**HIGHLIGHT LEGEND:**

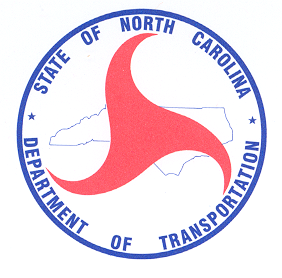
Yellow highlighted text must be replaced with project-specific text.

*Blue highlighted text* is instructional; follow its guidance but delete it from your TNR.

Green highlighted sections serve as example text – delete these from your TNR but use them as appropriate to craft the appropriate text for your report.

**Instructions for using this template**

The text provided is suggested, not mandatory. As long as the information in your report is clear, accurate, and complaint with NCDOT Noise Policy and Manual, you can opt to use your own language. However, your TNR does need to contain all the pertinent information listed herein, and in the order provided in this Template.



TRAFFIC NOISE REPORT

PROJECT DESCRIPTION

County(ies)

STIP Project No. X-XXXX

WBS Project No. X.XXXX.X.X

FA No. XXX-XXXX(XXX) *(if no FA No., delete this line)*

Prepared for:

North Carolina Department of Transportation

Environmental Analysis Unit

Traffic Noise and Air Quality Group

Prepared in compliance with:

2021 NCDOT Traffic Noise Policy

*If subject to different policy, cite it instead, here and throughout document.*

Submitted by:

FIRM NAME

Month Year

**TRAFFIC NOISE REPORT**

PROJECT DESCRIPTION

County(ies)

STIP Project No. X-XXXX

WBS Project No. X.XXXX.X.X

FA No. XXX-XXXX(XXX) *(if no FA No., delete this line)*

Prepared for:

North Carolina Department of Transportation

Environmental Analysis Unit

Traffic Noise and Air Quality Group

Prepared by:

FIRM NAME

*Analyst and Reviewer must be prequalified in Work Code 253 by NCDOT*

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

*Name Name*

*Traffic Noise Reviewer Traffic Noise Analyst*

Accepted by:

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Date \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Traffic Noise & Air Quality Group

Environmental Analysis Unit

# Executive Summary

The North Carolina Department of Transportation (NCDOT) proposes to construct project name, general project description including termini, number of alternatives and length in name of County(ies) (refer to Figure 1). The Build Alternative(s) is/are shown on Figures X through X.

A/An [insert type of environmental document and indicate whether federal or state] is anticipated for this project. This project is included in the NCDOT State Transportation Improvement Program (STIP) as Project X-XXXX. The Date of Public Knowledge will be the approval date of the MCDC or CE or SEA/FONSI or FONSI or ROD.

This Traffic Noise Report (TNR) documents the methodologies, results, and recommendations in compliance with Federal Highway Administration (FHWA) Title 23 CFR 772 *Procedures for Abatement of Highway Traffic Noise and Construction Noise,* the 2021 NCDOT *Traffic Noise Policy* (NCDOT Policy), and the accompanying 2022 NCDOT *Traffic Noise Manual* (NCDOT Manual). *(If different policy/manual applies, cite it instead.)* Per FHWA Title 23 CFR 772.5(2) and NCDOT Policy, the proposed project is a “Type I” project because it[describe the Type I improvements].

Traffic noise impacts and temporary construction noise impacts can be a consequence of transportation projects. This TNR utilized computer models created with the Federal Highway Administration Traffic Noise Model® (FHWA TNM 2.5), validated to field-collected traffic noise measurement data, to determine existing and to predict future worst noise hour equivalent noise levels and to identify impacted receptors resulting from the proposed project. *If no validation was required, state that instead, and explain why it wasn’t needed.*

Construction noise impacts may occur due to the proximity of noise-sensitive receptors to anticipated project construction activities. All reasonable efforts should be made to minimize exposure of noise-sensitive land uses to construction noise. Such efforts may include, but are not limited to, appropriate scheduling of construction activities, noise attenuating measures on construction equipment, and a consistent and open public involvement program.

Design Year (year) Build condition traffic noise is predicted to impact XX (number of) noise-sensitive receptors (*do not include number of impacted grid points; only include impacted ERs*) near the project for Build Alternative X (*describe for each Build alternative including description of general locations and types of any predicted traffic noise impacts)*.

*If noise barriers were found to be likely, conclude Executive Summary with the following text or similar:*

In accordance with the 2021 NCDOT Policy, consideration for noise abatement measures was given to all impacted receptors. NCDOT Policy requires identification of whether it is “likely” or “unlikely” that noise barriers will be installed for each noise sensitive area identified. “Likely” does not mean a firm commitment. The final decision on feasibility and reasonableness of noise abatement will be made upon completion of the project design, completion of a Design Noise Report (DNR) a practicability assessment (where applicable), and the public involvement process. **XX (number of) *traffic noise abatement measures assessed in this traffic noise analysis preliminarily meet NCDOT Policy feasibility and reasonableness criteria and are considered likely to be installed for the X-XXXX project.*** These likely noise abatement measures are described below or in Table X*.*

*List likely noise walls in a table format like the one below OR in a bulleted list. Depending on the number of likely barriers and/or alternatives, it may or may not make sense to report in a table. Use the table if it is helpful based on the specific project. If a bulleted list is used instead, it need only include barrier name and location.*

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Table X: Likely Noise Walls** | | | | | | | |
| **Build Alternative**  **(Noise Barrier Location)** | | **Length**  **(feet)** | **Area**  **(square feet)** | | | **Number of Benefited Receptors** | **Area per Benefited Receptor / Allowable Area per Benefited Receptor** |
| **BUILD ALTERNATIVE XX** |  | | |  |  | | |
| NW3 use common description of wall location | | 465 | 4,875 | | | 6 | 813/1,500 |
| NW4 | | 560 | 13,317 | | | 2 | 6,659/1,500 |
| NW5 | | 420 | 6,181 | | | 11 | 562/1,500 |
| **BUILD ALTERNATIVE XX** |  | | |  |  | | |
| NW3 | | 465 | 4,875 | | | 6 | 813/1,500 |
| NW4 | | 560 | 13,317 | | | 2 | 6,659/1,500 |
| NW5 | | 420 | 6,181 | | | 11 | 562/1,500 |
| 1. The likelihood for noise wall construction is preliminary and subject to change, pending completion of final design and the public involvement process. | | | | | | | |

*If no noise barriers were found to be likely, conclude Executive Summary with the following text or similar:*

In accordance with the 2021 NCDOT Policy, consideration for noise abatement measures was given to all impacted receptors. *If there were no impacts, state that no noise abatement measures were considered because there were no impacts.* NCDOT Policy requires identification of whether it is “likely” or “unlikely” that noise barriers will be installed for each noise sensitive area identified. “Likely” does not mean a firm commitment. **No traffic noise abatement measures assessed in this preliminary traffic noise analysis meet NCDOT Policy feasibility and reasonableness criteria, and all noise abatement measures are considered to be “unlikely” to be installed for the X-XXXX project.**Unless changes to the project occur that would result in either additional predicted traffic noise impacts or different feasibility and reasonableness conclusions for the evaluated traffic noise abatement measures, additional traffic noise analysis during final design is not recommended, and no noise abatement measures are proposed for incorporation into the project. *Possible changes that could meet this definition include, but are not limited to project design changes, additional build alternative(s), revised traffic forecasts, and new development permitted and/or constructed in the project study area prior to the DoPK.* This analysis completes the traffic noise requirements of the Title 23 CFR Part 772 and NCDOT Traffic Noise Policy. *Modify the preceding two sentences as appropriate. E.g., if no walls are likely but some are close, then they may need to be revisited with a DNR even if no other project changes occur; in this case, this analysis would NOT complete the requirements of 23 CFR 772 and the Policy. Coordinate with NCDOT TNAQ before making this commitment in the TNR.*

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Traffic Noise Report

**Proposed Project Description**

**County(ies), STIP No.** X-XXXX

# 1.0 PROJECT LOCATION, DESCRIPTION AND BACKGROUND

The North Carolina Department of Transportation (NCDOT) proposes to construct project name and detailed project description including termini, number of Build alternatives and length in Name of County(ies) (refer to Figure 1). The project is included in the State Transportation Improvement Program (STIP) as X-XXXX.

