HOOKS STREET ALTERNATIVE CORRIDOR EVALUATION

From Hancock Road to Hartle Road (CR 455)

Noise Study Technical Memorandum

June 2021

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1.0 INTRODUCTION

METRO Consulting Group, LLC (METRO), on behalf of Lake County (County) is conducting an Alternative Corridor Evaluation (ACE) to study alternative alignments for an extension of Hooks Street from Hancock Road to CR 455 (Hartle Road), a distance of approximately 1.36 miles. The County is activating its plans to extend a new, two-lane section of Hooks Street and complete the final portion of that roadway. The study's goal is to develop and analyze three (3) alternatives within the area defined by this boundary to determine the alternative that best addresses the identified needs. This Noise Study Technical Memorandum is prepared as part of the ACE for the preferred alternative.

The Hooks Street extension is anticipated to serve as a major east/west connector. The primary purpose of the proposed roadway project is to provide an alternative for drivers trying to reach CR 455. It will alleviate traffic on SR 50 and provide the transportation connections and capacity needed to relieve congestion on other area roads, as well as support the provision of goods and services to future developments consistent with local and regional planning efforts.

If future design-year noise levels at noise-sensitive receivers approach, meet, or exceed the Noise Abatement Criteria (NAC) established by The Federal Highway Administration (FHWA) in 23 CFR 772 or increase 15 dB(A) over existing noise levels as a direct result of the transportation improvement project, noise abatement must be considered. The FHWA Traffic Noise Modeling (TNM) Version 2.5 computer program was used to determine if noise impacts are predicted once the roadway is constructed in the proposed Design Year 2045.

2.0 PROJECT DESCRIPTION

The Study Area is defined as a ±61.4-acre, ±1.4-mile-long corridor in Sections 26/27 of Township 22 South, Range 26 East. The project center is at Latitude 28° 32′ 34.50″ North, Longitude 81° 42′ 43.00″ West approximately. The proposed improvements will include the construction of a new roadway that connects the current eastern terminus of Hooks Street to the western edge of CR 455 (**Figure 1**). The Study Area encompasses and helps to guide the development of alignment alternatives for the proposed roadway improvements. The corridor is oriented east to west and consists of undeveloped land surrounded on all sides by dense residential and commercial development. The intent of the ACE is to analyze three (3) alignment alternatives through these lands and recommend a preferred alignment for this new section of Hooks Street that will meet the project's transportation goals while providing the least impact to the environment and existing development.

Figure 1: Location Map of Hooks Street Extension Study Area

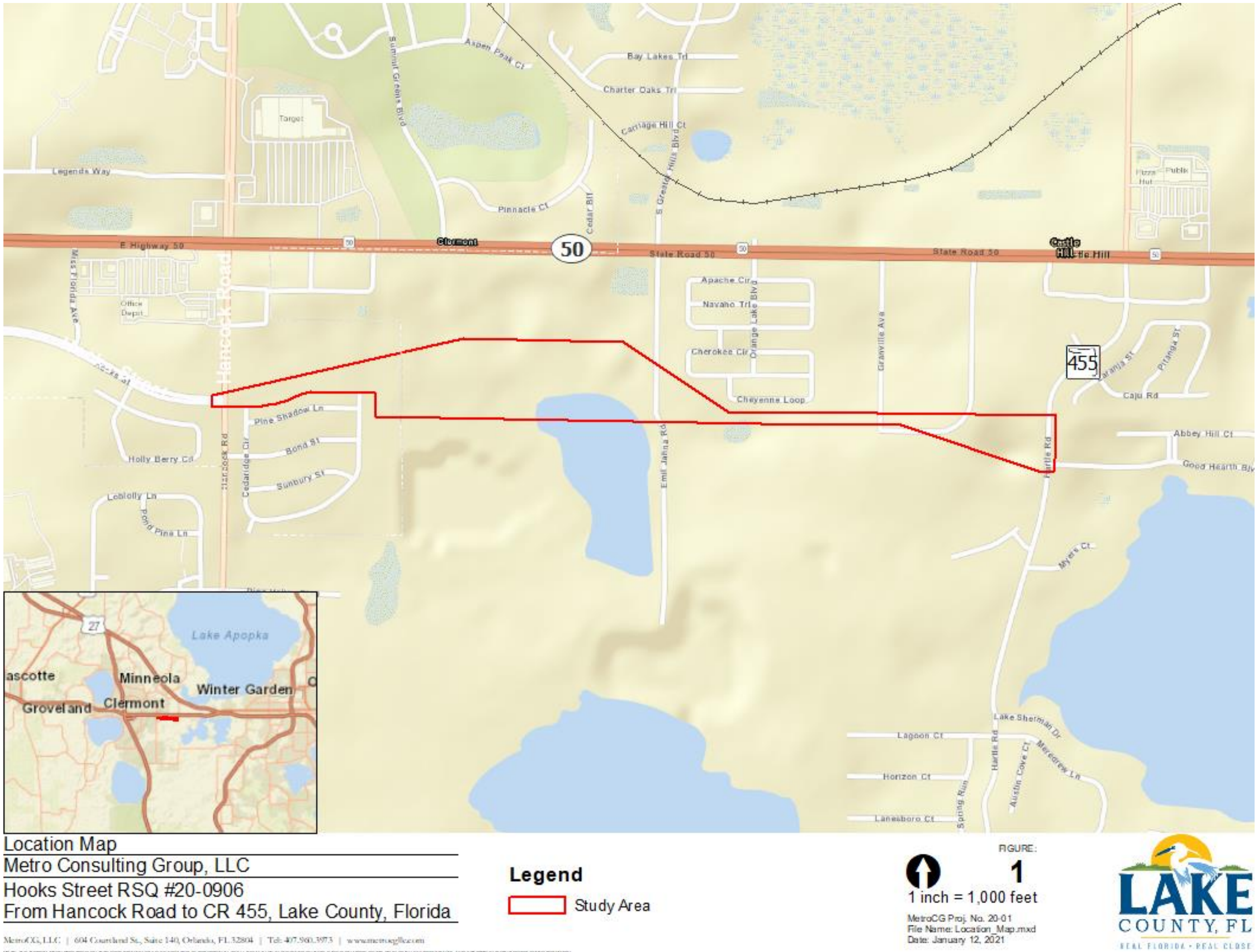


Figure 2 shows the preferred alignment (Green Alignment) that is the focus of this Noise Study. This alignment will require the acquisition of new right-of-way along most of its length and the construction of a new, two-lane divided urban section from Hancock Road to Hartle Road (CR 455), for a total length of approximately 1.4 miles. The proposed typical section (**Figure 3**) consists of two (2) through lanes separated by a grass median, with buffered bicycle lanes and eight-foot sidewalks on each side of the roadway section. Construction of the extension will address traffic operation improvements and improve multimodal travel capabilities. The preferred alignment includes the following study intersections: (1) Hooks Street at Hancock Road; (2) a roundabout at Hooks Street at Emil Jahna Road; and 3) Hooks Street at CR 455.

3.0 PURPOSE AND NEED

The area surrounding the proposed Hooks Extension project is mostly developed with medium- and high-density residential such as the Hills of Clermont and Waterbrooke subdivisions and Orange Lake Mobile Home Park. It also encompasses several mixed-use commercial developments, including one large commercial business called Senninger Irrigation. **Figure 4** depicts a recent aerial photograph of the Study Area. The Study Area is within the City of Clermont which, during the last two decades, has grown rapidly partially due to its proximity to Orlando and tourist attractions such as Sea World and Disney World. Continued population and employment growth in Clermont have generated a steady increase in travel demand for the area.

According to Florida 2070 (Florida Department of Agriculture, et al. 2017), a joint project from the University of Florida GeoPlan Center, the Florida Department of Agriculture and Consumer Services, and the nonprofit group 1000 Friends of Florida that examined the state’s development trends and possible effects decades from now, this area is anticipated to experience significant human development over the next 50 years, with some almost doubling in population. Future population growth and development are already occurring and are projected to increase in the local area, as seen by the ongoing construction and expansion of the Waterbrooke subdivision and Senninger Irrigation, as well as the advertised plans for new commercial development adjacent to Hancock Road.

The primary purpose of the proposed Hooks Street extension will be to provide adequate travel capacity and mobility to serve the predicted growth. It will also provide the transportation connections and capacity needed to relieve congestion on area roads and will support the provision of goods and services to future developments consistent with local and regional planning efforts. Secondary purposes are improved traffic safety, improved local traffic circulation, multimodal access, increased emergency service response time, and improved property access in the area, leading to economic development and job growth.

