Wyoming Department of Transportation

Noise Requirements for Type I Federal-aid Projects

Effective Date: January 2022

This document describes the implementation of noise requirements set forth by the Federal Highway Administration Title 23 Code of Federal Regulations Part 772: *Procedures for Abatement of Highway Traffic Noise and Construction Noise*. These requirements were developed by the Wyoming Department of Transportation and approved by the Federal Highway Administration.

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TABLE OF CONTENTS

TABLES

FIGURES

APPENDICES

1.0 INTRODUCTION

This document represents the Wyoming Department of Transportation (WYDOT) guidelines and procedures for highway traffic noise, construction noise, and noise abatement as they affect the human environment. It describes WYDOTs implementation of Federal Highway Administration (FHWA) traffic noise requirements codified in 23 Code of Federal Regulations (CFR) Part 772, Procedures for Abatement of Highway Traffic Noise and Construction Noise. These guidelines and procedures apply when transportation projects use federal funding or need FHWA approval. This document also provides guidance on documenting noise impacts as a part of the National Environmental Policy Act (NEPA).

Not all projects warrant a noise analysis or consideration of noise abatement. Projects that do not add capacity such as resurfacing, traffic signal upgrades, and culvert replacements, typically have no impact on the existing noise environment and therefore do not need to be evaluated for potential noise impacts and abatement. However, constructing roads in a new location, large interchange projects, new rest stops, and other projects designated as Type I projects (see Section 2.2), could affect the noise environment and therefore are evaluated for noise impacts.

Once a project has been determined to be a Type I project, existing noise levels are identified and computer models created based on projected traffic volumes to determine the future or design-year noise levels. If these noise levels exceed certain thresholds, the impacted site(s) are analyzed for potential noise impacts and abatement.

Noise abatement is commonly accomplished by constructing a noise barrier between the highway and adjacent impacted sites. To ultimately provide noise abatement, WYDOT must determine that noise abatement is both feasible (see Section 5.1.1) and reasonable (see Section 5.1.2). For a list of noise terminology and definitions see Appendix A

1.1 Purpose

The federal regulation 23 CFR 772, *Procedures for Abatement of Highway Traffic Noise and Construction Noise* describes the methods that must be followed to evaluate and abate highway traffic noise on federal-aid projects. WYDOT's Traffic Noise Analysis Procedures and Standards reflect the federal regulation and includes the requirement and standards on how highway traffic noise impacts and abatement are measured, defined, and evaluated. Highway projects developed in conformance with these standards and procedures are deemed to be in conformance with the federal regulation.

2.0 TRAFFIC NOISE FUNDAMENTALS

Sound can be defined as energy generated by movement or vibration that can be sensed by the ear. Noise, generally, is defined as unwanted sound, and is the description usually given to sound that emanates from highway traffic. Each sound (noise) can be expressed in terms of three primary characteristics: magnitude, frequency, and time.

The magnitude of a sound event can be measured in terms of its acoustic pressure. Because the range of pressure values can vary over several orders of magnitude, the unit typically used to describe sound levels is the decibel (dB), which is a relation of the sound pressure level to a standard reference pressure. This ratio is then converted to a more compact logarithmic scale.

Since sound travels in waves, there are also varying frequencies associated with each sound event. The human ear does not respond equally to all frequencies. Filtering of these frequencies must be done to obtain accurate measurements since traffic noise comprises many frequencies. The filtering (weighting of frequencies) of the "A" scale on sound-level meters most closely approximates the average frequency response of the human ear and is the scale that is used for traffic noise analyses. Decibel units described in this manner are referred to as A-weighted decibels, or dB(A).

Noise Perceptions

The dB is used to measure the loudness of noise on a logarithmic scale as it provides a reasonable way to represent how the human ear senses the logarithmic (order of magnitude) levels of change in sound energy. A change of 3 dB is a barely perceivable change in noise levels, a change of 5dB is readily perceivable and an increase of 10 dB is perceived as being twice as loud.

Decibel Addition

Because noise loudness is measured on a logarithmic scale, sound levels cannot be added or subtracted arithmetically. For example, exposure to two 60 dB noise sources does not correspond to a 120 dB noise level. Rather, due to the logarithmic scale, two sources of equal noise added together (i.e., a doubling of the noise source) results in an increase of 3 dB. That is, 60 dB plus 60 dB yields a total noise level of 63 dB. Table 1 provides the rules for combining sound levels for "decibel addition".

Table 1. Rules for Decibel Addition

Difference between sound levels	Amount to add to higher value
0 to 1 dB	3 dB
2 to 3 dB	2 dB
4 to 9 dB	1 dB
10 dB or more	0 dB

Common Sound Levels

Figure 1 shows representative sound levels (in dB) for a variety of common indoor and outdoor activities. To put common sound levels into perspective, normal speech at a distance of three (3) feet is approximately 60 to 65 dB. Highway traffic noise ranges from about 60 to 80 dB at a distance of 50 feet.

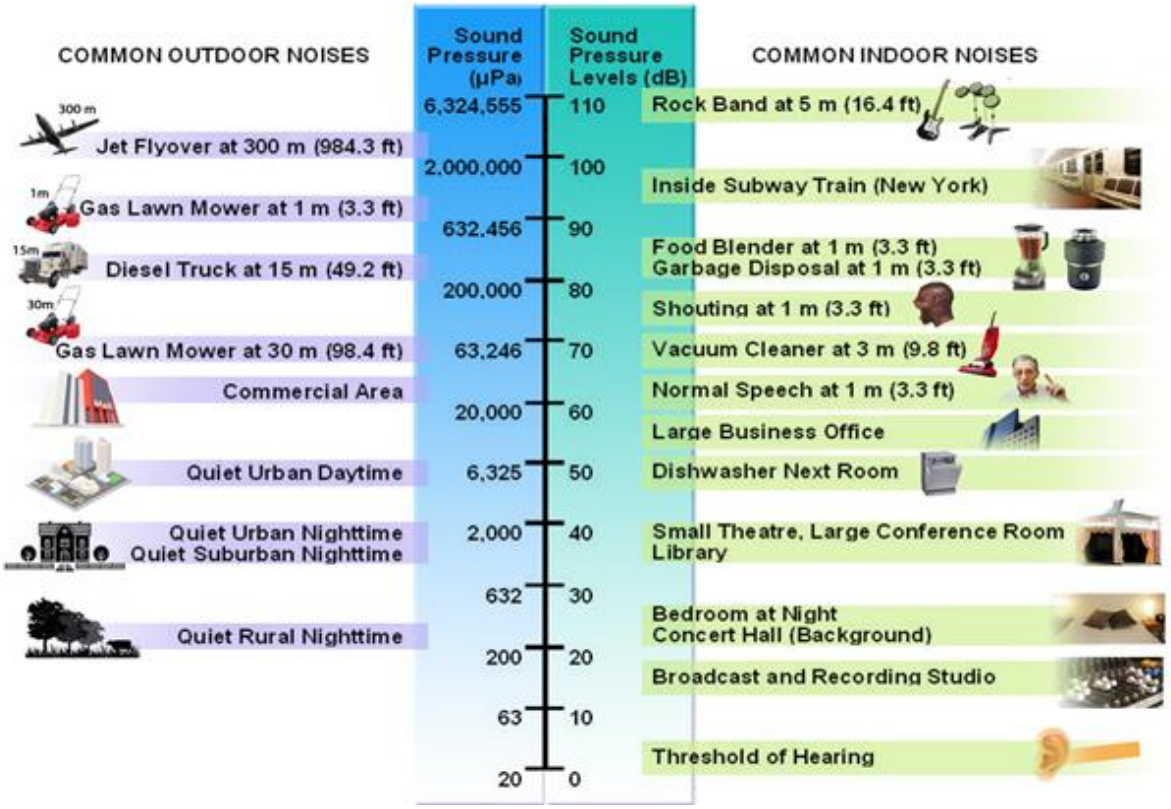

Figure 1. Common Outdoor and Indoor Sounds

Highway Noise Generation and Sources

Highway noise generation is dependent on three main factors: traffic volume, traffic speed, and the number of trucks. Each of these varies at any given moment. The dominant noise sources vary by speed and by vehicle type (i.e., car vs. heavy truck). Propulsion noise (engine, exhaust, and transmission) is typically the dominant noise source when a vehicle is traveling at low speeds. Tire-pavement noise typically becomes the dominant noise source when a vehicle travels at higher speeds.

Sound intensity tends to fluctuate with time, so a method is required to describe a noise source, such as a highway in a steady state condition. The descriptor most commonly used is the equivalent steady state sound level, or Leq. This value represents the same amount of acoustic energy that is contained in a time-varying sound measurement over a specified period.

For highway projects, the accepted noise descriptor is the worst-hour, Leq(h), for determining existing and design-year noise levels and impacts. The worst-hour reflects the conditions that will produce the worst traffic noise which are the highest traffic volume traveling at the highest possible speed. When traffic volume exceeds these conditions, traffic slows down, which in turn decreases the noise levels.

Sound Propagation

Highway traffic noise is generated by moving vehicles. This gives a listener the perception of a linear noise source rather than a single, identifiable point of noise. As distance increases from the

highway, noise is reduced or attenuated. If all other factors are held constant, the noise level generally declines by approximately 3 dB(A) when the distance from the noise source doubles over a hard surface. For example, if the predominant land cover is a hard surface (e.g., asphalt, brick, or concrete), with a traffic noise level of 75 dB(A) at 50 feet from the roadway, the resulting noise level at 100 feet would be 3 dB(A) lower, or 72 dB(A) and at 200 feet the noise level would be 6 dB(A) lower or 69 dB(A).

