

APPENDIX D: NOISE VIBRATION REPORT

Port Bienville Railroad
Hancock and Pearl River Counties, Mississippi
Project Number FRA-0023-00(003)/105494 101000

NOISE AND VIBRATION REPORT



Prepared for:

Mississippi Department of Transportation
Federal Railroad Administration

Prepared by:



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APPENDIX A — NOISE AND VIBRATION CONTOURS

Acronyms and Abbreviations

dB	decibel
dBA	A-weighted decibel
EIS	Environmental Impact Statement
FRA	Federal Railroad Administration
FTA	Federal Transit Administration
GIS	geographic information system
L_{dn}	Day-Night Average Sound Level
L_{eq}	equivalent average sound level
mph	miles per hour
NASA	National Aeronautics and Space Administration
RMS	root mean square
SSC	Stennis Space Center
VdB	vibration decibels

INTRODUCTION

The Mississippi Department of Transportation, Federal Railroad Administration, and Hancock County Port and Harbor Commission are preparing an Environmental Impact Statement (EIS) to evaluate a proposed new freight rail line that would provide a direct connection between the Port Bienville Railroad and the Norfolk Southern rail line near Interstate 59, north of NASA's John C. Stennis Space Center (Project No. FRA-0023-00(003)/105494 101000). This railroad would provide a second Class I rail connection to Port Bienville and the Port Bienville Industrial Park. The project is approximately 24 miles in length and located in the southwestern part of the state of Mississippi.

This report contains the results of the noise and vibration assessment for the EIS in Chapter 1 (noise) and Chapter 2 (vibration).

CHAPTER 1. NOISE

This chapter presents the results of an assessment of noise effects that would result from the proposed project. The assessment followed the guidance for a General Noise Assessment according to the Transit Noise and Vibration Impact Assessment report (FTA-VA-90-1003-06) adopted by the Federal Transit Administration (FTA) in May 2006. Noise assessments were also performed for the project based on Federal Railroad Administration (FRA) guidance documents (Final Environmental Impact Statement for locomotive horn rule), with recommended adjustments to apply FTA methodologies to freight train analyses.

No evaluation of noise levels under the No-build Alternative was conducted due to the fact that the proposed project is a new rail line that would not exist under the No-build Alternative.

1.1 NOISE DESCRIPTORS

Noise is unwanted or undesirable sound. Sound travels through the air as waves of tiny air pressure fluctuations caused by vibration. The intensity or loudness of a sound is determined by how much the sound pressure fluctuates. For convenience, sound pressure is expressed in decibel (dB) notation.

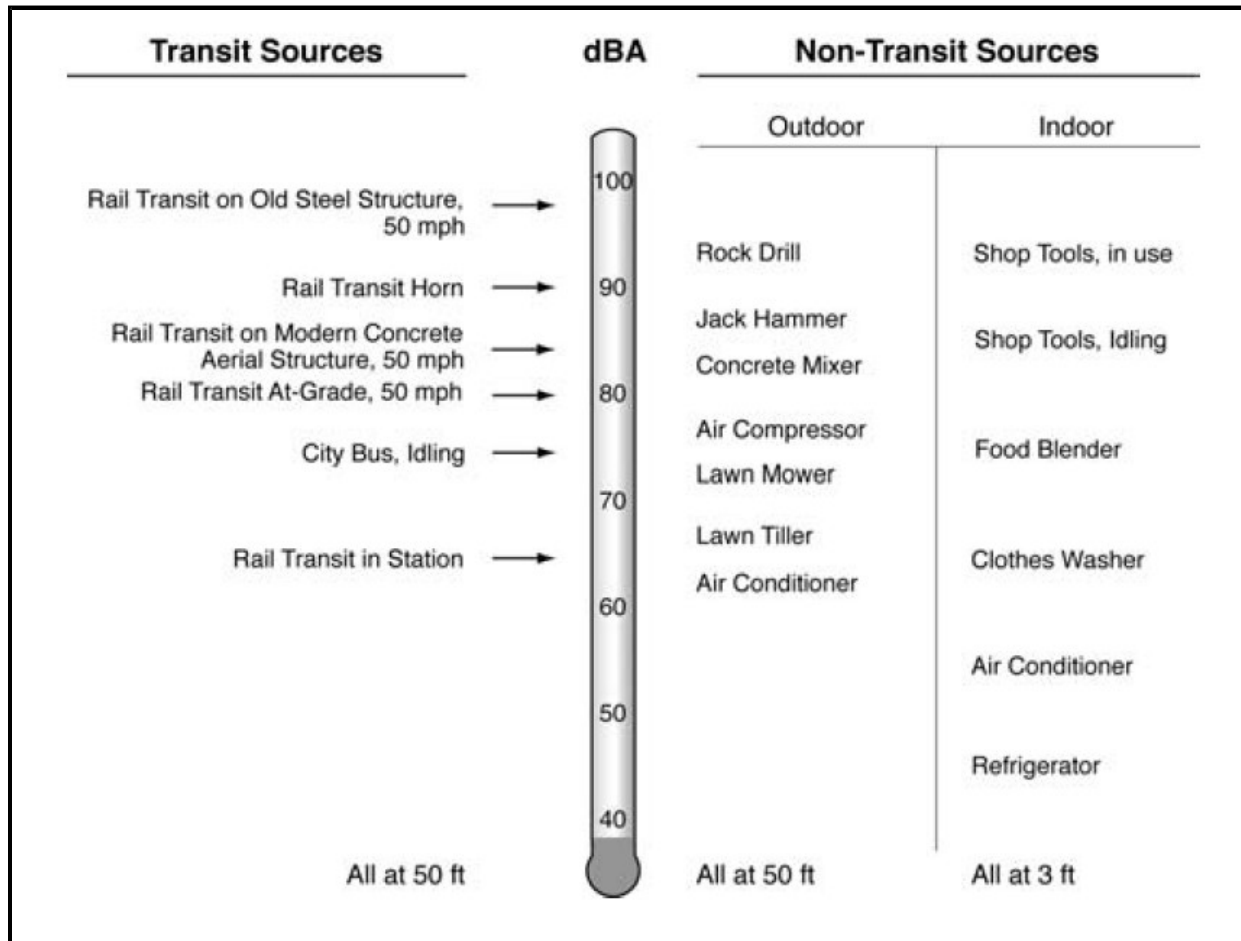
Most sounds consist of a broad range of sound frequencies, from low frequencies to high frequencies. The average human ear does not perceive all frequencies equally. Therefore, the A-weighting scale was developed to approximate the way the human ear responds to sound levels; it mathematically applies less "weight" to frequencies we do not hear well, and applies more "weight" to frequencies we do hear well. Typical A-weighted noise levels for various types of sound sources are summarized in **Figure 1**.

The equivalent average sound level (L_{eq}) is often used to describe sound levels that vary over time, usually a 1-hour period. The L_{eq} is often described as the constant sound level that is an equivalent exposure level to the actual time-varying sound level over the period (hour). Daily cumulative noise exposure can be calculated using 24 consecutive 1-hour L_{eq} values.

A common community noise rating is the Day-Night Average Sound Level (DNL or L_{dn}). The L_{dn} is

the 24-hour L_{eq} but includes a 10-dBA adjustment to noise that occurs during the nighttime hours (between 10 PM and 7 AM) where sleep interference might be an issue. The 10-dBA adjustment makes the L_{dn} useful when assessing noise in residential areas or for land uses where overnight sleep occurs.

