircraft overflights (near and far), biogenic sounds (birds and dogs), and distant electrical equipment. Appendix D provides details of the data acquired during the noise measurement program, including noise monitor output, site sketches, photographs, noise level data with site summary results, and traffic counts with hourly totals. The locations of the measurement sites are shown on the overview map in Figure 1.

Table 2 Short-term Noise Monitoring Summary

Site No.	Address/Location	Date	Time Start (hh:mm:ss)	Duration (minutes)	Monitored Total L_{eq} (dBA)	Monitored Traffic-Only L_{eq} (dBA)
M1	8485 Turkey Run Drive	5-Jan-2017	12:23:00	30	62	62
M2	8484 Turkey Run Drive	5-Jan-2017	11:17:00	30	60	60
M3	6860 Traveler's Way	5-Jan-2017	9:40:00	30	58	58
M4	8598 James Madison Hwy	5-Jan-2017	13:34:00	30	74	74

Source: HMMH, 2017

3.2 Predicted Existing Noise Levels

For calculation of loudest-hour noise levels throughout the study area, many additional receiver locations were added to the measurement sites in the TNM to provide a comprehensive basis of comparison for the analysis of noise impacts from the existing and future project conditions. Using the appropriate loudest-hour traffic data, existing and future traffic noise levels were predicted for the measurement sites and the additional receiver locations. The computation methods and predicted noise levels are presented in the next section of this report.

The noise measurements provided valuable information on current noise conditions and the effects of terrain and shielding on sound propagation from the roadway to the nearby residential land uses. However, because existing noise levels are not always measured during the loudest hour of the day, estimates of the loudest-hour existing noise levels were computed with an FHWA-approved noise prediction model using the appropriate traffic data as input. These predicted estimates of existing noise levels for the loudest hour of the day are then used as the baseline against which probable future noise levels are compared and potential noise impacts assessed. Additional information on the computation methods and computed levels used in this study are provided in Section 4.

3.3 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. VDOT considers the "Date of Public Knowledge" as the date that the final National Environmental Protection Act (NEPA) approval is made. VDOT has no obligation to provide noise mitigation for any undeveloped land that is permitted or constructed after this date.

While the project corridor contains undeveloped lands, there are no planned or permitted lands or developments with noise-sensitive land use within a 500-foot buffer zone around the project roadways. The planned Arrington development for active adults would be located along the entire west side of the project corridor, from just inside the Warrenton service district at the intersection of Alwington Boulevard and Route 29/15/17 Business to Lovers Lane in Fauquier County. The planned development includes residential land use, which would be located more than 500 feet beyond the project's buffer zone, and agricultural land use (slated as a possible vineyard), which would be located between the residential land use and the project roadways. Appendix E provides a concept plan of the Arrington development.

4 TRAFFIC NOISE PREDICTION

This section discusses the noise prediction model, the model validation process, traffic data used as input to the noise prediction model, and then presents a summary of the predicted noise levels.

4.1 Noise Prediction Model

HMMH used the latest version of the FHWA's Traffic Noise Model (TNM Version 2.5) to compute future Build case loudest-hour noise levels and develop the preliminary heights, lengths and locations for all potential noise barriers along the project corridor. 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.

TNM runs were developed from MicroStation roadway design and existing terrain contour files that were supplied by VDOT and aerial imagery from ESRI ArcMap. The proposed Project consists of a new grade-separated interchange with the associated on- and off-ramps, a relocated Route 880 (Lord Fairfax Drive), and a new location for the Turkey Run Drive intersection on Route 880. This preliminary noise study evaluated the potential noise impact for a design concept described as a diamond interchange with signalized ramp terminals. This design concept includes signalized intersections on either side of the new overpass – at the end of the Route 29/15/17 northbound off-ramp and at the end of the Route 29/15/17 Bypass southbound off-ramp.

The noise model also included a number of "dummy" lanes (roadways without traffic) to represent paved shoulders, turning lanes, and side streets. The modeling accounted for the variability in the local terrain and included the following parameters that affect the propagation of traffic noise: terrain lines, ground zones, and fixed height barriers to represent buildings. The default ground type used in the modeling was "lawn."

To fully characterize future noise levels at all noise-sensitive land uses in the study area, noise prediction receivers (also called "receptors" and/or "sites") were added to the measurement sites in the TNM runs. The study area consists primarily of exterior residential (Category B) land use and lands that are currently undeveloped and not permitted (Category G) adjacent to project roadways. All TNM runs are provided upon request in native electronic form.

4.2 Noise Model Validation

According to FHWA and VDOT policies, the accuracy of the noise prediction model must be verified on a project-by-project basis. The noise model validation process compares existing noise levels monitored in the field with predicted noise levels from the FHWA TNM using the traffic conditions during the monitoring period as input to the model. The purpose of the noise model validation is to evaluate the success of the model in representing the important acoustical characteristics of the study area. This is determined by examining the overall trend of the differences between measured and predicted noise levels at each measurement site. Individual site to site differences may vary significantly, depending on factors that may affect either the measured noise level or the predicted noise level at a given site. Examples of factors that affect noise levels are provided below:

- Atmospheric conditions (upwind, neutral or downwind conditions), shielding by structures that are difficult to model, and/or the presence of "loud" vehicle pass-bys during the measurement.
- The level of detail in modeling terrain features and locating receptors, as well as the degree to which ground zones, tree zones, and sparse rows of buildings are incorporated into the model.

FHWA and VDOT consider the noise model to be validated when measured noise levels are within +/- 3 dBA of predicted noise levels for existing conditions.

FHWA discourages the "calibration" of a noise model through the use of adjustment factors within the noise model to match measured and predicted levels. FHWA recognizes that many factors are present both in the measurement of noise and in the development of a model that can lead to variability of outcomes. Differences between measured and predicted levels that are outside the accepted accuracy of the model are likely due to unusual circumstances during the measurements, or to insufficient detail or inaccurate assumptions in the model. Only after a thorough examination of the measurement conditions and the modeling assumptions has been completed, should the highway noise analyst consider the use of adjustment factors in the model. FHWA recognizes that in some cases, it may not be possible to identify a specific reason for not validating a specific measurement site. Any such cases are to be documented in the noise study report.

Table 3 presents a site-by-site comparison of measured noise levels and the corresponding TNM-computed noise levels. At three out of four sites, the differences between measured and predicted noise levels fall within three decibels, which is the accepted level of accuracy in the noise model. The Project-wide average difference between calculated noise levels and monitored noise levels was 1.8 decibels (over all four sites), which generally shows excellent agreement between monitored and modeled sound levels, and suggests confidence in the modeling assumptions.

Table 3 Computed vs. Measured Sound Levels at Measurement Sites

Site No.	CNE(s)	Address / Location / Land Use	Monitored L_{eq} (dBA)*	TNM-Computed L_{eq} (dBA)	Difference (dB) (computed *minus* monitored)
M1	B	8485 Turkey Run Drive	62.1	64.8	2.7
M2	B	8484 Turkey Run Drive	60.4	64.5	4.1
M3	C	6860 Traveler's Way	58.3	59.4	1.1
M4	D	8598 James Madison Hwy	74.4	73.9	-0.5
Average difference:					1.8
Standard deviation of difference:					2.0

* Monitored traffic-only sound level
Source: HMMH, 2017

4.2.1 Validation results at Site M2

The validation results at Site M2 were slightly outside the normally acceptable range. As shown in Table 3, the difference between the TNM-computed noise level and the monitored level was 4.1 decibels, suggesting that TNM is slightly over-predicting at this location. The validation exercise included many refinements to the modeling assumptions to achieve the best possible agreement with

monitored noise level data. Based on the validation, the refinements to the noise model included terrain lines to capture the topography of the intervening terrain, tree zones, stop-and-go traffic at the existing signalized intersection, and different ground types along the propagation path.

The existing signalized intersection was modeled according to the guidance and best practices in National Cooperative Highway Research Program (NCHRP) Report 311 *Predicting Stop-and-Go Traffic Noise Levels* and NCHRP Report 791 *Supplemental Guidance on the Application of FHWA's Traffic Noise Model (TNM)*. The results of the validation suggest that TNM may be over-predicting the effects of accelerating vehicles leaving the intersection on the northbound lanes of the Bypass – particularly at Site M2.

As shown in the photograph for Site M2 in Appendix D, the intervening terrain along the right-of-way between the microphone location and the Bypass was a mix of brush and field grass. The best agreement with monitored data was achieved when the ground vegetation along the right-of-way was modeled as a tree zone with "field grass" beneath it. The results of the validation suggest that TNM may be under predicting the combined effects of ground vegetation and ground type at this site.[2]

Other reasons for the discrepancy between monitored and computed levels may be related to inaccuracies in modeling relatively complex terrain. Adjacent to Site M2, the highway is depressed and the right-of-way is wooded. The model includes terrain lines and tree zones that are located in close proximity to one another – sometimes leaving "gaps" in the modeled tree zones that otherwise are not present.

After a thorough examination of the assumptions used in the model, as well as the monitoring data, field notes and site photographs,[3] it is believed that the combined effects described in the preceding paragraphs may contribute to the discrepancy between modeled and monitored noise levels at Site M2.

Appendix D provides the normalized traffic count data that were collected simultaneously with the noise monitoring data and subsequently used as input to the FHWA TNM for model validation.

4.3 Traffic Data for Noise Prediction

The traffic data used in the noise analysis must produce sound levels representative of the loudest hour of the day in the future design year, per FHWA and VDOT policy. Traffic data were supplied by VDOT as AM Peak Hour, PM Peak Hour, and Saturday Peak Hour volumes for both the Existing and the Design Year for each roadway in the local network. Truck percentages and speed limits also were provided for each roadway in the local network.

HMMH conducted a determination of the loudest hour of the day consistent with VDOT's current methodology. Given the modest number of receptors for this proposed interchange project, HMMH calculated traffic noise levels at all of the receptors in the study area, using the traffic data for each of the three peak hour conditions as input to TNM, for both Existing conditions and the Design Year Build alternative. For both Existing conditions and the Design Year Build alternative, the Saturday Peak Hour produced higher noise levels at a majority of the modeled receptors. The PM Peak Hour

[2] That is, TNM may be under predicting the excess attenuation due to ground vegetation and/or ground type.

[3] During the measurements, the sky was overcast and the temperature was 37 degrees F. In addition, wind speeds were generally low and in a direction parallel to the highway, so the effects of wind on sound propagation were negligible.

produced the next highest noise levels at the modeled receptor locations. Appendix B provides the loudest-hour traffic data that were used as input to the TNM. Since only 22 noise-sensitive receptors were modeled for this proposed Project, Appendix B also provides a table that shows the computed traffic noise levels at each receptor location using the traffic data for each of the three peak hours.

4.4 Presentation of Results

The study area primarily consists of exterior residential (Category B) land use and undeveloped lands that are not permitted (Category G).

Table 4 summarizes the range of predicted noise levels by CNE. The table includes a description of each CNE and its land use, the FHWA Activity Category, and the loudest-hour traffic noise levels, which are presented in terms of the A-weighted equivalent sound level, or L_{eq}, in dBA. Loudest-hour noise levels were computed for 2016 Existing conditions, as well as the design-year (2040) Build alternative. Appendix C provides tables that list the computed sound levels at all of the modeled receptors included in the noise assessment.