Figure 2: Preferred Alternative Alignment for Hooks Street Extension

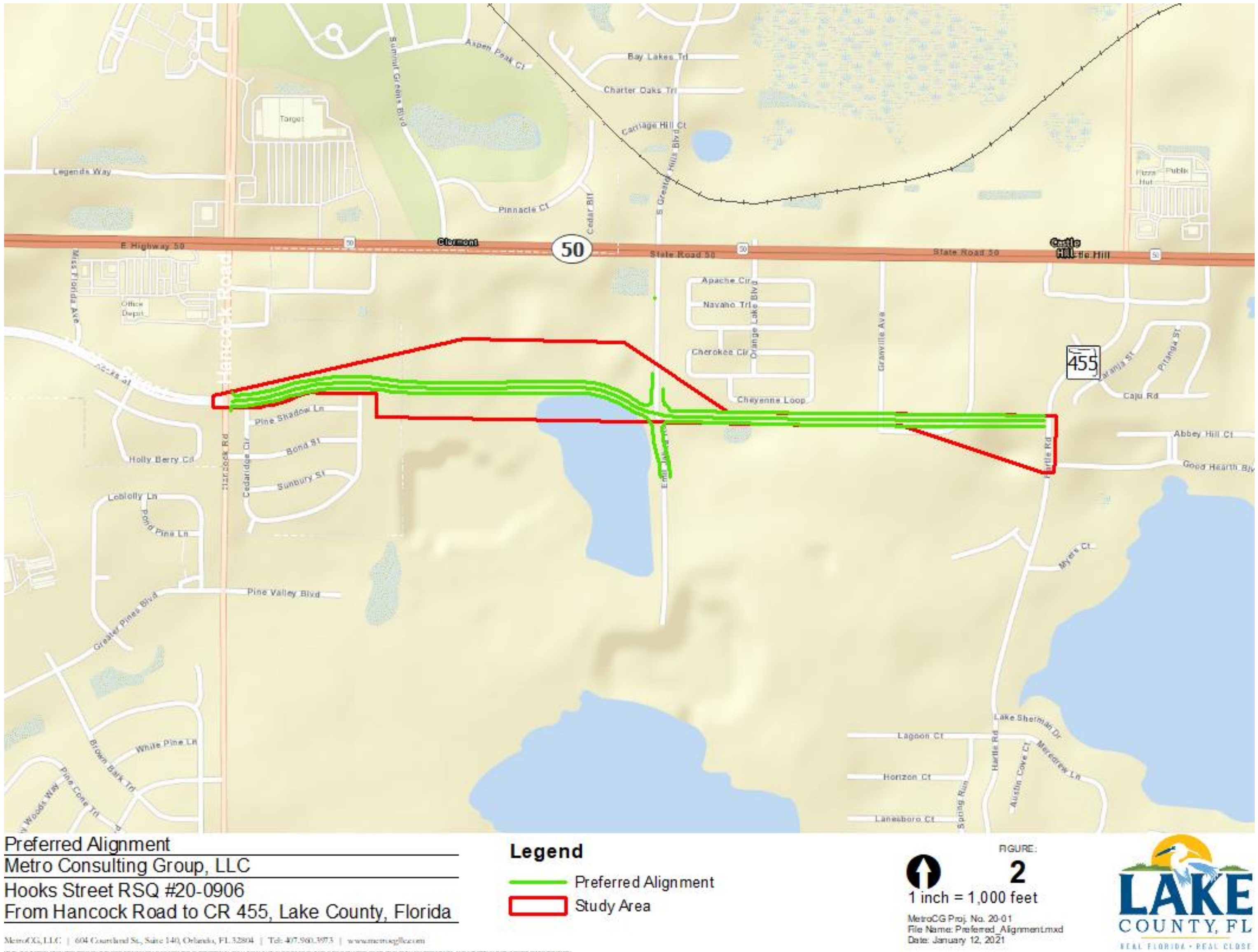


Figure 3: Typical Section for Hooks Street Extension

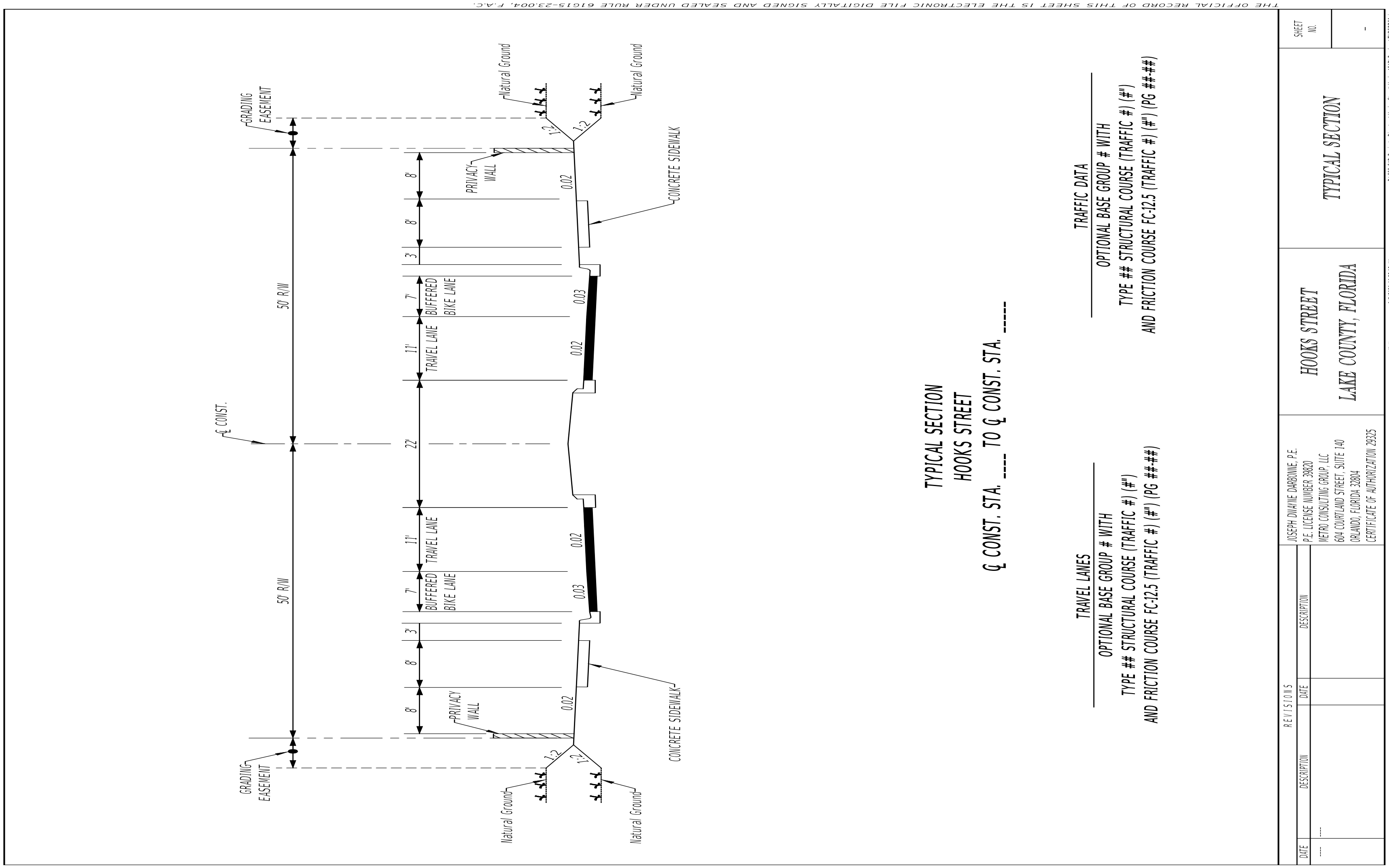


Figure 4: Aerial Photograph of Hooks Street Extension Study Area

Aerial Photo

Metro Consulting Group, LLC

Hooks Street RSQ #20-0906

From Hancock Road to CR 455, Lake County, Florida

MetroCG, LLC | 604 Courtland St., Suite 140, Orlando, FL 32804 | Tel: 407.960.3973 | www.metrocgllc.com

Legend

Study Area

FIGURE:
4

1 inch = 1,000 feet

MetroCG Proj. No. 20-01
File Name: Aerial_Photo.mxd
Date: January 12, 2021

LAKE COUNTY, FL
REAL FLORIDA • REAL CLOSE

4.0 METHODS

If future design-year noise levels at noise-sensitive receivers approach [within 1 dB(A)], meet, or exceed the NAC established by the FHWA in 23 CFR 772 or increase 15 dB(A) over existing noise levels as a direct result of the transportation improvement project, noise abatement must be considered. The FHWA's TNM Version 2.5 computer program was used to determine if noise impacts are predicted. If impacts are predicted to occur, a noise abatement evaluation is justified and then conducted to determine if abatement is considered reasonable and feasible for any noise-sensitive sites. The format and content of this report are based on the procedures and policy established in Part 2, Chapter 18 "Noise" of the FDOT PD&E Manual (January 2019) and on the regulatory material found in 23 Code of Federal Regulations (CFR), Part 772 entitled "Procedures for Abatement of Highway Traffic Noise and Construction Noise," both of which are available from the FHWA and FDOT.