However, over soft surfaces (e.g., grass, fields, undeveloped ground), the noise level would decline approximately 4.5 dB(A) for every doubling of distance. For example, if grass is the predominant ground cover, with a traffic noise level of 75 dB(A) at 50 feet from the roadway, the noise level at 100 feet would be 4.5 dB(A) lower, or 70.5 dB(A), and at 200 feet the noise level would be 9 dB(A) lower, or 66 dB(A).

Noise Receptors and Receivers

Receptors represent noise-sensitive locations, such as a backyard or a restaurant's outdoor seating area. Receivers are discrete Traffic Noise Model (TNM) modeling points that represent receptors. A TNM receiver can represent a single or group of receptors (i.e., using one TNM receiver to represent a group of residences with similar sound levels).

The receiver site location for modeling should focus on the exterior area of frequent human use. These areas include porches, play areas, or any type of gathering place that faces the roadway. If a group of individual receptors share similar acoustical properties and settings, a representative, consolidated receiver site may be used in modeling. The total number of individual receptors represented by the consolidated receiver site must be identified in the impact tables and report.

A receptor does not have to be impacted to be counted as "benefited". Although noise abatement measures are designed to provide the desired noise reduction for impacted receptors, the abatement measure often provides noise reduction for other non-impacted receptors located farther back from the road (i.e., second-row). These receptors would be counted as "benefited" in the reasonableness analysis if their reductions are at or above the minimum benefited noise reduction of 5 dB(A).

2.1 Noise Regulations and NEPA Guidance

The following regulations and guidelines provide the legal requirements and guidance for the noise analysis procedures presented in this document.

- National Environmental Policy Act (NEPA) of 1969 established the decision-making framework for federal actions. NEPA requires Federal agencies such as the FHWA to assess the environmental effects of proposed major Federal actions prior to making a decision. The evaluation and mitigation of potential adverse effects, including traffic noise, are to be considered during this decision-making process.
- Federal-aid Highway Act of 1970 required FHWA to develop noise standards and abatement requirements for highway traffic noise. These standards are contained in the FHWA highway traffic noise regulation 23 CFR 772.
- Noise Control Act of 1972 establishes the authority for federal agencies to regulate noise emissions from specific sources, such as commercial products, aircraft, railroads and motor vehicles. Noise emission standards are regulated by the U.S. Environmental Protection Agency (USEPA), not by FHWA or WYDOT.

- FHWA Noise Standards - 23 CFR Part 772 "Procedures for Abatement of Highway Traffic Noise and Construction Noise", requires the following during the planning and design of a highway project: 1) identification of highway traffic noise impacts; 2) examination of potential abatement measures; 3) the incorporation of reasonable and feasible highway traffic noise abatement measures into the highway project; 4) coordination with local officials to provide helpful information on compatible land use planning and control; and 5) identification and incorporation of necessary measures to abate construction noise. The Federal regulations were specifically written to allow flexibility in the development of state policies appropriate for the resources and other influences specific to each individual state.
- FHWA Policy and Guidance - "Highway Traffic Noise: Analysis and Abatement Guidance", December 2011, provides state transportation agencies guidance to develop their own state policy on transportation noise.

2.2 Applicability

A federal-aid project may require noise analysis depending on the nature of the proposed action(s). Under 23 CFR 772, projects are classified as Type I, Type II or Type III.

Type I projects include:

- Construction of a highway in a new location.
- Physical alteration of an existing highway where there is either:
    a. Substantial Horizontal Alteration - A project that halves the distance between the nearest edge of travel lane and existing sensitive receptors.
    b. Substantial Vertical Alteration - A project that exposes the line of site between a receptor and the traffic noise source or has a 5-foot vertical change.
- Addition of through-travel lane(s) by new construction or restriping an existing highway. This includes the addition of a through-traffic lane that functions as a high-occupancy vehicle lane, high-occupancy toll lane, bus lane, or truck-climbing lane.
- Addition of an auxiliary lane of accumulated length greater than 2,500 feet to a highway, by new construction or restriping, including lanes that function as passing lanes or continuous access lanes, except for when the auxiliary lane is a turn lane. Note: lane length is measured by completed lane width. The tapered portion is not considered within the 2,500 feet, as it would not add capacity.
- Addition of new interchanges or alterations of existing interchanges. This includes the addition or relocation of ramps, or ramps added to a quadrant to complete an existing partial interchange.
- A project which removes or alters shielding (either natural or manmade), exposing the line-of-sight between the receptor and the traffic noise source. For example, to improve highway sight distance an existing earth berm or hillside is flattened, resulting in a direct line-of-sight between the highway and an existing residence. Vegetation does not have sufficient noise abatement properties and cannot be considered for these shielding effects.

- Addition of a new or substantial alteration of a weigh station, rest stop, ride-share lot, or toll plaza.

If any action of the proposed project meets the above criteria, then the project is a Type I and requires a traffic noise analysis. However, the level of analysis will vary depending on the project. The flow chart (Figure 2) illustrates the process for determining whether a project needs a noise analysis.

Type II projects (also called retrofit projects) are those that provide noise abatement on an existing highway in a location where there will not be any new highway construction.

For a Type II project to be eligible for federal-aid funding, the highway agency must develop and implement a priority program in accordance with 23 CFR 772.7(e). Type II programs are voluntary and at the discretion of the state highway agency. The State of Wyoming does not have a Type II program; therefore, retrofit projects are not eligible for federal-aid funding.

Type III Projects do not meet the Type I or Type II criteria and do not require a traffic noise analysis, under 23 CFR 772. These types of projects will not add capacity to a roadway. Type III projects are typically pavement preservation related such as bridge rehabilitation, resurfacing, adding shoulders, etc.

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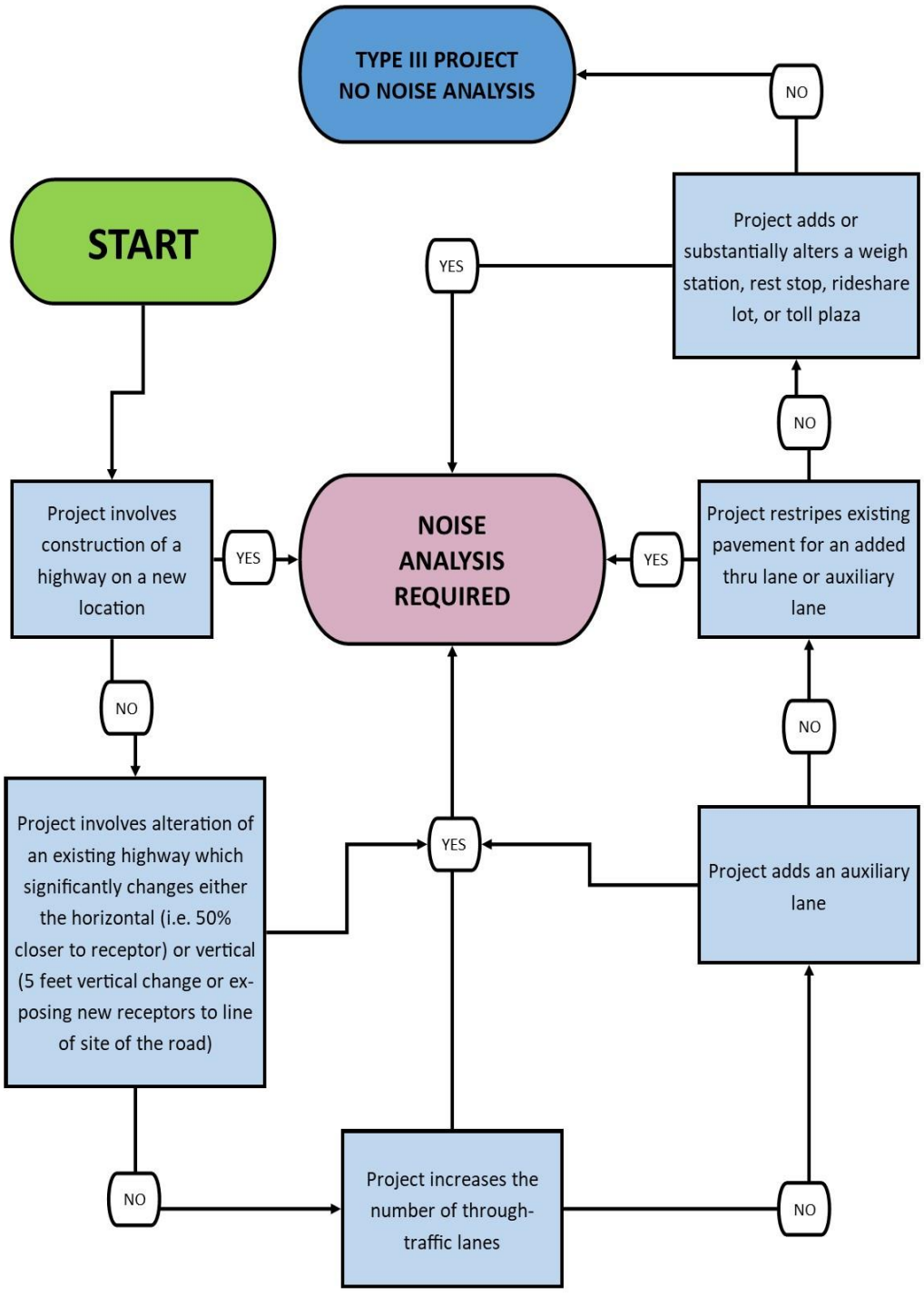

*Document decisionmaking in the project file.