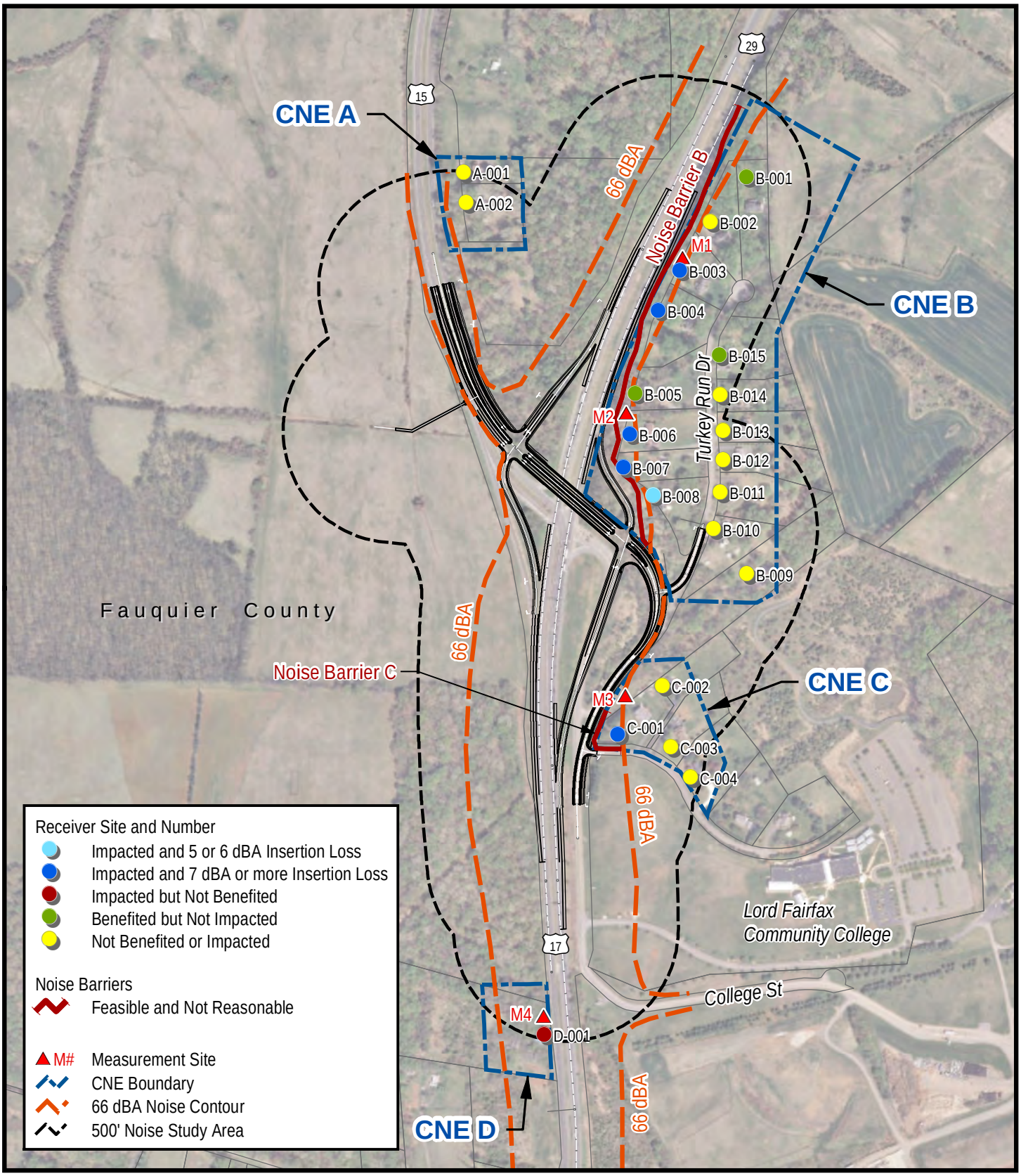
The proposed Project is not related to the interstate system, nor does it result in a "constructive use" of a Section 4(f) property. Consequently, this preliminary noise study does not include an analysis of traffic noise levels for the design year (2040) No-build alternative, consistent with VDOT's State Noise Abatement Policy.

Table 4 Ranges of Predicted Exterior Noise Levels for the Worst Hour

CNE	Land Use – Description	Range of Predicted Exterior Noise Levels for the Worst Hour (dBA)		
		Activity Category	2016 Existing	2040 Build
A	Single-family homes on Route 29/15/17 Business	B	58 to 60	60 to 62
B	Single-family homes on Turkey Run Drive	B	45 to 67	49 to 70
C	Single-family homes on Travelers Way	B	56 to 63	60 to 66
D	Single-family home on Route 29/15/17	B	75	77

Figure 2 provides a location map for the CNEs, noise-sensitive receptors, 66 dBA L_{eq} "contour" for the 2040 Build alternative, and potential noise barriers. Each receptor is shown in Figure 2 with a color-coded dot that indicates the status of each receptor according to its 2040 Build noise level, both with and without a noise barrier. The color code and corresponding receptor status are as follows:

- Light blue - impacted (without noise barrier) and 5 or 6 dBA of insertion loss (with noise barrier);
- Dark blue - impacted (without noise barrier) and 7 dBA or more of insertion loss (with noise barrier);
- Red - impacted (without noise barrier) and not benefited, i.e. less than 5 dBA of insertion loss (with noise barrier);
- Green - not impacted (without noise barrier) and benefited (with noise barrier); and
- Yellow - not impacted (without noise barrier) or benefited (with noise barrier).



Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

VDOT Virginia Department of Transportation

Figure 2
Location Map for Common Noise Environments, Receptors, Build Contours and Barriers

Route 15/17/29 Interchange Project
Warrenton and Fauquier County

UPC No. 77384

0 600 1,200 Feet

5 NOISE IMPACT ASSESSMENT

The potential noise impact of the Route 29/15/17 Interchange Project was assessed according to FHWA and VDOT noise assessment guidelines, described in detail in Section 2. In summary, noise impact would occur wherever Project noise levels are expected to approach within one decibel, or exceed 67 dBA L_{eq}, at noise-sensitive land uses in Activity Category B (exterior residential) during the loudest hour of the day. Noise impact also would occur wherever Project noise levels cause a substantial increase over existing noise levels—an increase of 10 dB or more is considered substantial by VDOT.

Table 5 presents a summary of the predicted noise impact for the 2016 Existing and 2040 Build alternative. The impacts are summarized for the entire study area, separately by FHWA Activity Category. For the 2040 Build alternative, Table 5 summarizes the type of impact. That is, the table indicates whether the potential noise impact was due to Project noise levels that approach or exceed the NAC for the applicable Activity Category or due to a substantial increase of Project noise levels over Existing noise. Five receptors would be exposed to Project noise levels that approach or exceed the NAC for residential land use. Two receptors in close proximity to the proposed on-ramp to Route 29/15/17 Bypass northbound would be exposed to noise impact as a result of a substantial increase. One of those residential properties also would be exposed to Project noise levels that would approach or exceed the NAC, and so its "impact type" is categorized as "Both" in the following table.

Table 5 Noise Impact Summary

Alternative	Impact Type[1]	Number of Impacted Units by Land Use and FHWA Activity Category[2]				
		Residential Exterior (B)	Recreational Exterior (C)	Institutional Interior (D)	Commercial Exterior (E)	Total
Existing	NAC	2	n/a	n/a	n/a	2
Build	NAC	5	n/a	n/a	n/a	7
	Sub'l Inc.	1	n/a	n/a	n/a	
	Both	1	n/a	n/a	n/a	

Source: HMMH, 2017
Notes:
1.) "NAC" = Noise levels approach or exceed the FHWA Noise Abatement Criteria (NAC) for applicable Activity Category; "Sub'l Inc." = Design Year Build noise levels causes a substantial increase (10 decibels, or more) over existing noise levels; "Both" = Design Year Build noise levels approach or exceed the applicable NAC and cause a substantial increase (10 decibels, or more) over existing noise levels.
2.) The FHWA Activity Category is shown in parenthesis.

Table 6 presents a summary of the predicted noise impact for the 2016 Existing and 2040 Build alternative by CNE.

Table 6 Predicted Traffic Noise Impact by Common Noise Environment (CNE)

CNE	Land Use – Description	Number of Impacted Dwellings Units		
		Activity Category	2016 Existing	2040 Build
A	Single-family homes on Route 29/15/17 Business	B	0	0
B	Single-family homes on Turkey Run Drive	B	1	5
C	Single-family homes on Travelers Way	B	0	1
D	Single-family home on Route 29/15/17	B	1	1
TOTALS			**2**	**7**

Figure 2 shows the locations of individual receptors where noise impacts are predicted to occur with the 2040 Build Alternative. Figure 2 also includes a noise impact contour for the 2040 Build Alternative without abatement to show where Project noise levels would approach or exceed the applicable NAC for Categories B and C. That is, the noise impact contour represents a worst-hour noise level of 66 dBA L_{eq} for ground-floor receptors.

6 NOISE ABATEMENT MEASURES

FHWA has identified certain noise abatement measures that may be incorporated in projects to reduce traffic noise impact. The following sections provide summaries of alternative noise abatement measures that were considered for this project, including the construction of noise barriers.

6.1 Alternative Noise 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 that have the potential to provide considerable noise reductions under certain circumstances. Mitigation measures considered for this project include:

- Traffic control measures (TCM),
- Alteration of horizontal and vertical alignments,
- Acoustical insulation of public-use and non-profit facilities,
- Acquisition of buffer land,
- Construction of earth berms,
- Construction of noise barriers.

6.1.1 Traffic Control Measures (TCM)

Traffic control measures normally considered for noise abatement include reduced speeds and truck restrictions. Reduced speeds would not be an effective noise mitigation measure alone since a substantial decrease in speed is necessary to provide a significant noise reduction. Typically, a 10 mph reduction in speed will result in only a 2 dBA decrease in noise level, which is not considered a sufficient level of attenuation to be considered feasible. Further, a 2 dBA change in noise level is not considered to be generally perceptible. Restricting truck usage is not practical since one of the primary purposes of the proposed interchange is to accommodate trucks. Diversion of truck traffic to other roadways would increase noise levels in those areas.

6.1.2 Alteration of Horizontal and Vertical Alignments

A significant alteration of the horizontal alignment of the mainline approaches to the proposed interchange would be necessary to make such a measure effective in reducing noise, since a doubling of distance to a highway is usually needed to effect a 5-decibel reduction. However, such shifts would have undesirable consequences, since right-of-way acquisitions, temporary/permanent easements and/or retaining walls may be required. Also, shifting the horizontal alignment of the mainline away from receptors on one side of the road would bring it closer to receptors on the other side of the road.

As noted in Section 4.1, this preliminary noise study evaluated the potential noise impact for a diamond interchange with signalized intersections. This design concept includes a somewhat large footprint than the roundabout concept, which is also under consideration by VDOT, but was not modeled for this study. The roundabout concept is expected to produce similar, or marginally less, noise impact than the diamond interchange concept. With the roundabout concept, the alignment of the relocated Lord Fairfax Road and the proposed ramps on the east side of the interchange would be located further from the residences on Turkey Run Drive.

6.1.3 Acoustical Insulation

Acoustical Insulation of public-use and non-profit facilities 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 will not be applied.

6.1.4 Acquisition of Buffer Land

The purchase of property for 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.

6.1.5 Construction of Earth Berms

Berms are considered a more attractive alternative to noise walls where there is sufficient land and fill available for them. However, berms do not appear feasible for the impacted properties because berms would greatly increase the cost and the footprint of the project by substantially increasing the amount of right of way required to accommodate them.

Additionally, the Noise Policy Code of Virginia (HB 2577, as amended by HB 2025) states: *"Requires that 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 would be given to these measures during the final design stage, where feasible. The response to this requirement from project management is included Appendix F.

6.2 Noise Barriers

The only remaining abatement measure investigated was the construction of noise barriers. The feasibility of noise barriers was evaluated in locations where noise impact is predicted to occur in the Build condition. Where the construction of noise barriers was found to be physically practical, barrier noise reduction was estimated based on roadway, barrier, and receiver geometry as described below.

To be constructed, any noise barriers identified in this document must satisfy VDOT's feasibility and reasonableness criteria. Therefore, the noise barrier design parameters and cost identified in this document are preliminary and should not be considered final. A final decision on the feasibility and reasonableness of noise barriers would be made during the noise barrier analysis conducted during the final design phase of the project, after the project design is further developed and traffic is updated. Also, the need for an analysis of reflected sound and the potential use of sound absorbing materials will be evaluated during the final design analysis. If a noise barrier is determined to be feasible and reasonable, the affected public would be given an opportunity to decide whether they are in favor of construction of the noise barrier. VDOT's formal policies for involving the public in noise abatement decisions are described in their Guidance Manual, in section 7.3.10.1 *Viewpoints of the benefited receptors,* section 12.3 *Affected Receptors/Community,* and section 12.4 *Voting Procedures*.

6.2.1 Feasibility and Reasonableness

FHWA and VDOT require that noise barriers be both "feasible" and "reasonable" to be recommended for construction.

To be feasible, a barrier must be acoustically effective, that is it must reduce noise levels at noise sensitive locations by at least 5 decibels, thereby "benefiting" the property. VDOT requires that at least fifty percent (50%) of the impacted receptors receive 5 decibels or more of insertion loss from the proposed barrier for it to be feasible.

A second feasibility criterion is that it must be possible to design and construct the barrier. Factors that enter into constructability include safety, barrier height, topography, drainage, utilities, maintenance of the barrier, and access to adjacent properties. VDOT has a maximum allowable height of 30 feet above ground level for noise barriers.

Barrier reasonableness is based on three factors: cost-effectiveness, ability to achieve VDOT's insertion loss design goal, and views of the benefited receptors. To be "cost-effective," a barrier cannot require more than 1600 square feet per benefited receptor (SF/BR). VDOT's maximum barrier height of 30 feet figures into the assessment of benefited receptors. Where multi-family housing includes balconies at elevations above that of a 30-foot high barrier, these receptors will not be assessed for barrier benefits and are not included in the determination of a barrier's feasibility or reasonableness.

The second reasonableness criterion is VDOT's noise reduction design goal of seven decibels. This goal must be achieved for at least one of the impacted receptors for the barrier to be considered reasonable.

The third reasonableness criterion relates to the views of the owners and residents of the potentially benefited properties. A majority of the benefited receptors must favor the barrier for it to be considered reasonable to construct. Community views would be surveyed during the final design phase of this project.