4.1 Noise Metrics

The noise levels documented in this report are based upon the hourly equivalent sound level [Leq(h)]. The Leq(h) represents the steady-state sound level, which contains the same amount of acoustic energy as the actual time-varying sound level over a one-hour period. Sound levels are measured and calculated in decibels (dB(A)), which is a unit of measure used to determine sound intensities. Leq(h) is measured on an A-weighted decibel scale (dB(A)), which is the scale that most closely approximates the response characteristics of the human ear to typical traffic noise levels.

4.2 Traffic Noise Modeling

The FHWA's TNM Version 2.5 computer program was used to determine if noise impacts are predicted. If impacts are predicted to occur, a noise abatement evaluation is justified and is conducted to determine if abatement is considered reasonable and feasible for any noise-sensitive sites. This model is the latest version of TNM and was used as required by 23 CFR 772.

The model estimates the acoustic intensity at noise receiver sites based upon the roadway design and is influenced by vehicle speed and type. TNM 2.5 predicted noise levels are reported in dB(A) Leq(h). Noise receiver sites were identified throughout the project corridor. Information that was loaded into TNM 2.5 to predict existing and Build noise levels includes roadway geometry; vehicle types, volumes, and speeds; existing barrier and buffer information, propagation path; and climatic conditions. The results of the validation are shown in **Section 5.1.**

Noise levels were modeled for the proposed project within the Noise Sensitive Areas (NSAs, **Section 5.2**) for the future Design Year 2045 conditions. Predicted TNM results are contained in **Section 6**. Chapter 18 of the FDOT PD&E Manual states that "a traffic noise impact occurs when the modeled future highway traffic noise levels approach or exceed the NAC. A traffic noise impact also occurs when modeled future highway traffic noise levels substantially exceed the existing highway traffic noise level, even though the modeled levels may not exceed the NAC. FDOT has determined that the NAC is approached when it is within 1 dB(A) of the appropriate NAC and that a substantial increase occurs when the increase over existing conditions (measured or predicted) is 15dB(A) or greater." For the NSAs involved in this study, if traffic noise levels exceed or approach the NAC for Category B of 66 dB(A) as described in **Section 4.4**, impacts are said to occur.

4.3 Traffic Data

To predict traffic noise levels and assess impacts, the traffic characteristics that would yield the highest traffic noise impacts are used. The highest traffic volumes and highest traffic speeds will (typically) create the noisiest conditions. Level of Service (LOS) C volumes representing the peak hourly traffic volumes are used unless traffic analysis demonstrates that this condition will not be reached. If this is the case, then demand peak hour volumes are to be used. Based upon the design traffic forecasted for the design year of 2045 from the Hooks Street Extension Design Traffic Technical Memorandum prepared for this project, the roadway is expected to reach LOS D volumes, so the Demand Peak Hour Volumes were used to model the Design Year 2045 volumes for noise projections. Traffic speeds used were the proposed speed limits for the 2045 design. See **Section 6.1** for more information about the traffic data.

4.4 Noise Abatement Criteria

The FHWA has established seven (7) land use categories that are used to assess the impact of noise on these activities, of which five (5) of these have NAC to consider. If predicted noise levels approach or exceed the NAC levels, or a substantial noise increase is predicted, noise abatement must be considered. A substantial noise increase occurs when the existing noise level is predicted to be exceeded by 15 dB(A) or more by the project. FDOT defines 'approach' as within 1.0 dB(A) of the FHWA criteria.

Noise-sensitive receiver sites include areas where frequent exterior human use occurs. Included are lands which require quiet (Activity Category A), residential areas (Activity Category B), a variety of non-residential land uses such as parks, schools, places of worship, and medical facilities (Activity Category C), and commercial properties with areas of exterior use, such as restaurants, hotels, and other places of business (Activity Category E). Activity Category D includes noise-sensitive sites that have interior uses but no exterior activities, such as hospitals, libraries, recording studios, television studios, and public meeting rooms. Activity Category F includes developed lands that are not sensitive to highway traffic noise, such as agriculture, airports, and industrial and retail facilities. Agriculture facilities were noted within the Study Area as Activity Category F land uses and do not require a noise analysis as stipulated in 23 CFR 772. Undeveloped vacant lands (Activity Category G) were also noted in the project corridor. There is not an NAC level for this category either, though FDOT must document highway traffic noise levels for all NAC categories and provide it to local officials.

Table 1: Noise Abatement Criteria – Hourly A-Weighted Sound Level-decibels [dB(A)]

Activity Category	Activity Leq(h)[1]		Evaluation Location	Description
	FHWA	FDOT		
A	57	56	Exterior	Lands on which serenity and quiet are of extraordinary significance and serve an important public need and where the preservation of those qualities is essential if the area is to continue to serve its intended purpose.
B[2]	67	66	Exterior	Residential
C[2]	67	66	Exterior	Active sports areas, amphitheaters, auditoriums, campgrounds, cemeteries, day care centers, hospitals, libraries, medical facilities, parks, picnic areas, places of worship, playgrounds, public meeting rooms, public or nonprofit institutional structures, radio studios, recording studios, recreational areas, Section 4(f) sites, schools, television studios, trails, and trail crossings.
D	52	51	Interior	Auditoriums, day care centers, hospitals, libraries, medical facilities, places of worship, public meeting rooms, public or nonprofit institutional structures, radio studios, recording studios, schools, and television studios.

Part 2, Chapter 17 of PD&E Manual (5/24/2011) (Based on Table 1 of 23 CFR Part 772)

1. The Leq(h) Activity Criteria values are for impact determination only and are not design standards for noise abatement measures.
2. Includes undeveloped lands permitted for this activity category.

For reference, **Table 2** shows the relationship between typical noise levels and common indoor/outdoor activities.

Table 2: Typical Noise Levels

Common Outdoor Activities	Noise Level dB(A)	Common Indoor Activities
	110	Rock Concert
Jet Engine		
	100	
Gas Lawn Mower at 3ft.		
	90	
Diesel Truck at 50ft, at 50mph		Food Blender at 3ft.
	80	Garbage Disposal at 3ft.
Noisy Urban Area Daytime		
Gas Lawn Mower at 100ft.	70	Vacuum Cleaner at 10ft.
Commercial Area		Normal Speech at 3ft.
Heavy Traffic at 300ft.	60	
		Large Business Office
Quiet Urban Area Daytime	50	Dishwasher Next Room
Quiet Urban Area Nighttime	40	Theater, Large Conference Room (background)
Quiet Suburban Area Nighttime		
	30	Library
Quiet Rural Area Nighttime		Bedroom at Night
	20	

Source: California Dept. of Transportation Technical Noise Supplement, Oct. 1998, Page 18.

4.5 Noise Abatement Measures

The FHWA requires that noise abatement measures be considered for a proposed project when the predicted noise levels approach, equal, or exceed NAC, or will increase substantially over existing levels. The most common and effective noise abatement measure is the construction of a noise barrier. As noted in 23 CFR 772.13(c)(1), the FHWA requires that, at a minimum, FDOT shall consider noise abatement in the form of a noise barrier. FHWA also considers the following activities as acceptable noise abatement measures.

4.5.1 Alignment Selection

The FHWA requires that noise abatement measures be considered for a proposed project when the predicted noise levels approach, equal, or exceed NAC, or will increase substantially over existing levels. The most common and effective noise abatement measure is the construction of a noise barrier. As noted in 23 CFR 772.13(c)(1), the FHWA requires that, at a minimum, FDOT shall consider noise abatement in the form of a noise barrier. FHWA also considers the following activities as acceptable noise abatement measures.

4.5.2 Property Acquisition

Property acquisition for buffer zones alone is considered costly. Buffer zones can provide relief from noise impacts by creating added distance between the noise generator and the noise receiver. Methods of applying land use controls to maintain and establish buffered areas through zoning may be established by local jurisdiction.

4.5.3 Land Use Controls

One of the most effective noise abatement measures is the proper implementation of land use controls to minimize future noise impacts. Local jurisdictions with zoning control can implement policies to limit the growth on noise-sensitive land uses adjacent to the roadway.

4.5.4 Traffic Management

Traffic management measures that limit vehicle type, speed, volume, and time of operations can be effective noise abatement measures.

