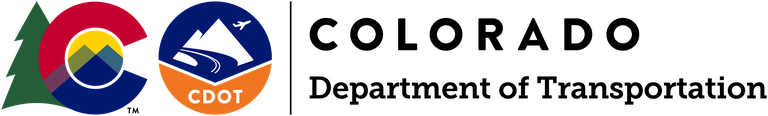
In-Kind Noise Wall Replacement Guidelines and Memorandum Templates

May 22, 2025



Revision History

|  |  |  |
| --- | --- | --- |
| Version Date | Version | Modification Summary |
| 2025 | 1 | Original CDOT guidance/1st version |

**LIST OF ABBREVIATIONS AND ACRONYMS**

CDOT Colorado Department of Transportation

CFR Code of Federal Regulations

dB decibels

dBA A-weighted decibels

DC Design Criteria

EB eastbound

FHWA Federal Highway Administration

ID identification number

Leq one-hour equivalent sound level

NAC Noise Abatement Criterion

NAAG Noise Analysis and Abatement Guidelines

OTIS Online Transportation Information System

SIMSA System for Inspection and Management of Structural Assets

TBD To be Determined

TNM FHWA’s Traffic Noise Model

WB westbound

1. Introduction

This guidance was written to bring consistency and efficiency to in-kind noise wall replacement projects. These projects are becoming more common due to the condition of noise walls that were built decades ago under Part 772 of Title 23 of the Code of Federal Regulations (23 CFR 772).

Colorado Department of Transportation (CDOT) is required to maintain these noise walls “*in perpetuity*.” This is stated on page 56 of Federal Highway Administration’s (FHWA’s) December 2011 “*Highway Traffic Noise: Analysis and Abatement Guidance*,” which is guidance for 23 CFR 772.This requirement is also stated in Section 4.2.2 of the 2020 CDOT *Noise Analysis and Abatement Guidelines* (NAAG).

Section 4.2.2 of the 2020 CDOT NAAG also states: “*If an existing barrier poses ongoing functionality or maintenance problems, it should be replaced with acceptable materials either as a part of the Type I highway project or as a state funded noise wall replacement project.*” This NAAG section contains additional applicable information about replacing existing noise walls with an in-kind noise wall, although most of it applies to Type I projects that include an existing noise wall, which this guidance document does not address.

In-kind means that the replacement noise wall will reduce noise as much as the original noise wall and does not refer to materials, alignment, or dimensions. One way to meet that would be to build a noise wall with the same dimensions as the original wall in the exact place. In practice, that might not be possible. Although it was common to build noise walls out of wood decades ago, this is generally no longer allowed except as in consultation with CDOT and FHWA. Noise walls are commonly made from concrete (cast-in-place or precast) and may be made of other materials, such as masonry blocks.

1. Applicability

This document applies to CDOT projects conceived to replace an old or failing noise wall with an in-kind, new noise wall so that the original noise reductions will effectively be maintained in perpetuity. Noise walls are walls that were built by CDOT on transportation right-of-way to reduce noise from transportation projects. Some walls have been built that may appear to be noise walls but were not built under 23 CFR 772 or with state funds and were not built to reduce noise. This guidance does not apply to those walls. For example, some walls that may appear to be noise walls were built for the T-Rex project on I-25 in south Denver as “committed walls,” not as noise abatement.

1. Guidance Steps

Use the following steps to determine whether the project meets Design Criteria, whether FHWA review is required, whether Noise Wall Analysis (i.e., modeling) or noise analysis (i.e., line-of-sight analysis) is required, and which memorandum template needs to be used to document the project.

**Step 1: Design Criteria Review**: Compare the Design Criteria in Section 4 to the project to determine if Design Criteria are met for the final design[[1]](#footnote-1) of the in-kind noise wall replacement and of the project. This will determine if FHWA review is required, whether modeling is required, and which memorandum template needs to be used.

Data for the existing noise wall (e.g., horizontal location, endpoints, and top-of-wall elevation) will be measured in the field at the beginning of the project. These measurements should be compared to as-built data (e.g., drawings), when available, so that replacement noise walls get compared to the noise wall that was built, rather than the wall as it exists today. For example, if the ground under the noise wall has shifted and changed the top-of-wall elevation, the proposed noise wall top-of-wall elevation should be compared to the as-built top-of-wall elevation rather than the current top-of-wall elevation. Another example is if an end panel had been removed to replace a panel in the middle of the noise wall but not been replaced itself, the endpoint is where the noise wall originally ended rather than where it currently ends. If as-built data is not available, the field measurements can be compared to other sources such as the noise wall final design, CDOT’s Online Transportation Information System (OTIS), and CDOT’s structural assets software: System for Inspection and Management of Structural Assets (SIMSA). The closest source to representing the as-built noise wall should be used.

Once data for proposed noise wall has been compared to the existing noise wall against the Design Criteria:

* 1. If Design Criteria 1 through 4 are met for the final design of a proposed replacement noise wall and project, noise analysis/modeling is not needed and FHWA review is not required. Go to Step 4 of Guidance Steps.
  2. If any Design Criteria 1 through 4 are not met for the final design of a proposed replacement noise wall and project, consider redesigning the noise wall and/or project such that it will meet Design Criteria 1 through 4.
     1. If such redesign is successful, see Step 1.A (above).
     2. If such redesign is not feasible and/or successful, analysis will be triggered (see Step 2 of Guidance Steps) and FHWA review is required. The analysis will be either line-of-sight or modeling.

**Step 2: Acceptable Deviations**: Deviations from Design Criteria 1 through 4 might be determined to be acceptable by CDOT and FHWA. If all such deviations are acceptable, noise analysis may be conducted via line-of-sight rather than Noise Wall Analysis (i.e., modeling). Generally, a noise wall design that deviates more than slightly from Design Criteria 1 through 4 will require a Noise Wall Analysis. This document contains the following limited guidance for what might constitute an acceptable deviation[[2]](#footnote-2):

1. Horizontal alignment: Shifting a noise wall closer to the roadway, which is the source of noise, or only slightly closer to receptors might be acceptable
2. Horizontal alignment: Shifting a noise wall more than five feet but building a wall with a higher top-of-wall elevation might be acceptable.
3. Top-of-wall elevation: Minor vertical deviations, such as the stepwise nature of panels between the existing and proposed top of wall elevations, that exceed 0.5 feet might be acceptable.

If any of the Design Criteria 1 through 4 are not met, the project can either:

* move forward with Noise Wall Analysis (Go to Step 3 of Guidance Steps) and document the project via the memorandum template in Appendix B or
* move forward with noise analysis via line-of-sight and submit a memorandum to FHWA using the template in Appendix C; if any deviations are not determined to be acceptable, a Noise Wall Analysis will be required.

The Appendix C memorandum will include the justification explaining why it is believed the deviation(s) from Design Criteria is/are acceptable and it must show that the line-of-sight is not broken, as specified in Design Criterion 5.

FHWA will determine with a CDOT noise specialist whether the deviation(s) is acceptable. This step might include revising the memorandum and/or changing the design and submitting a revised memorandum to FHWA. If deviations are ultimately determined to be unacceptable, a Noise Wall Analysis will be done as described in Step 3 of Guidance Steps.

**Step 3: Noise Wall Analysis**: If any of the Design Criteria 1 through 4 are not met and either no attempt is made to justify the deviations(s) or deviation(s) are determined to be unacceptable, as described in Step 2 of Guidance Steps, a Noise Wall Analysis needs to be done as described in Section 5. The proposed noise wall must function as well as the existing noise wall, as specified in Design Criterion 5.

**Step 4: Project Documentation and Communication**: The project file will include email(s) and memorandum(s) herein described. All emails will include the project subaccount number(s) and at least two ways to describe the existing and proposed noise walls, including a description of where the noise wall is located and the Structure ID (see “Noise Wall Identification” in Section 5.1 of this document). The location description should enable a person to find the wall online and identify which wall is being replaced. It should, at a minimum, include the roadway the noise wall is next to and either the nearest cross streets or one cross street and the direction the wall goes from there (e.g., north side of I-70, between Harlan Street and Eaton Street). Memorandum(s) will use template(s) provided in this guidance document as follows:

1. Appendix A – Use the “In-Kind Noise Wall Replacement Memorandum (Meets All Design Criteria Without Noise Analysis)” template if Design Criteria 1 through 4 are met for the final design of a proposed replacement noise wall and project.
2. Appendix B – Use the “In-Kind Noise Wall Replacement Memorandum (Noise Wall Modeling Shows Meets Noise Design Criterion 5)” template if any Design Criteria 1 through 4 are not met for the final design of a proposed replacement noise wall and the deviation(s) were either determined to be unacceptable (See Step 2 of Guidance Steps) or the project does not try to justify the deviation(s) and goes straight to modeling.
3. Appendix C – Use the “In-Kind Noise Wall Replacement Memorandum (Line-of-Sight Analysis Shows Meets Noise Design Criterion 5)” template if any Design Criteria 1 through 4 are not met for the final design of a proposed replacement noise wall and project and the project is seeking to justify the deviation(s) (See Step 2 of Guidance Steps).
4. If a project proposes to replace more than one noise wall, the project team determines whether to:
   1. Include all noise walls in one memorandum, which would use relevant sections pulled from all three of the Appendix’s A through C templates, as applicable. If noise analysis is required for any of the noise walls via either modeling or line-of-sight, the memorandum must be addressed to FHWA, as shown in the templates.
   2. Include a separate memorandum for multiple noise walls that meet each type of situation - following Appendix A, B and C templates, respectively.  A project could have up to three memoranda in this case.
   3. Provide one memorandum per noise wall, using the appropriate template for each.
5. If a project proposes to replace more than one noise wall and documents the project using more than one memorandum, as described in Part D of this step, each memorandum will explain that it covers only part of a project.
6. To use a template:
7. All red text (shown within {braces}) in the template are instructions to the user and should be deleted, including the braces.
8. Text highlighted in grey (shown within [brackets]) should be typed over with the correct text for the project. The grey highlight and brackets should be removed.
9. Editorial corrections should be made, if applicable. For example, if the template is written using a singular term that is plural for the project (or vice versa), change the text accordingly.
10. The templates do not address all potential situations. If the template does not address something encountered during the Noise Wall Analysis for a project, either consult with a CDOT noise specialist while preparing the memorandum or prepare the memorandum using best professional judgement and communicate to the CDOT noise specialist the alterations that were needed to best represent the project.

**Step 5: FHWA Review**: If a project memorandum needs to be reviewed by FHWA (i.e., must use Appendix B or C template), FHWA’s comments must be adequately (as determined by FHWA) addressed prior to “finalizing” it. The memorandum will be sent from the CDOT Environmental Project Manager to, at a minimum, an FHWA Area Engineer familiar with the project, an FHWA environmental staff member familiar with the CDOT noise program, the CDOT Noise Program Manager, and the appropriate CDOT Resident Engineer.

**Step 6: Design Changes**: Resources that influence noise wall design are listed in Appendix D. As the project goes through different levels of design, if any changes are made that affect whether Design Criteria are met or that affect factor(s) related to deviations that were previously determined to be acceptable, the project must repeat the evaluation beginning at the Design Criteria determination described in Step 1 of Guidance Steps.

**Step 7: Project memoranda**:

1. A “final” memorandum will be required for each level of design that requires a Design Criteria determination.
2. Retain each memorandum in the project file. This means the “final” of each is retained; drafts are not retained.
3. Memoranda will not indicate “draft” or “final;” they will be identified by date.
4. Each memorandum “final” version will have a unique memorandum date.
5. Each memorandum “final” version will include the date of the project design that is described in the memorandum and the date each noise wall design that is described in the memorandum.

**Step 8: Tracking Projects**: Submit all final (i.e., non-draft) memoranda to the CDOT Noise Program Manager. This person will track all in-kind noise wall replacement projects across Colorado in one place, including the rationale for any Design Criteria deviations that did not require modeling as well as deviations that were considered unacceptable.

