CREATE

Noise and Vibration Assessment Methodology

June 2014

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1. INTRODUCTION

This document discusses procedures for assessing noise and vibration impacts of proposed projects within the CREATE Program. Each proposed project will be evaluated for potential noise and vibration impacts to fulfill National Environmental Policy Act of 1969 (NEPA) requirements.

Unlike highway and transit improvement projects, there are no federal guidance documents or methods specifically applicable for the evaluation of freight train traffic noise and vibration impacts. The Federal Transit Administration (FTA) has developed a *Transit Noise and Vibration Assessment, May 2006* manual (FTA Manual) for the evaluation of transit projects, but this methodology does not specifically address freight train traffic.

These procedures include modifications to the methodology described in the FTA Manual. The modifications allow for the evaluation of freight train traffic noise and vibration impacts. Other modifications, such as those related to interior noise assessments, are also included because the CREATE Program is funded through SAFETEA-LU Section 1301. Section 1301 requires the CREATE Program to be subject to requirements of Title 23, United States Code, as applicable.

The purpose of this document is to provide noise and vibration assessment guidance by defining a consistent and defensible approach for project evaluations. As each project is unique, judgment is needed in applying the procedures to the individual projects.

2. BACKGROUND

The CREATE projects include both commuter train and freight train traffic along the project corridors. There are major differences between commuter and freight train traffic. Freight trains have different and the potential for greater noise impacts than commuter trains due to the greater locomotive horsepower, and differences in train schedules (freight trains typically have more frequent and more nighttime activity), train weight (freight trains are typically heavier), and train length (freight trains are typically longer).

The FTA methodology included in the FTA Manual is generally applicable for assessing the potential noise and vibration impacts from the proposed CREATE projects; however, due to the differing characteristics of freight trains, this document modifies some aspects of the FTA methodology for the purpose of applying it to the CREATE projects. The FTA impact criteria were developed from established basic research on noise annoyance; therefore, they are considered applicable for assessing CREATE impacts.

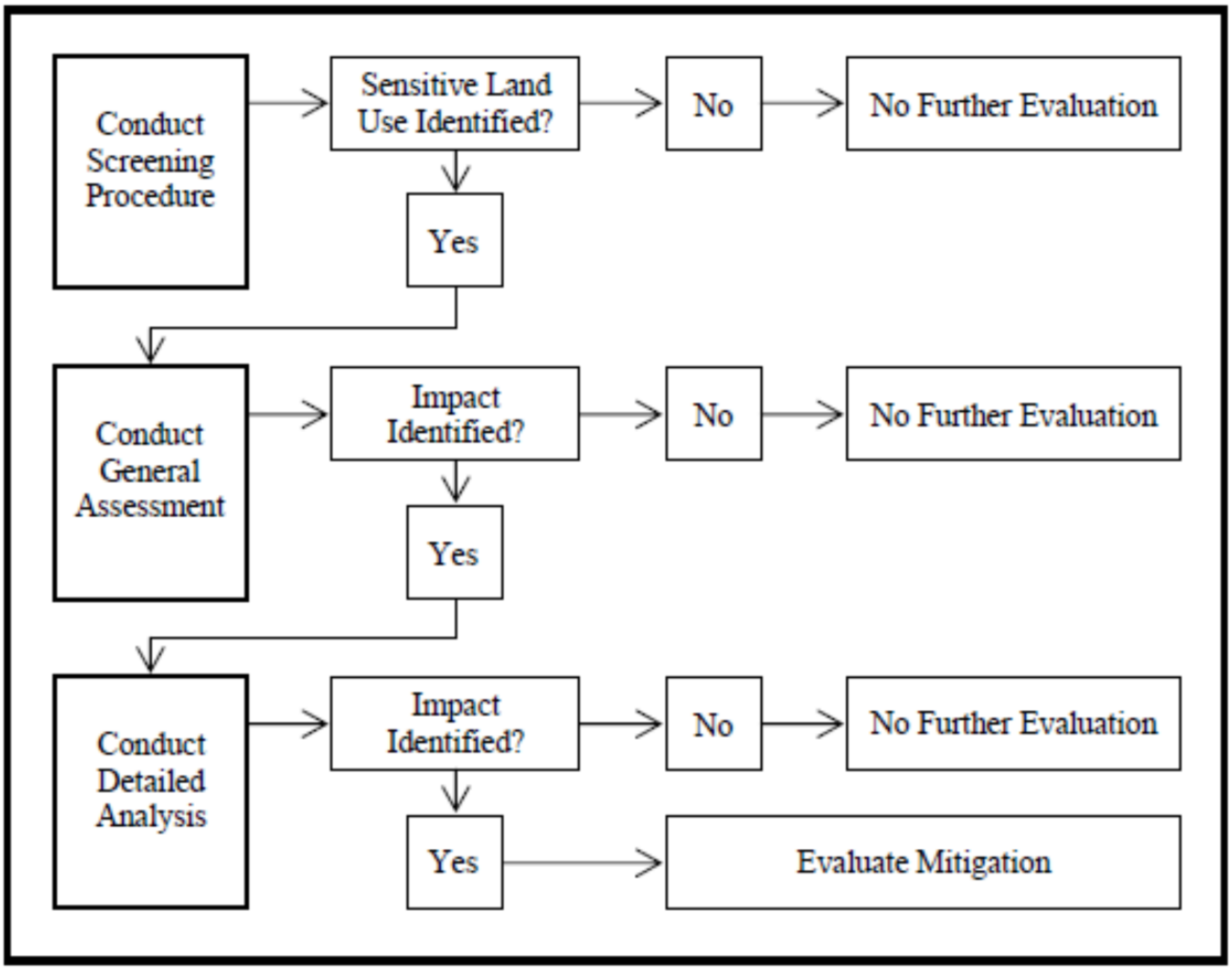
The FTA Manual does not include a methodology for performing interior noise assessments, nor does it include interior noise impact criteria. This document includes an interior noise assessment methodology that will be applied at locations where interior noise must be evaluated and utilizes the interior noise impact criterion included in 23 CFR Part 772 to determine whether impacts occur.

The noise screening distances and the general assessment model included in the FTA Manual have been modified to address freight train traffic associated with the CREATE Program. The train traffic input data are developed by a train traffic model that includes all of the CREATE Program infrastructure improvements. Generally, each project's noise and vibration assessment assumes that the entire CREATE Program is implemented. Each project's noise and vibration impacts are based on impacts resulting from implementing the entire CREATE Program rather than only the implementation of the single project that is being assessed. Any exceptions to this approach will be reviewed on a case-by-case basis.

3. OVERALL FTA IMPACT ASSESSMENT METHODOLOGY

The FTA noise assessment methodology is presented in the FTA Manual. FTA's approach is a three-tier process and is summarized in Figure 3-1.

FIGURE 3-1
FTA Noise and Vibration Assessment Process



Tier 1 – Screening Procedure

The *Noise Screening Procedure* uses screening distances to identify noise-sensitive land uses in the vicinity of the project. The FTA screening distances are based on conservative assumptions for commuter train traffic. The *Noise Screening Procedure* is presented in Chapter 4 of the FTA Manual.

For the CREATE Program, new noise screening distances have been developed for identifying locations where a CREATE project may cause noise impacts from freight and commuter/passenger (Amtrak and Metra) train activity.

The *Vibration Screening Procedure* uses screening distances to identify vibration-sensitive land uses in the vicinity of the project. The *Vibration Screening Procedure* is presented in Chapter 9 of the FTA Manual.

Tier 2 – General Assessment

The *General Noise Assessment* methodology is presented in Chapter 5 of the FTA Manual and uses project specific information. A *CREATE Railroad Noise Model User Guide*, included in Appendix B, has been developed specifically for application on CREATE projects. These two guidance documents are to be used for the *General Noise Assessment*.

Noise levels are predicted at sensitive receptor locations for the existing, no-build and build scenarios using the FTA methodology with the CREATE railroad noise model. If the *General Noise Assessment* methods predict potential noise impacts, then the *Detailed Noise Analysis* methods are used to refine the analysis and predict potential impacts.

The *General Vibration Assessment* methodology is presented in Chapter 10 of the FTA Manual and uses information regarding the project specifics. If the *General Vibration Assessment* methods predict potential vibration impacts, then the *Detailed Vibration Analysis* methods are used to refine the analysis and predict potential impacts.

Tier 3 – Detailed Analysis

The *Detailed Noise Analysis* methodology is presented in Chapter 6 of the FTA Manual. The *Detailed Noise Analysis* provides the highest degree of accuracy using site-specific information. The *Detailed Noise Analysis* utilizes additional information not included in the *General Noise Assessment*, including topographic information. Noise impacts identified in the *Detailed Noise Analysis* will require the evaluation of mitigation. The FTA methodology provides equations in Chapter 6 (*Detailed Noise Analysis*) of the FTA Manual that are used to evaluate the effectiveness of noise walls.

The *Detailed Vibration Analysis* methodology is presented in Chapter 11 of the FTA Manual.

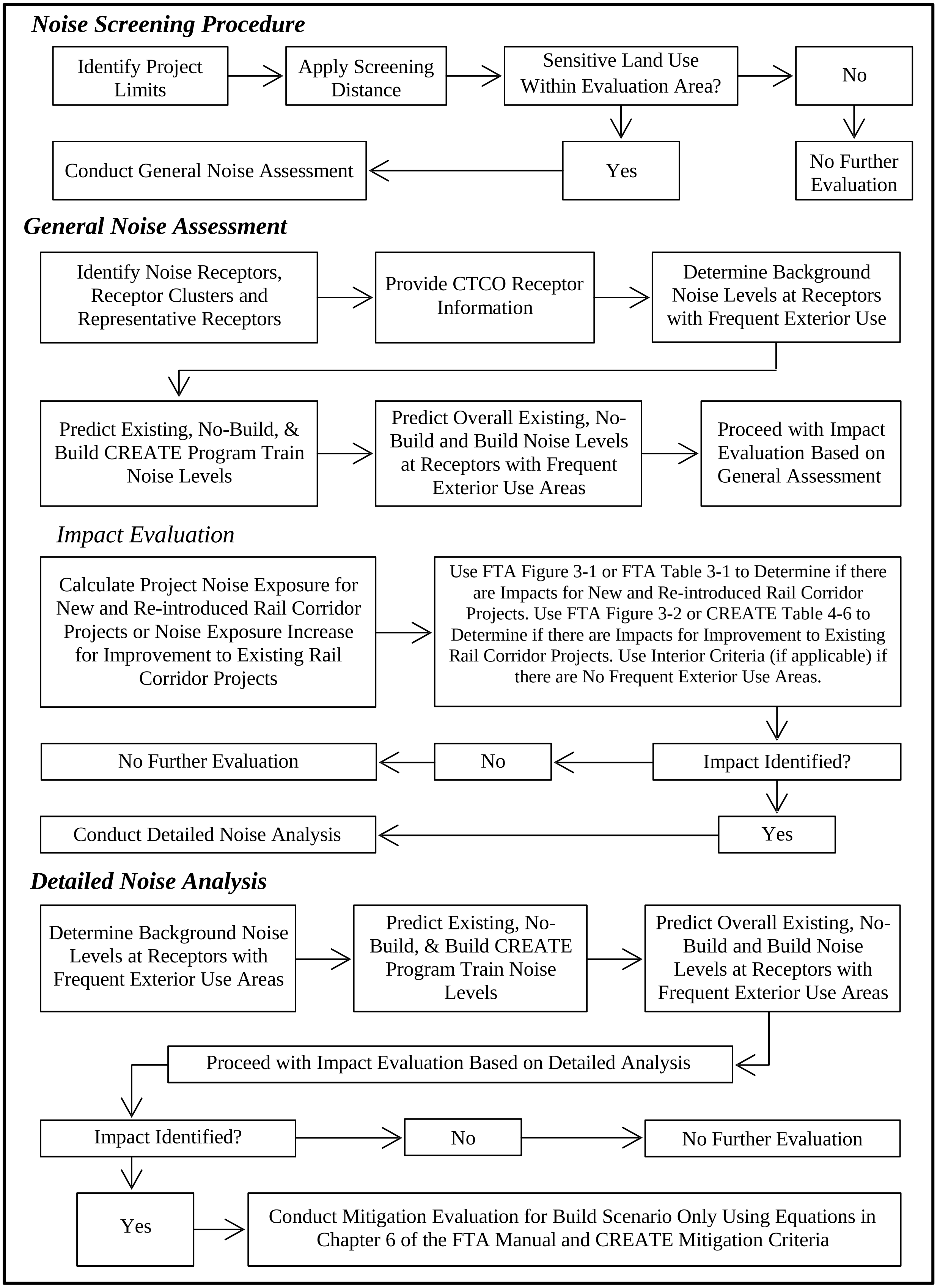
4. KEY ELEMENTS OF NOISE ASSESSMENT

The three-tiered methodology developed by FTA will be used to evaluate the noise impacts of proposed CREATE projects. Descriptions of the differences between the FTA Manual and procedures for the assessment of CREATE projects are discussed in the following sections. These differences relate to the utilization of the CREATE railroad noise model, the model inputs, evaluating the existing, no-build, and build conditions, and applying the FTA impact criteria consistently for all projects. Figure 4-1 presents the general flow chart for the CREATE noise evaluation.

Application of the CREATE screening distances, the CREATE Noise Modeling and the FTA methodology will be demonstrated throughout the document using an example project (See Appendices D and E). The following is a general description of the example project.

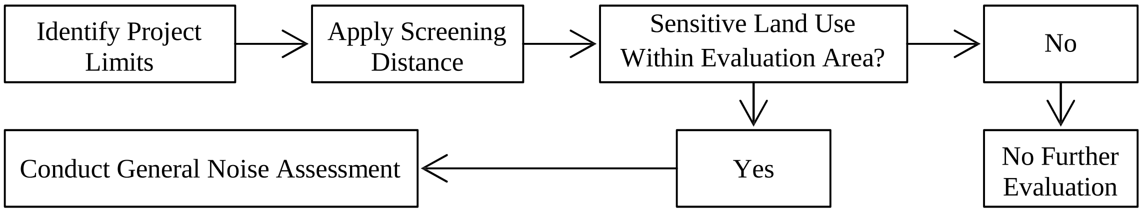
Example Project Description: *Example project EX-1 includes signal upgrades to improve track control between the southwest/northeast (Track 1, 2, 3 and 4) track corridor and the north/south track corridor (Track 1). (See Exhibit 1 in Appendix D.) The corridor is located within the Chicago (urban) area. Currently, trains moving from one corridor to the other are limited to 10 mph due to the restricted visibility. Signal improvements will improve track control allowing trains to move through the corridor at 30 mph. Infrastructure improvements are limited to replacing the two signal controls in the signal control box. There are no track improvements proposed. In addition to the increase in train speed between the signals, the improved track control will allow more trains to move through the switches (Track 1). No speed, volume or other changes are expected on the three additional tracks (Tracks 2, 3, and 4).*

FIGURE 4-1
CREATE Noise Assessment Process



4.1 Noise Screening Procedure

Noise Screening Procedure (Tier 1)



4.1.1 Project Limits

Each proposed CREATE project was defined based upon its independent utility. Each project has unique features and proposed improvements. These site-specific conditions are to be considered in defining the project limits. The project's purpose and need statement should be reviewed to assist in determining the project limits.

> ***Example Project EX-1***
>
> **Infrastructure improvements are limited to upgrading two signal controls in the signal control box. While the signal controls may be in one location where the physical construction work will occur, the actual signals controlled by these improvements are in two separate locations. Therefore, the project limits extend to the signal locations and these project limits establish the basis for the noise and vibration evaluation area.**
> **See Appendix D, Exhibit 1.**

In general, for projects where a Categorical Exclusion (CE) is anticipated, the evaluation area designated for noise assessments will be based upon the project limits. The noise evaluation area will encompass the area defined by applying the appropriate screening distances to the project's limits. The project limits should include infrastructure directly changed by the project's proposed improvements. All infrastructure elements that affect the train characteristics (speed, volume, distance to receiver, switch locations) should be included in the project limits. The project limits do not include areas outside of the infrastructure improvement area that may experience changes as a result of the infrastructure improvements. (See example project discussion.)

Projects with potentially significant impacts may require the preparation of an Environmental Assessment (EA) and/or an Environmental Impact Statement (EIS). Within these environmental documents, direct noise impacts from the proposed CREATE Program will be evaluated for sensitive receptors identified within the noise evaluation area, similar to the CE projects. Additionally, these projects may require a qualitative evaluation of secondary or indirect noise and vibration impacts for those areas beyond the project limits.

4.1.2 Screening Distances and Noise Evaluation Area

Once the project limits have been determined, the first tier of the FTA assessment can be applied to determine the noise evaluation area. Noise screening distances are applied to the project limits to determine the noise evaluation area. If the project being evaluated includes improvements to more than one track, the appropriate screening distances will be applied to each track to determine the noise evaluation area for the project. For CREATE projects that include only commuter/passenger trains, the noise screening procedures in Chapter 4 of the FTA Manual will be applied. For projects that include only freight trains, or both commuter/passenger and freight trains, the procedures described below will be applied.

> ***Example Project EX-1***
>
> **Infrastructure improvements are limited to the two signals. Train speeds and volumes will increase beyond the two signals. The noise and vibration evaluation area will be the area along the railroad tracks between the two signals to address potential impacts of the speed change. The screening distances are measured from the railroad tracks between the two signals. See Appendix D, Exhibit 2.**

Noise screening distances for CREATE Program train traffic have been developed for low, medium and high train activity within three ambient noise condition categories. If there are unobstructed sight lines between the noise source (i.e. trains) and the sensitive receptor, use the screening distances in Table 4-1. If there are obstructions (e.g., buildings, terrain) in the sight line between the noise source (i.e. trains) and the sensitive receptor, use the screening distances in Table 4-2. Table 4-3 defines the low, medium and high ranges of train activity for freight and commuter/passenger rail. Table 4-4 the ambient noise levels for the three defined ambient noise level categories: normal suburban residential, urban residential and noisy urban residential. Refer to the supporting memorandum in Appendix A for specifics on how to use the tables.

In order to utilize these tables, the build alternative(s) train traffic information must be obtained from the Chicago Transportation Coordination Office (CTCO). A determination must be made as to which sections of the projects have generally homogeneous train traffic characteristics. These sections will likely coincide with major control points where train traffic changes substantially. Once these sections have been identified, the sections should be delineated on aerial photography and provided to the CTCO, along with other receptor specific information as described in Section 4.2.2. The CTCO will provide train volumes and other train information for each section. These train volumes will be used in conjunction with Tables 4-1 through 4-4, as appropriate, in determining screening distances and establishing noise evaluation areas. The CREATE screening procedures are meant to be conservative to ensure that all potentially impacted receptors are included in the noise analysis. The highest train variable in Table 4-3 should be used to determine the activity characteristics and screening distance.

An alternative screening method may be used which does not require the CTCO to provide train data for the screening process. The alternative method assumes the worst-case scenario, so it is a more conservative screening method than the method described in the preceding paragraph. In this alternative screening method, use the "High (Freight)" screening distances found in Tables 4-1 and 4-2, as applicable, for the appropriate "Ambient Category" of the project (see Table 4-4). If sensitive land uses are identified within the "High" screening distance, then a General Noise Assessment must be performed as described in Section 4.2.

TABLE 4-1[4]
Screening Distances for Unobstructed Sight Lines for Low, Medium and High Train Activity vs. Noise Receptor Location

Screening Distance (ft from centerline of track)				
Ambient Category	**Train Volume**			
	Low (Freight Only)	**Low Mix (Freight and Passenger[3])**	**Medium (Freight[1])**	**High (Freight[1,2])**
Normal Suburban Residential	400	450	1,000	1,500
Urban Residential	300	350	750	1,200
Noisy Urban Residential	150	200	450	750

[1] Addition of commuter/passenger train traffic does not change screening distances.
[2] Use this category for grade crossings where horns are sounded.
[3] Appropriate category when commuter/passenger/commuter present with low freight activity.
[4] Table 4-1 derived from Table 4-2.

TABLE 4-2*
Screening Distances with Intervening Obstructions for Low, Medium and High Train Activity vs. Noise Receptor Location**

Screening Distance (ft from centerline of track)				
Ambient Category	**Train Volume**			
	Low (Freight Only)	**Low Mix (Freight and Passenger[3])**	**Medium (Freight[1])**	**High (Freight[1,2])**
Normal Suburban Residential	200	225	500	1,000
Urban Residential	150	175	375	750
Noisy Urban Residential	75	100	225	500

[1] Addition of commuter/passenger train traffic does not change screening distances.
[2] Use this category for grade crossings where horns are sounded.
[3] Appropriate category when commuter/passenger/commuter present with low freight activity.
*Source for Tables 4-1, 4-2, and 4-3: *Screening Distances for Potential Noise Impact by Ambient Location and Train Activity for CREATE Projects* (see Appendix A).
**Obstructions can include intervening buildings, terrain, embankments, and structures such as overpasses and retaining walls that block the line of sight between the noise source (i.e. trains) and sensitive receptors.

TABLE 4-3*
Low, Medium and High Freight Train Activity Characteristics

Train Activity	Trains per Day	Speed (mph)	Length of Cars (feet)	Locomotives /train
Low	5 to 40	10 to 20	1,000 to 4,000	1 to 2.08
Medium	41 to 75	20 to 30	4,000 to 6,000	2.08 to 2.5
High	More than 75	More than 30	More than 6,000	More than 2.5

*Source for Tables 4-1, 4-2, and 4-3: *Screening Distances for Potential Noise Impact by Ambient Location and Train Activity for CREATE Projects,* Appendix A.

TABLE 4-4*
Ambient Noise Level Categories

Ambient Category	Range of L_{dn} (dB(A))	Average L_{dn} (dB(A))	Average Census Tract Population Density per Square Mile
Normal Suburban Residential	53 to 57	55	2,000
Urban Residential	58 to 62	60	6,300
Noisy Urban Residential	63 to 67	65	20,000

*Source for Tables 4-1, 4-2 and 4-3: *Screening Distances for Potential Noise Impact by Ambient Location and Train Activity for CREATE Projects,* Appendix A.

4.1.3 Identify Sensitive Receptors

The noise evaluation area is utilized to determine if there are any sensitive land uses that may be affected due to implementing the project. The three FTA land use categories (1, 2, and 3) are used to categorize sensitive receptors within the noise evaluation area. These land uses and the appropriate noise metric for assessing impacts are presented in Table 4-5.

TABLE 4-5
Land Use Categories

Land Use Category	Noise Metric dB(A)	Description of Land Use
1	Outdoor L_{eq} (h)*	Tracts of land where quiet is an essential element in their intended purpose. This category includes lands set aside for serenity and quiet, and such land uses as outdoor amphitheaters and concert pavilions, as well as National Historic Landmarks with significant outdoor use. Also included are recording studios and concert halls.
2	Outdoor L_{dn}	Residences and buildings where people normally sleep. This category includes homes, hospitals and hotels where a nighttime sensitivity to noise is assumed to be of utmost importance.
3	Outdoor L_{eq} (h)*	Institutional land uses with primarily daytime and evening use. This category includes schools, libraries, theaters, and churches where it is important to avoid interference with such activities as speech, meditation and concentration on reading material. Places for meditation or study associated with cemeteries, monuments, museums, campgrounds and recreational facilities can also be considered to be in this category. Certain historical sites and parks are also included.
* L_{eq} for the noisiest hour of transit-related activity during hours of noise sensitivity.		

Source: Harris Miller Miller and Hanson, *Transit Noise and Vibration Impact Assessment*, FTA, 2006.

Based on the review of the land uses within the project's noise evaluation area, sensitive receptors will be identified. The noise evaluation will continue with the *General Noise Assessment* if noise-sensitive land uses are identified within the noise evaluation area. If there are no noise-sensitive land uses within the noise evaluation area, then no further evaluation is required, and the project should be documented accordingly.

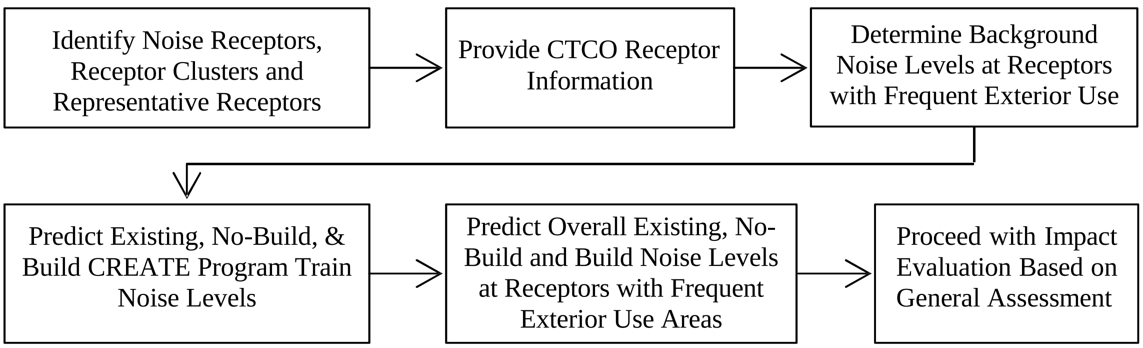
The noise metrics established by FTA apply to exterior use area locations. If no exterior use areas are identified for receptors within the screening distance, refer to Section 5 (Interior Noise Assessment) to evaluate these receptors. Residential land uses shall always be evaluated for exterior use areas where outdoor use is most likely to occur.

For parks, if frequent exterior use locations such as paths, picnic tables, shelters, and ball fields are within the screening limits, a general assessment must be performed for the parks at these exterior use locations. If these types of frequent exterior use locations are not within the screening limits, in general, a *General Noise Assessment* will not be required for these parks, even though a portion of the park with no identified exterior use locations may be within the screening distance.

CREATE projects often overlap or are within close proximity of other CREATE Projects in corridors with multiple rail lines. Also, some CREATE projects are in close proximity to other CREATE projects that are in different corridors. Therefore, sensitive receptors can be affected by CREATE train noise from multiple projects. When sensitive receptors have been identified for a project through the noise screening procedure, CREATE Program train noise sources from all CREATE projects, both in the same corridor and adjacent corridors, must be identified and used in the *General Noise Assessment* and the *Detailed Noise Analysis*.

4.2 General Noise Assessment

General Noise Assessment (Tier 2)



Once sensitive receptors are identified in the screening procedure of the noise assessment, additional project-specific information is needed to conduct the *General Noise Assessment*. This includes receptor specific train traffic data from the CTCO and background noise levels. The FTA *General Noise Assessment* methodology will be applied using these data.

4.2.1 Identify Noise Receptors, Receptor Clusters and Representative Receptors

Receptor Clusters

Sensitive receptors can be clustered (grouped together) where the noise level is expected to be similar and land uses are the same. For example, a group of residences equidistant from the rail line may

> ***Example Project EX-1***
>
> **The noise and vibration screening zones depicted in Appendix D, Exhibit 2 were reviewed for sensitive receptors which are highlighted in Appendix D, Exhibit 3. The noise screening zone varies from 750 feet based on an urban area with a high train activity level (train speed greater than 30 mph), to 1,200 feet based on urban residential with a high train activity level (See Appendix D, Exhibit 2). Within each of the receptor clusters, the representative receptors locations have been identified (See Appendix D, Exhibit 3). Based on the information available, the receptor information can be tabulated and presented to the CTCO to develop the train traffic data needed for the modeling.**

be clustered, as each will have similar noise exposure. One residence can be selected within the clustered group to represent the cluster. This approach is consistent with FTA and FHWA approaches in assessing potential impacts. See Section 6.1.3 and Appendix C in the FTA Manual for further information on receptor clusters.

Receptor Location

Each receptor cluster will be represented by a single receptor location. The location of this receptor within the cluster shall represent the "worst case" condition allowing for a conservative estimate for the receptor cluster. For these representative receptors, and for stand-alone receptors, the distance to the railroad tracks will be measured from the frequent exterior use area facing the noise source for noise predictions. When the land use is Category 2, (residences and buildings where people normally sleep), the frequent exterior use area may be assumed to be approximately six feet from the side of the building facing the noise source, unless there is an identifiable frequent exterior use location closer to the noise source, such as a patio near the back property line of a residence. In those cases, the frequent exterior use location closer to the noise source should be analyzed for impact.

For parks (normally Category 3), use the frequent exterior use locations such as paths, picnic tables, shelters, and ball fields for assessment purposes. For schools, playgrounds are considered frequent exterior use locations.

In determining and abating noise impacts, primary consideration is given to exterior areas. Abatement will usually be necessary only where frequent human use occurs and a lowered noise level would be of benefit. In those situations where there are no exterior activities to be affected, or where the exterior activities are far from or physically shielded in a manner that prevents an impact on exterior activities, FHWA's interior criterion will be used as the basis for determining noise impacts. For those Category 2 (hospitals only) and 3 receptors without any identifiable areas of frequent exterior use, interior noise levels will be evaluated based upon the noise level at the face of the building less the appropriate noise reduction factor, rather than six feet from the building, as discussed in Section 5, Interior Noise Assessment. The exception to this is for Land Use Category 2, residential receptors, where interior assessments are not required and an exterior location will always be evaluated based on the location most likely used for outdoor use.

The receptor elevation is not a factor in the *General Noise Assessment* as the model input only includes the horizontal distance between the source and the receptor; however, the receptor elevation (i.e. floor) in a multi-story building should be considered when evaluating the "worst-case" receptor location in the *Detailed Noise Analysis*. Elevated track locations have the potential to generate higher noise levels above the ground floor level.

For multi-story, multi-resident buildings (e.g., apartments) and/or their common areas, the area(s) of frequent use must be analyzed for impacts. The area of frequent human use will be exterior areas. In some instances, balconies/patios may be present that must be analyzed because they are identified as areas of frequent human use. In other instances, balconies may not exist or may have very limited use, but instead, common areas (e.g., pools, picnic areas, playgrounds) are present that must be analyzed because they are identified as areas of frequent human use. There may also be instances where both the balconies and the common area(s) need to be analyzed. Generally, in the case of common areas, impacts to the common area would be considered impacts on the residences of the apartments and each of the receptors/units generally would be considered to have the impact identified at the common area (i.e., all apartments would have the same impact).

If other, public meeting rooms, schools, churches, libraries, hospitals and auditoriums do not have frequent exterior use areas, they also must be assessed for interior noise impacts as described in Section 5, Interior Noise Assessment.

Undeveloped lands should also be considered as potential receptor locations. If the land is to be permitted as a land use meeting one of the land use categories (see Table 4-5), it should be evaluated if it is permitted for development prior to the approval of the environmental document for the project. The undeveloped lands will be considered permitted for development and should be included in the analysis if a building permit was issued/approved before the approval of the environmental document. If an undeveloped land was not included in the initial noise analysis because no building permit had been issued/approved at that time, but a building permit is issued/approved subsequent to the analysis and prior to receiving environmental approval (i.e., approval of the Categorical Exclusion (CE), the Finding of No Significant Impact (FONSI) for an Environmental Assessment, or the Record of Decision (ROD) for an Environmental Impact Statement), the undeveloped land must be assessed for noise and vibration impacts prior to environmental approval.

Information for both noise and vibration receptors can be incorporated into the same exhibits.

4.2.2 <u>Provide CTCO Receptor Information</u>

The sensitive receptors identified in the screening process will be provided to the CTCO for the purpose of generating the train traffic data needed for the noise and vibration evaluation. The identified areas selected for analysis are to be shown on an exhibit and the information specific to the receptor location summarized in a table. The following shall be provided to the CTCO:

Example Project EX-1

Appendix D, Exhibit 4 depicts an example table presenting the receptor information table to be provided to CTCO. This will be used to generate the receptor database and generate the train traffic data for the noise and vibration assessment.

- State plane coordinates, address and unique identifying number for the individual receptor or representative receptor in a cluster.
- Aerial photography depicting the individual receptor or cluster, including the representative receptor.
- Addresses or ranges of addresses of all receptors within a cluster.
- Identification of all tracks in the vicinity of the project that may be affecting the receptors for which train traffic information is needed.

> ***Example Project EX-1***
>
> **If the CREATE Program affects train traffic on Track 1 but does not affect train traffic on Tracks 2, 3 and 4, the train noise from non-CREATE trains operating on Tracks 2, 3 and 4 will be included in the background noise level.**
>
> **If the CREATE Program affects train traffic on Tracks 1, 2, 3 and 4, the train noise from train operations on those tracks will be included in the CREATE Program train noise levels.**

4.2.3 Determine Background Noise Levels

Background noise levels have to be determined to perform noise assessments at receptors with frequent exterior use areas. Determining background noise levels is not required when performing interior noise assessments for Improvement to Existing Rail Corridor Projects. For these project types, interior noise impacts are based solely on CREATE Program Train Noise Levels. Therefore, for those non-residential receptors without identifiable exterior use areas, proceed to Section 4.2.4 to predict CREATE Program Train Noise Levels without determining background noise levels. Determining background noise levels may be required when performing interior noise assessments for New and Re-introduced Rail Corridor Projects. If the CREATE Program Train Noise Level (Design Year) is below the interior noise impact threshold (51 dB(A)), the CREATE Program Train Noise Level (Design Year) will be compared to the existing background noise level to determine if there is an impact. If the CREATE Program Train Noise Level (Design Year) is more

> ***Example Project EX-1***
>
> **Appendix E, Exhibit 5 presents the one-minute L_{eq} (dB(A)) values measured at a receptor location (as an example). One train passed the meter during a five-minute period (minute 15 to minute 19). The monitoring session was extended five minutes from 60 minutes to 65 minutes to collect a full 60-minute period with no trains. The noise data with the train present was removed from the data set.**
>
> **Each of the remaining one-minute L_{eq} values was then converted to an equivalent sound pressure. The average equivalent sound pressure was then converted back to a decibel noise level to determine the overall hourly L_{eq} value for this session (66.3 dB(A)) and represents the background noise level. If the measurement occurred between 7 am and 7 pm, the estimated L_{dn} value would be 64.3 dB(A) (66.3 – 2 = 64.3 which would then be rounded to 64 dB(A)). Correction factors are in Appendix D of the FTA manual.**

than 14 dB(A) above the existing background noise level, an impact occurs. Refer to Section 5, Interior Noise Assessments, for further details.

The FTA recognizes six options for determining existing noise for various land uses. These methods are described in the FTA Manual (Appendix D, *Determining Existing Noise*) and include look-up tables (Table 5-7, *Estimating Existing Noise Exposure for General Assessment*) and varying noise monitoring approaches. Given the urban setting of the CREATE Program, accurately estimating existing noise levels is important. Background noise contributions from adjacent expressways, local streets, and other rail sources need to be identified as part of estimating the existing noise levels. The background noise level determined for the existing condition will be used as the background noise level for the no-build and build scenario evaluations.

For CREATE projects on new or re-introduced rail corridors, accurately estimating the existing noise levels includes capturing only background noise sources, as there is no train activity in the project corridor. For CREATE projects that improve existing corridors, accurately estimating the existing noise levels includes capturing both the background noise sources (that is, exclusive of CREATE Program train noise, such as highways, local roads, airport traffic, industrial activity, etc.) and the existing noise from CREATE Program train traffic (commuter and freight). CREATE Program train traffic can consist of two components: (1) CREATE program trains on tracks affected by the project, and (2) CREATE program trains on adjacent CREATE projects.

For the purpose of assessing CREATE projects, the following modified noise monitoring methods will be used:

Noise Monitoring Approach (Modified FTA Option 1 and Option 4)

If CREATE freight and commuter/passenger train traffic information is provided by the CTCO for the existing scenario, noise monitoring will be used to evaluate the background noise levels using Option #1 for non-residential land uses on page D-2 of Appendix D and Option #4 for residential land uses on page D-3 of Appendix D in the FTA Manual. The FTA appendix is included in Appendix C. These options use one-hour noise monitoring periods to measure the hourly L_{eq}. For residential land uses (Option #4), the L_{dn} will be computed from the hourly L_{eq}. The noise monitoring results will be modified to account for the noise sources other than the CREATE freight or CREATE commuter trains using the corridor adjacent to the potentially affected land use if CREATE freight or commuter train traffic information is provided by the CTCO.

If CREATE freight or commuter train traffic information is not provided by the CTCO for the existing scenario, the noise monitoring will have to account for all noise sources including the CREATE freight and commuter train noise sources. In these circumstances, the noise monitoring period will be determined on a case-by-case basis.

Methodology Used when CREATE Freight and Commuter Train Traffic Information is Provided by the CTCO for the Existing Scenario

Step 1 - Monitor noise levels at the receptor locations for approximately one hour while recording the independent one-minute L_{eq} values. Record the time interval when CREATE Program trains (i.e. trains traveling on tracks affected by the CREATE Program) pass the meter and extend the one-hour interval by the train event time length. (See example project discussion.)

Step 2 - Remove the one-minute L_{eq} values from the data set for the time interval(s) the CREATE Program train pass-by events occurred. Then calculate the hourly L_{eq} from the remaining data. This is the background existing noise level if evaluating land use categories 1 or 3 (non-residential). For land use category 2 (residential), use the conversion method in Appendix D (Page D-4) of the FTA Manual to convert the hourly L_{eq} to an L_{dn} value.

> Note: If there are adjacent tracks that are not affected by the CREATE Program and trains are using the track during the noise monitoring, the train information (number of trains, number of cars and locomotives per train, speed, and distance from monitor) for these lines should be recorded. These trains then become part of the background noise level. This is to assure the existing non-CREATE Program train traffic on the adjacent lines is captured in the background noise level.

If CREATE freight and commuter/passenger train traffic information for the existing scenario is not provided by the CTCO, the methodology for estimating existing scenario noise levels, including monitoring requirements, will be determined on a case-by-case basis.

Alternative Method for Describing Background Noise along Heavily Used Rail Corridors when CREATE Freight and Commuter Train Traffic Information is Provided by the CTCO for the Existing Scenario

The method outlined above is the preferred method as it allows the capture of background noise conditions through noise monitoring. However, it requires the availability of sufficient time for a representative measurement when no CREATE Program trains are using the tracks affected by the CREATE Program. This may not be practical along heavily used corridors where within an hour period, the train pass-by events may extend 15 minutes or more.

Noise monitoring can be limited to 60 minutes along corridors where the noise monitoring period may have extended CREATE Program train events (15 minutes or more). During the monitoring period, the CREATE Program train information will be recorded (number of trains, number of locomotives and railcars, distance to noise monitor, and the approximate speed). The noise contribution of the CREATE Program trains during the one-hour period will be estimated using the CREATE general assessment spreadsheet and the actual CREATE Program train information collected during the one-hour period. The noise level predicted with the CREATE general assessment spreadsheet will be subtracted from the measured hourly noise level (L_{eq}) to predict the background noise level when performing a *General Noise Assessment*. The noise level predicted with the CREATE detailed analysis spreadsheet will be subtracted from the measured hourly noise level (L_{eq}) to predict the background noise level when performing a *Detailed Noise Analysis*.

Noise Exposure Computations from Partial Measurements

Measurements can be made at some receptors and then these measurements can be used to estimate noise exposure at nearby receptors. In general, it is preferable to take noise measurements at each receptor, or at each representative receptor in a cluster; however, measurements at one receptor can be used to represent the noise environment at other receptors, but only when proximity to major noise sources is similar among the receptors. If this methodology is proposed, documentation should be provided outlining the rationale for using representative measurement sites. Typical situations where representative measurement sites can be used to estimate noise are included in the FTA Manual, Section 6.6.3.

4.2.4 <u>Predict Existing, No-Build and Build CREATE Program Train Noise Levels</u>

CREATE Program Train Noise Levels have to be predicted to perform noise assessments at receptors with frequent exterior use areas and for non-residential receptors with no identifiable frequent exterior use areas.

In general, the CTCO, using the train model developed for the CREATE Program, will generate existing and future (design year) train traffic data for the existing, no-build and build scenarios for each CREATE project. This model provides freight traffic data from noon Wednesday to noon Sunday, a period of 96 hours. The train data provide the arrival and departure time for each train, the train speed, the number of rail cars, the length and weight of each train, and the number of locomotives used for each train. These data are provided for each receptor location for each track affected by the CREATE Program adjacent to the receptor location.

Example Project EX-1

Appendix E, Exhibit 6 depicts example CTCO data for one track adjacent to one receptor. This represents an example set of data that will be prepared for each track segment in front of each receptor location. Data will be provided by CTCO for the existing, no-build and build condition. For each receptor location, the train data for each track will need to be included in the noise predictions.

If CREATE freight or commuter/passenger train traffic information is not provided by the CTCO for the existing scenario, noise monitoring will be required to obtain CREATE Program Train Noise Levels for both freight and commuter/passenger trains. In these circumstances, the noise monitoring period will be determined on a case-by-case basis.