The proposed project will *describe improvements.* EXAMPLES - construct a highway on new location, add through lanes to an existing roadway facility, construct a new interchange, add or relocate interchange ramps within an existing interchange.

A/An [insert type of environmental document and indicate whether federal or state] is anticipated for this project. The Date of Public Knowledge will be the approval date of the MCDC or CE or SEA/FONSI or FONSI or ROD.

*Describe existing facility(ies) and any other relevant features of the existing environment (e.g., other transportation noise sources like rail or aviation).* *Describe the stage of designs e.g. preliminary or final design* *at the time of this report.* *Describe alternatives, typical sections and limits, posted speeds, design speed(s), and type of access control for each major roadway modeled. Describe level of design the noise analysis was based on.*

*Describe existing land uses. Describe any proposed land uses, if known, and cite source of information e.g. county planning office, etc. State county(ies) and municipality(ies) the project falls in.*

The noise sensitive land uses within the project area are primarily *describe land uses, including NAC categories. State number of residential and non-residential receptors (this means the equivalent receptors and not the number of grid points) that were analyzed for noise impacts.*

For the purpose of this Traffic Noise Report (TNR), the project study area was divided into XX (number of) Noise Study Areas (NSAs) to group receptors influenced by similar noise sources. The general locations of these NSAs are shown on Figure 1 and are defined as follows:

EXAMPLE  
NSA 1: North of NC 49 and west of Mallard Creek Church Road

NSA 2: South of NC 49 and west of realigned Back Creek Church Road

NSA 3: North of NC 49 and east of Mallard Creek Church Road

NSA 4: South of NC 49 and east of realigned Back Creek Church Road

NSA 5: West of realigned Back Creek Church Road and south of Back Creek

NSA 6: East of realigned Back Creek Church Road and south of Back Creek

Figures 2-X through 2-X show the Build Alternative(s) and NSAs identified along the project corridor.

*Discuss all previous noise studies for the project, if applicable. If there have been no previous studies, then state so.*

*Describe any other unique information related to the project and/or the project area.*

# 2.0 PROCEDURE

This TNR represents the analysis of the predicted traffic noise impacts and the identification of any “likely” noise abatement measures in the vicinity of the proposed X-XXXX project.

This analysis is consistent with Title 23 Code of Federal Regulations, Part 772, U.S. Department of Transportation, Federal Highway Administration (FHWA), *Procedures for Abatement of Highway Traffic Noise and Construction Noise*, the 2021 NCDOT *Traffic Noise Policy*, dated November 29, 2021, and the accompanying 2022 NCDOT *Traffic Noise Manual,* effective October 12, 2022.

The FHWA Traffic Noise Model® (TNM 2.5) was used to predict Base Year (year)Existing, Design Year (year) No-Build and Design Year (year) Build condition hourly equivalent traffic noise levels, Leq(h), for noise-sensitive receptors near the proposed project (refer to Figures 2-X through 2-X).

The noise analysis documented in this TNR was conducted in accordance with the following procedures:

* *Initial Project Scoping / Preparation:* Project (state design level assessed in the TNR) design was obtained; field maps were prepared; project mapping, GIS data, aerial photography, traffic data, and other available pertinent information was reviewed. In accordance with Traffic Noise Manual Section 7.6, a Noise Analysis Work Plan was approved on [insert date of approval] prior to initiation of any noise measurements or modeling.
* *Monitoring / Fieldwork:* Ambient sound level data was collected at XX (number of) XX-minute short-term and XX (number of) XX-hour long-term measurement locations on date(s)(refer to photographs in Appendix A and Figures 2-X through 2-X). These measurements were taken in accordance with Section 7.8 of the NCDOT Traffic Noise Manual, and in consideration of the FHWA Reports FHWA-PD-96-046 “Measurement of Highway Related Noise,” FHWA-HEP-18-065 “Noise Measurement Handbook,” and FHWA-HEP-18-066 “Noise Measurement Field Guide.” Traffic volume data, including vehicle classifications, was obtained during each measurement session by (state methodology – e.g., video record, hand-counting, traffic tubes, etc.). Traffic speeds during each measurement session were determined by (state methodology – e.g., distance/time calculations, driving the corridor, speed detection device, etc.). Types of land use and property addresses were determined for all noise-sensitive receptors. Weather data was acquired using (cite equipment or other weather data resource). Finally, a field measurement site sketch and event log were created for each noise measurement session.
* *Baseline TNM model:* A TNM 2.5 model representing existing conditions was created utilizing receptors, roadways, terrain lines, ground zones, and barriers (to represent buildings). Classified traffic and speed data during each measurement session was applied to validate the baseline TNM model at all ambient noise measurement locations for which traffic was the dominant source to within ±3 decibels (±3 dB(A)). A Noise Model Validation Memorandum was approved on date (refer to Appendix C).
* *Traffic Noise Level Prediction:* Base Year (year) Existing condition and Design Year (year) No-build condition hourly traffic volumes and speeds that yielded the loudest hourly noise levels were added to the appropriate roadways in the validated baseline TNM model(s). Traffic volumes were divided into automobiles, medium trucks and heavy trucks based on the (cite source of traffic volumes – e.g. traffic forecast for the project). Then project (state design level – e.g. functional, preliminary or final) design was incorporated into the validated TNM model(s), and Design Year (year) Build condition hourly traffic volumes and speeds were added following the same procedure described for the Existing and No-Build conditions. TNM-predicted traffic noise levels at all noise sensitive receptors were then calculated and documented, including the screening of TNM-predicted traffic noise levels against ambient noise measurement data acquired in the field (see Appendix B)*.*
* *Impact Assessment:* NCDOT Noise Abatement Criteria (NAC) and Substantial Increase criteria were applied to assess predicted traffic noise NAC and Substantial Increase impacts at all noise sensitive receptors for the Design Year (year) Build condition; impacts for each Detailed Study Alternative (or Build Alternative, as applicable) were documented (refer to Table X and Appendix B) and locations where abatement had to be considered were identified. [If applicable] For non-residential land use receptors, the number of Equivalent Receptors (ERs) were determined per Traffic Noise Manual Section 7.10.3 (refer to Appendix B).
* *Abatement Analysis* (if applicable): Noise abatement measures as defined by the NCDOT Traffic Noise Policy were considered for the potential benefit of all traffic noise impacts. Locations for which noise barriers in the form of earth berms or noise walls may be feasible were identified, and noise barriers were incorporated into the Design Year (year) Build condition TNM model(s) per Traffic Noise Manual Section 7.10.6. TNM Noise Barrier Assessments, and (if applicable), TNM Parallel Barrier Assessments, were used to identify optimized barriers that provide noise level reduction benefits to as many predicted impacted receptors as possible, meet applicable feasibility and reasonableness criteria, and address all other pertinent engineering considerations (refer to Appendix E).
* *Noise level contours*: Design Year Build traffic noise level contours were evaluated to assist land use planning efforts by local governments (see Sections 8.0 and 11.0).
* *Construction Noise:* Project-related construction noise was considered for potential effects to noise-sensitive receptors throughout the project corridor.

# 3.0 CHARACTERISTICS OF NOISE

Noise is defined as unwanted sound. It is emitted from many natural and man-made sources. Highway traffic noise is usually a composite of noises from engine exhaust, drive train, and tire-roadway interaction.

The magnitude of noise is usually described by a ratio of its sound pressure to a reference sound pressure, which is usually twenty micro-Pascals (20Pa). Since the range of sound pressure ratios varies greatly – over many orders of magnitude, a base-10 logarithmic scale is used to express sound levels in dimensionless units of decibels (dB). The commonly accepted limits of detectable human hearing sound magnitudes are between the threshold of hearing at 0 decibels and the threshold of pain at 140 decibels.