1. Design Criteria

Of the following five Design Criteria, it may be possible for a project to deviate from one or more of the first four:

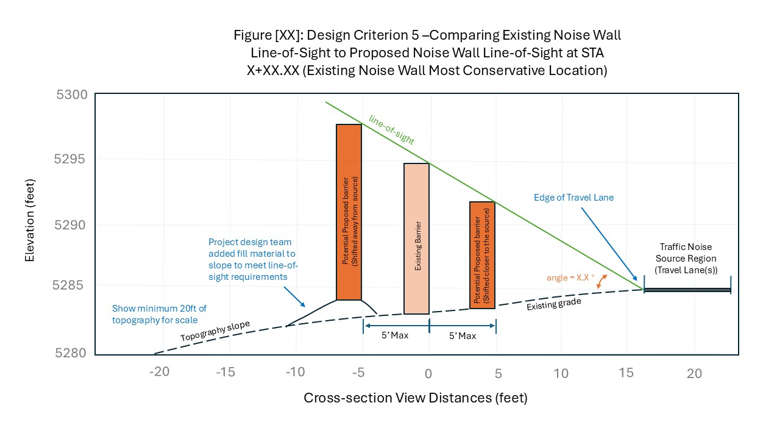
1. The proposed noise wall design maintains the horizontal alignment within 5.0 feet of the existing noise wall for the entire length of the wall.[[3]](#footnote-3)
2. The top-of-wall elevation of the proposed noise wall is no more than 0.5 feet below the existing top-of-wall elevation[[4]](#footnote-4) or it is at or above the existing top-of-wall elevation[[5]](#footnote-5).
3. The proposed noise wall may not have a gap at structures more than the gap in the existing noise wall at the time of its construction. In cases where there was and will be a gap,[[6]](#footnote-6) the proposed design must include details to address the gap/interface between the two structure(s). Overlapping walls may be used to address gaps, as described in Chapter 16 of the CDOT Roadway Design Guide. The method to address gaps shall be developed between CDOT and FHWA.
4. The endpoints (latitude and longitude) of the proposed noise wall will be at the same location as the existing noise wall, barring potential horizontal shifts described in Design Criterion 1, or the endpoints shall be further apart and thus more protective.
5. All proposed noise walls must function as well as the existing noise walls that are being replaced. This is shown by meeting one of the following three tests:
6. Noise walls that meet Design Criteria 1 through 4 can be assumed to meet Design Criterion 5 without noise wall analysis (i.e., modeling or line-of-sight analysis).
7. Noise walls that do not meet all four Design Criteria 1 through 4 but have an acceptable deviation(s) for any Design Criteria 1 through 4 that are not met can be assumed to meet Design Criterion 5 without Noise Wall Analysis (i.e., modeling). However, the project noise analysis needs to show that the line-of-sight between the travel lanes and receptors protected by the noise wall will not be broken. This is shown when the angle of the line from the edge of the nearest travel lane to the top of the proposed noise wall will be the same or greater than the angle of the line for the existing noise wall (see Section 6 for details on how to do this analysis).
8. Noise walls that do not meet all four Design Criteria 1 through 4 and do not have an acceptable deviation from every Design Criteria that is not met must be analyzed as described in the Noise Wall Analysis (see Section 5) and modeling must show that the proposed noise wall, compared to the existing noise wall, will not cause an increase of greater than 0.4 dB[[7]](#footnote-7) at any receptor location.
9. Noise Wall Analysis (Modeling)

A Noise Wall Analysis for an in-kind noise wall replacement project is similar to the analysis described in the CDOT NAAG. Where there are differences between the analysis described in the CDOT NAAG versus this document, this document prevails. If a situation arises not addressed in this section, consult with a CDOT noise specialist. Limited situations may warrant changes to this analysis, if such change(s) are acceptable by both a CDOT noise specialist and FHWA. Justifications for any analysis changes must be provided in the project memorandum.

1. Setting Up Analysis
2. **Noise Wall Identification**: Prior to being constructed, every noise wall is given a Structure identification number (ID). The Structure ID is composed of numbers and letters (e.g., N070A270014LRA). These IDs can be found at the System for Inspection and Management of Structural Assets (SIMSA) website (simsa.codot.gov) or in CDOT Online Transportation Information System (OTIS) MapView layer named “Noise Barriers.” Each existing and replacement noise wall will have unique Structure IDs. The Noise Wall Analysis can use additional names for noise walls (e.g., Wall A), but the memorandum must provide each Structure ID (e.g., “Wall A has Structure ID N070A270014LRA). Until a proposed noise wall has a Structure ID, “Structure ID TBD by Staff Bridge” can be used in the memorandum.
3. **Noise Wall Material**: The memorandum will indicate the material each existing and proposed noise wall is/will be made from (e.g., wood, precast concrete, cast-in-place concrete, brick, block, metal, fiberglass, plastic [transparent or opaque]) and whether each existing and proposed noise wall is/will be reflective or absorptive.
4. **Noise Model and Version**: Conduct an analysis using the current CDOT approved model for CDOT noise analyses. At the time this guidance was created, CDOT has approved the FHWA Traffic Noise Model (TNM), Version 2.5. CDOT will issue a memorandum when the use of TNM should shift from version 2.5 to 3. FHWA’s current version of TNM 3 is TNM 3.2, but FHWA is expected to release updates prior to CDOT’s approval of using TNM 3.
5. **Noise Study Zone**: Use a Noise Study Zone as defined in the CDOT NAAG, except as noted below. At the time this guidance was created, the Noise Study Zone is defined in Section 3.3 of the 2020 NAAG. Note the following:
   1. A project that consists solely of replacing a noise wall has project extents that begin and end at the ends of the noise wall.
   2. If more than one noise wall is being replaced with in-kind noise walls as part of a project, each noise wall has a separate Noise Study Zone, unless two or more noise walls are close enough to each other that their Noise Study Zones overlap.
   3. The Noise Study Zone does not extend in all directions from the roadway. Only receivers behind the noise wall are modeled. Traffic extends on the roadway either 300 or 500 feet beyond the noise wall, depending on the size of the Noise Study Zone.
   4. If the existing noise wall to be replaced is across the roadway from another existing noise wall, the portion of the noise wall that is not being replaced that is across from the noise wall that is being replaced should be included in the model. For example, if two noise walls are the same length, start at the same location (across the highway from each other), and are parallel to each other, both noise walls would be modeled in their entirety. However, if some of the noise wall that is not being replaced extends beyond the project limits, the portion extending beyond the project limit does not get modeled.
6. **Scenarios:** Model the existing condition, which includes the existing noise wall, and the design condition, which includes the proposed noise wall.
7. **Validation**: The project areas for in-kind noise wall replacement projects are small relative to traditional CDOT highway projects. It is not necessary to validate the model. Therefore, field noise measurements are not needed.
   1. Model Inputs
8. **Receivers**: Model all receptors that meet the following criteria: noise sensitive (i.e., Activity Categories A through E) and behind the existing noise wall (within 500 feet of the edge of the nearest travel lane for freeways and expressways[[8]](#footnote-8) or 300 feet for all other types of roads).
   1. Activity Category F and G land uses are not considered in this analysis.
   2. A receiver may represent more than one receptor, as described in Section 1.6 of the 2020 CDOT NAAG. A receptor will not be modeled by more than one receiver.
   3. “Benefitted” receptor and Date of Public Knowledge are terms that do not apply to this Noise Wall Analysis. Therefore, it does not matter whether receptors have changed (e.g., been built, rebuilt, or changed land use) since the noise wall was originally built.
9. **Modeled Roadways**: Generally, only the primary project roadway (i.e., the roadway that the noise wall is built along) will be modeled. An example of a potential exception is a noise wall that is near an intersection which has another roadway that is an important local traffic noise source. A CDOT noise specialist must approve modeling a roadway other than the primary roadway.
10. **Differences in How Roadways Were Modeled Between Scenarios**: Generally, there will not be differences in how the roadways are modeled between the existing and design year scenarios since the project will typically not affect the roadway. A CDOT noise specialist must approve modeling differences in the roadway between scenarios.
11. **TNM Objects and Elevations**: These are modeled in the same way as described in the CDOT NAAG.
12. **Wall Height, Length, Horizontal Distance From Roadway, Endpoints, and Top-of-Wall Elevation (existing and proposed):** The existing wall height, length, horizontal distance from roadway, endpoints, and top-of-wall elevation should be determined using the methods described in Step 1 of Section 3. A noise wall is generally not built along the entire length of the wall at the same grade, at the same horizontal distance from the roadway, with the same height, or at the same top elevation. The existing and proposed noise walls must be modeled accurately. Because panels of the replacement wall might be of different lengths than panels of the existing wall, the replacement wall might be longer than the existing wall. If the proposed noise wall will be shorter in length than the existing noise wall, a justification will be provided in the memorandum. Noise walls with shorter lengths might not be acceptable. FHWA and CDOT noise specialist comments need to be addressed.
13. **Pavement Type**: Although this analysis does not fall under 23 CFR 772, the original analysis that resulted in the existing noise wall did. Average pavement type must be used under Section 772.9(b) of 23 CFR 772. Therefore, use average pavement type in the model.
14. **Ground Type**: The model allows several ground types to be used as a default, including “lawn,” “pavement,” “field grass,” “hard soil,” and “loose soil.” The most appropriate choice should be used. If a project area has more than one ground type, the most significant area is used as the default and the lesser but still noteworthy areas (e.g., 20 percent or more) can be coded as different ground types as a TNM Object.
15. **Traffic Data:** Unlike with a 23 CFR 772 analysis, use the same traffic data in both models. Existing year traffic data should be used if it is available. Otherwise, use the best available traffic data.
    1. Model Outputs and Analysis Documentation
16. **Abatement Analysis, Design Criteria 1 to 4**: Noise walls for in-kind replacement projects are evaluated against Design Criteria (see Section 4). Design Criteria 1 through 4 consider the noise wall horizontal alignment, top-of-wall elevation, gaps between the proposed panel wall and bridge structure (if applicable), and wall endpoints.
17. **Abatement Analysis, Design Criterion 5**: The project memorandum will include a figure showing each receiver and a table that lists each receiver, the modeled noise level (existing and proposed), and the difference between them. Any increase must be 0.4 dB or less, as described in Design Criterion 5 (see Section 4).
18. **Abatement Analysis, 23 CFR 772**: Noise walls for in-kind replacement projects are not evaluated against feasibility and reasonableness criteria, as is done under 23 CFR 772. For example, a Benefited Receptor Survey is not conducted for in-kind replacement noise walls.
19. **Form 1209**: The Noise Abatement Evaluation Worksheet is not used, because in-kind noise wall replacements are not compared to feasibility and reasonableness criteria.
20. Line-of-Sight Noise Analysis

A line-of-sight noise analysis for an in-kind noise wall replacement project is not described in the CDOT NAAG and shall be done in accordance with this guidance document. If a situation arises not addressed in this section, consult with a CDOT noise specialist. Limited situations may warrant changes to this analysis, if such change(s) are acceptable by both a CDOT noise specialist and FHWA. Justifications for any analysis changes must be provided in the project memorandum.