The following approach will be used to calculate the rail characteristics for the number of trains, speed, number of engines and number of cars. All of these factors are needed as inputs to the noise and vibration analyses. The rail characteristics determined using the following approach will be input into the CREATE general assessment spreadsheet along with the distance between the receptor locations and the tracks to predict the train noise levels.

Approach for L_{dn} Estimation

1. The consultant will determine the peak traffic day, (Thursday, Friday or Saturday). Wednesday and Sunday are not to be considered as part of the evaluation due to limitations of the train traffic prediction model. The day with the peak number of trains will be used for the analysis.

2. For both the daytime (7 am to 10 pm) and nighttime periods (10 pm to 7 am), the following values will be calculated:

    a. Average speed
    b. Average number of locomotives per train
    c. Average length of railcars per train
    d. Average number of trains per hour

3. The length of cars will be calculated based upon the total train length and average length of locomotives (75 feet) using the following formula:

Length of Railcars = Total train length (ft) – (No. of Locomotives * 75 ft)

Variation for L_{eq} Estimation

For receptor locations where the L_{eq} noise metric is used, the CTCO data will need to be evaluated to predict the peak hour train volume that corresponds to the hours of receptor noise-sensitivity. The above listed data will need to be calculated for the peak hour.

Approach for L_{max} Estimation

The L_{max} is the maximum A-weighted sound level for a single pass by event. The L_{dn} and L_{eq} noise metrics will be used to determine the potential noise impacts; however, computation of the L_{max} for the existing, build and no-build alternatives provides a more complete description of the noise effects of the proposed project. Appendix F of the FTA Manual provides the formulas for calculating L_{max} for the locomotives and for the railcars.

The L_{max} calculation is based on the reference sound exposure level (SEL_{ref}), distance between the noise receptor and tracks, the speed and the length of locomotives or railcars. Determination of the project L_{max} will likely require computing the L_{max} for several combinations of distance, speed and length. The SEL_{ref} values for the various noise sources are provided in the *CREATE Railroad Noise Model User Guide* (Table 1) provided in Appendix B. The project documentation will report the L_{max} for the receptor location with the highest L_{max} value and indicate the noise source (locomotive or railcar). In order to determine which receptor location has the highest L_{max} value, L_{max} will be calculated for each receptor requiring a *Detailed Noise Analysis.*

Additional Noise Inputs for the General Noise Assessment

Other potential noise sources within a corridor include idling trains, horn noise, track crossovers, and worn wheels. All of these can occur under existing and future conditions on the rail lines. The CREATE general assessment spreadsheet includes input for additional noise sources not included in the original FTA general assessment spreadsheet, including idling trains and track crossovers.

<u>Idling Trains</u> - The hourly L_{eq} or L_{dn} value should be estimated for the idling train using the CREATE general assessment spreadsheet. The idling train noise source is identified as “layover track”. The inputs for the layover track include distance (between locomotives and receiver) and number of trains per hour. The CTCO data will identify idling trains as trains with different “HE Arrival” and “HE Departure” times. The noise assessment should capture idling noise and add that component to the *General Noise Assessment*. The proposed projects will likely reduce idling activity; however, there may be new locations where trains are staged.

<u>Horn Noise</u> - The hourly L_{eq} or L_{dn} value can be estimated for horn noise using the SEL_{REF} provided in the FTA Manual (Table 6-3, *Source Reference SELs at 50 feet: Fixed Guideway Sources at 50 mph*). The noise assessment should capture horn noise (i.e. grade crossings) and add that component to the *General Noise Assessment*. The proposed projects will likely reduce horn noise activity; however, there may be new locations where trains are staged. Horn noise associated with locomotive startup for idling trains is considered short in duration and will not be included in the noise assessment.

<u>Worn Wheels</u> - One variation between the evaluation of commuter train traffic and freight train traffic is the variability of wheel maintenance between carriers. In addition, one train may have rail cars from several different freight carriers. The likelihood of worn wheels on a freight train is greater when compared to commuter rail lines. To account for the higher probability of worn wheels, the CREATE general assessment freight railcars noise source includes an input for the percentage of worn wheels. Unless project specific data are available, the percentage of worn wheels should be input as 1%.

<u>Track Crossovers</u> – Track crossovers include switches, turnouts, crossing diamonds, or other track irregularities that create a wheel to rail impact, which would potentially increase the noise level. The CREATE general assessment spreadsheet includes track crossovers as a noise source. Inputs for this noise source include distance (between the track crossover and the receptor), the number of trains per hour using the crossover (day and night), and the average duration of train pass-by events in seconds (day and night). The average pass-by duration can be determined based on the average train length and average train speed.

As noted in Section 4.2.3, interior noise impacts are based solely on CREATE Program Train Noise Levels. Therefore, for those non-residential receptors without identifiable frequent exterior use areas, predict CREATE Program Train Noise Levels as follows:

For New and Re-introduced Rail Corridor Projects, there are no existing or no-build CREATE Program Train noise levels. Therefore, only the Build Scenario CREATE Program Train Noise Level (Design Year) will have to be predicted. Build Scenario CREATE Program Train Noise Level (Design Year) includes all train noise from build scenario (design year) trains operating on CREATE Program tracks.

For Improvement to Existing Rail Corridor Projects, CREATE Program Train Noise Levels will be predicted for the existing, no-build and build scenarios as follows:

1. Existing Scenario CREATE Program Train Noise Level includes all train noise from existing trains operating on tracks affected by the CREATE Program.
2. No-Build Scenario CREATE Program Train Noise Level (Design Year) includes all train noise from no-build scenario (design year) trains operating on tracks affected by the CREATE Program.
3. Build Scenario CREATE Program Train Noise Level (Design Year) includes all train noise from build scenario (design year) trains operating on tracks affected by the CREATE Program.

For non-residential receptors without identifiable frequent exterior use areas, proceed to Section 5, Interior Noise Assessments. For receptors with frequent exterior use areas, proceed to Section 4.2.5.

4.2.5 Predict Overall Existing, No-Build and Build Noise Levels at Receptors with Frequent Exterior Use Areas

Noise assessments will be performed for the existing, no-build and build scenarios. Based on the methodology presented in Section 4.2.3, the background noise level can be predicted at each receptor location based on measurements at the site, or representative data from a similar receptor site (see Section 4.2.3 Determine Background Noise Levels, subsection "*Noise Exposure Computations from Partial Measurements*").

For New and Re-introduced Rail Corridor Projects, the noise levels for the existing and no-build scenarios will be identical; therefore the noise evaluation will predict two noise levels, which are reported as whole numbers, for the scenarios as follows:

4. Existing and No-Build Scenario Noise Level (Background Noise Level)
5. Build Scenario CREATE Program Train Noise Level (Design Year)
    - Build Scenario CREATE Program Train Noise Level (Design Year) includes all train noise from build scenario (design year) trains operating on tracks affected by the CREATE Program.

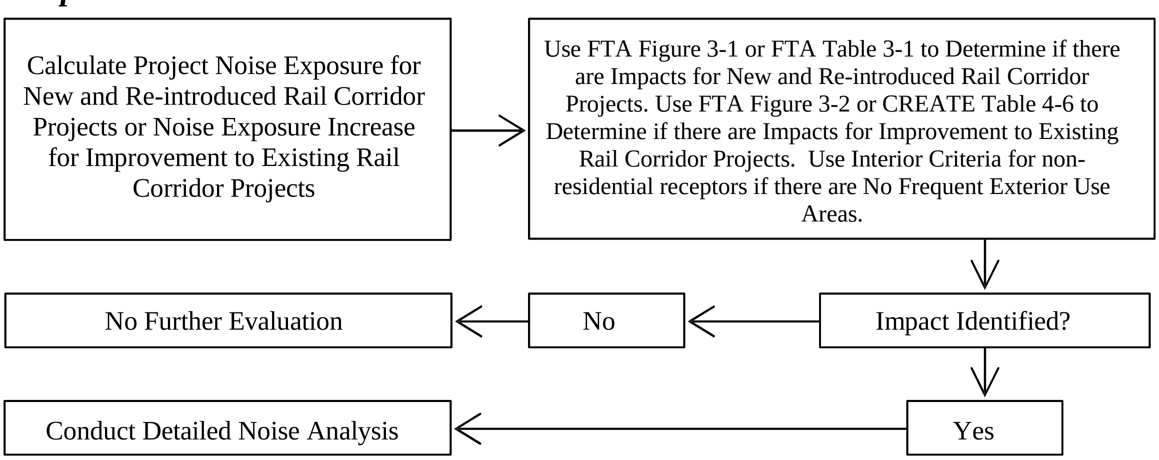
For Improvement to Existing Rail Corridor Projects, the noise evaluation will predict noise levels for the existing, no-build and build scenarios. The noise levels for each scenario are determined by adding the background noise level to each of the three CREATE Program train noise levels as follows:

1. Existing Scenario Noise Level (Background Noise Level + Existing Scenario CREATE Program Train Noise Level)
    - Background Noise Level includes all non-train noise and all train noise from trains operating on tracks not affected by the CREATE Program.
    - Existing Scenario CREATE Program Train Noise Level includes all train noise from existing trains operating on tracks affected by the CREATE Program.
2. No-Build Scenario Noise Level (Background Noise Level + No-Build Scenario CREATE Program Train Noise Level (Design Year))
    - No-Build Scenario CREATE Program Train Noise Level (Design Year) includes all train noise from no-build scenario (design year) trains operating on tracks affected by the CREATE Program.
3. Build Scenario Noise Level (Background Noise Level + Build Scenario CREATE Program Train Noise Level (Design Year))
    - Build Scenario CREATE Program Train Noise Level (Design Year) includes all train noise from build scenario (design year) trains operating on tracks affected by the CREATE Program

The impact evaluation is presented in the following section (Section 4.3). As part of the NEPA documentation, the existing, no-build, and build noise levels will be presented with a narrative and supporting table.

4.3 Noise Impact Evaluation

Impact Evaluation



Exterior Areas

The noise impact evaluation outlined in the FTA Manual is based on the comparison of the existing noise levels to the *proposed project noise level*. The impact criteria as presented in Figure 3-1 (*Noise Impact Criteria for Transit Projects*) in the FTA manual are most applicable to areas without existing rail activities. For CREATE projects on new and re-introduced rail corridors, Figure 3-1 or Table 3-1 in the FTA Manual will be used for evaluating potential CREATE Program noise impacts. Figure 3-1 and Table 3-1 from the FTA Manual are included in Appendix C.

Most of the CREATE projects improve existing active rail systems and have an existing train noise contribution that will be present in the build condition. For this reason, Figure 3-2 (*Increase in Cumulative Noise Level Allowed by Criteria (Land Use Cat. 1& 2)*) in the FTA manual can be used for evaluating potential CREATE Program noise impacts on the majority of the CREATE projects; however, Figure 3-2 does not include impact criteria for land use Category 3. Table 4-6, Cumulative Noise Level Increase Allowed by FTA Noise Impact Criteria, includes impact thresholds for Categories 1, 2 and 3, and therefore should be used instead of Figure 3-2 in the FTA Manual to determine impacts for Improvement to Existing Rail Corridor Projects.

TABLE 4-6
Cumulative Noise Level Increase Defining FTA Noise Impact Criteria

Existing Noise Exposure	Impact Threshold for Increase in Cumulative Noise Exposure (dB(A))					
	Category 1 or 2 Sites			Category 3 Sites		
L_{eq} or L_{dn}	No Impact	Impact	Severe Impact	No Impact	Impact	Severe Impact
45	<9	9-14	>14	<13	13-19	>19
46	<8	8-13	>13	<13	13-18	>18
47	<8	8-12	>12	<12	12-17	>17
48	<7	7-12	>12	<11	11-16	>16
49	<7	7-11	>11	<11	11-16	>16
50	<6	6-10	>10	<10	10-15	>15
51	<6	6-10	>10	<9	9-14	>14
52	<5	5-9	>9	<9	9-14	>14
53	<5	5-8	>8	<8	8-13	>13
54	<4	4-8	>8	<8	8-12	>12
55	<4	4-7	>7	<7	7-12	>12
56	<4	4-7	>7	<7	7-11	>11
57	<4	4-6	>6	<7	7-10	>10
58	<3	3-6	>6	<6	6-10	>10
59	<3	3-5	>5	<6	6-9	>9
60	<3	3-5	>5	<6	6-9	>9
61	<3	3-5	>5	<5	5-9	>9
62	<3	3-4	>4	<5	5-8	>8
63	<3	3-4	>4	<5	5-8	>8
64	<3	3-4	>4	<5	5-8	>8
65	<2	2-4	>4	<4	4-7	>7
66	<2	2-4	>4	<4	4-7	>7
67	<2	2-3	>3	<4	4-7	>7
68	<2	2-3	>3	<4	4-6	>6
69	<2	2-3	>3	<4	4-6	>6
70	<2	2-3	>3	<4	4-6	>6
71	<2	2-3	>3	<4	4-6	>6
72	<2	2-3	>3	<3	3-6	>6
73	<2	2	>2	<3	3-5	>5
74	<2	2	>2	<3	3-5	>5
75	<1	1-2	>2	<2	2-5	>5

L_{dn} is used for land uses where nighttime sensitivity is a factor;
Maximum 1-hour L_{eq} is used for land use involving only daytime activities.

The use of Figures 3-1 and 3-2 (FTA Manual), and Table 4-6 is for exterior locations and will require the use of two noise levels to conduct the impact evaluation. The following outlines the general procedure to evaluate the potential noise impacts for exterior use areas:

New and Re-introduced Rail Corridor Projects

1. Determine the project noise exposure based on the train traffic data provided by the CTCO. This is determined by calculating the CREATE Program Build Train Noise Level (Design Year).

2. Determine the potential for an impact from FTA Figure 3-1 or FTA Table 3-1 using the Existing Scenario Noise Level (background noise level) and the project noise exposure determined in Step 1 above.

3. Determine if the project noise exposure generates no impact, a moderate impact, or a severe impact.

Improvement to Existing Rail Corridor Projects

1. Determine the noise exposure increase due to the implementation of the CREATE Program based on the train traffic data provided by CTCO. This is determined by arithmetic subtraction of the Existing Scenario Noise Level from the Build Scenario Noise Level.

Build Scenario Noise Level (dB(A)) – Existing Scenario Noise Level (dB(A)) = Noise Exposure Increase

2. Determine the potential for an impact from CREATE Table 4-6 or FTA Figure 3-2 using the Existing Scenario Noise Level (X-axis) and the noise exposure increase (Y-axis) determined in Step 1 above.

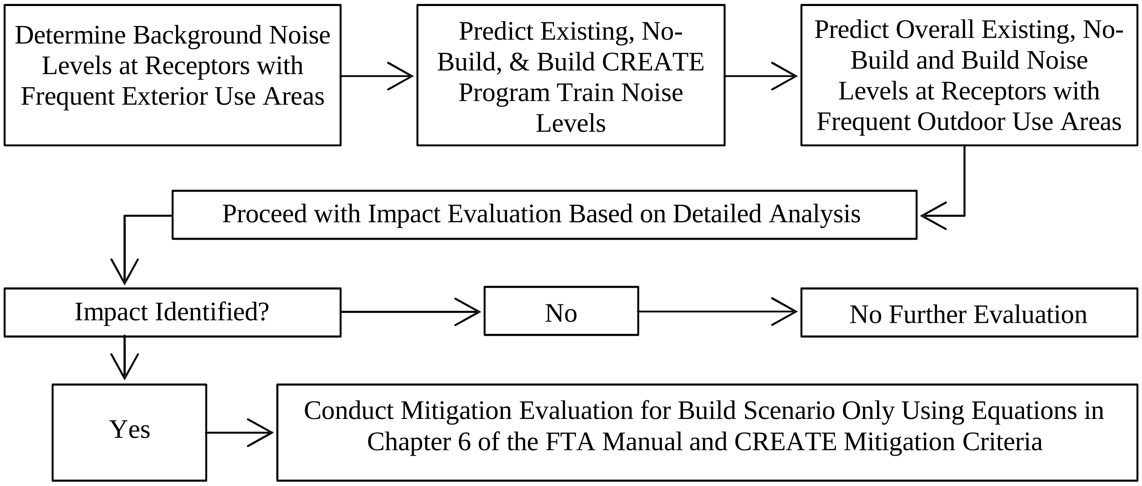
3. Determine if the noise exposure increase generates no impact, a moderate impact, or a severe impact.

If an impact is determined to occur using the *General Noise Assessment* methodology, then a *Detailed Noise Analysis* is required which will use additional project information to refine the predicted noise levels. The impact evaluation outlined in this section (Section 4.3) will be conducted again using the refined build and existing noise levels.

Interior Areas
As previously noted, the methodology for evaluating interior noise impacts is included in Section 5.

4.4 Detailed Noise Analysis

Detailed Noise Analysis (Tier 3)



The *Detailed Noise Analysis* is the third tier in the FTA noise impact assessment methodology and is conducted when noise impacts are determined using the *General Noise Assessment*. The *Detailed Noise Analysis* uses additional receptor and track information to refine the noise analysis results. The FTA methodology in Chapter 6 of the FTA Manual provides the approach used to collect and analyze the additional data. Once the overall existing, no-build, and build noise levels are predicted using the *Detailed Noise Analysis*, the impact evaluation presented in Section 4.3 is used to re-evaluate the potential noise impacts. The re-evaluation is only necessary for those receptors where impacts were identified in the *General Noise Assessment*.

The determination of noise impacts using the *Detailed Noise Analysis* warrants the evaluation of noise mitigation for the project at the impacted receptor locations using the mitigation criteria included in Section 4.5 of these procedures. The effects of incorporating noise mitigation measures into the proposed project can be predicted using the FTA Manual (*Detailed Noise Analysis*).

4.5 Mitigation Discussion

In general, mitigation evaluation will be based upon the full build condition of the CREATE Program. Any exceptions to this approach will be reviewed on a case-by-case basis. Mitigation based on the full build condition is necessary, as isolating the impacts of individual projects on receptors is generally not feasible.

The *Detailed Noise Analysis* in the FTA manual provides equations for evaluating noise barriers. When there is a noise impact, noise abatement must be considered subject to the following criteria:

1. ***Feasibility***

- Feasibility generally addresses the engineering aspects of implementing a noise barrier. This includes considerations for operations, safety, drainage, and utilities.

- Noise mitigation measures must provide a Build Scenario CREATE Program Train Noise Level (Design Year) noise reduction of at least five (5) dB(A) (both exterior and interior) for the mitigation measure to be considered feasible.

2. ***Reasonableness***

- Cost-Effectiveness: For exterior moderate impacts, noise mitigation measures must not exceed a cost of $5,000 per benefited receptor for each decibel meeting and exceeding the moderate impact threshold up to a total limit of $30,000 per benefited receptor. For exterior impacts that are severe, noise walls must not exceed a cost of $30,000 per benefited receptor for which a severe impact has been identified. This can include receptors located above ground-floor elevation in multi-story buildings (e.g., second-floor apartments).

- Cost-Effectiveness: For interior impacts, noise mitigation measures must not exceed a cost of $5,000 per benefited receptor for each decibel exceeding the Existing Scenario CREATE Program Train Noise Level up to a total limit of $30,000 per benefited receptor.

- Viewpoints of Benefited Receptors: For interior and exterior impacts, the viewpoints of benefited receptors shall be solicited to determine their desire for implementation of the noise mitigation measures. The viewpoint responses will be used as a component of the reasonableness criteria. Further details of the viewpoint solicitation process can be found in Section 10.

Generally, the barrier should extend four times as far in each direction as the distance from the receiver to the barrier. In some circumstances, shielding from other structures may allow the length of the barrier to be less than four times as far in each direction as the distance from the receiver to the barrier.

Noise mitigation measure costs are based on a $25.00 per square foot unit cost for walls up to and including 15 feet tall; $37.50 per square foot up to and including 30 feet tall, and $50.00 per square foot up to and including 45 feet tall. In some cases, additional costs such as land acquisition or additional civil and structural work may be necessary to implement a feasible noise wall. When these situations arise, the additional costs could be included as part of the analysis to determine reasonableness (cost-effectiveness) of the noise mitigation. The analysis should include making a determination as to the lowest cost of installing a feasible noise barrier based on the proposed site conditions. For example, in some cases, it may be less costly to install a taller noise wall; however, in other cases, it may be less costly to make minor modifications (i.e., additional civil and/or structural work). Table 4-7 contains example unit costs for additional civil and structural work that could be used in the analysis. If the additional work necessary to implement a feasible noise wall includes work not listed in Table 4-7, it may be appropriate to use other justified unit costs to reflect the actual scope of proposed work. These considerations should be coordinated in advance with IDOT and FHWA and the documentation supporting the use of these unit costs will be required.

TABLE 4-7
Example Unit Costs for Additional Civil and Structural Work

Description	Unit	Estimated Unit Cost
Furnished Fill	Cubic Yard	$41
The equipment, material and labor necessary to install fill to sub-base elevations, compacted to specifications and ready to receive sub-ballast, ballast, roadway base course, as required for completing final grading and or installing transportation systems. Clearing, grubbing and landscaping is incidental to embankment work.		
Vehicular bridge	Square Foot	$358
The equipment, material and labor necessary to perform structural excavation, install foundations, substructures, concrete, structural steel, stone and waterproofing as required to construct a highway bridge structure.		
Tall Cast-In-Place Retaining Wall Installation (>15'): E-80 loading	Square Foot	$360
The equipment, material and labor necessary to construct a cast-in-place concrete retaining wall complete with foundation to accommodate E-80 loading. Includes excavation, backfill above the heel.		
Cast in place retaining wall: Highway loading	Square Foot	$342
The equipment, material and labor necessary to construct a cast-in-place concrete retaining wall complete with foundation to accommodate highway loading. Includes excavation, backfill above the heel.		

For exterior impacts, a benefited receptor is defined as a receptor with predicted noise impacts and that receives a Build Scenario CREATE Program Train Noise Level (Design Year) noise reduction of five (5) dB(A) or more. For interior impacts, a benefited receptor is defined as a receptor with predicted noise impacts and that receives an interior Build Scenario CREATE Program Train Noise Level (Design Year) noise reduction of five (5) dB(A) or more. This can include receptors located above ground-floor elevation in multi-story buildings (e.g. second-floor hospital rooms).

Multi-story, Multi-Resident Buildings

For multi-resident buildings, each unit (i.e., apartment) afforded at least a 5 dB(A) noise reduction would represent one benefited receptor. When analyzing abatement for common areas, generally consider all units to be benefited if a noise reduction of five (5) dB(A) or more is achieved at the common area.

Existing noise levels for above ground floors may be modeled when balconies are present. Actual measurements do not have to be taken above ground levels.

Mitigation should not be excluded for lower floor impacts merely on the basis that mitigation cannot be provided for upper floor impacts. In any instance, mitigation should be analyzed to benefit as many floors and units as possible.

Non-residential Buildings

If impacts are identified for motels, hotels, public meeting rooms, schools, churches, libraries, hospitals or auditoriums, mitigation shall be considered. If school playgrounds are determined to have moderate or severe impacts, generally the number of classrooms facing the noise source will be used as the number of benefited receptors for the purpose of determining whether noise mitigation measures are reasonable. If an impacted playground is not located between the school and the noise source, contact FHWA/IDOT for further guidance.

Other Noise Mitigation Strategies

Noise barriers are generally the most practical noise mitigation option given their overall effectiveness and the ability to incorporate the option on railroad right-of-way; however, they may not meet the feasible (5 dB(A) Build Scenario CREATE Program Train Noise Level (Design Year) noise reduction) or reasonable (cost-effectiveness) criteria based on site characteristics or constraints.

Acquisition of real property or interests therein (predominantly unimproved property) may be used as a noise mitigation strategy to serve as a buffer zone to preempt development which would be adversely impacted by noise.

The use of noise insulation to mitigate noise impacts for non-residential receptor locations shall be discussed with FHWA on a case-by-case basis.

If none of these measures are determined to be feasible or reasonable, noise abatement measures other than these may be proposed on a case-by-case basis.

Noise Abatement Documentation

A project's noise and/or vibration impacts may need to be re-assessed if there are revisions to the CREATE Program or to the project that may cause the results of the noise and/or vibration assessment to change. Therefore, the following statement will be included in all CREATE Program environmental documents:

> “The noise and/or vibration analyses for this project may need to be reassessed if: a) the project is revised in a manner in which impacts of the project may change due to the project revisions (e.g., a new track alignment is moved closer to a receptor), or b) the CREATE Program's train model is updated due to projects being removed or added to the CREATE Program.”

The following statement will be included in all CREATE Program environmental documents where noise mitigation measures are deemed feasible and reasonable:

> "Based on the noise analysis, noise abatement measures are likely to be implemented based on the preliminary design. The noise barriers determined to meet the feasible and reasonable criteria are identified in Table (reference table). If it subsequently develops during final design that constraints not foreseen in the preliminary design occur, or public input substantially changes reasonableness, the abatement measure may need to be modified or removed from the project plans. A final decision on the installation of the noise abatement measure(s) will be made upon the completion of the project's final design and the public involvement process."

5. INTERIOR NOISE ASSESSMENT

If there are no exterior activities to be affected by the project noise (e.g., a school with no outdoor common areas), or where the exterior activities are far from or physically shielded from the project in a manner that prevents an impact on exterior activities, FHWA's interior criterion will be used as the basis of determining noise impacts for non- residential receptor locations.

In this circumstance, L_{eq} will be calculated to determine impacts. The predicted interior Build Scenario CREATE Program Train Noise Level (Design Year) may be derived by subtracting the noise reduction factor for the building in question from the computed exterior Build Scenario CREATE Program Train Noise Level (Design Year). If field measurements of these noise reduction factors are obtained or the factors are calculated from detailed acoustical analyses, the measured or calculated reduction factors should be used. In the absence of such calculations or field measurements of noise reduction, the noise reduction factor may be obtained from the following table:

TABLE 5-1
Building Noise Reduction Factors due to Building Exteriors

Building Type	Window Condition	Structure Reduction
All	Open	10 dB
Light Frame	Ordinary Sash (closed)	20 dB
	Storm Windows	25 dB
Masonry	Single Glazed	25 dB
	Double Glazed	35 dB

Note: The window shall be considered open unless there is firm knowledge that the windows are in fact kept closed almost every day of the year.
Source: USDOT FHWA, *Highway Traffic Noise: Analysis and Abatement Guidance*, December 2011.

An impact occurs if the interior Build Scenario CREATE Program Train Noise Level (Design Year) is 51 L_{eq}(h) or greater; or if the predicted interior Build Scenario CREATE Program Train Noise Level (Design Year) exceeds the interior Existing Scenario CREATE Program Train Noise Level by more than 14 dB(A). If an impact occurs using the *General Noise Assessment* methodology, then the *Detailed Noise Analysis* methodology will be used with additional project information to refine the predicted interior noise levels. When assessing noise levels for multi-story buildings in the *Detailed Noise Analysis*, the vertical distance between the noise source(s) and the receptor must be a component included in the noise propagation equations. A *Detailed Noise Analysis* of interior noise levels likely will evaluate several floors of multi-story buildings. The impact evaluation outlined in this section will be conducted again during the *Detailed Noise Analysis* using the refined build, no-build and existing interior CREATE Program Train Noise Levels that are developed in the *Detailed Noise Analysis*. Mitigation assessments will be conducted using the procedures and criteria in Section 4.5.

When schools are evaluated for interior noise impacts, each classroom facing the noise source is a receptor, and a library, dining facility or auditorium facing the noise source will be equivalent to two receptors. When churches are evaluated for interior noise impacts, it is a single receptor. When hospitals, nursing homes and other similar facilities are evaluated for interior noise impacts, each room that faces the noise source that has facilities where patients/residents sleep is a receptor.

See Appendix F for additional example exterior and interior noise assessment summary tables.

6. CONSTRUCTION NOISE AND VIBRATION

The following text will be included in all CREATE project environmental documents:

> “Construction Noise and Vibration
>
> The construction of the proposed project could result in temporary noise and vibration increases within and adjacent to the project area. The noise and vibration will be generated primarily from trucks and heavy machinery used during construction. Any anticipated noise and vibration impacts will likely be confined to normal working hours, which are generally considered to be “noise and vibration tolerant” periods. Construction contractors need to be aware of local noise ordinances to assure compliance in Cook County and within the cities that construction activities occur. No adverse noise and vibration impacts are anticipated during the construction phase of the project.”

7. VIBRATION ASSESSMENT

7.1 Introduction

Vibration impacts include both Ground-Borne Vibration and Ground-Borne Noise. Vibration impacts are assessed for a one-time event and based on the maximum vibration level. While the freight locomotives are slightly heavier than the commuter/passenger locomotives, the vibration screening distances included in the FTA Manual, Section 9.2.2, Table 9-2, will be used for freight train and commuter/passenger train evaluations. The screening distances in this table are measured from existing or proposed railroad right-of-way to the receptor (see Appendix D, Exhibit 3). This application of FTA vibration screening distances is with the understanding that the FTA screening distances were developed for commuter/passenger rail projects and may have limitations in their applicability to freight rail projects. Figure 10-1 (*Generalized Ground Surface Vibration Curves*) in the FTA Manual, which is included in Appendix C, depicts the same vibration curve for passenger and freight locomotives. Therefore, the *General Vibration Assessment* methodology included in the FTA Manual is generally applicable to both commuter/passenger and freight rail projects.

The vibration assessment project limits are identical to the noise assessment project limits identified for the noise assessment in Section 4.1.2.

Vibration Screening Procedure

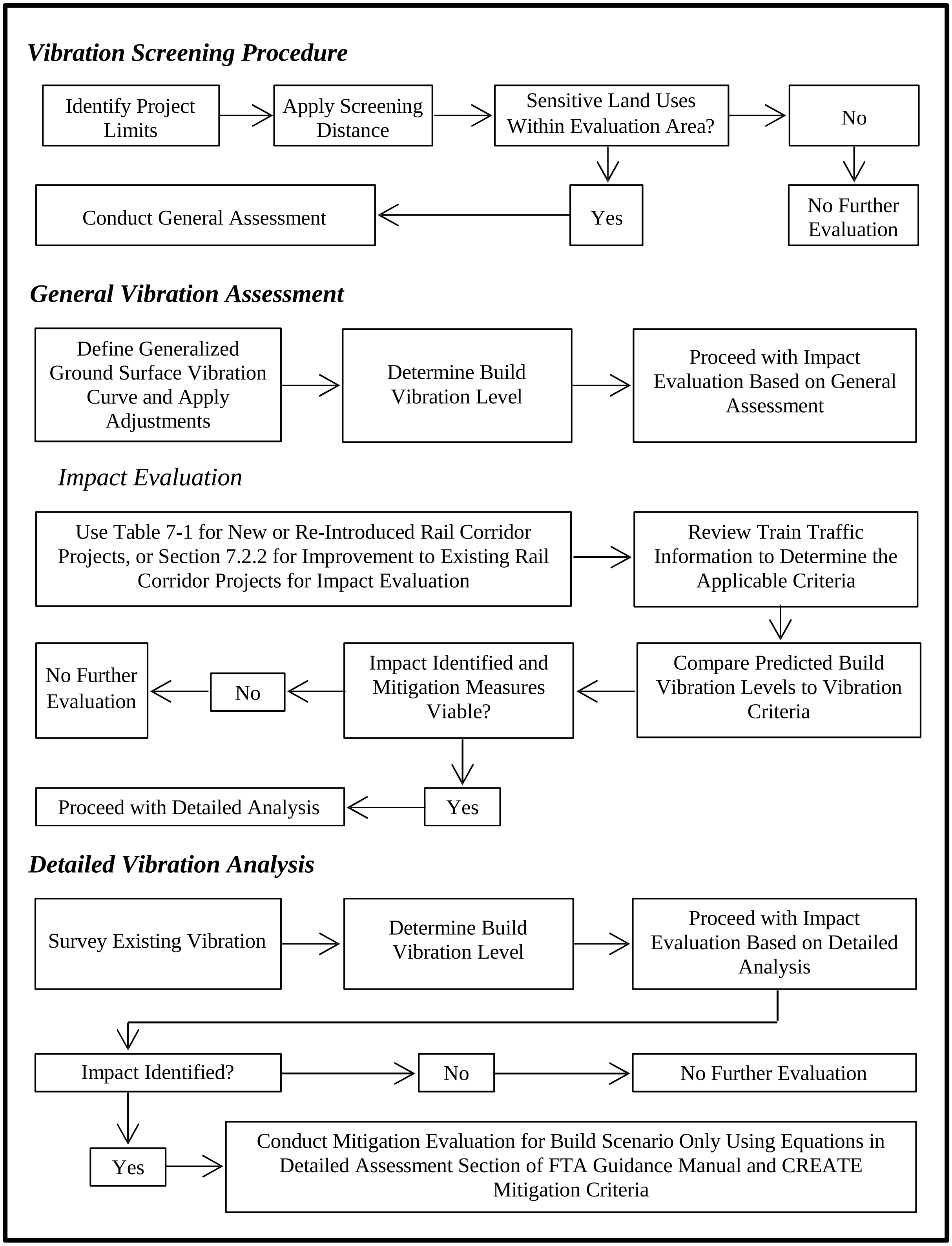
The *Vibration Screening Procedure* follows the methodology presented in the FTA Manual. The screening distances in Table 9-2 (FTA Manual) are applied to the project limits to identify the vibration assessment evaluation area. If there are any sensitive land uses within the vibration evaluation area, a *General Vibration Assessment* is required.

General Vibration Assessment and Detailed Vibration Analysis

The vibration impact evaluation for the CREATE projects generally follows the methodology presented in the FTA Manual; however, a *Detailed Vibration Analysis* may not always be required.

When the *General Vibration Assessment* identifies an impact, the determination as to whether a *Detailed Vibration Analysis* is required will be made on a case-by-case basis. Special track support systems and trenches have not been proven as effective measures for mitigating vibration impacts for freight rail projects, nor for at-grade or elevated heavy-rail commuter/passenger rail projects. Therefore, the only vibration mitigation measures that will be considered for the CREATE Program, other than maintenance programs, are planning and design of special track work and buffer zones. If planning and design of special track work and/or buffer zones are viable mitigation measures for CREATE projects when impacts are identified in the *General Vibration Assessment*, then a *Detailed Vibration Analysis* will be required. If planning and design of special track work and/or buffer zones are not viable mitigation measures for CREATE projects when impacts are identified in the *General Vibration Assessment*, then a *Detailed Vibration Analysis* will not be required. Figure 7-1 depicts the basic flow chart for the vibration assessment.

FIGURE 7-1
CREATE Vibration Assessment Process



7.2 Impact Assessment

7.2.1 Land Use Categories

The criteria for acceptable ground-borne vibration are expressed in terms of rms velocity levels in decibels and the criteria for acceptable ground-borne noise are expressed in terms of A-weighted sound levels. The limits are specified for the three land-use categories defined below:

- **Vibration Category 1 - High Sensitivity:** Included in Category 1 are buildings where vibration would interfere with operations within the building, including levels that may be well below those associated with human annoyance. Concert halls and other special-use facilities are covered separately in FTA Manual, Table 8-2. Typical land uses covered by Category 1 are: vibration-sensitive research and manufacturing, hospitals with vibration-sensitive equipment, and university research operations. The degree of sensitivity to vibration will depend on the specific equipment that will be affected by the vibration. Equipment such as electron microscopes and high resolution lithographic equipment can be very sensitive to vibration, and even normal optical microscopes will sometimes be difficult to use when vibration is well below the human annoyance level. Manufacturing of computer chips is an example of a vibration-sensitive process.

  The vibration limits for Vibration Category 1 are based on acceptable vibration for moderately vibration-sensitive equipment such as optical microscopes and electron microscopes with vibration isolation systems. Defining limits for equipment that is even more sensitive requires a detailed review of the specific equipment involved. This type of review is usually performed during the *Detailed Vibration Analysis* associated with the final design phase and not as part of the environmental impact assessment. Mitigation of transit vibration that affects sensitive equipment typically involves modification of the equipment mounting system or relocation of the equipment rather than applying vibration control measures to the rail project.

  Note that this category does not include most computer installations or telephone switching equipment. Although the owners of this type of equipment often are very concerned about the potential of ground-borne vibration interrupting smooth operation of their equipment, it is rare for computer or other electronic equipment to be particularly sensitive to vibration. Most such equipment is designed to operate in typical building environments where the equipment may experience occasional shock from bumping and continuous background vibration caused by other equipment.

- **Vibration Category 2 - Residential:** This category covers all residential land uses and any buildings where people sleep, such as hotels and hospitals. No differentiation is made between different types of residential areas. This is primarily because ground-borne vibration and noise are experienced indoors and building occupants have practically no means to reduce their exposure. Even in a noisy urban area, the bedrooms often will be quiet in buildings that have effective noise insulation and tightly closed windows. Moreover, street traffic often abates at night when trains continue to operate. Hence, an occupant of a bedroom in a noisy urban area is likely to be just as exposed to ground-borne noise and vibration as someone in a quiet suburban area. The criteria apply to the rail-generated ground-borne vibration and noise whether the source is subway or surface running trains.

- **Vibration Category 3 - Institutional:** Vibration Category 3 includes schools, churches, other institutions, and quiet offices that do not have vibration-sensitive equipment, but still have the potential for activity interference. Although it is generally appropriate to include office buildings in this category, it is not appropriate to include all buildings that have any office space. For example, most industrial buildings have office space, but it is not intended that buildings primarily for industrial use be included in this category.

Table 7-1 (referenced from FTA Manual Table 8-1) shows the land use categories for ground-borne vibration and noise, which are similar to those for noise assessments.

TABLE 7-1
Ground-Borne Vibration (GBV) and Ground-Borne Noise (GBN) Impact Criteria for General Assessment

Land Use Category	GBV Impact Levels[1] (VdB re 1 micro inch/sec)			GBN Impact Levels[1] (dB re 20 micro Pascals)		
	Frequent Events [2]	Occasional Events[3]	Infrequent Events 4[3]	Frequent Events [2]	Occasional Events [3]	Infrequent Events [4]
Category 1: Buildings where low background vibration is essential for interior operations.	**65 VdB[5]**	**65 VdB[5]**	**65 VdB[5]**	**N/A[5]**	**N/A[5]**	**N/A [5]**
Category 2: Residences and buildings where people normally sleep.	**72 VdB**	**75 VdB**	**80 VdB**	**35 dB(A)**	**38 dB(A)**	**43 dB(A)**
Category 3: Institutional land uses with primarily daytime use.	**75 VdB**	**78 VdB**	**83 VdB**	**40 dB(A)**	**43 dB(A)**	**48 dB(A)**

1. An impact occurs if the GBV and GBN levels in the table are achieved or exceeded.
2. "Frequent Events" is defined as more than 70 vibration events per day. For a typical line-haul freight train where the rail car vibration lasts for several minutes, the frequent events criterion should be applied to the rail car vibration. Most rapid transit projects fall into this category.
3. "Occasional Events" is defined as between 30 and 70 vibration events of the same source per day. Most commuter trunk lines have this many operations. Generally this category not applicable to freight rail cars but could apply to freight locomotives.
4. "Infrequent Events" is defined as fewer than 30 vibration events per day. This category includes most commuter rail branch lines. Generally this category is not applicable to freight rail cars but could apply to freight locomotives. The locomotive vibration only lasts for a short time, the infrequent-events criteria are appropriate for fewer than 30 events per day.
5. This criterion limit is based on levels that are acceptable for most moderately sensitive equipment such as optical microscopes. Vibration sensitive manufacturing or research will require detailed evaluation to define the acceptable vibration levels. Ensuring lower vibration levels in a building often requires special design of the HVAC systems and stiffened floors.

Note: Vibration-sensitive equipment is not sensitive to ground-borne noise.

Source: Harris Miller Miller and Hanson, *Transit Noise and Vibration Impact Assessment*, FTA, 2006.

7.2.2 Impact Criteria

Vibrations from locomotives and railcars must be assessed separately for freight rail trains. To determine the unadjusted ground surface vibration for locomotives, use the "Locomotive Powered Passenger or Freight (50 mph)" curve shown in Figure 10-1 (FTA Manual). For freight rail cars, use the "Rapid Transit or Light Rail Vehicles (50 mph)" curve shown in Figure 10-1 (FTA Manual). Adjustment factors for the generalized prediction of ground-borne vibration and noise are included in Table 10-1 (FTA Manual). Once the base curve has been selected, these adjustment factors can be used to develop vibration projections for specific receiver positions inside the buildings. It has been determined that the elevated structure adjustment in Table 10-1 would not be appropriate for embankments and only a -5VdB adjustment should be made for embankments.

