Appendix J

Noise and Vibration Technical Report

Technical Report

Noise and Vibration Assessment

Port of Gulfport Expansion Project Environmental Impact Statement

Gulfport, Mississippi

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Introduction

This technical report describes the assessment methodology employed for determination of potential impacts related to the operational airborne noise and vibrations from the increased rail traffic resulting from the proposed improvements to the Port of Gulfport. The analysis was conducted to support The Port of Gulfport Expansion Project Environmental Impact Statement (EIS). The region of influence (ROI) for this analysis was the Kansas City Southern (KCS) railway, which begins at the Port of Gulfport, and terminates approximately 70 miles to the north in Hattiesburg, Mississippi (MS). From there it connects with the Norfolk Southern line that continues into the northeast U.S. connecting to networks serving the entire eastern U.S. The KCS railway line also connects to the Canadian National line in Hattiesburg and continues to Chicago and Canada.

The project team performed a General Noise Assessment and General Vibration Assessment in accordance with Federal Railroad Administration (FRA) guidance and Federal Transit Administration (FTA) guidelines published in "Transit Noise and Vibration Impact Assessment" (May 2006, available at https://www.transit.dot.gov/sites/fta.dot.gov/files/docs/FTA_Noise_and_Vibration_Manual.pdf). Noise and vibration impacts of future rail traffic associated with the No-Action Alternative and the Proposed Project Alternative were evaluated to assess the project-related effects of airborne noise and vibration. Analysis results indicated a number of potential airborne noise impacts throughout the Project corridor, with the largest concentration in the Gulfport and Hattiesburg areas. Ground-borne vibration (GBV) impacts would affect considerably fewer receptors than airborne noise impacts, and were generally located in the high-speed rural areas. No receptors currently fall within the ground-borne noise (GBN) impact contours, and none would be impacted under either the No-Action or Proposed Project Alternatives.

1.0 AIRBORNE NOISE

1.1 BACKGROUND

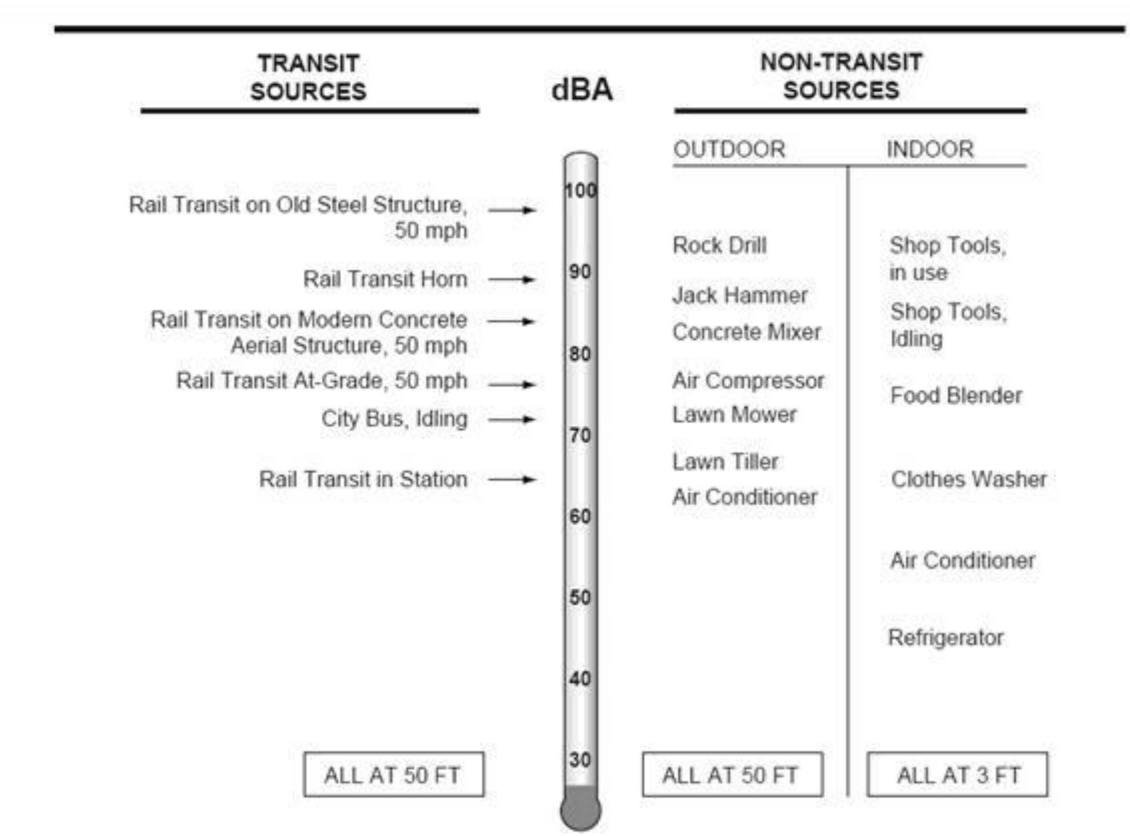
The following is a summary of basic noise concepts. The FTA guidance manual, “Transit Noise and Vibration Impact Assessment" (May 2006) discusses these concepts in greater detail.

Sound travels through the air as waves of tiny air pressure fluctuations caused by vibration. In general, sound waves travel away from the noise source as an expanding spherical surface. As a result, the energy contained in a sound wave is spread over an increasing area as it travels away from the source, resulting in a decrease in loudness at greater distances from the noise source. Noise is typically defined as unwanted or undesirable sound.

The intensity or loudness of a sound is determined by how much the sound pressure fluctuates above and below the atmospheric pressure and is expressed in units of decibels. The decibel (dB) scale used to describe sound is a logarithmic scale that accounts for the large range of sound pressure levels in the environment. Using this scale, the range of sound normally encountered can be expressed by values between 0 and about 140 dB.

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 don't hear well, and applies more "weight" to frequencies we do hear well. The A-weighted decibel (dBA) is the unit of measurement adopted in the FTA impact assessment procedures. For comparison purposes, typical dBA noise levels for various types of sound sources are summarized in Figure 1.

The logarithmic nature of dB scales is such that individual dB levels for different noise sources cannot be added directly to give the noise level for the combined noise source. For example, two noise sources that produce equal dBA levels at a given location will produce a combined noise level that is 3 dBA greater than either sound alone. When two noise sources differ by 10 dBA, the combined noise level will be 0.4 dBA greater than the louder source alone.



Source: FTA, "Transit Noise and Vibration Impact Assessment" (May 2006)

Figure 1. Typical A-weighted sound levels

People generally perceive a 10 dBA increase in a noise level as a doubling of loudness. For example, an average person will perceive a 70 dBA sound as twice as loud as a 60 dBA sound. People generally cannot detect differences of one dBA to two dBA. Most people with average hearing abilities can detect differences of three dBA. Most people under normal listening conditions would likely perceive a five-dBA change as a noticeable change.

When distance is the only factor considered, sound levels from isolated point sources of noise typically decrease by about six dBA for every doubling of distance (e.g., increasing from 50 feet to 100 feet, 100 feet to 200 feet, 200 to 400 feet) from the noise source. When the noise source is a continuous line (e.g., train moving along a track) noise levels decrease by about three dBA for every doubling of distance away from the source.