1. Setting Up Analysis
2. **Number of line-of-sight lines**: Each noise wall being replaced by the project will have one line-of-sight analysis, which will have two or four line-of-sight lines: one for the existing noise wall and one for the proposed wall, at one or two locations, as described in the next paragraph. If two locations are used, each location will have two lines, so there would be four line-of-sight lines in the analysis.
3. **Location of line-of-sight lines**: Place the line-of-sight line at the most conservative location for the existing and proposed noise walls, which depends on factors such as topography. For example, if the elevation of the land adjacent to the noise wall increases, start the line where the edge of the closest through lane is closest to the existing noise wall. Separate lines are drawn for the existing and proposed noise walls. If the most conservative location of the existing noise wall is different than the most conservative location of the proposed noise wall, each set of two lines (existing and proposed noise walls) will begin at two different locations along the roadway.
4. **Start point of line-of-sight line**: Start the line-of-sight line at grade level (elevation of 0.0 feet above the roadway) at the edge of the closest through lane to the noise wall, including if the lane is an auxiliary lane. The line will not begin at turn lanes or ramps. The existing and proposed noise wall lines start at the same point for each location.
5. **End point of line-of-sight line**: The line-of-sight line ends at the top of the noise wall and is perpendicular to the road and noise wall. The existing and proposed noise wall lines can and likely will end at different points.
   1. Analysis Outputs and Analysis Documentation
6. **Abatement Analysis, Design Criteria 1 to 4**: Noise walls for in-kind replacement projects are evaluated against Design Criteria (see Section 4). Design Criteria 1 through 4 consider the noise wall horizontal alignment, top-of-wall elevation, gaps between the proposed panel wall and bridge structure (if applicable), and wall endpoints.
7. **Abatement Analysis, Design Criterion 5**: The project memorandum will include a figure showing both noise walls (existing and proposed) at the most conservative location, the noise source (edge of the nearest travel lane), and the line-of-sight lines between the noise source and each noise wall. If lines-of-sight are developed at two locations, each location will be shown. The angle of the proposed noise wall line-of-sight line must be at the same angle or greater than the existing noise wall line-of-sight line, as described in Design Criterion 5 (see Design Criteria in Section 4).
   1. Angles shall be reported and compared by using degrees (°) to the tenths decimal place[[9]](#footnote-9).
   2. To convert an angle from radians to degrees, use the following formula: Angle in Radians × 180°/π = Angle in Degrees
   3. The angle to be reported is the angle between the line-of-sight line (i.e., hypotenuse; also called the “c” side of a triangle) and the line on the ground between the noise source and the noise wall (i.e., the x-axis; also called the “b” side of a triangle).
8. **Analysis Documentation Example**: The following example figure shows the type of information that will be included in a project memorandum line-of-sight figure. It shows a cross section at a station location of the most conservative location for the existing noise wall. Figures in the project memorandum will only show two noise walls (existing and proposed). This example figure shows three noise walls to show that when a proposed noise wall is moved closer to the edge of travel lane, the wall can preserve the line-of-sight with a lower top-of-elevation versus a noise wall that is moved further from the edge of travel lane.



Appendix A

**Template**

**In-Kind Noise Wall Replacement Memorandum**

**(Meets ALL Design Criteria Without NOISE Analysis)**



Memorandum

|  |  |
| --- | --- |
| **TO:** | Project File |
| **FROM:**  **CC:** | [name of CDOT Engineer or CDOT Environmental Project Manager]  [name of FHWA Area Engineer], [name of FHWA Environmental Staff], [name of CDOT Noise Program Manager], [name of CDOT Engineer or CDOT Environmental Project Manager {whichever is not sending the memo}] {May also copy other staff, such as the environmental project manager and another CDOT noise specialist; the CDOT Noise Program Manager must be copied} |
| **DATE:** | [Date] |
| **SUBJECT:** | [Project Name] (Project Number [XXX###] and Subaccount Number [#####]:  In-kind noise wall replacement of existing noise wall (Structure ID [XXX###]) {e.g., N070A270014LRA; If this memo addresses more than one noise wall replacement, change “wall” to “walls” and list each existing noise wall Structure ID}: Project meets Design Criteria without noise analysis {Every noise wall listed here must meet all Design Criteria without any deviations.} |

{Template applicability: This memorandum template may only be used for a final project memorandum if the project meets all five Design Criteria without any deviations.}

## PROJECT OVERVIEW

Colorado Department of Transportation (CDOT) Region [number], under [Project Name] Project, plans to replace the existing noise wall, Structure ID [XXX###], at [project location] {Describe the project location, including the primary roadway and direction associated with the wall (e.g., WB I-70), City, and County} (see Figure 1). {If this memorandum addresses more than one noise wall replacement, change the first sentence to make it plural and provide the location information of each wall using one bullet for each noise wall. Move the Structure IDs so they are listed as part of the bullets. If the project has more than one noise wall and will address one or more noise walls in another memorandum, as described in Parts D and E of Step 4 of Section 3 of CDOT’s 2025 guidance document “In-Kind Noise Wall Replacement Guidelines and Memorandum Templates,” explain that in this paragraph in each project memorandum. Use consistent text in each project memorandum. Each project memorandum should include the Structure ID number for all noise walls being replaced by the project; indicate which noise walls are covered in detail by the memorandum; and list the date(s) of the other memorandum(s) that cover details of other noise walls being replaced by the project.}

CDOT and FHWA have agreed that in-kind noise wall replacement projects can be documented without noise wall analysis (i.e., modeling or line-of-sight analysis) if the replacement noise wall meets Design Criteria as defined in CDOT’s 2025 guidance document “*In-Kind Noise Wall Replacement Guidelines and Memorandum Templates*,” as summarized in this memorandum. This project meets all Design Criteria without any deviations and does not require noise wall analysis.

This memorandum is based on design files provided from [name of company]. The files were received on [date(s) received] {date(s) refers to when CDOT received the file(s)}. The project design that is described in this memorandum is dated [date of design] and is at [level of design {e.g., 60% design}]. The noise wall design that is described in this memorandum is dated [date of design] and is at [level of design {e.g., 60% design}]. {If the memorandum covers more than one noise wall and they have different dates and/or level of designs, change this sentence so that it uses bullets to provide the relevant information for each noise wall, with one bullet per noise wall.}

## EXISTING AND PROPOSED NOISE WALLS

{If there is more than one noise wall in the project, and this memorandum will address all of them, add the following sentence: “This project will replace [number] noise walls.” Then copy the rest of this section for each existing noise wall and add one title at the beginning of information about each wall, such as “Wall 1: [Structure ID].”}

Existing noise wall, Structure ID [XXX###] {If using shorter noise wall descriptions, such as “Wall 1,” add “(which is referred to as Wall 1 in this memorandum)” after the Structure ID}, was originally built as part of {Provide information about the project under which the wall was built, including the project name and, if known, the project number and subaccount number. If the project number and/or subaccount numbers are not known, state that.}. The project environmental decision document, a [type of environmental decision document] {i.e., signed Form 128, Finding of No Significant Impact, or Record of Decision} was signed on [date] {Provide the date the decision document was signed, using the exact date, if known. At a minimum, provide the year it was signed}. The noise wall was constructed in [year of construction] {Provide the year that the existing noise wall was built. If construction began in one year and was completed the following year, list the year in which construction began.} and is made out of [material type] {Provide the material that the existing noise wall is made out of}. {Provide as much of the information described in this paragraph as possible. If the information is unknown, refer to it and state that it is not known, but provide an estimate or guess, as applicable. For example, if the year of construction is not known but it is known that it was built by a specific year, it could be stated as “The year of construction is not known, although it is known that the existing noise wall was constructed by 1995.”}

The source of the following existing noise wall data is {either list the source here, if it is all from one source, or use this text: “provided for each data point below.” Sources of data, in their order of preference, are described in Step 1 of Section 3 of CDOT’s 2025 guidance document “*In-Kind Noise Wall Replacement Guidelines and Memorandum Templates*.” If more than one source of data was used to determine the values listed in the next four bullets, add the sources to the bullet list either via footnotes or within parenthesis, at the end of the bullet text.} The existing noise wall:

* is [number of feet] feet long, with endpoints at [latitude and longitude of both wall endpoints], {Be clear about which endpoint is which and state which coordinate system is being used.}
* ranges from [number of feet] to [number of feet] high, {The height should be rounded to the tenths place after the decimal.}
* has top-of-wall elevations that range from [x,xxx.x] to [x,xxx.x] feet above sea level, and {Provide the range in elevation above sea level to the tenths place; for example, “5,310.1 to 5,312.4 feet above sea level”}
* ranges from [number of feet] to [number of feet] from the edge of the nearest travel lane. {The distance should be rounded to the tenths place after the decimal.}

The noise wall needs to be demolished and rebuilt because [reason]. {Provide the reason that the existing noise wall is being rebuilt.} The proposed noise wall will be made of [material type]. {State the material(s) that the proposed noise wall will be made of.}

The source of following proposed noise wall data is {either list the source here, if it is all from one source, or use this text: “provided for each data point below.” If more than one source of data was used to determine the values listed in the next four bullets, add the sources to the bullet list either via footnotes or within parenthesis, at the end of the bullet text.} The proposed noise wall:

* will be [number of feet] feet long, with endpoints at [latitude and longitude of both wall endpoints], {Be clear about which endpoint is which and state which coordinate system is being used.}
* ranges from [number of feet] to [number of feet] high, {The height should be rounded to the tenths place after the decimal.}
* will have top-of-wall elevations that range from [x,xxx.x] to [x,xxx.x] feet above sea level, and {provide the range in elevation above sea level to the tenths place; for example, “5,310.3 to 5,312.5 feet above sea level”}
* will range from [number of feet] to [number of feet] from the edge of the nearest travel lane. {The distance should be rounded to the tenths place after the decimal.}

## DESIGN CRITERIA

This project meets all Design Criteria, as follows: {If this memorandum represents more than one noise wall, each of those noise walls must meet all Design Criteria. Change the text in this section to reflect that it applies to each noise wall by adding a sentence to the introduction for this section and then making changes as appropriate to reflect multiple noise walls are being discussed. For example, for Design Criteria 1, change “The …wall” to “Each…wall.” and refer to multiple figures (e.g., Figures 2a and 2b). It might be appropriate to report the comparison to Design Criteria for each noise wall as a separate list. In that case, there would be a list from 1 through 5 for each noise wall.}

1. The proposed noise wall design maintains the horizontal alignment within 5.0 feet of the existing noise wall for the entire length of the wall, as shown on Figure 2.
2. {Include one of the following two sentences, whichever is applicable, and delete the other sentence. Even if only part of the proposed top-of-wall is below the existing top-of-wall elevation but meets the Design Criteria, use the first sentence.} The top-of-wall elevation of the proposed noise wall is no more than 0.5 feet below the existing top-of-wall elevation for the entire length of the wall, as shown on Figure 3. OR The top-of-wall elevation of the proposed noise wall is at or above the existing top-of-wall elevation for the entire length of the wall, as shown on Figure 3.
3. {Include one of the following four choices, whichever is applicable, and delete the other three choices.} The existing noise wall is not adjacent to a structure, so Design Criterion 3 (related to connections to an adjacent structure) is not applicable. OR The existing noise wall is adjacent to a structure but there won’t be a gap between the proposed noise wall and structure, so Design Criterion 3 (related to connections to an adjacent structure) is not applicable. OR The existing noise wall is adjacent to a structure and there will be a gap between the proposed noise wall. However, the existing wall does not have and was not originally built with a connection to the structure(s), so Design Criterion 3 (related to connections to an adjacent structure) is not applicable. OR The existing noise wall is adjacent to a structure and there will be a gap between the proposed noise wall and structure, so the proposed design includes where the noise wall(s) interface with the structure(s) and addresses the gap(s) using a method developed between CDOT and FHWA. {If the fourth choice is applicable, add text here to explain the situation and how the project will meet Design Criterion 3. If adding a table and/or figure to the memorandum, add a reference to it/them here (e.g., “as shown on Figure 4”).}
4. {Include one of the following two sentences, whichever is applicable, and delete the other sentence.} The endpoints (latitude and longitude) of the proposed noise wall will be at the same location as the existing noise wall, barring potential horizontal shifts as described in Design Criterion 1, as shown in Figure 2.OR The endpoints (latitude and longitude) of the proposed noise wall will be further apart than the existing noise wall, and thus more protective, as shown in Figure 2.
5. Noise walls that meet Design Criteria 1 through 4 can be assumed to meet Design Criterion 5 (i.e., the proposed noise wall will function as well as the existing noise wall that is being replaced) without noise analysis (i.e., modeling or line-of-sight analysis).