4.5.5 Noise Barriers

Noise barriers reduce noise levels by blocking the sound path between a roadway and noise-sensitive sites. To be effective, barriers must be continuous, sufficiently long and tall, shield a reasonably sized impacted area or a number of people, and provide appreciable noise level reduction. Noise barriers are to be modeled at locations where noise increases exceeded abatement criteria during the design year and evaluated for feasibility and reasonableness. A wide range of factors are used to evaluate noise abatement measures as reasonable and feasible. Feasibility deals with engineering considerations such as the ability to construct a barrier using standard construction techniques and methods to provide a reduction of at least 5 dB(A) to an impacted receiver site. Additionally, for a noise barrier to be considered acoustically feasible, at least two impacted receiver sites must achieve a 5 dB(A) reduction or greater.

As noted in 23 CFR 772.13(c)(1), the FHWA requires that, at a minimum, FDOT shall consider noise abatement in the form of a noise barrier. When a noise abatement measure such as a sound barrier is determined to be feasible, the reasonableness is then evaluated. Three (3) reasonableness factors must be collectively achieved for the noise abatement measure to be deemed reasonable: the achievement of the noise reduction design goal (7 dB(A) for at least one receiver per FDOT criteria), the cost effectiveness of the noise abatement measure, and the consideration of the viewpoints of the benefited property owners and residents.

To effectively reduce the noise coming around its ends, a barrier's length should be at least eight times the distance from the home or receiver to the barrier, with the receiver located at the mid-point of the barrier. Openings in noise barriers for driveway connections or intersecting streets destroy their effectiveness. When examining the cost-reasonableness of a modeled noise barrier design for a residential area, the upper limit of $42,000 per benefited receiver has been set by FDOT using the standard construction cost of $30.00 per square foot. A benefited receiver is defined as a noise sensitive site that will obtain a minimum of 5 dB(A) of noise reduction as a result of a specific noise abatement measure, whether or not they are predicted as having a noise impact. Only benefited receiver sites can be included in the calculation of a barrier being cost reasonable.

5.0 TRAFFIC NOISE ANALYSIS

According to **Section 18.1.2** of the FDOT's PD&E Manual's Definitions, this is considered a Type I project. A Type I project is a "highway construction project (new location or physical alteration of existing highway) which substantially changes horizontal and vertical alignment, profile or adds number of through lanes." This conforms with Title 23 CFR Part 772 that also defines "the construction of a highway on new location" as a Type I project. Additionally, according to Title 23 CFR Part 772, "If a project is determined to be a Type I project under this definition, then the entire project area as defined in the Environmental Document is a Type I project and would require a noise analysis."

5.1 Noise Model Validation

The purpose of field measuring existing traffic noise levels is to (1) ensure that traffic noise is the main source of noise and to validate the TNM input values and verify that the model accurately predicts the existing traffic noise based upon the current conditions, and (2) to estimate existing ambient noise levels along the new alignment section of the project for use in determining impacts when compared to predicted future levels. To collect the necessary data, field monitoring was conducted by a noise monitoring specialist in accordance with the FHWA's guidance document "Measurement of Highway-Related Noise" on September 19, 2018.

Because the proposed improvements are for a new roadway where one does not currently exist, only ambient background noise was collected. A Larson Davis SoundTrack LxT Noise Logging Dosimeter was used to collect existing sound levels at the location. The average sound level over a one-hour period is considered the Level Equivalent Hourly [Leq(h)] and is used in the noise modeling process. The dosimeter was calibrated on site just prior to the onset of each sampling event to ensure accuracy and mounted on a tripod at a height of approximately five (5) feet, which is standard and equivalent to the average height of the human ear.

During the field validation event, noise readings were taken three (3) separate times for 15-minute intervals at three (3) separate Sites over two separate days during periods of non-peak traffic activity. The three (3) 15-minute interval readings were averaged for each day and Site and used in the model to describe the background noise. All three (3) Sites were located via GPS using ESRI's GIS Collector software and an iPhone 8 Plus.

Site 1 and Site 2 were within the Hills of Clermont subdivision at different locations on Cedaridge Circle, adjacent to the proposed new alignment of Hooks Street, and parallel with the backyards abutting it. It should be noted that a brick wall exists along the property boundary of all the homes abutting the proposed right-of-way within this subdivision. This wall varied between four and six feet tall along its entire length. For modeling purposes, the minimum height of four feet is used for the existing barrier. For the purposes of entering background noise data within the TNM model, Sites 1&2 were combined and averaged. Site 3 was within the Orange Lake Mobile Home Park in a stormwater pond also adjacent to the proposed Hooks Street extension and parallel with the backyards of homes abutting the same.

Design files were used to establish the input parameters for modeling the roadway, including vertical and horizontal geometry and ground elevations. Because there was no terrain data available, the model runs were conducted with all features kept at ground level.

The TNM model was validated at field sampling locations along the proposed new alignment of Hooks Street in three (3) locations as described previously. Ambient noise levels were recorded for comparison to modeled results. **Table 3** shows the average results of those data collected.

Table 3: Traffic Noise Model Validation Results Leq dB(A)

Field Station	Day 1 Avg	Day 2 Avg	Overall Avg	
Site 1	51.03	49.43	50.23	Site 1&2 Avg 49.63
Site 2	48.37	49.70	49.03	
Site 3	48.60	52.00	50.3	

5.2 Noise Sensitive Sites

A noise-sensitive receiver is defined as "any property (owner occupied, rented, or leased) where frequent exterior human use occurs." The project was broken up into geographic Noise Sensitive Areas (NSAs) to facilitate the analysis of traffic related noise impacts. Three (3) NSAs that have the potential to be impacted by the project were identified and are shown on the Noise Sensitive Areas Map. One was within The Hills of Clermont subdivision. The second and third NSAs included the Orange Lake MHP and Waterbrooke Community (**Figure 5**). The potentially impacted noise-sensitive sites identified for the Study Area consisted only of single-family residences. The NSAs within the Study Area present a single type of site to model within TNM: single family residences that were modeled using a point to represent each home.

Following is a description of each NSA:

Noise Sensitive Area 1

This area contains 34 residences that were modeled for potential noise impacts (**Figure 6**). Thirty of these residences were located within the first and second row of homes adjacent to the proposed eastbound travel lane of the Hooks Street extension preferred alternative within the Hills of Clermont subdivision. Four (4) were located adjacent to the eastbound travel lane, on the west side of Hancock Road within the South Ridge subdivision.

Noise Sensitive Area 2

This area contains 31 residences that were modeled for potential noise impacts (**Figure 7**). Thirty of these residences were located adjacent to the westbound lane of the Hooks Street extension preferred alignment and one was adjacent to the northbound lane of Emil Jahna Road. All of these residences were within the Orange Lake Mobile Home Park.

Noise Sensitive Area 3

This area contains 35 residences that were modeled for potential noise impacts (**Figure 7**). Twenty-five of these residences were located adjacent to the eastbound lane of the Hooks Street extension preferred alignment, with ten residences adjacent to the northbound lane of Emil Jahna Road. All of these residences were within the Waterbrook Community.

5.3 Existing Noise Levels

In accordance with both FHWA and FDOT Noise Policy for new roadway projects, noise measurements are taken to determine the ambient noise levels since there is no existing traffic noise. For this project, measurements were collected along the proposed new preferred alignment. The land use along the proposed new alignment consists of existing or future residences in all three (3) NSAs. Field measurements determined that the average existing or background noise level within NSA 1 was 49.63 and the average existing noise level NSAs 2&3 was 50.3 dB(A).