The equivalent sound level (Leq) is often used to describe sound levels that vary over time, usually a one-hour period. Leq is the descriptor adopted in the FTA impact assessment procedures when evaluating noise sensitive sites with primarily daytime and evening use. The Leq is considered an energy-based average noise level. Using twenty-four consecutive one-hour Leq values it is possible to calculate daily cumulative noise exposure. The descriptor used to express daily cumulative noise exposure is the Day-Night Sound Level (Ldn). Ldn is the descriptor adopted in the FTA impact assessment procedures when evaluating sensitive sites with a nighttime sensitivity to noise. The Ldn includes a 10-dBA increase imposed on noise that occurs during the nighttime hours (defined in the 2006 FTA guidance manual as between 10 p.m. and 7a.m.) to account for greater nighttime sensitivity to noise. The 10-dBA increase makes the Ldn useful when assessing noise sensitive land uses with nighttime use such as residences and other buildings where people normally sleep.

1.2 NOISE IMPACT CRITERIA

The following is a summary of noise impact criteria established to evaluate potential noise impacts. The FTA guidance manual, “Transit Noise and Vibration Impact Assessment" (May 2006) discusses development of the noise impact criteria in greater detail.

FTA noise impact criteria depend upon the land use of affected receptors, as well as existing noise exposure at that receptor. The FTA recognizes three land use categories for assessing airborne noise impacts, identified and described in Table 1, and assigns a noise descriptor to each land use category.

Table 1. Categories for Noise-Sensitive Receptors

Land-Use Category	Noise Descriptor, dBA	Description of Land-Use Category
1	Outdoor Leq(h)*	Tracts of land where quiet is an essential element in their intended purpose. This category includes lands set aside for serenity and quiet, such 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 Ldn	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 Leq(h)[2]	Institutional land uses with primarily daytime and evening use. This category includes schools, libraries, 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: FTA, "Transit Noise and Vibration Impact Assessment" (May 2006). *Leq for the noisiest hour of transit-related activity during hours of noise sensitivity*.

The FTA noise impact criteria (summarized in Figure 2, FTA Noise Impact Criteria) are defined by two curves, representing severe and moderate noise impacts, as defined below.

> *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 it is not feasible or reasonable (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, and existing outdoor-indoor sound insulation, and the cost-effectiveness of mitigating noise to more acceptable levels. Noise levels in the moderate impact range also require consideration and implementation of mitigation measures determined to be reasonable.

Figure 2 shows that noise impact criteria are determined as a function of existing noise exposure versus project-related noise exposure.

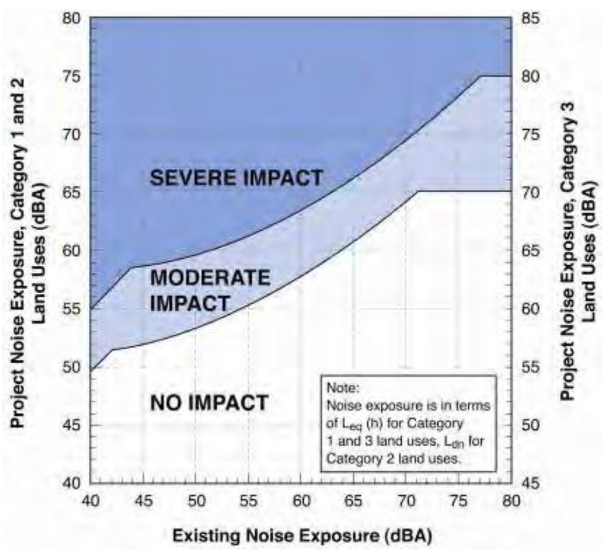


Figure 2. FTA noise impact criteria

1.3 NOISE ASSESSMENT METHODOLOGY

The noise analysis was performed in accordance with FTA guidelines published in the "Transit Noise and Vibration Impact Assessment" (May 2006). The FTA guidance manual provides three levels of evaluation: 1) a Noise Screening Procedure, 2) a General Noise Assessment Procedure and 3) a Detailed Noise Analysis Procedure. Consistent with FTA application, the General Noise Assessment was performed for comparison of the No-Action Alternative and the Proposed Project Alternative described in Section 2.8 of the EIS.

Because the Proposed Project Alternative would include an increase in rail traffic during nighttime hours, the noise analysis conservatively evaluated rail-related noise at land uses where overnight sleep occurs. This includes Category 2 and certain Category 3 land uses (i.e. campgrounds). However, we did conduct a search for Category 1 land uses using the methods described below. None were identified. Overall impacts would be lessened as operational hours are expanded into daytime hours.

Using the Geographic Information System (GIS), a 0.5-mile buffer was created on either side of the track for the length of the rail line to determine the locations of potentially affected noise-sensitive receptors. Residences and other sensitive land uses where people normally sleep were identified using current high-resolution aerial photography combined with Google Street View. Residences in densely populated areas in Harrison County (i.e., Gulfport) were crosschecked against county tax department parcel data and land-use records. This process effectively filtered former residential structures (Land Use Category 2) that are currently used for business purposes (not identified as noise sensitive).

Ambient noise levels were measured at 24 residential receptor locations along the KCS railway corridor. Receptors were selected to represent a range of population densities along the length of the rail line. Receptor locations, sample times, and Leq and calculated Ldn are provided in Appendix 1. Noise was measured during June 2-4, 2014 with SoundProDL1 Datalogging sound level meters (serial numbers BLN050002 and BLG06004), encased in a Quest 2900 outdoor monitoring kit. The meters were calibrated at the beginning of each sampling day in accordance with manufacturer instructions. Noise was measured (in accordance with Option 4 for residential land uses identified in Appendix D of the 2006 FTA "Transit Noise and Vibration Impact Assessment") for a one-hour period between 7:30 a.m. and 5:30 p.m. The Leq that was measured during that period was converted to Ldn by subtracting two dB from the Leq. As documented by FTA, this method results in a moderate underestimation of the computed Ldn.

In 2000, the Federal Railway Administration (FRA) published the *Horn Noise MS Excel Spreadsheet Model* to assess the impacts of locomotive horns on the local noise environment. The project team completed model runs including scenarios that incorporated existing noise levels, number of trains, train speed, presence or absence of horns, and noise shielding. The model results were incorporated into the GIS and compared with the locations of residential receptors to determine the number of impacted receptors. Existing noise impacts from train traffic were not evaluated, as those impacts were already incorporated into the noise data collected during the June 2014 sampling period. Rail traffic associated with the No-Action Alternative and the Proposed Project Alternative was evaluated in order to assess the project-related effects of airborne noise.

1.4 EXISTING CONDITIONS

Two general areas of existing noise conditions were identified along the Project corridor according to similarities in ambient conditions and average noise levels. These included the developed areas of Gulfport and Hattiesburg at the north and south ends of the KCS railway line, and the rural/small town areas between.

The Gulfport and Hattiesburg noise environment includes two segments on each end of the KCS line. The Gulfport segment extends from the southern terminus of the KCS line to Clark Drive, located just north of the KCS line/Interstate 10 intersection. The Hattiesburg segment extends from the KCS line/Highway 98 intersection to the northern terminus of the line. Common ambient noise sources in these predominantly urban and suburban areas included vehicular traffic, rail traffic, aircraft, and human voices/activity. The average Ldn within these segments was 53 dBA.

The rural/small town segment includes the portion of the line between the Gulfport and Hattiesburg segments. Ambient noise sources in these predominantly rural areas included vehicular traffic, rail traffic, barking dogs, and birds. The average Ldn within these segments was 50 dBA. Noise data and location information for existing conditions are provided in Appendix 1, Table A1-1 and Figure A1-1.