Section 7.3, *Noise Abatement Determination* in VDOT's Guidance Manual discusses the maximum height that VDOT considers for building noise barriers. VDOT has found that costs increase substantially for noise barriers that are taller than 30 feet, so they have established 30 feet as a maximum statewide. Further, VDOT has established a policy to ensure equitable evaluations of the Feasibility and Reasonableness of noise barriers that would benefit multistory residential building units with individual outdoor usage such as balconies and patios. This policy requires the noise analyst to draw a horizontal line from the top of a 30-foot tall noise barrier perpendicular to the highway to the multi-story building. Where the line meets the building is called the "point of intersection." This also can be thought of as the elevation of a 30-foot barrier opposite the building. Only noise sensitive sites that meet or are below the point of intersection may be considered in the feasibility and reasonableness determinations.

6.2.2 Barriers Found Not Feasible

As shown in Table 6, traffic noise impacts were predicted to occur with the 2040 Build alternative at one residence in CNE D. This impacted residence has existing driveway access onto Route 29/15/17 that will be maintained with the design year Build alternative. A noise barrier is not feasible for this residential receptor since driveway access via Route 29/15/17 must be maintained.

6.2.3 Summary of Potential Noise Barriers

Details of each of the evaluated barriers are given in Table 7 and described in narratives below. Each of the barriers is also shown in Figure 2 as a solid line. Appendix F presents the preliminary Warranted, Feasible and Reasonable Worksheets for the two noise barriers described in this section. The table of predicted sound levels for all receivers in Appendix C includes the computed noise levels with the evaluated barriers and the computed barrier insertion loss values.

The potential noise barriers summarized in Table 7 and shown in the graphics of Figure 2 have not been intentionally placed outside of VDOT right of way. While the need for additional right-of-way to construct some barriers for this project is not anticipated, it also cannot be precluded in the future, given the limited information available for this preliminary analysis.

Barrier B was evaluated to mitigate the predicted noise impact at five single-family homes on Turkey Run Drive. The most cost-effective design that provides a minimum 5-dB noise reduction for at least 50% of the impacted receptors and the noise reduction goal of 7-dB for at least one impacted receptor is summarized in Table 7. Barrier B would be 13 feet high and 2,124 feet long, with a surface area of 27,578 square-feet. This noise barrier wall would benefit all five impacted receptors, plus three additional non-impacted receptors. The noise barrier would meet the noise reduction goal at four of the five impacted receptors. Although Barrier B was found to be feasible, it was found to be not reasonable with a surface area per benefited receptor value of 3,447 SF/BR.

Given that there is a relatively large gap between the single-family homes represented by receptors B-004 and B-005, alternate design concepts were evaluated for Barrier B in an attempt to find a cost-reasonable one. Barrier B also was evaluated as two separate stand-alone barriers – one for the north end of CNE B and one at the south end.

- Barrier B (north end, stand-alone): A 13-foot high noise barrier wall, with a length of 1,074 feet and a surface area of 13,922 square-feet, would benefit two impacted receptors plus one additional non-impacted receptor. At of 4,641 SF/BR, this design concept is not reasonable.

- Barrier B (south end, stand-alone): A 13-foot high noise barrier wall, with a length of 843 feet and a surface area of 10,963 square-feet, would benefit only the 3 impacted receptors, with a SF/BR of 3,654.

Barrier C is a potential noise barrier for a single impacted residence on Travelers Way. The evaluation for Barrier C was consistent with Appendix H *Single Impacted Receptor Methodology* of VDOT's noise abatement policy. Barrier C would be 16 feet high and 292 feet long with a surface area of 4,667 square-feet. It would benefit all impacted areas of the relatively large front yard at Receptor C-001. However, Barrier C is not cost-reasonable at 4,667 SF/BR, since it only benefits a single residential receptor. Furthermore, at this stage of the project, Barrier C is considered tentatively feasible. This noise barrier may have potential conflicts with overhead utilities on the north side of the impacted property at C-001. The final feasibility determination of Barrier C will be made during the project final design if found to be feasible (acoustically) and reasonable.

Table 7 Summary of Potential Noise Barriers

Barrier ID	Noise Barrier Parameters						Number of Receptors				Surface Area/ Benefited Receptor (SF/BR)[2]	Barrier Status[3]
	Noise Reduction (dBA)		Length (feet)	Height (feet)	Surface Area (sq-feet)	Cost[1] at $42/sq-feet	Impacted	Impacted & Benefited	Not Impacted & Benefited	Total Benefited		
	Range	Average										
B	5 to 12	7.3	2,124	13	27,578	$1,158,276	5	5	3	8	3,447	F & NR
C	9	9	292	16	4,667	$196,014	1	1	0	1	4,667	F & NR[4]

Source: HMMH, 2017

Notes:

1.) This unit cost is a statewide average based on the three most recent years of historic data and only includes noise barrier material and installation costs.

2.) Where SF/BR exceeds VDOT's maximum of 1600, a noise barrier would not be considered cost-reasonable.

3.) Barrier Status: F & R = Feasible and Reasonable; F & NR = Feasible and Not Reasonable; NF = Not Feasible.

4.) Potential utility conflicts associated with Barrier C would be further evaluated during the final design of the Project, if the noise barrier is shown to be warranted, feasible and reasonable at that time.

7 CONSTRUCTION NOISE CONSIDERATION

Construction noise provisions are contained in Section 107.16(b)3 Noise of the 2007 VDOT Road and Bridge Specifications. 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 P.M. and 6 A.M. 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.

8 INFORMATION FOR LOCAL GOVERNMENT OFFICIALS

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 information on noise-compatible land-use planning, noise impact zones in undeveloped land in the highway project corridor and federal participation in Type II projects (noise abatement only). This section of the report provides that information, as well as information about VDOT's noise abatement program.

8.1 Noise-Compatible Land-Use Planning

Section 9.0 of VDOT's 2011 noise policy outlines 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. Figure 2 includes a noise contour that depicts the zone where noise impact would occur adjacent to the highway under the 2040 Build Alternative for exterior first-floor residential and recreational land uses.

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

8.2 VDOT's Noise Abatement Program

Information on VDOT's noise program is provided in "Highway Traffic Noise Impact Analysis Guidance Manual (Version 7)," updated July 14, 2015. This document is available on VDOT's web page (http://www.virginiadot.org/projects/pr-noise-walls-about.asp) and from VDOT's Noise Abatement Section, Virginia Department of Transportation, 1401 E. Broad St., Richmond, VA 23219.

9 REFERENCES

Bowlby, W., R.L. Wayson and R.E. Stammer, Jr., *Predicting Stop-and-Go Traffic Noise Levels*, National Cooperative Highway Research Program Report 311, Transportation Research Board, National Academy of Sciences, Washington, D.C., 1989.

Federal Highway Administration, US Department of Transportation. July 13, 2010. *23 CFR Part 772, as amended 75 FR 39820, Procedures for Abatement of Highway Traffic Noise and Construction Noise*. Washington, DC: http://www.fhwa.dot.gov/environment/noise/regulations_and_guidance/

Federal Highway Administration, US Department of Transportation. June 2010, revised January 2011. *Highway Traffic Noise: Analysis and Abatement Guidance*. Washington, DC: http://www.fhwa.dot.gov/environment/noise/regulations_and_guidance/analysis_and_abatement_guidance/revguidance.pdf

Federal Highway Administration, US Department of Transportation. January 1998. *FHWA Traffic Noise Model, Version 1.0 User's Guide. FHWA-PD-96-009.* Cambridge, MA: U.S. Department of Transportation, Research and Special Programs Administration, John A. Volpe National Transportation Systems Center, Acoustics Facility. http://www.fhwa.dot.gov/environment/noise/traffic_noise_model/old_versions/tnm_version_10/users_guide/index.cfm

Federal Highway Administration, US Department of Transportation. February 1998. *FHWA Traffic Noise Model, Version 1.0: Technical Manual, Report No. FHWA-PD-96-010 and DOT-VNTSC-FHWA-98-2*. Cambridge, MA: U.S. Department of Transportation, Research and Special Programs Administration, John A. Volpe National Transportation Systems Center, Acoustics Facility. http://www.fhwa.dot.gov/environment/noise/traffic_noise_model/old_versions/tnm_version_10/tech_manual/index.cfm

Harris Miller Miller & Hanson Inc., et al, *Supplemental Guidance on the Application of FHWA's Traffic Noise Model (TNM)*, National Cooperative Highway Research Program Report 791, Transportation Research Board, National Academy of Sciences, Washington, D.C., 2014. http://apps.trb.org/cmsfeed/TRBNetProjectDisplay.asp?ProjectID=2986

US Department of Transportation, John A. Volpe National Transportation Systems Center. July 2004. *TNM Version 2.5 Addendum to Validation of FHWA's TNM® (TNM) Phase 1 report.* Cambridge, MA. http://www.fhwa.dot.gov/environment/noise/traffic_noise_model/model_validation/

Virginia Department of Transportation. July 14, 2015. Highway Traffic Noise Impact Analysis Guidance Manual (Version 7). Richmond, VA. http://www.virginiadot.org/projects/pr-noise-walls-about.asp

APPENDIX A LIST OF PREPARERS

This appendix lists the preparers of this report.

Preparers with HMMH are as follows:

- Christopher Bajdek – noise barrier analysis, documentation, Project Manager.
- Michael Hamilton – report graphics.
- Christopher Menge – quality assurance.
- Zachary Weiss – noise measurements, noise modeling, validation and impact assessment.

TNM Certification of HMMH's Principal-in-Charge, Christopher Menge, is on file in VDOT's offices.

APPENDIX B TRAFFIC DATA USED IN NOISE ANALYSIS

This appendix provides the loudest-hour roadway traffic volumes and speeds used in the noise modeling for the 2016 Existing conditions in Table 8 and for the 2040 Build alternative in Table 9. Table 10 compares the TNM-computed traffic noise level at each receptor location using each of the three peak hour periods (AM, PM, and Saturday) as input to TNM. Table 10 indicates the peak hour that produced a worst noise hour condition.

Table 8 2016 Existing Conditions: AM, PM, and Saturday Peak Hour Traffic Data

Traffic Link	AM Peak (vph)	PM Peak (vph)	Saturday Peak (vph)	Medium Trucks (%)	Heavy Trucks (%)	AM Peak Hour (vph)			PM Peak Hour (vph)			Saturday Peak Hour (vph)			Speed (mph)
						Autos	MT	HT	Autos	MT	HT	Autos	MT	HT	
US 29/15/17 North of Interchange NB	1524	1273	1469	6.0%	10.0%	1281	91	152	1070	76	127	1234	88	147	55
US 29/15/17 South of Interchange NB	1961	1382	1709	6.1%	9.0%	1665	120	176	1174	84	124	1451	104	154	55
US 29/15/17 North of Interchange SB	853	1726	1587	5.1%	11.5%	711	44	98	1440	88	198	1323	81	183	55
US 29/15/17 South of Interchange SB	892	2202	1768	5.1%	8.5%	771	45	76	1903	112	187	1528	90	150	55
Business US 29/15/17 EB	213	685	470	6.2%	2.5%	195	13	5	626	42	17	429	29	12	45
Business US 29/15/17 WB 2	568	349	547	6.0%	3.2%	516	34	18	317	21	11	496	33	18	45
Lord Fairfax Drive WB 1	64	40	181	5.9%	3.0%	58	4	2	37	2	1	165	11	5	35
Lord Fairfax Drive WB 2	75	133	194	5.9%	3.0%	69	4	2	121	8	4	177	11	6	35
Lord Fairfax Drive WB 3	78	140	199	5.9%	3.0%	71	5	2	128	8	4	181	12	6	35
Lord Fairfax Drive WB 4	85	136	200	5.9%	3.0%	77	5	3	124	8	4	182	12	6	35
Lord Fairfax Drive EB 1	128	105	182	5.3%	3.0%	117	7	4	96	6	3	167	10	5	35
Lord Fairfax Drive EB 2	127	100	174	5.3%	3.0%	116	7	4	92	5	3	160	9	5	35
Lord Fairfax Drive EB 3	124	100	172	5.3%	3.0%	113	7	4	92	5	3	158	9	5	35
Lord Fairfax Drive EB 4	42	33	168	5.3%	3.0%	39	2	1	30	2	1	154	9	5	35
College St EB	86	61	8	0.0%	0.0%	86	0	0	61	0	0	8	0	0	25
College St WB	13	84	15	0.0%	0.0%	13	0	0	84	0	0	15	0	0	25
Traveler's Way EB	2	6	8	0.0%	0.0%	2	0	0	6	0	0	8	0	0	25
Traveler's Way WB	3	8	5	0.0%	0.0%	3	0	0	8	0	0	5	0	0	25
Turkey Run Dr EB	2	6	8	0.0%	0.0%	2	0	0	6	0	0	8	0	0	25
Turkey Run Dr WB	8	5	3	0.0%	0.0%	8	0	0	5	0	0	3	0	0	25
US 29/15/17 NB Offramp	30	20	51	6.1%	9.0%	25	2	3	17	1	2	43	3	5	25
US 29/15/17 SB Offramp	53	78	98	5.1%	11.5%	44	3	6	65	4	9	82	5	11	25
US 29/15/17 SB Onramp	137	565	137	5.9%	3.0%	125	8	4	515	33	17	125	8	4	30
US 29/15/17 NB Lturn	473	214	356	6.1%	9.0%	401	29	43	182	13	19	302	22	32	25
US 29/15/17 SB Lturn	58	44	69	5.1%	11.5%	48	3	7	37	2	5	57	4	8	25
Lord Fairfax Drive WB Lturn	13	33	30	5.3%	3.0%	12	1	0	30	2	1	27	2	1	25
Lord Fairfax Drive WB Rturn	30	46	77	5.3%	3.0%	27	2	1	43	2	1	71	4	2	25
Business US 29/15/17 WB 1	-	-	-	-	-	472	31	12	252	17	2	414	28	7	45
Lord Fairfax Drive WB 4.1 (Rturn break)	-	-	-	-	-	50	3	2	81	6	3	111	8	4	35
Lord Fairfax Drive WB 4.2 (Lturn break)	-	-	-	-	-	38	2	2	51	4	2	84	6	3	35
US 29/15/17 South of Interchange NB (Lturn break)	-	-	-	-	-	1264	91	133	992	71	105	1149	82	122	55
US 29/15/17 South of Interchange NB (Rturn break)	-	-	-	-	-	1237	89	132	949	69	104	1078	78	120	55
US 29/15/17 North of Interchange SB (Rturn break)	-	-	-	-	-	667	41	92	1375	84	189	1241	76	172	55
US 29/15/17 North of Interchange SB (Lturn break)	-	-	-	-	-	619	38	85	1338	82	184	1184	72	164	55
US 29/15/17 South of Interchange SB (before Onramp)	-	-	-	-	-	646	37	72	1388	79	170	1403	82	146	55
Lord Fairfax Drive EB 0 (before Offramp)	-	-	-	-	-	92	5	1	79	5	1	124	7	0	35
Business US 29/15/17 EB 2	-	-	-	-	-	70	5	1	111	9	0	304	21	8	45