Figure 5: Noise Sensitive Areas for the Hooks Street Extension

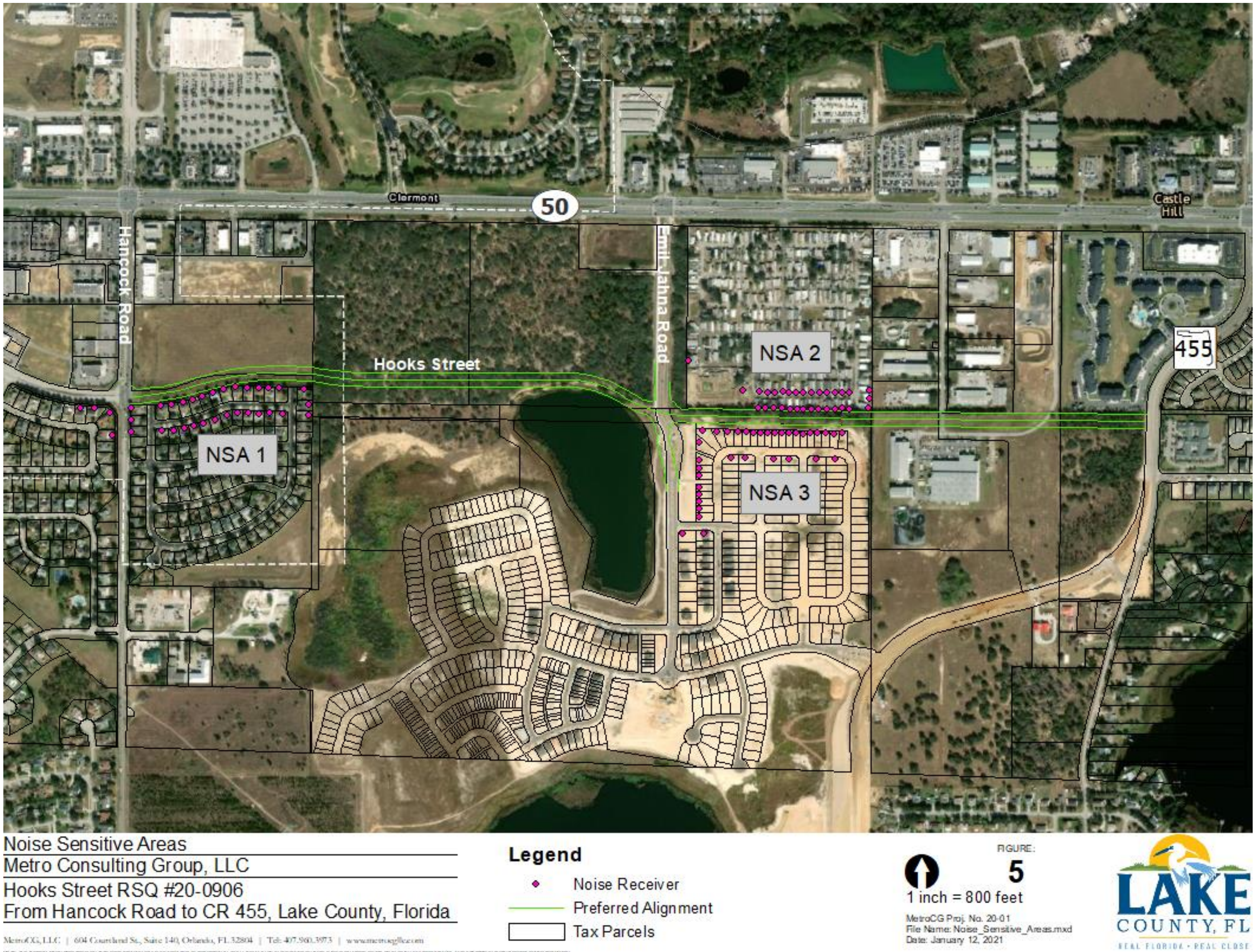
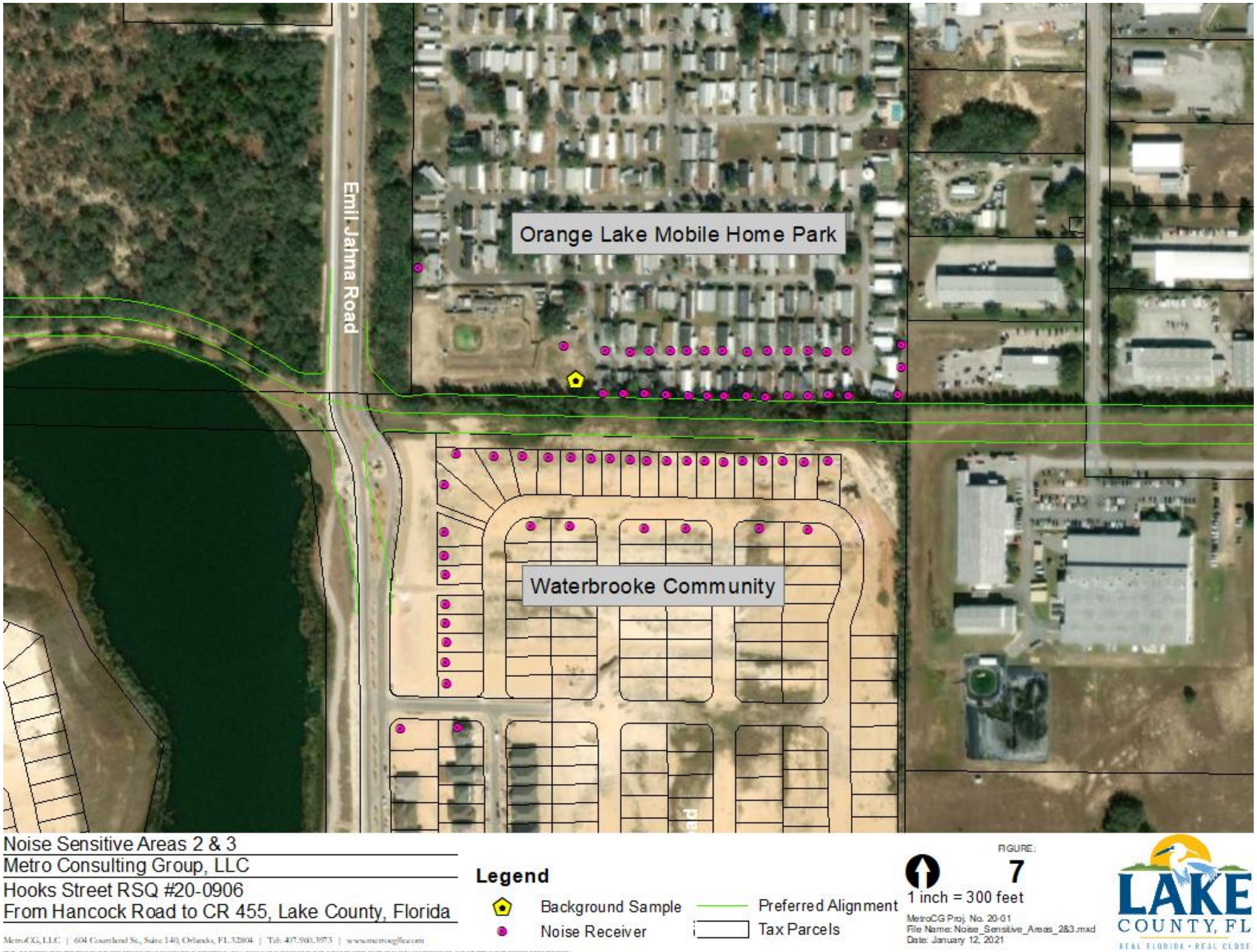


Figure 6: Noise Sensitive Area 1

Figure 7: Noise Sensitive Areas 2 and 3



6.0 PREDICTED NOISE LEVELS

The three (3) NSAs consist of receivers that fall under NAC Activity Category B (residential) exclusively.

6.1 Noise Impact Analysis

Based upon the results of the background data collection, there were no receivers that approached or exceeded the NAC for this Activity Category of 66 dB(A).

Future noise levels were predicted for the Design Year 2045 conditions. The future noise levels were predicted to approach or exceed the NAC of 66 dB(A) or substantially exceed the current levels at NSA 1, NSA 2, and NSA 3. Traffic volumes used for the analysis were demand peak hour numbers calculated by the project's Traffic Engineer (**Table 4**). Speeds were defined as 45 mph along both travel lanes of the Hooks Street Extension, except for the sections within 700 feet of the intersections at Emil Jahna Road and Hancock Road where the speed was dropped to 25 mph. Speeds were defined as 25 mph along the entire length of Emil Jahna Road in both directions. **Figure 8** shows 14 impacted receivers in NSA 1. **Figure 9** shows 15 impacted receivers in NSA 2 and 11 impacted receivers in NSA 3, in relation to the preferred alignment.

Table 4: Peak Demand Hour Traffic Volumes for the Design Year (2045)

Peak Hour Design Year Volumes Both Directions		
Roadway	**Segments**	**2045**
Hooks Street	Hancock Road to Emil Jahna Road	560
Hooks Street	Emil Jahna Road to Hartle Road (CR 455)	600

<u>Noise Sensitive Area 1</u>

This area represents Activity Category B and has no receivers predicted to be impacted in the existing Year Model and 14 receivers predicted to be impacted in the Build (Design Year 2045) Model. The average background noise level for this NSA was calculated as 49.64 dB(A). The predicted Build noise levels for this NSA range from 54.4 dB(A) to 67.5 dB(A). Ten receivers are predicted to have a both a substantial increase of 15 dB or more and exceed the NAC of 66 dB(A). Three (3) receivers are predicted to have only a substantial increase of 15 dB or more, and a fourth receiver is predicted to approach a substantial increase.