1.5 NOISE IMPACT ASSESSMENT

Impacts for the No-Action Alternative and the Proposed Project Alternative are based on maximum Port facility throughput, which is expected to occur in 2060. The rail impacts analysis includes horn noise in the vicinity of at-grade crossings, as well as wayside noise, which results from the interaction between train wheels and the tracks.

1.5.1 No-Action Alternative

Under the No-Action Alternative, the Port would generate approximately 28 train trips per day between (to or from) the Port and the Gulfport Rail Yard. Eighteen train trips per day would be anticipated from the Gulfport Rail Yard to the KCS railway northern terminus.

Table 2 presents the calculated distance from the track to the moderate and severe impact contours for Land Use Category 2 receptors associated with the No-Action Alternative. Impact contours for various shielding scenarios and speed regimes were calculated and are shown in Appendix 2, Figure A2-1. Table 3 shows the number of noise sensitive receptors that would fall within the moderate and severe noise impact contours under the No-Action scenario. The Land Use Category 2 receptors are primarily single-family residences. However, the impacted receptors include two hotels and 18 multi-unit residences within the moderate noise impact contour, and seven multi-unit residences in the severe noise impact contour. Two campgrounds located adjacent to the KCS railway line are included as Land Use Category 3 receptors. Both campgrounds fall within the severe noise impact contour.

As shown on Table 3, 1,054 Land Use Category 2 receptors (approximately 15 per mile) would be included in the moderate impact contour, and 1,638 (approximately 24 per mile) would fall within the severe impact contour. The majority of these receptors are located in or near the cities of Gulfport and Hattiesburg, primarily due to the combination of population density and the high number of at-grade crossings in these more urbanized areas.

Table 2. No-Action Alternative – Distance to Noise Impact Contours

Segment Location	Ambient Noise Level	Train Speed (mph)	Train Length (Rail Cars)	Train Trips Per Day	Distance to Moderate Impact Contour (feet)		Distance to Severe Impact Contour (feet)	
					Road Crossing	Wayside	Road Crossing	Wayside
Port North to Rail Yard (33rd St.)	53	10	(2,400' (37)	28	1,572	680	952	386
Rail Yard (33rd St.) to Polk St.	53	10	3,900' (60)	18	1,346	579	806	324
Polk St. to Dedeaux Rd.	53	20	3,900' (60)	18	1,313	533	838	295
Dedeaux Rd. to Clark Rd.	53	49	3,900' (60)	18	1,199	857	760	505
Clark Rd. to Hwy 98	50	49	3,900' (60)	18	1,969	1013	1,216	590
Hwy 98 North to MP 65	53	49	3,900' (60)	18	1,456	857	898	505
MP 65 to Northern Terminus	53	10	3,900' (60)	18	1,149	538	726	317

Table 3. No-Action – Impacted Receptors

Land Use Category	Moderate Impact	Severe Impact
Category 2	1,054	1,638
Category 3	0	2

1.5.2 Proposed Project Alternative

Under the Proposed Project Alternative, the Port would generate up to 47 train trips per day between (to or from) the Port and the Gulfport Rail Yard, 19 more than the No-Action Alternative. Nearly 29 train trips per day (11 more than the No-Actin Alternative) would be anticipated from the Gulfport Rail Yard to the KCS railway northern terminus.

Table 4 presents the calculated distance from the track to the moderate and severe impact contours for Land Use Category 2 receptors associated with the Proposed Project Alternative. Impact contours for various shielding scenarios and speed regimes were calculated and are shown in Appendix 2, Figure A2-2. Table 5 shows the number of noise sensitive receptors that would fall within the moderate and severe noise impact contours under the Proposed Project Alternative scenario. The Category 2 receptors are primarily single-family residences. However, the impacted receptors include three hotels (one more than the No-Action Alternative) and 18 multi-unit residences (the same as the No-Action Alternative) within the moderate noise impact contour. One hotel (one more than the No-Action Alternative) and eight multi-unit residences (one more than the No-Action Alternative) would occur within the severe noise impact contour. Two Land Use Category 3 receptors (the same two campgrounds as the No-Action Alternative) would be within the severe noise impact contour under the Proposed Project Alternative scenario. The number of receptors within the moderate impact contour would increase by 268 (a 25 percent increase) compared to the No-Action Alternative, and receptors in the severe impact contour would increase by 144 (a nine percent increase) (Table 5).

Table 4. Proposed Project Alternative – Distance to Noise Impact Contours

Segment Location	Ambient Noise Level	Train Speed	Train Length (Rail Cars)	Train Trips Per Day	Distance to Moderate Impact Contour (feet)		Distance to Severe Impact Contour (feet)	
					Road Crossing	Wayside	Road Crossing	Wayside
Port North to Rail Yard (33rd St.)	53	10	2,400’ (37)	47	1,867	825	1,144	476
Rail Yard (33rd St.) to Polk St.	53	10	3,900’ (60)	29	1,612	709	978	403
Polk St. to Dedeaux Rd.	53	20	3,900’ (60)	29	1,342	601	858	358
Dedeaux Rd. to Clark Rd.	53	49	3,900’ (60)	29	1,408	1,030	903	617
Clark Rd. to Hwy 98	50	49	3,900’ (60)	29	2,013	1,213	1,246	719
Hwy 98 North to MP 65	53	49	3,900’ (60)	29	1,726	1,030	1,078	617
MP 65 to Northern Terminus	53	20	3,900’ (60)	29	1,651	756	1,028	440

Table 5. Proposed Project Alternative – Impacted Receptors

Land Use Category	Moderate Impact	Change from No-Action	Severe Impact	Change from No-Action
Category 2	1,322	+268	1,782	+144
Category 3	0	0	2	0

1.5.3 Summary of Potential Airborne Noise Impacts

The Proposed Project Alternative would result in increased train-generated noise along the KCS railway when compared to the No-Action Alternative. Table 6 provides a summary of the impacts to Land Use Category 2 receptors. No Land Use Category 1 receptors were identified within the impact contours. Two Land Use Category 3 receptors were included in the analysis (campgrounds situated near the KCS railway line in the rural area between Gulfport and Hattiesburg). These two receptors would be within the severe impact contours for both the No-Action Alternative and the Proposed Project Alternative. Table 6 summarizes the change in noise impacts between the No-Action and Proposed Project Alternatives. Under the Proposed Project Alternative, the number of moderately impacted receptors would increase by 25 percent, and the number of severely impacted receptors would increase by nine percent. The implementation of the Proposed Project Alternative would result in an additional four receptors per mile that would be moderately impacted, and two receptors per mile that would be severely impacted compared to the No-Action Alternative.

Table 6. Summary of Noise Impacts to Category 2 Receptors

	Impacted Category 2 Receptors	Change from No-Action	Percentage Change in Impacted Receptors	Number of Impacted Receptors per Mile
No Action Alternative				
Moderate Impact	1,054	NA	NA	15
Severe Impact	1,638	NA	NA	24
Proposed Project Alternative				
Moderate Impact	1,322	+268	+25%	19
Severe Impact	1,782	+144	+9%	26

1.6 NOISE MITIGATION

The FTA and FRA require that mitigation measures be considered when a noise assessment suggests either severe or moderate impacts. The Proposed Project Alternative would result in an increase in both severe and moderate impacts to noise-sensitive receptors. The majority of these impacts would occur in the Hattiesburg and Gulfport areas due to the combination of high population densities and numerous at-grade rail crossings (with their associated horn noise).

Reducing horn noise by the use of noise barriers is generally not feasible because they reduce driver visibility at intersections. Residential soundproofing is a mitigation option for smaller scale impacts, but is not feasible in this case due to the large number of impacted receptors. The most feasible noise mitigation measure would likely be the establishments of Quiet Zones in the Greater Gulfport and Hattiesburg areas.