**Figure 1: [Project Name] Project Vicinity**

{This figure shows the general vicinity of the project and the specific location (e.g., including nearby cross streets). Include the following, at a minimum, on this figure:

* Existing condition labeled roadway(s) associated with project
* Proposed Action project limits, clearly labeled
* Existing noise wall, clearly labeled
* Locator map (e.g., inset showing larger area with project area)
* Scale
* Compass rose or North arrow}

**Figure 2: Design Criteria 1 & 4: Existing and Proposed Noise Wall Horizontal Alignments and Endpoints**

{This figure shows the existing and proposed noise wall horizontal alignments, including endpoints, using a plan view (“birds’ eye” view). The source will typically be the design plan set. Include the following, at a minimum, on this figure:

* Existing condition labeled roadway(s) associated with project
* Existing and proposed noise wall alignments, clearly labeled
* Endpoints for each noise wall, clearly labeled
* Station numbers (at least two per wall, for reference)
* Cause(s) of deviation(s) from Design Criteria 1 and/or 4, if applicable (e.g., show utility lines that led to deviation)
* Scale
* Compass rose or North arrow}

**Figure 3: Design Criterion 2 – Profile View of Existing and Proposed Noise Wall Top-of-Wall Elevation**

{This figure shows the existing and proposed noise walls using a profile view (“side” view, facing the front of the wall). The source will typically be the design plan set. It must be clear where the top-of-elevation of the proposed noise wall is in relation to the top-of-elevation of the existing noise wall. Include the following, at a minimum, on this figure:

* Overlaid existing and proposed noise walls (entire noise walls, section-by-section), clearly labeled
* Use different colors and/or types of line to make clear which noise wall is existing and which is proposed; include a key or label the top-of-elevation lines so it is clear which is which
* The x-axis has station numbers representing feet (e.g., 2+85). The y-axis has wall elevations in feet (e.g., 5,200 feet)
* Cause(s) of deviation(s) from Design Criteria 2, if applicable (e.g., show utility lines that led to deviation)
* If all the information required to be on this figure cannot legibly fit on one page/one figure, create as many figures as needed and number them 3A, 3B, 3C, etc. and include a Figure 3 that is "zoomed out" and that shows boundaries of Figure 3A, 3B, 3C, etc.}
* Scale
* Compass rose or North arrow}

Appendix B

**TEmplate**

**In-Kind Noise Wall Replacement Memorandum**

**(****NOISE WALL MODELING SHOWS MEETS NOISE Design CriteriON 5)**



Memorandum

|  |  |
| --- | --- |
| **TO:** | [name of FHWA Area Engineer], [name of FHWA Environmental Staff] {Project file must show that FHWA signed off on this memo; this can be done via email} |
| **FROM:**  **CC:** | [CDOT Environmental Project Manager]  [name of CDOT Noise Program Manager], [CDOT Resident Engineer], Project File {May also copy other staff, e.g., CDOT engineer, CDOT project manager, and/or another CDOT noise specialist. The CDOT Noise Program Manager must be copied.} |
| **DATE:** | [Date] |
| **SUBJECT:** | [Project Name] (Project Number [XXX###] and Subaccount Number [#####]: In-kind Noise Wall Replacement of Existing Noise Wall (Structure ID [XXX###]) {e.g., N070A270014LRA; If this memo addresses more than one noise wall replacement, change “wall” to “walls” and list each existing noise wall Structure ID }: Project has Noise Wall Analysis (i.e., modeling) |

{Template applicability: This memorandum template, which documents noise modeling analyses, may only be used for a final project memorandum if the decibel noise reduction requirement of Design Criterion 5 is met.}

## PROJECT OVERVIEW

Colorado Department of Transportation (CDOT) Region [number], under [Project Name] Project, plans to replace the existing noise wall, Structure ID [XXX###], at [project location] {Describe the project location, including the primary roadway and direction associated with the wall (e.g., WB I-70), City, and County} (see Figure 1). {If this memorandum addresses more than one noise wall replacement, change the first sentence to make it plural and provide the location information of each wall using one bullet for each noise wall. Move the Structure IDs so they are listed as part of the bullets. If the project has more than one noise wall and will address one or more noise walls in another memorandum, as described in Parts D and E of Step 4 of Section 3 of CDOT’s 2025 guidance document “In-Kind Noise Wall Replacement Guidelines and Memorandum Templates,” explain that in this paragraph in each project memorandum. Use consistent text in each project memorandum. Each project memorandum should include the Structure ID number for all noise walls being replaced by the project; indicate which noise walls are covered in detail by the memorandum; and list the date(s) of the other memorandum(s) that cover details of other noise walls being replaced by the project.}

CDOT and FHWA have agreed that in-kind noise wall replacement projects shall be documented with Noise Wall Analysis (i.e., modeling) if any Design Criteria 1 through 4 are not met and the project either did not conduct or failed a line-of-sight analysis. Design Criteria and noise analysis requirements are described in CDOT’s 2025 guidance document “*In-Kind Noise Wall Replacement Guidelines and Memorandum Templates.*” This project meet(s) Design Criteria [# of Design Criteria that is/are met] but does not meet Design Criteria [# of Design Criteria that is/are not met]{Note that Design Criterion 5 must be met; it does not have any acceptable deviations}. Therefore, a Noise Wall Analysis was conducted for the project. It is documented in this memorandum and shows that the proposed noise wall will function as well as the existing noise wall that is being replaced.

This memorandum is based on design files provided from [name of company]. The files were received on [date(s) received] {date(s) refers to when CDOT received the file(s)}. The project design that is described in this memorandum is dated [date of design] and is at [level of design {e.g., 60% design}]. The noise wall design that is described in this memorandum is dated [date of design] and is at [level of design {e.g., 60% design}]. {If the memorandum covers more than one noise wall and they have different dates and/or level of designs, change this sentence so that it uses bullets to provide the relevant information for each noise wall, with one bullet per noise wall.}

## EXISTING AND PROPOSED NOISE WALLS

{If there is more than one noise wall, add the following sentence: “This project will replace [number] noise walls.” Then copy the rest of this section for each existing noise wall and add one title at the beginning of information about each wall, such as “Wall 1: [Structure ID].”}

Existing noise wall, Structure ID [XXX###] {If using shorter noise wall descriptions, such as “Wall 1,” add “(which is referred to as Wall 1 in this memorandum)” after the Structure ID}, was originally built as part of {Provide information about the project under which the wall was built, including the project name and, if known, the project number and subaccount number. If the project number and/or subaccount numbers are not known, state that.}. The project environmental decision document, a [type of environmental decision document] {i.e., signed Form 128, Finding of No Significant Impact, or Record of Decision} was signed on [date] {Provide the date the decision document was signed, using the exact date, if known. At a minimum, provide the year it was signed}. The noise wall was constructed in [year of construction] {Provide the year that the existing noise wall was built. If construction began in one year and was completed the following year, list the year in which construction began.} and is made of [material type] {Provide the material that the existing noise wall is made out of}. {Provide as much of the information described in this paragraph as possible. If the information is unknown, refer to it and state that it is not known, but provide an estimate or guess, as applicable. For example, if the year of construction is not known but it is known that it was built by a specific year, it could be stated as “The year of construction is not known, although it is known that the existing noise wall was constructed by 1995.”}

The source of existing noise wall data is {either list the source here, if it is all from one source, or use this text: “provided for each data point below.” Sources of data, in their order of preference, are described in Step 1 of Section 3 of CDOT’s 2025 guidance document “*In-Kind Noise Wall Replacement Guidelines and Memorandum Templates*.” If more than one source of data was used to determine the values listed in the next four bullets, add the sources to the bullet list either via footnotes or within parenthesis, at the end of the bullet text.} The existing noise wall:

* is [number of feet] feet long, with endpoints at [latitude and longitude of both wall endpoints], {Be clear about which endpoint is which and state which coordinate system is being used.}
* ranges from [number of feet] to [number of feet] high, {The height should be rounded to the tenths place after the decimal.}
* has top-of-wall elevations that range from [x,xxx.x] to [x,xxx.x] feet above sea level, and {Provide the range in elevation above sea level to the tenths place; for example, “5,310.1 to 5,312.4 feet above sea level”}
* ranges from [number of feet] to [number of feet] from the edge of the nearest travel lane. {The distance should be rounded to the tenths place after the decimal.}

The noise wall needs to be demolished and rebuilt because [reason]. {Provide the reason that the existing noise wall is being rebuilt.} The proposed noise wall will be made of [material type]. {State the material(s) that the proposed noise wall will be made of.}

The source of the following proposed noise wall data is {either list the source here, if it is all from one source, or use this text: “provided for each data point below.” If more than one source of data was used to determine the values listed in the next four bullets, add the sources to the bullet list either via footnotes or within parenthesis, at the end of the bullet text.} The proposed noise wall:

* will be [number of feet] feet long, with endpoints at [latitude and longitude of both wall endpoints], {Be clear about which endpoint is which and state which coordinate system is being used.}
* ranges from [number of feet] to [number of feet] high, {The height should be rounded to the tenths place after the decimal.}
* will have top-of-wall elevations that range from [x,xxx.x] to [x,xxx.x] feet above sea level, and {provide the range in elevation above sea level to the tenths place; for example, “5,310.3 to 5,312.5 feet above sea level”}
* will range from [number of feet] to [number of feet] from the edge of the nearest travel lane. {The distance should be rounded to the tenths place after the decimal.}

## DESIGN CRITERIA

Of Design Criteria 1 through 4, the project meets [provide the applicable number(s)] but does not meet [provide the applicable number(s)], as follows: {If this memorandum represents more than one noise wall, change the text in this section so that it applies to each noise wall separately (e.g., the introductory sentence would be repeated for each noise wall and there would be a list from 1 through 5 for each noise wall.)}

1. {Include one of the following two sentences, whichever is applicable, and delete the other sentence.} Meets: The proposed noise wall design maintains the horizontal alignment within 5.0 feet of the existing noise wall for the entire length of the wall, as shown on Figure 2. OR Does Not Meet: The proposed noise wall design does not maintain the horizontal alignment within 5.0 feet of the existing noise wall for the entire length of the wall, as shown on Figure 2 and described in Table [XX {for DC1}].
2. {Include one of the following two sentences, whichever is applicable, and delete the other sentence.} Meets: For the entire length of the wall, the top-of-wall elevation of the proposed noise wall is no more than 0.5 feet below the existing top-of-wall elevation or it is at or above the existing top-of-wall elevation, as shown on Figure 3 and Table [XX {for DC2}]. OR Does Not Meet: The top-of-wall elevation of the proposed noise wall is more than 0.5 feet below the existing top-of-wall elevation for [the entire OR part of the] {Keep the applicable text and delete the other option} length of the wall, as shown on Figure 3 and Table [XX {for DC2}]. {Include Table [XX {for DC2}] if any proposed sections are lower than the corresponding existing noise wall section, even if the noise wall meets Design Criterion 2. If Table [XX {for DC2}] does not need to be included, remove the reference to it in this paragraph.}
3. {Include one of the following four choices, whichever is applicable, and delete the other three choices.} Meets/Not Applicable: The existing noise wall is not adjacent to a structure, so this Design Criterion is not applicable. OR Meets/Not Applicable: The existing noise wall is adjacent to a structure, but there won’t be a gap between the proposed noise wall and structure, so this Design Criterion is not applicable. OR Meets/Not Applicable: The existing noise wall is adjacent to a structure, but the existing noise wall does not have and was not originally built with a connection to the adjacent structure(s), so this Design Criterion is not applicable. OR Meets: The existing noise wall is adjacent to a structure and there will be a gap between the proposed noise wall and structure, so the proposed design includes where the noise wall interfaces with the structure(s) and addresses the gaps. The method to address gaps was developed between CDOT and FHWA, as described in this memorandum in the section “Design Criterion 3 Discussion.” [A table and/or figure related to this Design Criterion may be included in the memorandum but are not required. If including one or both, refer to them by adding “as shown in Figure (XX, for DC3) and/or Table (XX, for DC3).”]}
4. {Include one of the following three sentences, whichever is applicable, and delete the other sentences.} Meets: The endpoints (latitude and longitude) of the proposed noise wall will be at the same location as the existing noise wall, barring potential horizontal shifts described in Design Criterion 1, as shown on Figure 2. OR Meets: The endpoints (latitude and longitude) of the proposed noise wall will be further apart than the existing noise wall endpoints, and thus more protective, as shown on Figure 2. OR Does Not Meet: The endpoints (latitude and longitude) of the proposed noise wall will be closer together than the existing noise wall endpoints, and thus less protective, as shown on Figure 2.
5. {Note that Design Criterion 5 must be met; it does not have any acceptable deviations}All proposed noise walls must function as well as the existing noise walls that are being replaced. For this project’s noise wall(s), this is shown by meeting the following test: Use modeling to show that the proposed noise wall, compared to the existing noise wall, will not cause an increase of greater than 0.4 dB at any receptor location. The maximum noise increase caused at any receptor due to the proposed noise wall will be [XX.X] dB, as shown in Table [XX {for DC5}].