Sound frequencies are reported in units of Hertz (Hz), which correspond to the number of vibrations per second of a given tone. A cumulative ‘sound level’ is equivalent to ten times the base-10 logarithm of the ratio of the sum of the sound pressures of all frequencies to the reference sound pressure. To simplify the mathematical process of determining sound levels, sound frequencies are grouped into ranges, or ‘bands.’ Sound levels are then calculated by adding the cumulative sound pressure levels within each band – which are typically defined as one ‘octave’ or ‘1/3 octave’ of the sound frequency spectrum.

The commonly accepted limitation of human hearing to detect sound frequencies is between 20 Hz and 20,000 Hz, and human hearing is most sensitive to the frequencies between 1,000 Hz – 6,000 Hz. Although people are generally not as sensitive to lower-frequency sounds as they are to higher frequencies, most people lose the ability to hear high-frequency sounds as they age. To accommodate varying receptor sensitivities, frequency sound levels are commonly adjusted, or ‘filtered’, before being logarithmically added and reported as a single ‘sound level’ magnitude of that filtering scale. The ‘A-weighted’ decibel filtering scale applies numerical adjustments to sound frequencies to emphasize the frequencies at which human hearing is sensitive, and to minimize the frequencies to which human hearing is not as sensitive.

Common indoor and outdoor noise levels are presented in Table X. As shown in the examples of noise levels, most individuals are exposed to fairly high noise levels from many sources on a regular basis.

The degree of disturbance or annoyance from exposure to unwanted sound – noise – depends upon three factors:

1. The amount, nature, and duration of the intruding noise
2. The relationship between the intruding noise and the existing (ambient) sound environment; and
3. The situation in which the disturbing noise is heard

In considering the first of these factors, it is important to note that individuals have varying sensitivity to noise. Loud noises bother some people more than other people. The time patterns and durations of noise(s) also affect perception as to whether it is offensive. For example, noises that occur during nighttime (sleeping) hours are typically considered to be more offensive than the same noises in the daytime.

Regarding the second factor, individuals tend to judge the annoyance of an unwanted noise in terms of its relationship to noise from other sources (background noise). A car horn blowing at night when background noise levels are low would generally be more objectionable than one blowing in the afternoon when background noise levels are typically higher. The response to noise stimulus is analogous to the response to turning on an interior light. During the daytime, an illuminated bulb simply adds to the ambient light, but when eyes are conditioned to the dark of night, a suddenly illuminated bulb can be temporarily blinding.

|  |  |  |
| --- | --- | --- |
| Table X: Common Indoor and Outdoor Noise Levels | | |
| **Common Outdoor Noise Levels** | **Noise Level (dB(A))** | **Common Indoor Noise Levels** |
| **Jet Flyover at 1,000 feet** | **110** | **Rock Band** |
| **100** | **Inside Subway Train (NY)** |
| **Gas Lawn Mower at 3 feet** |  |  |
| **Diesel Truck at 50 feet** | **90** | **Food Blender at 3 feet** |
| **Noisy Urban Daytime** | **80** | **Garbage Disposal at 3 feet** |
| **Gas Lawn Mower at 100 feet** | **70** | **Vacuum Cleaner at 10 feet** |
| **Commercial Area** |  | **Normal Speech at 3 feet** |
|  | **60** |  |
|  |  | **Large Business Office** |
| **Quiet Urban Daytime** | **50** | **Dishwasher Next Room** |
| **Quiet Urban Nighttime** | **40** | **Small Theater, Large Conference Room (Background)** |
| **Quiet Suburban Nighttime** |  | **Library** |
|  | **30** |  |
| **Quiet Rural Nighttime** |  | **Bedroom at Night, Concert Hall**  **(Background)** |
| **20** |  |
|  | **Broadcast and Recording Studio** |
| **10** |  |
| **0** | **Threshold of Hearing** |
| Adapted from Guide on Evaluation and Attenuation of Traffic Noise, American Association of State Highway and Transportation Officials (AASHTO). 1974 (revised 1993). | | |

The third factor – situational noise – is related to the interference of noise with activities of individuals. In a 60 dB(A) environment such as is commonly found in a large business office, normal conversation would be possible, while sleep might be difficult. Loud noises may easily interrupt activities that require a quiet setting for greater mental concentration or rest; however, the same loud noises may not interrupt activities requiring less mental focus or tranquility.

Over time, individuals tend to accept the noises that intrude into their lives on a regular basis. However, exposure to prolonged and/or extremely loud noise(s) can prevent use of exterior and interior spaces and has been theorized to pose health risks. Appropriately, regulations exist for noise control or mitigation from many particularly offensive sources, including airplanes, factories, railroads, and highways. For all “Type I” federal, state, or federal-aid highway projects in the State of North Carolina, traffic and construction noise impact analysis and abatement assessment is dictated by the applicable NCDOT Policy.

# 4.0 NOISE ABATEMENT CRITERIA

## 4.1 Title 23 Code of Federal Regulations, Part 772 (23 CFR 772)

The FHWA has developed NAC and procedures to be used in the planning and design of highways. The purpose of 23 CFR 772 is, “To provide procedures for noise studies and noise abatement measures to help protect the public’s health, welfare and livability, to supply noise abatement criteria, and to establish requirements for information to be given to local officials for use in the planning and design of highways approved pursuant to title 23 U.S.C.”

The abatement criteria and procedures are set forth in 23 CFR 772, which also states, “In abating traffic noise impacts, a highway agency shall give primary consideration to exterior areas where frequent human use occurs.”

A summary of the NAC for various land uses is presented in Table X. The Leq, or equivalent sound level, is the equivalent steady-state sound level which in a stated period contains the same acoustic energy as a time-varying sound level during the same period. Regarding traffic noise, fluctuating sound levels of traffic noise are represented in terms of Leq, the steady, or ‘equivalent’, noise level with the same energy.

## 4.2 North Carolina Department of Transportation Traffic Noise Policy

The 2021 NCDOT Traffic Noise Policy (November 29, 2021) establishes official policy on highway noise. This policy describes the NCDOT process that is used in determining traffic noise impacts, construction noise impacts and abatement measures and the equitable and cost-effective expenditure of public funds for traffic noise abatement. Where the FHWA has given highway agencies flexibility in implementing the 23 CFR 772 standards, this policy describes the NCDOT approach to implementation. This policy is included as Appendix E/F of this report.

## 4.3 Noise Abatement Criteria

Table X lists the FHWA NAC land use activity categories, and the noise levels that, when approached, met, or exceeded with the project build condition, constitute an impact.

|  |  |  |  |
| --- | --- | --- | --- |
| Table X: Noise Abatement Criteria | | | |
| Hourly Equivalent A-Weighted Sound Level (decibels (dB(A)) | | | |
| **Activity**  **Category** | **Activity Criteria1**  **Leq(h)2** | **Evaluation**  **Location** | **Activity Description** |
| A | 57 | Exterior | Lands on which serenity and quiet are of extraordinary significance and serve an important public need and where the preservation of those qualities is essential if the area is to continue to serve its intended purpose. |
| B 3 | 67 | Exterior | Residential |
| C 3 | 67 | Exterior | Active sport areas, amphitheaters, auditoriums, campgrounds, cemeteries, daycare 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, Section4(f) sites, schools, television studios, trails, and trail crossings |
| D | 52 | Interior | Auditoriums, day care centers, hospitals, libraries, medical facilities, places of worship, public meeting rooms, public or nonprofit institutional structures, radio studios, recording studios, schools, and television studios |
| E 3 | 72 | Exterior | Hotels, motels, offices, restaurants/bars, and other developed lands, properties or activities not included in A-D or F |
| F | -- | -- | Agriculture, airports, bus yards, emergency services, industrial, logging maintenance facilities, manufacturing, mining, rail yards, retail facilities, shipyards, utilities (water resources, water treatment, electrical), and warehousing |
| G | -- | -- | Undeveloped lands that are not permitted |
| 1 The Leq(h) Activity Criteria values are for impact determination only and are not design standards for noise abatement measures.  2 The equivalent steady-state sound level which in a stated period of time contains the same acoustic energy as the time-varying sound level during the same time period, with Leq(h) being the hourly value of Leq.  3 Includes undeveloped lands permitted for this activity category. | | | |

# 5.0 AMBIENT NOISE LEVELS

Ambient noise is noise which is all around us caused by natural and manmade events. It includes the wind, rain, thunder, birds chirping, insects, household appliances, commercial operations, lawn mowers, airplanes, automobiles, etc. It is all noise that is present in a particular area.