If vibration impact levels from either locomotives or rail cars meet or exceed the criteria in Table 7-1, an impact occurs. Vibrations from locomotives and railcars are not assessed separately for commuter/passenger rail trains. If the project being evaluated includes improvements to more than one track, and there are sensitive land uses within the vibration evaluation area, the *General Vibration Assessment* and the *Detailed Vibration Analysis* (if required) must evaluate the track that most closely approaches the impact threshold if no impacts are identified, or the track that exceeds to impact criteria to the greatest degree if impacts are identified.

New or Re-introduced Rail Corridor

Table 7-1 will be used to determine if there are impacts.

Improvement to Existing Rail Corridor

One factor not incorporated in the criteria is how to account for existing vibration. In most cases, the existing environment does not include a substantial number of perceptible ground-borne vibration or noise events. The existing train vibration can be either measured or estimated using the General Assessment procedures in Chapter 10 of the FTA Manual. The most common example of needing to account for the pre-existing vibration is when the project is located in an existing rail corridor. Following are methods of handling representative scenarios:

1. *Infrequently-used rail corridor (existing train volume is fewer than 5 trains per day):* Use the general vibration criteria, Table 7-1, to determine whether the Build Scenario CREATE Program Train Vibration Level (Design Year) exceeds the impact criteria. The Build Scenario CREATE Program Train Vibration Level (Design Year) only considers vibrations from the additional trains operating on tracks affected by the CREATE Program - in the design year. When using Table 7-1, the frequency category (frequent, occasional, or infrequent) and impact level is determined by the additional number of commuter/passenger rail trains and freight rail trains (use "frequent events" if any additional freight trains) operating on the tracks affected by

the CREATE Program as a result of the implementation of the CREATE Program. If the Build Scenario CREATE Program Train Vibration Level (Design Year) exceeds the impact criteria, a potential impact occurs. If the Build Scenario CREATE Program Train Vibration Level (Design Year) does not exceed the impact criteria, a potential impact does not occur and no further analysis is required. Existing vibration, even if it exceeds the impact criteria, is not a factor in determining whether the Build Scenario CREATE Program Train Vibration Level (Design Year) results in an impact.

2. *Moderately-used rail corridor (existing train volume is from 5 to 12 trains per day):* If the existing train vibration exceeds the impact criteria given in Table 7-1, there will be no impact from the Build Scenario CREATE Program Train Vibration Level (Design Year) if the levels estimated using the procedures outlined in either Chapter 10 or 11 of the FTA Manual are at least 5 VdB less than the existing train vibration. The impact criteria shall be applied as described for the following two conditions:

   Existing Train Vibration Exceeds the Impact Criteria: If the Build Scenario CREATE Program Train Vibration Level (Design Year) is at least 5 VdB or less than existing, then a potential impact does not occur and no further analysis is required. For example, if the existing vibration level is 65 VdB, no impact would be assessed if the Design Year vibration level was 60 VdB or less. Otherwise, use the general vibration criteria, Table 7-1, to determine whether the Build Scenario CREATE Program Train Vibration Level (Design Year) exceeds the impact criteria. If the Build Scenario CREATE Program Train Vibration Level (Design Year) exceeds the impact criteria, a potential impact occurs. If the Build Scenario CREATE Program Train Vibration Level (Design Year) does not exceed the impact criteria, a potential impact does not occur and no further analysis is required.

   Existing Train Vibration Does Not Exceed the Impact Criteria: Use the general vibration criteria, Table 7-1, to determine whether the Build Scenario CREATE Program Train Vibration Level (Design Year) exceeds the impact criteria. If the Build Scenario CREATE Program Train Vibration Level (Design Year) exceeds the impact criteria, a potential impact occurs. If the Build Scenario CREATE Program Train Vibration Level (Design Year) does not exceed the impact criteria, a potential impact does not occur and no further analysis is required.

3. *Heavily-used rail corridor (existing train volume is more than 12 trains per day):* If the existing train vibration exceeds the impact criteria given in Table 7-1, the Build Scenario CREATE Program Train Vibration Level (Design Year) will cause additional impact if the Build Scenario CREATE Program train volumes substantially increase the number of vibration events. Approximately doubling the number of events is required for a substantial increase.

   If the existing train vibration exceeds the impact criteria given in Table 7-1, and there is not a significant increase in vibration events, there will be additional impact only if the Build Scenario CREATE Program Train Vibration Level (Design Year), estimated using the procedures of Chapters 10 or 11 (of the FTA Manual), is 3 VdB or more than the existing vibration level.

If the existing train vibration does not exceed the impact criteria given in Table 7-1, use the general vibration criteria, Table 7-1, to determine whether the Build Scenario CREATE Program Train Vibration Level (Design Year) exceeds the impact criteria. If the Build Scenario CREATE Program Train Vibration Level (Design Year) exceeds the impact criteria, an impact occurs. If the Build Scenario CREATE Program Train Vibration Level (Design Year) does not exceed the impact criteria, an impact does not occur and no further analysis is required.

4. *Moving existing tracks:* Another scenario where existing vibration can be substantial is when new train operations will use an existing railroad right-of-way and result in shifting the location of existing railroad tracks. The track relocation and reconstruction can result in lower vibration levels, in which case the CREATE Program is beneficial to those receptors within project's vibration evaluation area. On the other hand, the track relocation and reconstruction can result in higher vibration levels, in which case the CREATE Program may result in an adverse impact to those receptors within the project's vibration evaluation area.

   If the existing (pre-move) train vibration equals or exceeds the impact criteria given in Table 7-1, and the post-move vibration from existing operations exceeds the pre-move vibration by 3 VdB or more, an impact occurs.

   If the existing (pre-move) train vibration equals or exceeds the impact criteria given in Table 7-1, and the post-move vibration from existing operations does not exceed the pre-move vibration by 3 VdB or more, the determination as to whether impacts occur should be determined by applying the appropriate criteria from either scenario 1, 2, or 3 above. In this instance, for the tracks that are moved, use the total number of trains using the moved tracks in the design year to determine the frequency category (frequent, occasional or infrequent) and impact level in Table 7-1. For example, if the existing (pre-move) train vibration equals or exceeds the impact criteria in Table 7-1, and the post-move vibration from existing operations does not exceed the pre-move vibration by 3 VdB or more, and the train volumes in the corridor on the tracks affected by the CREATE Program meet the definition of a heavily used rail corridor, apply the criteria in scenario 3 above to determine if an impact occurs.

   If the existing (pre-move) train vibration does not equal or exceed the impact criteria given in Table 7-1, the determination as to whether impacts occur should be determined by applying the appropriate criteria from either scenario 1, 2 or 3 above. In this instance, for the tracks that are moved, use the total number of trains using those tracks in the design year to determine the frequency category (i.e., frequent, occasional or infrequent) and the vibration impact level in Table 7-1.

The *General Vibration Assessment* identifies the potential ground-borne vibration and ground-borne noise impacts; a detailed assessment confirms whether a vibration impact occurs. As presented in Section 7.1, the need for a *Detailed Vibration Analysis* will generally be conducted if planning and design of special trackwork or buffer areas are viable mitigation options.

Spreadsheet examples have been prepared for each of the four scenarios and for the no-build alternative (see Appendix E). The analyst should be aware of the following:

1. The spreadsheets are based upon the specific conditions in Example Project EX-1. In the example project, two tracks are affected by the CREATE Program, and the train traffic characteristics are similar for both tracks. Therefore, in the spreadsheets, the same adjustment factors (speed, source, path and receiver) are applied to both tracks. If these assumptions are not valid for the project being assessed, the analyst will have to modify the spreadsheets to reflect the specific project's conditions. For instance, the spreadsheets may need to be revised to analyze a different number of involved tracks. Additionally, different adjustment factors may have to be applied to each track based upon the specific train traffic characteristics for each track.

2. The distance measured is from the centerline of the track to the face of the building.

3. The Moving Existing Tracks spreadsheets are applicable for projects in which the CREATE Program will move existing tracks. The spreadsheets simply evaluate the effect of changing the distance between the track and the receptor. The existing (pre-move) and build (post-move) scenarios are both analyzed using the existing train operations.

   The Moving Existing Tracks spreadsheets are used to perform a quick screening within the general assessment process that requires few calculations. If an impact is assessed based on the quick screening process, then the detailed assessment should be considered. If an impact is not assessed using the quick screening process, then the standard general assessment spreadsheets (infrequently-used, moderately-used, or heavily-used corridor analyses) must be used to determine if an impact would be assessed based upon the Build Scenario CREATE Program Train Vibration Level (Design Year). The Moving Existing Tracks spreadsheets cannot be used to determine that a project does not result in vibration impacts.

7.3 Vibration Mitigation Discussion

In general, when there is a vibration impact based on the *Detailed Vibration Analysis*, vibration abatement should be evaluated as part of the proposed project unless any one of the following cannot be satisfied:

1. The minimum length of track mitigated must be determined from calculations based on the FTA *Detailed Vibration Analysis* method.
2. The vibration mitigation treatment must provide at least 3 VdB reduction for every impacted dwelling to be considered effective.
3. The following formula will be applied to determine if the mitigation is cost effective: Mitigation cost divided by VdB reduction divided by number of buildings protected. If this dollar amount exceeds $15,000, the treatment is not considered to be cost effective.

A commitment will be included in the NEPA document to re-assess the project's vibration impacts if there are revisions to the CREATE Program or the project may cause the results of the vibration assessment to change.

Vibration Abatement Documentation

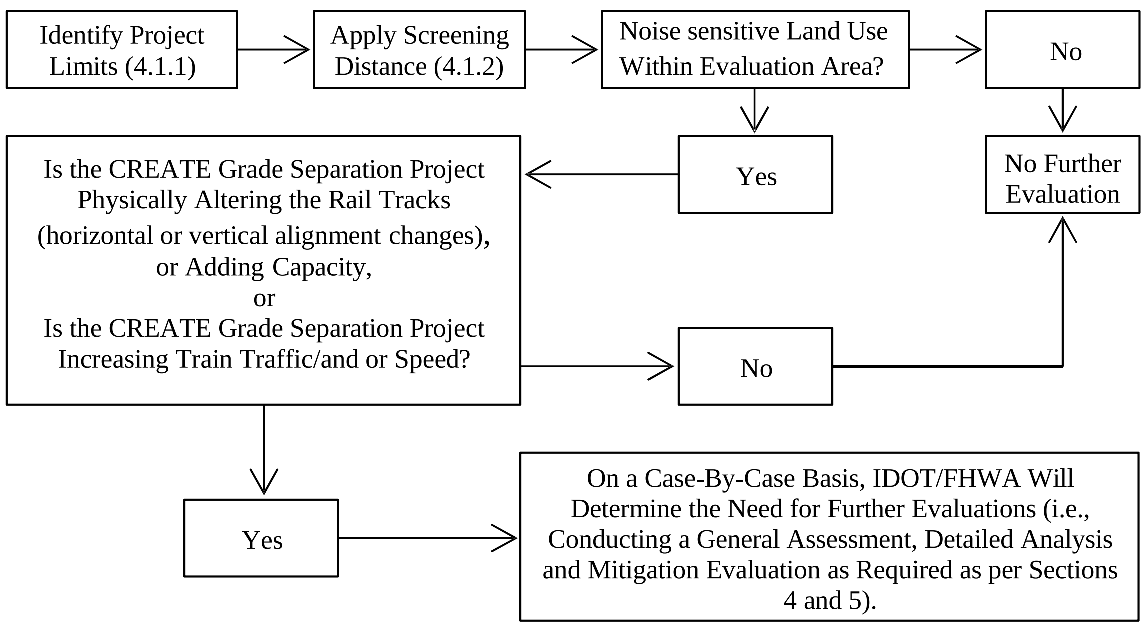
The following text will be included in all CREATE Program environmental documents when vibration impacts occur:

> "The following maintenance procedures will be accomplished by the rail industry to mitigate vibration impacts through minimizing vibration sources:
>
> - Regularly scheduled rail grinding
> - Wheel truing programs
> - Vehicle reconditioning programs
> - Use of wheel-flat detectors"

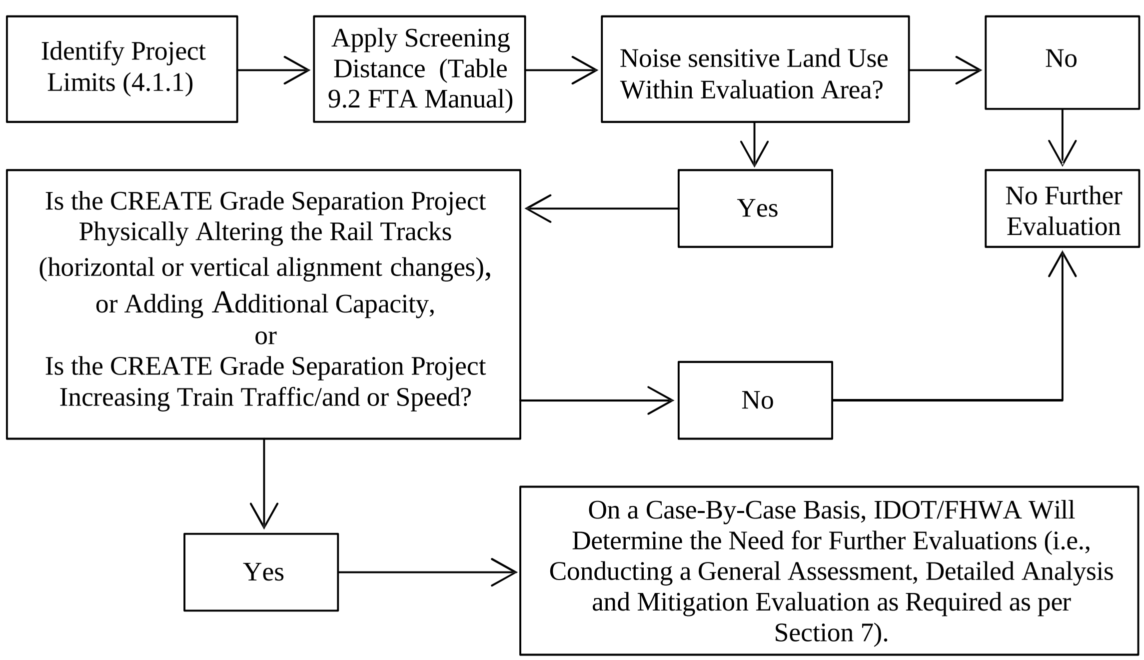
8. HIGHWAY-RAIL GRADE SEPARATION NOISE AND VIBRATION ASSESSMENTS

For highway-rail grade separation projects, highway noise analyses will be performed as per IDOT's Bureau of Design and Environment Manual, Chapter 26, Section 26-6. Furthermore, the following screening procedures will be applied to determine if train noise and vibration analyses are required for potential receptors adjacent to the rail corridor:

Noise Screening Procedure



Vibration Screening Procedure



9. NEPA PROJECT EVALUATION

The CREATE Program noise and vibration impact assessment is being conducted to fulfill NEPA requirements. Using the evaluation outlined in this methodology manual, the potential noise and vibration impacts will be identified using the suggested documentation formats. Example tables of the noise and vibration evaluation data are included in Appendix E. Exterior noise impacts will be identified as no impact, moderate impact, or severe impact. Interior noise impacts will be identified as no impact or impact. Vibration impacts will be identified as no impact or impact.

Based on the evaluation results, IDOT and FHWA will review the data and documentation. This will include but is not limited to the review of the following:

- Build alternative(s) noise/vibration levels compared to the existing and no-build alternative levels
- Build alternative(s) level of impact (no impact, moderate impact or severe impact for exterior use areas; no impact or impact for interior use areas)
- Absolute noise/vibration levels
- Noise/vibration level above impact criteria
- Receptor type
- Number of impacted receptors
- Feasibility and reasonableness of mitigation options

FHWA, in consultation with IDOT, will determine if any of the noise and/or vibration impacts are significant, based on both context and intensity of impacts. The following summarizes the actions to be taken based on the results of the noise and vibration (which includes ground-borne vibration and ground-borne noise) impact evaluation:

- If no noise or vibration impacts are identified, the evaluation should be documented and presented to the public through the normal public involvement activities.

- If noise or vibration impacts are identified but mitigation is determined not to be feasible and reasonable, and if there are any potential historic buildings (over 50 years old) within the possible impact area, an ESRF addendum will be required to determine if the resource is potentially eligible for the National Register of Historic Places (NRHP).

- If noise or vibration impacts are identified, mitigation is determined to be feasible and reasonable and is proposed, and impacts still occur with proposed mitigation; and if there are any potential historic buildings (over 50 years old) within the possible impact area, an ESRF addendum will be required to determine if the resource is potentially eligible for the NRHP.

- If noise or vibration impacts are identified, regardless of proposed mitigation measures, IDOT and FHWA will determine if the impacts are significant.
    - If the impacts are deemed significant, an EIS will be required which includes the noise and vibration impact analyses. The Draft EIS (DEIS) will be available for public review and comment.
    - If the impacts are deemed non-significant, the ECAD or Environmental Assessment process can continue and the information will be presented through the normal public involvement process. Information presented will include the noise and vibration impact evaluations.

- If mitigation is feasible and cost-effective, the desires of the benefited receptors will be determined via the viewpoints solicitation process (see Section 10 for further details).

If vibration impacts have been identified, it should be determined if mitigation is feasible and reasonable. Programmatic mitigation measures should always be documented in the environmental document when impacts are identified. These programmatic measures will be identified as activities that are being implemented to minimize impacts. This information shall be presented to the public through the normal public involvement process.

10. Viewpoints of Benefited Receptors and Coordination with the Public

The viewpoints of benefited receptors shall be solicited via written correspondence in the form of letters and viewpoint solicitation forms for noise barriers found to be feasible and cost-effective. The viewpoints of benefited receptors shall be used to determine the desire for implementation of the noise barriers. Benefited receptors include property owners (including non-residential properties) and renters/leasers residing on the benefited property.

While the desire is to obtain as many responses as possible, the goal is to obtain responses from at least one-third (33-percent) of the benefited receptors for each noise barrier being considered. If responses from one-third of the benefited receptors are not received after the first attempt, a second attempt shall be made. IDOT Division of Public and Intermodal Transportation (DPIT) may consider delivering the second attempt for viewpoint solicitation by certified mail or other form of certified delivery. The desire for the proposed noise abatement can be determined after viewpoints from at least one-third of the responses have been received or after two attempts have been made to obtain the responses. If after the second attempt there are still less than one-third of the responses received, the tally can be conducted based on the responses received.

Once the responses have been collected, the viewpoints must be tallied. In order for noise barrier to be implemented, greater than 50-percent of the benefited receptors responding must be in favor of it. Viewpoints will be tallied for each individual noise barrier.

A response from first row benefited receptors (receptors directly abutting the railroad right-of-way) will be counted and weighted as two responses. Benefited receptors not in the first row will count as one vote. The purpose of providing more weight to the front row receptors is to give them additional consideration in the decision-making process. In the case of rental properties, the tenant shall always count as one response and the owner shall always count as one response per benefited unit. First row rental properties will not be weighted.

As part of the public involvement process, the noise analysis should be presented at the public meeting/hearing for any recommended noise barriers. The information is typically presented on project exhibits and should include evaluated noise barrier locations and noise barriers likely to be implemented pending the viewpoints of benefited receptors (provided they are feasible and cost-effective). Supporting noise analysis information (i.e., noise analysis memorandum/report) should be available for review at the public meeting or hearing.

The purpose of sharing the noise analysis information is to engage local officials, property owners and residents adjacent to the project area, with a particular emphasis given to soliciting the viewpoints benefited receptors. The public meeting or hearing is one of the recommended mechanisms to obtain the viewpoint from at least one-third of the benefited receptors. Every effort should be made to identify the intent and need of getting documented feedback from the benefited receptors. This may include identifying benefited receptors on the exhibits.

The level of public involvement will vary from one project to another and is influenced by the type of project, level of noise impacts that may result as well as corresponding noise barriers, and general interest shown by the public. Comments may be solicited from the public by a variety of methods, including the following:

- Public meetings
- Public hearings
- Letters
- Newspaper advertisements
- Telephone, door-to-door or mail surveys
- Flyers and/or posters
- Website
- Telephone hotline

The views of benefited receptors, including whether they find a proposed barrier(s) acceptable or desirable, are a major consideration in determining the reasonableness of the proposed barrier(s). Comments from the benefited receptors regarding noise wall texture and color will also be considered; however, all design features are ultimately decided upon by IDOT. In order for any proposed noise barrier comment from benefited receptors to be taken into consideration, it must be submitted in writing in letter format, e-mail or recorded at a public meeting or public hearing.

The noise analysis memorandum/report and the NEPA documentation will summarize the specific steps taken to solicit the viewpoints of benefited receptors, as well as the conclusions from this process.

APPENDIX A

Screening Distances for Potential Noise Impact by Ambient Location and Train Activity for CREATE Projects

HARRIS MILLER MILLER & HANSON INC.
77 South Bedford Street
Burlington, MA 01803
T 781.229.0707
F 781.229.7939
W www.hmmh.com

TECHNICAL MEMORANDUM

To:	Diane Campione, Benesch
From:	Jason Ross, Senior Consultant Carl Hanson, P.E. PhD, Senior Vice President
Date:	February 10, 2006 / *CREATE Program Clarification (12/12/06)*
Subject:	Screening Distances for Potential Noise Impact by Ambient Location and Train Activity for CREATE Projects
Reference:	HMMH Job No. 301340.000

BACKGROUND

Harris Miller Miller & Hanson Inc. (HMMH) has developed screening distances for determining the potential limits of noise impact from freight and passenger (Amtrak and Metra) train activity for CREATE projects. These screening distances have been determined from a railroad noise model developed for the CREATE project and are based on train operations data provided by CTCO and general ambient noise categories. The CREATE railroad noise model is based on the Federal Transit Administration (FTA) General Transit Noise Assessment spreadsheet, but includes additional noise sources such as freight locomotives, freight cars and track crossovers.

The train operations data include train symbols, arrival and departure times, speeds, total cars, total tonnage, length of trains and number of locomotives per train for noise-sensitive receptors over several days. Low, medium and high train activity levels have been calculated for the number of trains, train speed, length of cars in train and the number of locomotives in train. Data were provided for a total of 258 receptor-days.

CREATE TRAIN OPERATIONS DATA

The train operations data provided were intended to show a representative range of freight, Amtrak and Metra train activities for which screening distances can be determined. The projects for which data were provided were:

- 3C-NV-P2
- 3C10-P-2
- NV-5BB10-P-2
- 5BB10-WA-3
- 3C10-WA-3
- 3C-WA-3
- NV-3C-EW-4
- NV-3C10-EW-4
- NV-5BB-EW-4
- 3C-NV-B3
- 3C10-NV-B3
- 5BB10-NV-B3

The distribution of values for freight activity were calculated for the following variables (see appendix):

- Number of trains per hour during the daytime hours (7am to 10pm)
- Number of trains per hour during nighttime hours (10pm to 7am)
- Speed of trains
- Length of train-car consists
- Number of locomotives per train

From these distributions low, medium and high levels of train activity were determined. These ranges of train activity are shown in Table 1.

Table 1. Low, medium and high freight train activity

Train Activity	Trains per Day	Speed (mph)	Length of Cars (feet)	Locomotives per Train
Low	5 to 40	10 to 20	1000 to 4000	1 to 2.08
Medium	41 to 75	20 to 30	4000 to 6000	2.08 to 2.5
High	More than 75	More than 30	More than 6000	More than 2.5

Some CREATE projects will have Amtrak and Metra trains as well as freight activity. For determining screening distances where freight and passenger trains are present, data from the P2-P3 CREATE projects were analyzed to determine the average levels of Amtrak and Metra activity. These values are shown below in Table 2.

Table 2. Medium Amtrak and Metra train activity

Train Activity	Trains per Day	Speed (mph)	Length of Cars (feet)	Locomotives per Train
Medium	25	44	769	1.36

CREATE PROGRAM CLARIFICATION (12/12/06)

Table 2 was developed for comparison to Table 4-2 in the FTA Manual to define the appropriate screening distance for the CREATE Program.

The values on Table 2 demonstrate the commuter/passenger train parameters (volumes, speed and length) are much less than the values in FTA's Table 4-2. As a result, this allows the reduction in screening distance and directs the CREATE Consultant to use the train volume "Low Mix" for when passenger/commuter present with low freight activity.

AMBIENT NOISE LEVEL CATEGORIES

To assess potential noise impact from transit and freight operations, the background or ambient sound level must be known since FTA noise impact criteria is a function of ambient noise. For conditions specific to the CREATE projects, three ambient noise level categories have been identified which relate to a noise-sensitive receptor's general location and surroundings. The ambient categories are normal suburban residential, urban residential and noisy urban residential. Table 3 shows the ambient noise levels for each category. These noise levels are based in on information from the U.S. Environmental Protection Agency (EPA)[1]. The average census tract population data is presented for each ambient noise level category. The average ambient noise level within each range was used for determining the screening distances.

Table 3. Ambient noise level categories

Ambient Category	Range of Ldn (dBA)	Average Ldn (dBA)	Average Census Tract Population Density People per Square Mile
Normal Suburban	53 to 57	55	2000
Urban Residential	58 to 62	60	6300
Noisy Urban Residential	63 to 67	65	20000

SCREENING DISTANCES WITH INTERVENING BUILDING ROWS

The CREATE railroad noise model was used to calculate day-night sound levels (Ldn), which is the applicable metric for assessing noise impact at Category 2 land use (residences, hotels, places where people normally sleep). The Ldn levels for low, medium and high freight train activity and low freight activity with passenger trains were calculated at distances ranging from 50 to 2000 feet. The higher values in each range of activity were used to determine the screening distances.

The screening distances are calculated for locations with intervening building rows. A minimum of one row of buildings was assumed in the screening distance. The inclusion of only one row of buildings instead of many is consistent the approach taken by FTA and ensures that the screening distances are conservative (greater than the actual impact distances). These Ldn levels were then assessed against the noise impact criteria for all three ambient noise level categories (normal suburban, urban residential and noisy urban residential).

The distances within which noise impact may occur for each of these conditions is shown below in Table 4. At medium and high freight train activity, the additional noise from passenger trains (primarily Metra) was relatively insignificant. Therefore, the addition of passenger trains increased the screening distances only for corridors with low freight activity.

[1] "Information on Levels of Environmental Noise Requisite to Protect Public Health and Welfare With an Adequate Margin of Safety", Environmental Protection Agency, March 1974.

Table 4. Screening distances for low, medium and high train activity vs. noise receptor location

Screening Distance (ft from centerline of corridor) *with Intervening Building Rows for CREATE Program*[3]				
Ambient Conditions	Train Volume			
	Low (Freight Only)	Low *Mix* (Freight and Passenger)	Med (Freight [1])	High (Freight [1,2])
Normal Suburban	200	225	500	1000
Urban Residential	150	175	375	750
Noisy Urban Residential	75	100	225	500

[1] Addition of passenger train traffic does not change screening distances.
[2] Use this category for grade crossings where horns are sounded.
[3] *CREATE Program Clarification (12/12/06)*

APPLICATION OF SCREENING DISTANCES

The screening distances presented here are for general consideration in determining the outer limits to noise impact. The areas defined by the screening distances are meant to be sufficiently large to encompass all potentially impacted locations. It should be noted that while these distances have a factor of safety included by using the upper limit of the range of activity, the screening distances do not specifically include additional noise sources that may be present such as horn blowing, wheel flats and/or track crossovers.

To determine the applicable ambient noise level category, ideally ambient noise measurements would be available to properly select the screening distance; however, typically noise measurement data are not available at the preliminary stages of noise impact assessment. Therefore, the selection of ambient noise level category should be made based on census tract population data or, in general, how well a location matches one of the noise level categories. For example, for residential areas near major roadways (expressways) it is appropriate to use the "noisy urban residential" category for screening distances based on the knowledge that a major roadway will significantly contribute to ambient sound levels.

Determining which level of train activity (low, medium or high) to use may be difficult when screening distances are needed for a location that might have a mixture of low, medium and high activity for each of the separate activity variables. In these situations it is necessary to consider all train activity variables and their relations to the given categories to determine which screening distance to use. If any parameter exceeds the ranges given, then the next highest category should be used. For example, if a particular node has 38 freight trains/day and would normally be categorized "Low", but the speeds average 30 mph, the appropriate category for screening would be "Medium."

If horn blowing at a grade crossing is a known noise source, then the "High" category should be used and the screening distance is applied over the length of track the horns are sounded.

CREATE PROGRAM CLARIFICATION (12/12/06)

The CREATE screening procedures are meant to be conservative to make sure all potential impacts are included. The highest train activity should be used to determine the screening distance.

APPENDIX

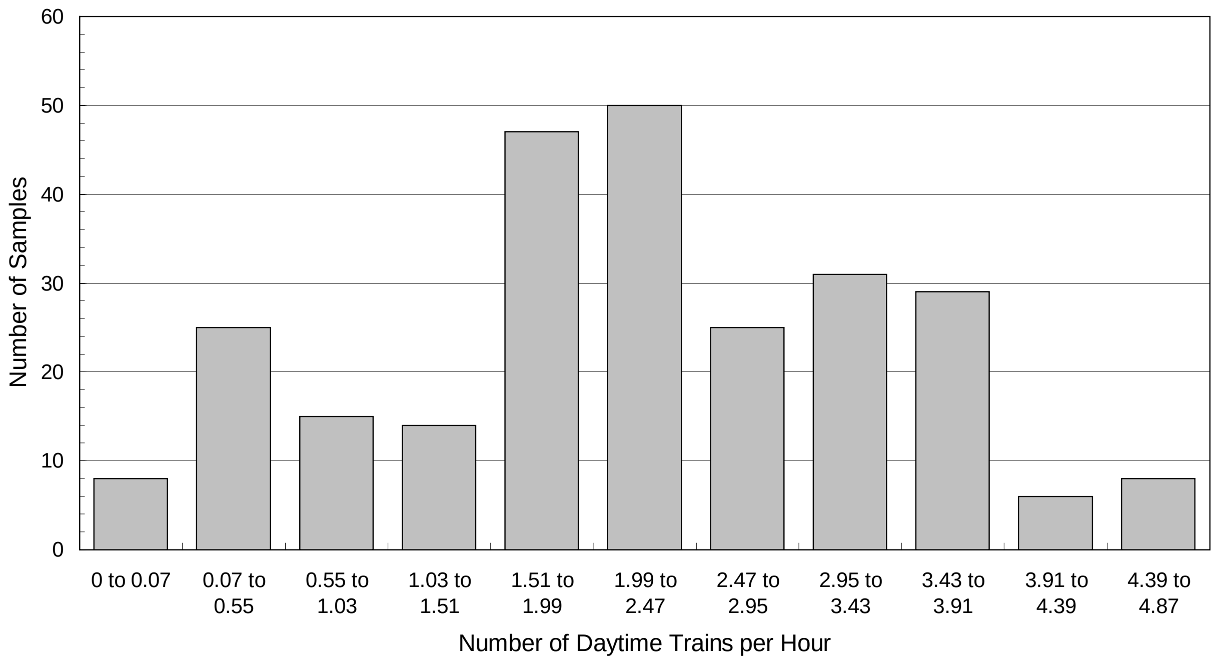


Figure 1. Distribution of trains per hour during the daytime (7am to 10pm)

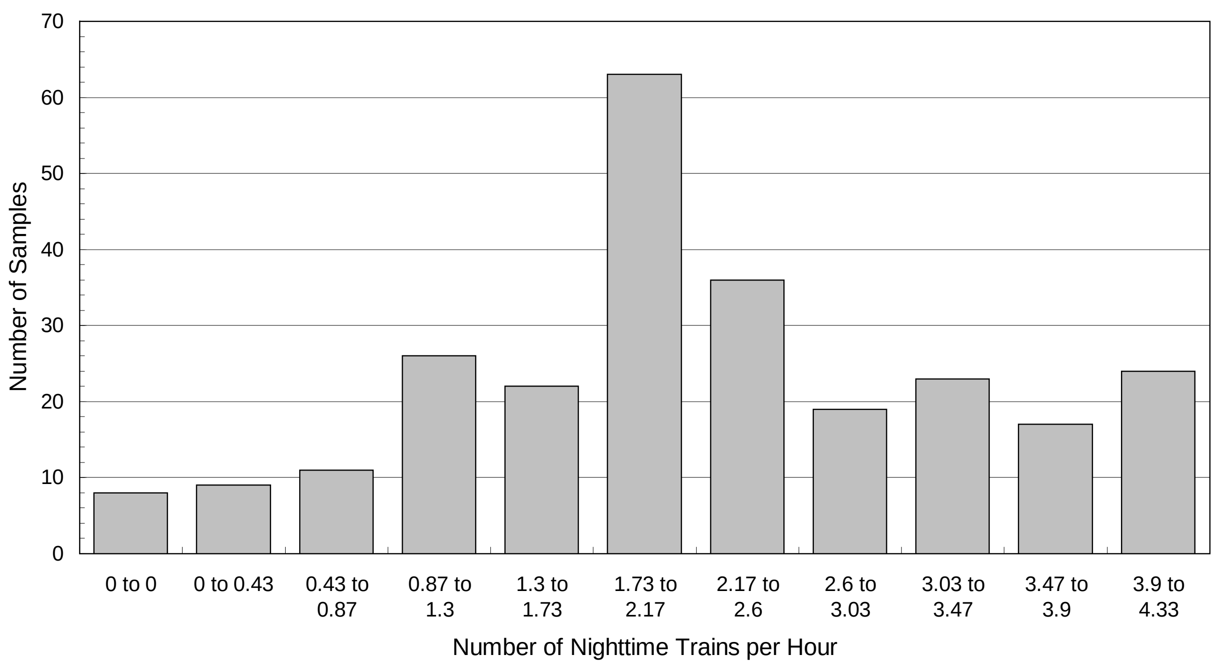


Figure 2. Distribution of trains per hour during the nighttime (10pm to 7am)

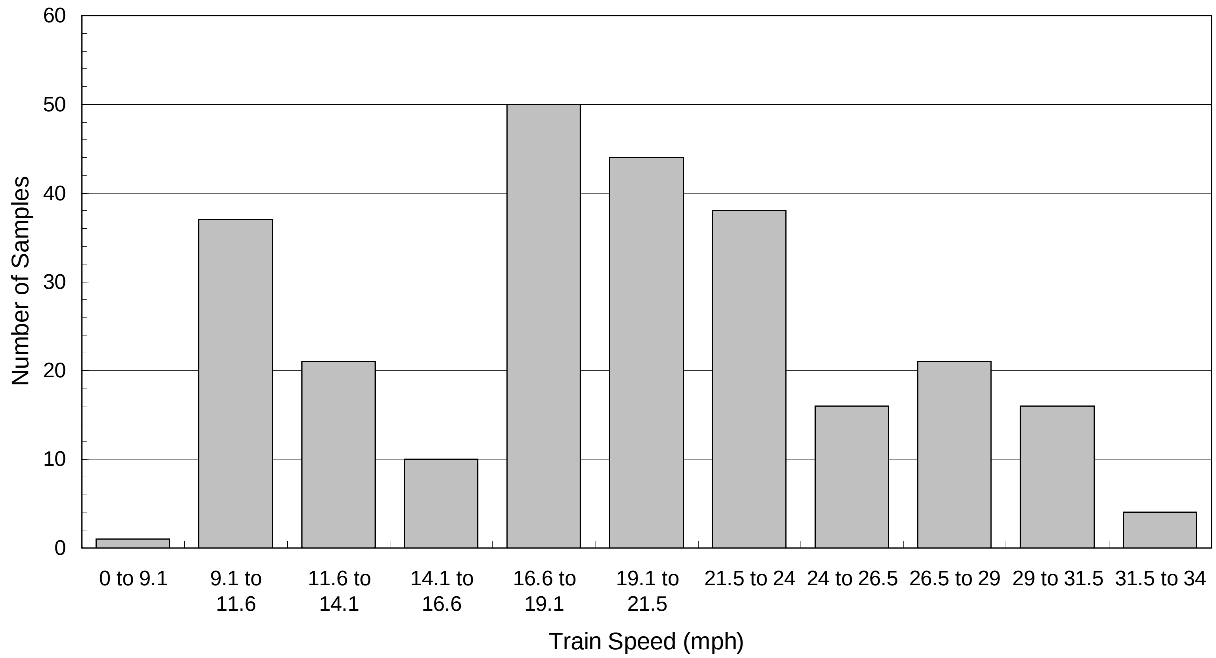


Figure 3. Distribution of train speeds

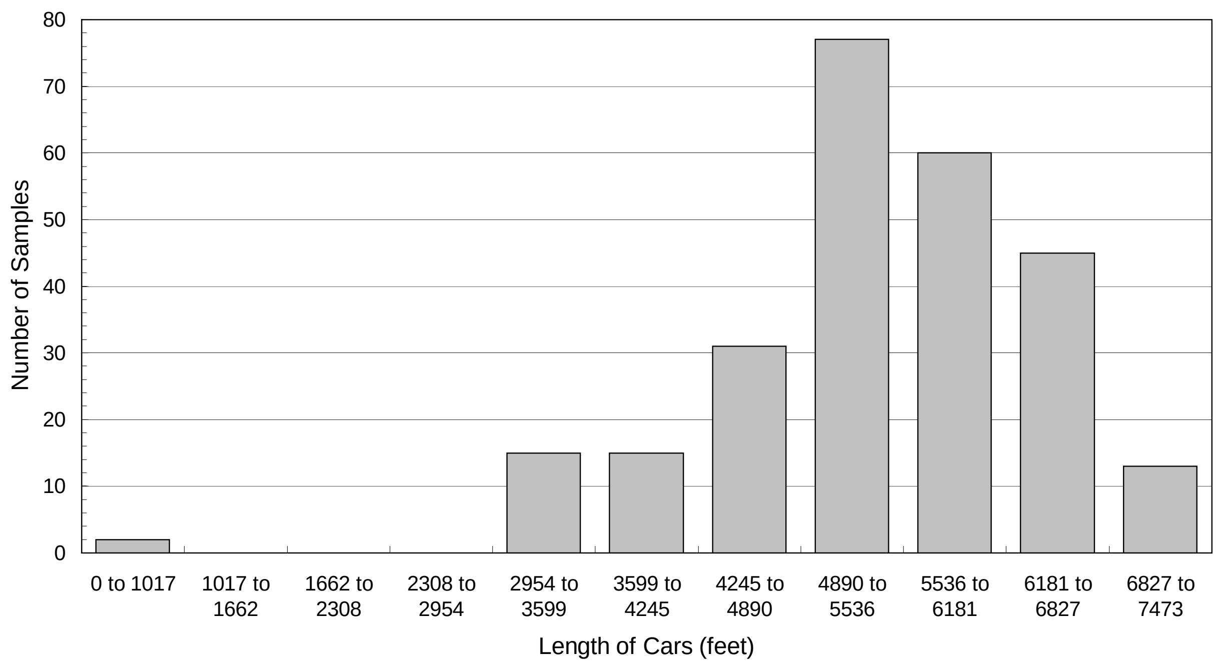


Figure 4. Distribution of length of cars in train

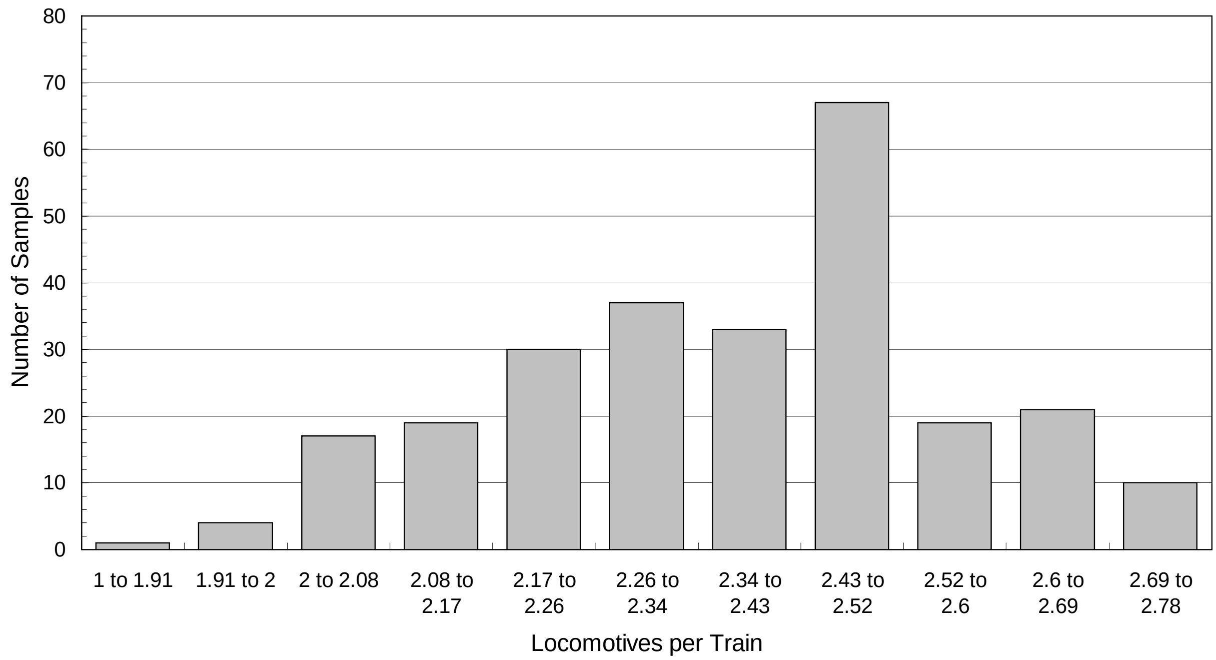


Figure 5. Distribution of locomotives per train

APPENDIX B

CREATE Railroad Noise Model User Guide, 2006

CREATE RAILROAD NOISE MODEL USER GUIDE

INTRODUCTION

The CREATE railroad noise model allows input of up to eight different types of noise sources, the activity of these noise sources and noise-sensitive receptor data to calculate hourly-equivalent (L_{eq}) or day-night (L_{dn}) noise levels. The model is based on the Federal Transit Administration (FTA) General Transit Noise Assessment spreadsheet including moving and stationary railroad and highway noise sources.