Table 9 2040 Build Alternative: AM, PM, and Saturday Peak Hour Traffic Data

Traffic Link	AM Peak (vph)	PM Peak (vph)	Saturday Peak (vph)	Medium Trucks (%)	Heavy Trucks (%)	AM Peak Hour (vph)			PM Peak Hour (vph)			Saturday Peak Hour (vph)			Speed (mph)
						Autos	MT	HT	Autos	MT	HT	Autos	MT	HT	
US 29/15/17 North of Interchange NB	2240	1900	2140	6.0%	10.0%	1882	134	224	1596	114	190	1798	128	214	55
US 29/15/17 South of Interchange NB	2855	2014	2464	6.1%	9.0%	2424	174	257	1710	123	181	2092	150	222	55
US 29/15/17 North of Interchange SB	1332	2547	2312	5.1%	11.5%	1111	68	153	2124	130	293	1928	118	266	55
US 29/15/17 South of Interchange SB	1305	3185	2547	5.1%	8.5%	1127	67	111	2752	162	271	2201	130	216	55
Business US 29/15/17 EB	422	1047	718	6.2%	2.5%	385	26	11	956	65	26	655	45	18	45
Business US 29/15/17 WB	860	590	824	6.0%	3.2%	780	52	28	536	35	19	749	49	26	45
Lord Fairfax Drive WB 1	141	157	289	5.9%	3.0%	129	8	4	143	9	5	263	17	9	35
Lord Fairfax Drive WB 2	189	320	329	5.9%	3.0%	172	11	6	291	19	10	300	19	10	35
Lord Fairfax Drive WB 3	193	331	336	5.9%	3.0%	176	11	6	301	20	10	306	20	10	35
Lord Fairfax Drive WB 4	202	337	341	5.9%	3.0%	184	12	6	307	20	10	311	20	10	35
Lord Fairfax Drive EB 1	407	269	322	5.3%	3.0%	373	22	12	247	14	8	295	17	10	35
Lord Fairfax Drive EB 2	405	262	311	5.3%	3.0%	372	21	12	240	14	8	286	16	9	35
Lord Fairfax Drive EB 3	404	253	308	5.3%	3.0%	371	21	12	232	13	8	283	16	9	35
Lord Fairfax Drive EB 4	195	107	270	5.3%	3.0%	179	10	6	98	6	3	248	14	8	35
College St EB	211	146	44	0.0%	0.0%	211	0	0	146	0	0	44	0	0	25
College St WB	51	163	46	0.0%	0.0%	51	0	0	163	0	0	46	0	0	25
Traveler's Way EB	2	9	3	0.0%	0.0%	2	0	0	9	0	0	3	0	0	25
Traveler's Way WB	4	11	7	0.0%	0.0%	4	0	0	11	0	0	7	0	0	25
Turkey Run Dr EB	3	8	11	0.0%	0.0%	3	0	0	8	0	0	11	0	0	25
Turkey Run Dr WB	11	7	4	0.0%	0.0%	11	0	0	7	0	0	4	0	0	25
US 29/15/17 NB Onramp	156	259	279	6.0%	3.0%	142	9	5	235	16	8	254	17	8	30
US 29/15/17 NB Offramp	771	372	602	6.0%	3.0%	702	46	23	339	22	11	548	36	18	30
US 29/15/17 SB Offramp	271	254	282	6.0%	3.0%	247	16	8	231	15	8	257	17	8	30
US 29/15/17 SB Onramp	245	893	517	6.0%	3.0%	223	15	7	812	54	27	470	31	16	30
US 29/15/17 NB Offramp (Rturn)	88	52	85	6.0%	3.0%	80	5	3	47	3	2	77	5	3	25
US 29/15/17 NB Offramp (Lturn)	683	320	517	6.0%	3.0%	622	41	20	291	19	10	470	31	16	25
US 29/15/17 SB Offramp (Rturn)	88	138	155	6.0%	3.0%	80	5	3	126	8	4	141	9	5	25
US 29/15/17 SB Offramp (Lturn)	183	116	127	6.0%	3.0%	167	11	5	106	7	3	115	8	4	25
Business US 29/15/17 EB Bridge	396	346	381	6.2%	2.5%	361	25	10	316	21	9	347	24	10	25
Business US 29/15/17 WB Bridge	807	528	723	6.0%	3.2%	733	48	26	479	32	17	657	43	23	25
Business US 29/15/17 EB (Rturn)	210	817	463	6.0%	3.0%	191	13	6	743	49	25	421	28	14	25
US 29/15/17 NB Interchange	-	-	-	-	-	1722	128	234	1371	101	170	1544	114	204	55
US 29/15/17 SB Interchange	-	-	-	-	-	864	52	145	1893	115	285	1671	101	258	55
Lord Fairfax Drive EB 0	-	-	-	-	-	293	17	9	200	11	6	218	12	7	35
Business US 29/15/17 EB (Rturn Break)	-	-	-	-	-	194	13	5	213	16	1	234	17	4	45

Table 10 Comparison of TNM-Computed Traffic Noise Levels for AM, PM, and Saturday Peak Hours

Receptor ID	TNM-Computed Sound Levels 2016 Existing Conditions			TNM-Computed Sound Levels 2040 Build Alternative		
	AM Peak Hour	PM Peak Hour	Saturday Peak Hour	AM Peak Hour	PM Peak Hour	Saturday Peak Hour
A-001	58.3	**59.9**	59.7	60.6	**61.9**	61.5
A-002	56.4	**58.0**	57.8	58.7	**60.0**	59.6
C-001	62.0	62.4	**62.7**	65.8	65.8	**66.0**
C-002	55.0	**56.1**	**56.1**	59.4	59.9	**60.0**
C-003	57.9	58.7	**58.8**	61.5	61.7	**61.9**
C-004	57.0	**58.0**	**58.0**	60.2	**60.7**	**60.7**
B-001	61.0	61.4	**61.7**	62.4	63.0	**63.1**
B-002	58.2	58.7	**58.9**	60.0	60.5	**60.6**
B-003	64.0	64.3	**64.6**	67.5	67.4	**67.7**
B-004	66.7	66.7	**67.1**	67.9	67.8	**68.1**
B-005	59.7	60.6	**60.8**	63.6	**64.7**	**64.7**
B-006	60.5	**61.9**	**61.9**	66.2	**67.6**	67.5
B-007	57.5	**59.2**	59.1	68.7	**69.6**	**69.6**
B-008	49.7	50.8	**50.9**	59.7	60.6	**60.7**
B-009	44.6	45.3	**45.4**	48.1	48.6	**48.8**
B-010	49.3	50.1	**50.2**	53.7	54.1	**54.3**
B-011	48.8	49.8	**49.9**	53.1	**53.8**	**53.8**
B-012	50.8	51.8	**51.9**	54.8	55.4	**55.5**
B-013	51.0	51.9	**52.0**	54.5	55.1	**55.2**
B-014	50.8	51.7	**51.8**	54.0	54.7	**54.8**
B-015	53.4	54.1	**54.3**	56.8	57.3	**57.4**
D-001	73.5	**75.9**	75.4	75.1	**77.4**	76.8
M1	65.1	65.5	**65.8**	68.7	68.8	**69.1**
M2	64.2	65.1	**65.2**	69.4	**70.2**	**70.2**
M3	59.8	60.6	**60.7**	64.8	65.0	**65.3**
M4	74.0	**76.4**	75.8	75.5	**77.9**	77.3

Notes: 1.) **Bold red** text indicates the traffic condition for the worst noise hour at each receptor location.

APPENDIX C PREDICTED TRAFFIC NOISE LEVELS

This appendix provides the predicted noise levels at all of the receiver (receptor) locations shown in the study graphics for the 2016 Existing and design-year 2040 Build alternative. The receptor sites are organized by CNE. Also provided are the name and location of each receptor site, the number of dwelling units or recreational units assigned to each receptor, a description of the land use, the applicable Noise Abatement Criteria, and the predicted loudest-hour L_{eq} sound levels. Build alternative sound levels are shown both without and with the effects of potential noise abatement measures, wherever noise barriers were found to be feasible from an engineering standpoint. THe following notes are in reference to the information in Table 11.

- Existing and Build noise levels that approach or exceed the FHW NAC are shown in **bold, red** text.
- Existing and Build noise levels are shown with **bold** or **bold, red** to indicate a substantial increase of Project noise over Existing levels.
- Insertion loss values shown in **bold** are greater than or equal to the acoustical feasibility goal of 5 decibels.
- **N/A** indicates that a noise barrier is not warranted.
- **NF** indicates the noise barrier is not feasible from an engineering standpoint.

Table 11 Predicted Traffic Noise Levels

CNE	Site No.	Address or Description	Dwelling Units	Activity Category	Land Use	NAC Impact Criteria	Loudest-hour L_{eq} (dBA)			
							2016 Existing	2040 Build		
								No Barrier	With Barrier	Insertion Loss
A	A-001	8413 JAMES MADISON HWY	1	B	Residential	67	60	62	**N/A**	**N/A**
A	A-002	8415 JAMES MADISON HWY	1	B	Residential	67	58	60	**N/A**	**N/A**
B	B-001	8453 TURKEY RUN DR	1	B	Residential	67	62	63	58	**6**
B	B-002	8450 TURKEY RUN DR	1	B	Residential	67	59	61	56	4
B	B-003	8454 TURKEY RUN DR	1	B	Residential	67	65	**68**	59	**8**
B	B-004	8464 TURKEY RUN DR	1	B	Residential	67	67	**68**	61	**7**
B	B-005	8474 TURKEY RUN DR	1	B	Residential	67	61	65	59	**7**
B	B-006	8484 TURKEY RUN DR	1	B	Residential	67	62	**68**	59	**9**
B	B-007	8506 TURKEY RUN DR	1	B	Residential	67	**59**	**70**	58	**12**
B	B-008	8516 TURKEY RUN DR	1	B	Residential	67	**51**	**61**	56	**5**
B	B-009	8549 TURKEY RUN DR	1	B	Residential	67	45	49	48	1
B	B-010	8525 TURKEY RUN DR	1	B	Residential	67	50	54	54	1
B	B-011	8513 TURKEY RUN DR	1	B	Residential	67	50	54	52	2
B	B-012	8505 TURKEY RUN DR	1	B	Residential	67	52	56	53	3
B	B-013	8483 TURKEY RUN DR	1	B	Residential	67	52	55	52	3
B	B-014	8479 TURKEY RUN DR	1	B	Residential	67	52	55	52	3
B	B-015	8467 TURKEY RUN DR	1	B	Residential	67	54	57	53	**5**
C	C-001	6860 TRAVELERS WAY	1	B	Residential	67	63	**66**	58	**9**
C	C-002	6854 TRAVELERS WAY	1	B	Residential	67	56	60	59	1
C	C-003	6850 TRAVELERS WAY	1	B	Residential	67	59	62	61	1
C	C-004	6838 TRAVELERS WAY	1	B	Residential	67	58	61	60	0
D	D-001	8598 JAMES MADISON HWY	1	B	Residential	67	**75**	**77**	**NF**	**NF**

APPENDIX D NOISE MEASUREMENT DATA

This appendix includes data acquired during the site visit and noise measurement program, including noise monitor calibration data, site sketches, photographs, field noise and traffic data sheets. Also included are noise measurement results spreadsheets, which include site summary results, noise monitor acoustic data with L_{eq} calculations, and simultaneous traffic count data.