*Describe the existing ambient noise environments throughout the project corridor for each NSA, neighborhood, or areas of differing noise exposure. Note any relevant observations during project area reconnaissance or during noise measurements. Note how/why traffic noise is, or is not, the dominant source for noise-sensitive receptors in each NSA. Include any existing noise walls along the project, what information sources were used to estimate the existing noise wall horizontal alignment and vertical profile, and how each wall is being affected by the project, in accordance with the 2022 Traffic Noise Manual Appendix D.4.1.*

EXAMPLE:

Ambient noise environments throughout the project corridor are similar. During a field visit, analysts noted birds chirping, insects, air conditioning units running near apartment buildings, and many aircraft taking off, landing, and flying overhead due to the presence of the nearby Marine Corps Air Station (MCAS) at Cherry Point. The major traffic noise sources throughout the project study area are Miller Blvd, NC 101, and US 70. The receptors along each intersecting roadway are also affected by traffic noise caused by the respective roadway.

In addition to gathering information and making general observations about the project study area, ambient noise measurement and field work are conducted to collect noise level and classified vehicle (see Table X) count data that can be used to develop a comparison between noise levels measured in the field at locations where traffic noise is the dominant noise source, and the predicted hourly-equivalent traffic noise levels obtained from TNM. This exercise is performed to validate the model to local conditions so that it can be used with confidence to predict the future worst noise hour equivalent noise levels and assess potential traffic noise impacts. Ambient noise measurements are also used to define ambient noise levels at locations where traffic noise is not the primary noise source. *If measurements were taken for any additional reasons, discuss them also.*

Short-term ambient noise measurement data was collected in 1-minute increments over a 20-minute period *(modify previous text as necessary)* in an array of XX (number of) sound level meters for XX (number of) sites along the project corridor. The ambient noise measurement locations are shown on Figures 2-X through 2-X. The measured ambient sound levels range from XX to XX dB(A). The noise measurement results, concurrent traffic counts, observed vehicle speeds, weather information for the measurement sites and photographs of each location are included in Appendix A.

*If applicable, describe long-term measurement collection, including location(s), purpose, time period, rolling loudest-hour Leq(h) determination (including justification for despiking if applicable), and how/where it is used in the study.*

# 6.0 NOISE MODEL VALIDATION

TNM model validation is the process by which the accuracy of the existing conditions TNM 2.5 model is refined and confirmed by comparing noise levels at field measurement locations to the TNM-predicted noise levels at those same locations under the same traffic conditions. The validation process is the basis upon which the TNMs for predicting existing year and design year noise levels were built. Since TNM can only predict traffic noise levels, TNM models can only be validated for locations for which traffic was the dominant noise source. TNM model validation was performed for all short-term measurement locations for which traffic was the dominant noise source. A TNM model is considered validated if it is a reasonable representation of the existing noise study area and/or project area, and the TNM-predicted traffic noise levels are within ±3.0 decibels (±3.0 dB(A)) of the measured equivalent sound levels obtained at locations for which traffic was the dominant noise source.

*Summarize project validation results here. Include explanation of any sites that did not validate and the reason(s).*

EXAMPLE:

Validation was achieved for 59 of the 62 noise measurement locations across 21 measurement sites. The one site that did not validate was primarily due to the observed traffic volumes exceeding LOS C capacity for both directions of I-85, which resulted in congested conditions and inconsistent travel speeds on the interstate during this measurement. The average speed on I-85 southbound (49 mph) was significantly lower than the posted speed limit (60 mph). The results of TNM model validation are included in Appendix C.

# 7.0 PROCEDURE FOR PREDICTING EXISTING NOISE LEVELS

Traffic noise emission is composed of several variables, including the number, types, and travel speeds of the vehicles, as well as the geometry of the roadway(s) on which the vehicles travel. Additionally, variables such as weather and intervening topography affect the transmission of traffic noise from the vehicle(s) to noise sensitive receptors.

Traffic noise consists of three primary parts: tire/pavement noise, engine noise, and exhaust noise. Of these sources, tire/pavement noise is typically the most offensive at unimpeded travel speeds. Sporadic traffic noises such as horns, squealing brakes, screeching tires, etc. are considered aberrant and are not included within the predictive model algorithm. Traffic noise is not constant; it varies in time depending upon the number, speed, type, and frequency of vehicles that pass by a given receptor. Furthermore, since traffic noise emissions are different for various types of vehicles, the TNM algorithm distinguishes between the source emissions from the following vehicle types depicted in Table X: automobiles (FHWA vehicle classifications 2 and 3), medium trucks (FHWA vehicle classification 5), heavy trucks (FHWA vehicle classifications 6 – 13), buses (FHWA vehicle classification 4), and motorcycles (FHWA vehicle classification 1).

|  |
| --- |
| Table X: Traffic Noise Model (TNM) Vehicle Classification Types |
|  |
| Source: <http://onlinemanuals.txdot.gov/txdotmanuals/tri/vehicle_classification_using_fhwa_13category_scheme.htm> |

In accordance with Federal Highway Administration requirements, detailed computer models were created using FHWA’s TNM 2.5 software. The traffic noise prediction model TNM 2.5 uses the number and type of vehicles on the planned roadway, vehicle speeds, the physical characteristics of the road (curves, hills, depressions, elevations, etc.), receptor location and height, and, if applicable, barrier type, barrier ground elevation, and barrier segment top elevations. The computer models were validated to within acceptable tolerances of field- measured traffic noise data and were used to predict existing worst noise hour equivalent traffic noise levels for noise sensitive receptor locations identified in the vicinity of the X-XXXX project.

This analysis uses the traffic volumes that yield the loudest existing hourly noise levels as the lesser of forecasted Base Year (year) peak hour traffic volumes and the maximum vehicle capacity that can maintain Level of Service “C” (LOS C) for all roadway segments.

*If applicable, describe any areas or NSAs where the field measurements were used as the existing level instead of the TNM predicted noise levels.*

Interior hourly-equivalent noise levels are determined for NAC D land uses, such as hospitals, schools, medical facilities, and places of worship, by applying building noise reduction factors based on building type and window treatment that can be found in FHWA publication *Highway Traffic Noise: Analysis and Abatement Guidance*. Appropriate land uses are included in this analysis as NAC D receptors if:

1. These land uses have no exterior area(s) of frequent human use,
2. These land uses do have exterior area(s) of frequent human use, but they are located significantly further from the primary traffic noise source and/or shielded by building(s) such that there were no predicted impacts, OR
3. These land uses have exterior area(s) of frequent human use that are predicted to be impacted by traffic noise, but outdoor abatement options have been determined to not be feasible or not be reasonable.

Refer to Appendix B for predicted Base Year (year) hourly equivalent traffic noise levels, as well as a comprehensive list of traffic noise receptors.

# 8.0 PROCEDURE FOR PREDICTING FUTURE NOISE LEVELS

The TNM 2.5 models developed for the existing condition were updated with forecasted traffic volumes for the Design Year No-Build condition and used to predict future no-build worst noise hour equivalent traffic noise levels for the same noise sensitive receptor locations. This analysis uses the traffic volumes that yield the loudest future no-build hourly noise levels as the lesser of forecasted Design Year (year) No-Build peak hour traffic volumes and the maximum vehicle capacity that can maintain LOS C for all roadway segments.