MODEL INPUT

The model allows input of the following noise sources, train activity and receptor data:

Moving Noise Sources

- Electric and diesel commuter locomotives
- Commuter passenger cars
- Light-rail transit (LRT) powered cars
- Automated-guideway transit (AGT) cars (steel-wheeled and rubber-tired)
- Monorail
- Magnetic-levitation (Maglev) trains
- Freight locomotives
- Freight cars (typical and empty hopper)
- Automobiles
- Buses (city and commuter)
- Commuter buses

Stationary Noise Sources

- Track crossovers (switches, turnouts, crossing diamonds)
- Rail yards or shops
- Layover tracks
- Bus storage yards
- Bus operating facilities
- Bus transit centers
- Parking garages
- Park and ride lots

Track Noise Sources

- Percentage of wheel flats for rail cars
- Jointed track
- Embedded track
- Aerial structure

Train Activity Data

- Number of trains per hour for:
  - Light-rail, commuter, AGT, monorail, Maglev, freight trains
  - Rail yards or shops and layover tracks
  - Track crossovers
- Number of vehicles per hour for:
  - Automobiles, city and commuter buses
  - Parking garages (automobiles) and park and ride lots (automobiles and buses)
  - Bus storage yards and bus transit center
  - Bus operating facilities (buses present and serviced)
  - Bus operating facility (buses serviced)
- Number of locomotives per train for:
  - Commuter trains (electric and diesel)
  - Freight trains
- Number of cars per train for:
  - Commuter, LRT, AGT, monorail and Maglev trains
  - Freight trains (length of cars)
- Duration of trains for:
  - Track crossovers
- Speed of vehicles for:
  - Trains and automobiles

Noise-Sensitive Receptor Data

- Land use type (FTA Category 1,2,3)
- Distance to noise sources
- Presence of noise barrier
- Intervening building rows

NOISE MODEL PROCESS

To calculate noise levels for sensitive receptors, perform the steps outlined in the flow diagram in Figure 1. Once the noise source number (one thru 23) is input, different metrics will appear in rows 26 to 38 that require input. Once all these variables are input, the noise model will automatically calculate the noise levels from each individual noise source (up to eight) as well as the cumulative noise levels from all noise sources together.

Figure 2 shows an example of typical input data into the CREATE railroad noise model.

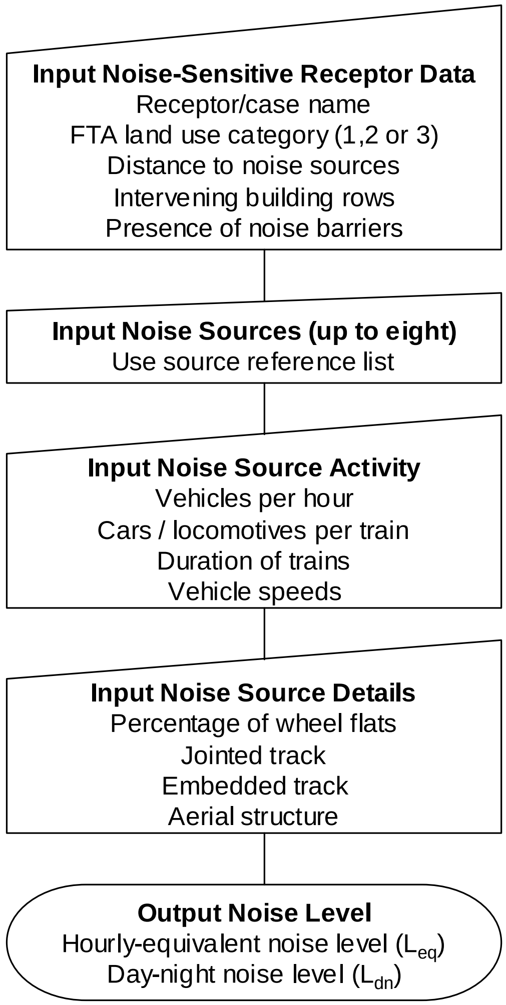


Figure 1. Flow diagram of noise modeling process

Parameter	**Source 1**	
Source Num.	Commuter Electric Locomotive	1
Distance (source to receiver)	distance (ft)	50
Daytime Hours	speed (mph)	25
(7 AM - 10 PM)	trains/hour	3
	locos/train	2
Nighttime Hours	speed (mph)	25
(10 PM - 7 AM)	trains/hour	1
	locos/train	2
Wheel Flats?		
Jointed Track?	Y/N	N
Embedded Track?	Y/N	N
Aerial Structure?	Y/N	N
Barrier Present?	Y/N	N
Intervening Rows of of Buildings	number of rows	0

Figure 2. Example of model input data

NOISE SOURCE AND RECEPTOR DETAILS

Summary of Noise Source Reference SELs

Reference SELs at 50 feet and speed coefficients are shown for all moving noise sources in Table 1. These reference SELs are per vehicle except for freight cars and hopper cars, which are based on 2000-feet of cars.

Table 2 shows the reference SELs at 50 feet and coefficients for all stationary noise sources. All of the stationary noise source coefficients are 10; however, the references are different (i.e. duration of pass-bys, trains per locomotive, buses per hour, etc.)

Table 1. Moving Noise Source Reference SELs and Speed Coefficients

Moving Noise Sources	SEL at 50 feet	Speed Coefficient	Reference Speed (mph)
Commuter Electric Locomotive	90	10.0	50
Commuter Diesel Locomotive	92	-10.0	50
Commuter Rail Car	82	20.0	50
RRT/LRT	82	20.0	50
AGT, Steel Wheel	80	20.0	50
AGT, Rubber Tire	78	20.0	50
Monorail	82	20.0	50
Maglev	72	20.0	50
Freight Locomotive	97	10.0	40
Freight Cars*	100	20.0	40
Hopper Cars (empty)*	104	20.0	40
Hopper Cars (full)*	100	20.0	40
Automobile	73	28.1	50
City Bus	84	23.9	50
Commuter Bus	88	14.6	50
* Freight and Hopper Cars+A51 SEL is based on 2000 feet of cars			

Table 2. Stationary Noise Source Reference SELs and Coefficients

Stationary Noise Sources	SEL at 50 feet	Reference Coefficient	Reference Value	Reference Metric
Track Crossover	100	10	3600	(seconds) duration of pass-bys
Rail Yard or Shop	118	10	20	(trains per hour)
Layover Tracks	109	10	1	(trains during hour)
Bus Storage Yard	111	10	100	(buses per hour)
Bus Oerations Facility	114	10	200	(buses per hour)
Bus Transit Center	101	10 / 10	20 / 60	(buses per hour) / (buses services per hour)
Parking Garage	92	10	1000	(autos per hour)
Park & Ride Lot	101	10 / 10	2000 / 24	(autos per hour) / (buses per hour)

Moving Noise Sources

Moving noise sources (listed in the Model Input section) are modeled to propagate noise as a line source over soft ground (grass, soft dirt). This results in a sound propagation rate of 4.5 decibels per distance doubling.

Moving noise sources also have a “speed coefficient” which represents the variability of the sound exposure level (SEL) of a vehicle pass-by as function of vehicle speed. The speed coefficients of each vehicle are a function of the potential increase or decrease in maximum noise level due to factors such as wheel/rail interaction, tire/pavement interaction or engine speed and the duration of the pass-by (a higher speed pass-by can actually result in a lower SEL due to the shorter duration of the event). For the moving noise sources in the CREATE model, speed coefficients range from –10 to 28.1.

Increasing the number of vehicles for moving sources relates to SEL on a 10 Log-basis. This results in a three-decibel increase in SEL for each doubling of the number of vehicles. For freight trains, the same relationship exists but is based on the length of cars rather than the specific number of cars.

Stationary Noise Sources

Stationary noise sources (listed in the Model Input section) are modeled to propagate noise as a point source over soft ground (grass, soft dirt). This results in a sound propagation rate of 7.5 decibels per distance doubling.

The SELs from noise sources such as rail yards, bus storage yards and parking lots, vary based on the number of vehicles present on a 10-Log basis. Similar to moving sources, a doubling in the number of vehicles results in an SEL increase of three decibels.

For the inclusion of idling locomotive noise sources, use layover tracks as a stationary source. This noise source will require the input of the number of trains during an hour. If one locomotive were to idle for 15 minutes, this is equivalent to 0.25 trains during an hour.

Track Noise Sources

For the inclusion of LRT, commuter or freight cars, the average percentage of wheel flats present should be input. The adjustment for wheel flats on cars could be as high as an additional five decibels; however, typically the actual percentage of cars with wheel flats is relatively low and noise levels typically increase by less than one decibel.

Jointed track produces an additional noise source at the wheel/rail interface as compared to continuous-welded rail (CWR). The presence of jointed track, therefore, will increase sound levels of commuter locomotives, commuter cars, LRT cars, freight locomotives and freight cars by five decibels.

For the operation of trains on embedded track, noise levels will be three decibels higher than on ballast and tie. This increase is due to the hard ground between the noise source and receptor allowing more efficient sound propagation.

Tracks that are elevated on an aerial structure will typically produce noise levels that are four decibels higher than tracks at grade. This increase in noise level is due to the radiation of the aerial structure as well as more efficient sound propagation from a source that is at a higher elevation.

The presence of a track crossover such as a switch, turnout or crossing diamond acts as a stationary noise source whenever the train travels over it. For this noise source, the duration and the number of trains per hour are required to determine the SEL from this source.

Noise-Sensitive Receptor Data

The FTA land use category must be input into the model. Land use category 1 and 3 correspond to locations where noise-sensitive receptors are present only during daytime hours and do not typically sleep (e.g. schools, churches and medical offices). Land use category 2 corresponds to locations where noise-sensitive receptors often sleep (e.g. hotel, motels, residences and hospitals). The hourly-equivalent (L_{eq}) noise level for the loudest-hour of train-related activity during hours of noise-sensitivity is used to assess potential impact at a category 1 or 3 receptor and the day-night (L_{dn}) noise level is used to assess potential impact at a category 2 receptor. The L_{dn} noise level includes a 10-decibel penalty for noise events that occur between 10pm and 7am; therefore, the input of both daytime and nighttime events is required for category 2 receptors

The presence of a noise barrier can be included in modeling noise levels. However, in a general assessment no details of the height or location of the noise barrier are input. It is assumed that the noise barrier would be effective in lowering noise levels a minimum of five decibels.

The model allows input of the number of intervening rows for receptors that are not adjacent to the noise source. For the first intervening building row, noise levels are modeled to decrease 4.5-decibels. For each additional intervening row (between two and five) an additional 1.5-decibel reduction is taken into account up to a maximum reduction of 10 decibels.

SPREADSHEET INFORMATION

To minimize the potential for error in modifying the CREATE railroad noise model, the spreadsheet has been password protected. The password protection disallows the deletion or modification to cells other than input or output cells (grey). Should modification of the spreadsheet be required for some reason, the spreadsheet can be unlocked with the password: “create”.

Noise Model Based on Federal Transit Adminstration General Transit Noise Assessment
Developed for Chicago Create Project

Case:

RESULTS			
Noise Source	**Ldn (dB)**	**Leq - daytime (dB)**	**Leq - nighttime (dB)**
All Sources	Enter Land Use		
Source 1			
Source 2			
Source 3			
Source 4			
Source 5			
Source 6			
Source 7			
Source 8			

Enter noise receiver land use category below

LAND USE CATEGORY	
Noise receiver land use category (1, 2 or 3)	

Enter data for up to 8 noise sources below - see reference list for source numbers

NOISE SOURCE PARAMETERS								
Parameter	**Source 1**	**Source 2**	**Source 3**	**Source 4**	**Source 5**	**Source 6**	**Source 7**	**Source 8**
Source Num.								
Distance (source to receiver)								
Daytime Hours (7 AM - 10 PM)								
Nighttime Hours (10 PM - 7 AM)								
Wheel Flats?								
Jointed Track?								
Embedded Track?								
Aerial Structure?								
Barrier Present?								
Intervening Rows of of Buildings								

SOURCE REFERENCE LIST	
Source	**Number**
Commuter Electric Locomotive	1
Commuter Diesel Locomotive	2
Commuter Rail Cars	3
RRT/LRT	4
AGT, Steel Wheel	5
AGT, Rubber Tire	6
Monorail	7
Maglev	8
Freight Locomotive	9
Freight Cars	10
Hopper Cars (empty)	11
Hopper Cars (full)	12
Crossover	13
Automobiles	14
City Buses	15
Commuter Buses	16
Rail Yard or Shop	17
Layover Tracks	18
Bus Storage Yard	19
Bus Op. Facility	20
Bus Transit Center	21
Parking Garage	22
Park & Ride Lot	23

CALCULATIONS

Term	Sou 1	Sou 2	Sou 3	Sou 4	Sou 5	Sou 6	Sou 7	Sou 8
SELref	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
C1 - Coef	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
C1 - Denom	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
C1 - Day Num	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
C1 - Night Num	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
C1 - Day	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
C1 - Night	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
C2 - Coef	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
C2 - Denom	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
C2 - Day Num	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
C2 - Night Num	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
C2 - Day	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
C2 - Night	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
C3 - Coef	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
C3 - Denom	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
C3 - Day Num	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
C3 - Night Num	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
C3 - Day	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
C3 - Night	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Leq50ft - Day	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Leq50ft - Night	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Ldn50ft	6.4	6.4	6.4	6.4	6.4	6.4	6.4	6.4
Dist Coef	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Adj. Dist	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Adj. Wheel Flats	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Adj. Jointed	0	0	0	0	0	0	0	0
Adj. Embed	0	0	0	0	0	0	0	0
Adj. Aerial	0	0	0	0	0	0	0	0
Adj. Shield	0	0	0	0	0	0	0	0
Leq - Day	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Leq - Night	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Ldn	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Need Land Use	1							
Calc Leq	0							

REFERENCE DATA

				Term 1				Term 2				Term 3								Combine
Num	Desc	Ref SEL	Dist Term	Desc	Denom	Min	Coef	Desc	Denom	Min	Coef	Desc	Denom	Min	Coef	Jointed	Embedded	Aerial	Barrier	1&2?
0		0	0		0	0	0													
1	Commuter Electric Locomotive	90	15	speed (mph)	50	20	10.0	trains/hour	1	0.01	10.0	locos/train	1	1	10	5.0	3.0	4.0	-5.0	0.0
2	Commuter Diesel Locomotiv	92	15	speed (mph)	50	20	-10.0	trains/hour	1	0.01	10.0	locos/train	1	1	10	5.0	3.0	4.0	-5.0	0.0
3	Commuter Rail Cars	82	15	speed (mph)	50	20	20.0	trains/hour	1	0.01	10.0	cars/train	1	1	10	5.0	3.0	4.0	-5.0	0.0
4	RRT/LRT	82	15	speed (mph)	50	20	20.0	trains/hour	1	0.01	10.0	cars/train	1	1	10	5.0	3.0	4.0	-5.0	0.0
5	AGT, Steel Wheel	80	15	speed (mph)	50	20	20.0	trains/hour	1	0.01	10.0	cars/train	1	1	10				-5.0	0.0
6	AGT, Rubber Tire	78	15	speed (mph)	50	20	20.0	trains/hour	1	0.01	10.0	cars/train	1	1	10				-5.0	0.0
7	Monorail	82	15	speed (mph)	50	20	20.0	trains/hour	1	0.01	10.0	cars/train	1	1	10				-5.0	0.0
8	Maglev	72	15	speed (mph)	50	20	20.0	trains/hour	1	0.01	10.0	cars/train	1	1	10			4.0	-5.0	0.0
9	Freight Locomotive	97	15	speed (mph)	40	20	10.0	trains/hour	1	0.01	10.0	locos/train	1	1	10	5.0	3.0	4.0	-5.0	0.0
10	Freight Cars	100	15	speed (mph)	40	20	20.0	trains/hour	1	0.01	10.0	h of cars (ft)	2000	40	10	5.0	3.0	4.0	-5.0	0.0
11	Hopper Cars (empty)	104	15	speed (mph)	40	20	20.0	trains/hour	1	0.01	10.0	h of cars (ft)	2000	40	10	5.0	3.0	4.0	-5.0	0.0
12	Hopper Cars (full)	100	15	speed (mph)	40	20	20.0	trains/hour	1	0.01	10.0	h of cars (ft)	2000	40	10	5.0	3.0	4.0	-5.0	0.0
13	Crossover	100	25	trains/hour	1	0.01	10.0	on of one trai	3600	0.01	10.0						3.0	4.0	-5.0	0.0
14	Automobiles	73	15	speed (mph)	50	30	28.1	vehicles/hou	1	0.01	10.0								-5.0	0.0
15	City Buses	84	15	speed (mph)	50	30	23.9	vehicles/hou	1	0.01	10.0								-5.0	0.0
16	Commuter Buses	88	15	speed (mph)	50	30	14.6	vehicles/hou	1	0.01	10.0								-5.0	0.0
17	Rail Yard or Shop	118	25	trains/hour	20	0.01	10.0												-5.0	0.0
18	Layover Tracks	109	25	trains/hour	1	0.01	10.0												-5.0	0.0
19	Bus Storage Yard	111	25	buses/hour	100	0.01	10.0												-5.0	0.0
20	Bus Op. Facility	114	25	buses/hour	200	0.01	10.0	es serviced/l	60	0.01	10.0								-5.0	1.0
21	Bus Transit Center	101	25	buses/hour	20	0.01	10.0												-5.0	0.0
22	Parking Garage	92	25	autos/hour	1000	0.01	10.0												-5.0	0.0
23	Park & Ride Lot	101	25	autos/hour	2000	0.01	10.0	buses/hour	24	0.01	10.0								-5.0	1.0

LAND USE DATA

Category	Ldn/Leq
0	
1	Leq
2	Ldn
3	Leq

APPENDIX C

Table and Figure Excerpts from
FTA *Transit Noise and Vibration Impact Assessment*
(May 2006)

TRANSIT NOISE AND VIBRATION IMPACT ASSESSMENT

FTA-VA-90-1003-06 **May 2006**

Office of Planning and Environment
Federal Transit Administration

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13. ABSTRACT (Maximum 200 words)

This report is the second edition of a guidance manual originally issued in 1995 which presents procedures for predicting and assessing noise and vibration impacts of proposed mass transit projects. All types of bus and rail projects are covered. Procedures for assessing noise and vibration impacts are provided for different stages of project development, from early planning before mode and alignment have been selected through preliminary engineering and final design. Both for noise and vibration, there are three levels of analysis described. The framework acts as a screening process, reserving detailed analysis for projects with the greatest potential for impacts while allowing a simpler process for projects with little or no effects.

This updated guidance contains noise and vibration impact criteria that are used to assess the magnitude of predicted impacts. A range of mitigation measures are described for dealing with adverse noise and vibration impacts. There is a discussion of noise and vibration during the construction stage and also discussion of how the technical information should be presented in the Federal Transit Administration's environmental documents. This guidance will be of interest not only to technical specialists who conduct the analyses but also to transit agency staff, federal agency reviewers, and members of the general public who may be affected by the projects.

14. SUBJECT TERMS
Transit noise and vibration analysis, noise and vibration impact criteria, noise and vibration mitigation measures, environmental impact assessment, National Environmental Policy Act compliance.

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Unclassified	Unclassified	Unclassified	

TRANSIT NOISE AND VIBRATION IMPACT ASSESSMENT

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Prepared for: Federal Transit Administration
Office of Planning and Environment
Washington DC 20590

Prepared by: Harris Miller Miller & Hanson Inc.
77 South Bedford Street
Burlington, MA 01803

Produced by: Vanasse Hangen Brustlin, Inc.
8300 Boone Boulevard, Suite 700
Vienna, VA 22182

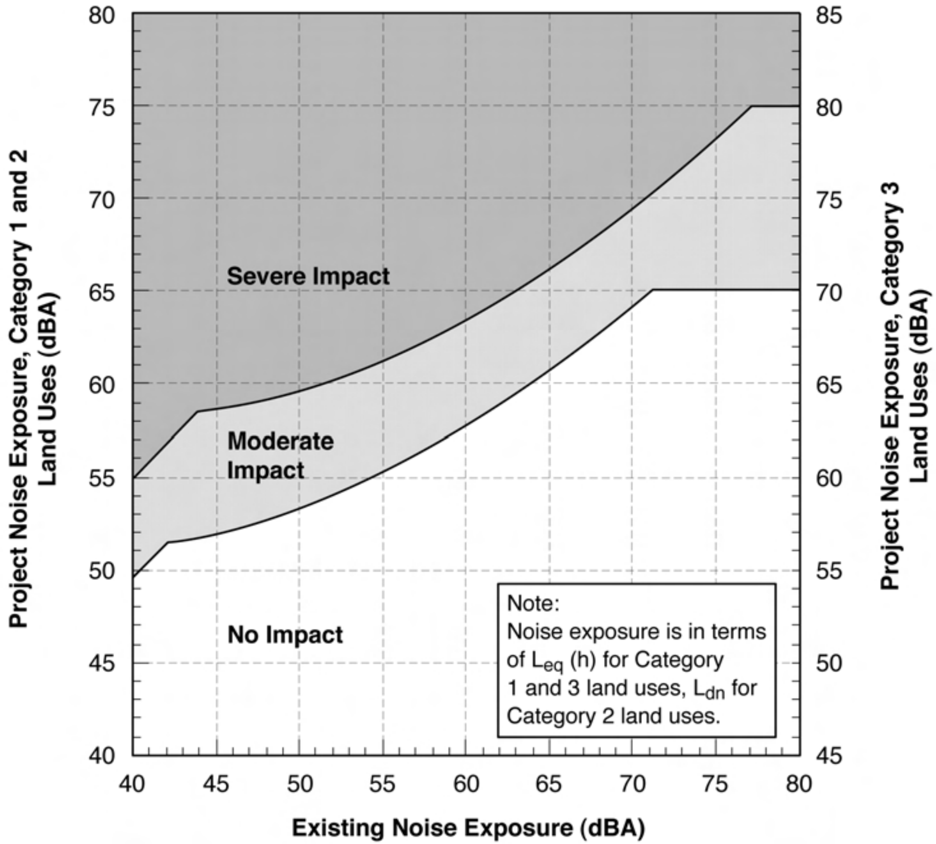


Figure 3-1. Noise Impact Criteria for Transit Projects

Table 3-1. Noise Levels Defining Impact for Transit Projects						
Existing Noise Exposure* $L_{eq}(h)$ or L_{dn} (dBA)	**Project Noise Impact Exposure,*** $L_{eq}(h)$ or L_{dn} (dBA)					
	Category 1 or 2 Sites			**Category 3 Sites**		
	No Impact	Moderate Impact	Severe Impact	No Impact	Moderate Impact	Severe Impact
<43	< Ambient+10	Ambient + 10 to 15	>Ambient+15	<Ambient+15	Ambient + 15 to 20	>Ambient+20
43	<52	52-58	>58	<57	57-63	>63
44	<52	52-58	>58	<57	57-63	>63
45	<52	52-58	>58	<57	57-63	>63
46	<53	53-59	>59	<58	58-64	>64
47	<53	53-59	>59	<58	58-64	>64
48	<53	53-59	>59	<58	58-64	>64
49	<54	54-59	>59	<59	59-64	>64
50	<54	54-59	>59	<59	59-64	>64
51	<54	54-60	>60	<59	59-65	>65
52	<55	55-60	>60	<60	60-65	>65
53	<55	55-60	>60	<60	60-65	>65
54	<55	55-61	>61	<60	60-66	>66
55	<56	56-61	>61	<61	61-66	>66
56	<56	56-62	>62	<61	61-67	>67
57	<57	57-62	>62	<62	62-67	>67
58	<57	57-62	>62	<62	62-67	>67
59	<58	58-63	>63	<63	63-68	>68
60	<58	58-63	>63	<63	63-68	>68
61	<59	59-64	>64	<64	64-69	>69
62	<59	59-64	>64	<64	64-69	>69
63	<60	60-65	>65	<65	65-70	>70
64	<61	61-65	>65	<66	66-70	>70
65	<61	61-66	>66	<66	66-71	>71
66	<62	62-67	>67	<67	67-72	>72
67	<63	63-67	>67	<68	68-72	>72
68	<63	63-68	>68	<68	68-73	>73
69	<64	64-69	>69	<69	69-74	>74
70	<65	65-69	>69	<70	70-74	>74
71	<66	66-70	>70	<71	71-75	>75
72	<66	66-71	>71	<71	71-76	>76
73	<66	66-71	>71	<71	71-76	>76
74	<66	66-72	>72	<71	71-77	>77
75	<66	66-73	>73	<71	71-78	>78
76	<66	66-74	>74	<71	71-79	>79
77	<66	66-74	>74	<71	71-79	>79
>77	<66	66-75	>75	<71	71-80	>80

* L_{dn} is used for land use where nighttime sensitivity is a factor; L_{eq} during the hour of maximum transit noise exposure is used for land use involving only daytime activities.

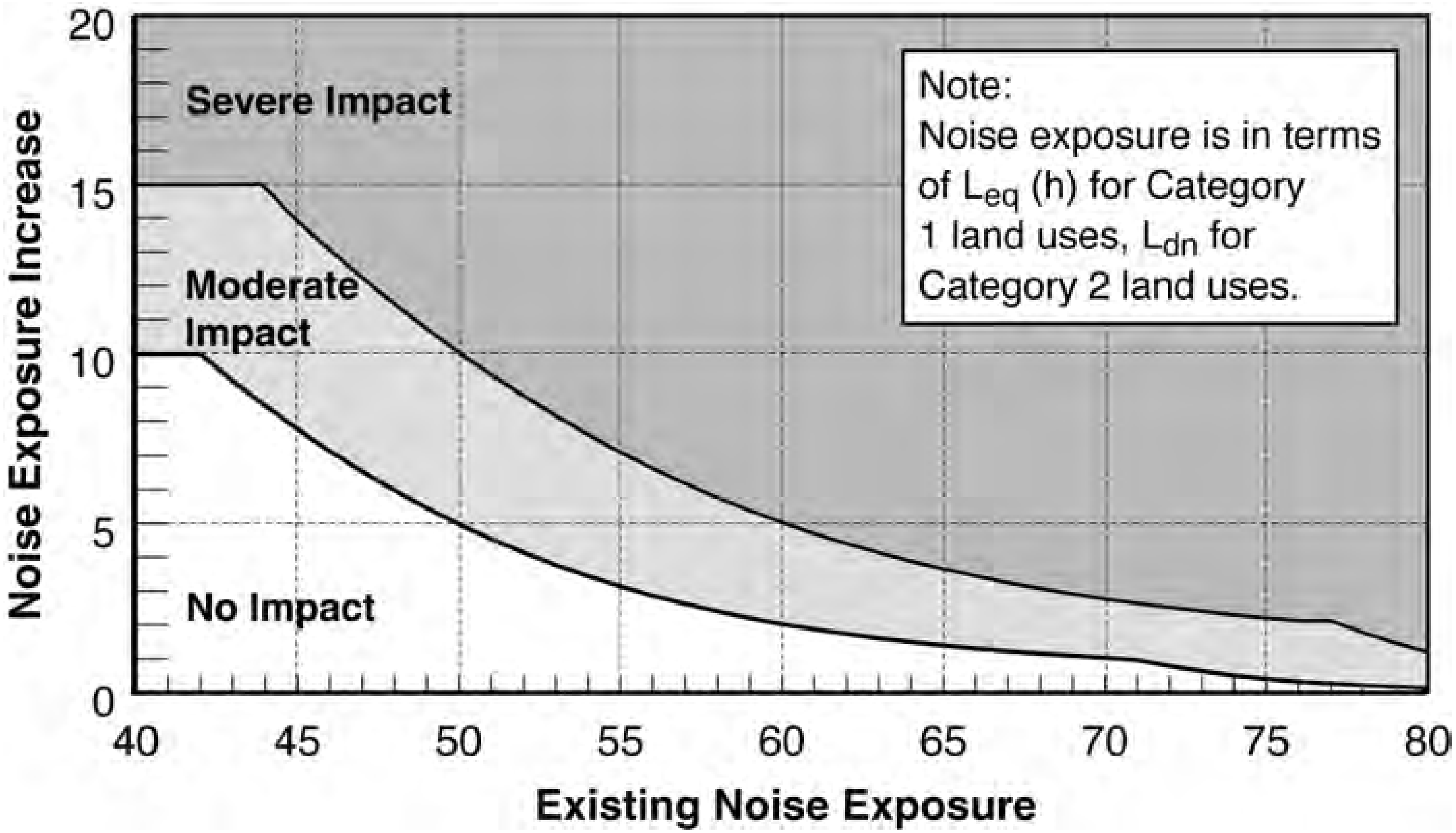


Figure 3-2. Increase in Cumulative Noise Levels Allowed by Criteria (Land Use Cat. 1 &2)

Table 4-1. Screening Distances for Noise Assessments

Type of Project		Screening Distance* (ft) Unobstructed	Screening Distance* (ft) Intervening Buildings
Fixed Guideway Systems:			
Commuter Rail Mainline		750	375
Commuter Rail Station	With Horn Blowing	1,600	1,200
	Without Horn Blowing	250	200
Commuter Rail-Highway Crossing with Horns and Bells		1,600	1,200
Rail Rapid Transit		700	350
Rail Rapid Transit Station		200	100
Light Rail Transit		350	175
Access Roads		100	50
Low- and Intermediate-Capacity Transit	Steel Wheel	125	50
	Rubber Tire	90	40
	Monorail	175	70
Yards and Shops		1000	650
Parking Facilities		125	75
Access Roads		100	50
Ancillary Facilities			
Ventilation Shafts		200	100
Power Substations		250	125
Bus Systems:			
Busway		500	250
BRT on exclusive roadway		200	100
Bus Facilities	Access Roads	100	50
	Transit Mall	225	150
	Transit Center	225	150
	Storage & Maintenance	350	225
	Park & Ride Lots w/Buses	225	150
Ferry Boat Terminals:		300	150

*Measured from centerline of guideway/roadway for mobile sources; from center of noise-generating activity for stationary sources.

Table 4-2. Assumptions for Screening Distances for Noise Assessments				
Type of Project		**Operations**	**Speeds**	**Descriptor**
Fixed Guideway Systems:				
Commuter Rail Mainline		66 day /12 night; 1 loco, 6 cars	55 mph	Ldn
Commuter Rail Station	With Horn Blowing	22 day / 4 night	N/A	Ldn
	W/O Horn Blowing	22 day / 4 night	N/A	Ldn
Commuter Rail-Highway Crossing with Horns and Bells		22 day / 4 night	55 mph	Ldn
Rail Rapid Transit		220 day / 24 night; 6-car trains	50 mph	Ldn
Rail Rapid Transit Station		220 day / 24 night	20 mph	Ldn
Light Rail Transit		150 day / 18 night; 2 artic veh.	35 mph	Ldn
Access Roads to Stations		1000 cars, 12 buses	35 mph	PH Leq*
Low- and Intermediate-Capacity Transit	Steel Wheel	220 day / 24 night	30 mph	Ldn
	Rubber Tire	220 day / 24 night	30 mph	Ldn
	Monorail	220 day / 24 night	30 mph	Ldn
Yards and Shops		20 train movements	N/A	PH Leq
Parking Facilities		1000 cars	N/A	PH Leq
Access Roads to Parking		1000 cars	35 mph	PH Leq
Ancillary Facilities				
Ventilation Shafts		Rapid Transit in Subway	50 mph	Ldn
Power Substations		Sealed shed, air conditioned	N / A	Ldn
***Bus Systems*:**				
Busway		30 buses, 120 automobiles	50 mph	PH Leq
BRT on exclusive roadway		30 buses	35 mph	PH Leq
Bus Facilities	Access Roads	1000 cars	35 mph	PH Leq
	Transit Mall	20 buses	N/A	PH Leq
	Transit Center	20 buses	N/A	PH Leq
	Storage & Maintenance	30 buses	N/A	PH Leq
	Park & Ride Lots w/Buses	1000 cars, 12 buses	N/A	PH Leq
Ferry Boat Terminals:		8 boats with horns used in normal docking cycle	N/A	PH Leq

* PH Leq = hour of maximum transit activity

Table 5-7. Estimating Existing Noise Exposure for General Assessment

Distance from Major Noise Source[1] (feet)			Population Density (people per sq mile)	Noise Exposure Estimates			
Interstate Highways[2]	Other Roadways[3]	Railroad Lines[4]		L_{eq} Day	L_{eq} Evening	L_{eq} Night	L_{dn}
10 - 50				75	70	65	75
50 - 100				70	65	60	70
100 - 200				65	60	55	65
200 - 400				60	55	50	60
400 - 800				55	50	45	55
800 and up				50	45	40	50
	10 - 50			70	65	60	70
	50 - 100			65	60	55	65
	100 - 200			60	55	50	60
	200 - 400			55	50	45	55
	400 and up			50	45	40	50
		10 - 30		--	--	--	75
		30 - 60		--	--	--	70
		60 - 120		--	--	--	65
		120 - 240		--	--	--	60
		240 - 500		--	--	--	55
		500 - 800		--	--	--	50
		800 and up		--	--	--	45
			1 - 100	35	30	25	35
			100 - 300	40	35	30	40
			300 - 1000	45	40	35	45
			1000 - 3000	50	45	40	50
			3000 - 10000	55	50	45	55
			10000 - 30000	60	55	50	60
			30000 and up	65	60	55	65

NOTES:

[1] Distances do not include shielding from intervening rows of buildings. General rule for estimating shielding attenuation in populated areas: Assume 1 row of buildings every 100 ft; -4.5 dB for the first row, -1.5 dB for every subsequent row up to a maximum of -10 dB attenuation.

[2] Roadways with 4 or more lanes that permit trucks, with traffic at 60 mph.

[3] Parkways with traffic at 55 mph, but without trucks, and city streets with the equivalent of 75 or more heavy trucks per hour and 300 or more medium trucks per hour at 30 mph.

[4] Main line railroad corridors typically carrying 5-10 trains per day at speeds of 30-40 mph.

Table 6-3. Source Reference SELs at 50 Feet: Fixed-Guideway Sources @ 50 mph			
Source	**Reference SEL (dBA)**	**Approximate L_{max} (dBA)**	**Prefer Measurements?**
Rail Cars	82	80	NO
Locomotives – Diesel	92	88	NO
Locomotives – Electric	90	86	NO
Diesel Multiple Unit (DMU)	85	81	YES
AGT - Steel Wheel	80	78	YES
AGT - Rubber Tire	78	75	YES
Monorail	82	80	YES
Maglev	72	70	YES
Transit Car Horns (Emergency)	93	90	NO
Transit Car Whistles	81	78	NO
Locomotive Horns			
At Grade Crossing	113	110	NO
From Crossing to 1/8 mile	113-3*(D_p/660)	110	
From 1/8 mile to ¼ mile	110	110	
D_p = distance from grade crossing parallel to tracks			

Table 6-7. Source Reference SELs at 50 Feet: Stationary Sources			
Source	**Reference SEL (dBA)**	**Approximate L_{max} (dBA)**	**Prefer Measurements?**
Auxiliary Equipment	101	65	YES
Locomotive Idling	109	73	NO
Rail Transit Idling	106	70	NO
Buses Idling	111	75	NO
Ferry Boat Landing, Idling and Departing	91	78	NO
Ferry Boat Fog Horn	90	84	NO
Track Crossover	100	90	NO
Track Curve Squeal	136	100	YES
Car Washes	111	75	YES
Crossing Signals	109	73	NO
Substations	99	63	NO

Table 9-2. Screening Distances for Vibration Assessment			
Type of Project	**Critical Distance for Land Use Categories*** **Distance from Right-of-Way or Property Line**		
	Cat. 1	**Cat. 2**	**Cat. 3**
Conventional Commuter Railroad	600	200	120
Rail Rapid Transit	600	200	120
Light Rail Transit	450	150	100
Intermediate Capacity Transit	200	100	50
Bus Projects (if not previously screened out)	100	50	--

* The land-use categories are defined in Chapter 8. Some vibration-sensitive land uses are not included in these categories. Examples are: concert halls and TV studios which, for the screening procedure, should be evaluated as Category 1; and theaters and auditoriums which should be evaluated as Category 2.

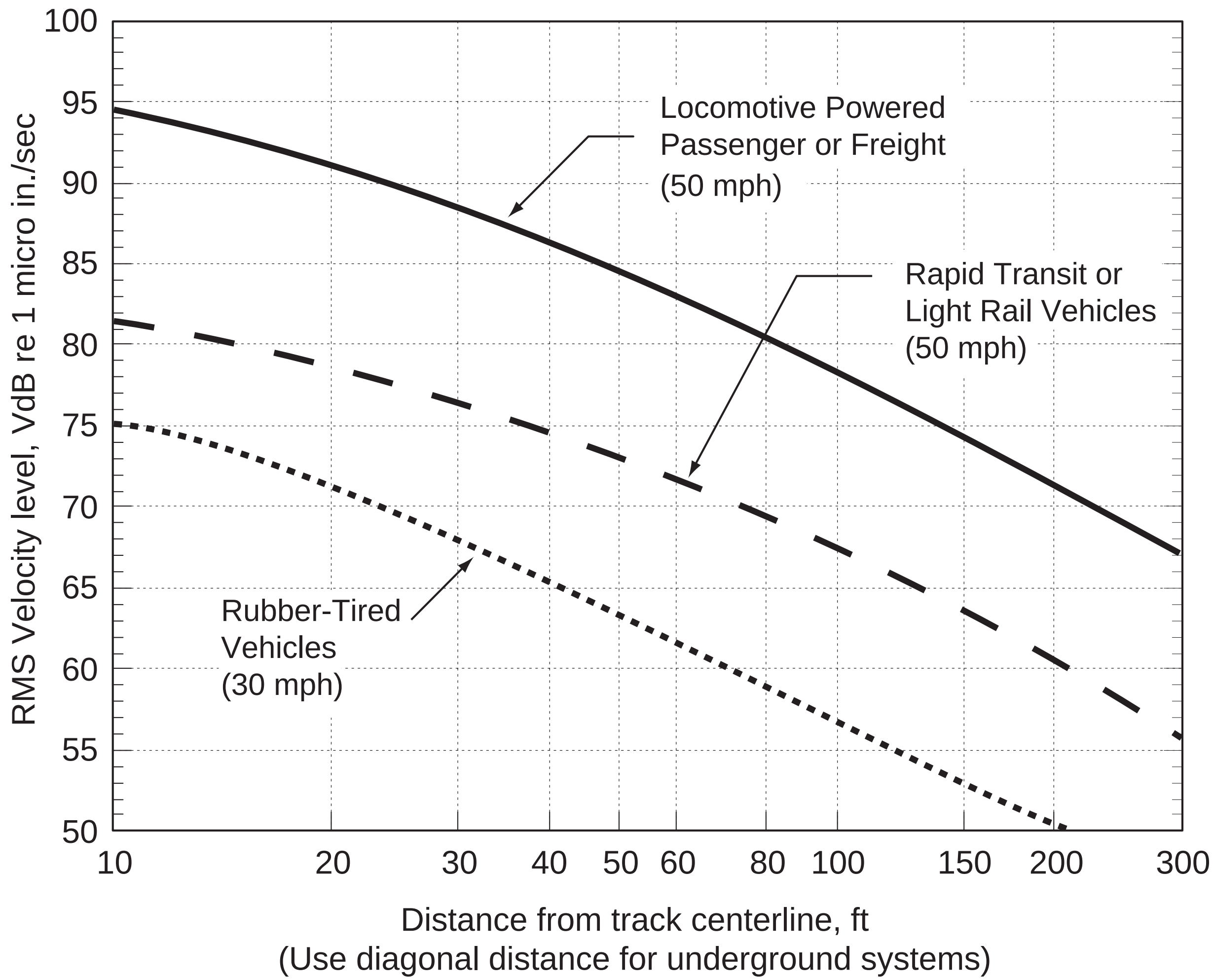


Figure 10-1. Generalized Ground Surface Vibration Curves

Option 4: For residential land uses, measure the hourly L_{eq} for one hour and then compute L_{dn}

The next level down in precision is to determine L_{dn} by measuring the hourly L_{eq} for one hour of the day and then to compute L_{dn} from this hourly L_{eq}. This method is useful when there are many sites in a General Assessment, or when checking whether a particular receiver of interest represents a cluster in a Detailed Analysis. The following procedures apply to this partial-duration measurement option for L_{dn}:

- Measure the one-hour L_{eq} during any hour of the day. The loudest hour during the daytime period is preferable. If this hour is not selected, then other hours may be used with less precision.
- Convert the measured hourly L_{eq} to L_{dn} with the applicable equation:

$$\text{For measurements between 7am and 7pm}: L_{dn} \approx L_{eq} - 2$$
$$\text{For measurements between 7pm and 10pm}: L_{dn} \approx L_{eq} + 3$$
$$\text{For measurements between 10pm and 7am}: L_{dn} \approx L_{eq} + 8$$

  The resulting value of L_{dn} will be moderately underestimated due to the use of the adjustment constants in these equations. As explained previously, this underestimate is intended to compensate for the reduced precision of the computed L_{dn} here, compared to the more precise methods of determining L_{dn}.