Sound Level Meter / RTA Settings							
Translated:	5-Jan-17	22:37:03					
File Translated:							
Model Number:	824						
Serial Number:	A3048						
Firmware Rev:	4.23						
Software Version:	3.12						
Name:	Harris Miller Miller & Hanson						
Descr1:	77 s Bedford Street Suite 120						
Descr2:	Burlington MA 01803						
Setup:	RT28.ssa						
Setup Descr:	RT28						
Location:							
Note 1:							
Note 2:							
Sound Level Meter / RTA Settings							
Bandwidth:	1						
Detector:	Fast						
Weighting:	A						
Peak-1 Weighting:	Flat						
Second Display:	TWA						
Gain:	0						
RTA Detector:	Fast						
RTA Weighting:	Flat						
AC Output Control:	AC-1 AC-2						
Ln							
Ln:	Disabled						
Ln Start Level:	15	dB					
Spectral Ln Option:	None						
Ln Percentiles							
Ln Percentiles							
L 1.0							
L 10.0							
L 33.0							
L 50.0							
L 90.0							
L 99.0							
Intervals							
Intervals:	Enabled						
Interval Time Sync:	Yes						
Interval Save Ln:	No						
Interval Save Ln Table:	No						
Interval Auto Stop:	No						
Interval Period:	0:01:00						

Interval Threshold:	0						
Interval Exchange Rate:	3	dB					
Interval Spectra Option:	None						
Time History							
Time History:	Enabled						
Time History Period:	1						
Time History Units:	1.0 seconds						
Resolution:	0.1	dB					
Timer							
Timer Mode:	Off						
Start Date:	1-Jan-00						
Stop Date:	31-Dec-99						
Start Time 1:	8:00						
Start Time 2:	0:00						
Stop Time 1:	17:00						
Stop Time 2:	0:00						
824 System Settings							
Translated:	5-Jan-17	22:37:03					
Calibration							
Calibrator S/N:	LD4182						
Calibrator Level:	114	dB					
Auto. Calibration:	No						
Calibration Time:	23:59						
Transducer:	Electret						
Noise Floor:	8	dB					
Rand. Inc Correction:	Disabled						
Linear Engineering Units:	Disabled						
Power Monitor							
Power Off Mode:	Manual Off						
Backlight:	Off						
LCD Contrast:	60						
Controls							
Logic Input Mode:	None						
Logic Output:	Off						
Modem Settings							
Modem control:	Disabled						
Dial out mode:	<none>						
Telephone Number:	<none>						
Monitor Number:	0						

Modem Init String:	X4 E0 Q0 V0 T M1 S0=5 &D						
824 SLM/RTA Run/Stop Log							
Translated:	5-Jan-17	22:37:03					
Rec #	Date	Time	R/S Num	Type	Cause	Time Hist Num	
1	5-Jan-17	9:27:04	1	Run	Key	1	
2	5-Jan-17	9:32:12	1	Stop	Key	309	
3	5-Jan-17	9:39:11	2	Run	Key	310	
4	5-Jan-17	10:10:17	2	Stop	Key	2177	
5	5-Jan-17	11:10:18	3	Run	Key	2178	
6	5-Jan-17	11:47:11	3	Stop	Key	4392	
7	5-Jan-17	12:22:35	4	Run	Key	4393	
8	5-Jan-17	12:53:14	4	Stop	Key	6232	
9	5-Jan-17	13:30:00	5	Run	Key	6233	
10	5-Jan-17	14:04:12	5	Stop	Key	8286	
Calibration Check Log							
Translated:	5-Jan-17	22:37:03					
Rec #	Date	Time	Level	Offset	Mode	Status	
1	5-Jan-17	10:11:14	113.9	-5.00E+01	Manual	Stable	
2	5-Jan-17	11:06:40	114	-5.00E+01	Manual	Stable	
3	5-Jan-17	11:47:57	113.9	-5.00E+01	Manual	Stable	
4	5-Jan-17	12:19:26	113.4	-5.00E+01	Manual	Stable	
5	5-Jan-17	12:19:50	113.4	-5.00E+01	Manual	Stable	
6	5-Jan-17	12:54:00	113.6	-5.00E+01	Manual	Stable	
7	5-Jan-17	13:27:55	114	-5.00E+01	Manual	Stable	
8	5-Jan-17	14:04:47	114.1	-5.00E+01	Manual	Stable	

SHORT-TERM NOISE MEASUREMENT DATA SHEET

PROJECT: Route 29-15-17 Interchange Improvement Project

JOB NO.: UPC 77384; HMMH 306780.011

MEASUREMENT SITE NO.: M1 PERSONNEL: ZFW

ADDRESS/DESCRIPTION: 8454 Turkey Run Dr. DATE: 1/5/17

#	1 Minute Period Starting	Meas'd Leq (dBA)	√ or X	Autos	Medium Trucks	Heavy Trucks	Other Noise Sources	COMMENTS (Include Calibration Data)
1	12:23	63.3						Cal: 113.4 dB
2	12:24	57.7						
3	12:25	63.2						
4	12:26	63.2						:15-27:30 apl. m/g
5	12:27	59.3						
6	12:28	65.2						:30-29:00 apl.
7	12:29	62.0						
8	12:30	59.0						
9	12:31	62.8						
10	12:32	59.5						:35-:40 dog barks
11	12:33	63.2						↳ intermittent afterwards,
12	12:34	61.8						but no noticible SLM effect
13	12:35	59.3						
14	12:36	58.1						
15	12:37	64.2						
16	12:38	60.6						:40-39:15 barks
17	12:39	62.5						:50 dual HT passby
18	12:40	64.8						
19	12:41	60.4						
20	12:42	62.6						:30-45:00 intermittent barks
21	12:43	64.6						
22	12:44	59.6						
23	12:45	61.2						
24	12:46	61.6						
25	12:47	60.7						
26	12:48	62.8						
27	12:49	59.7						
28	12:50	62.0						
29	12:51	63.1						
30	12:52	61.7						Cal: 113.6 dB

TOTAL Leq = SUBSET Leq =

√ = Other sources contributed to Leq X = Exclude period - contaminated by non-characteristic sources

>> ADD SKETCH AND WEATHER CONDITIONS TO REVERSE OR OTHER SHEET <<

PROJECT: Route 29-15-17 Interchange Improvement Project

JOB NO.: UPC 77384; HMMH 306780.011

SHORT-TERM NOISE MEASUREMENT SITE LOG

ASSESSMENT AREA: _____ MEASUREMENT SITE NO.: M1

ADDRESS: 8454 Turkey Run Dr.

OWNER:

DESCRIPTION:

NOISE SOURCES: Mainline, Loud & Faint Airplanes, Dog Barks, Birds

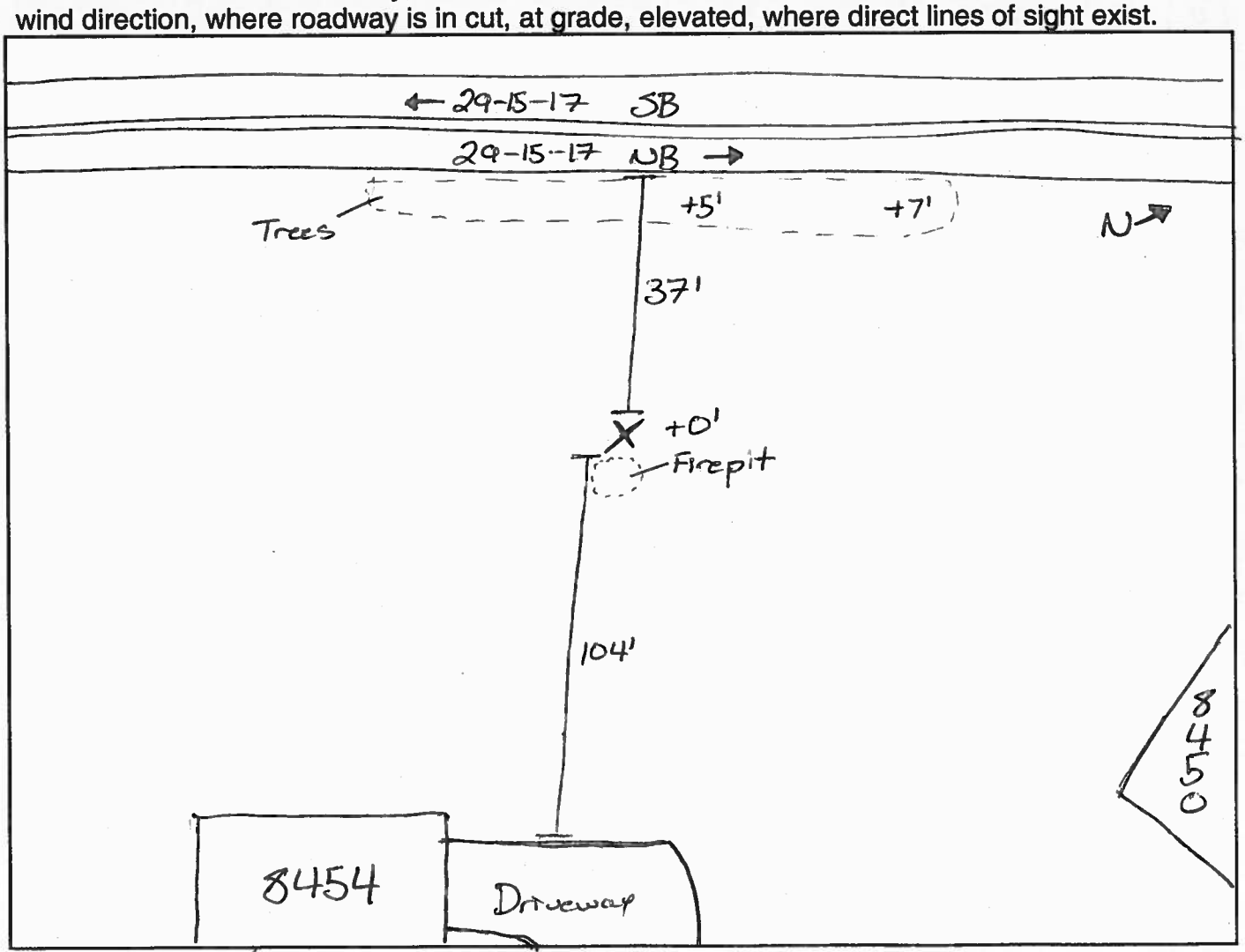
NOISE MONITOR: LD824 S/N: A3048

MICROPHONE/PREAMP: GRAS 40AQ / PRM902 S/N: 33135 / 4477

CALIBRATOR: CAL200 S/N: 9045

TEMP. RANGE (°F): 36°/46 °o /Rel. Humidity WEATHER CONDITIONS: Overcast

SITE SKETCH: Show roadway, homes, local roads, reference distances, arrows for North & wind direction, where roadway is in cut, at grade, elevated, where direct lines of sight exist.



PHOTOS: ✓ GPS COORDINATES: N. 38.68955°; W 77.78524°

Site M1: looking east at microphone position and single-family home
UPC 77384

SHORT-TERM NOISE MEASUREMENT DATA SHEET

PROJECT: Route 29-15-17 Interchange Improvement Project

JOB NO.: UPC 77384; HMMH 306780.011

MEASUREMENT SITE NO.: M2 PERSONNEL: ZFW

ADDRESS/DESCRIPTION: 8484 Turkey Run Dr. DATE: 1/5/17

#	1 Minute Period Starting	Meas'd Leq (dBA)	√ or X	Autos	Medium Trucks	Heavy Trucks	Other Noise Sources	COMMENTS (Include Calibration Data)
1	11:17	63.2						Cal: 114.0 dB
2	11:18	56.8						
3	11:19	59.7						
4	11:20	61.7						
5	11:21	56.5						:30 SB Backup
6	11:22	60.5						:30 SB 60
7	11:23	61.3						
8	11:24	55.0						
9	11:25	62.8						:00 Backup → :15 60
10	11:26	61.8						
11	11:27	56.2					:55 HT Idle	:20 Backup
12	11:28	64.5						:15 60
13	11:29	59.3						
14	11:30	60.5						
15	11:31	62.2						
16	11:32	59.2						:25 Backup
17	11:33	61.4						:15 60
18	11:34	60.0						
19	11:35	59.1						:25 Backup
20	11:36	60.0						:05 60
21	11:37	60.0						:45 Backup
22	11:38	55.7					:55 60	:15-:20 HF Brakes
23	11:39	63.2						
24	11:40	57.7						
25	11:41	56.4						:05 Backup
26	11:42	62.8						:00 60
27	11:43	59.7						
28	11:44	59.3						:15 Backup → :50 60
29	11:45	60.3						
30	11:46	55.3						Cal 114.0 dB

TOTAL Leq = SUBSET Leq =

√ = Other sources contributed to Leq X = Exclude period - contaminated by non-characteristic sources

>> ADD SKETCH AND WEATHER CONDITIONS TO REVERSE OR OTHER SHEET <<

PROJECT: Route 29-15-17 Interchange Improvement Project

JOB NO.: UPC 77384; HMMH 306780.011

SHORT-TERM NOISE MEASUREMENT SITE LOG

ASSESSMENT AREA: _____ MEASUREMENT SITE NO.: M2

ADDRESS: 8484 Turkey Run Dr.