(State level or project design evaluated – functional, preliminary, etc.) project plans of the build alternative or detailed study alternatives *(choose appropriate one and delete the other)* were used in this TNR. These designs were incorporated into the TNM 2.5 models developed for the existing condition, along with appropriate forecasted traffic volumes for the Design Year Build condition, to predict future build condition worst noise hour equivalent traffic noise levels for all noise sensitive receptor locations identified in the vicinity of the X-XXXX project that are not anticipated to be relocated because of the project. This analysis uses the traffic volumes that yield the loudest future build condition hourly noise levels as the lesser of forecasted Design Year (year) Build peak hour traffic volumes and the maximum vehicle capacity that can maintain LOS C for all roadway segments. Refer to Appendix B for predicted Design Year (year) No-Build and Design Year (year) Build hourly equivalent traffic noise levels, as well as a comprehensive list of traffic noise receptors.

# 9.0 TRAFFIC NOISE IMPACTS

Traffic noise impacts occur when the predicted future build condition traffic noise levels either: [a] approach or exceed the FHWA NAC (with "approach" meaning within 1 dB(A) of the NAC values listed in Table X), or [b] substantially exceed the existing noise levels in the design year by 10 dB(A) or greater.

Traffic noise is predicted to create XX (number of) impacts in the Design Year (year) Build condition *if more than one Build alternative, describe for each*. The number and types of predicted traffic noise impacts are shown in Table X. Impacts are designated as either Design Year (year) Build condition noise levels approaching or exceeding the FHWA NAC, Design Year (year) Build condition noise levels causing a substantial increase over existing ambient noise levels, or by both criteria being met.

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Table X: Traffic Noise Impact Summary for Build Condition | | | | | | | |
| **DETAILED STUDY ALTERNATIVE** | **REASON FOR NOISE IMPACT** | **SUMMARY OF IMPACTED RECEPTORS6** | | | | | |
| **BY ACTIVITY CATEGORY5** | | | | | |
| **A** | **B** | **C** | **D** | **E** | **ALL ACTIVITY CATEGORIES** |
| Build Alternative 1  *(repeat for each Build alternative)* | Based on NAC Criteria Only1 | 0 | 49 | 16 | 0 | 0 | 65 |
| Based on Substantial Increase Criteria Only2 | 0 | 3 | 0 | 0 | 0 | 3 |
| Based on Both Criteria3 | 0 | 0 | 0 | 0 | 0 | 0 |
| TOTAL DSA IMPACTS4 | 0 | 52 | 16 | 0 | 0 | 68 |
| 1: Predicted traffic noise level impacts due to design year worst hour Build-condition noise levels approaching or exceeding the FHWA NAC | | | | | | | |
| 2: Predicted design year worst hour noise levels exceeding existing worst hour noise levels by 10 dB(A) or greater. (NCDOT Substantial Increase Criteria). | | | | | | | |
| 3: Predicted traffic noise level impacts due to both 1 and 2 above. | | | | | | | |
| 4: Only one of the Note 1 or Note 2 conditions must be met for an impact to occur. | | | | | | | |
| 5: NACs F and G are not included because there are no impact criteria for non-noise sensitive land uses (NAC F) and undeveloped lands (NAC G). No analysis of noise impacts is required for these. Regarding NAC G, noise levels are provided to local officials to aid them in future land use planning efforts. | | | | | | | |
| 6: Values noted for Activity Category C, D, and E include Equivalent Receptor values for these non-residential land uses. | | | | | | | |

*For each NSA, describe the primary noise sensitive land uses, the number of receptors (or equivalent receptors – not grid points) included in the analysis, and the number and nature of impacts.*

EXAMPLE:

**NSA 24**

NSA 24 is located south of NC 7 (McAdenville Road) between Fay Street and NC 7 (North Main Street). There were 52 residential receptors modeled in this area. Two places of worship were modeled: Exodus Church, which was evaluated for exterior and interior noise impacts, and O’Connor Grove Methodist Church, which was evaluated for interior noise impacts only. Three restaurants with outdoor dining were also modeled and evaluated for exterior impacts. There are two predicted traffic noise impacts for the Build Alternative, one based on NAC criteria only, and one substantial increase only impact. The NAC criteria impact is predicted to occur at Akahana Asian Bistro, a first-row receptor along US 29/74 (Wilkinson Boulevard). The residential substantial increase impact is located along Rankin Street and is a first-row receptor along the proposed realignment of NC 7 (North Main Street).

# 10.0 POTENTIAL TRAFFIC NOISE ABATEMENT MEASURES

NCDOT requires that feasible and reasonable noise abatement measures be considered to abate all predicted future build condition traffic noise impacts. Feasibility and reasonableness are distinct and separate considerations. Feasibility is the consideration as to whether noise abatement measures *can* be implemented. Reasonableness is the consideration as to whether noise abatement measures *should* be implemented. Per NCDOT Policy, various traffic noise abatement measures may be considered, including highway alignment selection, traffic systems management measures, noise barriers (noise walls and earthen berms), and noise insulation of NAC D land use facilities.

## 10.1 Highway Alignment Selection

Highway alignment selection for traffic noise abatement measures involves modifying the horizontal and vertical geometry of the proposed facility to minimize traffic noise to noise-sensitive receptors. The selection of alternative alignments for noise abatement purposes must consider the balance between noise impacts and other engineering and environmental parameters. For noise abatement, horizontal alignment selection is primarily a matter of locating the roadway at a sufficient distance from noise sensitive receptors. Appreciable reductions in traffic noise transmissions to sensitive receptors can be made by adjusting the vertical highway alignment and/or section geometry. For example, lowering a roadway below existing grade creates a cut section which could act similarly as an earth berm, depending upon the relative location(s) of noise-sensitive receptor(s).

*Describe why changes to the alignment would/would not be practicable for this project.*

## 10.2 Traffic System Management Measures

Traffic management measures such as prohibition of truck traffic, lowering speed limits, limiting traffic volumes, and/or limiting time of operation were considered as possible traffic noise impact abatement measures. The purpose of the X-XXXX project is to increase the functional capacity of the highway facility. Prohibition of truck traffic, reduction of the speed limit below the existing speed limits or the proposed XXmiles per hour speed limit, or screening total traffic volumes would diminish the functional capacity of the highway facility and are not considered practicable.

*If applicable, describe any practicable traffic system management measures recommended for this project.*

## 10.3 Noise Barriers

Passive noise abatement measures are effective because they absorb sound energy, extend the source-to-receptor sound transmission path, or both. Sound absorption is a function of abatement medium (e.g., earth berms absorb more sound energy than noise walls of the same height because earth berms are more massive). The source-to-receptor path is extended by placement of an obstacle, such as a wall, that sufficiently blocks the transmission of sound waves that travel from the source to the receptor.

Highway noise barriers are primarily constructed as solid-mass walls or earth berms adjacent to limited-access, or *de facto* access, roadways that are near noise-sensitive land use(s). To be effective, a noise barrier must be long enough and tall enough to shield the impacted receptor(s) from traffic noise. Furthermore, the shielding should be continuous. On roadway facilities with direct access for driveways, noise barriers may not be feasible because gaps for driveways diminish noise barrier ability to attenuate traffic noise. Due to the requisite lengths for effectiveness, noise barriers are typically not economical for isolated or most low-density areas. However, noise barriers may be economical for the benefit of as few as two predicted traffic noise impacts if the barrier benefits enough total receptors – impacted and non-impacted combined – to meet applicable reasonableness criteria.