Figure 1: Typical Noise Levels



Source: Transit Noise and Vibration Impact Assessment (FTA-VA-90-1003-06)

1.2 EVALUATION CRITERIA

1.2.1 Noise Sensitive Land Uses

FTA noise impact thresholds are a function of land use type and existing noise exposure. The FTA differentiates noise-sensitive land uses into three distinct categories. **Table 1** summarizes the land use categories and associated noise metrics.

Table 1: Land Use Categories and Metrics for Noise Impact Criteria

Land Use Category	Noise Metric (dBA)	Description of Land Use Category
Category 1	Outdoor $L_{eq(h)}$ ^a	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.
Category 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.
Category 3	Outdoor $L_{eq(h)}$ ^a	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.

Source: Transit Noise and Vibration Impact Assessment (FTA-VA-90-1003-06)

^a L_{eq} for the noisiest hour of transit-related activity during hours of noise sensitivity

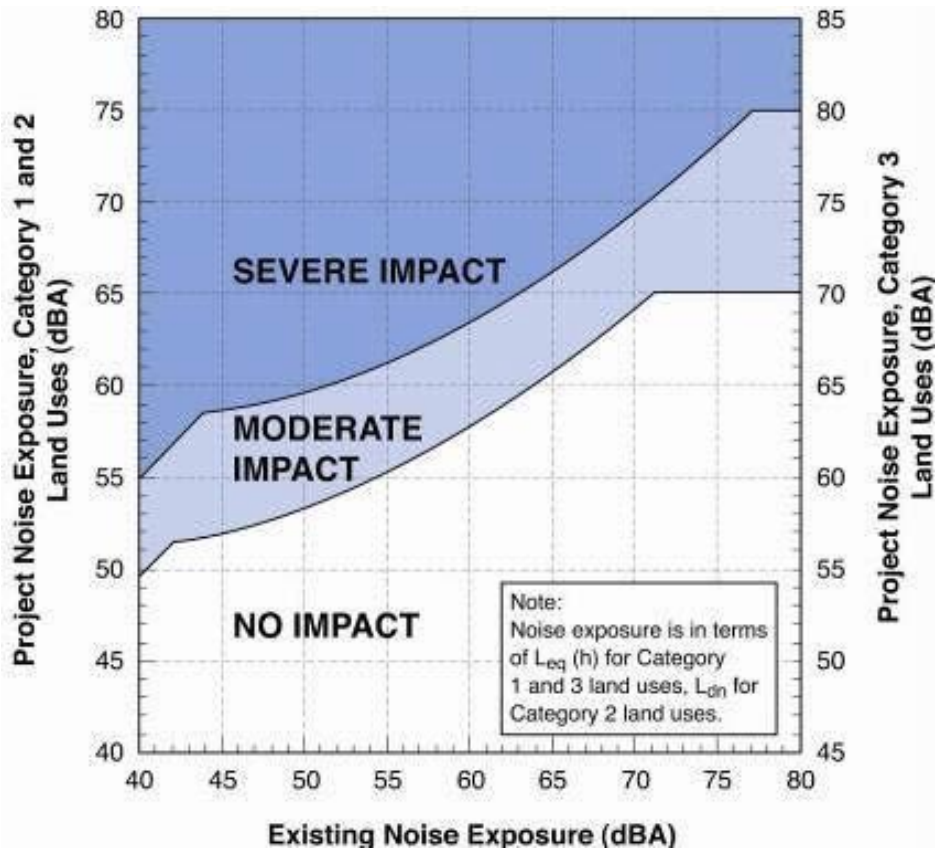
Historic buildings and parks are a special case. For historic buildings, noise-sensitivity is determined by the current land use, not the historic land use. For instance, a historic house used as a commercial shop is not considered noise-sensitive, whereas a historic warehouse converted to multi-unit residences is noise-sensitive in Category 2 (because of the current residential use). Parks that are used for passive recreation such as reading, meditation or sedate conversation are noise sensitive Category 3 land uses, whereas parks used for active recreation such as sporting fields, playgrounds, or areas where social groups gather are not considered noise-sensitive.

The L_{dn} descriptor is used to assess transit-related noise for residential areas and land uses where overnight sleep occurs (Category 2). The L_{eq} descriptor is used to assess transit-related noise at other noise-sensitive land uses (Category 1 and Category 3), specifically during the noisiest hour of transit-related activity concurrent with the receptors' hours of noise sensitivity.

1.2.2 Noise Impact Thresholds

The FTA noise impact criteria are used to predict future noise impacts from transit operations. The FTA noise impact criteria are shown in **Figure 2**. The figure illustrates existing noise exposure and project-related noise exposure, and shows how FTA noise impact thresholds vary with existing noise levels.

Figure 2: FTA Noise Impact Criteria



Source: Transit Noise and Vibration Impact Assessment (FTA-VA-90-1003-06)

The FTA defines three types of noise impacts as described below. The magnitude of impact affects whether noise mitigation is investigated or implemented.

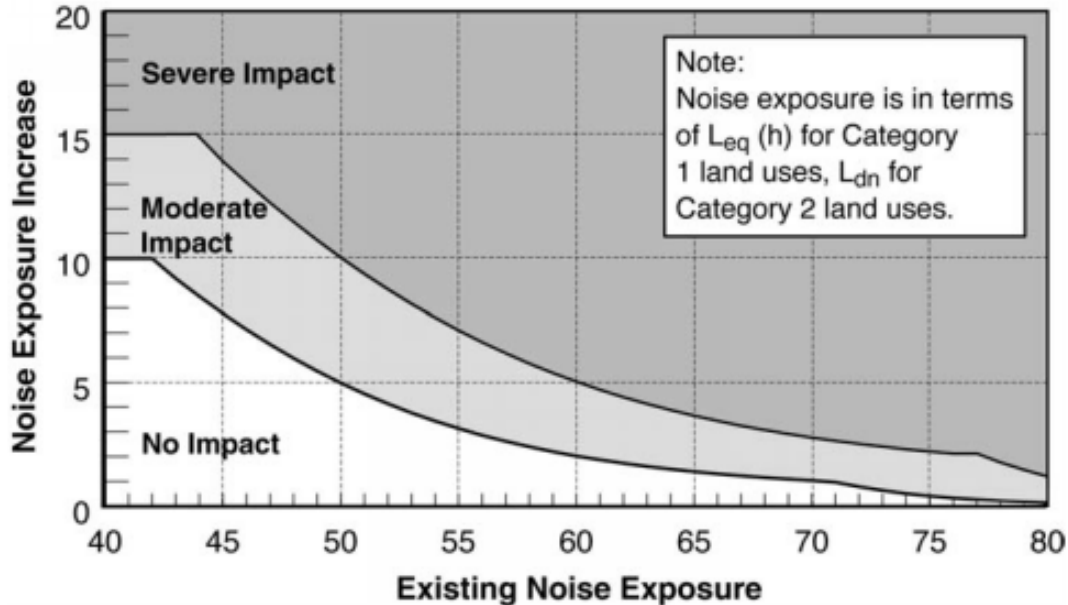
Severe Impact: A significant percentage of people are highly annoyed by noise in this range. Noise mitigation would normally be specified for severe impact areas unless there is no practical method of mitigating the impact.