OWNER: _____

DESCRIPTION: _____

NOISE SOURCES: Mainline

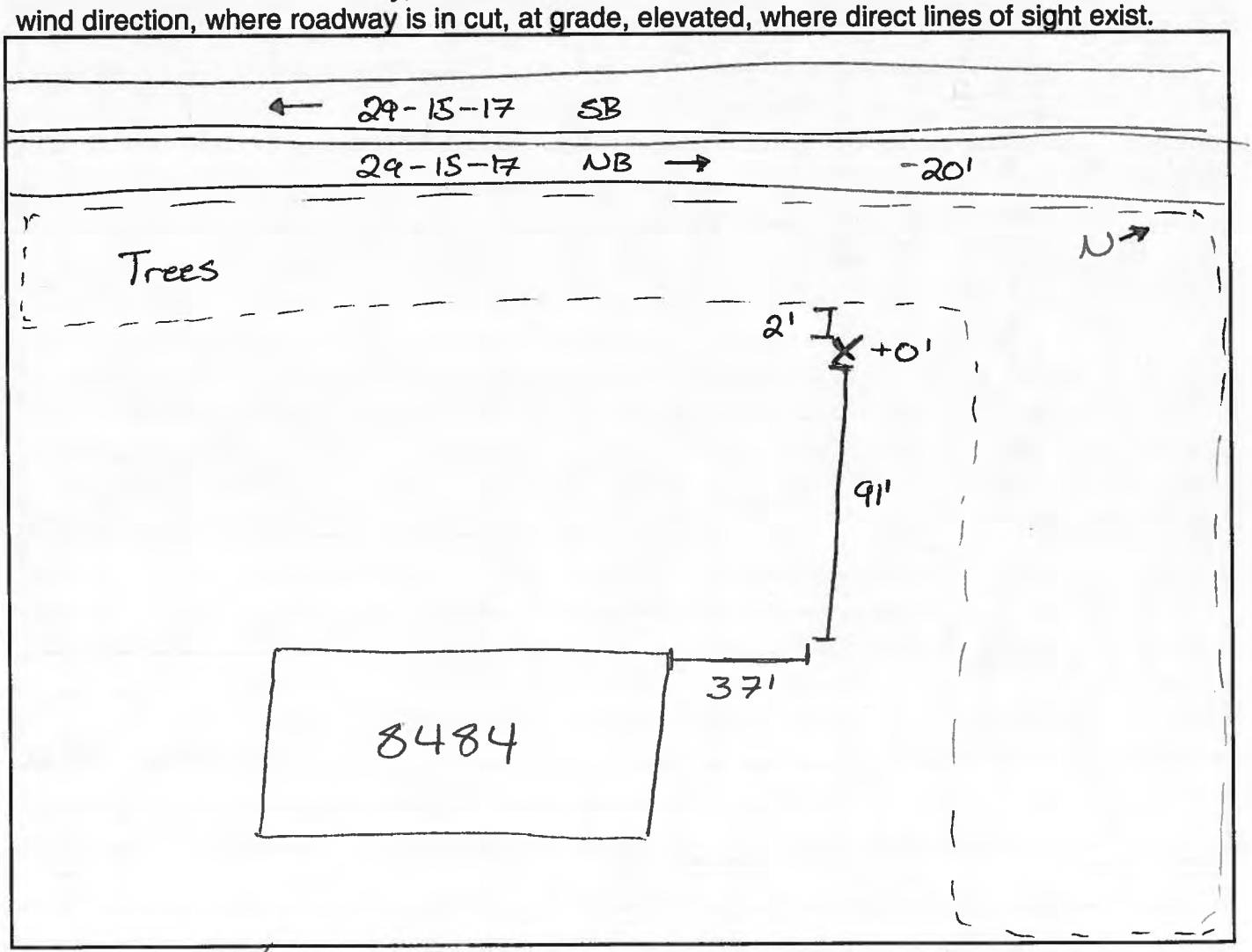
NOISE MONITOR: LD824 S/N: A3048

MICROPHONE/PREAMP: GRAS 40AQ / PRM902 S/N: 33135 / 4477

CALIBRATOR: CAL200 S/N: 9045

TEMP. RANGE (°F): 37° / 51% /Rel. Humidity WEATHER CONDITIONS: Overcast

SITE SKETCH: Show roadway, homes, local roads, reference distances, arrows for North & wind direction, where roadway is in cut, at grade, elevated, where direct lines of sight exist.



PHOTOS: ✓ GPS COORDINATES: N. 38.68772°; W. 77.786080

Site M2: looking south (along right-of-way) at microphone position
UPC 77384

SHORT-TERM NOISE MEASUREMENT DATA SHEET

PROJECT: Route 29-15-17 Interchange Improvement Project

JOB NO.: UPC 77384; HMMH 306780.011

MEASUREMENT SITE NO.: M3 PERSONNEL: ZFW

ADDRESS/DESCRIPTION: 6860 Traveler's Way DATE: 1/5/17

#	1 Minute Period Starting	Meas'd Leq (dBA)	√ or X	Autos	Medium Trucks	Heavy Trucks	Other Noise Sources	COMMENTS (Include Calibration Data)	
1	9:40	56.2						114.1 dB Cal	
2	9:41	59.6							
3	9:42	54.2							
4	9:43	59.1							
5	9:44	58.1							
6	9:45	58.3							
7	9:46	59.3						:45 Dumptruck NB	POCA
8	9:47	57.9						:15 Dumptruck NB	Ld. FFX POCA
9	9:48	58.7						:30 Dumptruck SB	POCA
10	9:49	60.6						:50 Dumptruck NB	POCA
11	9:50	55.8							
12	9:51	58.9						:25 Dumptruck SB	Ld. FFX POCA
13	9:52	63.3						:15 Loud HT POCA	
14	9:53	57.0							
15	9:54	58.3							
16	9:55	61.3							
17	9:56	54.7							
18	9:57	55.5							
19	9:58	57.2							
20	9:59	59.4							
21	10:00	55.7							
22	10:01	58.5							
23	10:02	59.6						:20 HT POCA	
24	10:03	55.5						:15 Dumptruck NB	POCA Ld. FFX
25	10:04	55.5							
26	10:05	59.6						:55 Dual Dumptruck	POCA
27	10:06	56.7						(NB&SB Ld. FFX)	
28	10:07	57.8							
29	10:08	57.1							
30	10:09	54.2						113.9 dB Cal	

TOTAL Leq = SUBSET Leq =

√ = Other sources contributed to Leq X = Exclude period - contaminated by non-characteristic sources

>> ADD SKETCH AND WEATHER CONDITIONS TO REVERSE OR OTHER SHEET <<

PROJECT: Route 29-15-17 Interchange Improvement Project

JOB NO.: UPC 77384; HMMH 306780.011

SHORT-TERM NOISE MEASUREMENT SITE LOG

ASSESSMENT AREA: _____ MEASUREMENT SITE NO.: M3

ADDRESS: 6860 Traveler's Way

OWNER:

DESCRIPTION:

NOISE SOURCES: Mainline, Lord Fairfax Rd., Faint Electrical Equipment, Faint aircraft

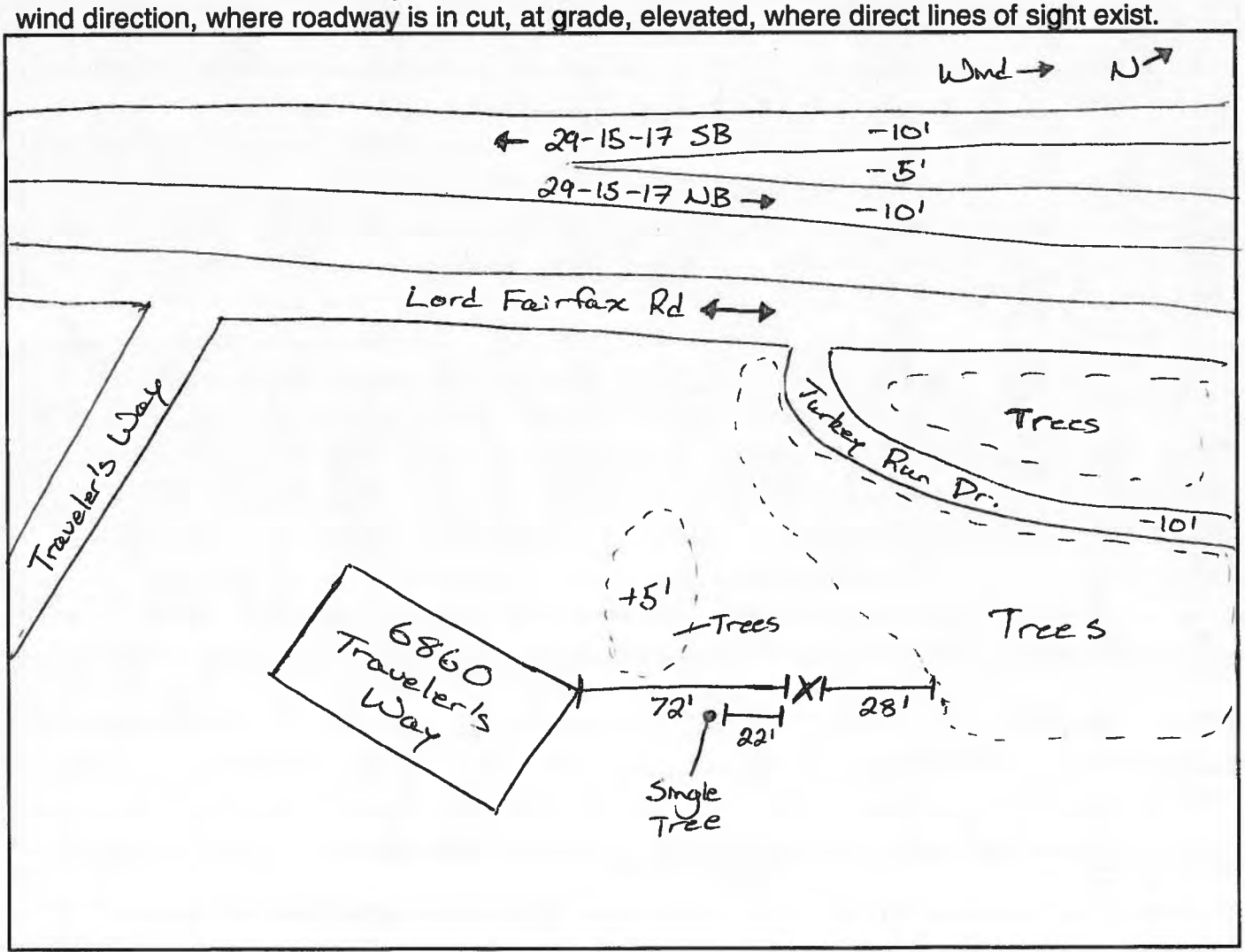
NOISE MONITOR: LD824 S/N: A3048

MICROPHONE/PREAMP: GRAS 40AQ / PRM902 S/N: 33135 / 4477

CALIBRATOR: CAL200 S/N: 9045

TEMP. RANGE (°F): 32°/64% /Rel. Humidity WEATHER CONDITIONS: Overcast

SITE SKETCH: Show roadway, homes, local roads, reference distances, arrows for North & wind direction, where roadway is in cut, at grade, elevated, where direct lines of sight exist.



PHOTOS: ✓ GPS COORDINATES: N 38.68419° ; W 77.78620°

HARRIS MILLER MILLER & HANSON INC.