By adopting approved Supplemental Safety Measures (SSMs) at each public grade crossing, a Quiet Zone of at least a half-mile long can be established that would preclude the need for use of a horn at rail crossings, and thus eliminate this noise source. These measures would be applicable in addition to the standard safety devices required at most public grade crossings (e.g. stop signs, reflective cross bucks, flashing lights with gates that do not completely block travel over the tracks). The six SSM's identified below have been predetermined by the FRA to fully or in tandem compensate for the lack of a locomotive horn:

1. *Reconstruct the street crossing into an under-over pass.* This measure, while expensive, would completely eliminate the need for a train to sound its horn.
2. *Temporary closure of a public highway-rail grade crossing.* This measure requires closure of the grade crossing one period for each 24 hours, and must be closed the same time each day.
3. *Four-quadrant gate system.* This measure involves the installation of at least one gate for each direction of traffic to fully block vehicles from entering the crossing.
4. *Gates with medians or channelization devices.* This measure keeps traffic in the proper travel lanes as it approaches the crossing. This denies the driver the option of circumventing the gates by traveling in the opposing lane.
5. *One-way street with gates.* This measure consists of one-way streets with gates installed so that all approaching travel lanes are completely blocked.
6. *Pole-mounted wayside warning horns.* This measure places warning horns on signal poles directly at the street crossing in question. The wayside horns are still relatively loud (92 dBA at 100 feet) but can be effectively aimed directly down the affected street to minimize disturbance to adjacent neighborhoods.

The lead agency in designating a Quiet Zone is the local public authority responsible for traffic control and law enforcement on the roads crossing the tracks. In order to satisfy the FRA regulatory requirements, the public transit agency must work closely with the highway/traffic agency while also coordinating with any freight or passenger railroad operator sharing the right-of-way.

2.0 GROUND-BORNE VIBRATION

This section summarizes potential ground-borne vibration (GBV) impacts associated with the proposed Project. The General Vibration Assessment described here was prepared in accordance with FTA guidelines ("Transit Noise and Vibration Impact Assessment," May 2006); the FRA relies on the FTA for noise and vibration impact assessment guidance. The purpose of this assessment is to determine the number of potential GBV impacts associated with the proposed Project at vibration-sensitive land uses (receptors) throughout the Project corridor. Existing and future rail traffic scenarios were analyzed, and the incremental increase in GBV associated with the proposed Project was identified.

2.1 BACKGROUND

The following is a summary of basic GBV concepts. The FTA guidance manual, "Transit Noise and Vibration Impact Assessment" (May 2006) discusses these concepts in greater detail.

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

Vibration consists of rapidly fluctuating motions. However, human response to vibration is a function of the average motion over a longer (but still relatively short) time period, such as one second. The root mean square (RMS) amplitude of a motion over a one second period is commonly used to predict human response to vibration. For convenience, decibel notation is used to describe vibration relative to a reference level. In this section, vibration decibels (VdB) relative to a reference of 10^{-6} inches per second (1 µin/sec) are used. VdB is the unit of measurement adopted in the FTA impact assessment procedure.

In contrast to airborne noise, GBV is not a phenomenon that most people experience every day. The background vibration level in residential areas is usually 50 VdB or lower. This is well below the threshold of perception for humans, which is around 65 VdB. Levels at which vibration interferes with sensitive instrumentation such as nuclear magnetic resonance (NMR) equipment and other optical instrumentation 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 GBV are construction equipment, steel-wheeled trains, and traffic on rough roads.

Vibration as it relates to railway movements is generally caused by uneven interactions between the wheels of the train and the railway surfaces. Examples of this include wheels rolling over rail joints and flat spots on wheels that are not true. These uneven interactions result in vibration that travels through the adjacent ground. This vibration can range from barely perceptible to very disruptive.

2.2 FTA VIBRATION CRITERIA

The following is a summary of vibration impact criteria established to evaluate potential vibration impacts. The FTA guidance manual, “Transit Noise and Vibration Impact Assessment" (May 2006) discusses development of the vibration impact criteria in greater detail.

The FTA recognizes three land use categories for assessing general vibration impacts.

Land Use Category 1 - High Vibration Sensitivity: This category includes environments where low ambient vibration is essential for building operations. Acceptable levels of vibration in these environments are well below the levels associated with human annoyance. Typical Category 1 land uses include vibration-sensitive research and manufacturing facilities, hospitals, and university research operations. Land Use Category 1 also includes special land uses, such as concert halls, television and recording studios, and theaters, which can be very sensitive to vibration and ground-borne noise. The FTA has developed special vibration criteria for these land uses.

Land Use Category 2 - *Residential:* This category includes all residential land uses and any building where people sleep, such as hotels and hospitals.

Land Use Category 3 - Institutional: This category includes schools, churches, other institutions, and quiet offices that do not have vibration-sensitive equipment, but still have the potential for activity interference.

FTA identifies separate criteria for both GBV and GBN. GBN is often masked by airborne-noise; therefore GBN criteria are primarily applied to subway operations in which airborne noise is negligible. The GBV and GBN criteria used in this assessment are shown in Table 7. These are the criteria adopted in the FTA impact assessment procedures when evaluating potential vibration impacts. The FTA recommends that the frequent-event criterion be applied for line-haul freight trains because of the lengthy vibration event caused by the rail cars.

The frequent event vibration impact threshold is lower than the other event vibration impact thresholds for occasional or infrequent events, and thus represents the most conservative case scenario.

Table 7. Ground-Borne Vibration and Ground-Borne Noise Impact Criteria

Land Use Category	Ground Borne Vibration Impact Levels (VdB re 1 Micro-inch/sec)			Ground Borne Noise Impact Levels (dB re 20 Micro pascals)		
	Frequent Events[1]	Occasional Events[2]	Infrequent Events[3]	Frequent Events[1]	Occasional Events[2]	Infrequent Events[3]
Category 1: Buildings where vibration would interfere with interior operations	65 VdB[4]	65 VdB[4]	65 VdB[4]	NA[4]	NA[4]	NA[4]
Category 2: Residences and buildings where people normally sleep	72 VdB	75 VdB	80 VdB	35 dBA	38 dBA	43 dBA
Category 3: Institutional land uses with primarily daytime use	75 VdB	78 VdB	83 VdB	40 dBA	43 dBA	48 dBA

dB = decibels
VdB = vibration decibels
dBA = A-weighted sound level
NA = Not Applicable
Source: FTA. "Transit Noise and Vibration Assessment" (May 2006)(FTA-VA-90-1103-06) page 8-3
Note: If the building will rarely be occupied when the trains are operating, there is no need to consider impact.

1. *"Frequent events" is defined as more than 70 vibration events per day.*
2. *"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.*
3. *"Infrequent Events" is defined as fewer than 30 vibration events of the same source per day. This category includes most commuter rail branch lines.*
4. *This Criterion limit is based on levels that are acceptable for most moderately sensitive equipment such as optical microscopes. Vibration-sensitive manufacturing or research would require detailed evaluation to define acceptable vibration levels. Ensuring lower vibration levels in a building often requires special design of the HVAC system and stiffened floors.*
5. *Vibration-sensitive equipment is generally not sensitive to ground-borne noise.*

2.3 GROUND-BORNE VIBRATION ASSESSMENT METHODOLOGY

The FTA guidance manual provides three levels of evaluation 1) Vibration Screening Procedure, 2) General Vibration Assessment and 3) Detailed Vibration Analysis. A General Vibration Assessment was performed to determine incremental GBV and GBN effects of the No-Action Alternative and the Proposed Project Alternative. The General Vibration Assessment as described by the FTA guidance manual (2006) is the potential vibration in terms of the overall vibration velocity level and the A-weighted sound level. Estimated GBV and GBN levels are compared to the impact criteria and potential impact distances are provided for comparison purposes. GBV and GBN effects were calculated for existing conditions, the No-Action Alternative and the Proposed Project Alternative, based on current and proposed rail traffic. The differences between the existing conditions, the No-Action alternative and the Proposed Project Alternative conditions are the incremental impacts.