Moderate Impact: In this range, other project-specific factors are considered to determine the magnitude of the impact and the need for mitigation. Other factors include the predicted increase over existing noise levels, the types and number of noise-sensitive land uses affected, existing outdoor-indoor sound insulation, and the cost-effectiveness of mitigating noise to more acceptable levels.

No Impact: In this range, the introduction of the project will result in an insignificant increase in the number of people highly annoyed by the new noise.

Figure 3 is also excerpted from the FTA guidance document (FTA-VA-90-1003-06) and shows the limits of allowable increase in noise level based on the existing noise level. The increases shown are consistent with the combined existing and project related noise levels previously shown in **Figure 2**.

Figure 3: Increase in Cumulative Noise Levels Allowed by FTA Criteria



Source: Transit Noise and Vibration Impact Assessment (FTA-VA-90-1003-06)

1.3 ASSESSMENT APPROACH

From a high-level overview, both the noise and the vibration assessments follow the same general steps:

1. Establish the boundaries of the noise study area.
2. Identify the potentially noise- or vibration-sensitive receptors within the study area, based upon land use.
3. Evaluate existing noise and vibration conditions of the receptors.
4. Set impact thresholds based upon land uses and existing conditions.
5. Estimate noise levels from the project using FTA equations and methods.
6. Identify receptors anticipated to experience noise impacts and determine the general magnitude of impact (moderate or severe).

1.3.1 Identifying Potentially Noise Sensitive Receptors

Receptor identification for noise-sensitive land uses included a review of land use-related GIS data, review of digital aerial photographs, and review of other publicly available information and imagery. Receptors in the study area were identified and categorized for noise-sensitive land uses according to FTA categories.

1.3.2 General Noise Assessment Methods

The noise assessment was conducted according to the General Assessment methods from FTA guidance.

Evaluating Existing Noise Conditions

The existing noise conditions or baseline noise levels throughout the noise study area were estimated by evaluating the proximity to nearby active transportation routes and by the population density. This estimation method is detailed in the FTA guidance documents. In general, this method is designed to slightly underestimate the existing noise level, which in turn limits the impact threshold for project-related noise to a more restrictive level.

Estimating Project-Related Noise Levels

The approach to estimating the project-related noise levels follows the following procedure:

1. Calculate the noise emission levels of project-related sources using equations from the FTA manual.
2. Calculate the propagation of noise from the project-related sources to the impact thresholds.
3. Calculate the noise impact contours for locomotive horn noise using the FRA spreadsheet model.
4. Overlay moderate noise impact contours and severe noise impact contours upon digital aerial photographs using GIS technology.

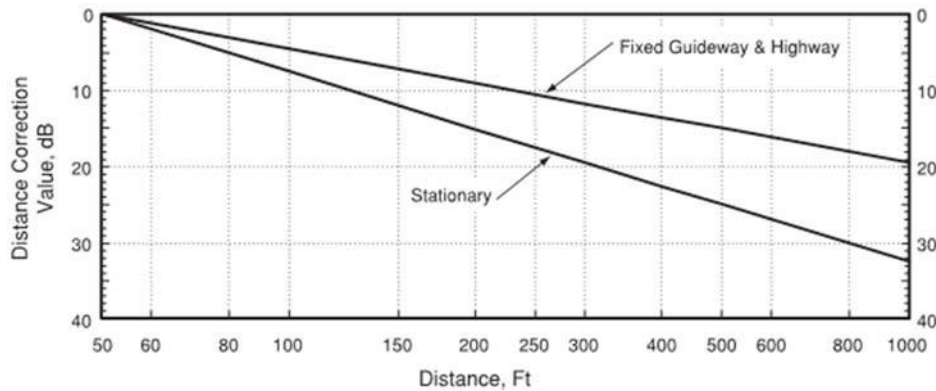
Using this approach, the noise-sensitive receptors within the impact contours are considered impacted.

Modeling Assumptions

Certain characteristics of the project have direct influence on the noise and vibration effects due to the project. The critical assumptions include the following:

- This assessment assumes 1 train per day (both inbound and outbound directions) with 65 freight rail cars and 2 diesel-electric locomotives.
- Trains occur in equal probability during daytime hours (7:00 AM to 10:00 PM) or in nighttime hours (10:00 PM to 7:00 AM).
- Train speeds are around 39 mph.

These characteristics are used as inputs for modeling the noise emission of each project-related noise source as a sound pressure level at 50 feet from the source. From these levels, the attenuation of sound with distance is given in the FTA guidance manual, reproduced in **Figure 4**. The sound level at 50 feet is adjusted according to the distance from the source. The fixed guideway curve is utilized for this project; there are no highway or stationary sources to evaluate.

Figure 4: Adjustment Curve for Attenuation over Distance

Source: Transit Noise and Vibration Impact Assessment (FTA-VA-90-1003-06)

The fixed guideway adjustment curve can be described using the equation:

$$A_{\text{dist}} = -15 \log \frac{D}{50}$$

This equation is rearranged to find the distance to the impact threshold.

1.4 AFFECTED ENVIRONMENT

A unique aspect of the study area is the Stennis Space Center (SSC), a NASA facility centrally located within the study area. The SSC is surrounded by a 125,000-acre acoustical buffer zone which makes up the majority of the study area. The purpose of the buffer is to mitigate noise impacts associated with the testing of various rocket engines.

Development or the construction of any standing structures is strictly prohibited within the buffer zone and is enforced by SSC. Because no permanent structures exist and no development is allowed to occur within the buffer zone (except within the secure area of SSC), there are no receptors within this area. The secure area is centrally located within the buffer zone and is delineated by dual security fences along its perimeter. The proposed project alignment does not encroach within the secure area.

Since no receptors are located within the SSC acoustical buffer zone, this noise assessment applies only to the very northern-most portion of the study area and the southern-most portion of the study area where the track alignment extends and terminates beyond the limits of the buffer zone.

The project corridor extends approximately 1.2 miles north of the SSC acoustical buffer, towards and into the town of Nicholson, MS. Land use in this northern portion of the project includes rural undeveloped (wooded) in the areas closest to the SSC, a highway, and scattered residences as the corridor moves closer to the town of Nicholson. The project corridor also extends approximately 2 miles south of the SSC. Land use adjacent to this portion of the corridor is largely undeveloped, with a few scattered homes along local roadways.

1.5 ENVIRONMENTAL CONSEQUENCES (ESTIMATED NOISE EFFECTS)

The results of the general assessment approach for noise impacts are shown in **Appendix A, Figure 1** with noise contours overlaid upon digital aerial photographs, and impacted receptors identified inside the contours. Refer to this figure for the discussion of noise effects.

Results of the general assessment determined the distance between the rail line and the noise impact contour. This distance is also a function of existing noise levels; therefore it varies. Noise contours narrow where background noise levels are louder (i.e. near highways, etc.). **Table 2** summarizes the range of existing noise levels and the range of noise impact contour distances associated with wayside noise.

Table 2: Wayside Noise Impact Distances

FTA Noise Category	Existing Sound Level Ldn (dBA)	Distance to Moderate Impact (feet)	Distance to Severe Impact (feet)
2	35	161	70
2	40	77	34
2	45	53	19
2	50	43	17
2	55	32	13
2	60	22	9
2	65	14	6
2	70	8	4
2	75	7	2

Locomotive horn noise impact contours were determined using the FRA locomotive horn noise model. **Table 3** presents results of those calculations.