- At all sites, locate the measurement microphone as shown in Figure 6-9, depending upon the relative orientation of project and existing sources. Desired is a microphone location that is shielded somewhat from the ambient source. At such locations, ambient noise will be measured at the quietest location on the property for purposes of noise impact assessment so that noise impact will be assessed most critically.
- Undertake all measurements in accordance with good engineering practice

APPENDIX D

Example Project EX-1 Exhibits

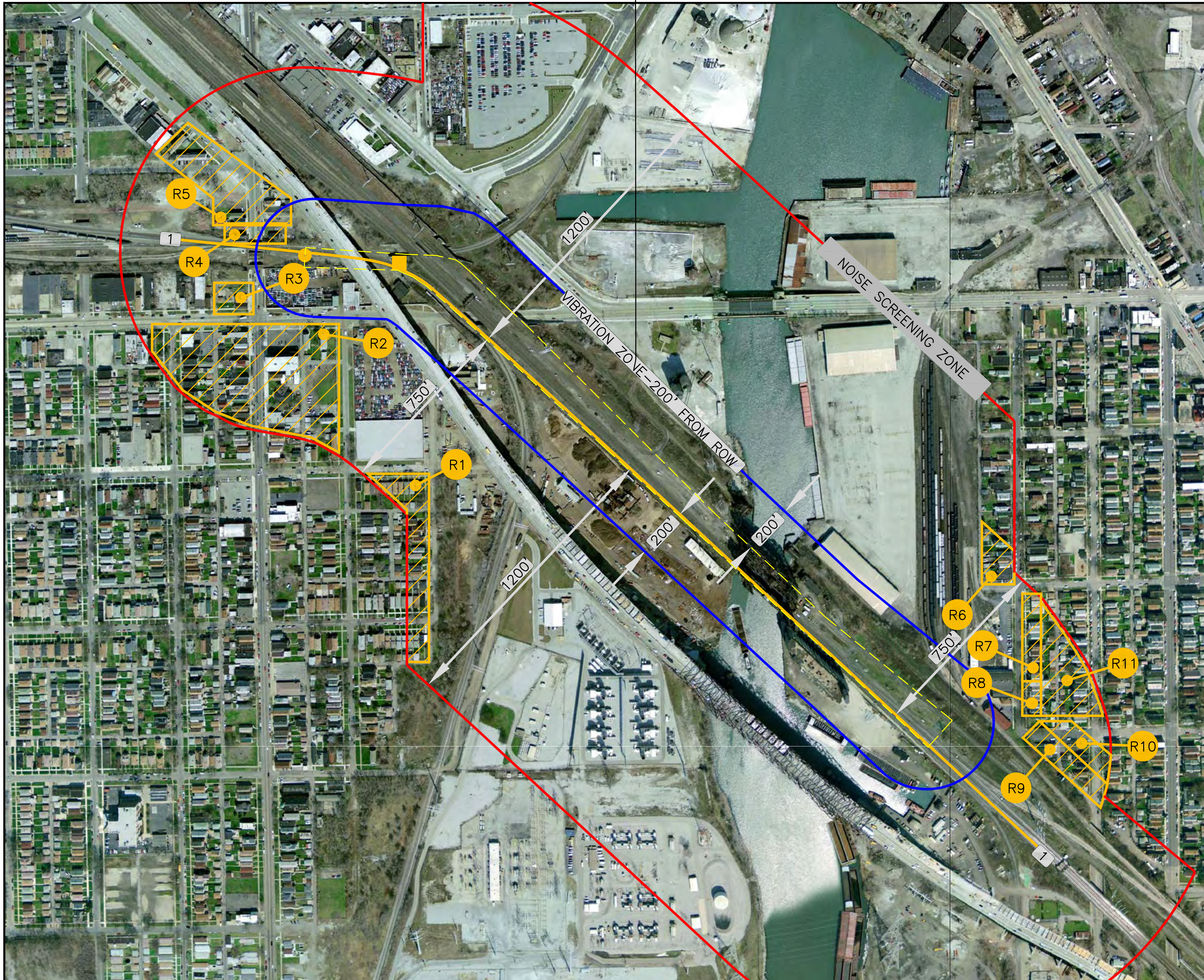
CADFILE: IDOTW07-PLM

EXHIBIT 1
PROJECT LOCATION MAP

CADFILE: IDOTW07-NVSZ

EXHIBIT 2
NOISE AND VIBRATION
SCREENING ZONES

CADFILE: IDOTWO7-RCL



– RECEPTOR CLUSTER

– RECEPTOR LOCATION AND NUMBER

NORTH

400' 0 400'

EXHIBIT 3
RECEPTOR CLUSTERS AND LOCATIONS

Exhibit 4

NOISE and VIBRATION RECEPTOR INFORMATION
CREATE Project EX-1

Receptor ID	Location	Addresses	State Plane Coordinates		Receptor Type	Evaluation
			Easting	Northing		
EX-1-R1	North of RR tracks and west of Chicago Skyway along E. 94th St.	2838 to 2864 E. 94th.	1489218.2	15154654.4	Residence	Noise
EX-1-R2	North of RR tracks and west of Chicago Skyway along Escanaba Av.	9300 to 9400 Escanaba Ave.	1489234.6	15154876.2	Residence	Noise
EX-1-R3	North of RR tracks and west of Chicago Skyway along Anthony Ave.	9310 to 9312 Anthony Av.	1489522.1	15154966.6	Residence	Noise
EX-1-R4	North of RR tracks and west of Chicago Skyway along S. Commercial Ave.	9413 to 9422 S. Commercial Ave.	1489957.5	15154358.6	Residence	Noise and Vibration
EX-1-R5	Northwest quadrant of S. Commercial Avenue and E.95th Street	9450 S. Commercial Ave.	1489982.2	15153997.1	Residence	Noise and Vibration
EX-1-R6	South of E. 95th Street between S. Commercial and S. Houston Ave.	3017 to 3025 E. 95th, 9500 to 9515 S. Commercial Av.	1490253.3	15153915.0	Residence and Church	Noise
EX-1-R7	West of RR tracks along E. 96th St.	3045 to 3065 E. 96th	1490376.5	15153233.1	Residence	Noise
EX-1-R8	Residential area east of RR tracks and Chicago Skyway	9658 to 9713 S. Avenue N, 9712 S. Avenue M	1493383.4	15152340.9	Residence	Noise
EX-1-R9	Residential area east of RR tracks and Chicago Skyway	9713 to 9753 S. Avenue N, 9712 to 9815 S. Avenue M	1493375.2	15152193.0	Residence	Noise
EX-1-R10	Residential area east of RR tracks and Chicago Skyway	9800 to 9831 S. Avenue M, 9828 to 9861 S. Avenue L, 9900 to 9906 S. EXing Ave	1493736.7	15151724.7	Residence	Noise
EX-1-R11	West of tracks and east of Calumet River	9914 to 9919 S. Avenue M	1493629.9	15151157.9	Residence	Noise
EX-1-R12	West of tracks and east of Calumet River	9920 to 9963 S. Avenue M	1493827.0	15150821.0	Residence	Noise

APPENDIX E

Example Project EX- 1 Noise and Vibration
Assessment Summary Tables

EXHIBIT 5

Example Hourly Leq Measurements

Minute	Leq, dBA	Equivalent Sound Pressure (10^(Leq/10))
1	65.6	3630780.548
2	65.9	3890451.45
3	66.3	4265795.188
4	66.8	4786300.923
5	66.5	4466835.922
6	65.6	3630780.548
7	65.1	3235936.569
8	64.8	3019951.72
9	64.7	2951209.227
10	64.7	2951209.227
11	65.9	3890451.45
12	66.5	4466835.922
13	67.1	5128613.84
14	69.2	8317637.711
15	70.3	Data removed due to train passing
16	72.5	
17	78.9	
18	76.8	
19	76.4	
20	69.2	8317637.711
21	68.7	7413102.413
22	67.5	5623413.252
23	66.7	4677351.413
24	65.8	3801893.963
25	65.3	3388441.561
26	64.8	3019951.72
27	67.1	5128613.84
28	66.3	4265795.188
29	66.5	4466835.922
30	66.8	4786300.923
31	67.9	6165950.019
32	66.8	4786300.923
33	66.3	4265795.188
34	65.8	3801893.963
35	65.4	3467368.505
36	66.8	4786300.923
37	66.7	4677351.413
38	65.8	3801893.963
39	64.9	3090295.433
40	64.8	3019951.72
41	64.9	3090295.433
42	65.7	3715352.291
43	65.5	3548133.892
44	66.9	4897788.194
45	67.1	5128613.84
46	66.8	4786300.923
47	66.7	4677351.413
48	69.7	9332543.008
49	65.8	3801893.963
50	64.9	3090295.433
51	65.9	3890451.45
52	66.4	4365158.322
53	66.8	4786300.923
54	66.4	4365158.322
55	65.9	3890451.45
56	65.7	3715352.291
57	65.3	3388441.561
58	65.9	3890451.45
59	65.1	3235936.569
60	64.5	2818382.931
61	64.9	3090295.433
62	64.5	2818382.931
63	65.9	3890451.45
64	66.4	4365158.322
65	66.9	4897788.194

Average	4314366.003	
Leq (hourly), dBA	66.3	(10 x LOG (Average Equivalent Sound Pressure))

EXHIBIT 6

EXAMPLE TRAIN DATA FOR RECEPTOR 1 - TRACK 1

Detector Node	Train Symbol	HE Arrival DD:HH:MM:SS	HE Departure DD:HH:MM:SS	TE Departure DD:HH:MM:SS	Speed MPH	Loads	Empties	Tons	Feet	Locos	Number Cars	
												Wed: 7 Trains
NV001-WA-3-1	SB-681-14-4	1-We:12:53:34	We:12:53:34	We:13:35:40	10	0	124	3027	2524	3		
NV001-WA-3-1	NS2-LC10 10-4	1-We:15:00:51	We:15:00:51	We:15:01:34	14	7	4	1121	264	3		
NV001-WA-3-1	SB-43G-14-4	1-We:17:43:40	We:17:43:40	We:17:59:09	14	11	75	3394	1747	2		
NV001-WA-3-1	SU-45E-14-4	1-We:19:01:58	We:19:01:58	We:19:22:27	14	28	49	4794	1569	2		
NV001-WA-3-1	UU-UP-PWR1-14-4	1-We:21:13:25	We:21:13:25	We:21:13:34	14	0	0	352	150	2		
NV001-WA-3-1	BS-TV 30-14-4	1-We:21:54:00	We:21:54:00	We:21:54:10	14	0	0	300	150	2		
NV001-WA-3-1	SN-174-14-4	1-We:22:01:32	We:22:01:32	We:22:08:22	14	34	89	6698	2480	2		
												Thurs: 14 Trains
NV001-WA-3-1	BN-T265-5	2-Th:04:48:27	Th:04:48:27	Th:05:06:18	5	28	47	4625	1644	4		
NV001-WA-3-1	SB-21N-15-5	2-Th:05:16:06	Th:05:16:06	Th:05:17:24	14	15	0	1715	480	1		
NV001-WA-3-1	UU-UP-PWR1-15-5	2-Th:05:20:49	Th:05:20:49	Th:05:20:59	14	0	0	352	150	2		
NV001-WA-3-1	SS-19A-15-5	2-Th:05:23:39	Th:05:33:26	Th:05:34:47	0	3	19	1319	479	2		
NV001-WA-3-1	BN-TV265-5	2-Th:07:27:27	Th:07:27:27	Th:07:47:15	5	40	0	4626	1962	2		
NV001-WA-3-1	SU-23M-15-5	2-Th:10:04:03	Th:10:04:03	Th:10:06:18	14	25	0	3702	828	3		
NV001-WA-3-1	SB-43G-15-5	2-Th:10:30:25	Th:10:30:25	Th:10:40:59	14	5	53	2432	1193	2		
NV001-WA-3-1	SS-43E-15-5	2-Th:11:01:22	Th:11:01:22	Th:11:05:25	14	14	59	3585	1490	2		
NV001-WA-3-1	NS2-LC10 11-5	2-Th:16:54:12	Th:16:54:12	Th:16:55:51	15	15	15	2373	612	3		
NV001-WA-3-1	SB-681-15-5	2-Th:17:07:25	Th:17:07:25	Th:17:29:45	14	0	126	2836	2541	2		
NV001-WA-3-1	SB-23N-15-5	2-Th:18:41:40	Th:18:41:40	Th:18:43:59	14	18	9	3474	846	1		
NV001-WA-3-1	SU-45E-15-5	2-Th:19:33:12	Th:19:33:12	Th:19:36:58	14	25	43	3963	1391	2		
NV001-WA-3-1	SN-174-15-5	2-Th:21:44:45	Th:21:44:45	Th:21:50:58	14	58	56	7928	2302	2		
NV001-WA-3-1	BS-TV 30-15-5	2-Th:23:40:10	Th:23:40:10	Th:23:40:20	14	0	0	300	150	2		
												Fri: 15 Trains (Maximum Day)
NV001-WA-3-1	UU-UP-PWR1-16-6	3-Fr:04:29:49	Fr:04:29:49	Fr:04:29:58	14	0	0	352	150	2	0	NIGHT
NV001-WA-3-1	SB-21N-16-6	3-Fr:05:16:25	Fr:05:16:25	Fr:05:17:09	14	8	0	1655	266	1	3	Average speed = 14 mph
NV001-WA-3-1	SS-19A-16-6	3-Fr:08:56:28	Fr:08:56:28	Fr:08:58:18	14	11	22	2124	676	1	11	Average number of locos = 2
NV001-WA-3-1	SS-43E-16-6	3-Fr:10:49:34	Fr:10:49:34	Fr:10:53:25	14	29	39	4948	1413	3	22	Average number of cars = 17
NV001-WA-3-1	SB-25K-16-6	3-Fr:11:43:45	Fr:11:43:45	Fr:12:11:11	14	273	0	6128	3187	3	54	Average per hour = (8 trains/9 hours) = 0.9
NV001-WA-3-1	NS2-LC10 12-6	3-Fr:12:20:23	Fr:12:20:23	Fr:12:22:02	14	15	15	2373	612	3	7	
NV001-WA-3-1	SU-23M-16-6	3-Fr:13:19:17	Fr:13:19:17	Fr:13:23:13	14	41	5	5378	1446	2	24	DAY
NV001-WA-3-1	SB-25K-17-6	3-Fr:15:02:44	Fr:15:02:44	Fr:15:18:02	14	22	4	3072	1747	2	29	Average speed = 14 mph
NV001-WA-3-1	SN-174-16-6	3-Fr:16:20:52	Fr:16:20:52	Fr:16:27:25	14	57	62	8322	2401	2	41	Average number of locos = 2
NV001-WA-3-1	SB-681-16-6	3-Fr:16:39:54	Fr:16:39:54	Fr:17:01:23	14	0	123	2756	2482	2	42	Average number of cars = 27
NV001-WA-3-1	SB-43G-16-6	3-Fr:17:11:13	Fr:17:11:13	Fr:17:48:34	14	5	61	2710	1351	2	22	Average per hour = (7 trains/15 hours) = 0.5
NV001-WA-3-1	SU-45E-16-6	3-Fr:18:30:42	Fr:18:30:42	Fr:18:35:10	14	37	44	5367	1648	2	27	
NV001-WA-3-1	BS-TV 30-16-6	3-Fr:22:11:43	Fr:22:11:43	Fr:22:11:53	14	0	0	300	150	2	0	NIGHT
NV001-WA-3-1	SN-174-17-6	3-Fr:22:22:31	Fr:22:22:31	Fr:22:26:09	14	32	30	5086	1338	5	18	Trains included in estimates listed above.
NV001-WA-3-1	SN-174X-16-6	3-Fr:23:51:56	Fr:23:51:56	Fr:23:56:50	14	15	74	4060	1807	2	30	
												Sat: 13 Trains
NV001-WA-3-1	SB-667-16-7	4-Sa:04:05:49	Sa:04:05:49	Sa:04:24:00	14	0	101	2295	2046	2		
NV001-WA-3-1	SB-21N-17-7	4-Sa:05:40:22	Sa:05:40:22	Sa:05:40:52	14	5	0	1235	175	1		
NV001-WA-3-1	SS-19A-17-7	4-Sa:07:52:53	Sa:07:52:53	Sa:07:55:10	14	4	36	1866	836	2		
NV001-WA-3-1	SB-2_25K-17-7	4-Sa:09:13:13	Sa:09:13:13	Sa:09:40:32	14	149	0	4723	3114	3		
NV001-WA-3-1	SS-43E-17-7	4-Sa:10:14:16	Sa:10:14:16	Sa:10:18:41	14	22	58	4338	1628	2		
NV001-WA-3-1	SB-23N-17-7	4-Sa:11:45:46	Sa:11:45:46	Sa:11:47:19	15	17	1	1966	571	1		
NV001-WA-3-1	SU-23M-17-7	4-Sa:12:16:49	Sa:12:16:49	Sa:12:20:44	14	45	1	6055	1446	2		
NV001-WA-3-1	SB-681-17-7	4-Sa:13:02:49	Sa:13:02:49	Sa:13:24:45	14	0	125	2829	2522	2		
NV001-WA-3-1	SB-43G-17-7	4-Sa:15:37:03	Sa:15:37:03	Sa:15:52:20	14	11	74	4340	1794	5		
NV001-WA-3-1	NS2-LC10 13-7	4-Sa:16:39:55	Sa:16:39:55	Sa:16:41:34	15	15	15	2373	612	3		
NV001-WA-3-1	SU-45E-17-7	4-Sa:18:22:43	Sa:18:22:43	Sa:18:25:20	14	18	28	3151	955	2		
NV001-WA-3-1	SB-667-17-7	4-Sa:20:49:09	Sa:20:49:09	Sa:21:08:31	14	0	110	2650	2247	3		
NV001-WA-3-1	BS-TV 30-17-7	4-Sa:23:45:50	Sa:23:45:50	Sa:23:46:00	14	0	0	300	150	2		
												Sun: 4 Trains
NV001-WA-3-1	SB-21N-18-8	8:06:15:41	8:06:15:41	8:06:16:16	14	6	0	1326	205	1		
NV001-WA-3-1	SB-681X-17-8	8:07:06:24	8:07:06:24	8:07:28:31	14	0	126	2856	2541	2		
NV001-WA-3-1	SB-25K-18-8	8:12:04:01	8:12:04:01	8:12:31:08	14	270	0	6717	3152	3		
NV001-WA-3-1	NS2-LC10 14-8	8:16:36:08	8:16:36:08	8:16:37:47	14	15	15	2373	612	3		

R:\Benesch\CREATE\Various\N&V Memo\[Example CTCO data.xls]3C

Number of Rail Cars = (Total Length - (Number of Locomotives *75 ft)) / 55 feet

Data comes sorted by train symbol. Resort data by HE arrival time (data shown here is already sorted).

CREATE NOISE ANALYSIS SUMMARY
Project: EX-1
Date: December 21, 2006

Assessment Level: **GENERAL ASSESSMENT**

Receptor ID	FTA Land Use/ Noise Metric (1)	No. of Buildings Within Cluster	Existing Land Use (2)	Background Noise Level, dBA (3)	Predicted Overall Noise Levels, dBA [4]			Build Increase Over Existing, dBA	FTA Allowable Increase, dBA Moderate / Severe	FTA Impact Level
					Existing	No-Build	Build			
EW4-R1	2 / L_{dn}	11	SFR	64	66	65	67	1	1 / 4	No
EW4-R2	2 / L_{dn}	6	SFR	64	65	65	66	1	1 / 4	No
EW4-R3	2 / L_{dn}	3	SFR	70	72	72	72	0	1 / 3	No
EW4-R4	2 / L_{dn}	6	SFR/MFR	71	74	75	77	3	1 / 2	**Severe**
EW4-R5	2 / L_{dn}	5	SFR	69	70	70	71	1	1 / 3	No
EW4-R6	2 / L_{dn}	10	SFR/MFR	67	69	70	70	1	1 / 3	No
EW4-R7	2 / L_{dn}	11	SFR/MFR	67	68	68	68	0	1 / 3	No
EW4-R8	2 / L_{dn}	6	SFR	56	61	62	62	1	2 / 5	No
EW4-R9	2 / L_{dn}	3	SFR	56	66	67	66	0	1 / 4	No
EW4-R10	2 / L_{dn}	5	SFR	56	68	69	68	0	1 / 3	No
EW4-R11	2 / L_{dn}	12	SFR	62	72	74	73	1	1 / 3	No

Notes:
(1) FTA Noise Impact Criteria apply the 24-hour L_{dn} for residences and nursing homes (Land Use Category 2) and the hourly L_{eq} for schools, parks and churches (Land Use Category 3).
(2) SFR = single-family residence; MFR = multi-family residence.
(3) Background noise levels determined from at one-hour measurement data or from a representative location.
(4) Overall noise levels are the logarithmic addition of the background noise level (without trains) and predicted train noise under the existing, no-build and build conditions. Existing, no-build and build train noise levels were predicted using the FTA General Assessment spreadsheet (CREATE Version).

CREATE NOISE ANALYSIS SUMMARY
Project: EX-1
Date: December 21, 2006

Assessment Level: **DETAILED ASSESSMENT**

Receptor ID	FTA Land Use/ Noise Metric (1)	No. of Buildings Within Cluster	Existing Land Use (2)	Background Noise Level, dBA (3)	Predicted Overall Noise Levels, dBA (4)			Build Increase Over Existing, dBA	FTA Allowable Increase, dBA Moderate / Severe	FTA Impact Level
					Existing	No-Build	Build			
EW4-R4	2 / L_{dn}	6	SFR/MFR	71	73	74	76	3	1 / 2	Severe

Notes:
(1) FTA Noise Impact Criteria apply the 24-hour L_{dn} for residences and nursing homes (Land Use Category 2) and the hourly L_{eq} for schools, parks and churches (Land Use Category 3).
(2) SFR = single-family residence; MFR = multi-family residence.
(3) Background noise levels determined from at one-hour measurement data or from a representative location.
(4) Overall noise levels are the logarithmic addition of the background noise level (without trains) and predicted train noise under the existing, no-build and build conditions. Existing, no-build and build train noise levels were predicted using the FTA Detailed Assessment procedures in Chapter 6 of the FTA *Transit Noise and Vibration Impact Assessment* (May 2006).

CREATE NOISE ABATEMENT EVALUATION

	EX-1
Date:	December 21, 2006
Assessment Level:	**ABATEMENT EVALUATION**
Receptor	EX1-R4
Potential Barrier Location	Toe of Embankment
Noise Metric	L_{dn}
Build Scenario Noise Level Without Barrier (Future CREATE Program Train Noise + Background), dBA	76
Noise Wall Height, ft	15
Noise Wall Length, ft	400
Unit Noise Wall Cost, $ (1)	$25.00
Total Noise Wall Cost, $	$150,000
Future CREATE Program Train Noise Reduction, dBA	5
Build Scenario Noise Reduction (Future CREATE program Noise+Background), dBA (2)	2
Number of Benefited Receptors (3)	2
Cost Per Benefited Receptor	$75,000
Impact Level	Severe Impact
Build Scenario Noise Level Increase that Does Not Result in a Moderate Impact, dBA	1
Build Scenario Noise Level Increase Over Existing Noise Level, dBA	3
Predicted Noise Level Increase Over Moderate Impact Threshold, dBA	2
IF MODERATE IMPACT: Reasonable Cost Level per Benefited Receptor for Decibels Exceeding Moderate Impact Threshold (Policy Value) (4)	Not Applicable due to Severe Impact
IF SEVERE IMPACT: Reasonable Cost Per Benefited Receptor (5)	$30,000
Does Noise Wall Achieve Noise Reduction Goal? (6)	Yes
Does Noise Wall Achieve the Economic Reasonability Policy Value? (7)	No
Is Noise Wall Likely to Be Implemented?	No

Notes:

(1) Noise wall costs are based on $25.00 per square foot unit cost for walls up to 15 feet tall; $37.50 per square foot up to 30 feet tall; and $50.00 per square foot up to 45 feet tall.

(2) Build Scenario Noise Reduction is a decrease in the overall noise (CREATE Program Train Noise + Background).

(3) A benefited receptor is a receptor with predicted noise impacts and that receives a Build Scenario CREATE Program Train Noise Level (Design Year) noise reduction of five (5) dBA or more

(4) For moderate impacts, an upper limit of $5,000 per benefited receptor for each decibel exceeding the impact threshold, up to $30,000 per dwelling.

(5) For severe impacts, an upper limit of $30,000 per benefited receptor

(6) Noise mitigation measures must provide a Build Scenario CREATE Program Train Noise Level (Design Year) noise reduction of at least five (5) dBA for the mitigation measure to be considered feasible.

(7) Does the "Reasonable Cost per Benefited Receptor" exceed the "Cost per Benefited Receptor"? If "Yes", then the noise wall achieves the Economic Reasonability Policy Value.

SAMPLE SPREADSHEETS FOR THE VIBRATION ASSESSMENT

NOTE: The following spreadsheets are based upon the specific conditions in Example Project EX-1. In the example project, two tracks are affected by the CREATE Program and the train traffic characteristics are similar for both tracks. Therefore, in the spreadsheets, the same adjustment factors (speed, source, path and receiver) are applied to both tracks. If these assumptions are not valid for the project being assessed, the analyst will have to modify the spreadsheets to reflect the specific project's conditions. For instance, the spreadsheets may need to be revised to analyze a different number of involved tracks. Additionally, different adjustment factors may have to be applied to each track based upon the specific train traffic characteristics for each track.

Vibration General Assessment Report Form For Source Calculations: CREATE Project EX-1

No-Build Alternative Locomotives

Receptors	Peak Day No-Build Volumes	No-Build Frequency Category [1]	Distance[2] Existing Track 1 (feet)	Distance[2] Existing Track 2 (feet)	Generalized Vibration Curve[3] Existing Track 1 (VdB)	Generalized Vibration Curve[3] Existing Track 2 (VdB)	Highest[4] No-Build Vibration Level at Each Receptor (VdB)
EX-R3	4	infrequent	50	65	85	83	87
EX-R4	4	infrequent	60	75	83	81	85
EX-R5	4	infrequent	225	240	70	69	70
EX-R6	4	infrequent	150	165	74	73	75
EX-R10	4	infrequent	50	65	85	83	84
EX-R11	4	infrequent	60	75	83	81	85

Notes:

(1) Determine if event is frequent; occasional or infrequent event. Refer to Table 7-1 for definition.

(2) Distances measured from centerlines of existing tracks to faces of buildings.

(3) Generalized Ground Surface Vibration Curve (Figure 10-1) for locomotive-powered passenger or freight trains at 50 mph.

(4) Highest vibration level, from the Generalized Vibration Curve (Figure 10-1), of either Track 1 or Track 2 at each receptor. The example project assumes the same adjustments are applied to both tracks. If the same adjustments cannot be applied to all tracks, the analyst may have to apply adjustments to the tracks individually to determine the highest predicted vibration at each receptor.

The "Predicted No-Build" is the "No-Build Scenario CREATE Program Train Vibration Level (Design Year)" which includes all train vibration from no-build scenario (design year) trains operating on tracks affected by the CREATE Program.

Vibration General Assessment Report Form For
Vibration Adjustment Factors
CREATE Project EX-1

No-Build Alternative
Locomotives

	Unadjusted	No Build Adjustments								Adjusted	
		Speed Adjustments		Source Adjustments		Path Adjustments		Receiver Adjustments			
Receptors	Highest[1] Vibration Level @ 50 mph at Each Receptor No-Build (VdB)	Average Track Speed - No-Build (mph)	Speed Adjustment No-Build (VdB)	Vehicle[2] Condition Existing (VdB)	Elevated Structure[3] Adjustment Existing (VdB)	Propagation Geology[4] Adjustment Existing (VdB)	Wood Frame Structure (VdB)	1-5 Floors Above Grade (VdB)	Floor Amplifi-cation (VdB)	No-Build Vibration (VdB)	No-Build GBN (dBA)
EX-R3	87	10	-14	0	-5	10	-5	-2	6	77	27
EX-R4	85	10	-14	0	-5	10	-5	-2	6	75	25
EX-R5	70	10	-14	0	-5	10	-5	-2	6	60	10
EX-R6	75	10	-14	0	-5	10	-5	-2	6	65	15
EX-R10	84	10	-14	0	-5	10	-5	-2	6	74	24
EX-R11	85	50	0	0	-5	10	-5	-2	6	89	39

Notes:

(1) Highest Vibration Level, from the Generalized Vibration Curve (Figure 10-1), of either the Southbound (Track 1) or Northbound (Track 2) at each receptor.

(2) For locomotives assume no worn wheel adjustment

(3) The existing tracks are on elevated structure/embankment (they are at least 1 feet higher than the base elevation at all receptors).

(4) Existing geological conditions assumed to have "efficient" vibration propagation.

The "Predicted No-Build" is the "No-Build Scenario CREATE Program Train Vibration Level (Design Year)" which includes all train vibration from no-build scenario (design year) trains operating on tracks affected by the CREATE Program.

Vibration General Assessment Report Form For Source Calculations: CREATE Project EX-1

No-Build Alternative Freight Rail Car

Receptors	Peak Day No-Build Volumes	No-Build Impact Frequency Category [1]	Distance[2] Existing Track 1 (feet)	Distance[2] Existing Track 2 (feet)	Generalized Vibration Curve[3] Existing Track 1 (VdB)	Generalized Vibration Curve[3] Existing Track 2 (VdB)	Highest[4] Predicted No-Build Vibration Level at Each Receptor (VdB)
EX-R9	50	frequent	50	65	73	71	76
EX-R3	16	frequent	50	65	73	71	75
EX-R4	20	frequent	60	75	72	70	73
EX-R5	24	frequent	225	240	59	59	59
EX-R6	28	frequent	150	165	64	63	64
EX-R10	28	frequent	50	65	73	71	72
EX-R11	20	frequent	60	75	72	70	73
EX-R12	52	frequent	50	65	73	71	72

Notes:

[1] Determine if event is frequent; occasional or infrequent event. Refer to Table 7-1 for definition.

[2] Distances measured from centerlines of existing and proposed tracks to faces of buildings.

[3] Generalized Ground Surface Vibration Curve (Figure 10-1) for rapid transit or light rail vehicles at 50 mph.

[4] Highest vibration level, from the Generalized Vibration Curve (Figure 10-1), of either Track 1 or Track 2 at each receptor. The example project assumes the same adjustments are applied to both tracks. If the same adjustments cannot be applied to all tracks, the analyst may have to apply adjustments to the tracks individually to determine the highest predicted vibration at each receptor.

The "Predicted No-Build" is the "No-Build Scenario CREATE Program Train Vibration Level (Design Year)" which includes all train vibration from no-build scenario (design year) trains operating on tracks affected by the CREATE Program.

Vibration General Assessment Report Form For
Vibration Adjustment Factors
CREATE Project EX-1

No-Build Alternative
Freight Rail Car

	Unadjusted	No-Build Adjustments								Adjusted	
		Speed Adjustments		Source Adjustments		Path Adjustments		Receiver Adjustments			
Receptors	Highest[1] Vibration Level @ 50 mph at Each Receptor Predicted No-Build (VdB)	Average Track Speed - No-Build (mph)	Speed Adjustment - No Build (VdB)	Vehicle[2] Condition Existing (VdB)	Elevated Structure[3] Adjustment Existing (VdB)	Propagation Geology[4] Adjustment Existing (VdB)	Wood Frame Structure (VdB)	1-5 Floors Above Grade (VdB)	Floor Amplifi-cation (VdB)	No-Build Vibration (VdB)	No-Build GBN (dBA)
EX-R9	76	24	-6	10	-5	10	-5	-2	6	84	34
EX-R3	75	10	-14	10	-5	10	-5	-2	6	75	25
EX-R4	73	10	-14	10	-5	10	-5	-2	6	73	23
EX-R5	59	10	-14	10	-5	10	-5	-2	6	59	9
EX-R6	64	10	-14	10	-5	10	-5	-2	6	64	14
EX-R10	72	50	0	10	-5	10	-5	-2	6	86	36
EX-R11	73	50	0	10	-5	10	-5	-2	6	87	37
EX-R12	72	50	0	10	-5	10	-5	-2	6	86	36

Notes:

(1) Highest Vibration Level, from the Generalized Vibration Curve (Figure 10-1), of either the Southbound (Track 1) or Northbound (Track 2) at each rec

(2) Worn wheel adjustment made for Freight Rail Car. For locomotives assume no worn wheel adjustment

(3) The existing tracks are on elevated structure/embankment (they are at least 1 feet higher than the base elevation at all receptors).

(4) Existing geological conditions assumed to have "efficient" vibration propagation.

The "Predicted No-Build" is the "No-Build Scenario CREATE Program Train Vibration Level (Design Year)" which includes all train vibration from no-build scenario (design year) trains operating on tracks affected by the CREATE Program.

Vibration General Assessment Report Form For Source Calculations:
CREATE Project EX-1

Infrequently Used (existing train volume < 5 trains/day) Locomotives

Receptors	Peak Day Existing Volumes	Peak Day Predicted Build Volumes	Predicted Build Frequency Category [(1)]	Distance[(2)] Existing Track 1 (feet)	Distance[(2)] Existing Track 2 (feet)	Distance[(2)] Proposed Track 1 (feet)	Distance[(2)] Proposed Track 2 (feet)	Generalized Vibration Curve[(3)] Existing Track 1 (VdB)	Generalized Vibration Curve[(3)] Existing Track 2 (VdB)	Generalized Vibration Curve[(3)] Proposed Track 1 (VdB)	Generalized Vibration Curve[(3)] Proposed Track 2 (VdB)	Highest[(4)] Predicted Existing Vibration Level at Each Receptor (VdB)	Highest[(4)] Predicted Build Vibration Level at Each Receptor (VdB)
EX-R3	4	4	infrequent	50	65	40	55	85	83	87	84	85	87
EX-R4	4	4	infrequent	60	75	50	65	83	81	85	82	83	85
EX-R5	4	4	infrequent	225	240	215	230	70	69	70	70	70	70
EX-R6	4	4	infrequent	150	165	140	155	74	73	75	74	74	75
EX-R10	4	4	infrequent	50	65	55	75	85	83	84	81	85	84
EX-R11	4	4	infrequent	60	75	50	65	83	81	85	82	83	85

Notes:

(1) Determine if event is frequent; occasional or infrequent event. Refer to Table 7-1 for definition.

(2) Distances measured from centerlines of existing and proposed tracks to faces of buildings.

(3) Generalized Ground Surface Vibration Curve (Figure 10-1) for locomotive-powered passenger or freight trains at 50 mph.

(4) Highest vibration level, from the Generalized Vibration Curve (Figure 10-1), of either Track 1 or Track 2 at each receptor. The example project assumes the same adjustments are applied to both tracks. If the same adjustments cannot be applied to all tracks, the analyst may have to apply adjustments to the tracks individually to determine the highest predicted vibration at each receptor.

The "Predicted Build" is the same as the "Build Scenario CREATE Program Train Vibration Level (Design Year)" as referenced in the Noise and Vibration Methodology Section 7.2.2 except when analyzing moved existing tracks. When analyzing moved existing tracks, the "Predicted Build" considers the total number of trains using those tracks in the design year to determine the frequency category (frequent, occasional or infrequent) and impact level in Table 7-1, as well as the vibration level.

Vibration General Assessment Report Form For
Vibration Adjustment Factors
CREATE Project EX-1

Infrequently Used (existing train volume < 5 trains/day)
Locomotives

	Unadjusted		Existing Adjustments								Predicted Build Adjustments								Adjusted	
			Speed Adjustments		Source Adjustments		Path Adjustments		Receiver Adjustments		Speed Adjustments		Source Adjustments		Path Adjustments		Receiver Adjustments			
Receptors	Highest[1] Vibration Level @ 50 mph at Each Receptor Existing (VdB)	Highest[1] Vibration Level @ 50 mph at Each Receptor Predicted Build (VdB)	Average Track Speed-Existing (mph)	Speed Adjustment - Existing (VdB)	Vehicle[2] Condition - Existing (VdB)	Elevated Structure[3] Adjustment - Existing (VdB)	Propagation Geology[4] Adjustment - Existing (VdB)	Wood Frame Structure (VdB)	1-5 Floors Above Grade (VdB)	Floor Amplification (VdB)	Average Track Speed - Predicted Build (mph)	Speed Adjustment - Predicted Build (VdB)	Vehicle[2] Condition - Existing (VdB)	Elevated Structure[3] Adjustment- Predicted Build (VdB)	Propagation Geology[4] Adjustment - Existing (VdB)	Wood Frame Structure (VdB)	1-5 Floors Above Grade (VdB)	Floor Amplification (VdB)	Predicted Existing Vibration (VdB)	Predicted Build Vibration (VdB)
EX-R3	85	87	10	-14	0	-5	10	-5	-2	6	10	-14	0	-5	10	-5	-2	6	75	77
EX-R4	83	85	10	-14	0	-5	10	-5	-2	6	10	-14	0	-5	10	-5	-2	6	73	75
EX-R5	70	70	10	-14	0	-5	10	-5	-2	6	10	-14	0	-5	10	-5	-2	6	60	60
EX-R6	74	75	10	-14	0	-5	10	-5	-2	6	10	-14	0	-5	10	-5	-2	6	64	65
EX-R10	85	84	10	-14	0	-5	10	-5	-2	6	50	0	0	-5	10	-5	-2	6	75	88
EX-R11	83	85	50	0	0	-5	10	-5	-2	6	50	0	0	-5	10	-5	-2	6	87	89

Notes:

(1) Highest Vibration Level, from the Generalized Vibration Curve (Figure 10-1), of either the Southbound (Track 1) or Northbound (Track 2) at each receptor.

(2) For locomotives assume no worn wheel adjustment.

(3) Existing and proposed tracks are elevated structure/embankment, because both the existing and proposed tracks would be at least 1 feet higher than the base elevation at all receptors

(4) Existing and proposed geological conditions assumed to have "efficient" vibration propagation.

The "Predicted Build" is the same as the "Build Scenario CREATE Program Train Vibration Level (Design Year)" as referenced in the Noise and Vibration Methodology Section 7.2.2 except when analyzing moved existing tracks. When analyzing moved existing tracks, the "Predicted Build" considers the total number of trains using those tracks in the design year to determine the frequency category (frequent, occasional or infrequent) and impact level in Table 7-1, as well as the vibration level.