Figure 2. Type I Noise Determination Analysis Flow Chart

3.0 TRAFFIC NOISE ANAYSIS

Determine if a noise analysis is needed early in the scoping process or soon after the project has been programmed. A Type I noise analysis may require extensive documentation, affect schedule and budget and may need additional resources to complete. While very little project information may be available at that time, an early review will alert design engineers that traffic noise could be an issue. By considering traffic noise in the preliminary planning stage, WYDOT may be able to shift an alignment or look at other actions to avoid and/or minimize a potential traffic noise impact.

A traffic noise impact occurs when any receptor is subjected to either 1) future (typically the design-year) noise levels that approach or exceed the Noise Abatement Criteria (NAC) in the Design-Year (see section 3.4), or 2) design-year noise levels that substantially exceed the existing noise levels (see section 3.5). Both of the above must be analyzed to adequately assess the noise impact of a proposed project. If any noise sensitive receptors are impacted, noise abatement measures must be considered and evaluated for those receptors under first the feasibility criteria and then, if it passes, the reasonableness factors (as outlined in Sections 6.1.1 and 6.1.2).

3.1 Personnel Qualifications

Only personnel that have successfully completed the following training in the area of highway noise can prepare a noise report (that uses FHWA's TNM) for WYDOT.

- Traffic noise course that provides training specifically on TNM modeling.
- FHWA course specifically on Highway Traffic Noise.

3.2 Type I Project Noise Analysis Requirements

All Type I projects require a noise analysis. However, not all analyses must be to the same level of detail. Three levels of noise analyses are allowed for Type I projects.

- Best Estimate Memo. This analysis consists of using FHWA's TNM Low Volume Road Tool. Information on this analysis is provided in Section 4.1
- Noise Screening Analysis. This analysis is for projects where no areas of frequent human use exist within; or if individual receptors are over 200 feet from each other. Information on a screening level analysis is provided in Section 4.2
- Traffic Noise Report. This report is for when noise impacts are possible and noise abatement may be feasible and reasonable. Information on this level of analysis is provided in Section 4.3.

A noise analysis is required for all build alternatives in the NEPA process for Type I projects. If any segment or component of a project or alternative meets the definition of a Type I project, then the entire project (or that alternative in its entirety) is considered to be Type I and is subject to the noise analysis requirements. For studies that examine broad corridors, the appropriate scope and methodology of the noise analysis should be discussed with WYDOT and FHWA-Wyoming Division, early in the planning process.

Include abatement measures, whether feasible and reasonable or not, in the final noise report. Only the abatement measure that is feasible and reasonable will be carried forward for public survey, when required. Include a Statement of Likelihood for noise abatement in the NEPA document since

the feasibility and reasonableness determination may change due to potential changes during final design. The documentation for highway noise abatement and Statement of Likelihood is described in 23 CFR 772.13(g) and provided in Section 5.2.

Conduct noise modeling, abatement evaluation, and design requirements using the latest approved version of the FHWA TNM.

3.3 Noise Study Area Limits

Noise Study Area Limits (NSAL) are approximately 500 feet from the proposed edge of pavement in all directions. The 500-foot NSAL is based on the limitations of the noise modelling software and the limited effect of a noise abatement to provide the desired attenuation past 500 feet.

The NSAL should be interpreted to mean that a noise abatement feature should treat the most logical extent or break point of an existing impacted neighborhood. Logical break points may include cross streets, alleys, commercial property, waterways, or other manmade and natural features interfering with the continuity of the noise abatement feature.

3.4 Traffic Noise Impact

A traffic noise impact occurs when a noise receptor is subjected to either:

- Future (or design-year) noise levels that approach or exceed the NAC (see section 3.4.1), or
- Design-year noise levels substantially exceed the existing noise levels. WYDOT defines a substantial noise impact when a receptor receives an increase in noise levels of at least 15 dB(A) over the existing noise levels. This impact criterion applies regardless of the NAC level. For example, an increase of noise from 45 dB(A) to a predicted 62 dB(A) would result in a noise impact. The net noise increase of 17 dB(A) is greater than the 15 dB(A) substantial increase threshold. A change in noise levels from 62 to 69 dB(A) for NAC Activity Category B or C would not be an impact under the substantial noise increase criteria but would still result in a noise impact since the NAC of 66 dB(A) has been exceeded.

3.4.1 Noise Abatement Criteria

The following table from 23 CFR 772 shows FHWA has designated Land Use Activity Categories A through G and associated NAC for various receptor/land use types. The NAC values are hourly equivalent A-weighted sound levels in decibels. The Activity Categories and their respective NAC are described and listed in Table 2 of this document, below. The NAC are for impact determination only; they are not design goals or design standards for noise abatement measures. When changes approach or exceed the relevant NAC, noise abatement must be considered.

The FHWA NAC focuses on sound levels where highway traffic noise could potentially interfere with speech communication in exterior areas. FHWA regulations (23 CFR 772.11(e)) require states to establish an “approach” level of at least 1 dB(A) less than the FHWA criteria, as shown in Table 2. WYDOT has defined the approach as 1 dB(A) less than the FHWA criteria. The values shown in Table 2 reflect the values that WYDOT considers when evaluating noise levels for each corresponding activity category. Any receptor subjected to noise levels that either currently reach or are predicted to reach the WYDOT Criteria (in Leq(h)) values stated in Table 2 are considered to be impacted by traffic noise. While the existing level can exceed the NAC, under the FHWA noise regulation, impacts are only associated with the “Build Alternatives”.

A noise sensitive land use is any location where highway traffic noise may be detrimental to the enjoyment and functional use of the property as defined by the NAC. This definition includes any property where a lowered noise level would be beneficial. In locations where there is no exterior activity or outside area with frequent human use, extensive noise modeling may not be needed.

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Table 2. Noise Abatement Criteria (NAC) by Activity Category

Activity Category	FHWA Criteria Leq(h)	WYDOT Criteria Leq(h)	Evaluation Location	Noise Sensitive Receptor	Activity Description
A	57	56	Exterior	Yes	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[1]	67	66	Exterior	Yes	Residential.
C[1]	67	66	Exterior	Yes[2]	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, recreational areas, Section 4(f) sites, schools, television studios, trails, and trail crossings.
D	52	51	Interior	Yes	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[1]	72	71	Exterior	Yes[2]	Hotels, motels, time-share resorts, vacation rental properties, offices, restaurants/bars, and other developed lands, properties or activities not included in A-D or F.
F	NA	NA	NA	No	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	NA	NA	NA	No	Undeveloped lands not specifically permitted for development.

1. Includes undeveloped lands specifically permitted for this activity category.
2. If a receptor does not have an outside area of frequent human use, then the receptor is not noise sensitive.

3.4.1.1 NAC Activity Category A

NAC Activity Category A are properties that are unique and are of extraordinary significance. Because of this, determining if a receptor qualifies as a NAC Activity Category A will be made on a case-by-case basis by WYDOT in consultation with FHWA.

3.4.1.2 NAC Activity Category B

This NAC activity category includes residential and multiple family dwellings, including mobile home parks and apartment buildings. Note: long term/extended use motel/hotels are also Category B per FHWA guidance.

3.4.1.3 NAC Activity Category C

NAC Activity Category C land uses are either individual sites, such as buildings (amphitheaters, auditoriums, libraries, Etc.) or properties with multiple use such as parks, campgrounds, cemeteries, etc. A receiver should be placed within the property at the location of frequent human use that represents the worst expected traffic noise condition. However, for properties that include multiple receptors with individual activity areas, the following guidance is provided.

Parks and Recreation Areas – Parks range in size and amenities from neighborhood pocket parks to linear greenbelts, to large regional parks and natural preserves with multiple trails and outdoor use facilities. Recreation areas may also encompass multiple activity areas within a large parcel of land. For each area with a discrete outdoor activity, receivers should be located within the park or recreation area boundary. Consider each receiver location individually for impacts. For example, if a park has a ball field, picnic area, and playground, three receivers should be assigned to that area. Examples of receiver assignments for parks and recreation areas:

- **Campgrounds** – One receiver is placed at each campsite closest to the road. Receivers should be placed at additional campsite locations if the terrain suggests it may have a higher noise level.
- **Picnic Areas** – One receiver placed closest to the road should be counted as a single functional area.
- **Pavilions** – One receiver placed closest to the road should be counted for each complex of tables, outdoor cooking facilities, covered pavilions, gazebos, etc. that could be considered oriented or situated to provide a single use area.
- **Sporting fields** – One receiver placed closest to the road should be counted for each formalized sporting field inclusive of its associated seating, access, pathways, and/or stadium complex. Less formalized activity areas such as grassy areas of a park or recreation area should have one receiver if it includes a common area that demonstrates frequent human use.
- **Golf Courses** – One receiver should be placed within the golf course that best represents the area that would likely have the highest noise level. If other outdoor activity areas exist within the course such as practice areas, picnic facilities, restaurant outdoor area, etc., each course segment and formalized activity area shall be identified with a separate receiver.

Jurisdictionally-Controlled Forests and Other Areas Officially Managed for Outdoor Recreational Activity – Jurisdictionally controlled areas generally are federal lands that must have a management plan that defines a specific outdoor activity use. If the management

area has no discernable outdoor area of frequent human use (i.e., trails/trailheads, camping facilities, picnic areas, etc.), a minimum of one generalized receiver shall be placed at an area along the recreation area that would likely have the highest noise level (such as roadside pullout).

Trails/Trail crossings – Individual trails should be assigned a receiver at areas where user congregating would be expected along the trail, such as a rest spot or scenic viewing areas. If no areas of frequent human use exist along the trail, then one receiver should be used for the entire trail. The receiver should be placed at an area along the trail that would likely have the highest noise level.