Table 3: Locomotive Horn Noise Impact Contour Dimensions

Impact Distances in Feet	US 11	Lower Bay Road
Impact Distance at Crossing	555	1111
Severe Impact Distance at Crossing	290	703
Impact Distance at 1/2 Zone Length	429	882
Severe Impact Distance at 1/2 Zone Length	217	547
Zone Length	780	780
1/2 Zone Length	390	390

Results of applying the noise impact distances identified above to digital aerial photos indicate that 14 receptors have potential to experience noise impacts, as shown in **Appendix A, Figure 1** and in **Table 4**. Receptor No. 3 has no noise impact but has a vibration impact as discussed in section 2.5.

Table 4: Noise Analysis Results

Receptor ID	Type	Land Use Category	Noise Metric (dBA)	Impact Magnitude
1	Residence	Category 2	Outdoor L_{dn}	Severe
2	Residence	Category 2	Outdoor L_{dn}	Severe
3	Residence	Category 2	Outdoor L_{dn}	No impact
4	Residence	Category 2	Outdoor L_{dn}	Moderate
5	Residence	Category 2	Outdoor L_{dn}	Moderate
6	Residence	Category 2	Outdoor L_{dn}	Moderate
7	Residence	Category 2	Outdoor L_{dn}	Moderate
8	Residence	Category 2	Outdoor L_{dn}	Moderate
9	Residence	Category 2	Outdoor L_{dn}	Moderate
10	Residence	Category 2	Outdoor L_{dn}	Moderate
11	Residence	Category 2	Outdoor L_{dn}	Moderate
12	Residence	Category 2	Outdoor L_{dn}	Moderate
13	Residence	Category 2	Outdoor L_{dn}	Moderate
14	Residence	Category 2	Outdoor L_{dn}	Moderate
15	Residence	Category 2	Outdoor L_{dn}	Moderate

Twelve receptors have potential to experience moderate noise impacts and two receptors have potential to experience severe noise impacts. All of the noise impacts are at the northern-most end of the study area, and all the noise impacts are from the predicted horn noise from the US 11 at-grade crossing.

Eliminating locomotive horn use at the US 11 at-grade crossing would mitigate the severe noise impacts. However it may not be cost-effective to implement quiet zones and cease use of locomotive horns at public at-grade crossings in the study area as a means to mitigate two severe noise impacts. Other mitigation measures could include receiver-based treatments such as building insulation programs or negotiated settlements. Building insulation programs refers to the acoustical insulation of the building, although sometimes thermal insulation can be utilized for additional acoustical insulation. Other building insulation measures include air conditioning, improved seals, improved doors and windows, or relocating vents or doors to another side of the building. Receiver-based noise mitigation measures may be more cost effective for the two severe noise impacts. Where moderate noise impacts are projected to occur, occupants may experience annoyance when trains are nearby. Noise mitigation measures are not recommended for locations where moderate noise impacts are projected to occur. FRA does not require mitigation for moderate noise impacts, because the magnitude of the change in noise levels or overall noise level is modest and not projected to substantially affect sleep or other activities.

1.6 SUMMARY

Noise associated with the proposed project has the potential to affect residential properties adjacent to the rail line. Using methods published by the FTA/FRA, project-related noise was evaluated to assess the potential for impacts. Analysis results indicate that project-related noise has the potential to exceed impact thresholds as defined by the FTA due to locomotive horn use at the US 11 at-grade crossing. Some limited mitigation options may be explored where severe noise impacts are projected to occur such as eliminating locomotive horn use at the US 11 at-grade crossing, retrofitting buildings with air conditioning and improved storm doors and windows, or negotiated settlements.

CHAPTER 2. VIBRATION

This chapter presents the results of an assessment of vibration effects that would result from the proposed project. The assessment followed the guidance for a General Vibration Assessment according to the Transit Noise and Vibration Impact Assessment report (FTA-VA-90-1003-06) adopted by the Federal Transit Administration (FTA) in May 2006. Vibration assessments were also performed for the project with recommended adjustments to apply FTA methodologies to freight train analyses.

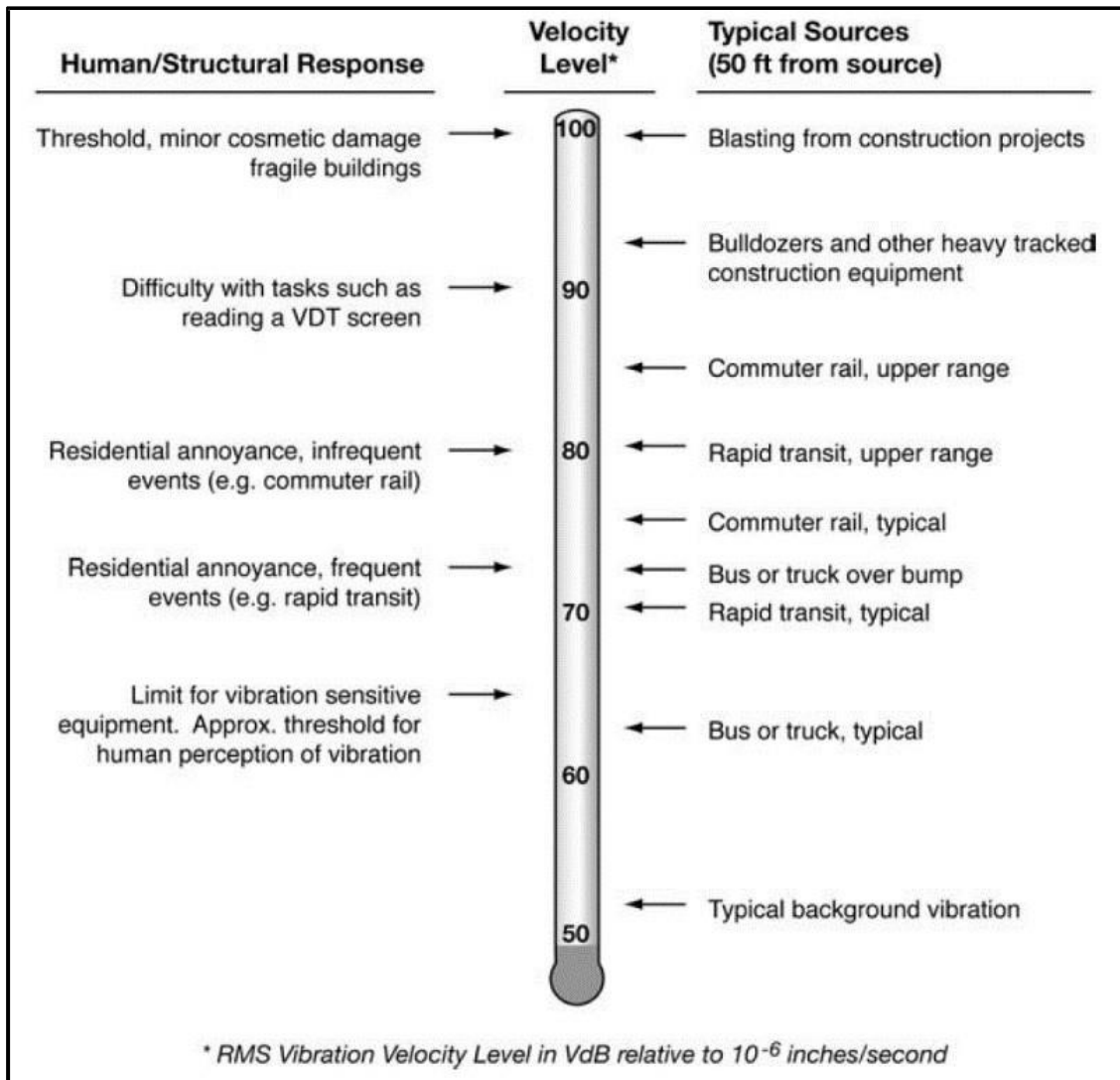
No evaluation of noise or vibration levels under the No-build Alternative was conducted due to the fact that the proposed project is a new rail line that would not exist under the No-build Alternative.