NCDOT Policy requires identification whether it is “likely” or “unlikely” that noise barriers will be installed for each NSA identified. “Likely” does not mean a firm commitment. Consideration for noise abatement measures was given to all impacted receptors. Traffic noise impacts are predicted to occur in XX (number of) NSAs. A total of YY (number of) noise barriers was/were evaluated for the benefit of NN (number of) predicted impacts. For each noise abatement measure, feasibility is considered first, then reasonableness. If noise abatement is not feasible, then consideration of reasonableness is not warranted. A receptor is considered benefited if a five dB(A) reduction in traffic noise levels is achieved with a noise barrier. The likelihood for noise abatement measures in each NSA is described below and presented in Table X. Detailed analysis of evaluated noise walls, including allowable noise barrier quantity calculations, can be found in Appendix D.

*Provide a paragraph for each NSA. May discuss each NSA in numerical order, or may group by likely first, then unlikely next. Describe in each paragraph the impacts, the abatement that was considered, whether or not it’s feasible and why; if it is feasible, whether or not it’s reasonable and why. Also include a discussion of reasonableness determinations for any noise abatement measures where it is not clear if the measure is feasible from an engineering standpoint. If multiple alignments or lengths were modeled, describe the optimized wall primarily, but also state other versions that were evaluated and why they are not preliminarily recommended. At a minimum, there should be a discussion of why a single wall to benefit every impact within an NSA was not feasible and reasonable. Typically, the reason is because a wall long enough and tall enough to benefit all impacts was not cost reasonable. Where there is no feasible and reasonable abatement measure, the version that came the closest to meeting the criteria must also be discussed. For each, end paragraph with a statement that says: Therefore, NW X is* ***likely/unlikely****.*

*For all impacted receptors that will not benefit from the proposed noise abatement measures, the text in this section should clearly demonstrate why this is the case. Similarly, the text in this section should clearly explain why the NRDG could not be achieved for any impacts not receiving a 7dB(A) noise level reduction (NLR),*

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| --- | --- | --- | --- | --- | --- | --- |
| **Table X: Allowable Noise Barrier Quantities per Benefit** | | | | | | |
| **Noise Barrier** | **Base**  **(sq ft)** | **Avg Inc1**  **[dB(A)]** | **Extra**  **(sq ft)** | **Avg over NAC1**  **[dB(A)]** | **Extra**  **(sq ft)** | **Total**  **(sq ft)** |
| NW6 | 1,500 | 0 | 0 | 1 | 0 | 1,500 |
| NW6A | 1,500 | 2 | 0 | 4 | 0 | 1,500 |
| NW7A&7B | 1,500 | 3 | 0 | 4 | 0 | 1,500 |
| NW7B | 1,500 | 3 | 0 | 6 | 500 | 2,000 |
| 1. For all impacted receptors | | | | | | |

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| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Table X:**  **Noise Barrier Analysis Summary** | | | | | | | | |
| **Noise Wall Analysis** | **Noise Analysis Summary** | | | **Abatement Analysis Summary** | | | | |
| **Impacts** | **Benefits** | | **Length**  **(ft)** | **Area**  **(ft2)** | **Area / Benefit (ft2)** | **Allowed Area / Benefit (ft2)** | **Prelim.Feasible & Reasonable** |
| **<7 dB(A)** | **≥7 dB(A)** |
| NW6 | 3 | 2 | 1 | 600 | 9,015 | 3,005 | 2,000 | NO |
| NW6A | 1 | 0 | 1 | 360 | 3,738 | 3,738 | 1,500 | NO |
| NW7A&7B | 71 | 9 | 13 | 3,420 | 56,925 | 2,588 | 1,500 | NO |
| **NW7B** | **12** | **4** | **1,680** | **20,100** | **1,256** | **1,500** | **YES** |
| (Null)2 | 1 | 0 | 0 | N/A | N/A | N/A | N/A | N/A |
| **Totals** | **12** | **23** | **18** | **1,6803** | **20,1003** |  |  |  |
| 1. Analyses of barrier system NW7A-NW7B and NW7B was performed for the same impacts. 2. Noise abatement was considered for all predicted traffic noise impacts. However, due to the inability to construct feasible and/or reasonable abatement, noise barrier analysis with TNM was not performed. 3. Total length and area are quantified for preliminarily feasible and reasonable noise abatement measures only. | | | | | | | | |

(Number of) traffic noise abatement measures were considered in the (level of design) design noise analysis documented in this TNR. NWX and NWX *(list all applicable noise abatement measures)* preliminarily meet(s) NCDOT Policy feasibility and reasonableness criteria, are preliminarily considered **Likely**, and are recommended for Final Design Noise Analysis to be documented in a Design Noise Report (DNR) as part of project final design. *If no noise walls preliminarily meet the feasibility and reasonableness criteria, please state this in place of the above paragraph listing preliminarily feasible and reasonable noise abatement measures as the conclusion to Section 10.3.*

## 10.4 Parallel Barriers (if applicable)

*Discuss parallel barrier analysis if conditions found in the 2022 Traffic Noise Manual Sections 7.10.10 are met, along with any conclusions regarding the potential use of any absorptive noise walls in accordance with Section 10.3.*

## 10.5 Noise Insulation

*If any NAC D land uses are included in the analysis, describe based on the examples below, otherwise just state that no NAC D land uses are located along the project corridor.*

EXAMPLE Multiple NAC D land uses are located along the project corridor. The corridor has uncontrolled access and noise barriers would not be feasible nor reasonable for most locations. The NAC D land uses described below were evaluated for interior sound levels to determine if noise insulation measures would be appropriate.

* With no exterior areas of frequent human use, only the interior of the Love Grove Church at 110 Williams Love Grove Church Road qualifies as a noise-sensitive receptor (NAC “D”) per NCDOT Policy. Interior noise levels are calculated as the predicted exterior traffic noise level of 67 decibels minus a 25 decibel Building Noise Reduction Factor for a masonry structure with single glazed windows (refer to Table X), for a predicted interior noise level of 42 decibels (67 dB(A) – 25 dB(A) = 42 dB(A)). The predicted interior 42 dB(A) sound level will not constitute an interior noise impact at Love Grove Church.
* With no impacted exterior areas of frequent human use, only the interior of the St. John AME Church at 861 St. Johns Church Road qualifies as a noise-sensitive receptor (NAC “D”) per NCDOT Policy. Interior noise levels are calculated as the predicted exterior traffic noise level of 70 decibels minus a 25 decibel Building Noise Reduction Factor for a masonry structure with single glazed windows (refer to Table 6), for a predictedinterior noise level of 45 decibels (70 dB(A) – 25 dB(A) = 45 dB(A)). The predicted interior 45 dB(A) sound level will not constitute an interior noise impact at St. John AME Church.

Traffic noise is/is not predicted to impact any NAC D land uses in the vicinity of the proposed project; therefore, consideration of noise insulation as a measure of feasible and reasonable noise abatement was/was not warranted. *Customize as appropriate. If consideration of noise insulation is warranted, more discussion must be included.*

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| Table X: Building Noise Reduction Factors  *Use table only if interior noise levels were evaluated – Change subsequent table numbers in TOC if not used.* | | |
| **Building Type** | **Window Condition** | **Noise Reduction Due to Exterior of the Structure** |
| All | Open1 | 10 dB(A) |
| Light Frame | Ordinary Sash (closed) | 20 dB(A) |
| Storm Windows | 25 dB(A) |
| Masonry | Single Glazed | 25 dB(A) |
| Double Glazed | 35 dB(A) |
| 1. The windows shall be considered open unless there is firm knowledge that the windows are in fact kept closed almost every day of the year. | | |
| FHWA-HEP-18-065, Noise Measurement Handbook, Final Report, June 2018 provides procedures to measure building noise reductions. | | |

# 11.0 CONSTRUCTION NOISE

The predominant construction activities associated with this project are expected to be *(describe relevant project-specific construction activities)*. Temporary and localized construction noise impacts may occur as a result of these activities. For information on typical noise level emissions of common construction equipment, refer to Table X.