<u>Noise Sensitive Area 2</u>

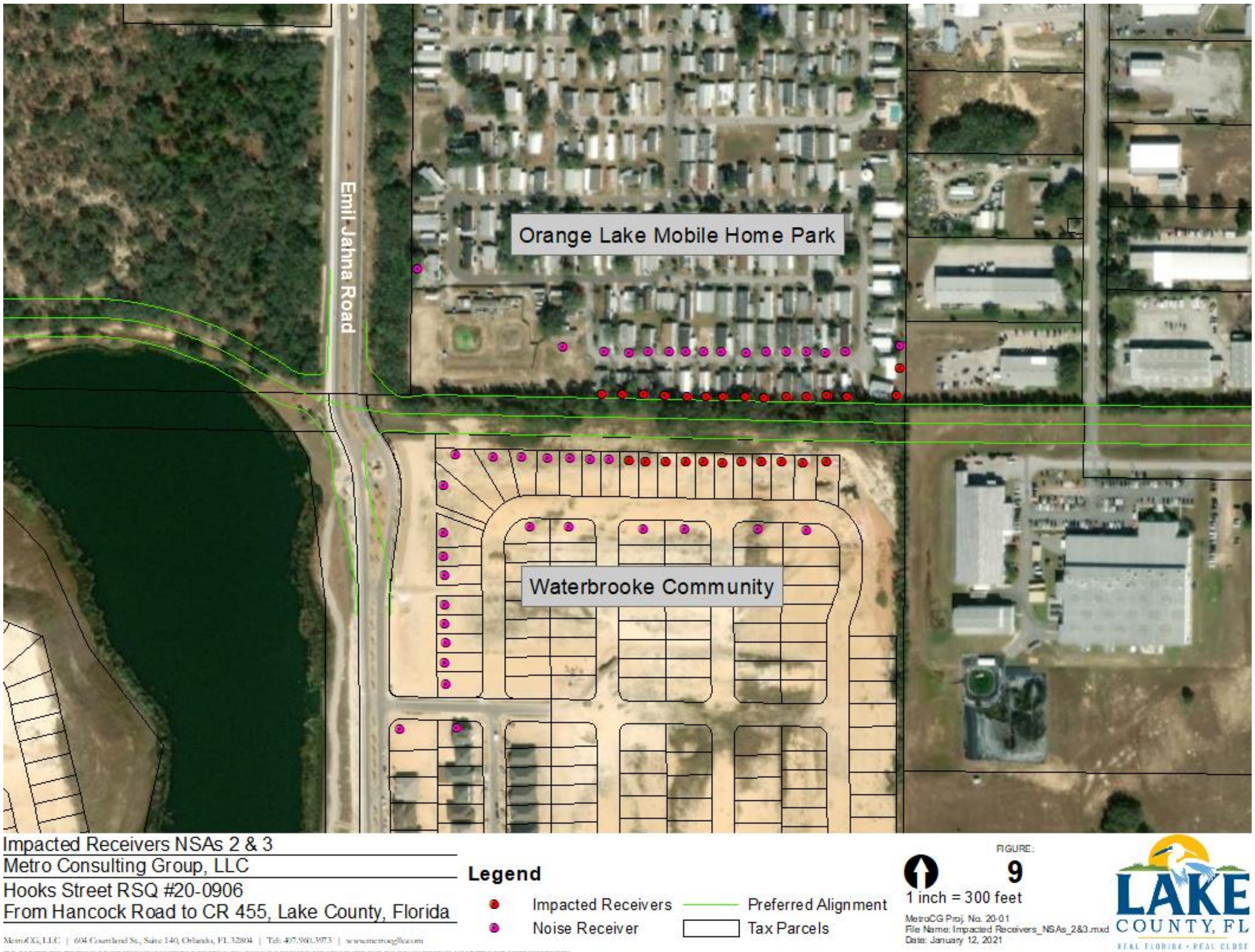
This area represents Activity Category B and has no sites predicted to be impacted in the existing Year Model and 10 receivers that will be impacted in the Build (Design Year 2045) Model. The average background noise level for this NSA range was calculated as 50.30 dB(A). The predicted Build noise levels for this NSA range from 53.3 dB(A) to 66.1 dB(A). Two (2) receivers are predicted to have a both a substantial increase of 15 dB or more and exceed the NAC of 66 dB(A). Seven (7) receivers are predicted to have only a substantial increase of 15 dB or more, and an eighth receiver is predicted to approach a substantial increase.

Noise Sensitive Area 3

This area represents Activity Category B and has no sites predicted to be impacted in the existing Year Model and 14 receivers that will be impacted in the Build (Design Year 2045) Model. The average background noise level for this NSA range was calculated as 50.30 dB(A). The predicted Build noise levels for this NSA range from 56.0 dB(A) to 68.4 dB(A). Twelve receivers are predicted to have a both a substantial increase of 15 dB or more and exceed the NAC of 66 dB(A). One (1) receiver is predicted to have only a substantial increase of 15 dB or more, and a second receiver is predicted to approach a substantial increase.

Figure 8: Impacted Noise Receivers for NSA

Figure 9: Impacted Noise Receivers for NSAs 2 & 3



6.2 Noise Abatement Analysis

Based upon the results of the background data collection, there were no receivers that approached or exceeded the NAC for this Activity Category of 66 dB(A).

Noise abatement was considered in the form of sound barrier walls for NSAs 1, 2, and 3. The barrier analysis results are summarized below and in **Table 5**.

NSA 1 Barrier

A six-foot noise barrier configuration did not meet the design goal of at least one receiver receiving greater than 7 dB(A) of benefit. A noise wall would need to be a minimum of six and a half feet (6.5ft) tall to meet the design goal (**Figure 10**). This configuration would fit within the cost per square foot threshold.

NSA 2 Barrier

A seven-foot barrier configuration did not meet the design goal of at least one receiver receiving greater than 7 dB(A) of benefit. A noise wall would need to be a minimum of seven and a half feet (7.5ft) tall to meet the design goal (**Figure 11**). This barrier would also benefit three (3) non-impacted receivers. This configuration would fit within the cost per square foot threshold.

NSA 3 Barrier

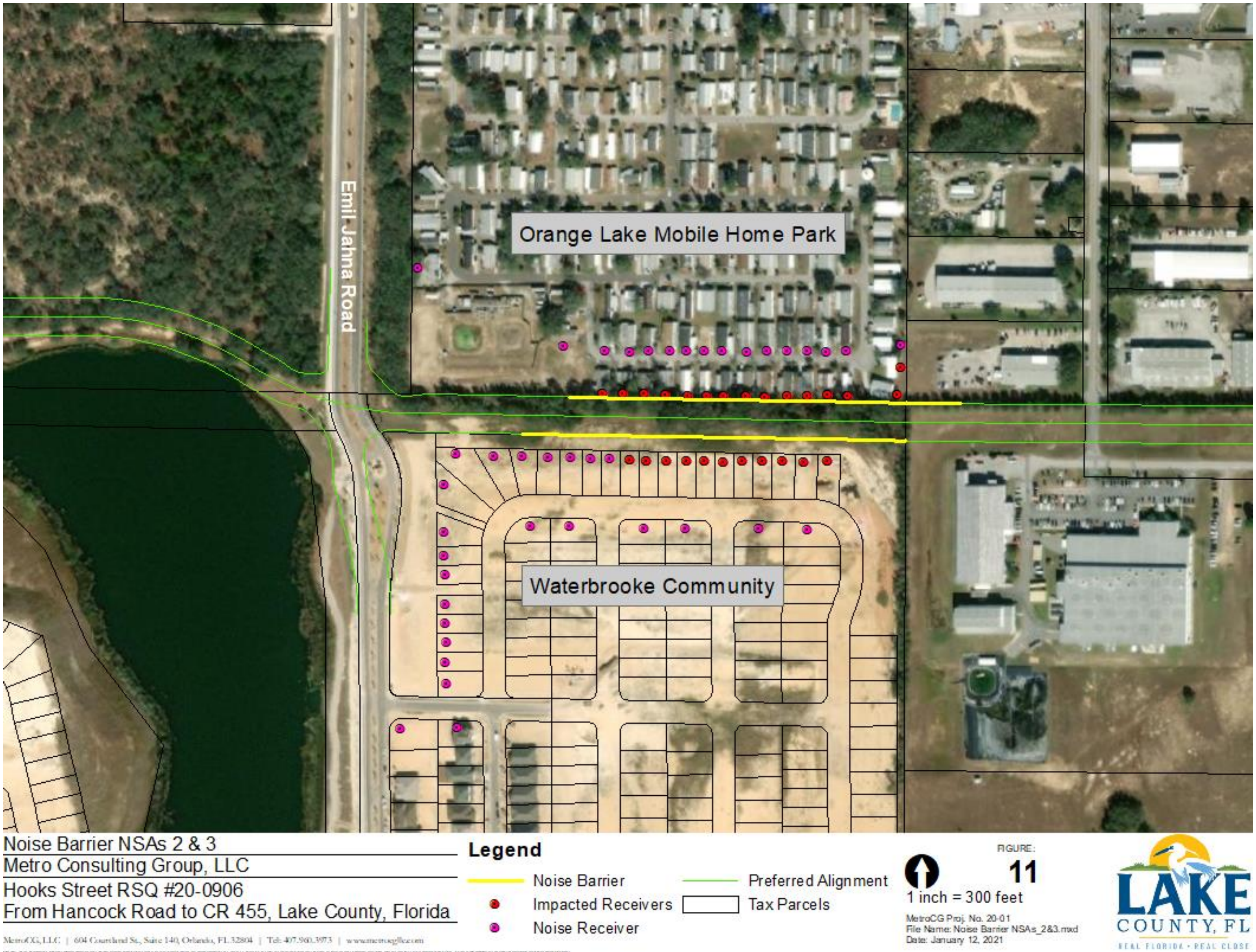
A six-foot barrier configuration did not meet the design goal of at least one receiver receiving greater than 7 dB(A) of benefit. A noise wall would need to be a minimum of six and a half feet (6.5ft) tall to meet the design goal (**Figure 11**). This barrier would also benefit 11 non-impacted receivers. This configuration would fit within the cost per square foot threshold.