## DESIGN CRITERION 3 DISCUSSION

{If this Design Criterion is not applicable to the project, this section heading and this text can be deleted. If this Design Criterion is applicable, describe the method used to address gaps and show that it was developed between CDOT and FHWA. At a minimum, explain how this Design Criterion is or is not being met. If the Design Criterion is not being met, provide the justification for not meeting it. Plan sheets showing how the Design Criterion is or is not met can be included and might be requested by CDOT and/or FHWA. Refer to any tables and/or figures that were developed and included in this memorandum to address this Design Criterion.}

## NOISE WALL ANALYSIS

The noise analysis includes identifying the Noise Study Zone, identifying the land uses within the Noise Study Zone, inputting several parameters into the noise model, running the model, and documenting the modeling outputs. These steps are described in this section.

### Noise Study Zone Identification

The Noise Study Zone is as described in the CDOT NAAG, except as noted in Section 5.1 of CDOT’s 2025 guidance document “*In-Kind Noise Wall Replacement Guidelines and Memorandum Templates.*” One difference is that the Noise Study Zone only extends in the direction of the noise wall and receptors behind the noise wall that is being replaced. {If the Noise Study Zone extends to include a noise wall across the roadway, describe that here.} {Include one of the following three sentences. The other two sentences should be deleted, as applicable.} The Noise Study Zone for this project extends 500 feet from the proposed edge of travel lanes throughout the project extent, as shown on Figure [**XX** {for DC5}]. {OR} The Noise Study Zone for this project extends 300 feet from the proposed edge of travel lanes throughout the project extent, as shown on Figure [**XX** {for DC5}]. OR The Noise Study Zone for this project extends 500 feet from the proposed edge of travel lanes of freeways or expressways and 300 feet for other types of roads, as shown on Figure [**XX** {for DC5}]. {(In some cases, the Noise Study Zone may extend beyond 300 or 500 feet, as described in Section 3.3 of the CDOT NAAG. If so, consider discussing the Noise Study Zone boundary with a CDOT noise specialist prior to submitting the noise report. If the Noise Study Zone extends beyond 300 or 500 feet, revise this section to state that and provide an explanation and justification of why it was extended.)}

### Land Use Identification

The project has [##] {state the total number of receivers} receivers, as listed in Table [XX, for DC5] and shown in Figure [XX {for DC5}]. They were modeled in the existing condition and design year scenarios. The receivers are in the following Activity Categories {If all the receivers are in the same Activity Category, replace the text “The receivers are in…Categories” and bullets with “The receivers are all Activity Category [XX].”}:

* Activity Category [X]: [##] receivers representing [##] receptors
* Activity Category [X]: [##] receivers representing [##] receptors

### TNM Model Inputs

The noise model software being used on this project was TNM Version 2.5. {(TNM 3.0 was released in February 2020. CDOT will issue a memorandum when the use of TNM should shift from version 2.5 to 3. If Version 3 is used, change the version number and month/year model was approved for use.)} It was used to analyze existing condition ([existing year]) and design year ([design year]) noise levels. As part of the analysis, the model calculated noise levels at receivers that are in the Noise Study Zone. Each receiver represented one or more receptors. {(If each receiver only represented one receptor, delete “or more” and change “receptors” to “receptor.”)} Modeling results represent predicted traffic conditions during worst-hour noise periods. {(If project traffic volumes exceeded those in Table 3 of the CDOT NAAG, also include the following sentence: “Because estimated traffic volumes from the [existing conditions OR design year] project traffic analysis exceeded the volumes listed in Table 3 of the CDOT NAAG, Table 3 volumes were used.)} Table [## {for inputs}] describes model inputs and methods.

### TNM Results

Modeled noise levels for the existing condition and design year scenarios are shown in Table [XX {for DC5}]. These results show that the proposed noise wall, compared to the existing noise wall, will not cause an increase of greater than 0.4 dBA at any receptor location. Figure [XX {for DC5}] shows where noise levels will increase and/or decrease as a result of the proposed noise wall replacement.

## TABLES AND FIGURES

**Table [XX** {for DC1}**]: Design Criterion 1 - Comparing Horizontal Alignment by Noise Wall Sections** {Only include this table if Design Criterion is not met by at least one section of the noise wall and only describe sections that do not meet it.}

|  |  |  |
| --- | --- | --- |
| **Station Range (feet)** | **Horizontal Change by Station Range (feet)** | **Direction of Horizontal Shift in Relation to Noise Source [Roadway** {Provide road name and direction}**]** |
| [###] - [###] | [##.#] - [##.#] | [Away From] {OR} [Towards] |
| [###] - [###] | [##.#] - [##.#] | [Away From] {OR} [Towards] |

{Information for table:

1. Station Range: Example of how to list station ranges: 2+85 – 3+30.
2. List separate station ranges for each of the following types of contiguous sections:
   1. Sections shifting horizontal alignment between 5.1 to 10.0 feet away from noise source (roadway)
   2. Sections shifting horizontal alignment more than 10.0 feet away from noise source (roadway)
   3. Sections shifting horizontal alignment between 5.1 to 10.0 feet towards noise source (roadway)
   4. Sections shifting horizontal alignment more than 10.0 feet towards noise source (roadway)
3. Horizontal changes should be reported in feet using one decimal place.
4. Horizontal changes are reported per station range either as distinct distances if a portion of the noise wall is parallel to the roadway (e.g., 5.2) or a range of distances for portions of the noise wall that are not parallel to the roadway (e.g., 5.1 – 9.7), as appropriate.
5. Replace [Roadway] in the header of the right-most column with the name of the roadway that the noise wall was built to reduce noise from and the direction of the roadway that is closest to the noise wall (e.g., EB I-70, WB East Hampden Ave).
6. For each station range, select the correct direction of horizontal shift (“Away From” or “Towards”) in relation to the noise source, which is the roadway along which the noise wall was built. Delete the other text on the row.
7. Rows should be added or removed, as needed.}

**Table [XX** {for DC2}**]: Design Criterion 2 - Comparing Top-of-Wall Elevations by Noise Wall Sections** {Only include this table if any proposed sections are lower than the corresponding existing noise wall section, even if the noise wall meets Design Criterion 2. Only describe proposed sections that are lower than the corresponding existing noise wall section.}

|  |  |  |
| --- | --- | --- |
| **Station Range (feet)** | **Vertical Change for Top-of-Wall Elevation by Station Range (feet)** | **Meets Design Criterion 2** |
| [###] - [###] | [##.#] - [##.#] | [Yes] {OR} [No] |
| [###] - [###] | [##.#] - [##.#] | [Yes] {OR} [No] |

{Information for table:

1. Station Range: Example of how to list station ranges: 2+85 – 3+30.
2. List separate station ranges for each of the following types of contiguous sections:
   1. Sections shifting proposed top-of-wall elevation between 0.1 to 0.5 feet lower than existing top-of-wall elevation; this meets Design Criterion 2
   2. Sections shifting proposed top-of-wall elevation between 0.6 to 1.0 feet lower than existing top-of-wall elevation; this does not meet Design Criterion 2
   3. Sections shifting proposed top-of-wall elevation more than 1.0 feet lower than existing top-of-wall elevation; this does not meet Design Criterion 2
3. Vertical changes should be reported in feet using one decimal place.
4. Vertical changes are reported per station range either as distinct distances if a portion of the noise wall maintains the same vertical change when comparing the existing to the proposed noise wall (e.g., 0.1) or a range of distances for portions of the noise wall that do not maintain the same vertical change when comparing the existing to the proposed noise wall (e.g., 0.6 – 0.9), as appropriate.
5. For each station range, indicate whether the vertical change for each station range meets Design Criterion 2, as “Yes” or “No.” Delete the other text on the row.
6. Rows should be added or removed, as needed.}

**Table [XX** {for inputs}**]: TNM Model Inputs and Methods**

|  |  |
| --- | --- |
| Noise Sensitive Receptors | Noise sensitive receptors are defined according to Table 1 of the 2020 CDOT NAAG. Receivers (modeled points) have been selected to represent these receptors within the Noise Study Zone. |
| Receivers | Receivers are listed in Table [XX {for noise levels}] and shown on Figure [XX, for noise levels]. |
| Modeled Roadways | The following roadways were modeled {if only one road is modeled, remove the bullets and revise this sentence to be singular}:   * [XXXXX] * [XXXXX] |
| Differences in Models Between Alternatives | {Describe differences between alternatives. If the only difference is that the noise wall is different, state that and say what types of things are different (e.g., horizontal alignment, top-of-wall elevation, endpoints, height), without going into detail about the differences.} |
| TNM Objects and Elevations | The following objects were modeled: [terrain lines, buildings modeled as building rows, buildings modeled as noise barriers, tree zones, and ground zones]. {OR} The only objects that were modeled were receivers and roadways. The Noise Study Zone does not contain any features that would affect noise to a degree that they needed to be included in the model. {Use text from one of the two options provided. If any objects besides buildings were modeled as noise barriers, such as retaining walls or vertical rock face cut slopes, include that in the list of objects that were modeled. If at least one type of object was modeled besides receivers and roadways, use the first option and tailor the list of modeled objects that is highlighted in grey so that it is correct for the project.} |
| Existing Noise Barrier | The Noise Study Zone does not contain any existing noise barriers other than the noise wall that is being replaced. {OR} {Describe noise barriers that already exist within the Noise Study Zone, if applicable, including the location, material, height, and length. State if the noise barrier will be impacted by the project, and if so, how}. {Choose an option and delete the other option.} |
| Modeled Pavement Type | Average |
| Default Ground Type | Lawn {OR} [XXXXX] {Choose an option and delete the other option. If “lawn” wasn’t used as the default ground type, identify the ground type used and provide the justification for using it.} |
| Traffic Data (See Appendix B) | * Roadway coordinates generated [source of coordinates {For example, from CAD or aerial photographs}] * Traffic volumes are from [source] and are for year [year] * Vehicle mix(es) is/are from [source] and are for year [year] * [Basis for identifying traffic noise worst-hour] |

**Table [XX** {for DC5}**]: Modeled Noise Levels Comparing Existing Noise Wall to Proposed Noise Wall**

| Receiver ID | Receiver Description | Activity Category / CDOT NAC (dBA) | Number of Receptors Represented by Receiver | Existing  Wall ([year]) Leq (dBA) | Proposed Wall ([year]) Leq (dBA) | Proposed Change From Existing(dB) | Proposed Wall Meets Design Criterion? (Yes or No) |
| --- | --- | --- | --- | --- | --- | --- | --- |
| [XXX###] | [XXXXXX] | [X / ##] | [#] | [##.#] | [##.#] | [+/-#.#] | [XXXX] |
| [XXX###] | [XXXXXX] | [X / ##] | [#] | [##.#] | [##.#] | [+/-#.#] | [XXXX] |
| [XXX###] | [XXXXXX] | [X / ##] | [#] | [##.#] | [##.#] | [+/-#.#] | [XXXX] |

{Information for table:

1. Receiver Description: Description and associated figure combined must be detailed enough to be able to find the receiver location outside this memorandum and to determine if the appropriate number of receptors per receiver were assigned. For example, addresses can be provided for single-family homes; apartment complexes can be named (e.g., White Tree Townhomes); and non-residential receptors should include a name (e.g., name of school or business) and/or type of receptor (e.g., pool, grill, picnic table) (e.g., Receiver Description could be “pool at Heartbreak Hotel”).
2. Noise levels should be reported using one decimal place.
3. Although the example text for column “Proposed Change From Existing” includes a plus sign (+), it is not necessary to include a plus sign if the noise level increases. Include a negative sign (-) if noise levels decrease from the existing condition to the proposed condition.
4. If more space is needed, either format the page so this table is landscape and/or break the table into more than one table. If splitting up the table horizontally, include the “Receiver ID” and “Receiver Description” columns in each table.
5. Every receiver must meet Design Criterion 5.