Vibration General Assessment Report Form For
Vibration Impact Summary
CREATE Project EX-1

Infrequently Used (existing train volume < 5 trains/day)
Locomotives

Ground-borne Vibration (GBV) Impacts							
1	2	3	4	5	6	7	8
Receptors	FTA [2] Vibration Land Use Category	Predicted Build Vibration Frequency event [1]	Predicted Build - FTA Vibration Impact Criteria [3] (VdB)	Predicted Existing Vibration (VdB)	Predicted Build Vibration (VdB)	Difference between Predicted Existing vibration and Predicted Build vibration (VdB)	Potential Impact? (Does the Predicted Build Vibration equal or exceed the FTA impact criteria in Column 4?) - Yes or No
EX-R3	2	infrequent	80	75	77	2	No
EX-R4	2	infrequent	80	73	75	2	No
EX-R5	2	infrequent	80	60	60	0	No
EX-R6	2	infrequent	80	64	65	1	No
EX-R10	2	infrequent	80	75	88	13	Yes
EX-R11	2	infrequent	80	87	89	2	Yes

Notes:

(1) Determine if event is frequent; occasional or infrequent event. Refer to Table 7-1 for definition.

(2) FTA Vibration Land Use Category #2 includes residences and other buildings where people normally sleep, and Category Land Use #3 includes institutional land uses with primarily daytime uses, such as schools and churches.

(3) Source Table 7-1

NA = Not applicable

The "Predicted Build" is the same as the "Build Scenario CREATE Program Train Vibration Level (Design Year)" as referenced in the Noise and Vibration Methodology Section 7.2.2 except when analyzing moved existing tracks. When analyzing moved existing tracks, the "Predicted Build" considers the total number of trains using those tracks in the design year to determine the frequency category (frequent, occasional or infrequent) and impact level in Table 7-1, as well as the vibration level.

Vibration General Assessment Report Form For
GBN Impact Summary
CREATE Project EX-1

Infrequently Used (existing train volume < 5 trains/day) Locomotives

Ground-borne Noise (GBN) Impacts							
1	2	3	4	5	6	7	8
Receptors	FTA [2] Vibration Land Use Category	Predicted Build GBN Frequency event [1]	Predicted Build - FTA GBN Impact Criteria [3] (dBA)	Predicted Existing GBN (dBA) [4]	Predicted Build GBN (dBA)	Difference between Predicted Existing GBN and Predicted Build GBN (dBA)	Potential Impact? (Does the Predicted Build Vibration equal or exceed the FTA impact criteria in Column 4?) - Yes or No
EX-R3	2	infrequent	43	25	27	2	No
EX-R4	2	infrequent	43	23	25	2	No
EX-R5	2	infrequent	43	10	10	0	No
EX-R6	2	infrequent	43	14	15	1	No
EX-R10	2	infrequent	43	25	38	13	No
EX-R11	2	infrequent	43	37	39	2	No

Notes:

(1) Determine if event is frequent; occasional or infrequent event. Refer to Table 7-1 for definition.

(2) FTA Vibration Land Use Category #2 includes residences and other buildings where people normally sleep, and Category Land Use #3 includes institutional land uses with primarily daytime uses, such as schools and churches.

(3) Source Table 7-1

(4) Assumes adjustment of -50 dB for low frequency vibration sources (FTA Manual Table 10-1).

NA = Not applicable

The "Predicted Build" is the same as the "Build Scenario CREATE Program Train Vibration Level (Design Year)" as referenced in the Noise and Vibration Methodology Section 7.2.2 except when analyzing moved existing tracks. When analyzing moved existing tracks, the "Predicted Build" considers the total number of trains using those tracks in the design year to determine the frequency category (frequent, occasional or infrequent) and impact level in Table 7-1, as well as the vibration level.

Vibration General Assessment Report Form For Source Calculations:
CREATE Project EX-1

Infrequently Used (existing train volume < 5 trains/day)
Freight Cars

Receptors	Peak Day Existing Volumes	Peak Day Predicted Build Volumes	Predicted Build Frequency Category [1]	Distance[2] Existing Track 1 (feet)	Distance[2] Existing Track 2 (feet)	Distance[2] Proposed Track 1 (feet)	Distance[2] Proposed Track 2 (feet)	Generalized Vibration Curve[3] Existing Track 1 (VdB)	Generalized Vibration Curve[3] Existing Track 2 (VdB)	Generalized Vibration Curve[3] Proposed Track 1 (VdB)	Generalized Vibration Curve[3] Proposed Track 2 (VdB)	Highest[4] Predicted Existing Vibration Level at Each Receptor (VdB)	Highest[4] Predicted Build Vibration Level at Each Receptor (VdB)
EX-R3	4	4	frequent	50	65	40	55	73	71	76	74	73	76
EX-R4	4	4	frequent	60	75	50	65	72	70	73	7	72	73
EX-R5	4	4	frequent	225	240	215	230	59	59	59	59	59	59
EX-R6	4	4	frequent	150	165	140	155	64	63	64	63	64	64
EX-R10	4	4	frequent	50	65	55	75	73	71	72	70	73	72
EX-R11	4	4	frequent	60	75	50	65	72	70	73	7	72	73

Notes:

[1] Determine if event is frequent; occasional or infrequent event. Refer to Table 7-1 for definition. Freight cars always assumed frequent

[2] Distances measured from centerlines of existing and proposed tracks to faces of buildings.

[3] Generalized Ground Surface Vibration Curve (Figure 10-1) for rapid transit or light rail vehicles at 50 mph.

[4] Highest vibration level, from the Generalized Vibration Curve (Figure 10-1), of either Track 1 or Track 2 at each receptor. The example project assumes the same adjustments are applied to both tracks. If the same adjustments cannot be applied to all tracks, the analyst may have to apply adjustments to the tracks individually to determine the highest predicted vibration at each receptor.

The "Predicted Build" is the same as the "Build Scenario CREATE Program Train Vibration Level (Design Year)" as referenced in the Noise and Vibration Methodology Section 7.2.2 except when analyzing moved existing tracks. When analyzing moved existing tracks, the "Predicted Build" considers the total number of trains using those tracks in the design year to determine the frequency category (frequent, occasional or infrequent) and impact level in Table 7-1, as well as the vibration level.

Vibration General Assessment Report Form For
Vibration Adjustment Factors
CREATE Project EX-1

Infrequently Used (existing train volume < 5 trains/day)
Freight Cars

	Unadjusted		Existing Adjustments								Predicted Build Adjustments								Adjusted	
			Speed Adjustments		Source Adjustments		Path Adjustments		Receiver Adjustments		Speed Adjustments		Source Adjustments		Path Adjustments		Receiver Adjustments			
Receptors	Highest[1] Vibration Level @ 50 mph at Each Receptor Existing (VdB)	Highest[1] Vibration Level @ 50 mph at Each Receptor Predicted Build (VdB)	Average Track Speed - Existing (mph)	Speed Adjustment Existing (VdB)	Vehicle[2] Condition Existing (VdB)	Elevated Structure[3] Adjustment Existing (VdB)	Propagation Geology[4] Adjustment Existing (VdB)	Wood Frame Structure (VdB)	1-5 Floors Above Grade (VdB)	Floor Amplifi-cation (VdB)	Average Track Speed - Predicted Build (mph)	Speed Adjustment - Predicted Build (VdB)	Vehicle[2] Condition Existing (VdB)	Elevated Structure[3] Adjustment - Predicted Build (VdB)	Propagation Geology[4] Adjustment Existing (VdB)	Wood Frame Structure (VdB)	1-5 Floors Above Grade (VdB)	Floor Amplifi-cation (VdB)	Predicted Existing Vibration (VdB)	Predicted Build Vibration (VdB)
EX-R3	73	76	10	-14	10	-5	10	-5	-2	6	10	-14	10	-5	10	-5	-2	6	73	76
EX-R4	72	73	10	-14	10	-5	10	-5	-2	6	10	-14	10	-5	10	-5	-2	6	72	73
EX-R5	59	59	10	-14	10	-5	10	-5	-2	6	10	-14	10	-5	10	-5	-2	6	59	59
EX-R6	64	64	10	-14	10	-5	10	-5	-2	6	10	-14	10	-5	10	-5	-2	6	64	64
EX-R10	73	72	10	-14	10	-5	10	-5	-2	6	50	0	10	-5	10	-5	-2	6	73	86
EX-R11	72	73	50	0	10	-5	10	-5	-2	6	50	0	10	-5	10	-5	-2	6	86	87

Notes:

(1) Highest Vibration Level, from the Generalized Vibration Curve (Figure 10-1), of either the Southbound (Track 1) or Northbound (Track 2) at each receptor.

(2) For locomotives assume no worn wheel adjustment

(3) Existing and proposed tracks are elevated structure/embankment, because both the existing and proposed tracks would be at least 1 feet higher than the base elevation at all receptors

(4) Existing and proposed geological conditions assumed to have "efficient" vibration propagation.

The "Predicted Build" is the same as the "Build Scenario CREATE Program Train Vibration Level (Design Year)" as referenced in the Noise and Vibration Methodology Section 7.2.2 except when analyzing moved existing tracks. When analyzing moved existing tracks, the "Predicted Build" considers the total number of trains using those tracks in the design year to determine the frequency category (frequent, occasional or infrequent) and impact level in Table 7-1, as well as the vibration level.

Vibration General Assessment Report Form For
Vibration Impact Summary
CREATE Project EX-1

Infrequently Used (existing train volume < 5 trains/day)
Freight Cars

Ground-borne Vibration (GBV) Impacts							
1	2	3	4	5	6	7	8
Receptors	FTA [2] Vibration Land Use Category	Predicted Build Vibration Frequency event [1]	Predicted Build - FTA Vibration Impact Criteria [3] (VdB)	Predicted Existing Vibration (VdB)	Predicted Build Vibration (VdB)	Difference between Predicted Existing vibration and Predicted Build vibration (VdB)	Potential Impact? (Does the Predicted Build vibration equal or exceed the FTA impact criteria in Column 4?) - Yes or No
EX-R3	2	frequent	72	73	76	3	Yes
EX-R4	2	frequent	72	72	73	1	Yes
EX-R5	2	frequent	72	59	59	0	No
EX-R6	2	frequent	72	64	64	0	No
EX-R10	2	frequent	72	73	86	13	Yes
EX-R11	2	frequent	72	86	87	1	Yes

Notes:

[1] Determine if event is frequent; occasional or infrequent event. Refer to Table 7-1 for definition.

[2] FTA Vibration Land Use Category #2 includes residences and other buildings where people normally sleep, and Category Land Use #3 includes institutional land uses with primarily daytime uses, such as schools and churches.

[3] Source Table 7-1

NA = Not applicable

The "Predicted Build" is the same as the "Build Scenario CREATE Program Train Vibration Level (Design Year)" as referenced in the Noise and Vibration Methodology Section 7.2.2 except when analyzing moved existing tracks. When analyzing moved existing tracks, the "Predicted Build" considers the total number of trains using those tracks in the design year to determine the frequency category (frequent, occasional or infrequent) and impact level in Table 7-1, as well as the vibration level.

Vibration General Assessment Report Form For
GBN Impact Summary
CREATE Project EX-1

Infrequently Used (existing train volume < 5 trains/day)
Freight Cars

Ground-borne Noise (GBN) Impacts							
1	2	3	4	5	6	7	8
Receptors	FTA [2] Vibration Land Use Category	Predicted Build GBN Frequency event [1]	Predicted Build - FTA GBN Impact Criteria [3] (dBA)	Predicted Existing GBN (dBA) [4]	Predicted Build GBN (dBA)	Difference between Predicted Existing GBN and Predicted Build GBN (dBA)	Potential Impact? (Does the Predicted Build GBN equal or exceed the FTA impact criteria in Column 4?) - Yes or No
EX-R3	2	frequent	35	23	26	3	No
EX-R4	2	frequent	35	22	23	1	No
EX-R5	2	frequent	35	9	9	0	No
EX-R6	2	frequent	35	14	14	0	No
EX-R10	2	frequent	35	23	36	13	Yes
EX-R11	2	frequent	35	36	37	1	Yes

Notes:

(1) Determine if event is frequent; occasional or infrequent event. Refer to Table 7-1 for definition.

(2) FTA Vibration Land Use Category #2 includes residences and other buildings where people normally sleep, and Category Land Use #3 includes institutional land uses with primarily daytime uses, such as schools and churches.

(3) Source Table 7-1

(4) Assumes adjustment of -50 dB for low frequency vibration sources (FTA Manual Table 10-1).

NA = Not applicable

The "Predicted Build" is the same as the "Build Scenario CREATE Program Train Vibration Level (Design Year)" as referenced in the Noise and Vibration Methodology Section 7.2.2 except when analyzing moved existing tracks. When analyzing moved existing tracks, the "Predicted Build" considers the total number of trains using those tracks in the design year to determine the frequency category (frequent, occasional or infrequent) and impact level in Table 7-1, as well as the vibration level.

Vibration General Assessment Report Form For Source Calculations:
CREATE Project EX-1

Moderately Used Rail Corridor (existing train volume from 5 to 12 trains/day)
Locomotives

Receptors	Peak Day Existing Volumes	Peak Day Predicted Build Volumes	Existing Impact Frequency Category [1]	Build Impact Frequency Category [1]	Distance[2] Existing Track 1 (feet)	Distance[2] Existing Track 2 (feet)	Distance[2] Proposed Track 1 (feet)	Distance[1] Proposed Track 2 (feet)	Generalized Vibration Curve[3] Existing Track 1 (VdB)	Generalized Vibration Curve[3] Existing Track 2 (VdB)	Generalized Vibration Curve[3] Proposed Track 1 (VdB)	Generalized Vibration Curve[3] Proposed Track 2 (VdB)	Highest[4] Predicted Existing Vibration Level at Each Receptor (VdB)	Highest[4] Predicted Build Vibration Level at Each Receptor (VdB)
EX-R3	4	6	infrequent	infrequent	50	65	40	55	85	83	87	84	85	87
EX-R4	6	6	infrequent	infrequent	60	75	50	65	83	81	85	82	83	85
EX-R5	14	7	infrequent	infrequent	225	240	215	230	70	69	70	70	70	70
EX-R6	30	6	occasional	infrequent	150	165	140	155	74	73	75	74	74	75
EX-R10	6	6	infrequent	infrequent	50	65	55	75	85	83	84	81	85	84
EX-R11	16	20	infrequent	infrequent	60	75	50	65	83	81	85	82	83	85
EX-R12	4	6	infrequent	infrequent	50	65	55	70	85	83	84	82	85	84

Notes:

(1) Determine if event is frequent; occasional or infrequent event. Refer to Table 7-1 for definition.

(2) Distances measured from centerlines of existing and proposed tracks to faces of buildings.

(3) Generalized Ground Surface Vibration Curve (Figure 10-1) for locomotive-powered passenger or freight trains at 50 mph.

(4) Highest vibration level, from the Generalized Vibration Curve (Figure 10-1), of either Track 1 or Track 2 at each receptor. The example project assumes the same adjustments are applied to both tracks. If the same adjustments cannot be applied to all tracks, the analyst may have to apply adjustments to the tracks individually to determine the high predicted vibration at each receptor.

The "Predicted Build" is the same as the "Build Scenario CREATE Program Train Vibration Level (Design Year)" as referenced in the Noise and Vibration Methodology Section 7.2.2 except when analyzing moved existing tracks. When analyzing moved existing tracks, the "Predicted Build" considers the total number of trains using those tracks in the design year to determine the frequency category (frequent, occasional or infrequent) and impact level in Table 7-1, as well as the vibration level.

Vibration General Assessment Report Form For
Vibration Adjustment Factors
CREATE Project EX-1

Moderately Used Rail Corridor (existing train volume from 5 to 12 trains/day)
Locomotives

	Unadjusted		Existing Adjustments								Predicted Build Adjustments								Adjusted	
			Speed Adjustments		Source Adjustments		Path Adjustments		Receiver Adjustments		Speed Adjustments		Source Adjustments		Path Adjustments		Receiver Adjustments			
Receptors	Highest[1] Vibration Level @ 50 mph at Each Receptor Existing (VdB)	Highest[1] Vibration Level @ 50 mph at Each Receptor Predicted Build (VdB)	Average Track Speed - Existing (mph)	Speed Adjustment Existing (VdB)	Vehicle[2] Condition Existing (VdB)	Elevated Structure[3] Adjustment Existing (VdB)	Propagation Geology[4] Adjustment Existing (VdB)	Wood Frame Structure (VdB)	1-5 Floors Above Grade (VdB)	Floor Amplification (VdB)	Average Track Speed - Predicted Build (mph)	Speed Adjustment - Predicted Build (VdB)	Vehicle[2] Condition Existing (VdB)	Elevated Structure[3] Adjustment - Predicted Build (VdB)	Propagation Geology[4] Adjustment Existing (VdB)	Wood Frame Structure (VdB)	1-5 Floors Above Grade (VdB)	Floor Amplification (VdB)	Predicted Existing Vibration (VdB)	Predicted Build Vibration (VdB)
EX-R3	85	87	10	-14	0	-5	10	-5	-2	6	10	-14	0	-5	10	-5	-2	6	75	77
EX-R4	83	85	10	-14	0	-5	10	-5	-2	6	10	-14	0	-5	10	-5	-2	6	73	75
EX-R5	70	70	10	-14	0	-5	10	-5	-2	6	10	-14	0	-5	10	-5	-2	6	60	60
EX-R6	74	75	10	-14	0	-5	10	-5	-2	6	10	-14	0	-5	10	-5	-2	6	64	65
EX-R10	85	84	50	0	0	-5	10	-5	-2	6	10	-14	0	-5	10	-5	-2	6	89	74
EX-R11	83	85	50	0	0	-5	10	-5	-2	6	50	0	0	-5	10	-5	-2	6	87	89
EX-R12	85	84	10	-14	0	-5	10	-5	-2	6	50	0	0	-5	10	-5	-2	6	75	88

Notes:

(1) Highest Vibration Level, from the Generalized Vibration Curve (Figure 10-1), of either the Southbound (Track 1) or Northbound (Track 2) at each receptor.

(2) Worn wheel adjustment made for Freight Rail Car. For locomotives assume no worn wheel adjustment

(3) Existing and proposed tracks are elevated structure/embankment, because both the existing and proposed tracks would be at least 1 feet higher than the base elevation at all receptors

(4) Existing and proposed geological conditions assumed to have "efficient" vibration propagation.

The "Predicted Build" is the same as the "Build Scenario CREATE Program Train Vibration Level (Design Year)" as referenced in the Noise and Vibration Methodology Section 7.2.2 except when analyzing moved existing tracks. When analyzing moved existing tracks, the "Predicted Build" considers the total number of trains using those tracks in the design year to determine the frequency category (frequent, occasional or infrequent) and impact level in Table 7-1, as well as the vibration level.

Vibration General Assessment Report Form For
Vibration Impact Summary
CREATE Project EX-1

Moderately Used Rail Corridor (existing train volume from 5 to 12 trains/day)
Locomotives

Ground-borne Vibration (GBV) Impacts												
1	2	3	4	5	6	7	8	9	10	11	12	13
Receptors	FTA [(2)] Vibration Land Use Category	Existing Vibration Frequency event [(1)]	Existing-FTA Vibration Impact Criteria [(3)] (VdB)	Predicted Build Vibration Frequency event [(1)]	Predicted Build - FTA Vibration Impact Criteria [(3)] (VdB)	Predicted Existing Vibration (VdB)	Predicted Build Vibration (VdB)	Difference between Predicted Existing vibration and Predicted Build vibration (VdB)	Does the Predicted Existing vibration equal or exceed the FTA impact criteria in Column 4? If Yes, go to Column 11. If No, go to Column 12.?	Is the Predicted Build vibration lower than Existing vibration by 5 VdB or greater? If Yes, go to Column 13 and indicate "No" - there is No Potential Impact . If No, Go to Column 12.	Does the Predicted Build vibration equal or exceed the FTA impact criteria in Column 6? If Yes, go to Column 13 and Indicate "Yes", there is a Potential Impact. If No, go to Column 13 and indicate "No", there is No Potential Impact.	Potential Impact? If Yes, proceed to Detailed Analysis if mitigation measures are viable.
EX-R3	2	infrequent	80	infrequent	80	75	77	2	No	NA	No	No
EX-R4	2	infrequent	80	infrequent	80	73	75	2	No	NA	No	No
EX-R5	2	infrequent	80	infrequent	80	60	60	0	No	NA	No	No
EX-R6	2	occasional	75	infrequent	80	64	65	1	No	NA	No	No
EX-R10	2	infrequent	80	infrequent	80	89	74	-15	Yes	Yes, Lower	NA	No
EX-R11	2	infrequent	80	infrequent	80	87	89	2	Yes	No	Yes	Yes
EX-R12	2	infrequent	80	infrequent	80	75	88	13	No	NA	Yes	Yes

Notes:

(1) Determine if event is frequent; occasional or infrequent event. Refer to Table 7-1 for definition.

(2) FTA Vibration Land Use Category #2 includes residences and other buildings where people normally sleep, and Category Land Use #3 includes institutional land uses with primarily daytime uses, such as schools and churches.

(3) Source Table 7-1

(4) See Source Calculations for existing and build volumes and refer to Section 7.2.2 item #3

NA = Not applicable

The "Predicted Build" is the same as the "Build Scenario CREATE Program Train Vibration Level (Design Year)" as referenced in the Noise and Vibration Methodology Section 7.2.2 except when analyzing moved existing tracks. When analyzing moved existing tracks, the "Predicted Build" considers the total number of trains using those tracks in the design year to determine the frequency category (frequent, occasional or infrequent) and impact level in Table 7-1, as well as the vibration level.

Vibration General Assessment Report Form For
GBN Impact Summary
CREATE Project EX-1

Moderately Used Rail Corridor (existing train volume from 5 to 12 trains/day)
Locomotives

Ground-borne Noise (GBN) Impacts

1	2	3	4	5	6	7	8	9	10	11	12	13
Receptors	FTA [2] Vibration Land Use Category	Existing GBN Frequency event [1]	Existing-FTA GBN Impact Criteria [3] (dBA)	Predicted Build GBN Frequency event [1]	Predicted Build - FTA GBN Impact Criteria [3] (dBA)	Predicted Existing GBN (dBA)	Predicted Build GBN (dBA)	Difference between Predicted Existing GBN and Predicted Build GBN (dBA)	Does the Predicted Existing GBN equal or exceed the FTA impact criteria in Column 4? If Yes, go to Column 11. If No, go to Column 12.	Is the Predicted Build GBN lower than Existing GBN by 5 dBA or greater? If Yes, go to Column 13 and Indicate "No" - there is No Potential Impact . If No, go to Column 12.	Does the Predicted Build GBN equal or exceed the Predicted Build FTA impact criteria in Column 6? If Yes, go to Column 13 and indicate "Yes", there is a Potential Impact. If No, go to Column 13 and indicate "No", there is No Potential Impact.	Potential Impact? If Yes, proceed to Detailed Analysis if mitigation measures are viable.
EX-R3	2	infrequent	43	infrequent	43	25	27	2	No	NA	No	No
EX-R4	2	infrequent	43	infrequent	43	23	25	2	No	NA	No	No
EX-R5	2	infrequent	43	infrequent	43	10	10	0	No	NA	No	No
EX-R6	2	occasional	38	infrequent	43	14	15	1	No	NA	No	No
EX-R7	2	infrequent	43	infrequent	43	39	24	-15	No	NA	No	No
EX-R8	2	infrequent	43	infrequent	43	37	39	2	No	NA	No	No
EX-R9	2	infrequent	43	infrequent	43	25	38	13	No	NA	No	No

Notes:

(1) Determine if event is frequent; occasional or infrequent event. Refer to Table 7-1 for definition.

(2) FTA Vibration Land Use Category #2 includes residences and other buildings where people normally sleep, and Category Land Use #3 includes institutional land uses with primarily daytime uses, such as schools and churches.

(3) Source Table 7-1

(4) See Source Calculations for existing and build volumes and refer to Section 7.2.2 item #3

(5) Assumes adjustment of -50 dB for low frequency vibration sources (FTA Manual Table 10-1).

NA = Not applicable

The "Predicted Build" is the same as the "Build Scenario CREATE Program Train Vibration Level (Design Year)" as referenced in the Noise and Vibration Methodology Section 7.2.2 except when analyzing moved existing tracks. When analyzing moved existing tracks, the "Predicted Build" considers the total number of trains using those tracks in the design year to determine the frequency category (frequent, occasional or infrequent) and impact level in Table 7-1, as well as the vibration level.

Vibration General Assessment Report Form For Source Calculations:
CREATE Project EX-1

Moderately Used Rail Corridor (existing train volume from 5 to 12 trains/day)
Freight Cars

Receptors	Peak Day Existing Volumes	Peak Day Predicted Build Volumes	Existing Impact Frequency Category [(1)]	Predicted Build Impact Frequency Category [(1)]	Distance[(2)] Existing Track 1 (feet)	Distance[(2)] Existing Track 2 (feet)	Distance[(2)] Proposed Track 1 (feet)	Distance[(1)] Proposed Track 2 (feet)	Generalized Vibration Curve[(3)] Existing Track 1 (VdB)	Generalized Vibration Curve[(3)] Existing Track 2 (VdB)	Generalized Vibration Curve[(3)] Proposed Track 1 (VdB)	Generalized Vibration Curve[(3)] Proposed Track 2 (VdB)	Highest[(4)] Predicted Existing Vibration Level at Each Receptor (VdB)	Highest[(4)] Predicted Build Vibration Level at Each Receptor (VdB)
EX-R3	4	6	frequent	frequent	50	65	40	55	73	71	75	72	73	75
EX-R4	6	6	frequent	frequent	60	75	50	65	72	70	73	71	72	73
EX-R5	14	7	frequent	frequent	225	240	215	230	59	59	59	59	59	59
EX-R6	30	6	frequent	frequent	150	165	140	155	64	63	64	63	64	64
EX-R10	6	6	frequent	frequent	50	65	55	75	73	71	72	70	73	72
EX-R11	16	20	frequent	frequent	60	75	50	65	72	70	73	71	72	73
EX-R12	4	6	frequent	frequent	50	65	55	70	73	71	72	71	73	72

Notes:

(1) Determine if event is frequent; occasional or infrequent event. Refer to Table 7-1 for definition.

(2) Distances measured from centerlines of existing and proposed tracks to faces of buildings.

(3) Generalized Ground Surface Vibration Curve (Figure 10-1) for rapid transit or light rail vehicles at 50 mph.

(4) Highest vibration level, from the Generalized Vibration Curve (Figure 10-1), of either Track 1 or Track 2 at each receptor. The example project assumes the same adjustments are applied to both tracks. If the same adjustments cannot be applied to all tracks, the analyst may have to apply adjustments to the tracks individually to determine the highest predicted vibration at each receptor.

The "Predicted Build" is the same as the "Build Scenario CREATE Program Train Vibration Level (Design Year)" as referenced in the Noise and Vibration Methodology Section 7.2.2 except when analyzing moved existing tracks. When analyzing moved existing tracks, the "Predicted Build" considers the total number of trains using those tracks in the design year to determine the frequency category (frequent, occasional or infrequent) and impact level in Table 7-1, as well as the vibration level.

Vibration General Assessment Report Form For
Vibration Adjustment Factors
CREATE Project EX-1

Moderately Used Rail Corridor (existing train volume from 5 to 12 trains/day)
Freight Cars

	Unadjusted		Existing Adjustments								Predicted Build Adjustments								Adjusted	
			Speed Adjustments		Source Adjustments		Path Adjustments		Receiver Adjustments		Speed Adjustments		Source Adjustments		Path Adjustments		Receiver Adjustments			
Receptors	Highest[1] Vibration Level @ 50 mph at Each Receptor Existing (VdB)	Highest[1] Vibration Level @ 50 mph at Each Receptor Predicted Build (VdB)	Average Track Speed - Existing (mph)	Speed Adjustment Existing (VdB)	Vehicle[2] Condition Existing (VdB)	Elevated Structure[3] Adjustment Existing (VdB)	Propagation Geology[4] Adjustment Existing (VdB)	Wood Frame Structure (VdB)	1-5 Floors Above Grade (VdB)	Floor Amplifi-cation (VdB)	Average Track Speed - Predicted Build (mph)	Speed Adjustment - Predicted Build (VdB)	Vehicle[2] Condition Existing (VdB)	Elevated Structure[3] Adjustment - Predicted Build (VdB)	Propagation Geology[4] Adjustment Existing (VdB)	Wood Frame Structure (VdB)	1-5 Floors Above Grade (VdB)	Floor Amplifi-cation (VdB)	Predicted Existing Vibration (VdB)	Predicted Build Vibration (VdB)
EX-R3	73	75	10	-14	10	-5	10	-5	-2	6	10	-14	10	-5	10	-5	-2	6	73	75
EX-R4	72	73	10	-14	10	-5	10	-5	-2	6	10	-14	10	-5	10	-5	-2	6	72	73
EX-R5	59	59	10	-14	10	-5	10	-5	-2	6	10	-14	10	-5	10	-5	-2	6	59	59
EX-R6	64	64	10	-14	10	-5	10	-5	-2	6	10	-14	10	-5	10	-5	-2	6	64	64
EX-R10	73	72	50	0	10	-5	10	-5	-2	6	10	-14	10	-5	10	-5	-2	6	87	72
EX-R11	72	73	50	0	10	-5	10	-5	-2	6	50	0	10	-5	10	-5	-2	6	86	87
EX-R12	73	72	10	-14	10	-5	10	-5	-2	6	50	0	10	-5	10	-5	-2	6	73	86

Notes:

(1) Highest Vibration Level, from the Generalized Vibration Curve (Figure 10-1), of either the Southbound (Track 1) or Northbound (Track 2) at each receptor.

(2) Worn wheel adjustment made for Freight Rail Car. For locomotives assume no worn wheel adjustment.

(3) Existing and proposed tracks are elevated structure/embankment, because both the existing and proposed tracks would be at least 1 feet higher than the base elevation at all receptors

(4) Existing and proposed geological conditions assumed to have "efficient" vibration propagation.

The "Predicted Build" is the same as the "Build Scenario CREATE Program Train Vibration Level (Design Year)" as referenced in the Noise and Vibration Methodology Section 7.2.2 except when analyzing moved existing tracks. When analyzing moved existing tracks, the "Predicted Build" considers the total number of trains using those tracks in the design year to determine the frequency category (frequent, occasional or infrequent) and impact level in Table 7-1, as well as the vibration level.

Vibration General Assessment Report Form For
Vibration Impact Summary
CREATE Project EX-1

Moderately Used Rail Corridor (existing train volume from 5 to 12 trains/day)
Freight Cars

Ground-borne Vibration (GBV) Impacts												
1	2	3	4	5	6	7	8	9	10	11	12	14
Receptors	FTA [(2)] Vibration Land Use Category	Existing Vibration Frequency event [(1)]	Existing-FTA [(3)] Vibration Impact Criteria (VdB)	Preicted Build Vibration Frequency event [(1)]	Predicted Build - FTA Vibration Impact Criteria [(3)] (VdB)	Predicted Existing Vibration (VdB)	Predicted Build Vibration (VdB)	Difference between Predicted Existing Vibration and Predicted Build Vibration (VdB)	Does the Existing vibration impact equal or exceed the FTA criteria in Column 4? If Yes, go to Column 11. If No, go to Column 12.	Is the Predicted Build vibration lower than Predicted Existing vibration by 5 VdB or greater? If yes, go to Column 13 and indicate "No" - there is No Potential Impact . If No, go to Column 12.	Does the Predicted Build vibration equal or exceed the FTA impact criteria in Column 6? If Yes, go to Column 13 and indicate "Yes", there is a Potential Impact. If No, go to Column 13 and indicate "No", there is No Potential Impact.	Potential Impact? If Yes, proceed to Detailed Analysis if mitigation measures are viable.
EX-R3	2	frequent	72	frequent	72	73	75	2	Yes	No	Yes	Yes
EX-R4	2	frequent	72	frequent	72	72	73	1	Yes	No	Yes	Yes
EX-R5	2	frequent	72	frequent	72	59	59	0	No	NA	No	No
EX-R6	2	frequent	72	frequent	72	64	64	0	No	NA	No	No
EX-R10	2	frequent	72	frequent	72	87	72	-15	Yes	Yes, Lower	NA	No
EX-R11	2	frequent	72	frequent	72	86	87	1	Yes	No	Yes	Yes
EX-R12	2	frequent	72	frequent	72	73	86	13	Yes	No	Yes	Yes

Notes:

(1) Determine if event is frequent; occasional or infrequent event. Refer to Table 7-1 for definition.

(2) FTA Vibration Land Use Category #2 includes residences and other buildings where people normally sleep, and Category Land Use #3 includes institutional land uses with primarily daytime uses, such as schools and churches.

(3) Source Table 7-1

(4) See Source Calculations for existing and build volumes and refer to Section 7.2.2 item #3

NA = Not applicable

The "Predicted Build" is the same as the "Build Scenario CREATE Program Train Vibration Level (Design Year)" as referenced in the Noise and Vibration Methodology Section 7.2.2 except when analyzing moved existing tracks. When analyzing moved existing tracks, the "Predicted Build" considers the total number of trains using those tracks in the design year to determine the frequency category (frequent, occasional or infrequent) and impact level in Table 7-1, as well as the vibration level.

Vibration General Assessment Report Form For
GBN Impact Summary
CREATE Project EX-1

Moderately Used Rail Corridor (existing train volume from 5 to 12 trains/day)
Freight Cars

Ground-borne Noise (GBN) Impacts												
1	2	3	4	5	6	7	8	9	10	11	12	13
Receptors	FTA (2) Vibration Land Use Category	Existing GBN Frequency event (1)	Existing- FTA GBN Impact Criteria (3) (dBA)	Predicted Build GBN Frequency event (1)	Predicted Build FTA (3) GBN Impact Criteria (dBA)	Total Predicted Existing GBN (dBA)	Total Predicted Build GBN (dBA)	Difference between Total Predicted Existing GBN and Build GBN (dBA)	Does the Existing GBN Impact equal or exceed the FTA criteria in Column 4? If Yes, go to Column 11. If No, go to Column 12.	Is the Predicted Build GBN lower than Existing GBN by 5 dBA or greater? If Yes, go to Column 13 and indicate "No" - there is No Potential Impact . If No, go to Column 12.	Does the Predicted Build GBN equal or exceed the FTA impact criteria in Column 6? If Yes, go to Column 13 and indicate "Yes", there is a Potential Impact. If No, go to Column 13 and indicate "No", there is No Potential Impact.	Potential Impact? If Yes, proceed to Detailed Analysis if mitigation measures are viable.
EX-R3	2	frequent	35	frequent	35	23	25	2	No	NA	No	No
EX-R4	2	frequent	35	frequent	35	22	23	1	No	NA	No	No
EX-R5	2	frequent	35	frequent	35	9	9	0	No	NA	No	No
EX-R6	2	frequent	35	frequent	35	14	14	0	No	NA	No	No
EX-R7	2	frequent	35	frequent	35	37	22	-15	Yes	Yes, Lower	NA	No
EX-R8	2	frequent	35	frequent	35	36	37	1	Yes	No	Yes	Yes
EX-R9	2	frequent	35	frequent	35	23	36	13	No	NA	Yes	Yes

Notes:

(1) Determine if event is frequent; occasional or infrequent event. Refer to Table 7-1 for definition.

(2) FTA Vibration Land Use Category #2 includes residences and other buildings where people normally sleep, and Category Land Use #3 includes institutional land uses with primarily daytime uses, such as schools and churches.

(3) Source Table 7-1

(4) See Source Calculations for existing and build volumes and refer to Section 7.2.2 item #3

(5) Assumes adjustment of -50 dB for low frequency vibration sources (FTA Manual Table 10-1).

NA = Not applicable

The "Predicted Build" is the same as the "Build Scenario CREATE Program Train Vibration Level (Design Year)" as referenced in the Noise and Vibration Methodology Section 7.2.2 except when analyzing moved existing tracks. When analyzing moved existing tracks, the "Predicted Build" considers the total number of trains using those tracks in the design year to determine the frequency category (frequent, occasional or infrequent) and impact level in Table 7-1, as well as the vibration level.

Vibration General Assessment Report Form For Source Calculations:
CREATE Project EX-1

Heavily Used Rail Corridor (existing train volume >12 trains/day)
Locomotives

Receptors	Peak Day Existing Volumes	Peak Day Predicted Build Volumes	Existing Impact Frequency Category (1)	Predicted Build Impact Frequency Category (1)	Distance(2) Existing Track 1 (feet)	Distance(2) Existing Track 2 (feet)	Distance(2) Proposed Track 1 (feet)	Distance(1) Proposed Track 2 (feet)	Generalized Vibration Curve(3) Existing Track 1 (VdB)	Generalized Vibration Curve(3) Existing Track 2 (VdB)	Generalized Vibration Curve(3) Proposed Track 1 (VdB)	Generalized Vibration Curve(3) Proposed Track 2 (VdB)	Highest(4) Predicted Existing Vibration Level at Each Receptor (VdB)	Highest(4) Predicted Build Vibration Level at Each Receptor (VdB)
EX-R9	40	50	occasional	occasional	50	65	30	45	85	83	89	86	85	89
EX-R3	16	16	infrequent	infrequent	50	65	40	55	85	83	87	84	85	87
EX-R4	16	20	infrequent	infrequent	60	75	50	65	83	81	85	82	83	85
EX-R5	16	24	infrequent	infrequent	225	240	215	230	70	69	70	70	70	70
EX-R6	16	28	infrequent	infrequent	150	165	140	155	74	73	75	74	74	75
EX-R10	16	28	infrequent	infrequent	50	65	55	75	85	83	84	81	85	84
EX-R11	16	20	infrequent	infrequent	60	75	50	65	83	81	85	82	83	85
EX-R12	24	52	infrequent	occasional	50	65	55	75	85	83	84	81	85	84

Notes:

(1) Determine if event is frequent; occasional or infrequent event. Refer to Table 7-1 for definition.

(2) Distances measured from centerlines of existing and proposed tracks to faces of buildings.

(3) Generalized Ground Surface Vibration Curve (Figure 10-1) for locomotive-powered passenger or freight trains at 50 mph.

(4) Highest vibration level, from the Generalized Vibration Curve (Figure 10-1), of either Track 1 or Track 2 at each receptor. The example project assumes the same adjustments are applied to both tracks. If the same adjustments cannot be applied to all tracks, the analyst may have to apply adjustments to the tracks individually to determine the highest predicted vibration at each receptor.

The "Predicted Build" is the same as the "Build Scenario CREATE Program Train Vibration Level (Design Year)" as referenced in the Noise and Vibration Methodology Section 7.2.2 except when analyzing moved existing tracks. When analyzing moved existing tracks, the "Predicted Build" considers the total number of trains using those tracks in the design year to determine the frequency category (frequent, occasional or infrequent) and impact level in Table 7-1, as well as the vibration level.

Vibration General Assessment Report Form For
Vibration Adjustment Factors
CREATE Project EX-1

Heavily Used Rail Corridor (existing train volume >12 trains/day)
Locomotives

	Unadjusted		Existing Adjustments								Predicted Build Adjustments								Adjusted	
			Speed Adjustments		Source Adjustments		Path Adjustments		Receiver Adjustments		Speed Adjustments		Source Adjustments		Path Adjustments		Receiver Adjustments			
Receptors	Highest[1] Vibration Level @ 50 mph at Each Receptor Existing (VdB)	Highest[1] Vibration Level @ 50 mph at Each Receptor Predicted Build (VdB)	Average Track Speed - Existing (mph)	Speed Adjustment Existing (VdB)	Vehicle[2] Condition - Existing (VdB)	Elevated Structure[3] Adjustment Existing (VdB)	Propagation Geology[4] Adjustment Existing (VdB)	Wood Frame Structure (VdB)	1-5 Floors Above Grade (VdB)	Floor Amplifi-cation (VdB)	Average Track Speed - Predicted Build (mph)	Speed Adjustment - Predicted Build (VdB)	Vehicle[2] Condition - Existing (VdB)	Elevated Structure[3] Adjustment - Predicted Build (VdB)	Propagation Geology[4] Adjustment Existing (VdB)	Wood Frame Structure (VdB)	1-5 Floors Above Grade (VdB)	Floor Amplifi-cation (VdB)	Predicted Existing Vibration (VdB)	Predicted Build Vibration (VdB)
EX-R9	85	89	10	-14	0	-5	10	-5	-2	6	24	-6	0	-5	10	-5	-2	6	75	87
EX-R3	85	87	10	-14	0	-5	10	-5	-2	6	10	-14	0	-5	10	-5	-2	6	75	77
EX-R4	83	85	10	-14	0	-5	10	-5	-2	6	10	-14	0	-5	10	-5	-2	6	73	75
EX-R5	70	70	10	-14	0	-5	10	-5	-2	6	10	-14	0	-5	10	-5	-2	6	60	60
EX-R6	74	75	10	-14	0	-5	10	-5	-2	6	10	-14	0	-5	10	-5	-2	6	64	65
EX-R10	85	84	10	-14	0	-5	10	-5	-2	6	50	0	0	-5	10	-5	-2	6	75	88
EX-R11	83	85	50	0	0	-5	10	-5	-2	6	50	0	0	-5	10	-5	-2	6	87	89
EX-R12	85	84	50	0	0	-5	10	-5	-2	6	50	0	0	-5	10	-5	-2	6	89	88

Notes:

(1) Highest Vibration Level, from the Generalized Vibration Curve (Figure 10-1), of either the Southbound (Track 1) or Northbound (Track 2) at each receptor.