2.1 VIBRATION DESCRIPTORS

Vibration consists of rapidly fluctuating motions. However, human response to vibration is a function of the average motion over a longer (but still short) time, such as 1 second. The root mean square (RMS) amplitude of a motion over a 1-second period is commonly used to predict human response to vibration. For convenience, decibel notation is used to describe vibration relative to a reference quantity. The FTA has adopted the notation VdB (for vibration decibels), which is decibels relative to a reference quantity of 1 microinch per second (10^{-6} in/s).

In contrast to airborne noise, ground-borne vibration is not an everyday experience for most people. The background vibration level in residential areas is usually 50 VdB or lower—well below the threshold of perception for humans, which is around 65 VdB. Levels at which vibration interferes with sensitive instrumentation such as medical imaging equipment or extremely high-precision manufacturing equipment can be much lower than the threshold of human perception. Most perceptible indoor vibration is caused by sources within a building such as the operation of mechanical equipment, movement of people, or slamming of doors. Typical outdoor sources of perceptible ground-borne vibration are construction equipment, steel-wheeled trains, and traffic on rough roads, though in most soils ground-borne vibration dissipates very rapidly. **Figure 5** illustrates common vibration sources and the human and structural response to various levels of ground-borne vibration.

Figure 5: Typical Vibration Levels and Responses



Source: Transit Noise and Vibration Impact Assessment (FTA-VA-90-1003-06)

Soil and subsurface conditions are known to have a strong influence on the levels of ground-borne vibration. Vibration propagation is generally more efficient in stiff, clay-type soils than in loose, sandy soils or at-grade track where the depth to bedrock is 30 feet or less. Soil layering and the depth to the water table can also affect ground-borne vibration, but the effects are not always predictable and are not well established (FTA-VA-90-1003-06).

Ground-borne vibration can be a serious concern for residents or at facilities that are sensitive to vibration, such as laboratories or recording studios. The effects of ground-borne vibration include perceptible movement of building floors, interference with vibration-sensitive instruments, rattling of windows, and the shaking of items on shelves or hanging on walls. Additionally, the vibration of room surfaces due to ground-borne vibration can result in ground-borne noise. Ground-borne noise is typically perceived as a low frequency rumbling sound.

2.2 EVALUATION CRITERIA

2.2.1 Vibration-Sensitive Land Uses

The FTA differentiates vibration-sensitive land uses into three distinct categories (**Table 5**). These categories are one factor for setting the vibration impact threshold.

Table 5: Land Use Categories for Transit Vibration Impact Criteria

Land Use Category	Description of Land Use Category
Category 1	High Vibration Sensitivity. Buildings where ambient vibration well below levels associated with human annoyance is essential for equipment or operations within the building. Typically includes vibration-sensitive research and manufacturing facilities, hospitals, and university research operations.
Category 2	Residential. Includes all residential land uses and any building where people sleep, such as hotels and hospitals.
Category 3	Institutional. Schools, churches, other institutions, and quiet offices that do not have vibration-sensitive equipment, but still have the potential for activity interference. Includes certain office buildings, but not all buildings that have office space.

Source: Transit Noise and Vibration Impact Assessment (FTA-VA-90-1003-06)

The Category 1 vibration impact threshold is acceptable for most moderately sensitive equipment; other highly sensitive equipment would require a detailed analysis to determine the acceptable vibration levels and the effect of the Project on each individual type of equipment. In any case, there are no ground-borne noise impact thresholds for Category 1 land uses because equipment sensitive to ground-borne vibration is generally not sensitive to ground-borne noise. However, there are other special Category 1 land uses, such as concert halls, television and recording studios, and theaters, which can be very sensitive to both ground-borne vibration and ground-borne noise. The FTA has developed other special vibration impact thresholds for these land uses.

2.2.2 Vibration Impact Thresholds

The FTA vibration impact criteria are used to predict future vibration impacts from transit operations. The thresholds are differentiated between vibration sensitive land uses and the frequency of the events.

- **Frequent Events:** More than 70 vibration events per day. Most rapid transit projects fall into this category.
- **Occasional Events:** Between 30 and 70 vibration events of the same source per day. Most commuter trunk lines along main corridors fall into this category.
- **Infrequent Events:** Fewer than 30 vibration events per day. This category includes most commuter rail branch lines along corridors that are less frequently traveled.

The impact criteria for ground-borne vibration are related to levels causing human annoyance or interfering with use of vibration-sensitive equipment. The basis for evaluating FTA vibration impact thresholds is the highest expected RMS vibration level for repeated vibration events from the same source. Ground-borne noise impacts are assessed based on criteria for human annoyance and activity interference. The criteria for acceptability are given in terms of the A-weighted sound

pressure level.

Table 6 shows the ground-borne vibration and ground-borne noise impact criteria for a general assessment (the detailed vibration assessment utilizes different impact thresholds).

Table 6: Ground-borne Vibration Impact Thresholds

Land Use Category	Ground-borne Vibration Impact Level (VdB re 1 micro inch/second)			Ground-borne Noise Impact Level (dBA re 20 micropascals)		
	Frequent Events	Occasional Events	Infrequent Events	Frequent Events	Occasional Events	Infrequent Events
Category 1 (highly sensitive, where vibration would interfere with operations)	65 ^a	65 ^a	65 ^a	N/A ^b	N/A ^b	N/A ^b
Category 2 (where overnight sleep occurs)	72	75	80	35	38	43
Category 3 (institutional with primarily daytime use)	75	78	83	40	43	48

Source: Transit Noise and Vibration Impact Assessment (FTA-VA-90-1003-06)

^a 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.

^b Vibration-sensitive equipment is generally not sensitive to ground-borne noise.

The impact thresholds for vibration from rail transit systems are also used to assess vibration impact from freight trains in shared right of way situations. However, for freight trains, the locomotive and rail car vibration are considered separately due to the significantly greater length, weight, and axle loads of a typical line-haul freight train. Locomotive vibration only lasts for a very short time; therefore, locomotive event frequency is the same as the train event frequency. However, the rail car vibration of a typical line-haul freight train lasts for several minutes. Therefore, each freight car is considered a separate event.

In cases where a new transit project will use an existing railroad right of way, FTA provides guidance based upon the existing vibration from the rail corridor. If the existing vibration levels are 5 VdB lower than the vibration due to the project, then the existing vibration can be disregarded, and the project vibration levels are assessed normally for impact. Otherwise, the frequency of existing trains in the rail corridor will direct the assessment of potentially adverse vibration impacts:

Infrequently-Used Rail Corridor: fewer than 5 trains per day. The project vibration levels are assessed normally for impact at vibration-sensitive receptors.