**Figure 1 - [Project Name] Project Vicinity**

{This figure shows the general vicinity of the project and the specific location (e.g., including nearby cross streets). Include the following, at a minimum, on this figure:

* Existing condition labeled roadway(s) associated with project
* Proposed Action project limits, clearly labeled
* Existing noise wall, clearly labeled
* Locator map (e.g., inset showing larger area with project area)
* Scale
* Compass rose or North arrow}

**Figure 2 – Design Criteria 1 & 4: Existing and Proposed Noise Wall Horizontal Alignments and Endpoints**

{This figure shows the existing and proposed noise wall horizontal alignments, including endpoints, using a plan view (“birds’ eye” view). The source will typically be the design plan set. Include the following, at a minimum, on this figure:

* Existing condition labeled roadway(s) associated with project
* Existing and proposed noise wall alignments, clearly labeled
* Endpoints for each noise wall, clearly labeled
* Station numbers (at least two per wall, for reference)
* Cause(s) of deviation(s) from Design Criteria 1 and/or 4, if applicable (e.g., show utility lines that led to deviation)
* Scale
* Compass rose or North arrow}

**Figure 3: Design Criterion 2 – Profile View of Existing and Proposed Noise Wall Top-of-Wall Elevation**

{This figure shows the existing and proposed noise walls using a profile view (“side” view, facing the front of the wall). The source will typically be the design plan set. It must be clear where the top-of-elevation of the proposed noise wall is in relation to the top-of-elevation of the existing noise wall. Include the following, at a minimum, on this figure:

* Overlaid existing and proposed noise walls (entire noise walls, section-by-section), clearly labeled
* Use different colors and/or types of line to make clear which noise wall is existing and which is proposed; include a key or label the top-of-elevation lines so it is clear which is which
* The x-axis has station numbers representing feet (e.g., 2+85). The y-axis has wall elevations in feet (e.g., 5,200 feet)
* Cause(s) of deviation(s) from Design Criteria 2, if applicable (e.g., show utility lines that led to deviation)
* If all information required to be on this figure cannot legibly fit on one page/one figure, create as many figures as needed and number them 3A, 3B, 3C, etc. and include a Figure 3 that is "zoomed out" and that shows boundaries of Figure 3A, 3B, 3C, etc.}
* Scale
* Compass rose or North arrow}

**Figure 4: Design Criterion 2 – Cross Section View of Existing and Proposed Noise Wall Top-of-Wall Elevation at Station [###]**

{This figure may be requested by FHWA and/or CDOT if the noise wall base elevation shifts along a sloped topography between the existing and proposed noise walls. This figure shows the existing and proposed noise walls using a cross-section view (“side” view, facing the side of the wall). The source will typically be the design plan set. It must be clear where the top-of-elevation of the proposed noise wall is in relation to the top-of-elevation of the existing noise wall. If including the figure, add a reference to it in the memorandum text. Include the following, at a minimum, on this figure:

* Cross view of existing noise wall alignment and proposed noise wall alignment at a specific station number, clearly labeled; identify which station number the figure represents in the figure title
* A line indicating topography of wall base elevation for existing and proposed noise walls; it should extend from at least 20 feet beyond the noise wall that is furthest from the road to the edge of the nearest travel lane
* Label the travel lane and indicate that it is the noise source
* Use different colors and/or types of line to make clear which noise wall is existing and which is proposed; include a key or label the walls so it is clear which wall is existing and which is proposed
* X-axis: Units of feet that show the distance between the existing and proposed noise wall
* Y-axis: Units of feet that show noise wall elevations (e.g., 5,200 feet)
* Indicate the distance between the existing and proposed noise walls on the figure by listing the distance with a double-headed arrow between the walls (e.g., 🡨 5.5 feet 🡪)
* Cause(s) of deviation(s) from Design Criteria 2, if applicable (e.g., show utility lines that led to deviation)
* Scale

If top-of-wall elevations need to be shown for more than one station number, create as many figures as necessary. Figures may use a continuing numbering system (e.g., if the first figure is Figure 4, the next could be Figures 5, 6, 7, etc.) or they can use a sub-set numbering system (e.g., figures could be Figure 4A, 4B, 4C, etc.).

**Figure [XX** {for DC3}**]: Design Criterion 3 – Addressing the Gap Between the Proposed Panel Wall and Bridge Structure**

{This figure shows the connection point between the existing and proposed noise wall with the structure, using a plan view (“birds’ eye” view). The source will typically be the design plan set. If providing a figure related to Design Criterion 3, include the following, at a minimum, on this figure:

* Existing and proposed connection point, clearly labeled
* Cause(s) of deviation(s) from Design Criterion 3, if applicable
* Scale
* Compass rose or North arrow

If additional figure(s) are needed, they may be added. For example, an exhibit showing a project-special treatment might be included as a separate figure.}

**Figure** [**XX** {for DC5}]**: Design Criterion 5 – Receivers and Changes in Noise Levels behind Noise Wall (Comparing Existing Noise Wall to Proposed Noise Wall)**

{Include the following, at a minimum, on this figure:

• Roadway(s) associated with project; include names of roadways that were modeled

• Noise Study Zone boundary, clearly labeled or identified in figure key

• Receiver locations for Activity Categories A through E, labeled with Receiver IDs. Use a way to distinguish between receivers where noise behind the proposed wall would be louder than noise behind the existing wall (e.g., a key that uses one shape or color to denote louder versus the same or quieter). If using different colors, it would be helpful to use a dark and light color that can be distinguished when printing the document in black and white).

• Existing and proposed noise barriers; clearly labeled or identified in figure key

• Scale (at a minimum, include 300 feet and/or 500 feet on the scale, as appropriate, to match the distance(s) to the Noise Study Zone)

• Compass rose or North arrow

Information for figure:

If all the information required to be on this figure cannot legibly fit on one page/one figure, create as many figures as needed and number them [XX]A, [XX]B, [XX]C, etc. Consider including a Figure [XX] that is “zoomed out” and that shows boundaries of Figure [XX]A, [XX]B, [XX]C, etc.}

Appendix C

**TEmplate**

**In-Kind Noise Wall Replacement Memorandum**

**(LINE-OF-SIGHT ANALYSIS SHOWS MEETS NOISE Design CriteriON 5)**



Memorandum

|  |  |
| --- | --- |
| **TO:** | [name of FHWA Area Engineer], [name of FHWA Environmental Staff] {Project file must show that FHWA signed off on this memo; this can be done via email} |
| **FROM:**  **CC:** | [CDOT Environmental Project Manager]  [name of CDOT Noise Program Manager], [CDOT Resident Engineer], Project File {May also copy other staff, e.g., CDOT engineer, CDOT project manager, another CDOT noise specialist. The CDOT Noise Program Manager must be copied.} |
| **DATE:** | [Date] |
| **SUBJECT:** | [Project Name] (Project Number [XXX###] and Subaccount Number [#####]: In-kind Noise Wall Replacement of Existing Noise Wall (Structure ID [XXX###]) {e.g., N070A270014LRA; If this memo addresses more than one noise wall replacement, change “wall” to “walls” and list each existing noise wall Structure ID }: Project has noise analysis (i.e., line-of-sight) |

{Template applicability: This memorandum template, which documents line-of-sight analyses, may be used for a draft project memorandums if the project meets the line-of-sight angle requirement of Design Criterion 5. However, it can only be used for a final project memorandum if the angle requirement is met and if deviations from Design Criteria 1 through 4 are ultimately determined to be acceptable by CDOT and FHWA. If the angle requirement is not met and/or deviations are not acceptable, noise modeling is required and the analysis must be documented using the Appendix B memorandum template.}

## PROJECT OVERVIEW

Colorado Department of Transportation (CDOT) Region [number], under [Project Name] Project, plans to replace the existing noise wall, Structure ID [XXX###], at [project location] {Describe the project location, including the primary roadway and direction associated with the wall (e.g., WB I-70), City, and County} (see Figure 1). {If this memorandum addresses more than one noise wall replacement, change the first sentence to make it plural and provide the location information of each wall using one bullet for each noise wall. Move the Structure IDs so they are listed as part of the bullets. If the project has more than one noise wall and will address one or more noise walls in another memorandum, as described in Parts D and E of Step 4 of Section 3 of CDOT’s 2025 guidance document “In-Kind Noise Wall Replacement Guidelines and Memorandum Templates,” explain that in this paragraph in each project memorandum. Use consistent text in each project memorandum. Each project memorandum should include the Structure ID number for all noise walls being replaced by the project; indicate which noise walls are covered in detail by the memorandum; and list the date(s) of the other memorandum(s) that cover details of other noise walls being replaced by the project.}

CDOT and FHWA have agreed that in-kind noise wall replacement projects can be documented with noise analysis (i.e., line-of-sight analysis) if any Design Criteria 1 through 4 are not met but the deviations are determined by CDOT and FHWA to be acceptable. Design Criteria and noise analysis requirements are described in CDOT’s 2025 guidance document “*In-Kind Noise Wall Replacement Guidelines and Memorandum Templates.*” This project meet(s) Design Criteria [# of Design Criteria that is/are met] but does not meet Design Criteria [# of Design Criteria that is/are not met]{Note that Design Criterion 5 must be met; it does not have any acceptable deviations}. Therefore, a line-of-sight noise analysis was conducted for the project. It is documented in this memorandum and shows that the proposed noise wall will function as well as the existing noise wall that is being replaced.

This memorandum is based on design files provided from [name of company]. The files were received on [date(s) received] {date(s) refers to when CDOT received the file(s)}. The project design that is described in this memorandum is dated [date of design] and is at [level of design {e.g., 60% design}]. The noise wall design that is described in this memorandum is dated [date of design] and is at [level of design {e.g., 60% design}]. {If the memorandum covers more than one noise wall and they have different dates and/or level of designs, change this sentence so that it uses bullets to provide the relevant information for each noise wall, with one bullet per noise wall.}

## EXISTING AND PROPOSED NOISE WALLS

{If there is more than one noise wall, add the following sentence: “This project will replace [number] noise walls.” Then copy the rest of this section for each existing noise wall and add one title at the beginning of information about each wall, such as “Wall 1: [Structure ID].”}

Existing noise wall, Structure ID [XXX###] {If using shorter noise wall descriptions, such as “Wall 1,” add “(which is referred to as Wall 1 in this memorandum)” after the Structure ID}, was originally built as part of {Provide information about the project under which the wall was built, including the project name and, if known, the project number and subaccount number. If the project number and/or subaccount numbers are not known, state that.}. The project environmental decision document, a [type of environmental decision document] {i.e., signed Form 128, Finding of No Significant Impact, or Record of Decision} was signed on [date] {Provide the date the decision document was signed, using the exact date, if known. At a minimum, provide the year it was signed}. The noise wall was constructed in [year of construction] {Provide the year that the existing noise wall was built. If construction began in one year and was completed the following year, list the year in which construction began.} and is made of [material type] {Provide the material that the existing noise wall is made out of}. {Provide as much of the information described in this paragraph as possible. If the information is unknown, refer to it and state that it is not known, but provide an estimate or guess, as applicable. For example, if the year of construction is not known but it is known that it was built by a specific year, it could be stated as “The year of construction is not known, although it is known that the existing noise wall was constructed by 1995.”}

The source of existing noise wall data is {either list the source here, if it is all from one source, or use this text: “provided for each data point below.” Sources of data, in their order of preference, are described in Step 1 of Section 3 of CDOT’s 2025 guidance document “*In-Kind Noise Wall Replacement Guidelines and Memorandum Templates*.” If more than one source of data was used to determine the values listed in the next four bullets, add the sources to the bullet list either via footnotes or within parenthesis, at the end of the bullet text.} The existing noise wall:

* is [number of feet] feet long, with endpoints at [latitude and longitude of both wall endpoints], {Be clear about which endpoint is which and state which coordinate system is being used.}
* ranges from [number of feet] to [number of feet] high, {The height should be rounded to the tenths place after the decimal.}
* has top-of-wall elevations that range from [x,xxx.x] to [x,xxx.x] feet above sea level, and {Provide the range in elevation above sea level to the tenths place; for example, “5,310.1 to 5,312.4 feet above sea level”}
* ranges from [number of feet] to [number of feet] from the edge of the nearest travel lane. {The distance should be rounded to the tenths place after the decimal.}