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| **Table X. Construction Equipment Typical Noise Level Emissions1** | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| **Equipment** | **Noise Level Emissions (dB(A)) at 50 Feet from Equipment2** | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
|  |  | **70** | | | | |  | | | | | | | **80** | | | | |  | | | | | **90** | | |  | | | **100** | | | |  |  | |
| Pile Driver3 |  | | |  | | | | | | | | | | | |  | | | | | | | | | | |  | | | | | | |  | | | |
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| Jack Hammer |  | | |  | | | | | | | | | | | |  | | | | | | | | | | |  | | | | | | |  | | | |
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| Tractor |  | | |  | | | | | | | | | | | |  | | | | | | | | | | |  | | | | | | |  | | | |
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| Road Grader |  | | |  | | | | | | | | | | | |  | | | | | | | | | | |  | | | | | | |  | | | |
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| Backhoe |  | | |  | | | | | | | | | | | |  | | | | | | | | | | |  | | | | | | |  | | | |
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| Truck |  | | |  | | | | | | | | | | | |  | | | | | | | | | | |  | | | | | | |  | | | |
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| Paver |  | | |  | | | | | | | | | | | |  | | | | | | | | | | |  | | | | | | |  | | | |
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| Pneumatic Wrench |  | | |  | | | | | | | | | | | |  | | | | | | | | | | |  | | | | | | |  | | | |
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| Crane |  | | |  | | | | | | | | | | | |  | | | | | | | | | | |  | | | | | | |  | | | |
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| Concrete Mixer |  | | |  | | | | | | | | | | | |  | | | | | | | | | | |  | | | | | | |  | | | |
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| Compressor |  | | |  | | | | | | | | | | | |  | | | | | | | | | | |  | | | | | | |  | | | |
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| Front-End Loader |  | | |  | | | | | | | | | | | |  | | | | | | | | | | |  | | | | | | |  | | | |
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| Generator |  | | |  | | | | | | | | | | | |  | | | | | | | | | | |  | | | | | | |  | | | |
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| Saws |  | | |  | | | | | | | | | | | |  | | | | | | | | | | |  | | | | | | |  | | | |
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| Roller (Compactor) |  | | |  | | | | | | | | | | | |  | | | | | | | | | | |  | | | | | | |  | | | |
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| 1. Adapted from *Noise Construction Equipment and Operations, Building Equipment, and Home Appliances*. US Environmental Protection Agency. Washington DC 1971. 2. Cited noise level ranges are typical for the equipment cited. Noise energy dissipates as a function of distance between the source and the receptor. For example, if the noise level from a pile driver at a distance of 50 feet = 100 decibels (dB(A)), then at 400 feet, it might be 82 decibels (dB(A)) or less. 3. Due to project safety and potential construction noise concerns, pile driving activities are typically limited to daytime hours. | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |

During daytime hours, the potential effects of construction noise could be temporary speech interference for passersby and those individuals living or working near the project. During evening and nighttime hours, steady-state construction noise emissions, such as those from paving operations, could be audible and may cause impacts to activities such as sleep. Sporadic evening and nighttime construction equipment noise emissions, such as from backup alarms, lift gate closures (“slamming” of dump truck gates), etc., will be perceived as distinctly louder than the steady-state acoustic environment, and could affect the general peace and usage of noise-sensitive areas – particularlyresidences, daycare centers, places of worship, and schools*.* Extremely loud construction noise activities such as usage of pile-drivers and impact-hammers (jack hammer, hoe-ram) may cause temporary, sporadic and acute construction noise impacts in isolated areas.

Construction activities that will produce extremely loud noises should be scheduled during times of the day when such noises will create as minimal disturbance as possible, specifically weekday daytime hours since the primary land uses expected to be temporarily affected by construction noise for the project are (insert relevant project-specific land uses by name - residential, daycare centers, places of worship, and schools etc.).

Generally, low-cost and easily implemented construction noise control measures should be incorporated into the project plans and specifications to the extent possible. These measures include, but are not limited to, work-hour limits, equipment exhaust muffler requirements, haul-road locations, elimination of “tail gate banging,” ambient-sensitive backup alarms, construction noise complaint mechanisms, and consistent and transparent community communication.

While discrete construction noise level prediction is difficult for a particular receptor or group of receptors, it can be assessed in a general capacity with respect to distance from known or likely project activities. For this project, *(describe relevant project-specific construction activities)* are anticipated to occur in the vicinity of noise-sensitive receptors along the entire length of the project. Although construction noise abatement should not place an undue burden on the financial cost of the project or the project construction schedule, pursuant to the requirements of Title 23 CFR 772.19, it is the recommendation of this TNR that: *Provide project specific recommendations below. Examples provided.*

* Earth removal, grading, hauling and paving activities in the vicinity of residences, daycare centers, places of worship, and schools should be limited to weekday daytime hours when practicable.
* If meeting the project schedule requires that earth removal, grading, hauling and / or paving must occur during evening, nighttime and / or weekend hours in the vicinity of residential neighborhoods, daycare centers, places of worship, and schools, the Contractor shall notify NCDOT as soon as possible. In such instance(s), all reasonable attempts shall be made to notify and to make appropriate arrangements for the abatement of the predicted construction noise upon the affected property owners and / or residents.
* Construction noise activities should be kept to a minimum when practicable in the vicinity of the following residential neighborhoods: Garden Ridge, Walnut Hills, and Holland Farms. Construction noise should also be kept to a minimum where practicable during operating hours at Bright Horizons Childcare Center, White Plains Baptist Church, and Rocky Mount High School.
* If construction noise activities must occur during context-sensitive hours in the vicinity of noise-sensitive areas, discrete construction noise abatement measures including, but not limited to, portable noise barriers and / or other equipment-quieting devices should be considered.
* Some construction activities could create extreme noise for nearby noise-sensitive land uses. It is the recommendation of this TNR that considerations be made for any nearby residences for all evening and/or nighttime periods (7:00 p.m. – 7:00 a.m.) throughout which extremely loud construction activities might occur.

For additional information on construction noise, please refer to the *FHWA Construction Noise Handbook* (FHWA-HEP-06-015) and the *Roadway Construction Noise Model* (RCNM), available online at:

<https://www.fhwa.dot.gov/environment/noise/construction_noise/handbook/>

# 12.0 TRAFFIC NOISE LEVELS FOR UNDEVELOPED LANDS WHERE NO BUILDING PERMITS HAVE BEEN ISSUED

Predicted Build condition traffic noise level contours are not a definitive means by which to assess traffic noise impacts; however, they can aid in future land use planning efforts in presently undeveloped areas. The distances from the proposed edge of the nearest travel lane at which the 71 dB(A) and 66 dB(A) noise level contours are predicted to occur for the X-XXXX project are listed below in Table X. 71 dB(A) represents the traffic noise impact threshold for FHWA NAC E land uses, while 66 dB(A) does the same for NAC B and C land uses.