Cemetery – One receiver should be counted for each area of a formalized memorial gathering facility (indoor or out). Individual gravesites, access ways, and informal activity areas are not considered individual sensitive receptors. However at least one receiver must be located on site. If no formalized gathering areas are readily identifiable, then receiver location(s) may involve discussion with property owner or manager and determined by WYDOT on a case-by-case basis.

Section 4(f) Sites – Section 4(f) sites encompass three types of sites – parks and recreation areas, wildlife refuges, and historic sites.

- Parks and Recreation Areas – addressed above.
- Wildlife Refuges – Wildlife or wildfowl refuges or preserves typically have docks, beaches, or trails where people congregate (area of frequent human use). More than one receptor may be identified depending on location or areas of frequent human use. At least one receiver should be assigned to the refuge or preserve at the area that would likely have the highest noise level. One receiver should be counted for each such use.

Historic Sites –Historic sites that have exterior areas with frequent human use (e.g., some historic houses), one receiver should be counted for each such use. For historic sites without frequent human use, no noise analysis is necessary. Noise levels could be required for Section 106 purposes, which may differ from highway traffic noise requirements.

3.4.1.4 NAC Activity Category D

This activity category includes the interior impact criteria for certain land use facilities listed in Activity Category C. Conduct an indoor analysis only after a determination is made that exterior abatement measures will not be feasible and reasonable. Locate indoor receivers at areas of frequent human use closest to the noise source.

Activity Category D designations are rare, and placement of receivers is done on a case-by-case basis in consultation with affected parties.

3.4.1.5 NAC Activity Category E

This activity category contains receptors that are generally less sensitive to highway traffic noise. If a motel/hotel property acts as a permanent or long-term residence, then this land use activity would be considered a NAC Activity Category B. Place the receiver at the area of most frequent use.

3.4.1.6 NAC Activity Category F

FHWA has not developed a NAC for these land uses, and a noise analysis is not required. Identify the use in a best estimate memo, noise screening analysis, or traffic noise report in accordance with these procedures.

3.4.1.7 NAC Activity Category G

No NAC has been developed for these land uses, and a noise analysis is not required. Identify the use in a best estimate memo, noise screening analysis, or traffic noise report in accordance with these procedures.

3.5 Determining Receptors for Analysis

Identify all receptors and their NAC categories on a map for reporting purposes. These include those NAC categories that may not need to be modeled (such as NAC Activity Categories F and G). The purpose of identifying these receptors is for proper NAC determination.

Once all receptors are identified in the NSAL, review each receptor for an "area of frequent human use". Always analyze NAC Activity Category B (residences) even if no area of frequent human use exists, as these areas are sensitive land uses and people's homes. For NAC Activity Categories C, D and E, identify the area of frequent human use, and, if there, measure noise to represent that location. For example, if a restaurant (NAC Activity Category E) has no outside seating, then the receptor will be identified and noted in the report that it was not a noise sensitive receptor (and no noise measurement needed). Conversely, if the restaurant had an outdoor seating area, then a noise measurement for that receptor would be required.

Structures that contain multiple residential units (apartments, condominiums and duplexes) are considered to have one receptor per residential unit. However, effective noise abatement above the first floor of a multi-story sensitive receptor typically does not meet the standards for reasonableness (Section 5.1.2). Noise walls or berms constructed tall enough to break the line of sight for upper story units require additional reinforcement and foundation improvements for wind loading that result in significantly greater construction costs and are therefore unlikely to meet the cost/benefit criteria required for reasonableness. Exceptions involve multistory apartments constructed below highway centerline elevations because of terrain conditions.

3.5.1 Permitted Development

Normally, the noise analysis does not consider undeveloped lands, unless they are identified in a land use survey within the project corridor, which then the noise analysis is to provide noise level estimates to local planning agencies. However, if a building permit has been issued on or before the date of public knowledge, assign that land use the appropriate NAC Activity Category and analyze in the same manner as developed lands in that category. Note: if a building permit was not issued by the date of public knowledge, abatement measures will not be considered for that property.

If no design changes occur by final design, the noise report remains valid. FHWA and WYDOT will not provide abatement measures for new receptors that were not in existence or permitted prior to the date of public knowledge (signature of original NEPA document).

If substantial design change occurs at or before final design, or an extensive passage of time (greater than five years), reevaluate the noise report.

4.0 TRAFFIC NOISE IMPACT ANALYSIS

Perform one of the following noise analyses depending on traffic volumes and NAC Activity Category.

- Best Estimate Memo (see Section 4.1)
- Noise Screening Report (see Section 4.2)
- Traffic Noise Report (see Section 4.3).

A flow chart depicting the steps to determine the level of a noise analysis required is shown on Figure 3.

If a Type 1 project (see Section 2.2), identify the traffic volume and number of receptors within the NSAL to determine the type of noise analysis. For roads with less than 14,000 Average Annual Daily Traffic (AADT) that have two or fewer receptors or have multiple receptors but over 200 feet from each other, use the FHWA TNM Low Volume Road Tool.

If noise receptors in the NSAL do not have an area of frequent human use, use the Low Volume Road Tool. See Section 4.1 for report requirements.

If the results of the Low Volume Road Tool show that the NAC has not been exceeded for the noise receptors, complete the Best Estimate Memo.

If the results of the Low Volume Road Tool show that more than two noise sensitive receptors approach (1 dBA below) the NAC, then review the project design to minimize noise impacts, or perform a Noise Screening Analysis (see Section 4.2) or a Traffic Noise Report (see Section 4.3).

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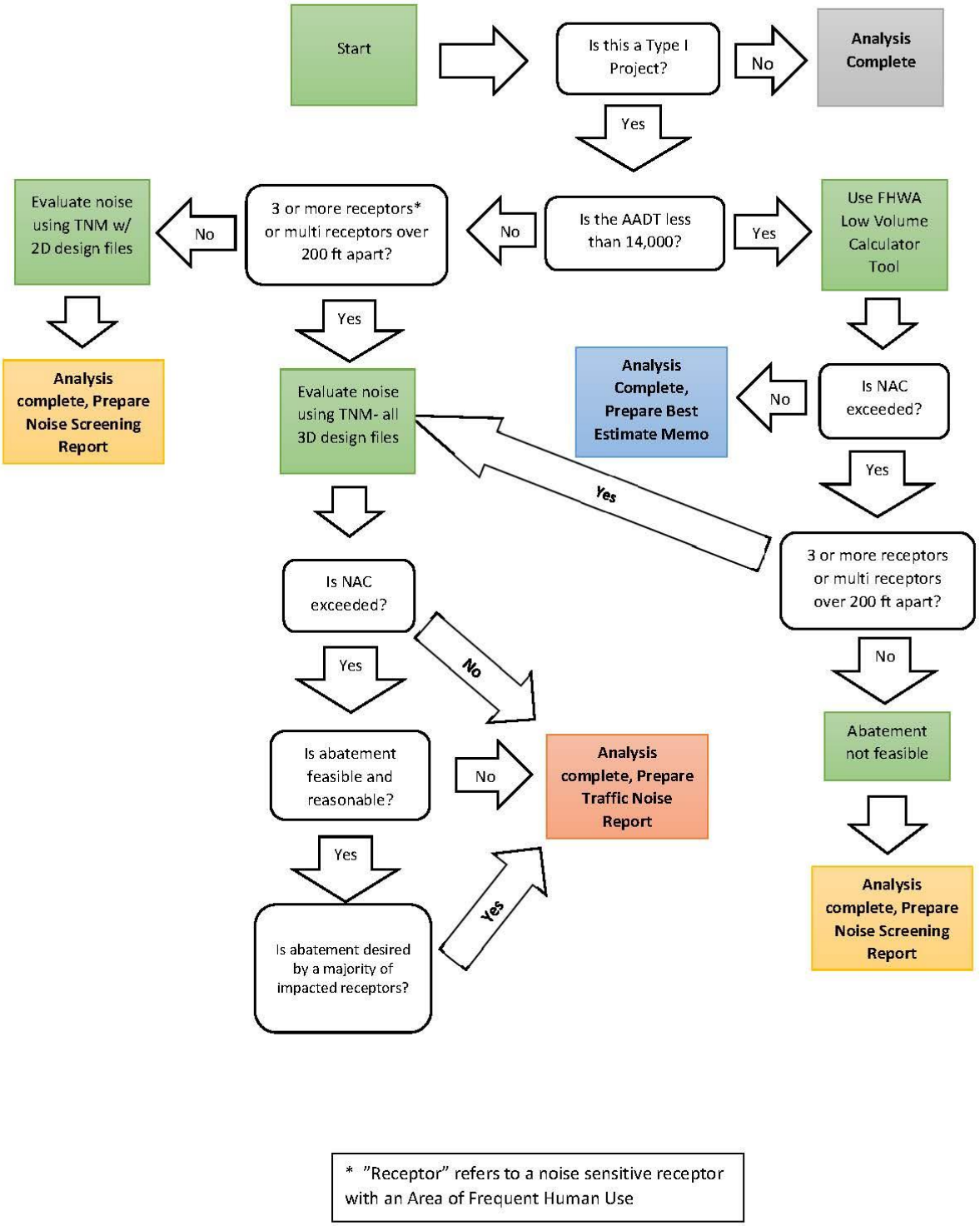

Figure 3. Traffic Noise Analysis Flow Chart

If traffic volume is greater than 14,000 AADT, perform a Noise Screening Analysis or a Noise Traffic Report. If there are two or less noise sensitive receptors in the project NSAL, but none have an area of frequent human use (NAC activity C or E), then prepare a Noise Screening Analysis. A Noise Screening analysis can also be used if multiple individual receptors are over 200 feet from each other. For a Noise Screening Analysis, TNM is still used, but with flat ground elevation data (a two-dimensional (2D) model as the Z-axis is constant).