The noise wall needs to be demolished and rebuilt because [reason]. {Provide the reason that the existing noise wall is being rebuilt.} The proposed noise wall will be made of [material type]. {State the material(s) that the proposed noise wall will be made of.}

The source of the following proposed noise wall data is {either list the source here, if it is all from one source, or use this text: “provided for each data point below.” If more than one source of data was used to determine the values listed in the next four bullets, add the sources to the bullet list either via footnotes or within parenthesis, at the end of the bullet text.} The proposed noise wall:

* will be [number of feet] feet long, with endpoints at [latitude and longitude of both wall endpoints], {Be clear about which endpoint is which and state which coordinate system is being used.}
* ranges from [number of feet] to [number of feet] high, {The height should be rounded to the tenths place after the decimal.}
* will have top-of-wall elevations that range from [x,xxx.x] to [x,xxx.x] feet above sea level, and {provide the range in elevation above sea level to the tenths place; for example, “5,310.3 to 5,312.5 feet above sea level”}
* will range from [number of feet] to [number of feet] from the edge of the nearest travel lane. {The distance should be rounded to the tenths place after the decimal.}

## DESIGN CRITERIA OVERVIEW

Of Design Criteria 1 through 4, the project meets [provide the applicable number(s)] but does not meet [provide the applicable number(s)], as follows: {If this memorandum represents more than one noise wall, change the text in this section so that it applies to each noise wall separately (e.g., the introductory sentence would be repeated for each noise wall and there would be a list from 1 through 5 for each noise wall.)}

1. {Include one of the following two sentences, whichever is applicable, and delete the other sentence.} Meets: The proposed noise wall design maintains the horizontal alignment within 5.0 feet of the existing noise wall for the entire length of the wall, as shown on Figure 2. OR Does Not Meet: The proposed noise wall design does not maintain the horizontal alignment within 5.0 feet of the existing noise wall for the entire length of the wall, as shown on Figure 2 and described in Table [XX {for DC1}].
2. {Include one of the following two sentences, whichever is applicable, and delete the other sentence.} Meets: For the entire length of the wall, the top-of-wall elevation of the proposed noise wall is no more than 0.5 feet below the existing top-of-wall elevation or it is at or above the existing top-of-wall elevation, as shown on Figure 3 and Table [XX {for DC2}]. OR Does Not Meet: The top-of-wall elevation of the proposed noise wall is more than 0.5 feet below the existing top-of-wall elevation for [the entire OR part of the] {Keep the applicable text and delete the other option} length of the wall, as shown on Figure 3 and Table [XX {for DC2}]. {Include Table [XX {for DC2}] if any proposed sections are lower than the corresponding existing noise wall section, even if the noise wall meets Design Criterion 2. If Table [XX {for DC2}] does not need to be included, remove the reference to it in this paragraph.}
3. {Include one of the following four choices, whichever is applicable, and delete the other three choices.} Meets/Not Applicable: The existing noise wall is not adjacent to a structure, so this Design Criterion is not applicable. OR Meets/Not Applicable: The existing noise wall is adjacent to a structure, but there won’t be a gap between the proposed noise wall and structure, so this Design Criterion is not applicable. OR Meets/Not Applicable: The existing noise wall is adjacent to a structure, but the existing noise wall does not have and was not originally built with a connection to the adjacent structure(s), so this Design Criterion is not applicable. OR Meets: The existing noise wall is adjacent to a structure and there will be a gap between the proposed noise wall and structure, so the proposed design includes where the noise wall interfaces with the structure(s) and addresses the gaps. The method to address gaps was developed between CDOT and FHWA, as described in this memorandum in the section “Design Criterion 3 Discussion.” [A table and/or figure related to this Design Criterion may be included in the memorandum but are not required. If including one or both, refer to them by adding “as shown in Figure (XX, for DC3) and/or Table (XX, for DC3).”]}
4. {Include one of the following three sentences, whichever is applicable, and delete the other sentences.} Meets: The endpoints (latitude and longitude) of the proposed noise wall will be at the same location as the existing noise wall, barring potential horizontal shifts described in Design Criterion 1, as shown on Figure 2. OR Meets: The endpoints (latitude and longitude) of the proposed noise wall will be further apart than the existing noise wall endpoints, and thus more protective, as shown on Figure 2. OR Does Not Meet: The endpoints (latitude and longitude) of the proposed noise wall will be closer together than the existing noise wall endpoints, and thus less protective, as shown on Figure 2.
5. {Note that Design Criterion 5 must be met; it does not have any acceptable deviations}All proposed noise walls must function as well as the existing noise walls that are being replaced. For this project’s noise wall(s), this is shown by meeting the following test: Show that the line-of-sight between the travel lanes and receptors protected by the noise wall will not be broken. This is shown when the angle of the line from the edge of the nearest travel lane to the top of the proposed noise wall will be the same or greater than the angle of the line for the existing noise wall. {Include one of the following two choices (both start with “The most conservative”), whichever is applicable, and delete the other choice.} The most conservative location for the line-of-sight analysis of the existing and proposed noise wall is the same location, so one set of lines was needed. The angle of the line-of-sight line to the existing wall is [XX.X] degrees and the angle of the line-of-sight line to the proposed wall is [XX.X] degrees, as shown in Figure [**XX** {for DC5}]. Therefore, the angle of the line to the proposed noise wall is {Insert here either “the same” or “greater than”, whichever is applicable, and delete the other choice.} the angle of the line for the existing noise wall. OR The most conservative locations for the line-of-sight analysis of the existing and proposed noise wall are different, so two sets of lines were needed in the analysis. For the existing wall conservative location, the angle of the line-of-sight line to the existing wall is [XX.X] degrees and the angle of the line-of-sight line to the proposed wall is [XX.X] degrees, as shown in Figure [**XX** {for DC5}]. Therefore, the angle of the line to the proposed noise wall is {Insert here either “the same” or “greater than”, whichever is applicable, and delete the other choice.} the angle of the line for the existing noise wall. For the proposed wall conservative location, the angle of the line-of-sight line to the existing wall is [XX.X] degrees and the angle of the line-of-sight line to the proposed wall is [XX.X] degrees, as shown in Figure [**XX** {for DC5}]. Therefore, the angle of the line to the proposed noise wall is {Insert here either “the same” or “greater than”, whichever is applicable, and delete the other choice.} the angle of the line for the existing noise wall.

## DESIGN CRITERION 1 DEVIATION DISCUSSION

{If the project does not deviate from Design Criterion 1, this section heading and this text can be deleted. Otherwise, explain how the project deviates from the Design Criterion, why the proposed noise wall cannot meet the Design Criterion, and the justification for building a noise wall with the deviation.}

## DESIGN CRITERION 2 DEVIATION DISCUSSION

{If the project does not deviate from Design Criterion 2, this section heading and this text can be deleted. Otherwise, explain how the project deviates from the Design Criterion, why the proposed noise wall cannot meet the Design Criterion, and the justification for building a noise wall with the deviation.}

## DESIGN CRITERION 3 DISCUSSION

{If this Design Criterion is not applicable to the project, this section heading and this text can be deleted. If this Design Criterion is applicable, describe the method used to address gaps and show that it was developed between CDOT and FHWA. At a minimum, explain how this Design Criterion is or is not being met. If the Design Criterion is not being met, provide the justification for not meeting it. Plan sheets showing how the Design Criterion is or is not met can be included and might be requested by CDOT and/or FHWA. Refer to any tables and/or figures that were developed and included in this memorandum to address this Design Criterion.}

## DESIGN CRITERION 4 DEVIATION DISCUSSION

{If the project does not deviate from Design Criterion 4, this section heading and this text can be deleted. Otherwise, explain how the project deviates from the Design Criterion, why the proposed noise wall cannot meet the Design Criterion, and the justification for building a noise wall with the deviation.}

## NOISE ANALYSIS

The noise analysis includes identifying the most conservative location(s) to place the line-of-sight lines, determining line-of-sight lines start and end points, determining and comparing the angles of the line-of-sight lines, and the documenting the analysis outcome. These steps are described in this section.

### Location of Line-of-Sight Lines

Requirements for placement of the line-of-sight lines is described in Section 6.1 of CDOT’s 2025 guidance document “*In-Kind Noise Wall Replacement Guidelines and Memorandum Templates.*” Line-of-sight lines end at the top of the existing and proposed noise walls. The line-of-sight line(s) start at the most conservative location(s). For this project, it was determined {Include one of the following two choices, whichever is applicable, and delete the other choice.} that the most conservative location for the line-of-sight analysis of the existing and proposed noise wall is the same location, which is at Station **[###]** and approximately at [describe where the sight line begins using something that could be identified on a map, such as cross streets or an address]. OR that the most conservative location for the line-of-sight analysis of the existing and proposed noise wall are at different locations. The existing wall conservative location is at Station **[###]** and approximately at [describe where the sight line begins using something that could be identified on a map, such as cross streets or an address]. The proposed wall conservative location is at Station **[###]** and approximately at [describe where the sight line begins using something that could be identified on a map, such as cross streets or an address]. {The next sentence is included and applies whether one or two locations are needed.} The line-of-sight lines start at grade level of the edge of the closest through lane on [primary roadway and direction associated with the wall (e.g., WB I-70)].

### Line-of-Sight Line Angles

{Include one of the following two choices, whichever is applicable, and delete the other choice.} Two lines-of-sight lines were developed at one location. The line-of-sight line between the roadway and existing noise wall is at an angle of [XX.X] degrees. The line-of-sight line between the roadway and proposed noise wall is at an angle of [XX.X] degrees. OR Four lines-of-sight lines were developed at two locations (one set of lines per location). At the existing wall conservative location, the line-of-sight line between the roadway and existing noise wall is at an angle of [XX.X] degrees. The line-of-sight line between the roadway and proposed noise wall is at an angle of [XX.X] degrees. At the proposed wall conservative location, the line-of-sight line between the roadway and existing noise wall is at an angle of [XX.X] degrees. The line-of-sight line between the roadway and proposed noise wall is at an angle of [XX.X] degrees. {The next sentence is included and applies whether one or two locations are needed.} The lines and angles are shown in Figure [XX {for DC5}].

### Analysis Outcome

At the most conservative location(s), the angle of the line to the proposed noise wall is {Insert here either “the same” or “greater than”, whichever is applicable, and delete the other choice. If the project needed to analyze two locations, change the sentence to reflect the plurality of “location,” “angle,” “line,” “is,” and “wall.” If there are two locations, one angle might be the same as the other at one location while at the other location, the angles are different.} the angle of the line for the existing noise wall. These results show that the proposed noise wall, compared to the existing noise wall, will not cause an increase of noise at any receptor location.