Per 23 CFR 772.9(c) and NCDOT Policy, noise contour lines shall not be used for determining highway traffic noise impacts. However, the 71 dB(A) and 66 dB(A) noise level contour information may be used for project alternative screening or for land use planning to comply with 23 CFR 772.17, and it should assist local authorities in exercising land use control over the remaining undeveloped lands, to avoid development of incompatible activities adjacent to the roadways within local jurisdiction.

|  |  |  |  |
| --- | --- | --- | --- |
| **Table X: Predicted Traffic Noise Contour Distances1** | | | |
| **NSA** | **Project Noise Contour Segment2** | **Distance from edge of nearest proposed travel lane (ft)** | |
| **663 dB(A)** | **713 dB(A)** |
| 1 | North of US 221, between ---- and ---- | 134 | Within R/W |
| 1 | North of US 221, between ---- and ---- | 179 | 94 |
| 2 | South of US 221, between ---- and ---- | 134 | 84 |
| 5 | South of US 221, between ---- and ---- | 157 | 69 |
| 1. The contour distances correlating to 66 dB(A) and 71 dB(A) NAC criteria are presented for consideration of land use control in undeveloped areas in which future development of NAC B, C, and/or E noise-sensitive land use receptors may occur (refer to Table X). 2. Noise contour segments represent specific undeveloped areas within the boundaries identified in the location description. 3. Noise contour distances to 66 dB(A) and 71 dB(A) are the distances between the edge of the nearest proposed travel lane and modeled receptors for which predicted traffic noise levels were 66 dB(A) and 71 dB(A), respectively, in Design Year (year) Build condition TNM models for the indicated NSAs. The distances should not be assumed to infer exact traffic noise levels for specific location(s) adjacent to the X-XXXX project. The distances to the 71 dB(A) and 66 dB(A) contours, as well as the distances between the 71 dB(A) and 66 dB(A) contours, vary according to the specific acoustically relevant features of each NSA. | | | |

Given the variation in cross sections and elevations adjacent to the project, it is recommended that any future development proposed in the vicinity of the project be modeled with accurate survey data to avoid creating incompatible land uses adjacent to the project.

# 13.0 NOISE-COMPATIBLE LAND USE

NCDOT strongly advocates the planning, design, and construction of noise-compatible development and encourages its practice among planners, building officials, developers, and others. Consideration for noise-compatible development is a shared responsibility among local, state, and federal agencies. NCDOT plans its highway construction in consideration of traffic noise impacts it may cause to noise-sensitive land uses. Likewise, local governments ideally plan their noise-sensitive land uses in consideration of existing sources of traffic noise.

As part of that shared responsibility, NCDOT provides information to local officials with responsibility for planning decisions with an estimate of future noise levels on undeveloped lands that lie within project boundaries. This information may be used to help guide land use planning decisions to help avoid future traffic noise impacts.

Although regulation of land use is not within the purview of FHWA or NCDOT, some widely accepted techniques for noise-sensitive land use planning near existing and proposed highway facilities include:

* Locating retail, industrial, manufacturing, and other noise-compatible land-uses adjacent to highways
* Incorporating effective traffic noise mitigating features, such as earth berms and solid-mass noise walls, as part of residential developments
* Utilization of noise-sensitive architectural design and site planning, such as the orientation of quiet spaces away from roadways
* Required use of sound insulating building materials and construction methods

If requested, NCDOT will assist local officials with coordination and distribution of this information to residents, property owners and developers. NCDOT will provide information to assist local jurisdictions in the development of local noise controls, when requested. NCDOT strongly advocates the planning, design and construction of noise-compatible development and encourages its practice among planners, building officials, developers and others.

# 14.0 CONCLUSION

Traffic noise and temporary construction noise can be a consequence of transportation projects, especially in areas near high-volume and high-speed existing steady-state traffic noise sources. This TNR utilized computer models created with the FHWA TNM 2.5, validated to field-collected traffic noise measurement data, to predict future noise levels and define impacted receptors along the proposed X-XXXX project.

Design Year (year) Build traffic volumes are predicted to create XX (number of) traffic noise impacts (*if more than one Build alternative describe for each*). Furthermore, construction noise impacts – some of them potentially substantial – may occur due to the proximity of numerous noise-sensitive receptors to project construction activities. It is the recommendation of this TNR that all reasonable efforts should be made to minimize exposure of noise-sensitive areas to construction noise impacts.

*If no abatement measures are reasonable and feasible use this text*:

In accordance with the 2021 NCDOT Policy, consideration for noise abatement measures was given to all impacted receptors. *If there were no impacts, state that no noise abatement measures were considered because there were no impacts.* NCDOT Policy requires identification whether it is “likely” or “unlikely” that noise barriers will be installed for each noise sensitive area identified. “Likely” does not mean a firm commitment. **No traffic noise abatement measures assessed in this preliminary traffic noise analysis meet NCDOT Policy feasibility and reasonableness criteria, and all noise abatement measures are considered “unlikely” to be installed for the** **X-XXXX project.**Unless modifications to the project preliminary design occur, such as consideration of additional build alternative(s) and/or changes to predicted Design Year (year) Build traffic volumes, no traffic noise abatement measures are recommended for detailed analysis during final design, and no noise abatement measures are proposed for incorporation into the project. This analysis completes the traffic noise requirements of the Title 23 CFR Part 772 and NCDOT Policy. *Modify the preceding two sentences as appropriate. E.g., if no walls are likely but some are close, then they may should be revisited with a DNR even if no other project changes occur; in this case, this analysis would NOT complete the requirements of 23 CFR 772 and the Policy.*

*If noise abatement measures are found to be feasible and reasonable, use this text:*

In accordance with the 2021 NCDOT Policy, consideration for noise abatement measures was given to all impacted receptors. NCDOT Policy requires identification whether it is “likely” or “unlikely” that noise barriers will be installed for each noise sensitive area identified. “Likely” does not mean a firm commitment. The final decision on feasibility and reasonableness of noise abatement will be made upon completion of the project design, completion of a DNR, a practicability assessment (where applicable), *[practicability assessment should only be included for projects with a SEPA document]* and the public involvement process. **XX (number of) *traffic noise abatement measures assessed in this traffic noise analysis preliminarily meet NCDOT Policy feasibility and reasonableness criteria and are considered “likely” to be installed for the X-XXXX project.*** These likely noise abatement measures are described below or in Table X*.*

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Table X: Likely Noise Walls** | | | | | | | |
| **Build Alternative**  **(Noise Barrier Location)** | | **Length**  **(feet)** | **Area**  **(square feet)** | | | **Number of Benefited Receptors** | **Area per Benefited Receptor / Allowable Area per Benefited Receptor** |
| **BUILD ALTERNATIVE XX** |  | | |  |  | | |
| NW3 use common description of wall location | | 465 | 4,875 | | | 6 | 813/1,500 |
| NW4 | | 560 | 13,317 | | | 2 | 6,659/1,500 |
| NW5 | | 420 | 6,181 | | | 11 | 562/1,500 |
| **BUILD ALTERNATIVE XX** |  | | |  |  | | |
| NW3 | | 465 | 4,875 | | | 6 | 813/1,500 |
| NW4 | | 560 | 13,317 | | | 2 | 6,659/1,500 |
| NW5 | | 420 | 6,181 | | | 11 | 562/1,500 |
| 1. The likelihood for noise wall construction is preliminary and subject to change, pending completion of final design and the public involvement process. | | | | | | | |

# 15.0 REFERENCES

Federal Highway Administration. CFR 23 Part 772 – Procedures for Abatement of Highway Traffic Noise and Construction Noise. [75 FR 39820-39838, July 13, 2010].

Federal Highway Administration. Highway Traffic Noise: Analysis and Abatement Guidance. December 2011.

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Lee, Cynthia S.Y. and Fleming, Gregg G. *Measurement of Highway-Related Noise*. U.S. Department of Transportation Research and Special Programs Administration John A. Volpe National Transportation Systems Center Acoustics Facility, DTS-75. Cambridge, MA. May 1996.

Federal Highway Administration. *Noise Measurement Field Guide (FHWA-HEP-18-066)*, June 2018.

Federal Highway Administration. *Noise Measurement Handbook (FHWA-HEP-18-065)*, June 2018.

North Carolina Department of Transportation. *Traffic Noise Policy.* November 29, 2021.

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Ahmed, Ishtiak; Chase, Thomas; Findley, Daniel J., Ph.D., PE – Institute for Transportation Research and Education (ITRE)/ North Carolina State University*. Level of Service C Volumes for Traffic Noise Modeling.* September 2018.

Transportation Research Board NCHRP Report 791. *Supplemental Guidance on the Application of FHWA’s Traffic Noise Model (TNM)*. August 2014. *Include only if cited in this TNR.*

*Add any additional references specifically cited in this TNR including traffic reports, prior TNRs, etc.*

*For proper formatting of appendices, see Traffic Noise Manual.*