Prepare a Traffic Noise Report (see Section 4.3) if anticipated project-related impacts result in evaluation of noise abatement that could be feasible and reasonable.

4.1 Best Estimate Memo

The Best Estimate Memo is used only if the low volume tool shows no impacts. This is the simplest noise report used when the traffic is less than 14,000 AADT with two or fewer noise sensitive receptors, or when receptors are not noise sensitive (no areas of frequent human use). Use when there are multiple noise receptors, but the area of frequent human use is over 200 feet from each other. If there are multiple receptors but some are clustered in an area, perform a Traffic Noise Report.

Per 23 CFR 772.17, report noise levels to the local planning agency with jurisdiction (or local official). Use the FHWA's Low Volume Road Tool to provide the noise levels for the local officials for planning purposes. Identify the receptor(s) and assign the NAC and decibel results. The memo should include a discussion of the proposed project action, a map showing receptor(s) locations and why the use of the tool is appropriate for this level of analysis.

Besides modeling the identified receptors, noise levels of a 10-point transect (using distances of 50, 75, 100, 125, 150, 200, 250, 300, 400, and 500 feet) should be provided for the existing, no-build and proposed Design-Year. Report these results to the nearest $1/10^{th}$ dB(A) and in tabular form. If no receptors are present, then state that in the report and include the 10-point transect results.

4.2 Noise Screening Analysis

The Noise Screening Analysis is a streamlined procedure using simplified TNM modeling to predict traffic noise levels and to estimate noise impacts.

Use the Noise Screening Analysis when traffic is greater than 14,000 AADT and two or less noise sensitive receptors, or receptors that are not noise sensitive (no areas of frequent human use) but located within the project NSAL. It can also be used if there are multiple noise receptors, but the area of frequent human use is over 200 feet from each other. In the case where there are multiple receptors, but some are clustered (within 200 feet of each other), then perform a Noise Report.

A Noise Screening Analysis can also be used for when noise impacts are anticipated, but potential noise abatement actions would clearly not be feasible and/or reasonable. These types of projects would be located on rural highways with uncontrolled access, have few receptors, and/or large distances between receptors.

The Noise Screening Analysis should include a discussion of the proposed project action, a map showing all receptor locations (even if not modeled [i.e., structures with NAC Category F]) and their respective NAC Category. Also, include the justification for using the screening methodology for using this type of reporting. Noise levels for the existing, no-build and proposed Design-Year need to be provided in a tabular form and reported to the nearest $1/10^{th}$ dB(A). In addition, report

noise levels with the 10-point transect (distances at 50, 75, 100, 125, 150, 200, 250, 300, 400, and 500 feet).

Other considerations in a Noise Screening Analysis include:

- Model validation is not required. However, if substantial topographic changes (as defined by Type I vertical and horizontal changes) occur in the study area, consider case by case on-site noise measurements;
- Model existing and design-year to determine if future noise levels will increase substantially, by 15 dB(A) or more;
- Prepare a Traffic Noise Report if noise abatement is clearly feasible and reasonable or when the cost reasonableness is within 10% or 20%;
- If noise abatement is determined not be feasible and reasonable, state this in the noise screening report.

Appendix B provides information for preparing a Noise Screening Analysis.

4.3 Traffic Noise Report

A Traffic Noise Report consists of a detailed discussion of existing and future traffic noise levels resulting from the proposed project. Prepare a Traffic Noise Report when the traffic volumes exceed 14,000 and three or more noise sensitive receptors are located within the project NSAL (refer to Figure 3). It is also required for new alignment projects.

The major steps for conducting a Traffic Noise Report are:

- Identify the NSAL and NAC Activity Category for all Receptors.
- Determine Existing Conditions. Take field measurements at sensitive receptors that illustrate the existing noise environment, as free from the influence of local non-traffic generated noise sources and shielding as practical. Measure during relatively free flowing conditions at or near the posted speed limit. The number of the modeling points used can vary depending on the individual project. A single representative receiver can be used for modeling several as long as those receptors are close together and have the same geometric relationship to the highway. Include the results of all modeled receptors and location in a tabular format.

  For roadways on new locations, determine current noise levels by using field measurements at representative receptor locations. Superimpose proposed new alignment and construction footprint on a base map that illustrates existing and permitted buildings, features and facilities that defines the appropriate noise NSAL and identified noise sensitive receptors.

- Determine the existing noise levels. Combine field measurement and modeling to determine the existing conditions of the noise in the NSAL. Take noise measurements with an American National Standards Institute (ANSI) Type I or Type II integrating sound meter in accordance with report FHWA-HEP-18-066, Noise Measurement Handbook (2017). For modeling the existing noise levels, use the most current version of the approved FHWA Traffic Noise Model (TNM) software. Express TNM analytical results to the nearest $1/10^{th}$ of a dB(A).

- Noise Model Validation. For widening projects or other projects involving an existing highway, validate the model by comparing field-measured noise levels with modeled noise levels. Model input data uses the same traffic volumes, mix and speeds that were tallied in the field. Measure a minimum of three measurement locations at least 15 minutes in duration to characterize the existing noise condition in the NSAL Lengthy projects or projects with diverse geometry or terrain features may require more validation locations. The validation effort should attempt to characterize the totality of the modeling effort and where noise levels are expected to vary due to conditions. However, for rural roads, three measurements at 10-minute duration are allowed. For the FHWA TNM run to be considered valid, the modeled levels at each location must be within +/- 3 dB(A) of the corresponding field measurements. If the difference is over 3 dB(A), the model should be reviewed and revised as appropriate and run again. If the model is still not within 3 dB(A) of the field measurements, discuss with WYDOT Environmental Services. Document the reason noise levels exceeded the field measurements in the Traffic Noise Report. Document model validation within the Traffic Noise Report. Standard validation practices are described in FHWA's website Frequently Asked Questions,

  https://www.fhwa.dot.gov/Environment/noise/regulations_and_guidance/faq_nois.cfm.

- TNM Noise Levels. Once the existing noise levels have been determined and the model validated, calculate the design-year noise levels for each receptor. The model should reflect the design-year conditions, usually 20 years post-construction for the worst-hour noise condition. The design hour volume (DHV) of the roadway modeled at the posted speed limit represents the worst-hour noise condition. Examine each alternative alignment, including the no-action alternative. The evaluation of the no-action alternative is done to satisfy NEPA requirements under 23 CFR 771.

  Potential right-of-way (ROW) acquisitions to be demolished will not normally need to be included in the design-year modeling, but will need to be included in the no-action alternative case. In addition, if a noise barrier is currently present it must also be included in the analysis of the future conditions, unless it will be demolished as part of future condition.

- Traffic Noise Impact Determination. Determine traffic noise impacts by 1) comparing the predicted design-year noise level to the NAC and 2) comparing the predicted design-year noise levels to existing noise levels to determine a substantial impact. If no traffic noise impacts are identified, the analysis is considered complete and further consideration of noise abatement is not required. State this determination in the noise report. If traffic noise impacts are identified or anticipated, then evaluate abatement for feasibility and reasonableness. If a barrier is determined not to be feasible, then no further analysis is necessary, but the noise report must include this information. Complete the Noise abatement Checklist (see Appendix E). Appendix C provides a list of items necessary to prepare a Traffic Noise Report.

5.0 EVALUATION OF TRAFFIC NOISE ABATEMENT

Proposed abatement is based on evaluation criteria for feasibility and reasonableness and must include analyzing a berm or wall. Primary consideration is given to exterior areas of residential sites or areas of frequent human use where a reduced noise level would be a benefit.

If a receptor is impacted under existing (or no-build) conditions and the project will result in noise conditions that will be reduced but still over the NAC, abatement will need to be considered (for instance, a residential receptor that is currently experiencing 73 dB(A) but traffic noise after the project will be 70 dB(A), it is still over the NAC and abatement will have to be evaluated). FHWA does not consider the planting of vegetation to be noise abatement since substantial noise reduction cannot be assured for the Design-Year. Vegetation would have to be extremely wide and dense to offer noise abatement and this is normally not reasonable to plant enough vegetation along a road to achieve noise reductions (FHWA 2011).

5.1 Noise Barrier Evaluation

Various locations and heights of barriers can be analyzed by the TNM. The amount of noise reduction, also known as insertion loss, will also be calculated by TNM. Insertion loss is the design-year noise levels with the barrier subtracted from the future no-barrier condition. For example, if the Leq(h) at a residence before a barrier is constructed is 75 dB(A) and the Leq(h) after a barrier is constructed is 65 dB(A), then the insertion loss would be 10 dB(A).

5.1.1 Feasibility

Feasibility primarily considers acoustical and engineering concerns such as topography, access, drainage, safety, and other noise sources. If a noise barrier has been evaluated for a particular location and is deemed not feasible, the reasonableness criteria does not need to be assessed. Document the noise abatement analysis as complete in the Traffic Noise Report.

5.1.1.1 Acoustical Feasibility

Acoustical feasibility refers to the minimum number of receptors that must receive a 5 dB(A) reduction for a proposed noise abatement. A noise barrier must provide a 5 dB(A) noise reduction for at least two impacted receptors in order to meet the acoustical feasibility requirement. Receptors that meet acoustic feasibility are considered benefitted receptors for purposes of calculating reasonableness. If only one individual receptor is impacted, noise abatement is not considered feasible and no further analysis is needed.

5.1.1.2 Engineering Feasibility

Several safety and maintenance considerations may dictate whether a noise barrier is feasible. Some safety and height limitations that make a noise barrier infeasible include reduction of drivers' sight distance, continuous shadowing causing icing of the driving lanes, severe drainage problems associated with the barrier, or installation in flood-prone areas. In addition, moving accesses/ driveways is generally not considered a feasible action.