This vibration assessment principally assessed project-related GBV at Land Use Category 2 and Land Use Category 3 (i.e., campgrounds). This vibration assessment also included a search for Land Use Category 1 sites where vibration levels below human perception may affect the use of the building. No Land Use Category 1 sites were identified.

The assessment began with data gathering and construction of GIS base maps for the project. The railroad alignments, train traffic data (number of locomotives and rail cars per train), aerial photography, and surface geology were among the critical information gathered. Train traffic data were compiled during the noise assessment. The traffic conditions developed for use in the noise assessment documented in the first part of this section were also applied in the vibration analysis. Likewise, receptors identified through the noise assessment aerial photography reconnaissance were also utilized in the vibration assessment.

Using GIS, a 0.5-mile buffer was created on either side of the track for the length of the rail line to determine the locations of potentially affected vibration and GBN-sensitive receptors. Residences and other sensitive land uses where people normally sleep were identified using current high-resolution aerial photography combined with Google Street View. Residences in densely populated areas in Harrison County (i.e., Gulfport) were crosschecked against county tax department parcel data and land-use records. This process effectively filtered former residential structures (Land Use Category 2) currently used for business and not identified as vibration sensitive.

Based on a review of geologic maps of Mississippi (http://www.epa.gov/gmpo/edresources/geology-image-02.html ,http://mrdata.usgs.gov/geology/state/state.php?state=MS), the Gulfport area is underlain by coastal deposits, which consist primarily of loams, sands, gravel, and clay. North of Gulfport the geology consists of the Citronelle Formation and Pascagoula and Hattiesburg Formation. The Citronelle Formation is composed of gravel and sandstone with a few thin layers of silt or clay. The Pascagoula and Hattiesburg Formation is composed of clay, sandy clay, and sand. Based on the FTA guidance manual, these three formations would be relatively inefficient at propagating GBV when compared to stiff clay or bedrock dominated formations.

There was no evidence discovered during the online research indicating that stiff clay or shallow bedrock, which are typically associated with efficient propagation of GBV, occur along the project alignment. It is therefore assumed that the geologic materials underlying the project are inefficient at propagating GBV.

The generalized ground surface vibration curves (Figure 10-1 in the *FTA Transit Noise and Vibration Assessment*) provide the distance from track centerline versus vibration decibel (VdB) levels. These curves represent the upper range of measured vibration levels for generalized conditions and well-maintained systems. In order to determine potential impacts at receptors, the generalized (reference) ground surface vibration curve needs to be adjusted to reflect conditions particular to a project and often for different conditions particular to a location within a project.

The GBV reference curve most applicable to this Project assumes a locomotive-powered passenger or freight train traveling at 50 miles per hour (mph); adjustments were applied to this reference curve to reflect the particular conditions for this Project, including speed adjustments, source adjustments, path adjustments and receptor adjustments.

Table 8 shows the adjustments used to determine an appropriate estimate of vibration levels for existing conditions. The adjustments accounted for track type, vehicle type and the speed regimes identified in the noise assessment.

Table 8. Existing Vibration Curve Adjustment Factors

Base Curve:			
Vehicle type:	Locomotive Powered passenger or freight		
Speed	50 mph		
Source Vibration Adjustment Factors:			
Speed Adjustment:	Particular to speed regimes, below		
Vehicle Parameters:	No special vehicle parameters		
Track Conditions:	CWR, special trackwork where applicable		10 VdB
Path Vibration Adjustment Factors:			
Geology:	Stiff clay/ Bedrock (efficient soil)	0 linear feet	10 VdB
	Sand /Gravel/Sediment (inefficient soil)	396,600 linear feet	0 VdB
	Total	396,600 linear feet	0 VdB
Rock Layer:	no rock layer		0 VdB
Foundation Coupling:	wood framed house		-5 VdB
Receiver Vibration Adjustment Factors:			
Floor Attenuation:	Number of floors above grade	1 floor	-2 VdB
Floor Resonance:	Amplification		6 VdB
Conversion to GBN:	Low-Frequency (<30 Hertz)		-50 VdB
49 MPH Speed Regime			
Speed Adjustment:	Speed	49 MPH	0 VdB
Total Adjustment for GBV: Wayside:			-1VdB
Total Adjustment for GBN Wayside:			-51 VdB
20 MPH Speed Regime			
Speed Adjustment:	Speed	20 MPH	-8 VdB
Total Adjustment for GBV: Wayside:			-9 VdB
Total Adjustment for GBN Wayside:			-59 VdB
10 MPH Speed Regime			
Speed Adjustment:	Speed	10 MPH	-14VdB
Total Adjustment for GBV: Wayside:			-15 VdB
Total Adjustment for GBN Wayside:			-65 VdB

CWR = Continuous Welded Rail
Mph = miles per hour
GBV = ground-borne vibration
GBN = ground-borne noise
VdB = vibration decibels

GBV curves, based on the adjustment factors for existing conditions contained in Table 8, are shown in Figure 3. Distances to GBV and GBN impact levels for existing conditions, based on the GBV curves and the thresholds listed in Table 7 are shown in Tables 9 and 10. Because the rail line is not used frequently, and trains do not run during nighttime hours, the "*occasional events*" GBV and GBN levels were used for existing condition. Following FTA recommendation, the "*frequent events*" criteria levels were used to assess impacts that would occur under the No-Action Alternative or the Proposed Project Alternative.

2.4 EXISTING CONDITIONS

The KCS railway is currently utilized infrequently; maximum current usage is about six trains per day. As shown on Table 9, the General Vibration Assessment identified 60 Land Use Category 2 receptors that are currently within the GBV impact contour. In Addition, two Land Use Category 3 receptors (campgrounds) are currently within the GBV impact contour. All receptors that fall within the GBV impact contour for the existing condition are located between Dedeaux Road and milepost 65 (i.e., the 49 mph speed zone).

As shown on Table 10, the maximum distance for GBN impacts is 20 feet, in the 49 mph speed zone between Dedeaux Road and milepost 65. No receptors were identified within the GBN impact contours.

2.5 GROUND-BORNE VIBRATION IMPACT ASSESSMENT

2.5.1 No-Action Alternative

Under the No-Action Alternative, the Port would generate approximately 28 train trips per day between (to or from) the Port and the Gulfport Rail Yard. Nearly 18 train trips per day would be anticipated from the Gulfport Rail Yard to the KCS railway northern terminus. Lower GBV and GBN criteria levels were used for the No-Action Alternative to account for the increase in freight traffic and the fact that some trains will be operating on the line during nighttime hours.

Table 11 shows the calculated distance to the GBV impact contours and the number of receptors for Land Use Category 2 receptors associated with the No-Action Alternative. Table 12 presents the calculated distance to the GBN impact contours under the No-Action scenario. The impacted Land Use Category 2 receptors are limited to single-family residences. Two campgrounds located near the KCS railway line are included as Land Use Category 3 receptors and fall within the GBV impact contour. Both fall outside the GBN impact contour.