Moderately-Used Rail Corridor: 5 to 12 trains per day. If the existing vibration levels already exceed the impact criterion at a vibration-sensitive receptor and the project-related vibration levels are at least 5 VdB less than the existing train vibration, then the project will not cause an impact. Otherwise the project vibration levels are assessed normally for impact.

Heavily-Used Rail Corridor: more than 12 trains per day. If the existing vibration levels already exceed the impact criterion at a vibration-sensitive receptor and the number of vibration events significantly increases due to the proposed project, then the project may cause a potential impact. Otherwise if the relocation results in vibration levels increase-over-existing of 3 VdB or more, then the project may cause a potential impact.

Moving Existing Tracks: shifting the location of existing railroad tracks or existing railroad traffic. If the track relocation and reconstruction results in lower vibration levels, then the project will benefit the receptor and will not cause an adverse impact. If the existing vibration levels already exceed the impact criterion at a vibration-sensitive receptor and the relocation results in more than a 3 VdB increase-over-existing vibration levels, then the project may cause a potential impact. Otherwise if new vibration levels increase due to the track relocation, then the project will cause an impact if the vibration exceeds the impact criterion for the receptor.

2.3 ASSESSMENT APPROACH

From a high-level overview, the vibration assessments follow the same general steps:

1. Establish the boundaries of the vibration study areas.
2. Identify the potentially vibration-sensitive receptors within the study area, based upon land use.
3. Set impact thresholds based upon land uses and existing conditions.
4. Estimate vibration levels from the project using FTA equations and methods.
5. Identify receptors anticipated to experience vibration impacts.

2.3.1 Identifying Potentially Vibration-Sensitive Receptors

Receptor identification for vibration-sensitive land uses included a review of land use-related GIS data, review of digital aerial photographs, and review of other publicly available information and imagery. Receptors in the study area were identified and categorized for vibration-sensitive land uses according to FTA categories.

2.3.2 General Vibration Assessment Methods

The vibration assessment was conducted according to the General Assessment methods from FTA guidance.

Evaluating Existing Vibration Conditions

In most buildings and structures, much of the vibration is due to internal sources such as mechanical equipment, motorized appliances, and human activity such as footfall vibrations or door-closing impacts. The existing vibration environment can be neglected when considering a new train vibration source.

Estimating Project-Related Vibration Levels

In overview, the vibration assessment consists of the following general steps:

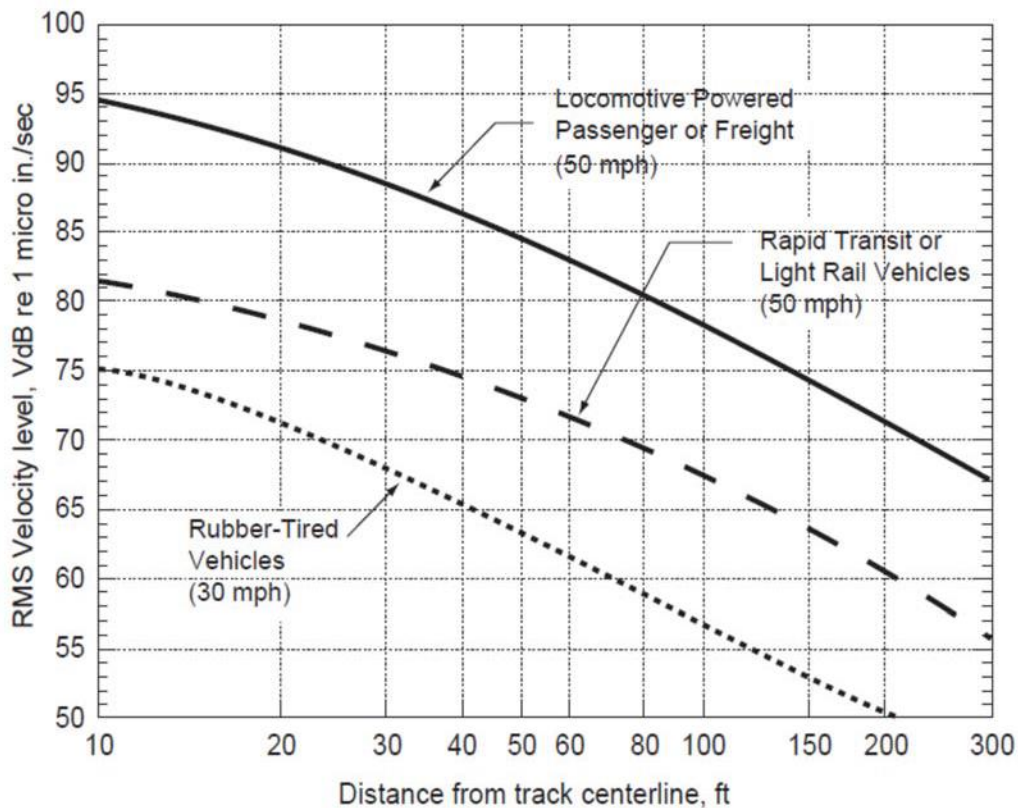
1. Select the appropriate generalized vibration curve from FTA guidance.
2. Select appropriate adjustment factors for the structures anticipated to be on each land use including corrections for speed, track configuration, geological conditions, and building/foundation type.
3. Determine the distance to impact for each land use.
4. Overlay vibration impact contours upon digital aerial photographs using GIS technology.

Using this method, the vibration-sensitive receptors within the impact contours are considered impacted.

Modeling Assumptions

The generalized vibration curve for this vibration assessment is the “Locomotive Powered Passenger or Freight (50 mph)” curve. This curve is provided in FTA guidance, and the figure with the curve is reproduced in **Figure 6**.

Figure 6: Generalized Ground Surface Vibration Curves



Source: Transit Noise and Vibration Impact Assessment (FTA-VA-90-1003-06)

Normally, the estimated level of vibration at a single receptor is found using the reference curve at the receptor's distance to the track. Adjustment factors are then arithmetically added to the reference vibration curve, and the resulting level is compared to the impact thresholds. This is algebraically equivalent to subtracting the same adjustments from the impact threshold and comparing it to the unadjusted reference curve. In this way, the graphical curves can be used to find the distance to vibration impact. Using the level of the adjusted criterion on the y-axis, the distance on the x-axis can be found from the generalized vibration curve.

- The critical assumptions for adjustments used in the vibration assessment include the following:
- This assessment assumes 1 train per day (both inbound and outbound directions).
- Train speeds are around 39 mph.

As a conservative assessment, soils in the project area were assumed to be efficient at transmitting vibration.

2.4 AFFECTED ENVIRONMENT

Since no receptors are located within the SSC acoustical buffer zone, this vibration assessment applies only to the very northern-most portion of the study area and the southern-most portion of the study area where the track alignment extends and terminates beyond the limits of the buffer zone. Refer to Section 1.4 for a description of the SSC and land uses within the northern and southern segments of the noise and vibration study area.

2.5 ENVIRONMENTAL CONSEQUENCES (ESTIMATED VIBRATION EFFECTS)

The results of the general assessment approach for vibration impacts are shown in **Appendix A, Figure 2** with vibration contours overlaid upon digital aerial photographs, and impacted receptors identified inside the contours. Refer to this figure for the discussion of vibration effects.

Results of the general vibration assessment indicate that vibration impacts are projected to occur at a distance of 169 feet from the rail line. Based on this distance, three receptors have potential to experience vibration impacts, as shown in **Appendix A, Figure 2** and in **Table 7**. All of the vibration impacts are at the northern-most end of the study area.