Table 5: Noise Barrier Analysis

Barrier Wall	Height (ft)	Length (ft)	Impacted Receivers	Impacted and Benefited Receivers	Non-Impacted Benefited Receivers	Total # Benefitted Receivers	Avg. Impacted Noise Reduction dB(A)	Cost ($30 ft2)	Avg Cost ($) per Benefited Receiver	Comment
NSA 1	6.5	1,391	14	13	0	13	6.60	$271,293	$20,869	One impacted receiver with only 4.2 dB improvement
NSA 2	7.5	1,015	10	10	3	13	6.90	$227,668	$17,513	Three non-impacted receivers benefitted
NSA 3	6.5	1,033	14	14	11	25	7.0	$198,929	$7,957	Eleven non-impacted receivers benefitted

Figure 10: Noise Barrier for NSA 1

Figure 11: Noise Barrier for NSAs 2 & 3



7.0 CONCLUSION

Three (3) noise-sensitive areas are identified adjacent to the proposed Hooks Street Extension. All three (3) are predicted to have noise impacts in the Design Year (2045). NSA 1 is predicted to have 14 impacted receivers, NSA 2 is predicted to have 10 impacted receivers, and NSA 3 is predicted to have 14 impacted receivers. Noise abatement walls were designed to reduce the predicted noise increase that meet the design goal of having 1) at least two (2) benefited receivers with a 5 dB(A) insertion loss; 2) at least one (1) receiver with a greater than 7 dB(A) insertion loss, and 3) a cost within $42,000 per benefited receiver.

A 6.5-foot-high and 1,391-foot-long noise wall along the preferred alignment's ROW adjacent to NSA 1 will provide the necessary noise reduction to benefit 13 out of 14 impacted receivers. The outlying receiver will receive a 4.2 dB reduction. The total cost for the NSA 1 wall is estimated to be $271,293 with a cost per benefitted receiver of $20,869. A 7.5-foot-high and 1,105-foot-long wall along the preferred alignment's right-of-way adjacent to NSA 2 will provide the necessary noise reduction to benefit all 10 impacted receivers and will provide at least a 5dB benefit to three (3) non-impacted receivers. The total cost for the NSA 2 wall is estimated to be $227,668 with a cost per benefitted receiver of $17,513. A 6.5-foot-high and 1,033-foot-long wall along the preferred alignment's right-of-way adjacent to NSA 3 will provide the necessary noise reduction to benefit all 14 impacted receivers and will provide at least a 5dB benefit to 11 non-impacted receivers. The total cost for the NSA 3 wall is estimated to be $198,929 with a cost per benefitted receiver of $7,957.

8.0 CONSTRUCTION NOISE AND VIBRATION

Construction activities for any of the proposed improvements will have temporary noise impacts for those residents and visitors within the immediate vicinity of the project. Noise and vibration impacts will be caused by heavy equipment movement and construction activities such as earth moving and vibratory compaction. Noise control measures should be implemented according to the FDOT's Standard Specifications for Road and Bridge Construction to minimize or eliminate some potential construction noise and vibration impacts. Section 335, F.S., exempts FDOT from compliance with local ordinances. FDOT policy is to follow the requirement of local ordinances to the extent that is reasonable; however, should unanticipated noise or vibration issues arise during the construction process, the Project Engineer will investigate additional methods of controlling these impacts. No construction vibration sensitive sites were identified during the noise study.

Noise Model Data

NSA 3

Name	No.	No. DU	Existing LAeq1h dBA	No Barrier LAeq1h Calculated dBA	No Barrier LAeq1h Critical NAC dBA	No Barrier Increase over Existing: Increase over Existing dB	No Barrier Increase over Existing: Critical Sub Inc dB	Impact Type	With Barrier Calc LAeq1h dBA	With Barrier Noise Reduction Calculated dB	With Barrier Noise Reduction Goal dB	Calculated minus goal dB
Receiver127	127	1	50.3	56	66	5.7	15	----	55.4	0.6	7	-6.4
Receiver128	128	1	50.3	59.3	66	9	15	----	57.2	2.1	7	-4.9
Receiver129	129	1	50.3	64.1	66	13.8	15	----	58.6	5.5	7	-1.5
Receiver130	130	1	50.3	65.3	66	15	15	Sub'l Inc	59.1	6.2	7	-0.8
Receiver132	132	1	50.3	67.1	66	16.8	15	Both	60.2	6.9	7	-0.1
Receiver134	134	1	50.3	67.7	66	17.4	15	Both	60.7	7.0	7	0.0
Receiver135	135	1	50.3	68.1	66	17.8	15	Both	60.9	7.2	7	0.2
Receiver136	136	1	50.3	68.1	66	17.8	15	Both	60.9	7.2	7	0.2
Receiver137	137	1	50.3	68.2	66	17.9	15	Both	60.9	7.3	7	0.3
Receiver138	138	1	50.3	68.4	66	18.1	15	Both	61.1	7.3	7	0.3
Receiver139	139	1	50.3	68.3	66	18	15	Both	61	7.3	7	0.3
Receiver140	140	1	50.3	68.3	66	18	15	Both	61	7.3	7	0.3
Receiver141	141	1	50.3	68.3	66	18	15	Both	61.1	7.2	7	0.2
Receiver142	142	1	50.3	68.3	66	18	15	Both	61.1	7.2	7	0.2
Receiver143	143	1	50.3	68.4	66	18.1	15	Both	61.2	7.2	7	0.2
Receiver144	144	1	50.3	68.5	66	18.2	15	Both	61.2	7.3	7	0.3
Receiver145	145	1	50.3	64.5	66	14.2	15	----	59.3	5.2	7	-1.8
Receiver146	146	1	50.3	62.6	66	12.3	15	----	58.4	4.2	7	-2.8
Receiver148	148	1	50.3	60.4	66	10.1	15	----	56.7	3.7	7	-3.3
Receiver149	149	1	50.3	61.1	66	10.8	15	----	56.6	4.5	7	-2.5
Receiver150	150	1	50.3	61.5	66	11.2	15	----	56.6	4.9	7	-2.1
Receiver151	151	1	50.3	62.1	66	11.8	15	----	56.7	5.4	7	-1.6
Receiver152	152	1	50.3	62.3	66	12	15	----	56.7	5.6	7	-1.4
Receiver153	153	1	50.3	62.4	66	12.1	15	----	56.8	5.6	7	-1.4
Receiver154	154	1	50.3	62.6	66	12.3	15	----	56.9	5.7	7	-1.3
Receiver155	155	1	50.3	62.7	66	12.4	15	----	57	5.7	7	-1.3
Receiver156	156	1	50.3	62.8	66	12.5	15	----	57	5.8	7	-1.2
Receiver157	157	1	50.3	62.9	66	12.6	15	----	57.2	5.7	7	-1.3
Receiver158	158	1	50.3	63	66	12.7	15	----	57.3	5.7	7	-1.3
Receiver159	159	1	50.3	63	66	12.7	15	----	57.5	5.5	7	-1.5
Receiver160	160	1	50.3	63.1	66	12.8	15	----	57.7	5.4	7	-1.6