Site M3: looking west at microphone position
UPC 77384

SHORT-TERM NOISE MEASUREMENT DATA SHEET

PROJECT: Route 29-15-17 Interchange Improvement Project

JOB NO.: UPC 77384; HMMH 306780.011

MEASUREMENT SITE NO.: M4

PERSONNEL: ZFW

ADDRESS/DESCRIPTION: 8598 James Madison Highway

DATE: 1/5/17

#	1 Minute Period Starting	Meas'd Leq (dBA)	√ or X	Autos	Medium Trucks	Heavy Trucks	Other Noise Sources	COMMENTS (Include Calibration Data)
1	13:34	73.4						Cal: 114.0 dB
2	13:35	76.7						34:10 54dBA (Almost Ambient)
3	13:36	70.8						:20 HT passby SB
4	13:37	70.1						
5	13:38	76.7						:05 HT passby SB
6	13:39	73.2						
7	13:40	67.1						
8	13:41	75.8						
9	13:42	73.5						
10	13:43	76.5						
11	13:44	76.7						:50 dual HT passby SB
12	13:45	74.3					:55 NB HT	Trace Snowfall Begins
13	13:46	69.7						
14	13:47	71.3						:35 SB HT
15	13:48	76.6						
16	13:49	75.5						
17	13:50	69.0						
18	13:51	77.2						
19	13:52	73.5						Slightly More Snow
20	13:53	75.5						
21	13:54	71.8						
22	13:55	76.8						
23	13:56	72.2						Moderate Snow
24	13:57	74.9						
25	13:58	74.5						
26	13:59	73.9						
27	14:00	76.4						:15-:45 Quiet Convo
28	14:01	68.3						
29	14:02	75.8						:50 SB HT
30	14:03	71.8						Cal: 114.1 dB

TOTAL Leq =

SUBSET Leq =

√ = Other sources contributed to Leq

X = Exclude period - contaminated by non-characteristic sources

>> ADD SKETCH AND WEATHER CONDITIONS TO REVERSE OR OTHER SHEET <<

PROJECT: Route 29-15-17 Interchange Improvement Project

JOB NO.: UPC 77384; HMMH 306780.011

SHORT-TERM NOISE MEASUREMENT SITE LOG

ASSESSMENT AREA: _____ MEASUREMENT SITE NO.: M4

ADDRESS: 8598 James Madison Highway

OWNER:

DESCRIPTION:

NOISE SOURCES: Mainline

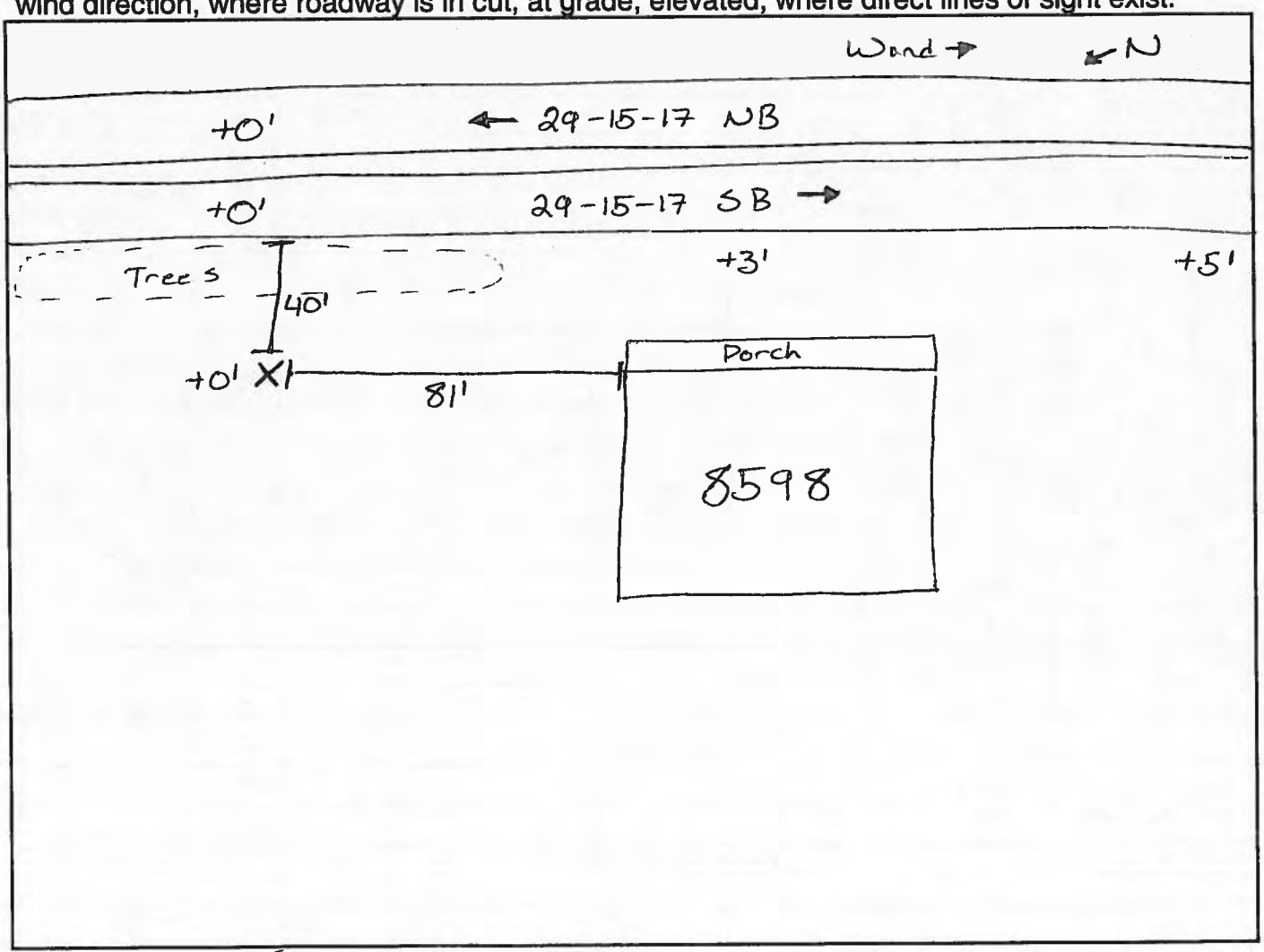
NOISE MONITOR: LD824 S/N: A3048

MICROPHONE/PREAMP: GRAS 40AQ / PRM902 S/N: 33135 / 4477

CALIBRATOR: CAL200 S/N: 9045

TEMP. RANGE (°F): 36°/45°F WEATHER CONDITIONS: Overcast / Light Snow

SITE SKETCH: Show roadway, homes, local roads, reference distances, arrows for North & wind direction, where roadway is in cut, at grade, elevated, where direct lines of sight exist.



PHOTOS: ✓ GPS COORDINATES: N 38.68032°; W 77.78757°

HARRIS MILLER MILLER & HANSON INC.

Site M4: looking south at microphone position
UPC 77384

PROJECT: Route 29-15-17 Interchange Improvement Project
JOB NO.: UPC 77384; HMMH 306780.011

TRAFFIC VOLUME COUNT DATA SHEET

ASSESSMENT AREA:
MEASUREMENT SITE NO.: M1
ADDRESS/DESCRIPTION: 8454 Turkey Run Dr.

START TIME: 12:23
END TIME: 12:53
DATE: 1/5/17
PERSONNEL: DSC/ZFW

ROADWAY:	29-15-17	DIRECTION 1: NB	DIRECTION 2: SB
First Sample: 5 **minutes** **Start Time:** 12:23			
	Automobiles	86	
	Medium Trucks (6 Tires)	6	
	Heavy Trucks (>6 Tires)	9	
	Average speed (mph)		
Second Sample: 5 **minutes** **Start Time:** 12:29			
	Automobiles		86
	Medium Trucks (6 Tires)		5
	Heavy Trucks (>6 Tires)		12
	Average speed (mph)		
Third Sample: 5 **minutes** **Start Time:** 12:35			
	Automobiles	61	
	Medium Trucks (6 Tires)	2	
	Heavy Trucks (>6 Tires)	9	
	Average speed (mph)		
Fourth Sample: 5 **minutes** **Start Time:** 12:41			
	Automobiles		89
	Medium Trucks (6 Tires)		4
	Heavy Trucks (>6 Tires)		17
	Average speed (mph)		

PROJECT: Route 29-15-17 Interchange Improvement Project
JOB NO.: UPC 77384; HMMH 306780.011

TRAFFIC VOLUME COUNT DATA SHEET

ASSESSMENT AREA: _____
MEASUREMENT SITE NO.: M1
ADDRESS/DESCRIPTION: 8454 Turkey Run Dr.

START TIME: 12:23
END TIME: 12:53
DATE: 1/5/17
PERSONNEL: DSC/ZFW

ROADWAY:	29-15-17	DIRECTION 1: NB	DIRECTION 2: SB
First Sample: 5 **minutes**			
Start Time: 12:47			
	Automobiles	62	71
	Medium Trucks (6 Tires)	4	8
	Heavy Trucks (>6 Tires)	9	14
	Average speed (mph)		
Second Sample: ____ **minutes**			
Start Time: _____			
	Automobiles		
	Medium Trucks (6 Tires)		
	Heavy Trucks (>6 Tires)		
	Average speed (mph)		
Third Sample: _____ **minutes**			
Start Time: _____			
	Automobiles		
	Medium Trucks (6 Tires)		
	Heavy Trucks (>6 Tires)		
	Average speed (mph)		
Fourth Sample: _____ **minutes**			
Start Time: _____			
	Automobiles		
	Medium Trucks (6 Tires)		
	Heavy Trucks (>6 Tires)		
	Average speed (mph)		

PROJECT: Route 29-15-17 Interchange Improvement Project
JOB NO.: UPC 77384; HMMH 306780.011

TRAFFIC VOLUME COUNT DATA SHEET

ASSESSMENT AREA: _____
MEASUREMENT SITE NO.: M2
ADDRESS/DESCRIPTION: 8484 Turkey Run Dr.

START TIME: 11:11
END TIME: 11:46
DATE: 1/5/17
PERSONNEL: DSC/ZFW

ROADWAY:	29-15-17	DIRECTION 1: NB	DIRECTION 2: SB
First Sample: 5 minutes, **Start Time:** 11:11			
	Automobiles	60	
	Medium Trucks (6 Tires)	7	
	Heavy Trucks (>6 Tires)	7	
	Average speed (mph)		
Second Sample: 5 minutes, **Start Time:** 11:17			
	Automobiles		83
	Medium Trucks (6 Tires)		6
	Heavy Trucks (>6 Tires)		18
	Average speed (mph)		
Third Sample: 5 minutes, **Start Time:** 11:23			
	Automobiles	81	
	Medium Trucks (6 Tires)	5	
	Heavy Trucks (>6 Tires)	20	
	Average speed (mph)		
Fourth Sample: 5 minutes, **Start Time:** 11:29			
	Automobiles		76
	Medium Trucks (6 Tires)		2
	Heavy Trucks (>6 Tires)		14
	Average speed (mph)		

PROJECT: Route 29-15-17 Interchange Improvement Project
JOB NO.: UPC 77384; HMMH 306780.011

TRAFFIC VOLUME COUNT DATA SHEET

ASSESSMENT AREA: _____
MEASUREMENT SITE NO.: M2
ADDRESS/DESCRIPTION: 8484 Turkey Run Dr.

START TIME: 11:11
END TIME: 11:46
DATE: 1/5/17
PERSONNEL: DSC/ZFW

ROADWAY:	29-15-17	DIRECTION 1: NB	DIRECTION 2: SB
First Sample: 5 **minutes** **Start Time:** 11:35			
	Automobiles	50	
	Medium Trucks (6 Tires)	2	
	Heavy Trucks (>6 Tires)	9	
	Average speed (mph)		
Second Sample: 5 **minutes** **Start Time:** 11:41			
	Automobiles		63
	Medium Trucks (6 Tires)		5
	Heavy Trucks (>6 Tires)		11
	Average speed (mph)		
Third Sample: _____ **minutes** **Start Time:** _____			
	Automobiles		
	Medium Trucks (6 Tires)		
	Heavy Trucks (>6 Tires)		
	Average speed (mph)		
Fourth Sample: _____ **minutes** **Start Time:** _____			
	Automobiles		
	Medium Trucks (6 Tires)		
	Heavy Trucks (>6 Tires)		
	Average speed (mph)		

PROJECT: Route 29-15-17 Interchange Improvement Project
JOB NO.: UPC 77384; HMMH 306780.011

TRAFFIC VOLUME COUNT DATA SHEET

ASSESSMENT AREA: _____
MEASUREMENT SITE NO.: M3
ADDRESS/DESCRIPTION: 6860 Traveler's Way

START TIME: 9:40
END TIME: 10:15
DATE: 1/5/17
PERSONNEL: DSC/ZFW

ROADWAY:	29-15-17	DIRECTION 1: NB	DIRECTION 2: SB
First Sample: 5 minutes, **Start Time:** 9:40			
	Automobiles	96	
	Medium Trucks (6 Tires)	3	
	Heavy Trucks (>6 Tires)	13	
	Average speed (mph)	56,58,54,61	
Second Sample: 5 minutes, **Start Time:** 9:46	29-15-17		
	Automobiles		78
	Medium Trucks (6 Tires)		3
	Heavy Trucks (>6 Tires)		14
	Average speed (mph)		
Third Sample: 5 minutes, **Start Time:** 9:52	Lord Fairfax Rd.		
	Automobiles	12	9
	Medium Trucks (6 Tires)	0	1
	Heavy Trucks (>6 Tires)	1	2
	Average speed (mph)		
Fourth Sample: 5 minutes, **Start Time:** 9:58	29-15-17		
	Automobiles	102	
	Medium Trucks (6 Tires)	8	
	Heavy Trucks (>6 Tires)	8	
	Average speed (mph)		

PROJECT: Route 29-15-17 Interchange Improvement Project
JOB NO.: UPC 77384; HMMH 306780.011