(2) Worn wheel adjustment made for Freight Rail Car. For locomotives assume no worn wheel adjustment

(3) Existing and proposed tracks are elevated structure/embankment, because both the existing and proposed tracks would be at least 1 feet higher than the base elevation at all receptors

(4) Existing and proposed geological conditions assumed to have "efficient" vibration propagation.

The "Predicted Build" is the same as the "Build Scenario CREATE Program Train Vibration Level (Design Year)" as referenced in the Noise and Vibration Methodology Section 7.2.2 except when analyzing moved existing tracks. When analyzing moved existing tracks, the "Predicted Build" considers the total number of trains using those tracks in the design year to determine the frequency category (frequent, occasional or infrequent) and impact level in Table 7-1, as well as the vibration level.

Vibration General Assessment Report Form For
Vibration Impact Summary
CREATE Project EX-1

Heavily Used Rail Corridor (existing train volume >12 trains/day)
Locomotives

Ground-borne Vibration (GBV) Impacts													
1	2	3	4	5	6	7	8	9	10	11	12	13	14
Receptors	FTA [(2)] Vibration Land Use Category	Existing Vibration Frequency event [(1)]	Existing FTA Vibration Impact Criteria [(3)] (VdB)	Predicted Build Vibration Frequency event [(1)]	Predicted Build FTA Vibration Impact Criteria [(3)] (VdB)	Predicted Existing Vibration (VdB)	Predicted Build Vibration (VdB)	Difference between Predicted Existing Vibration and Predicted Build Vibration (VdB)	Does Predicted Existing Vibration equal or exceed the FTA impact criteria in Column 4? If Yes, go to Column 11. If No, go to Column 13.	Does the ratio of Build Train Events to Existing Train Events equal or exceed 2? If Yes, go to Column 14 and indicate "Yes." If No, go to column 12 [(4)]	Does the Predicted Build vibration exceed the Predicted Existing vibration by 3 VdB or Greater? If Yes, go to Column 14 and indicate "Yes" - there is a Potential Impact. If No, go to Column 14 and indicate "No" - there is No Potential Impact. [(4)]	Does Predicted Build Ground-borne Vibration equal or exceed the FTA impact criteria in Column 6? If Yes, go to Column 14 and indicate "Yes" - there is a Potential Impact. If No, go to Column 14 and indicate "No" - there is No Potential Impact. [(4)]	Potential impact? If Yes, proceed to Detailed Analysis if mitigation measures are viable.
EX-R9	2	occasional	75	occasional	75	75	87	12	Yes	No	Yes	NA	Yes
EX-R3	2	infrequent	80	infrequent	80	75	77	2	No	NA	NA	No	No
EX-R4	2	infrequent	80	infrequent	80	73	75	2	No	NA	NA	No	No
EX-R5	2	infrequent	80	infrequent	80	60	60	0	No	NA	NA	No	No
EX-R6	2	infrequent	80	infrequent	80	64	65	1	No	NA	NA	No	No
EX-R10	2	infrequent	80	infrequent	80	75	88	13	No	NA	NA	Yes	Yes
EX-R11	2	infrequent	80	infrequent	80	87	89	2	Yes	No	No	NA	No
EX-R12	2	infrequent	80	occasional	75	89	88	-1	Yes	Yes	NA	NA	Yes

Notes:

(1) Determine if event is frequent; occasional or infrequent event. Refer to Table 7-1 for definition.

(2) FTA Vibration Land Use Category #2 includes residences and other buildings where people normally sleep, and Category Land Use #3 includes institutional land uses with primarily daytime uses, such as schools and churches.

(3) Source Table 7-1

(4) See Source Calculations for existing and build volumes and refer to Section 7.2.2 item #3

NA = Not applicable

The "Predicted Build" is the same as the "Build Scenario CREATE Program Train Vibration Level (Design Year)" as referenced in the Noise and Vibration Methodology Section 7.2.2 except when analyzing moved existing tracks. When analyzing moved existing tracks, the "Predicted Build" considers the total number of trains using those tracks in the design year to determine the frequency category (frequent, occasional or infrequent) and impact level in Table 7-1, as well as the vibration level.

Vibration General Assessment Report Form For GBN Impact Summary
CREATE Project EX-1

Heavily Used Rail Corridor (existing train volume >12 trains/day)
Locomotives

Ground-borne Noise (GBN) Impacts													
1	2	3	4	5	6	7	8	9	10	11	12	13	14
Receptors	FTA [2] Vibration Land Use Category	Existing GBN Frequency event [1]	Existing-FTA GBN Impact Criteria [3] (dBA)	Predicted Build GBN Frequency event [1]	Predicted Build FTA GBN Impact Criteria [3] (dBA)	Predicted Existing GBN (dBA) [5]	Predicted Build GBN (dBA) [5]	Difference between Predicted Existing GBN and Predicted Build GBN (dBA)	Does the Predicted Existing GBN equal or exceed the FTA impact criteria in Column 4? If Yes, go to Column 11. If No, go to Column 13.	Does the ratio of Predicted Build train impact events to Existing equal or exceed 2? If Yes, go to Column 14 and indicate "Yes." If no, go to column 12 [4]	Does the Predicted Build GBN exceed the Predicted Existing GBN by 3 dBA or greater? If yes, go to Column 14 and indicate "Yes" - there is a Potential Impact. If No, go to Column 14 and indicate "No" - there is No Potential Impact. [4]	Does Predicted Build GBN equal or exceed the FTA impact criteria in Column 6? If Yes, go to Column 14 and indicate "Yes" there is a Potential Impact. If No, go to Column 14 and indicate "No" - there is No Potential Impact. [4]	Potential Impact? If Yes, proceed to Detailed Analysis if mitigation measures are viable.
EX-R2	2	occasional	38	occasional	38	25	37	12	No	NA	NA	No	No
EX-R3	2	infrequent	43	infrequent	43	25	27	2	No	NA	NA	No	No
EX-R4	2	infrequent	43	infrequent	43	23	25	2	No	NA	NA	No	No
EX-R5	2	infrequent	43	infrequent	43	10	10	0	No	NA	NA	No	No
EX-R6	2	infrequent	43	infrequent	43	14	15	1	No	NA	NA	No	No
EX-R7	2	infrequent	43	infrequent	43	25	38	13	No	NA	NA	No	No
EX-R8	2	infrequent	43	infrequent	43	37	39	2	No	NA	NA	No	No
EX-R9	2	infrequent	43	occasional	38	39	38	-1	No	NA	NA	Yes	Yes

Notes:

[1] Determine if event is frequent; occasional or infrequent event. Refer to Table 7-1 for definition.

[2] FTA Vibration Land Use Category #2 includes residences and other buildings where people normally sleep, and Category Land Use #3 includes institutional land uses with primarily daytime uses, such as schools and churches.

[3] Source Table 7-1

[4] See Source Calculations for existing and build volumes and refer to Section 7.2.2 item #3

[5] Assumes adjustment of -50 dBA for low frequency vibration sources (FTA Manual Table 10-1).

NA = Not applicable

The "Predicted Build" is the same as the "Build Scenario CREATE Program Train Vibration Level (Design Year)" as referenced in the Noise and Vibration Methodology Section 7.2.2 except when analyzing moved existing tracks. When analyzing moved existing tracks, the "Predicted Build" considers the total number of trains using those tracks in the design year to determine the frequency category (frequent, occasional or infrequent) and impact level in Table 7-1, as well as the vibration level.

Vibration General Assessment Report Form For Source Calculations:
CREATE Project EX-1

Heavily Used Rail Corridor (existing train volume >12 trains/day)
Freight Rail Car

Receptors	Peak Day Existing Volumes	Peak Day Predicted Build Volumes	Existing Impact Frequency Category [1]	Build Impact Frequency Category [1]	Distance[2] Existing Track 1 (feet)	Distance[2] Existing Track 2 (feet)	Distance[2] Proposed Track 1 (feet)	Distance[1] Proposed Track 2 (feet)	Generalized Vibration Curve[3] Existing Track 1 (VdB)	Generalized Vibration Curve[3] Existing Track 2 (VdB)	Generalized Vibration Curve[3] Proposed Track 1 (VdB)	Generalized Vibration Curve[3] Proposed Track 2 (VdB)	Highest[4] Predicted Existing Vibration Level at Each Receptor (VdB)	Highest[4] Predicted Build Vibration Level at Each Receptor (VdB)
EX-R9	40	50	frequent	frequent	50	65	30	45	73	71	76	74	73	76
EX-R3	16	16	frequent	frequent	50	65	40	55	73	71	75	72	73	75
EX-R4	16	20	frequent	frequent	60	75	50	65	72	70	73	71	72	73
EX-R5	16	24	frequent	frequent	225	240	215	230	59	59	59	59	59	59
EX-R6	16	28	frequent	frequent	150	165	140	155	64	63	64	63	64	64
EX-R10	16	28	frequent	frequent	50	65	55	75	73	71	72	70	73	72
EX-R11	16	20	frequent	frequent	60	75	50	65	72	70	73	71	72	73
EX-R12	24	52	frequent	frequent	50	65	55	75	73	71	72	70	73	72

Notes:

(1) Determine if event is frequent; occasional or infrequent event. Refer to Table 7-1 for definition.

(2) Distances measured from centerlines of existing and proposed tracks to faces of buildings.

(3) Generalized Ground Surface Vibration Curve (Figure 10-1) for rapid transit or light rail vehicles at 50 mph.

(4) Highest vibration level, from the Generalized Vibration Curve (Figure 10-1), of either Track 1 or Track 2 at each receptor. The example project assumes the same adjustments are applied to both tracks. If the same adjustments cannot be applied to all tracks, the analyst may have to apply adjustments to the tracks individually to determine the highest predicted vibration at each receptor.

The "Predicted Build" is the same as the "Build Scenario CREATE Program Train Vibration Level (Design Year)" as referenced in the Noise and Vibration Methodology Section 7.2.2 except when analyzing moved existing tracks. When analyzing moved existing tracks, the "Predicted Build" considers the total number of trains using those tracks in the design year to determine the frequency category (frequent, occasional or infrequent) and impact level in Table 7-1, as well as the vibration level.

Vibration General Assessment Report Form For
Vibration Adjustment Factors
CREATE Project EX-1

Heavily Used Rail Corridor (existing train volume >12 trains/day)
Freight Rail Car

	Unadjusted		Existing Adjustments								Predicted Build Adjustments								Adjusted	
			Speed Adjustments		Source Adjustments		Path Adjustments		Receiver Adjustments		Speed Adjustments		Source Adjustments		Path Adjustments		Receiver Adjustments			
Receptors	Highest[1] Vibration Level @ 50 mph at Each Receptor Existing (VdB)	Highest[1] Vibration Level @ 50 mph at Each Receptor Predicted Build (VdB)	Average Track Speed - Existing (mph)	Speed Adjustment - Existing (VdB)	Vehicle[2] Condition Existing (VdB)	Elevated Structure[3] Adjustment Existing (VdB)	Propagation Geology[4] Adjustment Existing (VdB)	Wood Frame Structure (VdB)	1-5 Floors Above Grade (VdB)	Floor Amplifi-cation (VdB)	Average Track Speed - Predicted Build (mph)	Speed Adjustment - Predicted Build (VdB)	Vehicle[2] Condition Existing (VdB)	Elevated Structure[3] Adjustment - Predicted Build (VdB)	Propagation Geology[4] Adjustment Existing (VdB)	Wood Frame Structure (VdB)	1-5 Floors Above Grade (VdB)	Floor Amplifi-cation (VdB)	Predicted Existing Vibration (VdB)	Predicted Build Vibration (VdB)
EX-R9	73	76	10	-14	10	-5	10	-5	-2	6	24	-6	10	-5	10	-5	-2	6	73	84
EX-R3	73	75	10	-14	10	-5	10	-5	-2	6	10	-14	10	-5	10	-5	-2	6	73	75
EX-R4	72	73	10	-14	10	-5	10	-5	-2	6	10	-14	10	-5	10	-5	-2	6	72	73
EX-R5	59	59	10	-14	10	-5	10	-5	-2	6	10	-14	10	-5	10	-5	-2	6	59	59
EX-R6	64	64	10	-14	10	-5	10	-5	-2	6	10	-14	10	-5	10	-5	-2	6	64	64
EX-R10	73	72	10	-14	10	-5	10	-5	-2	6	50	0	10	-5	10	-5	-2	6	73	86
EX-R11	72	73	50	0	10	-5	10	-5	-2	6	50	0	10	-5	10	-5	-2	6	86	87
EX-R12	73	72	50	0	10	-5	10	-5	-2	6	50	0	10	-5	10	-5	-2	6	87	86

Notes:

(1) Highest Vibration Level, from the Generalized Vibration Curve (Figure 10-1), of either the Southbound (Track 1) or Northbound (Track 2) at each receptor.

(2) Worn wheel adjustment made for Freight Rail Car. For locomotives assume no worn wheel adjustment

(3) Existing and proposed tracks are elevated structure/embankment, because both the existing and proposed tracks would be at least 1 feet higher than the base elevation at all receptors

(4) Existing and proposed geological conditions assumed to have "efficient" vibration propagation.

The "Predicted Build" is the same as the "Build Scenario CREATE Program Train Vibration Level (Design Year)" as referenced in the Noise and Vibration Methodology Section 7.2.2 except when analyzing moved existing tracks. When analyzing moved existing tracks, the "Predicted Build" considers the total number of trains using those tracks in the design year to determine the frequency category (frequent, occasional or infrequent) and impact level in Table 7-1, as well as the vibration level.

Vibration General Assessment Report Form For
Vibration Impact Summary
CREATE Project EX-1

Heavily Used Rail Corridor (existing train volume >12 trains/day)
Freight Rail Car

Ground-borne Vibration (GBV) Impacts													
1	2	3	4	5	6	7	8	9	10	11	12	13	14
Receptors	FTA [(2)] Vibration Land Use Category	Existing Vibration Frequency event [(1)]	Existing-FTA Vibration Impact Criteria [(3)] (VdB)	Predicted Build Vibration Frequency event [(1)]	Proposed FTA Vibration Impact Criteria [(3)] (VdB)	Predicted Existing Vibration (VdB)	Predicted Build Vibration (VdB)	Difference between Predicted Existing vibration and Predicted Build vibration (VdB)	Does the Predicted Existing vibration equal or exceed the FTA impact criteria in Column 4? If Yes, go to Column 11. If No, go to Column 13.	Does the ratio of Predicted Build train impact events to Existing equal or exceed 2? If Yes, go to Column 14 and indicate "Yes". If No, go to column 12 [(4)]	Does the Predicted Build vibration exceed the Predicted Existing vibration by 3 VdB or greater? If Yes, go to Column 14 and indicate "Yes" - there is a Potential Impact. If No, go to Column 14 and indicate "No" - there is No Potential Impact. [(4)]	Does the Predicted Build vibration equal or exceed the FTA impact criteria in Column 6? If Yes, go to Column 14 and indicate "Yes" - there is a Potential Impact. If No, go to Column 14 and indicate "No" - there is No Potential Impact. [(4)]	Potential Impact? If Yes, proceed to Detailed Analysis if mitigation measures are viable.
EX-R9	2	frequent	72	frequent	72	73	84	11	Yes	No	Yes	NA	Yes
EX-R3	2	frequent	72	frequent	72	73	75	2	Yes	No	No	NA	No
EX-R4	2	frequent	72	frequent	72	72	73	1	Yes	No	No	NA	No
EX-R5	2	frequent	72	frequent	72	59	59	0	No	NA	NA	No	No
EX-R6	2	frequent	72	frequent	72	64	64	0	No	NA	NA	No	No
EX-R10	2	frequent	72	frequent	72	73	86	13	Yes	No	Yes	NA	Yes
EX-R11	2	frequent	72	frequent	72	86	87	1	Yes	No	No	NA	No
EX-R12	2	frequent	72	frequent	72	87	86	-1	Yes	Yes	NA	NA	Yes

Notes:

(1) Determine if event is frequent; occasional or infrequent event. Refer to Table Table 7-1 for definition.

(2) FTA Vibration Land Use Category #2 includes residences and other buildings where people normally sleep, and Category Land Use #3 includes institutional land uses with primarily daytime uses, such as schools and churches.

(3) Source Table 7-1

(4) See Source Calculations for existing and build volumes and refer to Section 7.2.2 item #3

NA = Not applicable

The "Predicted Build" is the same as the "Build Scenario CREATE Program Train Vibration Level (Design Year)" as referenced in the Noise and Vibration Methodology Section 7.2.2 except when analyzing moved existing tracks. When analyzing moved existing tracks, the "Predicted Build" considers the total number of trains using those tracks in the design year to determine the frequency category (frequent, occasional or infrequent) and impact level in Table 7-1, as well as the vibration level.

Vibration General Assessment Report Form For GBN Impact Summary
CREATE Project EX-1

Heavily Used Rail Corridor (existing train volume >12 trains/day)
Freight Rail Car

Ground-borne Noise (GBN) Impacts

1	2	3	4	5	6	7	8	9	10	11	12	13	14
Receptors	FTA [(2)] Vibration Land Use Category	Existing GBN Frequency event [(1)]	Existing-FTA GBN Impact Criteria [(3)] (dBA)	Predicted Build GBN Frequency event [(1)]	Proposed FTA GBN Impact Criteria [(3)] (dBA)	Predicted Existing GBN (dBA) [(5)]	Predicted Build GBN (dBA) [(5)]	Difference between Predicted Existing GBN and Predicted Build GBN (dBA)	Does the Predicted Existing GBN equal or exceed the FTA impact criteria in Column 4? If Yes, go to Column 11. If No, go to Column 13.	Does the ratio of Predicted Build train impact events to Existing equal or exceed 2? If Yes, go to Column 14 and indicate "Yes." If No, go to column 12. [(4)]	Does the Predicted Build GBN exceed the Predicted Existing GBN by 3 dBA or greater? If Yes, go to Column 14 and indicate "Yes" - there is a Potential Impact. If No, go to Column 14 and indicate "No" - there is No Potential Impact. [(4)]	Does the Predicted Build GBN equal or exceed the FTA impact criteria in Column 6? If Yes, go to Column 14 and indicate "Yes" - there is a Potential Impact. If No, go to Column 14 and indicate "No" - there is No Potential Impact. [(4)]	Potential Impact? If Yes, proceed to Detailed Analysis if mitigation measures are viable.
EX-R2	2	frequent	35	frequent	35	23	34	11	No	NA	NA	No	No
EX-R3	2	frequent	35	frequent	35	23	25	2	No	NA	NA	No	No
EX-R4	2	frequent	35	frequent	35	22	23	1	No	NA	NA	No	No
EX-R5	2	frequent	35	frequent	35	9	9	0	No	NA	NA	No	No
EX-R6	2	frequent	35	frequent	35	14	14	0	No	NA	NA	No	No
EX-R7	2	frequent	35	frequent	35	23	36	13	No	NA	NA	Yes	Yes
EX-R8	2	frequent	35	frequent	35	36	37	1	Yes	No	No	NA	No
EX-R9	2	frequent	35	frequent	35	37	36	-1	Yes	Yes	NA	NA	Yes

Notes:

(1) Determine if event is frequent; occasional or infrequent event. Refer to Table 7-1 for definition.

(2) FTA Vibration Land Use Category #2 includes residences and other buildings where people normally sleep, and Category Land Use #3 includes institutional land uses with primarily daytime uses, such as schools and churches.

(3) Source Table 7-1

(4) See Source Calculations for existing and build volumes and refer to Section 7.2.2 item #3

(5) Assumes adjustment of -50 dB for low frequency vibration sources (FTA Manual Table 10-1).

NA = Not applicable

The "Predicted Build" is the same as the "Build Scenario CREATE Program Train Vibration Level (Design Year)" as referenced in the Noise and Vibration Methodology Section 7.2.2 except when analyzing moved existing tracks. When analyzing moved existing tracks, the "Predicted Build" considers the total number of trains using those tracks in the design year to determine the frequency category (frequent, occasional or infrequent) and impact level in Table 7-1, as well as the vibration level.

Vibration General Assessment Report Form For Source Calculations: CREATE Project EX-1

Moving Existing Tracks
Locomotives

Receptors	Peak Day Existing Volumes	Existing Impact Frequency Category [(1)]	Distance[(2)] Existing Track 1 (feet)	Distance[(2)] Existing Track 2 (feet)	Distance[(2)] Proposed Track 1 (feet)	Distance[(2)] Proposed Track 2 (feet)	Generalized Vibration Curve[(3)] Existing Track 1 (VdB)	Generalized Vibration Curve[(3)] Existing Track 2 (VdB)	Generalized Vibration Curve[(3)] Proposed Track 1 (VdB)	Generalized Vibration Curve[(3)] Proposed Track 2 (VdB)	Highest[(4)] Predicted Pre-Move Vibration Level at Each Receptor (based on existing operations) (VdB)	Highest[(5)] Predicted Post-Move Vibration level at Each Receptor (based on existing operations) (VdB)
EX-R1												
EX-R2	40	occasional	50	65	40	55	85	83	87	84	85	87
EX-R3	16	infrequent	50	65	40	55	85	83	87	84	85	87
EX-R4	16	infrequent	60	75	50	65	83	81	85	82	83	85
EX-R5	16	infrequent	225	240	215	230	70	69	70	70	70	70
EX-R6	16	infrequent	150	165	140	155	74	73	75	74	74	75
EX-R7	40	occasional	50	65	55	75	85	83	84	81	85	84
EX-R8	40	occasional	50	65	40	55	85	83	87	84	85	87
EX-R9	40	occasional	50	65	30	45	85	83	89	86	85	89

Notes:

(1) Determine if event is frequent; occasional or infrequent event. Refer to Table 7-1 for definition.

(2) Distances measured from centerlines of existing and proposed tracks to faces of buildings.

(3) Generalized Ground Surface Vibration Curve (Figure 10-1) for locomotive-powered passenger or freight trains at 50 mph.

(4) Highest vibration level, from the Generalized Vibration Curve (Figure 10-1), of either Track 1 or Track 2 at each receptor. The example project assumes the same adjustments are applied to both tracks. If the same adjustments cannot be applied to all tracks, the analyst may have to apply adjustments to the tracks individually to determine the highest predicted vibration at each receptor.

(5) Potential vibration effects of moving tracks.

Vibration General Assessment Report Form For **Moving Existing Tracks**
Vibration Adjustment Factors **Locomotives**
CREATE Project EX-1

	Unadjusted		Existing Adjustments										Adjusted	
			Speed Adjustments		Source Adjustments		Path Adjustments		Receiver Adjustments					
Receptors	Highest[1] Vibration Level @ 50 mph at Each Receptor - Pre-Move (based on existing operations) (VdB)	Highest[1] Vibration Level @ 50 mph at Each Receptor - Post-Move (based on existing operations) (VdB)	Average Track Speed Existing (mph)	Speed Adjustment Existing (VdB)	Vehicle[2] Condition Existing (VdB)	Elevated Structure[3] Adjustment Existing (VdB)	Propagation Geology[4] Adjustment Existing (VdB)	Wood Frame Structure (VdB)	1-5 Floors Above Grade (VdB)	Floor Amplifi-cation (VdB)			Predicted Pre-Move Vibration (based on existing operations) (VdB)	Predicted Post-Move Vibration (based on existing operations) (VdB)
EX-R2	85	87	10	-14	0	-5	10	-5	-2	6			75	77
EX-R3	85	87	10	-14	0	-5	10	-5	-2	6			75	77
EX-R4	83	85	10	-14	0	-5	10	-5	-2	6			73	75
EX-R5	70	70	10	-14	0	-5	10	-5	-2	6			60	60
EX-R6	74	75	10	-14	0	-5	10	-5	-2	6			64	65
EX-R7	85	84	10	-14	0	-5	10	-5	-2	6			75	74
EX-R8	85	87	24	-6	0	-5	10	-5	-2	6			83	85
EX-R9	85	89	24	-6	0	-5	10	-5	-2	6			83	87

Notes:

(1) Highest Vibration Level, from the Generalized Vibration Curve (Figure 10-1), of either the Southbound (Track 1) or Northbound (Track 2) at each receptor.

(2) For locomotives assume no worn wheel adjustment

(3) The existing and proposed tracks are both on elevated structure/embankment (they are at least 1 foot higher than the base elevation of all receptors), therefore, they both receive the same elevated structure adjustments. If the proposed tracks have different elevated structure adjustments than the existing tracks, the analyst would need to account for this difference by applying a different elevated structure adjustment to predict the Post-Move Vibration.

(4) Existing and proposed geological conditions assumed to have "efficient" vibration propagation.

Vibration General Assessment Report Form For
Vibration Impact Summary
CREATE Project EX-1

Moving Existing Tracks
Locomotives

Ground-borne Vibration (GBV) Impacts										
1	2	3	4	5	6	7	8	9	10	11
Receptors	FTA [2] Vibration Land Use Category	Pre-Move and Post-Move Vibration Frequency event [1] (based on existing operations)	Pre-Move and Post-Move FTA Vibration Impact Criteria [3] (based on existing operations) (VdB)	Predicted Pre-Move Vibration (VdB) (based on existing operations)	Predicted Post-Move Vibration (based on existing operations) (VdB)	Difference between Predicted Pre-Move vibration and Predicted Post-Move vibration (VdB)	Does the predicted Pre-Move Vibration equal or exceed the FTA impact criteria in Column 4? If Yes, go to Column 9. If No, go to Column 10.	Is the difference between the Predicted Pre-Move Vibration and Predicted Post-Move Vibration 3 VdB or greater? If Yes, go to Column 11 and indicate "Yes" - there is a Potential Impact. If No, go to Column 10.	Use appropriate Infrequently-(I), Moderately-(M), or Heavily-Used (H) corridor criteria to determine if there is an Impact.	Potential Impact? If Yes, Proceed to Detailed Analysis if mitigation measures are viable.
EX-R2	2	occasional	75	75	77	2	Yes	No	Use I, M or H Spreadsheet	
EX-R3	2	infrequent	80	75	77	2	No	NA	Use I, M or H Spreadsheet	
EX-R4	2	infrequent	80	73	75	2	No	NA	Use I, M or H Spreadsheet	
EX-R5	2	infrequent	80	60	60	0	No	NA	Use I, M or H Spreadsheet	
EX-R6	2	infrequent	80	64	65	1	No	NA	Use I, M or H Spreadsheet	
EX-R7	2	occasional	75	75	74	-1	Yes	No	Use I, M or H Spreadsheet	
EX-R8	2	occasional	75	83	85	2	Yes	No	Use I, M or H Spreadsheet	
EX-R9	2	occasional	75	83	87	4	Yes	Yes	NA	Yes

Notes:

[1] Determine if event is frequent; occasional or infrequent event. Refer to Table 7-1 for definition.

[2] FTA Vibration Land Use Category #2 includes residences and other buildings where people normally sleep, and Category Land Use #3 includes institutional land uses with primarily daytime uses, such as schools and churches.

[3] Source Table 7-1

NA = Not applicable

Vibration General Assessment Report Form For **Moving Existing Tracks**
GBN Impact Summary **Locomotives**
CREATE Project EX-1

Ground-borne Noise (GBN) Impacts										
1	2	3	4	5	6	7	8	9	10	11
Receptors	FTA [2] Vibration Land Use Category	Pre-Move and Post-Move GBN Frequency event [1] (based on existing operations)	Pre-Move and Post-Move FTA GBN Impact Criteria [3] (based on existing operations) (dBA)	Predicted Pre-move GBN (dBA) [4] (based on existing operations)	Predicted Post-Move GBN (based on existing operations) (dBA)	Difference between Predicted Pre-Move GBN and Predicted Post-Move GBN (dBA)	Does the Predicted Pre-Move GBN equal or exceed the FTA impact criteria in Column 4? If Yes, go to Column 9. If No, go to Column 10.	Is the difference between the Predicted Pre-Move GBN and Predicted Post-Move GBN 3 dBA or greater? If Yes, go to Column 11 and indicate "Yes" - there is a Potential Impact. If No, go to Column 10.	Use appropriate Infrequently-(I), Moderately-(M), or Heavily-Used (H) Corridor Criteria to determine if there is an Impact.	Potential Impact? If Yes, proceed to Detailed Analysis if mitigation measures are viable.
EX-R2	2	occasional	38	25	27	2	No	NA	Use I, M or H Spreadsheet	
EX-R3	2	infrequent	43	25	27	2	No	NA	Use I, M or H Spreadsheet	
EX-R4	2	infrequent	43	23	25	2	No	NA	Use I, M or H Spreadsheet	
EX-R5	2	infrequent	43	10	10	0	No	NA	Use I, M or H Spreadsheet	
EX-R6	2	infrequent	43	14	15	1	No	NA	Use I, M or H Spreadsheet	
EX-R7	2	occasional	38	25	24	-1	No	NA	Use I, M or H Spreadsheet	
EX-R8	2	occasional	38	33	35	2	No	NA	Use I, M or H Spreadsheet	
EX-R9	2	occasional	38	33	37	4	No	NA	Use I, M or H Spreadsheet	

Notes:

(1) Determine if event is frequent; occasional or infrequent event. Refer to Table 7-1 for definition.

(2) FTA Vibration Land Use Category #2 includes residences and other buildings where people normally sleep, and Category Land Use #3 includes institutiona land uses with primarily daytime uses, such as schools and churches.

(3) Source Table 7-1

(4) Assumes adjustment of -50 dB for low frequency vibration sources (FTA Manual Table 10-1).

NA = Not applicable

Vibration General Assessment Form For Source Calculations: CREATE Project EX-1

Moving Existing Tracks
Freight Cars

Receptors	Peak Day Existing Volumes	Existing Impact Frequency Category [1]	Distance[2] Existing Track 1 (feet)	Distance[2] Existing Track 2 (feet)	Distance[2] Proposed Track 1 (feet)	Distance[2] Proposed Track 2 (feet)	Generalized Vibration Curve[3] Existing Track 1 (VdB)	Generalized Vibration Curve[3] Existing Track 2 (VdB)	Generalized Vibration Curve[3] Proposed Track 1 (VdB)	Generalized Vibration Curve[3] Proposed Track 2 (VdB)	Highest[4] Predicted Pre-Move Vibration Level at Each Receptor (based on existing operations) (VdB)	Highest[5] Predicted Post-Move Vibration Level at Each Receptor (based on existing operations) (VdB)
EX-R1												
EX-R2	40	frequent	50	65	40	55	73	71	75	72	73	75
EX-R3	16	frequent	50	65	40	55	73	71	75	72	73	75
EX-R4	16	frequent	60	75	50	65	72	70	73	71	72	73
EX-R5	16	frequent	225	240	215	230	59	59	59	59	59	59
EX-R6	16	frequent	150	165	140	155	64	63	64	63	64	64
EX-R7	40	frequent	50	65	55	75	73	71	72	70	73	72
EX-R8	40	frequent	50	65	40	55	73	71	75	72	73	75
EX-R9	40	frequent	50	65	30	45	73	71	76	74	73	76

Notes:

(1) Determine if event is frequent; occasional or infrequent event. Refer to Table 7-1 for definition.

(2) Distances measured from centerlines of existing and proposed tracks to faces of buildings.

(3) Generalized Ground Surface Vibration Curve (Figure 10-1) for rapid transit or light rail vehicles at 50 mph.

(4) Highest vibration level, from the Generalized Vibration Curve (Figure 10-1), of either Track 1 or Track 2 at each receptor. The example project assumes the same adjustments are applied to both tracks. If the same adjustments cannot be applied to all tracks, the analyst may have to apply adjustments to the tracks individually to determine the highest predicted vibration at each receptor.

(5) Potential vibration effects of moving tracks.

Vibration General Assessment Form For
Vibration Adjustment Factors
CREATE Project EX-1

Moving Existing Tracks
Freight Cars

	Unadjusted		Existing Adjustments								Adjusted	
			Speed Adjustments		Source Adjustments		Path Adjustments		Receiver Adjustments			
Receptors	Highest[1] Vibration Level @ 50 mph at Each Receptor - Pre-move (based on existing operations) (VdB)	Highest[1] Vibration Level @ 50 mph at Each Receptor - Post-move (based on existing operations) (VdB)	Average Track Speed Existing (mph)	Speed Adjustment Existing (VdB)	Vehicle[2] Condition Existing (VdB)	Elevated Structure[3] Adjustment Existing (VdB)	Propagation Geology[4] Adjustment Existing (VdB)	Wood Frame Structure (VdB)	1-5 Floors Above Grade (VdB)	Floor Amplifi-cation (VdB)	Predicted Pre-Move Vibration (based on existing operations) (VdB)	Predicted Post-Move Vibration (based on existing operations) (VdB)
EX-R2	73	75	10	-14	10	-5	10	-5	-2	6	73	75
EX-R3	73	75	10	-14	10	-5	10	-5	-2	6	73	75
EX-R4	72	73	10	-14	10	-5	10	-5	-2	6	72	73
EX-R5	59	59	10	-14	10	-5	10	-5	-2	6	59	59
EX-R6	64	64	10	-14	10	-5	10	-5	-2	6	64	64
EX-R7	73	72	10	-14	10	-5	10	-5	-2	6	73	72
EX-R8	73	75	24	-6	10	-5	10	-5	-2	6	81	83
EX-R9	73	76	24	-6	10	-5	10	-5	-2	6	81	84

Notes:

(1) Highest Vibration Level, from the Generalized Vibration Curve (Figure 10-1), of either the Southbound (Track 1) or Northbound (Track 2) at each receptor.

(2) Existing and proposed freight trains anticipated as having worn wheels based on worst-cast scenario.

(3) The existing and proposed tracks are both on elevated structure/embankment (they are at least 1 foot higher than the base elevation of all receptors), therefore, they both receive the same elevated structure adjustments. If the proposed tracks have different elevated structure adjustments than the existing tracks, the analyst would need to account for this difference by applying a different elevated structure adjustment to predict the Post-Move Vibration.

(4) Existing and proposed geological conditions assumed to have "efficient" vibration propagation.

Vibration General Assessment Report Form For
Vibration Impact Summary
CREATE Project EX-1

Moving Existing Tracks
Freight Cars

Ground-borne Vibration (GBV) Impacts										
1	2	3	4	5	6	7	8	9	10	11
Receptors	FTA [(2)] Vibration Land Use Category	Pre-Move and Post-Move Vibration Frequency event [(1)] (based on existing operations)	Pre-Move and Post-Move FTA Vibration Impact Criteria [(3)] (based on existing operations) (VdB)	Predicted Pre-Move Vibration (VdB) (based on existing oeprations)	Predicted Post-Move Vibration (based on existing operations) (VdB)	Difference between Predicted Pre-Move Vibration and Predicted Post-Move Vibration (VdB)	Does the Predicted Pre-Move Vibration equal or exceed the FTA impact criteria in Column 4? If Yes, go to Column 9. If No, go to Column 10.	Is the difference between the Predicted Pre-Move Vibration and Predicted Post-Move Vibration 3 VdB or greater? If Yes, go to Column 11 and indicate "Yes" - there is a Potential Impact. If No, go to Column 10.	Use appropriate Infrequently-(I), Moderately-(M), or Heavily-Used (H) corridor criteria to determine if there is an Impact.	Potential Impact? If Yes, proceed to Detailed Analysis if mitigation measures are viable.
EX-R2	2	frequent	72	73	75	2	Yes	No	Use I, M or H Spreadsheet	
EX-R3	2	frequent	72	73	75	2	Yes	No	Use I, M or H Spreadsheet	
EX-R4	2	frequent	72	72	73	1	Yes	No	Use I, M or H Spreadsheet	
EX-R5	2	frequent	72	59	59	0	No	NA	Use I, M or H Spreadsheet	
EX-R6	2	frequent	72	64	64	0	No	NA	Use I, M or H Spreadsheet	
EX-R7	2	frequent	72	73	72	-1	Yes	No	Use I, M or H Spreadsheet	
EX-R8	2	frequent	72	81	83	2	Yes	No	Use I, M or H Spreadsheet	
EX-R9	2	frequent	72	81	84	3	Yes	Yes	NA	Yes

Notes:

[(1)] Determine if event is frequent; occasional or infrequent event. Refer to Table 7-1 for definition.

[(2)] FTA Vibration Land Use Category #2 includes residences and other buildings where people normally sleep, and Category Land Use #3 includes institutional land uses with primarily daytime uses, such as schools and churches.

[(3)] Source Table 7-1

NA = Not applicable

Vibration General Assessment Report Form For **Moving Existing Tracks**
GBN Impact Summary **Freight Cars**
CREATE Project EX-1

Ground-borne Noise (GBN) Impacts										
1	2	3	4	5	6	7	8	9	10	11
Receptors	FTA [(2)] Vibration Land Use Category	Pre-Move and Post-Move Vibration Frequency event [(1)] (based on existing operations)	Pre-Move and Post-Move FTA GBN Impact Criteria [(3)] (based on existing operations) (dBA)	Predicted Pre-Move GBN (dBA) [(4)] (based on existing operations)	Predicted Post-Move GBN (Based on Existing Operations) (dBA)	Difference between Pre-Move GBN and Post-Move GBN (dBA)	Does the Pre-Move GBN equal or exceed the FTA impact criteria in Column 4? If Yes, go to Column 9. If No, go to Column 10.	Is the difference between the Predicted Pre-Move GBN and the Predicted Post-Move GBN 3 dBA or greater? If Yes, go to Column 11 and indicate "Yes" - there is a Potential Impact. If No, go to Column 10.	Use appropriate Infrequently-(I), Moderately-(M), or Heavily-Used (H) corridor criteria to determine if there is an Impact.	Potential Impact? If Yes, proceed to Detailed Analysis if mitigation measures are viable.
EX-R2	2	frequent	35	23	25	2	No	NA	Use I, M or H Spreadsheet	
EX-R3	2	frequent	35	23	25	2	No	NA	Use I, M or H Spreadsheet	
EX-R4	2	frequent	35	22	23	1	No	NA	Use I, M or H Spreadsheet	
EX-R5	2	frequent	35	9	9	0	No	NA	Use I, M or H Spreadsheet	
EX-R6	2	frequent	35	14	14	0	No	NA	Use I, M or H Spreadsheet	
EX-R7	2	frequent	35	23	22	-1	No	NA	Use I, M or H Spreadsheet	
EX-R8	2	frequent	35	31	33	2	No	NA	Use I, M or H Spreadsheet	
EX-R9	2	frequent	35	31	34	3	No	NA	Use I, M or H Spreadsheet	

Notes:

(1) Determine if event is frequent; occasional or infrequent event. Refer to Table 7-1 for definition.

(2) FTA Vibration Land Use Category #2 includes residences and other buildings where people normally sleep, and Category Land Use #3 includes institutional land uses with primarily daytime uses, such as schools and churches.

(3) Source Table 7-1

(4) Assumes adjustment of -50 dB for low frequency vibration sources (FTA Manual Table 10-1).