Cost	Benefitted Receivers	Cost per Receiver
$ 198,929.00	25	$ 7,957.16

Avg Impacted Noise Benefit

7.0

NSA 2

				LAeq1h		No Barrier			With Barrier						
						Increase over Existing				Noise Reduction					
Name	No.	No. DU	Existing LAeq1h	Calculated	Critical NAC	Increase over Existing	Critical Sub Inc	Impact Type	Calc LAeq1	Calculated	Goal	Calculated minus goal	Cost	Benefitted Receivers	Cost per Receiver
			dBA	dBA	dBA	dB	dB		dBA	dB	dB	dB			
Receiver92	92	1	50.3	54	66	3.7	15	----	53.5	0.5	7	-6.5	$ 227,668.00	13	$ 17,512.92
Receiver93	93	1	50.3	53.3	66	3	15	----	52.5	0.8	7	-6.2			
Receiver94	94	1	50.3	54.5	66	4.2	15	----	53.8	0.7	7	-6.3			
Receiver95	95	1	50.3	55	66	4.7	15	----	54.3	0.7	7	-6.3			
Receiver96	96	1	50.3	55.5	66	5.2	15	----	54.8	0.7	7	-6.3			
Receiver97	97	1	50.3	55.8	66	5.5	15	----	55.1	0.7	7	-6.3			
Receiver98	98	1	50.3	56.1	66	5.8	15	----	55.4	0.7	7	-6.3			
Receiver99	99	1	50.3	56.6	66	6.3	15	----	55.9	0.7	7	-6.3			
Receiver100	100	1	50.3	56.9	66	6.6	15	----	56.1	0.8	7	-6.2			
Receiver101	101	1	50.3	57.3	66	7	15	----	56.6	0.7	7	-6.3			
Receiver102	102	1	50.3	58.8	66	8.5	15	----	58.2	0.6	7	-6.4			
Receiver103	103	1	50.3	61	66	10.7	15	----	60.6	0.4	7	-6.6			
Receiver104	104	1	50.3	61.1	66	10.8	15	----	60.4	0.7	7	-6.3			
Receiver105	105	1	50.3	61.2	66	10.9	15	----	59.1	2.1	7	-4.9			
Receiver106	106	1	50.3	61.4	66	11.1	15	----	57.7	3.7	7	-3.3			
Receiver107	107	1	50.3	61.8	66	11.5	15	----	57.4	4.4	7	-2.6			
Receiver108	108	1	50.3	62.3	66	12	15	----	57.3	5.0	7	-2.0			
Receiver109	109	1	50.3	63	66	12.7	15	----	57.4	5.6	7	-1.4			
Receiver110	110	1	50.3	64	66	13.7	15	----	57.8	6.2	7	-0.8			
Receiver111	111	1	50.3	64.9	66	14.6	15	----	58.2	6.7	7	-0.3	Avg Impacted Noise Benefit		
Receiver112	112	1	50.3	65.4	66	15.1	15	Sub'l Inc	58.5	6.9	7	-0.1	6.9		
Receiver113	113	1	50.3	65.6	66	15.3	15	Sub'l Inc	58.6	7.0	7	0.0			
Receiver114	114	1	50.3	65.7	66	15.4	15	Sub'l Inc	58.7	7.0	7	0.0			
Receiver115	115	1	50.3	65.8	66	15.5	15	Sub'l Inc	58.8	7.0	7	0.0			
Receiver116	116	1	50.3	65.9	66	15.6	15	Sub'l Inc	58.9	7.0	7	0.0			
Receiver117	117	1	50.3	65.9	66	15.6	15	Sub'l Inc	58.9	7.0	7	0.0			
Receiver118	118	1	50.3	65.9	66	15.6	15	Sub'l Inc	59	6.9	7	-0.1			
Receiver119	119	1	50.3	66.1	66	15.8	15	Both	59.2	6.9	7	-0.1			
Receiver120	120	1	50.3	66.1	66	15.8	15	Both	59.4	6.7	7	-0.3			
Receiver121	121	1	50.3	60.5	66	10.2	15	----	56.4	4.1	7	-2.9			
Receiver122	122	1	50.3	60.3	66	10	15	----	55.8	4.5	7	-2.5			
Receiver123	123	1	50.3	59.8	66	9.5	15	----	55.2	4.6	7	-2.4			
Receiver124	124	1	50.3	58	66	7.7	15	----	55.1	2.9	7	-4.1			
Receiver125	125	1	50.3	57.5	66	7.2	15	----	55.4	2.1	7	-4.9			

NSA 1

				No Barrier					With Barrier			
				LAeq1h		Increase over Existing				Noise Reduction		
Name	No.	No. DU	Existing LAeq1h	Calculated	Critical NAC	Increase over Existing	Critical Sub Inc	Impact Type	Calc LAeq1	Calculated	Goal	Calculated minus goal
			dBA	dBA	dBA	dB	dB		dBA	dB	dB	dB
Receiver58	58	1	49.6	54.4	66.0	4.8	15.0	----	54.3	0.1	7.0	-6.9
Receiver59	59	1	49.6	56.4	66.0	6.8	15.0	----	56.4	0.0	7.0	-7.0
Receiver60	60	1	49.6	58.7	66.0	9.1	15.0	----	57.5	1.2	7.0	-5.8
Receiver61	61	1	49.6	55.4	66.0	5.8	15.0	----	53.2	2.2	7.0	-4.8
Receiver62	62	1	49.6	56.8	66.0	7.2	15.0	----	53.9	2.9	7.0	-4.1
Receiver63	63	1	49.6	58.8	66.0	9.2	15.0	----	55.9	2.9	7.0	-4.1
Receiver64	64	1	49.6	66.7	66.0	17.1	15.0	Both	59.4	7.3	7.0	0.3
Receiver65	65	1	49.6	66.4	66.0	16.8	15.0	Both	59.7	6.7	7.0	-0.3
Receiver66	66	1	49.6	66.1	66.0	16.5	15.0	Both	59.4	6.7	7.0	-0.3
Receiver67	67	1	49.6	66.0	66.0	16.4	15.0	Both	59.4	6.6	7.0	-0.4
Receiver68	68	1	49.6	66.2	66.0	16.6	15.0	Both	59.6	6.6	7.0	-0.4
Receiver69	69	1	49.6	66.4	66.0	16.8	15.0	Both	59.8	6.6	7.0	-0.4
Receiver70	70	1	49.6	67.0	66.0	17.4	15.0	Both	60.4	6.6	7.0	-0.4
Receiver71	71	1	49.6	67.5	66.0	17.9	15.0	Both	60.4	7.1	7.0	0.1
Receiver72	72	1	49.6	67.0	66.0	17.4	15.0	Both	60.5	6.5	7.0	-0.5
Receiver73	73	1	49.6	66.2	66.0	16.6	15.0	Both	59.8	6.4	7.0	-0.6
Receiver74	74	1	49.6	65.8	66.0	16.2	15.0	Sub'l Inc	59.3	6.5	7.0	-0.5
Receiver75	75	1	49.6	65.6	66.0	16.0	15.0	Sub'l Inc	59.2	6.4	7.0	-0.6
Receiver76	76	1	49.6	65.4	66.0	15.8	15.0	Sub'l Inc	59.2	6.2	7.0	-0.8
Receiver77	77	1	49.6	64.3	66.0	14.7	15.0	----	60.2	4.1	7.0	-2.9
Receiver78	78	1	49.6	61.0	66.0	11.4	15.0	----	59.3	1.7	7.0	-5.3
Receiver79	79	1	49.6	59.5	66.0	9.9	15.0	----	58.1	1.4	7.0	-5.6
Receiver80	80	1	49.6	57.8	66.0	8.2	15.0	----	54.2	3.6	7.0	-3.4
Receiver81	81	1	49.6	57.9	66.0	8.3	15.0	----	54.4	3.5	7.0	-3.5
Receiver82	82	1	49.6	58.1	66.0	8.5	15.0	----	54.6	3.5	7.0	-3.5
Receiver83	83	1	49.6	58.3	66.0	8.7	15.0	----	54.8	3.5	7.0	-3.5
Receiver84	84	1	49.6	58.5	66.0	8.9	15.0	----	55.1	3.4	7.0	-3.6
Receiver85	85	1	49.6	58.8	66.0	9.2	15.0	----	55.4	3.4	7.0	-3.6
Receiver86	86	1	49.6	59.2	66.0	9.6	15.0	----	55.8	3.4	7.0	-3.6
Receiver87	87	1	49.6	59.2	66.0	9.6	15.0	----	55.9	3.3	7.0	-3.7
Receiver88	88	1	49.6	59.0	66.0	9.4	15.0	----	55.9	3.1	7.0	-3.9
Receiver89	89	1	49.6	59.0	66.0	9.4	15.0	----	56	3.0	7.0	-4.0
Receiver90	90	1	49.6	59.0	66.0	9.4	15.0	----	56.2	2.8	7.0	-4.2
Receiver91	91	1	49.6	59.1	66.0	9.5	15.0	----	56.6	2.5	7.0	-4.5

Total Cost	Benefitted Receivers	$ per Receiver
$271,293	13	$20,868.69

Avg Impacted Noise Reduction

6.6