A noise barrier must also be able to meet the acoustical feasibility criteria without being excessively tall. Barriers greater than 20 feet in height may not be feasible from an engineering standpoint due to the potential to compromise the wall's stability and structural integrity, given normal construction design specifications. Coordinate with the project design team to determine if a barrier height is feasible from an engineering standpoint.

Barrier placement should also consider acoustics and maintenance of the barrier. Acoustically, the best locations for barriers are usually either close to the receptor or close to the noise source, depending on the terrain. Provide enough access on both sides of the barrier to allow maintenance vehicles and/or other appropriate equipment to safely navigate.

5.1.2 Reasonableness

Reasonableness of abatement measures evaluates the combination of environmental, economic, and social resources affected by the noise abatement.

Reasonable noise abatement must, at a minimum, collectively achieve the noise reduction design goal, the cost-benefit evaluation, and the benefited receptors desire for an abatement measure. Failure to achieve all of these criteria will result in the noise abatement deemed unreasonable.

Noise Reduction Design Goal

Noise barriers must achieve a minimum noise reduction design goal of 7 dB(A) to be considered reasonable. The noise reduction design goal is different from Acoustical Feasibility (Section 5.1.1.2) which requires a 5 dB(A) noise reduction for a minimum of two impacted receptors (with frequent human use). If noise abatement can be constructed to meet that minimum 5 dB(A) at the two impacted receptors criteria, then design is carried forward and the abatement must meet the Noise Reduction Design Goal of 7 dB(A) for at least one impacted receptor. If this design goal is not attainable or does not meet the Cost Effectiveness Index, then the noise abatement cannot be carried forward. This requirement ensures that the majority of impacted and benefited receptors behind a noise barrier will experience a noticeable reduction in noise.

External noise sources such as aircraft, rail, or industrial noise can contribute to the noise environment. However, the FHWA TNM modeling software only determines the traffic noise environment. Assessment of external noise is beyond the limits of the TNM. External sources that can influence field measurement should be noted in the noise analysis.

Barrier Cost

The maximum allowable cost per benefited receptor is $29,100 and is reviewed every five years for relevance.

The Barrier Cost Index is used for planning purposes to provide a consistent level of consideration for noise abatement decision-making.

The Barrier Cost Index is determined by dividing the approximate cost of the barrier (length x height x $35.00) by the predicted or modeled total decibel reduction for all benefiting receptors of 5 dB(A) or more. The average unit cost per square foot is $35.00 for a proposed wall (or berm) less than a ¼-mile long and $29.10 over ¼-mile long. The square foot unit cost will be reanalyzed every five years.

Viewpoints of Benefited Receptors

The FHWA noise regulation requires the viewpoint or desires of the benefited residents and property owners be considered in determining the reasonableness of noise abatement. Conduct the desirability survey and determination during the NEPA process or final design. Consider the preferences of the benefited property owners when determining if the barrier is reasonable. A resurvey of desirability may be required if a change in project design, regulation, or existing conditions result in a NEPA reevaluation.

Viewpoints of benefited receptors can be solicited through meetings, a mail service, door-to-door campaign, or some other defensible means. A good faith effort must be made to contact owners and residents to obtain their preference regarding noise abatement. Experience has shown that a single

polling opportunity is not sufficient; several efforts to reach affected residents should be expected to reach a majority. Written and spoken communications will be in English and the dominant secondary language, if identified.

For benefited receptors of single-family residences, the viewpoint of the property owners are surveyed first. If the majority of the property owners (50% +1) agree to build a wall, then the process is complete. After a good faith effort, if a majority of property owners do not respond, the wall does not get built.

For a rental house, duplex, triplex, fourplex, apartment, etc., the owner will be surveyed first. If the owner wants a wall, then it is documented, and no further survey is needed. If the owner does not want a wall, tenants will be surveyed. Each unit in a multi-family building should be counted as one residence. If a majority of the residences (50%+1) agree to build the wall, then the process is complete. After a good faith effort, if a majority of the residences do not respond, the wall does not get built.

The Noise Abatement Determination Checklist summarily documents if the proposed abatement is feasible and or reasonable (see Appendix E). Complete this checklist for each proposed abatement when the decision to construct abatement (or not) has been determined.

5.2 Statement of Likelihood

A Statement of Likelihood should be included in the noise report and is required in the NEPA document. It is based on the feasibility and reasonableness analysis of noise abatement. The Statement of Likelihood recommends whether it is likely or unlikely that noise abatement will be provided. Likely does not mean a firm commitment. The final decision for abatement will be made upon completion of the project design and noise wall desirability process. If abatement is necessary, the Statement of Likelihood shall include the preliminary location, benefited receptors affected, estimated insertion loss (or reduction in noise) by dB(A).

5.3 Special Insulation Abatement Considerations

Noise insulation of Activity Category D of land uses, such as places of worship and schools, may be considered as an abatement measure in accordance with 23 CFR 772.15(c)(5). This evaluation will be made on a case-by-case basis. Any decisions in this regard must be documented in the noise report. Post-installation maintenance, repair, and operational costs for noise insulation are not eligible for federal-aid or WYDOT funding.

5.4 Noise Impact Compensation and Third-Party Funding

Property owners or residents cannot receive federal-aid funds as monetary compensation *in lieu* of noise abatement. In addition, property owners and residents cannot receive direct monetary compensation for unmitigated damages caused by highway traffic noise impacts.

Private or third-party funding can be used on projects to make functional enhancements to a noise abatement measure already determined to be feasible and reasonable, such as adding absorptive treatment, access doors, or aesthetic enhancements. Private or third-party funding is not allowed on a federal-aid Type I project to discount the cost of the noise abatement measure in order to influence the determination of feasible and/or reasonable. Private or third-party funding cannot be used to augment the dimensions or change the cost-benefit index of abatement measures recommended on a federal-aid project. Other landscape or hardscape features may be constructed with private or

third-party funding as part of a non-federal-aid project in interstate ROW that may provide some noise abatement without meeting the feasible and reasonable determination.

6.0 CONSTRUCTION CONSIDERATIONS

6.1 Construction Noise

Minimizing construction noise is important; however, in the absence of standardized federal criteria for assessing construction noise impacts related to transportation projects (FHWA, 2006)[1], use the standards and requirements developed by local governments.

Some local governments have noise ordinances that may restrict the amount of noise that can be emitted from a construction operation during certain hours or in certain areas (i.e., residential neighborhoods). Review county, city, or local noise ordinances to determine if any such ordinances exist and document in the traffic noise report.

In the Traffic Noise Report, discuss construction noise to be addressed in a general manner with emphasis on the temporary nature of any adverse effects. Identify any applicable low cost and easily accomplished construction noise reduction techniques such as work hour limits, maintained mufflers, modification of backup alarm systems, location of haul roads, and public outreach.

7.0 COORDINATION WITH LOCAL PUBLIC AGENCIES

Provide the noise analysis document to the local public agency(s) prior to completion of the NEPA document. The purpose is to notify the local agency regarding noise levels so they can plan accordingly. Ensure that local agencies are provided the following information.

- A brief introduction to the project and the information to be shared.
- Discussion of noise compatible planning concepts and best estimation of Design-Year noise levels on undeveloped lands.
- A table showing the existing and best estimation of Design-Year noise levels.
- A 10-point transect of noise levels at 50-foot, 75-foot, 100-foot, 125-foot, 150-foot, 200-foot, 250-foot, 300-foot, 400-foot, and 500-foot.
- A map showing the best estimation of Design-Year noise levels.

A sample letter is provided in Appendix F.

8.0 NEPA REPORTING ON TRAFFIC NOISE

Complete the Traffic Noise Report, Noise Screening Analysis, or Best Estimate Memo, and include in the NEPA Document. Noise information in an Environmental Assessment (EA) or Environmental Impact Statement (EIS) should summarize the existing and future noise levels, noise impacts, and abatement measures, if any. Also needs to include a Statement of Likelihood.

If applicable, include a Statement of Likelihood in the CE.

[1] https://www.fhwa.dot.gov/environment/noise/construction_noise/handbook/

9.0 REFERENCES

FHWA 1981. FHWA-DP-45-1R, Sound Procedures for Measuring Highway Noise, 1981

FHWA 2006. Construction Noise Handbook. Website October 2021. https://www.fhwa.dot.gov/environment/noise/construction_noise/handbook/

FHWA 2011. Highway Traffic Noise: Analysis and Abatement Guidance. FHWA A-HEP-10-025

FHWA 2017. FHWA-HEP-18-066, Noise Measurement Field Guide –Final Report

FHWA 2017. FHWA-EP-18-065 Noise Measurement Handbook.

FHWA 2021. Synthesis of Noise Effects on Wildlife Populations. Accessed March, 2021 http://www.fhwa.dot.gov/environment/noise/noise_effect_on_wildlife/.

FHWA 2021. FHWA's Frequently Asked Questions Website accessed March, 2021 https://www.fhwa.dot.gov/Environment/noise/regulations_and_guidance/faq_nois.cfm.

FHWA 2021. FHWA Low Volume Road Tool. Accessed March, 2021 https://www.fhwa.dot.gov/environment/noise/traffic_noise_model/

FHWA 2021. Traffic Noise Model. Accessed on September, 2021 https://www.fhwa.dot.gov/environment/noise/traffic_noise_model/

APPENDIX A

DEFINITIONS

Approach—Noise levels which are within 1 dB(A) of the Noise Abatement Criteria for a corresponding NAC Activity Category.

Automobiles—All vehicles with 2 axles and 4 tires. Includes passenger cars, vans, and light panel and pick-up trucks.