As shown on Table 13, 122 Land Use Category 2 receptors (approximately two per mile) would be included in the GBV impact contours, the majority of which are located in rural areas. This is primarily due to the higher train speed, which increases the impact of GBV. As with the existing conditions, two Category 3 receptors (campgrounds) would be within the 49 mph GBV impact contour. As shown in Table 12, no receptors would be included in the GBN impact contours under the No-Action Alternative.

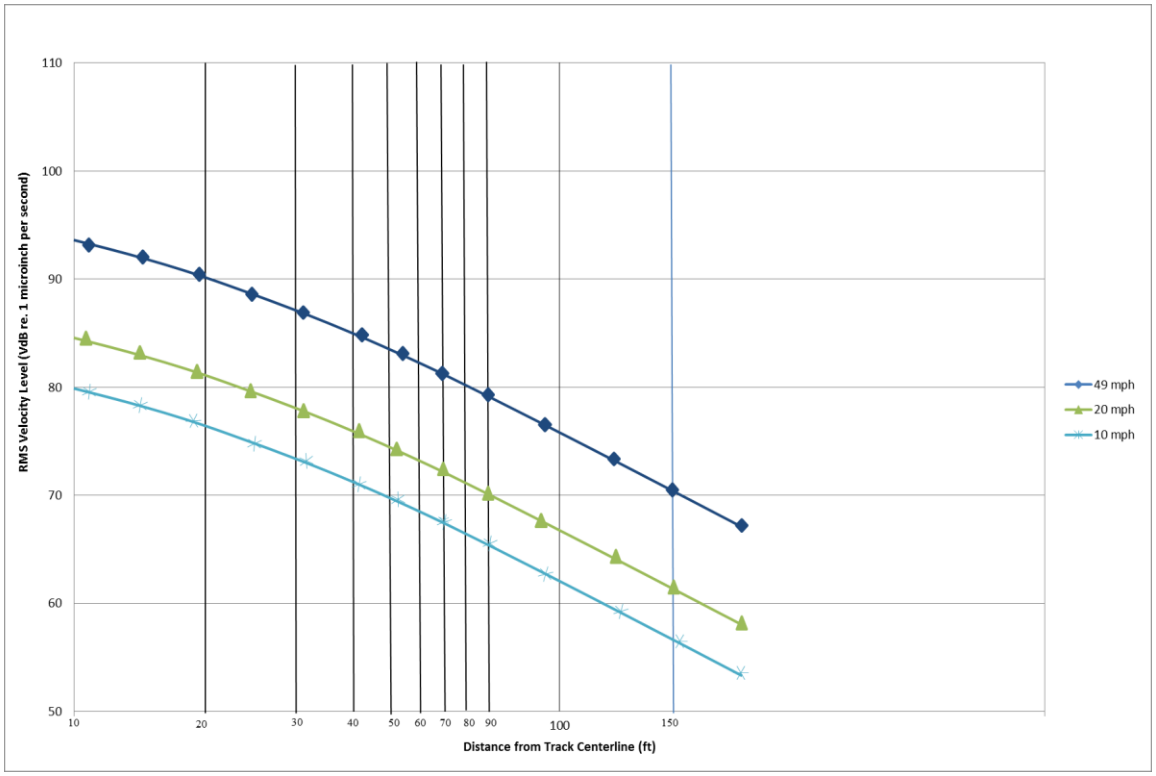


Figure 3. Ground-borne vibration curves (adjusted)

Table 9. Existing Ground-Borne Vibration (GBV) Impact Contour Distances and Number of Receptors

Train Speed (mph)	10	20	49
Impact Distances (feet)	30	50	125
Number of Receptors	0	0	60

Note: 75 VdB was used as the GBN impact level based on the current infrequent use of the track.
mph = miles per hour

Table 10. Existing Ground-Borne Noise (GBN) Impact Contour Distances and Number of Receptors

Train Speed (mph)	10	20	49
Impact Distances (feet)	20	<20	20
Number of Receptors	0	0	0

Note: 40 VdB was used as the GBN impact level based on the current infrequent use of the track.

Table 11. No-Action Alternative Ground-Borne Vibration (GBV) Impact Contour Distances and Number of Receptors

Train Speed (mph)	10	20	49
Impact Distances (feet)	45	80	153
Number of Receptors	10	0	112

Note: 72 VdB was used as the GBV impact level to account for the increased frequency and the nighttime use of the track.
mph = miles per hour

Table 12. No-Action Alternative Ground-Borne Noise (GBN) Impact Contour Distances and Number of Receptors

Train Speed (mph)	10	20	49
Impact Distances (feet)	<20	<20	40
Number of Receptors	0	0	0

Note: 35 dBA was used as the GBN impact level to account for the increased frequency and the night use of the track.
mph = miles per hour

2.5.2 Proposed Project Alternative

Under the Proposed Project Alternative, the Port would generate up to 47 train trips per day between (to or from) the Port and the Gulfport Rail Yard, 19 more than the No-Action Alternative. Nearly 29 train trips per day (11 more than the No-Actin Alternative) would be anticipated from the Gulfport Rail Yard to the KCS railway northern terminus. Because this alternative represents less than a doubling of train traffic compared to the No-Action Alternative, the GBN and GBV impacts that are described in Section 2.5.1 for the No-Action Alternative would be applicable to the Proposed Project Alternative.

2.5.3 Summary of Ground-Borne Vibration and Noise Potential Impacts

The project team performed a General Vibration Assessment to determine potential GBV and GBN impacts that would be associated with implementation of the No-Action Alternative or the Proposed Project Alternative. Impacts would be similar for the No-Action Alternative and the Proposed Project Alternative. Table 13 provides a comparison between the existing conditions and the No-Action and Proposed Project Alternative for Land Use Category 2 receptors. No Land Use Category 1 receptors were identified within 0.5 miles of the KCS railway, and the number of Land Use Category 3 receptors (campgrounds) located within the GBV impact contours would remain at two regardless of the alternative selected. As the table shows, the number of impacted Land Use Category 2 receptors would approximately double, from 60 to 122 compared to existing conditions for the No-Action and Proposed Project Alternatives. Of the additional receptors that would be impacted, all but 10 would be located in the rural areas, where the train speeds can reach 49 mph.

No receptors currently fall within the GBN impact contours, and none would be impacted under either the No-Action or Proposed Project Alternatives.

Table 13. Summary of Ground-Borne Vibration Impacts

Scenario	Impacted Category 2 Receptors	Change From Existing Conditions	Percentage Change in Impacted Receptors	Number of Impacted Receptors per Mile
Existing Conditions	60	NA	NA	0.85
No-Action Alternative and Proposed Project Alternative	122	+62	+103%	1.74

2.6 GROUND-BORNE VIBRATION MITIGATION

The proposed increase in rail traffic would occur in an existing corridor, so relocating tracks or creating buffer zones are not viable mitigation options. Regular maintenance could be used as a mitigation measure against the effects of vibration. Maintenance may include regularly scheduled rail grinding, wheel truing programs, use of wheel-flat detectors and general reconditioning programs.

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Appendix 1

Sound Monitoring Receptor Data and Location Map

Table A1-1. Monitored Receptor Sites.