## TABLES AND FIGURES

**Table [XX** {for DC1}**]: Design Criterion 1 - Comparing Horizontal Alignment by Noise Wall Sections** {Only include this table if Design Criterion is not met by at least one section of the noise wall and only describe sections that do not meet it.}

|  |  |  |
| --- | --- | --- |
| **Station Range (feet)** | **Horizontal Change by Station Range (feet)** | **Direction of Horizontal Shift in Relation to Noise Source [Roadway** {Provide road name and direction}**]** |
| [###] - [###] | [##.#] - [##.#] | [Away From] {OR} [Towards] |
| [###] - [###] | [##.#] - [##.#] | [Away From] {OR} [Towards] |

{Information for table:

1. Station Range: Example of how to list station ranges: 2+85 – 3+30.
2. List separate station ranges for each of the following types of contiguous sections:
   1. Sections shifting horizontal alignment between 5.1 to 10.0 feet away from noise source (roadway)
   2. Sections shifting horizontal alignment more than 10.0 feet away from noise source (roadway)
   3. Sections shifting horizontal alignment between 5.1 to 10.0 feet towards noise source (roadway)
   4. Sections shifting horizontal alignment more than 10.0 feet towards noise source (roadway)
3. Horizontal changes should be reported in feet using one decimal place.
4. Horizontal changes are reported per station range either as distinct distances if a portion of the noise wall is parallel to the roadway (e.g., 5.2) or a range of distances for portions of the noise wall that are not parallel to the roadway (e.g., 5.1 – 9.7), as appropriate.
5. Replace [Roadway] in the header of the right-most column with the name of the roadway that the noise wall was built to reduce noise from and the direction of the roadway that is closest to the noise wall (e.g., EB I-70, WB East Hampden Ave).
6. For each station range, select the correct direction of horizontal shift (“Away From” or “Towards”) in relation to the noise source, which is the roadway along which the noise wall was built. Delete the other text on the row.
7. Rows should be added or removed, as needed.}

**Table [XX** {for DC2}**]: Design Criterion 2 - Comparing Top-of-Wall Elevations by Noise Wall Sections** {Only include this table if any proposed sections are lower than the corresponding existing noise wall section, even if the noise wall meets Design Criterion 2. Only describe proposed sections that are lower than the corresponding existing noise wall section.}

|  |  |  |
| --- | --- | --- |
| **Station Range (feet)** | **Vertical Change for Top-of-Wall Elevation by Station Range (feet)** | **Meets Design Criterion 2** |
| [###] - [###] | [##.#] - [##.#] | [Yes] {OR} [No] |
| [###] - [###] | [##.#] - [##.#] | [Yes] {OR} [No] |

{Information for table:

1. Station Range: Example of how to list station ranges: 2+85 – 3+30.
2. List separate station ranges for each of the following types of contiguous sections:
   1. Sections shifting proposed top-of-wall elevation between 0.1 to 0.5 feet lower than existing top-of-wall elevation; this meets Design Criterion 2
   2. Sections shifting proposed top-of-wall elevation between 0.6 to 1.0 feet lower than existing top-of-wall elevation; this does not meet Design Criterion 2
   3. Sections shifting proposed top-of-wall elevation more than 1.0 feet lower than existing top-of-wall elevation; this does not meet Design Criterion 2
3. Vertical changes should be reported in feet using one decimal place.
4. Vertical changes are reported per station range either as distinct distances if a portion of the noise wall maintains the same vertical change when comparing the existing to the proposed noise wall (e.g., 0.1) or a range of distances for portions of the noise wall that do not maintain the same vertical change when comparing the existing to the proposed noise wall (e.g., 0.6 – 0.9), as appropriate.
5. For each station range, indicate whether the vertical change for each station range meets Design Criterion 2, as “Yes” or “No.” Delete the other text on the row.
6. Rows should be added or removed, as needed.}

**Figure 1 - [Project Name] Project Vicinity**

{This figure shows the general vicinity of the project and the specific location (e.g., including nearby cross streets). Include the following, at a minimum, on this figure:

* Existing condition labeled roadway(s) associated with project
* Proposed Action project limits, clearly labeled
* Existing noise wall, clearly labeled
* Locator map (e.g., inset showing larger area with project area)
* Scale
* Compass rose or North arrow}

**Figure 2 – Design Criteria 1 & 4: Existing and Proposed Noise Wall Horizontal Alignments and Endpoints**

{This figure shows the existing and proposed noise wall horizontal alignments, including endpoints, using a plan view (“birds’ eye” view). The source will typically be the design plan set. Include the following, at a minimum, on this figure:

* Existing condition labeled roadway(s) associated with project
* Existing and proposed noise wall alignments, clearly labeled
* Endpoints for each noise wall, clearly labeled
* Station numbers (at least two per wall, for reference)
* Cause(s) of deviation(s) from Design Criteria 1 and/or 4, if applicable (e.g., show utility lines that led to deviation)
* Scale
* Compass rose or North arrow}

**Figure 3: Design Criterion 2 – Profile View of Existing and Proposed Noise Wall Top-of-Wall Elevation**

{This figure shows the existing and proposed noise walls using a profile view (“side” view, facing the front of the wall). The source will typically be the design plan set. It must be clear where the top-of-elevation of the proposed noise wall is in relation to the top-of-elevation of the existing noise wall. Include the following, at a minimum, on this figure:

* Overlaid existing and proposed noise walls (entire noise walls, section-by-section), clearly labeled
* Use different colors and/or types of line to make clear which noise wall is existing and which is proposed; include a key or label the top-of-elevation lines so it is clear which is which
* The x-axis has station numbers representing feet (e.g., 2+85). The y-axis has wall elevations in feet (e.g., 5,200 feet)
* Cause(s) of deviation(s) from Design Criteria 2, if applicable (e.g., show utility lines that led to deviation)
* If all information required to be on this figure cannot legibly fit on one page/one figure, create as many figures as needed and number them 3A, 3B, 3C, etc. and include a Figure 3 that is "zoomed out" and that shows boundaries of Figure 3A, 3B, 3C, etc.}
* Scale
* Compass rose or North arrow}

**Figure 4: Design Criterion 2 – Cross Section View of Existing and Proposed Noise Wall Top-of-Wall Elevation at Station [###]**

{This figure may be requested by FHWA and/or CDOT if the noise wall base elevation shifts along a sloped topography between the existing and proposed noise walls. This figure shows the existing and proposed noise walls using a cross-section view (“side” view, facing the side of the wall). The source will typically be the design plan set. It must be clear where the top-of-elevation of the proposed noise wall is in relation to the top-of-elevation of the existing noise wall. If including the figure, add a reference to it in the memorandum text. Include the following, at a minimum, on this figure:

* Cross view of existing noise wall alignment and proposed noise wall alignment at a specific station number, clearly labeled; identify which station number the figure represents in the figure title
* A line indicating topography of wall base elevation for existing and proposed noise walls; it should extend from at least 20 feet beyond the noise wall that is furthest from the road to the edge of the nearest travel lane
* Label the travel lane and indicate that it is the noise source
* Use different colors and/or types of line to make clear which noise wall is existing and which is proposed; include a key or label the walls so it is clear which wall is existing and which is proposed
* X-axis: Units of feet that show the distance between the existing and proposed noise wall
* Y-axis: Units of feet that show noise wall elevations (e.g., 5,200 feet)
* Indicate the distance between the existing and proposed noise walls on the figure by listing the distance with a double-headed arrow between the walls (e.g., 🡨 5.5 feet 🡪)
* Cause(s) of deviation(s) from Design Criteria 2, if applicable (e.g., show utility lines that led to deviation)
* Scale

If top-of-wall elevations need to be shown for more than one station number, create as many figures as necessary. Figures may use a continuing numbering system (e.g., if the first figure is Figure 4, the next could be Figures 5, 6, 7, etc.) or they can use a sub-set numbering system (e.g., figures could be Figure 4A, 4B, 4C, etc.).

**Figure [XX** {for DC3}**]: Design Criterion 3 – Addressing the Gap Between the Proposed Panel Wall and Bridge Structure**

{This figure shows the connection point between the existing and proposed noise wall with the structure, using a plan view (“birds’ eye” view). The source will typically be the design plan set. If providing a figure related to Design Criterion 3, include the following, at a minimum, on this figure:

* Existing and proposed connection point, clearly labeled
* Cause(s) of deviation(s) from Design Criterion 3, if applicable
* Scale
* Compass rose or North arrow

If additional figure(s) are needed, they may be added. For example, an exhibit showing a project-special treatment might be included as a separate figure.}

**Figure** [**XX** {for DC5}]**: Design Criterion 5 –Comparing Existing Noise Wall Line-of-Sight to Proposed Noise Wall Line-of-Sight at Station [###]** {If more than one station must be used, change the title from “at Station [###}” to “at Stations [###} and [###]”}

{This figure shows the existing and proposed noise walls using a cross-section view (“side” view, facing the side of the wall). The source will typically be the design plan set. Include the following, at a minimum, on this figure:

* Existing and proposed noise walls at the station number determined to be the most conservative location for the line-of-sight lines
* Line-of-sight lines between the roadway and existing/proposed noise walls at the most conservative location
* Two views shall be provided if the most conservative location for the line-of-sight line is not at the same station number for existing and proposed noise wall; each view shall show both noise walls (existing and proposed)
* Line indicating topography of wall base elevation for existing and proposed noise walls; the topography line should extend at least 20 feet beyond the wall that is furthest from the road to the edge of the nearest travel lane and continue for at least another 20 feet from the edge of the travel lane nearest the closest noise wall
* Show where the edge of the nearest travel lane to the existing and proposed noise wall is and include the label “Traffic Noise Source Region" above the lane
* Use different colors and/or types of line to make clear which noise wall is existing and which is proposed; include a key or label the walls so it is clear which is which
* Identify the angles for the line-of-sight line to the tenths decimal place of the existing noise wall and the proposed noise wall (one angle per line)
* X-axis: Units of feet that show the distance between the existing and proposed noise wall (e.g., 5.5 feet)
* Y-axis: Units of feet that show noise wall elevations (e.g., 5,200 feet)}

Appendix D

**Noise Wall Design Resources**

The following resources address noise wall design:

* 1. CDOT 2020 Noise Abatement and Analysis Guidelines, Section 4.2 (Noise Barrier Evaluation Considerations)
  2. CDOT 2023 Roadway Design Guide, Chapter 16 (Noise Guide)
  3. FHWA 2000 Highway Noise Barrier Design Handbook (FHWA-EP-00-005)

1. Noise wall and project design might change prior to final design. A noise wall can be evaluated against this guidance one or more times before noise wall and project design have concluded. Sometimes what is initially called “final” design changes prior to construction. Follow the directions in this document at whichever level of design the noise wall and project are at even if the project is not at its true final design. Once one or more Design Criteria are not met for any level of noise wall and project design, FHWA will review each memorandum documenting the design from that point forward and noise analysis (i.e., line-of-sight or modeling) would be triggered. [↑](#footnote-ref-1)
2. It is anticipated that after CDOT and FHWA have had more noise wall replacement projects, this guidance will be updated to include more examples and possibly to define the terms "minor" and "slight." [↑](#footnote-ref-2)
3. The horizontal alignment shift should be rounded to the tenths place after the decimal. Therefore, a shift of 5.04 feet would round to 5.0 feet and would meet the Design Criterion but a shift of 5.05 feet would round to 5.1 feet and would be a deviation from this Design Criterion. An average shift in alignment is not calculated. If any part of the proposed noise wall is shifted horizontally by more than 5.0 feet when compared to the existing noise wall, it is a deviation. [↑](#footnote-ref-3)
4. The top-of-wall elevation shift should be rounded to the tenths place after the decimal. Therefore, a shift that is 0.54 feet below the existing top-of-wall elevation would round to 0.5 feet and would meet the Design Criterion but a shift that is 0.55 feet below the existing top-of-wall elevation would round to 0.6 feet and would be a deviation from this Design Criterion. An average shift in top-of-wall elevation is not calculated. If any part of the proposed noise wall top-of-wall elevation is shifted horizontally lower by more than 0.5 feet when compared to the existing noise wall, it is a deviation. [↑](#footnote-ref-4)
5. The top-of-wall elevation of the noise wall should meet Design Criteria 2 at each point along the length of the noise wall. Because panels come in specific dimensions, the average top-of-wall elevation might exceed the requirement even if some areas of a panel are below the requirement. [↑](#footnote-ref-5)
6. If the existing noise wall does not currently have a connection to any structure but is adjacent to a structure, determine if the existing noise wall originally had a connection to the adjacent structure. It is possible that the connection has failed or otherwise been removed, thus creating a gap. [↑](#footnote-ref-6)
7. Noise levels should be rounded to the tenths place after the decimal, if the version of TNM being used reports noise to the hundredths place after the decimal. Therefore, a noise level of 0.44 dB would round to 0.4 dB and would meet the Design Criterion but noise level of 0.45 dB would round to 0.5 dB and would be a deviation from this Design Criterion. [↑](#footnote-ref-7)
8. See definitions of freeways and expressways in current CDOT NAAG (for the 2020 NAAG, definitions are in Appendix A) [↑](#footnote-ref-8)
9. An angle of 30.45° would round to 30.5°. An angle of 30.44° would round to 30.4°. [↑](#footnote-ref-9)