Auxiliary Lane—Auxiliary lanes are not intended to increase road capacity, but to facilitate the operations of the roadway. Examples include any lanes that connect the on-ramp of one interchange with the off-ramp of the next interchange, truck climbing lanes, passing lanes, acceleration and deceleration lanes, and turn lanes. Auxiliary lanes which are less than 2,500 feet in length or function primarily as turn lanes do not themselves make the project a Type I project (see turning lane definition).

Background Noise—The total of all noise in a system or situation, independent of the presence of the source of interest (ambient noise).

Benefited Receptor—All receptors, both impacted and non-impacted, that receive a noise level reduction of 5 dB(A) or more through placement of a noise abatement measure.

Berm—An earthen mound constructed for use as a noise barrier.

Best Estimate Memo. Regulation 23 CFR 772.17 requires notification be sent to local officials of the "best estimation" of future Design-Year noise levels.

Cost Benefit Index—A value used to determine the cost-reasonableness of noise abatement based on an average barrier cost per unit area.

Date of Public Knowledge—The date of approval of the appropriate environmental decision document for a highway project (signed CE, FONSI, or ROD).

Decibel (dB(A))—The basic unit for measuring the difference of sound pressure levels of a sound event from a reference pressure. To approximate the range of frequencies of sound most audible to the human ear, an A-weighting factor is applied. Sound levels are usually reported in A-weighted decibels.

Design-Year—The future year used to estimate the probable traffic volume and predicted future noise levels for which a highway is designed (usually 20 years from start of construction).

Existing Noise Levels—The level of noise measured or modeled at a receptor for the pre-construction condition of the highway project area.

Feasibility—The combination of acoustical and engineering factors considered in the evaluation of a noise abatement measure.

Highway—A roadway. The use of highway and roadway in this procedures and standards document is interchangeable. In general, a highway is a main road available to the public for use for travel or transportation.

Impacted Receptor—Any receptor which, under future conditions, is either subjected to noise levels that approach or exceed the noise abatement criteria or a substantial increase in noise levels.

Insertion Loss—The predicted reduction in the noise level resulting from implementation of noise abatement.

Leq(h)—Hourly Equivalent Noise Level; the equivalent steady-state sound level that contains the same amount of acoustic energy as the time-varying sound level over a one-hour period; the noise descriptor that is used for all traffic noise analyses.

Low Volume Road Tool. Developed by FHWA, the tool provides an accurate method for determining noise levels on roads of less than 14,000 AADT.

Medium Trucks—Any vehicle with 2 axles and 6 tires.

Noise Abatement—Measures used to reduce traffic noise levels.

Noise Abatement Criteria (NAC)—Absolute noise levels used to determine that a noise impact occurs when the level is equaled or exceeded.

Noise Barrier—A solid structure (wall or berm) constructed between a noise source and noise impacted receptors to abate the highway traffic noise.

Noise Reduction Design Goal—The optimum desired dB(A) noise reduction determined from calculating the difference between future build noise levels with abatement, to future build noise levels without abatement. The noise reduction design goal shall be at least 7 dB(A).

Noise Study Area Limit (NSAL) —The area contained within the environmental study or a 500-foot distance (halo) in all directions from the proposed edge of traveled lane(s) throughout the extents of the project, whichever is larger. This 500-foot halo defines the extent of the noise analysis and shall include noise-sensitive receptors on all sides of the highway. The 500-foot boundary represents the minimal NSAL, so that if there is a reasonable expectation that noise impacts would extend beyond that boundary, the NSAL must be expanded to include those receptors.

Parallel Barriers—Two barriers which face each other on opposite sides of a highway.

Permitted—Planned development on currently undeveloped land that has obtained a formal building permit.

Predicted Noise Levels—Post-construction noise levels as determined via use of a traffic noise prediction model for the design-year.

Property Owner—An individual or group of individuals that holds a title, deed, or other legal documentation of ownership of a property or a residence.

Reasonableness—The combination of social, economic, and environmental resources considered in the evaluation of a noise abatement measure.

Receiver—A modeling or measurement location that represents noise sensitive land uses: can represent multiple receptors.

Receptor—A discrete or representative location of a noise sensitive area(s), such as a backyard or restaurant's outdoor seating area.

Resident—A resident occupies a primary home or place of abode, in which a person's habitation is fixed. The intended distinction between a resident and a property owner is that a resident secures a lease to occupy a permanent building or part of a building and may include a house, condominium, apartment, room in a house, or mobile home. To further refine the definition of a resident for the sole purpose of traffic noise abatement preference survey, the lease must be intended for long term residence (has lived in the unit for over 1 year) and is not intended for vacation, holiday or seasonal occupancy.

Roadway—A highway. The use of highway and roadway in this procedures and standards document is interchangeable. In general, a roadway is the strip of land over which a road is built and generally connotes a rural area.

Statement of Likelihood—A statement provided in the environmental decision document based on the noise abatement feasibility and reasonableness analysis completed at the time the environmental document is being approved.

Substantial Noise Increase—For a Type I project, the predicted noise levels increase by 15 dB(A) or more over the existing noise levels as a result of a highway project.

Ten-point transect. Specific distances used by ITD to provide standard noise levels at a given distance. Distances in feet: 50, 75, 100, 125, 150, 200, 250, 300, 400, 500.

Through Lane—A through lane is any general purpose or managed lane that provides capacity to the roadway. However, if an intersection adds a lane that is not over 2,500 feet of a full lane width and/or is not considered adding capacity, then it is not considered a through lane.

Traffic Noise Model (TNM)—Current FHWA approved traffic noise prediction software for use on highway projects. As of this writing, TNM 2.5.

Traffic Noise Impacts—Impacts which occur when the predicted traffic noise levels approach or exceed the noise abatement criteria or when the predicted traffic noise levels substantially exceed the existing noise levels.

Turn Lane—For the purposes of noise analysis, a turn lane is considered to be the designated lanes required for storage and for completion of a full turning movement. This includes striped deceleration and acceleration lanes that merge into existing through lane traffic. On freeway facilities, extending existing ramp acceleration or deceleration lane(s) to meet current engineering design standard lengths is considered a turn lane(s), including the extension of an existing ramp lane(s) to connect two closely spaced existing interchanges, not to exceed 2,500 feet in accumulated length, to accommodate weaving. Under these definitions, the addition of a turn lane would constitute a Type III project.

Type I Projects—A proposed federal action or federal-aid highway project for the construction of a highway on new location or the physical alteration of an existing highway which significantly changes either the horizontal or vertical alignment or increases the number of through traffic lanes. See full criteria identified in Section 2.3.1.

Type II Projects—A proposed federal action or federal-aid highway project for noise abatement on an existing highway. No Type II program currently exists in Wyoming.

Type III Projects—A federal action or federal-aid highway project that does not meet the classifications of a Type I or Type II project. Type III projects are not required to undergo noise analysis.

Undeveloped Lands—Lands on which no current human activity areas already exist or are not currently permitted for future development.

Worst Traffic Noise Condition—Traffic conditions that yield the highest absolute noise levels by consisting of the highest volume of traffic traveling at the highest possible speed. In general, this is the roadway design hour traffic volume at the posted speed limit.

APPENDIX B

INFORMATION FOR A NOISE SCREENING ANALYSIS

This type of report is a streamlined approach for documenting that noise impacts are unlikely. A Noise Screening Analysis is generally appropriate for two types of projects: projects that have NAC Activity Category C, D, or E receptors only and do not have an area of frequent human use; or when noise impacts may be anticipated, but potential noise abatement actions will clearly not be feasible and reasonable.

Report information:

- Reason why noise screening analysis is the appropriate level of documentation.
- Identification of existing conditions.
- In TNM, use flat ground elevation data with straight-line roads. Modeled receivers will be offset perpendicularly from the center of the model roads at distances of 50 feet, 75 feet, 100 feet, 125 feet, 150 feet, 200 feet, 250 feet, 300 feet, 400 feet, and 500 feet.
- The modeled roads will extend out 500 feet from the edge of the roadway (i.e., a minimum of 1,000 feet total length). Noise levels need to be reported to the nearest 10th of a decibel.
- Noise map for local planning agencies. Map showing the 10-point transect to identify future noise impact levels for local planning agencies.
- For reporting, provide results in tabular form for Design-Year, and No-action alternatives, if appropriate.
- Information for local officials. Discussion of noise compatible planning concepts and future noise levels on undeveloped lands.

Other technical considerations such as assuming the appropriate worst-hour traffic volumes, vehicle fleet mix, etc. will be the same as for a Traffic Noise Report. Other considerations in a Noise Screening Analysis include:

- Model validation is not required. However, if significant topographic changes occur in the study area, on-site noise measurements will be considered case by case.
- Existing and design-year must be modeled to determine if future noise levels will increase substantially, by 15 dB(A) or more.

APPENDIX C

TRAFFIC NOISE REPORT REQUIREMENTS

Information for Noise Analysis

Noise studies must identify 1) locations where noise impacts are predicted to occur; 2) noise abatement which are feasible and reasonable, and which are likely to be incorporated in the project; and 3) noise abatement which are not feasible and reasonable. The noise analysis shall include the following information for each alternative under detailed study, including the no-action alternative:

- **Identification of noise sensitive land uses.** Identification of existing sensitive receptors, developed lands, and undeveloped lands for which development is permitted.
- **Determination of existing noise levels.** Measurement and or prediction of existing worst-hour noise levels at noise-sensitive land uses.
- **Determination of future noise level.** Prediction of design-year worst-hour noise levels for the No-Build and Build Alternatives.
- **Determination of traffic noise impacts.**
- **Noise abatement evaluation.** Evaluation of noise abatement measures for impacted noise-sensitive land uses. The study will only include this step if there are impacts.
- **Discussion of construction noise.** Identification of affected land uses, short-term nature of construction noise, and any noise control measures to be implemented.
- **Information for local officials.** Discussion of noise compatible planning concepts and future noise levels on undeveloped lands.
- **Noise map for local planning agencies.** Map showing the 10-point transect to identify future noise impact levels for local planning agencies.
- **Abatement Determination Checklist.** See Appendix E.
- **TNM Results.** An electronic media copy of the TNM files.