Table 7: Vibration Impacts

Receptor ID	Type	Land Use Category
1	Residence	Category 2
2	Residence	Category 2
3	Residence	Category 2

All of these vibration impacts are at the northern-most end of the study area. Two of the receptors with vibration impacts are the same two receptors with severe noise impacts.

Vibration mitigation is very difficult to implement on freight train projects due to the very heavy axle loads. Vibration mitigation measures available for transit train projects are not effective for

freight trains. Operational restrictions such as reduced speed may reduce the magnitude of vibration experienced at receptors, but will increase the duration of vibration as well as other effects to noise exposure and road traffic delays. Track and wheel maintenance is considered a viable mitigation option for groundborne vibration of freight trains; this can include regularly scheduled rail grinding, wheel truing programs, vehicle reconditioning programs, and use of wheel-flat detectors where feasible.

2.6 SUMMARY

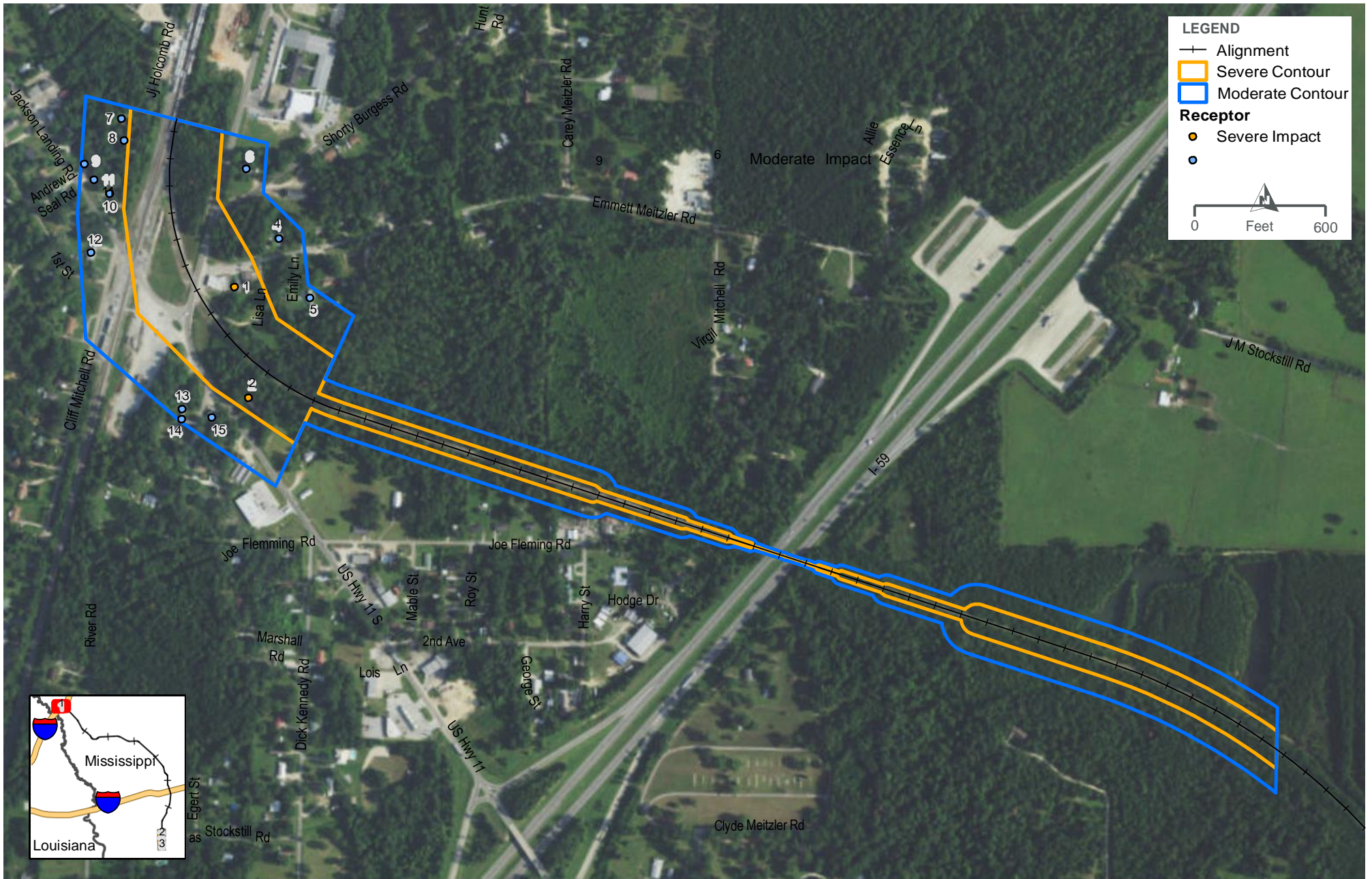
Vibration associated with the proposed project has the potential to affect residential properties adjacent to the rail line. Using methods published by the FTA, project-related vibration was evaluated to assess the potential for impacts. Analysis results indicate that project-related vibration has the potential to exceed impact thresholds as defined by the FTA. There are limited practical means to mitigate ground-borne vibration impacts due to freight trains other than track and wheel maintenance programs.

REFERENCES

Federal Transit Administration (FTA). 2006. Transit Noise and Vibration Impact Assessment (FTA-VA-90-1003-06). Office of Planning and Environment. May 2006.

Federal Railroad Administration (FRA). 2003. Use of Locomotive Horns at Highway-Rail Grade Crossings Final Environmental Impact Statement (FEIS). December 5, 2003.