SAMPLE NAME	SAMPLE ID	TIME START	TIME END	LEQ (dBA)	CALCULATED LDN (dBA) (LEQ-2db)
1	07-SO20-03062014-195158(50002)	10:18:00 AM (cst)	10:19:00 AM (cst)	48.8	46.8
2	06-SO19-03062014-195158(50002)	09:11:00 AM (cst)	10:11:00 AM (cst)	67.3	65.3
3	08-SO24-03062014-195159(50002)	11:28:00 AM (cst)	12:28:00 PM (cst)	55.3	53.3
4	06-SO11-03062014-191601(60004)	09:19:43 AM (cst)	10:20:15 AM (cst)	52.6	50.6
5	07-SO12-03062014-191601(60004)	10:33:12 AM (cst)	10:34:04 AM (cst)	51.6	49.6
6	08-SO13-03062014-191602(60004)	11:40:14 AM (cst)	12:40:36 AM (cst)	56.0	54
7	09-SO25-03062014-195200(50002)	15:00:00 PM (cst)	16:00:00 PM (cst)	45.3	43.3
8	10-SO16-03062014-191602(60004)	15:40:56 PM (cst)	16:40:56 PM (cst)	58.6	56.6
9	09-SO15-03062014-191602(60004)	14:28:56 PM (cst)	15:28:56 PM (cst)	51.0	49
10	10-SO26-03062014-205854(50002)	16:14:00 PM (cst)	17:14:00 PM (cst)	45.4	43.4
11	01-SO04-02062014-205855(50002)	08:23:00 AM (cst)	09:23:00 AM (cst)	52.9	50.9
12	03-SO06-02062014-205855(50002)	11:45:00 AM (cst)	12:45:00 PM (cst)	56.2	54.2
13	04-SO07-02062014-205855(50002)	14:29:00 PM (cst)	15:29:00 PM (cst)	51.7	49.7
14	05-SO08-02062014-205855(50002)	16:19:00 PM (cst)	17:19:00 PM (cst)	55.8	53.8
15	11-SO17-04062014-205443(60004)	07:38:55 AM (cst)	08:38:55 AM (cst)	51.9	49.9
16	12-SO18-04062014-205443(60004)	08:51:04 AM (cst)	09:51:04 AM (cst)	60.4	58.4
17	15-SO21-04062014-205444(60004)	13:38:00 PM (cst)	14:38:00 PM (cst)	50.2	48.2
18	13-SO19-04062014-205444(60004)	10:09:35 AM (cst)	11:09:35 AM (cst)	50.5	48.5
19	15-SO31-04062014-205855(50002)	13:38:00 PM (cst)	14:38:00 PM (cst)	61.0	59
20	14-SO30-04062014-205855(50002)	12:29:00 PM (cst)	13:29:00 PM (cst)	59.6	57.6
21	14-SO20-04062014-205444(60004)	12:25:00 PM (cst)	13:25:00 PM (cst)	58.1	56.1
22	11-SO27-04062014-205854(50002)	07:30:00 AM (cst)	08:30:00 AM (cst)	54.9	52.9
23	12-SO28-04062014-205854(50002)	08:39:00 AM (cst)	09:39:00 AM (cst)	54.9	52.9
24	13-SO29-04062014-205855(50002)	10:09:00 AM (cst)	11:09:00 AM (cst)	54.6	52.6