The noise report (for both Noise Screening Analysis and Traffic Noise Report) includes the following:

- **Executive Summary**

  The Executive Summary contains the following information:

  a) General project description. Focus on those items that could affect the noise environment such as a lane addition.

  b) Receptors impacted by project (NAC category, Noise level, and general location)

  c) Necessary noise abatement (if required)

- **Table of Contents**

  The Table of Contents contains the following information:

a) Section and subsection numbers, titles, and pages

b) Appendix titles

c) List of Tables, with table numbers, titles, and pages

d) List of Figures, with figure numbers, titles, and pages

- **Description of Project Location, Action and Background**

  Provide a project location, description, and background that expands upon the general description found in the Executive Summary, including the following.

  a) A detailed project description, including the type of project location, length, posted/design speeds, and year.

  b) A description of existing land uses and proposed land uses (if known). A zoning map is required and should be included in the appendix.

  c) A description of each noise receptor (NAC category). Provide location on a map

Procedure

Briefly state that the noise analysis included the following.

a) Using noise measurement procedures were conducted under approved FHWA and WYDOT guidance.

b) Using the latest approved version of the FHWA Traffic Noise Model® (TNM) (TNM 2.5 at time of writing) to model existing, no-build (if needed), and build noise levels; to help determine noise impacts; and to help evaluate noise abatement feasibility and reasonableness.

c) Using WYDOT (and FHWA) Noise Abatement Criteria (NAC) to identify impacts.

d) Evaluating the feasibility and reasonableness of potential noise abatement measures.

Characteristics of Noise

Provide an informative description of the characteristics of noise.

Ambient Noise Levels

Provide a description of the ambient noise level data gathered as part of the fieldwork. Include:

a) A general definition of ambient noise

b) An explanation of why measurements were taken (e.g., model validation; establishing existing levels.)

c) A general description of the ambient noise environment(s) in the vicinity of the project, including dominant and otherwise significant sources of existing noise

d) The number, general descriptions, and photographs of the locations of ambient noise level data collection as appropriate.

Noise Model Validation

Provide a discussion of the TNM validation process. The discussion should state that the validation process was used as the basis upon which the TNM for predicting existing year and Design-Year noise levels were built. Include table of results.

Procedure for Predicting Existing Noise Levels

Provide a description of how and where existing noise levels were determined, a listing of the existing noise levels, and how worst-hour existing noise levels were determined. The descriptions, locations (addresses) and types (land use activity areas) of noise sensitive receptors.

Procedure for Predicting Future Noise Levels

Provide a description of the TNM analysis process for predicting future noise levels associated with Design-Year traffic for the build (and possibly the no-build) alternative(s).

Traffic Noise Impacts

Compare the Design-Year worst-hour noise levels with existing worst-hour noise levels. List the appropriate NAC level(s) with the location and number of noise-impacted receptors. Use color-coding on plan sheets and in tables.

Potential Traffic Noise Abatement Measures

Provide a discussion of optional traffic noise abatement measures including, but not limited to the following:

a) Highway alignment selection

b) Traffic system management measures

c) Buffer zones

d) Noise barriers (noise walls and earthen berms). All traffic noise abatement measure assessments shall be described in detail, including the measures that do not meet feasibility and reasonableness criteria. Include the following in the Discussion and tables:

- The results of acoustical and engineering feasibility evaluations performed for proposed noise abatement.
- If feasible, then add the results of reasonableness determinations for proposed noise abatement.

Noise Levels for Undeveloped Lands Where No Building Permits Have Been Issued

For undeveloped lands where no building permits for development have been issued, provide noise level information to local public officials and others for their use in future planning efforts. Conduct a 10-point transect and show in tabular form.

Construction Noise

Discuss Construction Noise in a general manner. Include any project-specific construction noise effects and recommended noise-control measures developed for the project, if any.

Conclusion

Provide a conclusion that provides a brief discussion of impacted receptors and a recommendation regarding noise abatement (e.g., further study necessary, recommendation of abatement measures, no further action, etc.). The recommendation should include the Statement of Likelihood, whether likely or unlikely, that noise abatement measures will be installed. The final decision on abatement will be made upon completion of the public involvement process, concurrence with the WYDOT and FHWA.

References

Include a list of applicable references.

Project Mapping

Include a representation of the entire project (NSAL) on a plan sheet image. Detailed small-scale images may be necessary to present receptor locations, traffic noise levels, impacts, and abatement in a readable manner. Include a title block, a legend (as applicable), north arrow, and map creation date.

Appendices

Provide appendices that contain the TNM Run result table and any other information pertinent to the project. The TNM model tables do not need to be specifically included in the document itself. Due to their large file size, they can be provided separately.

APPENDIX D

EXAMPLE BARRIER COST CALCULATION

Barrier Cost Example

The Barrier Cost Index value is determined by dividing the approximate cost of the barrier (length * height * $35) by the predicted or modeled total decibel reduction for all benefiting receptors of 5 dB(A) or more. The average unit cost per square foot is $35 per square foot for a proposed wall (or berm) less than a ¼ mile long and $29.10 for walls over ¼ mile long.. Cost is based on wall height above centerline, which is the same height used in TNM, however the barriers are constructed at the ROW line which are normally about 4 feet lower. The square foot unit cost will be reanalyzed every 5 years.

Example: the TNM indicates that a 250 foot long, 10-foot-high wall is required to effectively abate the noise impact to 15 single-family residences

height = 10 feet + 4 feet = 14 feet

250' (Wall length) x 14' (height) x $35.00

Total Barrier Cost for the Planning Estimate is $122,500.

The cost per benefited receptor is $29,100.

So, if there are 15 benefited receptors:

Cost per benefited receptor = $122,500/15 = $8,167 per benefited receptor. Since this is less than $29,100, then this cost is reasonable for a noise wall.

APPENDIX E

NOISE ABATEMENT DETERMINATION CHECKLIST

See next page for checklist form

Project Name: _____ Project #_____

A. FEASIBILITY:

1. Can a 5 dB(A) noise reduction be achieved for at least two impacted receptors by constructing a noise barrier or berm without limiting property or neighborhood access?

   ❒ YES ❒NO

2. Does the barrier conform to project standards regarding traffic safety, maintenance, drainage concerns involving the proposed noise barrier or berm?

   ❒ YES ❒NO

3. Can a noise barrier or berm less than a height of 20 feet be constructed?

   ❒ YES ❒NO

4. Can an effective barrier be constructed considering the existing site characteristics and topography, and without reconfiguring the site or neighborhood (not including minor access modifications)?

   ❒ YES ❒NO

B. REASONABLENESS:

1. Has the design goal of 7 dB(A) noise reduction for abatement measure been met for at least one impacted receptor?

   ❒ YES ❒NO

2. Is the Cost Per Benefited Receptor below $29,100?

   ❒ YES ❒NO

3. Do(es) the majority of property owner(s) want a noise wall or berm?

   ❒YES ❒NO

4. Are a majority of the responding benefited residences (50%+1) in favor of the recommended noise abatement measure?

   ❒ YES ❒NO

C. STATEMENT OF LIKELIHOOD:

1. Are noise mitigation measures feasible?

   ❒YES ❒NO

2. Are noise mitigation measures reasonable?

   ❒ YES ❒NO

3. Is insulation of buildings both feasible and reasonable?

   ❒ YES ❒NO

4. Shall noise abatement measures be provided?

❒ YES ❒NO

D. ABATEMENT DECISION DESCRIPTION AND JUSTIFICATION: (Provide location and dimensions of wall or berm). (Add as an attachment to this form)

Completed by:_____ Date:_____

APPENDIX F

SAMPLE LETTER TO LOCAL OFFICIALS

(Place on WYDOT letterhead)

4 July 2021

Natrona County Commissioners, Chairman
200 N. Center
Suite 115
Casper, WY 82601

RE: WYDOT Project I254161 Glenrock to Casper / Casper Marginal Noise Study

Dear Mr. Chairman,

The Wyoming Department of Transportation (WYDOT) is proposing to construct an additional lane on each side of I-25 from North of Poplar St to South of Center Street (RM 188.01 to RM 188.89I-15) in Natrona County. This road-widening project will result in traffic noise projections as depicted on the attached noise report.

The attached report and tables of transects was completed during the course of the traffic noise study for this project. This information depicts the noise level anticipated to be produced by the projected Design-Year traffic volume (year 2040). Any vacant properties along this section of I-25 that may be developed over the next several years and construction close to the travel lanes may result in a volume of noise sufficient to exceed Federal traffic noise abatement criteria (NAC). In planning for future development along the I-25 project limits please, note that traffic noise may become a factor and that any building or development plans should take this issue into consideration. After the date of public knowledge, (the approval date of the environmental determination), the Federal Highway Administration (FHWA) and WYDOT are no longer responsible for providing noise abatement for new development adjacent to the highway.

The date of public knowledge for this project is: _____.

This notification of future noise impacts and the possibility of Federal funding for noise abatement are issued in accordance with 23 Code of Federal Regulations 772.15.

Sincerely,

Attachment: Noise Report including project table and map showing noise levels

CC: County/City Planning Department/ Local Metropolitan Planning Organization

City Mayor