NA = Not applicable

APPENDIX F

Additional Example Exterior and Interior Noise Assessment Summary Tables

Table 1: Receptor Clusters and Distances

Receptor	Exterior Or Interior Uses	FTA Land Use[1] Noise Metric	Number of Buildings Within Cluster	Existing Land Use[2]	Location Relative To Metra Tracks	Distance[3] to Exist. Track 1 Southbound (feet)	Distance[3] to Exist. Track 2 Northbound (feet)	Distance[3] to Prop. Track 1 Southbound (feet)	Distance[3] to Prop. Track 2 Northbound (feet)	Rows of Intervening Structures
R1 single-family residence *221 W. 66th Street*	Exterior	2/ L_{dn}	1	SFR	1st Row West	74	60	51	34	0
R1A single-family residence *6621 S. Yale Avenue*	Exterior	2/ L_{dn}	4	SFR	1st Row West	129	115	110	92	0
R1B single-family residence *6451 S. Yale Avenue*	Exterior	2/ L_{dn}	3	SFR	1st Row West	84	70	68	46	0
R1C single-family residence *6653 S. Yale Avenue*	Exterior	2/ L_{dn}	1	SFR	1st Row West	71	57	56	32	0
R2 single-family residence *6566 S. Ross Avenue*	Exterior	2/ L_{dn}	10	SFR	1st Row West	84	70	53	38	0
R3 single-family residence *6067 S. LaSalle Street*	Exterior	2/ L_{dn}	5	SFR	1st Row West	99	86	85	70	0
R4 single-family residence *5959 S. LaSalle Street*	Exterior	2/ L_{dn}	12	SFR	1st Row West	129	113	113	90	0
R5 Alden Princeton *255 W. 69th Street*	Interior		1	Nursing home	1st Row East	124	138	124	138	0
R6 Alden Wentworth *201 W. 69th Street*	Exterior	2/ L_{dn}	1	Nursing home	2nd Row East	360	375	360	375	1
R7 Parker School *6800 S. Stewart Avenue*	Interior		1	Elementary School	1st Row West	117	101	108	94	0
R8 Kennedy King College *6800 S. Wentworth Avenue*	Interior		1	College	1st Row East	150	164	164	179	0
R9 single-family residence *5928 S. Lafayette Avenue*	Exterior	2/ L_{dn}	3	SFR	1st Row East	147	163	163	189	0
R10 single-family residence *6630 S. Yale Avenue*	Exterior	2/ L_{dn}	4	SFR	2nd Row West	226	213	211	189	1
R11 The Yale Apartments *6565 S. Yale Avenue*	Interior		1	MFR	2nd Row West	155	142	124	109	1
R12 single-family residence *6545 S. Wentworth Avenue*	Exterior	2/ L_{dn}	3	SFR	1st Row East	128	142	166	181	0
R13 single-family residence *6066 S. LaSalle Street*	Exterior	2/ L_{dn}	15	SFR	2nd Row West	244	231	231	216	1
R14 single-family residence *5958 S. LaSalle Street*	Exterior	2/ L_{dn}	10	SFR	2nd Row West	272	257	257	234	1
R15 Prairie Haven Homes *301 W. Marquette Road*	Interior		1	Senior Housing	1st Row West	144	130	130	108	0
R16 Pleasant – Green Church *140 W. 59th Street*	Interior		1	Church	2nd Row West	284	269	269	241	1
R17 Kingdom Hall *48 W. 59th Street*	Interior		1	Church	1st Row East	174	188	189	218	0
R18 single-family residence *5851 S. LaSalle Street*	Exterior	2/ L_{dn}	10	SFR	1st Row West	128	112	112	84	0
R19 single-family residence *6547 S. Yale Avenue*	Exterior	2/ L_{dn}	6	SFR & MFR	2nd Row West	227	209	188	173	1
R20 single-family residence *310 W. Normal Parkway*	Exterior	2/ L_{dn}	1	SFR	1st Row West	174	160	160	137	0
R21 single-family residence *5750 S. Lafayette Avenue*	Exterior	2/ L_{dn}	14	SFR	2nd Row East	297	312	299	315	1

Notes: [1] FTA Noise Impact Criteria apply the 24-hour L_{dn} for residences and nursing homes (Land Use Category 2) and the hourly L_{eq} for schools, parks, and churches (Land Use Category 3).
[2] SFR = single-family residence; MFR = multifamily residence.
[3] Distances are measured perpendicularly from the centerline of the tracks, to the building face for interior receptors and to a point six feet from the building face for exterior receptors.

Table 2: Background Noise Levels

Receptor	Start Time And Date	Total Sample Duration (min.)	Measured Background L_{eq}[1] (dBA)	Measured With Metra L_{eq} (dBA)	Number of Trains During Measurement	Assumed Background L_{eq}[2] (dBA)	Comments/Noise Sources	FTA Land Use[3] Category	Background L_{eq} or L_{dn}[4] For Noise Assessments
R1 single-family residences	Not measured	--	--	--	--	54	Similar to R2	2	L_{dn} = 52
R2 single-family residences	1:46 p.m. 3/29/06	31	54	--	Metra = 0 CTA = 0	--	--	2	L_{dn} = 52
R3 single-family residences	9:42 a.m. 3/23/06	16	59	--	Metra = 0 CTA = 2	--	Some local traffic on nearby surface streets	2	L_{dn} = 57
R4 single-family residence	Not measured	--	--	--	--	59	Similar to R3	2	L_{dn} = 57
R5 Alden Princeton	Not measured	--	--	--	--	54	Similar to R8	2	L_{dn} = 52
R6 Alden Wentworth	Not measured	--	--	--	--	54	Similar to R8	2	L_{dn} = 52
R7 Parker School	Not measured	--	--	--	--	51	Similar to R15	3	L_{eq} = 51
R8 Kennedy King College	3:03 p.m. 3/29/06	92	54	62	Metra = 10 CTA = 0	--	Occasional vehicles in college parking lot	3	L_{eq} = 54
R9 single-family residences	2:52 p.m. 3/23/06	26	63	67	Metra = 1 CTA = 2	--	Siren, car horn	2	L_{dn} = 61
R10 single-family residences	Not measured	--	--	--	--	54	Similar to R11	2	L_{dn} = 52
R11 The Yale Apartments	11:39 a.m. 3/29/06	29	54	55	Metra = 1 CTA = 0	--	Helicopter	2	L_{dn} = 52
R12 single-family residences	Not measured	--	--	--	--	54	Similar to R2	2	L_{dn} = 52
R13 single-family residences	10:49 a.m. 3/23/06	16	60	--	Metra = 0 CTA = 2	--	--	2	L_{dn}= 58
R14 single-family residences	Not measured	--	--	--	--	60	Similar to R13	2	L_{dn} = 58
R15 Prairie Haven Homes	9:27 a.m. 3/29/06	91	51	58	Metra = 4 CTA = 0	--	Some local traffic on 67th Street; helicopter	2	L_{dn} = 49
R16 Pleasant Green Church	11:57 a.m. 3/23/06	37	58	58	Metra = 1 CTA = 4	--	Local traffic on 59th Street; construction activity several blocks away	3	L_{eq} = 58
R17 Kingdom Hall	1:50 p.m. 3/23/06	26	64	--	Metra = 0 CTA = 5	--	Siren, voices	3	L_{eq} = 64
R18 single-family residences	Not measured	--	--	--	--	60	Similar to R16	2	L_{dn}= 56
R19 single-family residence	Not measured	--	--	--	--	54	Similar to R11	2	L_{dn} = 52
R20 single-family residence	Not measured	--	--	--	--	51	Similar to R15	2	L_{dn} = 49
R21 single-family residences	Not measured	--	--	--	--	64	Similar to R17	2	L_{dn} = 62

Notes: (1) Measured background noise levels calculated from one-minute sample intervals without any Metra trains. Noise from CTA was included in the background noise.
(2) For receptors without direct noise measurements, background noise levels (without Metra) were assumed from nearby measurements.
(3) FTA Land Use Category 2 includes residences, hospitals, and hotels; FTA Land Use Category 3 includes schools, churches, and parks.
(4) FTA Noise Impact Criteria apply the 24-hour L_{dn} for Land Use Category 2 and the hourly L_{eq} for Land Use Category 3. To convert L_{eq} to L_{dn} for measurements between 7 a.m. and 7 p.m.: [$L_{dn} = L_{eq} – 2$] (FTA, 2006). After conversion to L_{dn}, background noise levels have been rounded to nearest decibel.

Table 3: CTCO Rail Operations Summary

Input	Existing Conditions		Future No-Build Alternative		Future Build Alternative	
Peak daily number of trains in both directions for maximum weekday[1]	78		78		108	
	North Bound/ Track 2	South Bound/ Track 1	North Bound/ Track 2	South Bound/ Track 1	North Bound/ Track 2	South Bound/ Track 1
V = Average daily hourly volume of train traffic[2] (trains/hour)	1.63	1.63	1.63	1.63	2.25	2.25
V_d = Average daytime hourly volumes[3] 7 a.m. to 10 p.m. (trains/hour)	2.13	2.33	2.13	2.33	2.93	3.2
V_n = Average nighttime hourly volumes[4] 10 p.m. to 7 a.m. (trains/hour)	0.78	0.44	0.78	0.44	1.11	.667
Highest hourly train volume[5]	6 (8-9 a.m.)	1 (8-9 a.m.)	6 (8-9 a.m.)	1 (8-9 a.m.)	8 (8-9 a.m.)	2 (8-9 a.m.)
N_{locos} = Average daytime number of locomotives per train[6] 7 a.m. to 10 p.m.	1	1	1	1	1	1
N_{locos} = Average nighttime number of locomotives per train[6] 10 p.m. to 7 a.m.	1	1	1	1	1	1
N_{cars} = Average daytime number of rail cars per train[7] 7 a.m. to 10 p.m.	6	6	6	6	6	6
N_{cars} = Average nighttime number of rail cars per train[7] 10 p.m. to 7 a.m.	6	6	6	6	6	6
S = Average daytime train speed[8] (miles/hour) 7 a.m. to 10 p.m.	40	40	40	40	70	70
S = Average nighttime train speed[8] (miles/hour) 10 p.m. to 7 a.m.	40	40	40	40	70	70

Notes and Sources:

(1) Total number of trains per weekday is the busiest weekday in the CTCO data, from midnight to midnight. Existing and future train data for CREATE Project P-1 were provided by the CTCO. The CTCO data includes non-revenue trains in addition to scheduled trains on Metra line. CTCO data are provided for a 96-hour block, from noon Wednesday to noon Sunday.

(2) Average daily hourly volume equals total trains per day divided by 24.

(3) Average daytime hourly volumes equal total number of train pass-bys between 7 a.m. and 10 p.m., divided by 15.

(4) Average nighttime hourly volumes equal total number of train pass-bys between 10 p.m. and 7 a.m., divided by 9.

(5) To determine noisiest hour of transit-related activity, for Land Use Category 3 under FTA Noise Impact Criteria. Corresponds to the morning rush hour, at peak-hour volumes and when schools would be in session.

(6) The average number of locomotives per train was determined from the CTCO data.

(7) The average number of rail cars per train based on CTCO data.

(8) Speed data obtained from Metra (Dec. 2004) for Existing conditions and from CTCO data for Future conditions.

Table 4: General Noise Assessment – Exterior Noise Levels

Receptor	FTA Land Use[1] Noise Metric	Number of Bldgs. Within Cluster	Existing Land Use[2]	Background Noise Levels Measured[3] (Without Metra) (dBA)	Predicted Overall Noise Levels[4]			Build Scenario Impacts		
					Existing Train Noise Exposure (dBA)	No-Build Train Noise Exposure (dBA)	Build Train Noise Exposure (dBA)	Increase in Overall Noise Exposure Build over Existing (dBA)	FTA Allowable Increase (dBA)	Impact Under FTA Criteria
R1 single-family residence *221 W. 66th Street*	2/ L_{dn}	9	SFR	52	65	65	71	6	2-4 – Moderate >4 - Severe	Severe
R2 single-family residence *6566 S. Ross Avenue*	2/ L_{dn}	10	SFR	52	65	65	70	5	2-4 – Moderate >4 - Severe	Severe
R3 single-family residence *6067 S. LaSalle Street*	2/ L_{dn}	5	SFR	57	64	64	67	3	2 – Moderate 4 - Severe	Moderate
R4 single-family residence *5959 S. LaSalle Street*	2/ L_{dn}	12	SFR	57	63	63	66	3	3-4 – Moderate >4 - Severe	Moderate
R6 Alden Wentworth *201 W. 69th Street*	2/ L_{dn}	1	Nursing home	52	54	54	55	1	4-8 – Moderate >8 - Severe	No Impact
R9 single-family residence *5928 S. Lafayette Avenue*	2/ L_{dn}	3	SFR	61	64	64	64	0	3-5 – Moderate >5 - Severe	No Impact
R10 single-family residence *6630 S. Yale Avenue*	2/ L_{dn}	4	SFR	52	56	56	57	1	4-7 – Moderate >7 - Severe	No Impact
R12 single-family residence *6545 S. Wentworth Avenue*	2/ L_{dn}	3	SFR	52	62	62	62	0	3-4 – Moderate >4 - Severe	No Impact
R13 single-family residence *6066 S. LaSalle Street*	2/ L_{dn}	15	SFR	58	59	59	60	1	3-5 – Moderate >5 - Severe	No Impact
R14 single-family residence *5958 S. LaSalle Street*	2/ L_{dn}	10	SFR	58	59	59	60	1	2-5 – Moderate >5 - Severe	No Impact
R18 single-family residence *5851 S. LaSalle Street*	2/ L_{dn}	10	SFR	56	63	63	66	3	3-4 – Moderate >4 - Severe	Moderate
R19 single-family residence *6547 S. Yale Avenue*	2/ L_{dn}	6	SFR & MFR	52	56	56	58	2	4-7 – Moderate >7 - Severe	No Impact
R20 single-family residence *310 W. Normal Parkway*	2/ L_{dn}	1	SFR	49	59	59	62	3	3-5 – Moderate >5 – Severe	Moderate
R21 single-family residence *5750 S. Lafayette Avenue*	2/ L_{dn}	14	SFR	62	62	62	63	1	3-4 – Moderate >4 - Severe	No Impact

Notes:
(1) FTA Noise Impact Criteria apply the 24-hour L_{dn} for residences and nursing homes (Land Use Category 2) and the hourly L_{eq} for schools, parks, and churches (Land Use Category 3).
(2) SFR = single-family residence; MFR = multifamily residence.
(3) Background Noise Levels calculated from measured, one-minute sample intervals without any Metra trains. Noise from CTA trains was included in background noise.
(4) Overall Noise Levels are the logarithmic addition of the measured Background Noise (without Metra) plus predicted Metra train noise under Existing, No-Build, and Build conditions. Existing and future Metra noise levels predicted with FTANOISE spreadsheet model (CREATE Version).

Table 5: General Noise Assessment – Interior Noise Levels

Receptor	FHWA Interior Noise Criterion L_{eq} (dBA)	Receptor Type	Number of Buildings w/in Cluster	Window Condition And Building Type	Noise Reduction Factor(1) (dBA)	Exterior Existing Predicted Train Noise(2) L_{eq} (dBA)	Interior Existing Predicted Train Noise(3) L_{eq} (dBA)	Exterior Predicted No-Build Train Noise(2) L_{eq} (dBA)	Interior Predicted No-Build Train Noise(3) L_{eq} (dBA)	Exterior Predicted Build Train Noise(2) L_{eq} (dBA)	Interior Predicted Build Train Noise(3) L_{eq} (dBA)	Interior Predicted Build Approach Or Exceed(4) 52 dBA?	Level Of Interior Noise Impact(5)
R5 Alden Princeton *255 W. 69th Street*	52	Nursing Home	1	Operable windows, a/c, masonry	10	60	50	60	50	62	52	Yes	Impact
R7 Parker School *6800 S. Stewart Avenue*	52	Elementary School	1	Operable windows, a/c, masonry	10	62	52	62	52	65	55	Yes	Impact
R8 Kennedy King College *6800 S. Wentworth Ave.*	52	College	1	Non-operable windows, a/c, concrete	25	59	34	59	34	61	36	No	None
R11 The Yale Apartments *6565 S. Yale Ave.*	52	MFR	1	Operable windows, a/c, masonry	10	55	45	55	45	59	49	No	None
R15 Prairie Haven Homes *301 W. Marquette Road*	52	Senior Housing	1	Operable windows, a/c, masonry	10	60	50	60	50	64	54	Yes	Impact
R16 Pleasant – Green Church *140 W. 59th Street*	52	Church	1	Non-operable windows, a/c, masonry	25	51	26	51	26	54	29	No	None
R17 Kingdom Hall *48 W. 59th Street*	52	Church	1	Non-operable windows, a/c, masonry	25	58	33	58	33	60	35	No	None

Notes: (1) Noise reduction factors for each receptor were determined from site visits and FHWA factors in Table 5-1 of CREATE Methodology.
(2)) Exterior rail noise from CREATE Program tracks predicted with the FTA spreadsheet model (CREATE Version).
(3) Interior noise levels estimated by subtracting noise reduction factor from predicted exterior train noise.
(4) Would the Predicted Interior Build Scenario CREATE Program Train Noise Level be 51 L_{eq}(h) or higher?
(5) A potential impact would occur if Interior Predicted Build L_{eq}(h) would be 51 dBA or greater.

The "Existing" is the same as the "Existing Scenario CREATE Program Train Noise" referenced in the CREATE Noise and Vibration Methodology Section 4.2.5.
The "Predicted No-Build" is the same as the "No-Build Scenario CREATE Program Train Noise Level (Design Year)" referenced in the CREATE Noise and Vibration Methodology Section 4.2.5.
The "Predicted Build" is the same as the "Build Scenario CREATE Program Train Noise Level (Design Year)" referenced in the CREATE Noise and Vibration Methodology Section 4.2.5.

Table 6: Detailed Noise Analysis – Exterior Noise Levels

Receptor	FTA Land Use[1] Noise Metric	No. of Bldgs. Within Cluster	Existing Land Use[2]	Background Noise Levels Measured[3] (Without Metra) (dBA)	Predicted Overall Noise Levels[4]			Build Alternative Impacts		
					Existing Train Noise Exposure (dBA)	No-Build Train Noise Exposure (dBA)	Build Train Noise Exposure (dBA)	Increase in Overall Noise Exposure Build over Existing (dBA)	FTA Allowable Increase (dBA)	Impact Under FTA Criteria
R1 single-family residence *221 W. 66th Street*	2/ L_{dn}	1	SFR	52	64		66	2	3-4 - Moderate >4 - Severe	None
R1A single-family residence *6621 S. Yale Avenue*	2/ L_{dn}	4	SFR	52	61		64	3	3-5 - Moderate >5 - Severe	Moderate
R1B single-family residence *6451 S. Yale Avenue*	2/ L_{dn}	3	SFR	52	64		68	4	3-4 - Moderate >4 - Severe	Moderate
R1C single-family residence *6653 S. Yale Avenue*	2/ L_{dn}	1	SFR	52	68		67	2	2-4 - Moderate >4 - Severe	Moderate
R2 single-family residence *6566 S. Ross Avenue*	2/ L_{dn}	10	SFR	52	64	64	66	2	3-4 – Moderate >4 – Severe	None
R3 single-family residence *6067 S. LaSalle Street*	2/ L_{dn}	5	SFR	57	63	63	65	2	3-4 – Moderate >4 – Severe	None
R4 single-family residence *5959 S. LaSalle Street*	2/ L_{dn}	12	SFR	57	62	62	65	3	3-4 – Moderate >4 – Severe	Moderate
R18 single-family residence *5851 S. LaSalle Street*	2/ L_{dn}	10	SFR	56	62	62	65	3	3-4 – Moderate >4 – Severe	Moderate
R20 single-family residence *310 W. Normal Parkway*	2/ L_{dn}	1	SFR	49	59	59	62	3	3-5 – Moderate >5 – Severe	Moderate

Notes: (1) FTA Noise Impact Criteria apply the 24-hour L_{dn} for residences and nursing homes (Land Use Category 2) and the hourly L_{eq} for schools, parks, and churches (Land Use Category 3).

(2) SFR = single-family residence; MFR = multifamily residence.

(3) Background Noise Levels calculated from measured, one-minute sample intervals without any Metra trains. Noise from CTA trains was included in background noise.

(4) Overall Noise Levels are the logarithmic addition of the measured Background Noise (without Metra) plus the predicted Metra train noise under Existing, No-Build, and Build conditions. Existing and future CREATE Program noise levels predicted with the FTA detailed noise analysis procedures in Chapter 6 of the FTA Manual.

Table 7: Detailed Noise Assessment – Interior Noise Levels

Receptor	FHWA Interior Noise Criterion L_{eq} (dBA)	Receptor Type	Number of Buildings w/in Cluster	Window Condition And Building Type	Noise Reduction Factor(1) (dBA)	Exterior Existing Predicted Train Noise(2) L_{eq} (dBA)	Interior Existing Predicted Train Noise(3) L_{eq} (dBA)	Exterior Predicted No-Build Train Noise(2) L_{eq} (dBA)	Interior Predicted No-Build Train Noise(3) L_{eq} (dBA)	Exterior Predicted Build Train Noise(2) L_{eq} (dBA)	Interior Predicted Build Train Noise(3) L_{eq} (dBA)	Interior Predicted Build Approach Or Exceed(4) 52 dBA?	Level Of Interior Noise Impact(5)
R5 Alden Princeton First Floor	52	Nursing Home	1	Operable windows, a/c, masonry	10	59	49	59	49	62	52	Yes	Impact
R5 Alden Princeton Second Floor	52	Nursing Home	1	Operable windows, a/c, masonry	10	60	50	60	50	62	52	Yes	Impact
R5 Alden Princeton Third Floor	52	Nursing Home	1	Operable windows, a/c, masonry	10	60	50	60	50	63	53	Yes	Impact
R7 Parker School First Floor	52	Elementary School	1	Operable windows, a/c, masonry	10	61	51	61	51	64	54	Yes	Impact
R7 Parker School Second Floor	52	Elementary School	1	Operable windows, a/c, masonry	10	61	51	61	51	64	54	Yes	Impact
R7 Parker School Third Floor	52	Elementary School	1	Operable windows, a/c, masonry	10	62	52	62	52	64	54	Yes	Impact
R7 Parker School Fourth Floor	52	Elementary School	1	Operable windows, a/c, masonry	10	62	52	62	52	65	55	Yes	Impact
R15 Prairie Haven First Floor	52	Senior Housing	1	Operable windows, a/c, masonry	10	59	49	59	49	63	53	Yes	Impact
R15 Prairie Haven Second Floor	52	Senior Housing	1	Operable windows, a/c, masonry	10	60	50	60	50	63	53	Yes	Impact

Notes: (1) Noise reduction factors for each receptor were determined from site visits and FHWA factors in Table 5-1 of CREATE Methodology.
(2) Exterior rail noise from CREATE Program tracks predicted with the FTA spreadsheet model (CREATE Version).
(3) Interior noise levels estimated by subtracting noise reduction factor from predicted exterior train noise.
(4) Would the Predicted Interior Build Scenario CREATE Program Train Noise Level be 51 L_{eq}(h) or higher?
(5) A potential impact would occur if Interior Predicted Build L_{eq}(h) would be 51 dBA or greater.

The “Existing” is the same as the “Existing Scenario CREATE Program Train Noise” referenced in the CREATE Noise and Vibration Methodology Section 4.2.5.
The “Predicted No-Build” is the same as the “No-Build Scenario CREATE Program Train Noise Level (Design Year)” referenced in the CREATE Noise and Vibration Methodology Section 4.2.5.
The “Predicted Build” is the same as the “Build Scenario CREATE Program Train Noise Level (Design Year)” referenced in the CREATE Noise and Vibration Methodology Section 4.2.5.

Table 8: Abatement Evaluation—Receptor R1

Receptor	R1	R1A	R1B	R1C
Potential Barrier Location	Not Required	On top of proposed retaining wall	On top of proposed retaining wall	On top of proposed retaining wall
Noise Metric	L_{dn}	L_{dn}	L_{dn}	L_{dn}
Existing Overall Scenario (Predicted Existing CREATE + Background)	64 dBA	61 dBA	64 dBA	65 dBA
Build Overall Scenario (Predicted Build CREATE + Background)	66 dBA	64 dBA	68 dBA	67 dBA
Increase in Overall Noise Exposure, Build over Existing	2 dBA	3 dBA	4 dBA	2 dBA
FTA/CREATE Impact Threshold	Moderate: 3-4 dBA Severe: >4 dBA	Moderate: 3-5 dBA Severe: >5 dBA	Moderate: 3-4 dBA Severe: >4 dBA	Moderate: 2-4 dBA Severe: >4 dBA
Impact?	None	Moderate	Moderate	Moderate
Reasonable Cost Level per Benefited Residence for Decibels Exceeding Impact Threshold(1)	N/A	$5,000	$10,000	$5,000
Number of Benefited Receptors(2)	0	4	3	1
Reasonable Mitigation Cost for Benefited Receptors	$0	$20,000	$30,000	$5,000
Total Reasonable Mitigation Cost for Entire Cluster	$55,000			
Noise Wall Height at Analysis Location	N/A	6 feet above top of proposed retaining wall	5 feet above top of proposed retaining wall	2 feet above top of proposed retaining wall
CREATE Program Train Noise Reduction with Noise Wall, at Analysis Location(3)	N/A	5 dBA	5 dBA	6 dBA
Approximate Noise Wall Length	844 feet			
Total Noise Wall Cost(3)	$158,000			
Does Noise Wall Achieve Noise Reduction Goal? (minimum 5-dBA reduction)	N/A	Yes	Yes	Yes
Does Noise Wall Achieve the Policy Economic Reasonability Value?(4)	No			
Is Noise Wall Likely to be Implemented?	No			

Notes:

(1) For "Moderate" Impacts, an upper limit of $5,000 per dwelling for each decibel exceeding the impact threshold, up to a limit of $30,000 per dwelling.

(2) Benefited Receptor defined as a receptor with predicted noise impacts and that receives a noise reduction of 5 dBA or more in Build Scenario CREATE Program Train Noise.

(3) Noise-wall costs based on $25.00 per square foot unit cost for walls up to 15 feet tall; $37.50 per square foot up to 30 feet tall, and $50.00 per square foot up to 45 feet tall.

(4) Does "Total Reasonable Mitigation Cost" exceed the "Total Noise Wall Cost"?

Table 9: Abatement Evaluation—Exterior Noise Levels

Receptor	R4	R18	R20
Potential Barrier Location	Along right of way, bottom of noise wall at ground level	Along right of way, bottom of noise wall at ground level	Along right of way, bottom of noise wall at ground level
Noise Metric	L_{dn}	L_{dn}	L_{dn}
Overall Build Scenario Noise Level Without Barrier (Future CREATE Program Noise + Background)	65 dBA	65 dBA	62 dBA
Noise Wall Height	17 ft (Above ground level)	14 ft (Above ground level)	21 ft (Above ground level)
Approximate Noise Wall Length	1,000 ft	1,125 ft	850 ft
Unit Noise Wall Cost(1)	$37.50/sq-ft	$25.00/sq-ft	$37.50/sq-ft
Total Noise Wall Cost	$638,000	$394,000	$670,000
Future CREATE Program Train Noise Reduction(2)	6 dBA	5 dBA	5 dBA
Number of Benefited Receptors(3)	12	10	1
Cost per Benefited Receptor	$53,200	$39,400	$670,000
FTA Impact Level	Moderate	Moderate	Moderate
Allowable Noise Level Increase Under FTA Criteria (Moderate Impact Threshold)	Moderate: 3-4 dBA Severe: >4 dBA	Moderate: 3-4 dBA Severe: >4 dBA	Moderate: 3-5 dBA Severe: >5 dBA
Predicted Increase in Overall Noise Exposure (Build over Existing)	3 dBA	3 dBA	3 dBA
Predicted Noise Increase over Moderate Impact Threshold	1 dBA	1 dBA	1 dBA
Reasonable Cost Level per Benefited Residence for Decibels Exceeding Moderate Impact Threshold(4)	$5,000	$5,000	$5,000
Does Noise Wall Achieve Noise Reduction Goal? (minimum 5-dBA reduction)	Yes	Yes	Yes
Does Noise Wall Achieve the Policy Economic Reasonability Value?(5)	No	No	No
Is Noise Wall Likely to be Implemented?	No	No	No

Notes:
(1) Noise wall costs are based on a $25.00 per square foot unit cost for walls up to 15 feet tall; $37.50 per square foot up to 30 feet tall, and $50.00 per square foot up to 45 feet tall. At R2, the noise wall would be on top of the proposed retaining wall, and the height of the retaining wall was deducted from the overall height of the noise wall to determine the total cost of the noise wall.
(2) Noise reduction goal of a feasible reduction of 5 dBA or more in future CREATE Program train noise.
(3) Benefited receptor assumed to receive a noise reduction of at least 5 dBA.
(4) For “Moderate” Impacts, an upper limit of $5,000 per dwelling for each decibel exceeding the impact threshold, up to a limit of $30,000 per dwelling. Minimum of $5,000 per dwelling for “Noise Level over Allowable” of less than 1 dBA.
(5) Does “Reasonable Cost per Benefited Value” exceed the “Cost per Benefited Receptor”?

Table 10: Abatement Evaluation—Interior Noise Levels

Receptor	R5 Alden Princeton First Floor	R5 Alden Princeton Second Floor	R5 Alden Princeton Third Floor	R15 Prairie Haven First Floor	R15 Prairie Haven Second Floor
Potential Barrier Location	Along right of way, bottom of noise wall at ground level	Along right of way, bottom of noise wall at ground level	Along right of way, bottom of noise wall at ground level	Along right of way, above proposed retaining wall	Along right of way, above proposed retaining wall
Noise Metric	L_{eq}	L_{eq}	L_{eq}	L_{eq}	L_{eq}
Noise Wall Height	20 ft above ground	23 ft above ground	26 ft above ground	17 ft above proposed retaining wall	20 ft above proposed retaining wall
Approximate Noise Wall Length	1,000 ft	1,000 ft	1,000 ft	850 ft	850 ft
Unit Noise Wall Cost(1)	$37.50/sq-ft	$37.50/sq-ft	$37.50/sq-ft	$37.50/sq-ft	$37.50/sq-ft
Total Noise Wall Cost	$750,000	$863,000	$975,000	$542,000	$638,000
CREATE Program Train Noise Reduction with Noise Wall(2)	5 dBA At first floor	5 dBA At second floor	5 dBA At Third Floor	6 dBA At first floor	5 dBA At second floor
Predicted Interior Build Scenario CREATE Program Train Noise (Without Barrier)	52 dBA	52 dBA	53 dBA	53 dBA	53 dBA
Predicted Interior Existing Scenario CREATE Program Train Noise	49 dBA	50 dBA	50 dBA	49 dBA	50 dBA
Number of Decibels Interior Build Scenario Exceeds Existing Scenario, at Floor of Receptor	3 dBA	2 dBA	3 dBA	4 dBA	3 dBA
Reasonable Mitigation Cost per Benefited Unit at Floor of Receptor(3)	$15,000	$10,000	$15,000	$20,000	$15,000
Number of Benefited Units(4)	1st floor = 14 units	1st floor = 14 units 2nd floor = 14 units Total = 28 units	1st floor = 14 units 2nd floor = 14 units 3rd floor = 14 units Total = 42 units	1st floor = 4 units	1st floor = 4 units 2nd floor = 4 units Total = 8 units
Reasonable Mitigation Cost per Floor	1st: 14*15,000=$210,000	1st: 14*15,000=$210,000 2nd: 14*10,000=$140,000	1st: 14*15,000=$210,000 2nd: 14*10,000=$140,000 3rd: 14*15,000=$210,000	1st: 4*20,000=$80,000	1st: 4*20,000=$80,000 2nd: 4*15,000=$60,000
Total Reasonable Mitigation Cost	$210,000	$350,000	$560,000	$80,000	$140,000
Does Noise Wall Achieve Noise Reduction Goal? (minimum 5-dBA reduction)	Yes	Yes	Yes	Yes	Yes
Does Noise Wall Achieve the Policy Economic Reasonability Value?(5)	No	No	No	No	No
Is Noise Wall Likely to be Implemented?	No	No	No	No	No

Notes:
(1) Noise-wall costs based on $25.00 per square foot unit cost for walls up to 15 feet tall; $37.50 per square foot up to 30 feet tall, and $50.00 per square foot up to 45 feet tall.
(2) Noise reduction goal of a feasible reduction of 5 dBA or more in interior CREATE Program train noise.
(3) For interior impacts, noise walls must not exceed a cost of $5,000 per benefited receptor for each decibel exceeding the Existing Scenario CREATE Program Train Noise, up to a total limit of $30,000 per benefited receptor.
(4) Benefited Units are units facing the tracks that would receive a noise reduction of at least 5 dBA in CREATE Program train noise.
(5) Does "Total Reasonable Mitigation Cost" exceed the "Total Noise Wall Cost"?

Table 11: Abatement Evaluation—Parker School

Receptor	R7 Parker School First Floor	R7 Parker School Second Floor	R7 Parker School Third Floor	R7 Parker School Fourth Floor
Potential Barrier Location	Along right of way, bottom of noise wall at ground level	Along right of way, bottom of noise wall at ground level	Along right of way, bottom of noise wall at ground level	Along right of way, bottom of noise wall at ground level
Noise Metric	L_{eq}	L_{eq}	L_{eq}	L_{eq}
Noise Wall Height	15 ft above ground	20 ft above ground	26 ft above ground	32 ft above ground
Approximate Noise Wall Length	800 ft	800 ft	800 ft	800 ft
Unit Noise Wall Cost(1)	$25.00/sq-ft	$37.50/sq-ft	$37.50/sq-ft	$50.00/sq-ft
Total Noise Wall Cost	$300,000	$600,000	$780,000	$1,280,000
CREATE Program Train Noise Reduction with Noise Wall(2)	6 dBA At first floor	5 dBA At second floor	5 dBA At third floor	6 dBA At fourth floor
Predicted Interior Build Scenario CREATE Program Train Noise (Without Barrier)	54 dBA	54 dBA	54 dBA	55 dBA
Predicted Interior Existing Scenario CREATE Program Train Noise	51 dBA	51 dBA	52 dBA	52 dBA
Number of Decibels Interior Build Scenario Exceeds Existing Scenario, at Floor of Receptor	3 dBA	3 dBA	2 dBA	3 dBA
Reasonable Mitigation Cost per Benefited Unit at Floor of Receptor(3)	$15,000	$15,000	$10,000	$15,000
Number of Benefited Units(4)	1st floor = 7 units	1st floor = 7 units 2nd floor = 4 units Total = 11 units	1st floor = 7 units 2nd floor = 4 units 3rd floor = 9 units Total = 20 units	1st floor = 7 units 2nd floor = 4 units 3rd floor = 9 units 4th floor = 7 units Total = 27 units
Reasonable Mitigation Cost per Floor	1st: 7*15,000=$105,000	1st: 7*15,000=$105,000 2nd: 4*15,000=$60,000	1st: 7*15,000=$105,000 2nd: 4*15,000=$60,000 3rd: 9*10,000=$90,000	1st: 7*15,000=$105,000 2nd: 4*15,000=$60,000 3rd: 9*10,000=$90,000 4th: 7*15,000=$105,000
Total Reasonable Mitigation Cost	$105,000	$165,000	$255,000	$360,000
Does Noise Wall Achieve Noise Reduction Goal? (minimum 5-dBA reduction)	Yes	Yes	Yes	Yes
Does Noise Wall Achieve the Policy Economic Reasonability Value?(5)	No	No	No	No
Is Noise Wall Likely to be Implemented?	No	No	No	No

Notes:
(1) Noise-wall costs based on $25.00 per square foot unit cost for walls up to 15 feet tall; $37.50 per square foot up to 30 feet tall, and $50.00 per square foot up to 45 feet tall.
(2) Noise reduction goal of a feasible reduction of 5 dBA or more in interior CREATE Program train noise.
(3) For interior impacts, noise walls must not exceed a cost of $5,000 per benefited receptor for each decibel exceeding the Existing Scenario CREATE Program Train Noise, up to a total limit of $30,000 per benefited receptor.
(4) Benefited Units are units facing the tracks that would receive a noise reduction of at least 5 dBA in CREATE Program train noise.
(5) Does "Total Reasonable Mitigation Cost" exceed the "Total Noise Wall Cost"?

Table 12: Predicted Exterior Maximum Noise Levels

Receptor	Existing Conditions			No Build			Build		
	L_{max} Locos	L_{max} Railcars	L_{max} Train	L_{max} Locos	L_{max} Railcars	L_{max} Train	L_{max} Locos	L_{max} Railcars	L_{max} Train
R1- Residences		Under revision							
R2- Residences	86	73	86	86	73	86	90	76	90
R3- Residences	85	73	85	85	73	85	88	76	88
R4- Residences	84	73	84	84	73	84	87	76	87
R5- Alden Princeton	83	73	83	83	73	83	86	76	86
R7- Parker School	84	73	84	84	73	84	87	76	87
R15- Prairie Haven	83	73	83	83	73	83	86	76	86
R18- Residences	84	73	84	84	73	84	88	76	88
R20- Residences	83	73	83	83	73	83	86	76	86

CREATE NOISE ABATEMENT EVALUATION

	B-8
Date:	November 16, 2007
Assessment Level:	**ABATEMENT EVALUATION**

Receptor	B8-R2 (1)	B8-R2.1 (1)
Receptor Type	Interior	Exterior
Potential Barrier Location	Along ROW	Along ROW
Noise Metric	L_{eq}	L_{dn}
Overall Build Scenario Noise Level Without Barrier (Future CREATE Program Noise + Background), dBA	Not Applicable	70
Interior CREATE Build Train Noise Level, dBA	62	Not Applicable
Noise Wall Height, ft	8	
Approximate Noise Wall Length, ft	2,300	
Unit Noise Wall Cost(2)	$25.00	
Total Noise Wall Construction Cost	$460,000(3)	
Future CREATE Train Noise Reduction, dBA	5	5
Future Overall Noise Level Reduction, dBA(3) (Only Calculated for Exterior Receptors)	Not Calculated	4
Number of Benefited Receptors(4)	1	23
FHWA/FTA/CREATE Impact Level	Impact	Moderate
Allowable Noise Level Increase Under FTA Criteria (Moderate Impact Threshold) (Only Use for Exterior Impacts)	Not Applicable	1
Predicted Noise Level Increase in Overall Noise Exposure (Build over Existing) (Only Calculated for Exterior Receptors)	Not Calculated	2
Predicted Noise Level Increase over Moderate Impact Threshold (Use for Exterior Impacts Only)	Not Applicable	1
Predicted Build CREATE Train Interior Noise Level Increase over Existing CREATE Train Interior Noise Level (Use for Interior Impacts Only)	2	Not Applicable
Reasonable Cost Level per Benefited Receptor per Decibel Increase Build Over Existing Noise Level (Interior) or per Decibel Exceeding Moderate Impact Threshold (Exterior)(5)	$5,000	$5,000
Reasonable Cost Per Benefited Receptor	$10,000	$5,000
Total Reasonable Cost of Noise Wall(6)	$125,000 (9)	
Does Noise Wall Achieve Noise Reduction Goal? (minimum 5-dBA reduction) (7)	Yes	Yes
Does Noise Wall Achieve the Economic Reasonability Policy Value? (8)	No	
Is Noise Wall Likely to Be Implemented?	No	

Notes:

(1) Abatement for receptor B8-R2 and B8-R2.1 were analyzed individually; however, for final evaluation to determine the total reasonableness of a noise wall, the abatement analysis of receptor B8-R2.1 was combined with receptor B8-R2, as they share a common noise wall.

(2) Noise wall costs based on $25.00 per square foot unit cost for wall up to 15 feet tall; $37.50 per square foot up to 30 feet tall; and $50.00 per square foot up to 45 feet tall.

(3) The total wall construction cost for R2/R2.1 is 2300 ft.*8 ft.*25.00 per square foot = 460,000.

(4) A benefited receptor is a receptor with predicted noise impacts and that receives a Build Scenario CREATE Program Train Noise Level (Design Year) noise reduction of five (5) dBA or more.

(5) **Exterior** - For "Moderate" impacts, a upper limit of $5,000 per dwelling for each decibel exceeding the impact threshold, up to a limit of $30,000 per dwelling. Minimum of $5,000 per dwelling for "Noise Level over Allowable" of less than 1 dBA. For severe impacts, an upper limit of $30,000 per benefited receptor.**Interior** - Upper limit of $5,000 per receptor for each decibel the CREATE build interior train noise level exceeds the CREATE existing interior train noise level, up to a maximum of $30,000 per receptor.

(6) "Total Reasonable Cost of Noise Wall" is the "Reasonable Cost Level per Benefited Receptor" times the total "Number of Benefited Receptors". This is the maximum noise wall cost that would be economically reasonable.

(7) Noise mitigation measures must provide a Build Scenario CREATE Program Train Noise Level (Design Year) noise reduction of at least five (5) dBA for the mitigation measure to be considered feasible.

(8) Does the "Total Reasonable Cost of Noise Wall" exceed the "Total Noise Wall Construction Cost"? If "Yes", then the noise wall achieves the Economic Reasonability Policy Value.

(9) For R2/R2.1: ($10,000 * 1) + ($5,000 * 23) = $125,000

Receptors that are grouped together share a common noise wall. All of the benefited receptors are included in the cost analysis.