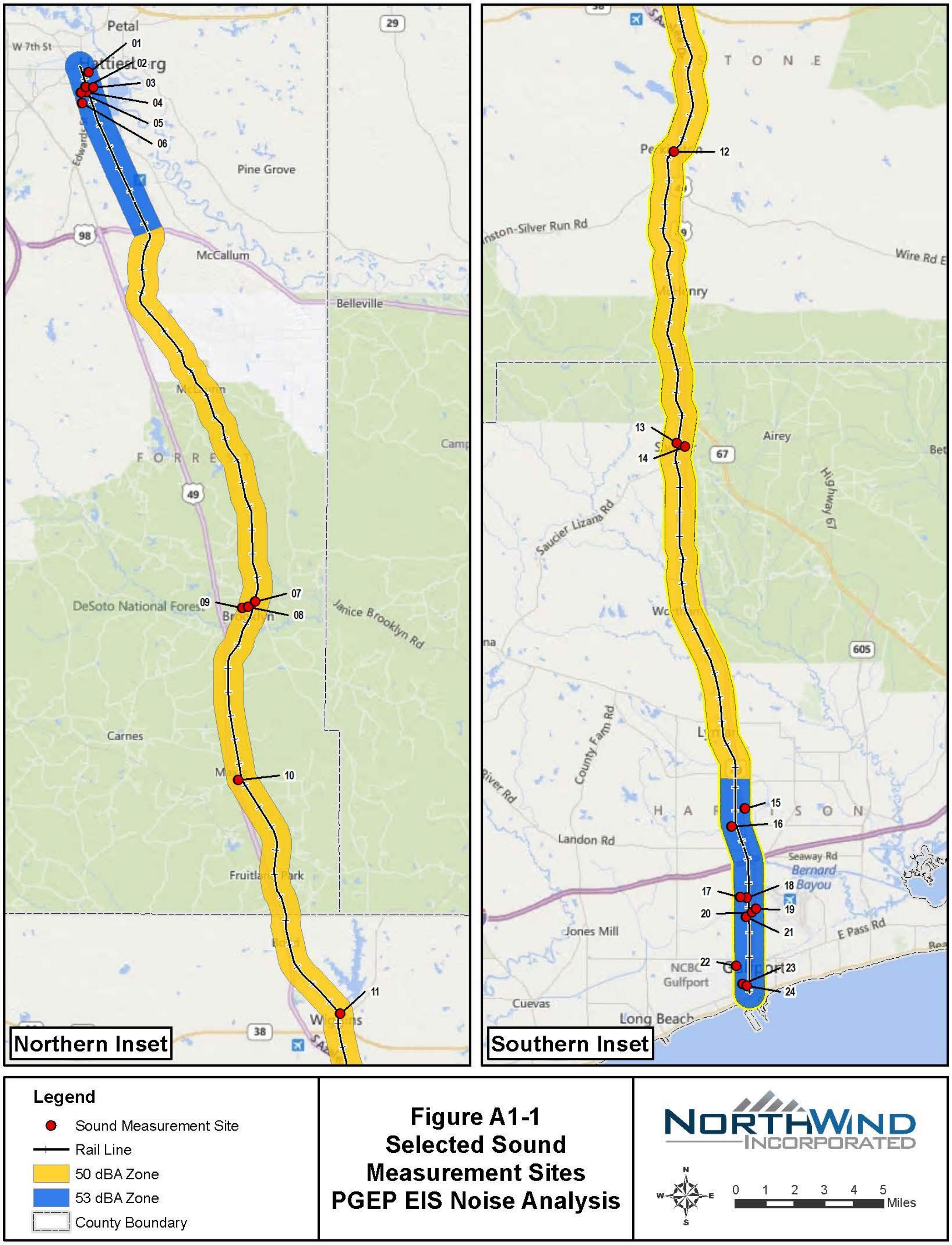


Figure A1-1
Selected Sound Measurement Sites
PGEP EIS Noise Analysis

Appendix 2

Noise Impact Contour Maps

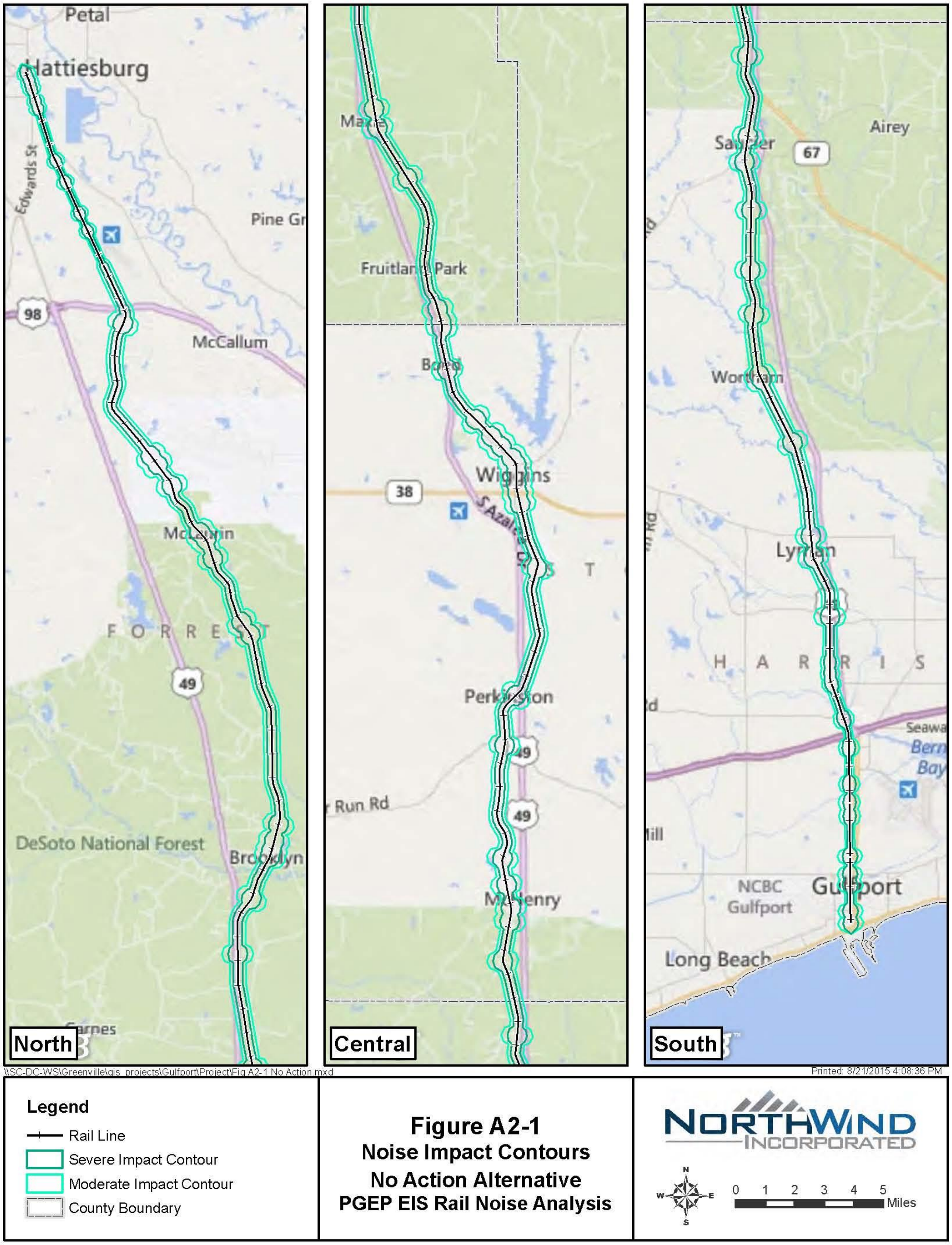
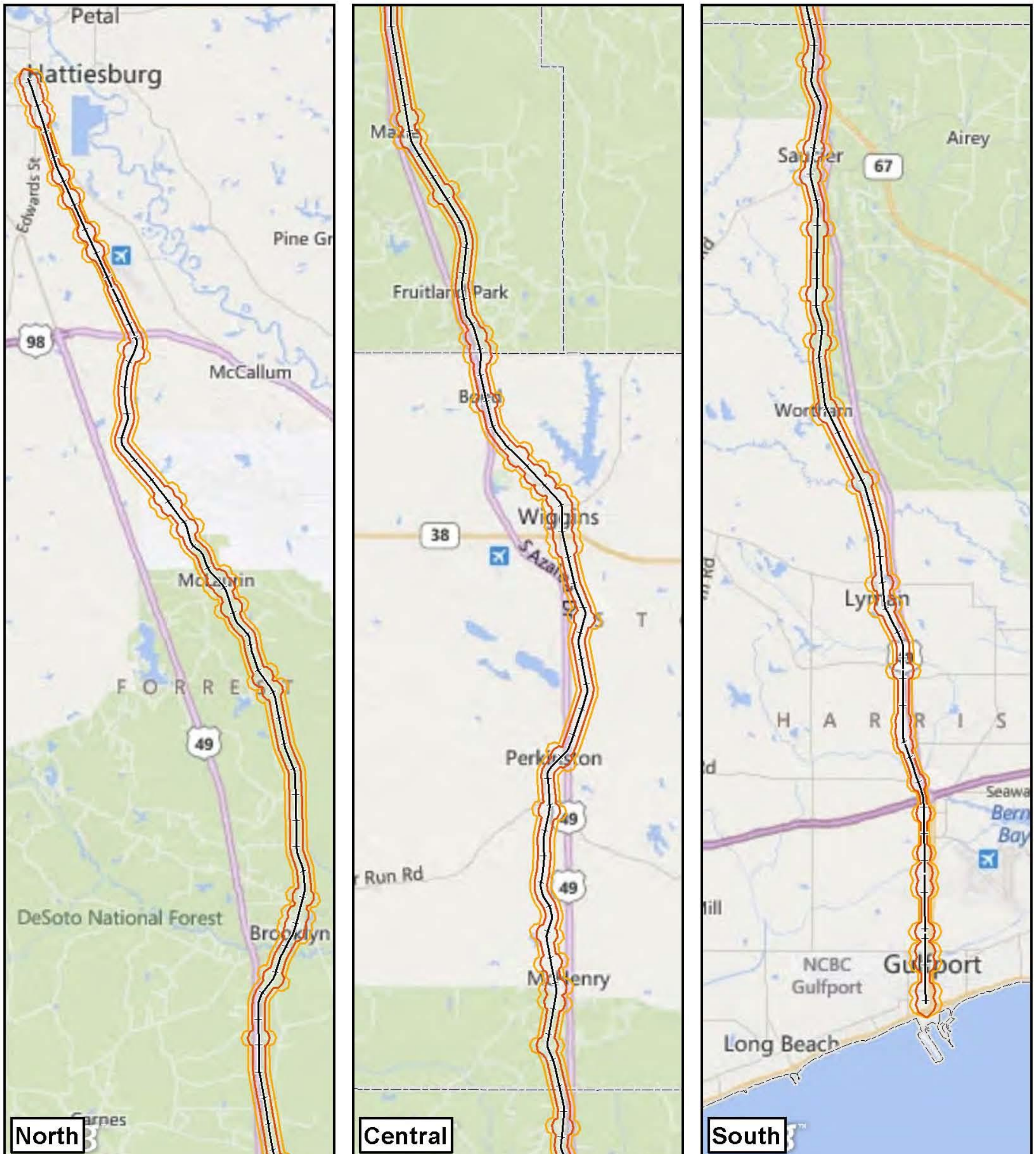


Figure A2-1
Noise Impact Contours
No Action Alternative
PGEP EIS Rail Noise Analysis



Legend

- Rail Line
- Severe Impact Contour
- Moderate Impact Contour
- County Boundary

Figure A2-2
Noise Impact Contours
Proposed Project Alternative
PGEP EIS Rail Noise Analysis

NORTHWIND INCORPORATED

N S E W

0 1 2 3 4 5 Miles