TRAFFIC VOLUME COUNT DATA SHEET

ASSESSMENT AREA:		START TIME:	9:40
MEASUREMENT SITE NO.:	M3	END TIME:	10:16
ADDRESS/DESCRIPTION:	6860 Travelers Way	DATE:	1/5/17
		PERSONNEL:	DSC/ZFW

ROADWAY:	29-15-17	DIRECTION 1: NB	DIRECTION 2: SB
First Sample: 5 **minutes** **Start Time:** 10:04			
	Automobiles		70
	Medium Trucks (6 Tires)		9
	Heavy Trucks (>6 Tires)		8
	Average speed (mph)		59,67,66,53
Second Sample: 5 **minutes** **Start Time:** 10:10	Lord Fairfax Rd.		
	Automobiles	7	8
	Medium Trucks (6 Tires)	1	2
	Heavy Trucks (>6 Tires)	2	3
	Average speed (mph)	30,31,35	30,32,36
Third Sample: _____ **minutes** **Start Time:** _____			
	Automobiles		
	Medium Trucks (6 Tires)		
	Heavy Trucks (>6 Tires)		
	Average speed (mph)		
Fourth Sample: _____ **minutes** **Start Time:** _____			
	Automobiles		
	Medium Trucks (6 Tires)		
	Heavy Trucks (>6 Tires)		
	Average speed (mph)		

PROJECT: Route 29-15-17 Interchange Improvement Project
JOB NO.: UPC 77384; HMMH 306780.011

TRAFFIC VOLUME COUNT DATA SHEET

ASSESSMENT AREA:		START TIME:	13:34
MEASUREMENT SITE NO.:	M4	END TIME:	14:04
ADDRESS/DESCRIPTION:	8598 James Madison Hwy	DATE:	1/5/17
		PERSONNEL:	DSC/ZFW

ROADWAY:	Bingham Rd.	DIRECTION 1: NB	DIRECTION 2: SB
First Sample: 5 **minutes** **Start Time:** 13:34			
	Automobiles	6	6
	Medium Trucks (6 Tires)	0	0
	Heavy Trucks (>6 Tires)	0	1
	Average speed (mph)		
Second Sample: 5 **minutes** **Start Time:** 13:40	29-15-17		
	Automobiles		36
	Medium Trucks (6 Tires)		3
	Heavy Trucks (>6 Tires)		6
	Average speed (mph)		65, 55
Third Sample: 5 **minutes** **Start Time:** 13:46	29-15-17		
	Automobiles	82	
	Medium Trucks (6 Tires)	7	
	Heavy Trucks (>6 Tires)	7	
	Average speed (mph)	58	
Fourth Sample: 5 **minutes** **Start Time:** 13:52	29-15-17		
	Automobiles		92
	Medium Trucks (6 Tires)		4
	Heavy Trucks (>6 Tires)		15
	Average speed (mph)		

PROJECT: Route 29-15-17 Interchange Improvement Project
JOB NO.: UPC 77384; HMMH 306780.011

TRAFFIC VOLUME COUNT DATA SHEET

ASSESSMENT AREA: _____
MEASUREMENT SITE NO.: M4
ADDRESS/DESCRIPTION: 8598 James Madison Hwy

START TIME: 13:34
END TIME: 14:04
DATE: 1/5/17
PERSONNEL: DSC/ZFW

ROADWAY:	29-15-17	DIRECTION 1: NB	DIRECTION 2: SB
First Sample: 5 **minutes** **Start Time:** 13:58			
	Automobiles	81	
	Medium Trucks (6 Tires)	5	
	Heavy Trucks (>6 Tires)	15	
	Average speed (mph)		
Second Sample: ____ **minutes** **Start Time:** _____			
	Automobiles		
	Medium Trucks (6 Tires)		
	Heavy Trucks (>6 Tires)		
	Average speed (mph)		
Third Sample: _____ **minutes** **Start Time:** _____			
	Automobiles		
	Medium Trucks (6 Tires)		
	Heavy Trucks (>6 Tires)		
	Average speed (mph)		
Fourth Sample: _____ **minutes** **Start Time:** _____			
	Automobiles		
	Medium Trucks (6 Tires)		
	Heavy Trucks (>6 Tires)		
	Average speed (mph)		

APPENDIX E PROPOSED ARRINGTON DEVELOPMENT - CONCEPT PLAN

This appendix includes a concept plan for the proposed Arrington active adult development.

Bowman CONSULTING

ARRINGTON

Fauquier County, Virginia

Active Adult Concept Plan

north

Scale: 1" = 600' (12"x18")
Scale: 1"=300' (24"x36")
Date: 3/30/2015

APPENDIX F RESPONSE FROM VDOT PROJECT MANAGEMENT ON ALTERNATIVE NOISE ABATEMENT MEASURES

This appendix includes a memo and survey sent to the VDOT project managers about the potential for use of alternative noise abatement measures, pursuant to Virginia House Bill 2577.

HMMH
77 South Bedford Street
Burlington, Massachusetts 01803
781.229.0707
www.hmmh.com

MEMORANDUM

To: Hal Jones PE, Project Manager, VDOT
From: Christopher Bajdek, Noise Abatement Engineer
Subject: UPC 77384, Route 29/15/17 Interchange
Virginia HB 2577 form
Reference: HMMH No. 306780.011
Date: March 8, 2017

The 2009 General Assembly passed Chapter 120 (HB 2577), which amends the Code of Virginia by adding in Article 15 of Chapter 1 of Title 33.1 a section numbered 33.1-223.2:21, relating to highway noise abatement.

House Bill 2577 States: Requires that whenever the CTB 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, 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. Landscaping in such a design would be utilized to act as a visual screen if visual screening is required.

In an effort to honor the intent of HB 2577 we are asking for your input (per Chapter VI of Materials Division's Manual of Instruction and Section 2B-3 Determination of Roadway Design of the VDOT Road Design manual (pages 2B-5 and 2B-6)). As part of the Noise Technical Report and technical files, we are seeking your professional opinion by providing comments for the project noted above. Please distribute this memorandum to the appropriate District staff and combine all responses into one response.

Should you have any questions, please contact me at (781) 229-0707 x3128, Jim Ponticello at (804) 371-6769 or LJ Muchenje at (804) 371-6768. Thank you for your time and consideration regarding this request.

Comment: Is noise reducing design feasible in lieu of construction of noise walls or sound barriers? For example, the roadway alignment can be shifted away from noise sensitive receptors or the roadway can be placed in deep cut (Location & Design to address)

Response: The Categorical Exclusion (CE) is based on improvements that would occur within or directly adjacent to the existing highway corridor and the planned interchange requires a bridge to be constructed over the mainline roadway. Ramp alignments are located as far away from noise receptors as feasible.

Comment: Can the project support the use of low noise pavement in lieu of construction of noise walls or sound barriers? (Materials Division to address)

Response: The Virginia Department of Transportation is not authorized by the Federal Highway Administration to use "quiet pavement" at this time as a form of noise mitigation. Upon completion of the Quiet Pavement Pilot Program and approval from FHWA, the use of "quiet pavement" will be given additional consideration.

Comment: Can landscaping be utilized to act as a visual screen if visual screening is required? (Location & Design to address)

Response: Landscaping is being considered for the project, but not necessarily for the purpose of providing a visual screen. The extent of landscaping ultimately included in the final design will be limited to the available funds.

Note: Please provide the name of each responder.

APPENDIX G WARRANTED, FEASIBLE AND REASONABLE WORKSHEETS

This appendix provides the required Warranted, Feasible and Reasonable Worksheets for all of the warranted noise barriers.

VDOT Highway Traffic Noise Abatement
Warranted, Feasible, and Reasonable Worksheet

Note: Not all questions apply depending on the design phase which may cause differing answers between preliminary and final design phase. Answers to the questions may change depending on the design phase of the project.

Date:	6-Mar-17
Project No. and UPC:	77384
County:	Fauquier
District:	Culpeper
Barrier System ID:	Barrier B
Community Name and/or CNE#	CNE B - Turkey Run Drive
Noise Abatement Category(s)	B
Design phase:	Preliminary design

	Warranted	
1	Community Documentation (if applicable)	
a.	Date community was permitted. (Per 23CFR 772 this is the date the building permit was issued).	NA
b.	Date of approval for the Categorical Exclusion (CE), Record of Decision (ROD), or Finding of No Significant Impact (FONSI):	NA
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."	NA
2	Criteria requiring consideration of noise abatement	
a.	Project causes design year noise levels to approach or exceed the Noise Abatement Criteria?	Yes
b.	Project causes a substantial noise increase of 10 dB(A) or more?	Yes

	Feasibility	
1	Impacted receptor units	
a.	Number of impacted receptor units:	5
b.	Number of impacted receptor units receiving 5 dB(A) 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?	Yes
2	Will placement of the noise barrier cause engineering or safety conflicts, e.g drainage issues or site distance issues?	NA
3	Will placement of the noise barrier restrict access to vehicular or pedestrian travel?	No
4	Will placement of the noise barrier conflict with existing utility locations?	NA

	Reasonableness	
1	**Surface Area (Square foot)-Benefit Factors**	
a.	Surface Area (Total square foot) of the proposed noise barrier. (ft^2)	27,578 SF
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.	3
d.	Total number of benefited receptors.	8
e.	Surface Area per benefited receptor unit. (ft^2/BR)	3,447 SF/BR
f.	Is (1e) less than or equal to the maximum square feet per benefited receptor (MaxSF/BR) value of 1600?	No
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	**Additional Noise Barrier Details**	
a.	Length of the proposed noise barrier. (ft)	2,124 ft
b.	Height range of the proposed noise barrier. (ft)	13 - 13 ft
c.	Average height of the proposed noise barrier. (ft)	13 ft
d.	Cost per square foot. ($/$ft^2$)	$42/SF
e.	Total Barrier Cost ($)	$1,158,276
f.	Barrier Material	
3	**Community Desires Related to the Barrier**	
	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.”	

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

Additional Reasons for Decision:
The noise barrier is not cost-reasonable as a result of this preliminary analysis.

VDOT Highway Traffic Noise Abatement
Warranted, Feasible, and Reasonable Worksheet

Note: Not all questions apply depending on the design phase which may cause differing answers between preliminary and final design phase. Answers to the questions may change depending on the design phase of the project.

Date:	6-Mar-17
Project No. and UPC:	77384
County:	Fauquier
District:	Culpeper
Barrier System ID:	Barrier C
Community Name and/or CNE#	CNE C - Travelers Way
Noise Abatement Category(s)	B
Design phase:	Preliminary design

	Warranted	
1	Community Documentation (if applicable)	
a.	Date community was permitted. (Per 23CFR 772 this is the date the building permit was issued).	NA
b.	Date of approval for the Categorical Exclusion (CE), Record of Decision (ROD), or Finding of No Significant Impact (FONSI):	NA
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."	NA
2	Criteria requiring consideration of noise abatement	
a.	Project causes design year noise levels to approach or exceed the Noise Abatement Criteria?	Yes
b.	Project causes a substantial noise increase of 10 dB(A) or more?	Yes

	Feasibility	
1	Impacted receptor units	
a.	Number of impacted receptor units:	1
b.	Number of impacted receptor units receiving 5 dB(A) or more insertion loss (IL):	1
c.	Percentage of impacted receptor units receiving 5 dB(A) or more IL	100%
d.	Is the percentage 50 or greater?	Yes
2	Will placement of the noise barrier cause engineering or safety conflicts, e.g drainage issues or site distance issues?	NA
3	Will placement of the noise barrier restrict access to vehicular or pedestrian travel?	No
4	Will placement of the noise barrier conflict with existing utility locations?	Yes

	Reasonableness	
1	**Surface Area (Square foot)-Benefit Factors**	
a.	Surface Area (Total square foot) of the proposed noise barrier. (ft^2)	4,667 SF
b.	Impacted noise sensitive receptor(s) receiving 5 dB(A) IL or more.	1
c.	Non-impacted noise sensitive receptor(s) receiving 5 dB(A) IL or more.	0
d.	Total number of benefited receptors.	1
e.	Surface Area per benefited receptor unit. (ft^2/BR)	4,667 SF/BR
f.	Is (1e) less than or equal to the maximum square feet per benefited receptor (MaxSF/BR) value of 1600?	No
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	**Additional Noise Barrier Details**	
a.	Length of the proposed noise barrier. (ft)	292 ft
b.	Height range of the proposed noise barrier. (ft)	16 - 16 ft
c.	Average height of the proposed noise barrier. (ft)	16 ft
d.	Cost per square foot. ($/$ft^2$)	$42/SF
e.	Total Barrier Cost ($)	$196,014
f.	Barrier Material	
3	**Community Desires Related to the Barrier**	
	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.”	

Decision	
Is the Noise Barrier(s) WARRANTED?	Yes
Is the Noise Barrier(s) FEASIBLE?	NA
Is the Noise Barrier(s) REASONABLE?	No

Additional Reasons for Decision:
The noise barrier is not cost-reasonable as a result of this preliminary analysis.
There may be a conflict with overhead utilities along the north property line of the residence at Receptor C-001.