APPENDIX A — NOISE AND VIBRATION CONTOURS



LEGEND

- +— Alignment
- ▭ Severe Contour
- ▭ Moderate Contour

Receptor

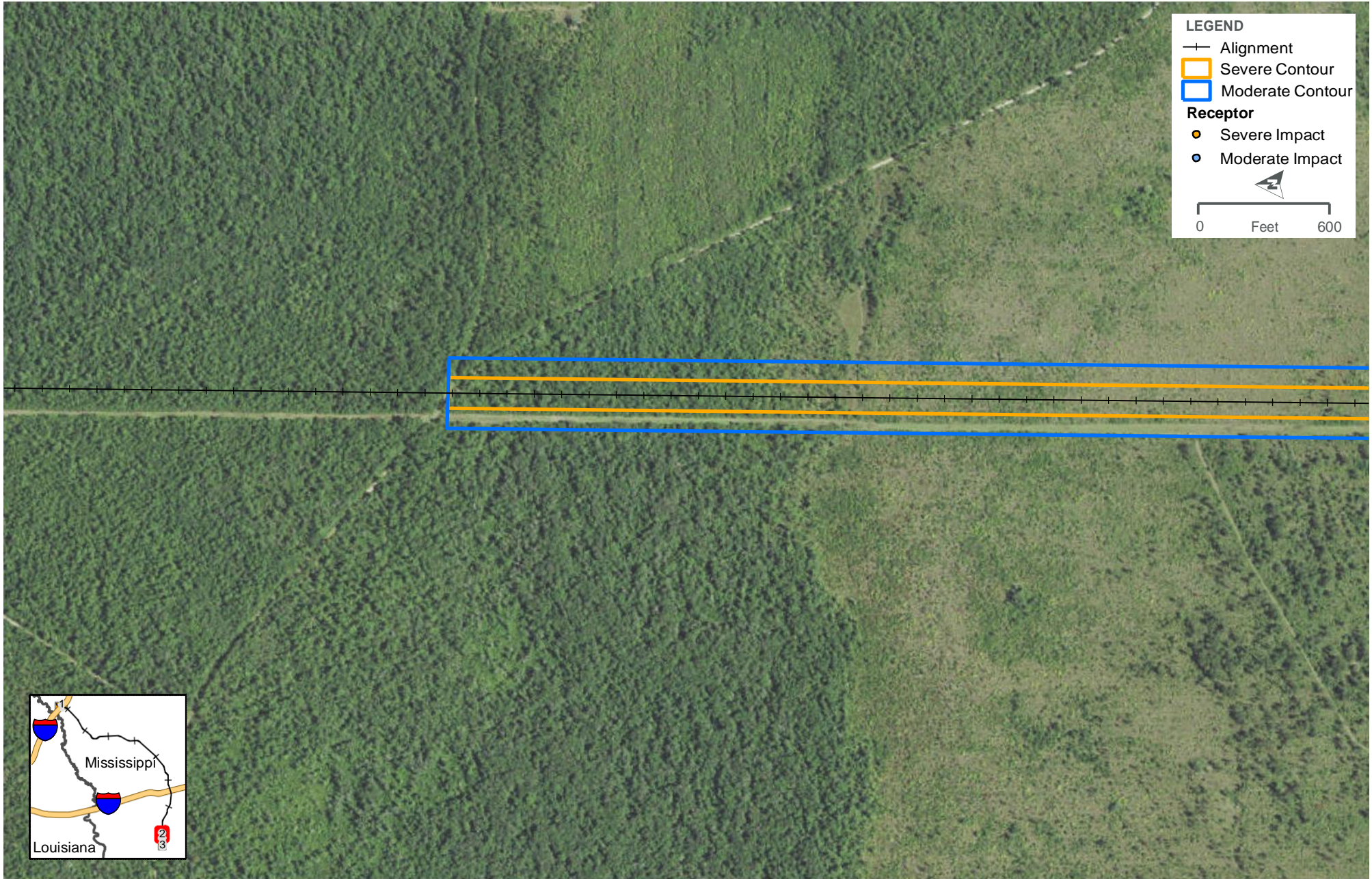
- Severe Impact
- Moderate Impact

0 Feet 600

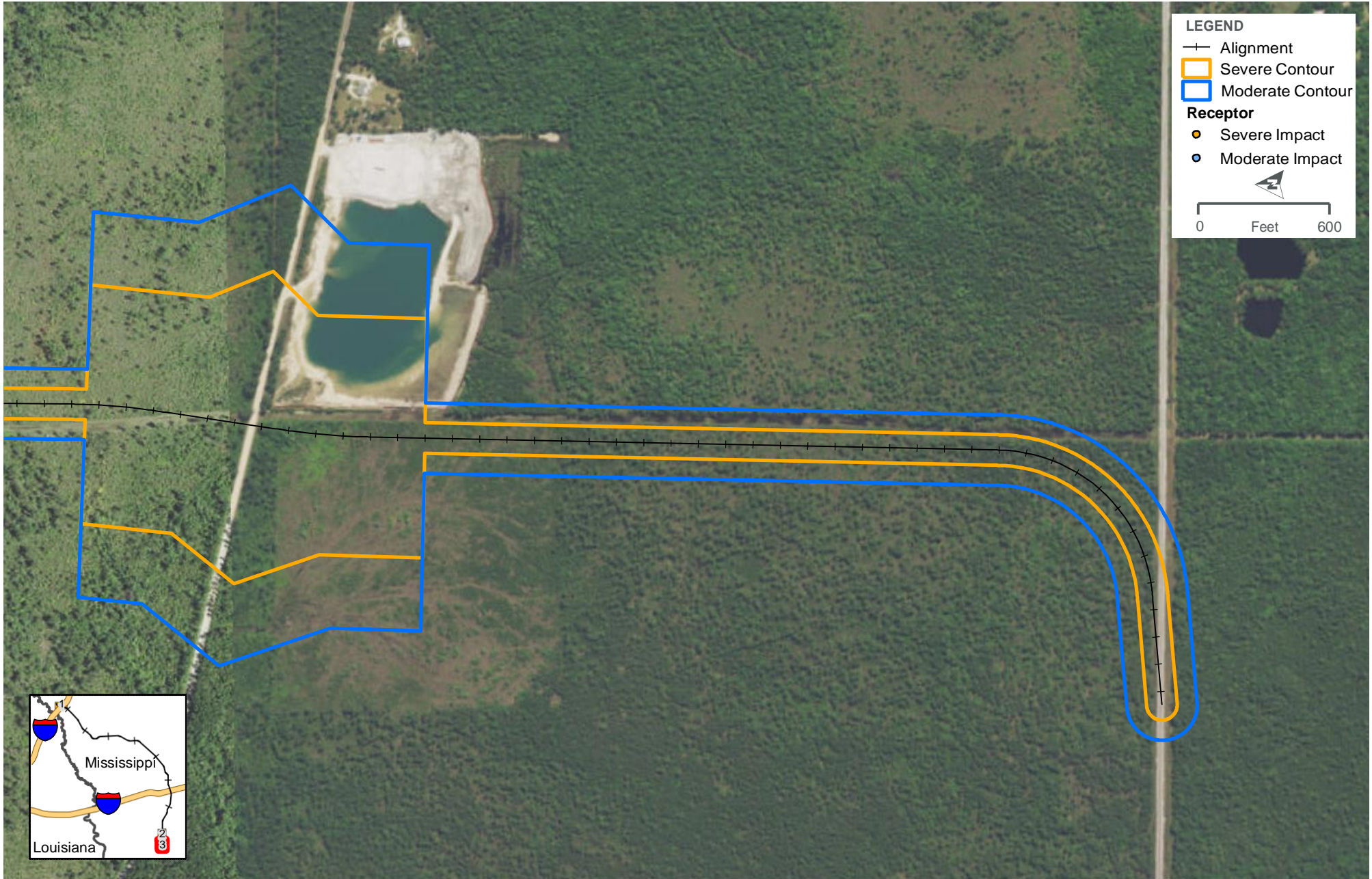


NOISE CONTOURS
PORT BIENVILLE
FIGURE 1 - PAGE 1 OF 3





NOISE CONTOURS
PORT BIENVILLE
FIGURE 1 - PAGE 2 OF 3



LEGEND

- +— Alignment
- ▭ Severe Contour
- ▭ Moderate Contour

Receptor

- Severe Impact
- Moderate Impact

0 Feet 600



NOISE CONTOURS
PORT BIENVILLE
FIGURE 1 - PAGE 3 OF 3





LEGEND

- Alignment
- Vibration Contour
- Vibration Impact



VIBRATION CONTOURS
PORT BIENVILLE
FIGURE 2 - PAGE 1 OF 3
PORT BIENVILLE EIS





LEGEND

- +— Alignment
- - - Vibration Contour
- Vibration Impact

0 Feet 600



VIBRATION CONTOURS
PORT BIENVILLE
FIGURE 2 - PAGE 2 OF 3





LEGEND

- +— Alignment
- - - Vibration Contour
- Vibration Impact

0 Feet 600



VIBRATION CONTOURS
PORT BIENVILLE
FIGURE 2 - PAGE 3 OF 3

