

# Final

# Noise Study Report

Malabar Road (SR 514) PD&E Study  
From East of Babcock Street (SR 507) to US 1  
Brevard County, Florida

Financial Project ID: 430136-1-22-01

ETDM Project Number: 13026

The environmental review, consultation, and other actions required by applicable federal environmental laws for this project are being, or have been, carried out by the Florida Department of Transportation (FDOT) pursuant to 23 U.S.C. §327 and a Memorandum of Understanding (MOU) dated December 14, 2016 and executed by the Federal Highway Administration and FDOT.

April 2018

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Prepared By

**ATKINS**

482 South Keller Road

Orlando, Florida 32810

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## Executive Summary

The Florida Department of Transportation (FDOT), District Five, conducted a Project Development and Environment (PD&E) Study to evaluate improvements to Malabar Road (SR 514) in Brevard County, Florida. The study limits begin east of Babcock Street (SR 507) [milepost (MP) 3.102] and extends to US 1 (MP 6.742), a distance of 3.64 miles. The proposed improvements involve widening of Malabar Road from a two-lane rural roadway to a four-lane divided facility from Babcock Road to Marie Street and expanding the two-lane non-divided existing road from Marie Street to US 1 into a two-lane divided (turning lane) roadway. The proposed improvements also change the intersections at Weber Road and Corey Road to round about intersections.

The PD&E Study included a traffic noise analysis for noise sensitive sites along Malabar Road within the project limits. The traffic noise study was completed in accordance with Title 23, Code of Federal Regulations, Part 772 (23 CFR 772), *Procedures for Abatement of Highway Traffic Noise and Construction Noise*<sup>1</sup> following policy and methodology established by FDOT in the *Project Development & Environment Manual*<sup>2</sup>, Part 2, Chapter 18 (June 2017), and *Traffic Noise Modeling and Analysis Practitioners Handbook*<sup>3</sup> (January 1, 2016). The purpose of the noise study was to identify noise sensitive sites that would be impacted with the proposed project and evaluate abatement measures at impacted noise sensitive sites.

For the existing, Design Year (2045) no build and Design Year (2045) build conditions, noise levels are predicted at 78 receptor points representing 57 residences, six recreational uses (community swimming pool at Enchanted Lakes Estates, Malabar Park baseball facilities, Little Impressions Academy playground, Berri Patch Preschool playground, First Baptist Church baseball field and Town of Malabar Disc Golf Park), eight institutional uses (Old Malabar School House, New Testament Bethel Ministries, Hope Ministries, Church For All Nations, Little Impressions Academy, Berri Patch Preschool, First Baptist Church of Malabar, and Iglesia Christiana Elohim Church), three medical facilities (Palm Bay Hospital, Internal Medicine and Brevard Health Alliance Inc.), picnic tables at the Moose Lodge and outdoor dining at one restaurant (Malabar Mo's Bar and Grill).

Exterior noise levels are predicted to approach or exceed the Noise Abatement Criteria for Design Year (2045) build conditions at 15 residences, the Little Impressions Academy playground, the First Baptist Church of Malabar baseball field, and the Town of Malabar Disc Golf Course. Compared to existing conditions, traffic noise levels for Design Year (2045) build conditions are predicted to increase 6.0 dB(A) or less. Therefore, traffic noise levels are not predicted to substantially increase at any noise sensitive site as a direct result of the transportation improvement project.

Noise abatement measures are considered at all noise sensitive sites with predicted noise levels that approach or exceed the Noise Abatement Criteria for Design Year (2045) build conditions. Traffic management and alignment modifications are not viable abatement measures. For currently undeveloped land, consideration of buffer zones during planning of future development is identified as a viable abatement measure that can be implemented by local officials responsible for land use planning.

Noise abatement is determined to be feasible and reasonable for Enchanted Lakes Mobile Home Park and RV Resort on the north side of Malabar Road.

Noise barriers are not feasible or cost reasonable at nine impacted residences primarily because the impact is at an isolated residence, the impacted residences are in an area where the density of residential development is low, or required gaps in a noise barrier to accommodate driveways/roads accessing Malabar Road limit the amount of noise reduction to less than 5 dB(A). Noise barriers are not feasible or cost reasonable at impacted non-residential sites (Little Impressions Preschool playground, First Baptist Church of Malabar baseball field, and the Town of Malabar Disc Golf Course) because the minimum noise reduction of 5 dB(A) could not be achieved or the noise sensitive site would not generate the person-hours of use on an average day required to meet the cost reasonable limit.

Some properties adjacent to Malabar Road are undeveloped. A land use review will be performed during the design phase of the project to ensure that all noise-sensitive land uses that have received a building permit prior to the project's Date of Public Knowledge are evaluated. Notably, there was no ongoing construction observed during the field review performed when establishing existing land use (July 23, 2013).

## Section 1.0 Introduction

### 1.1 Project Summary

The Florida Department of Transportation (FDOT), District Five, conducted a Project Development and Environment (PD&E) Study to evaluate improvements to Malabar Road [State Road (SR) 514] in Brevard County, Florida. The study limits begin east of Babcock Street (SR 507) [milepost (MP) 3.102] and extends to US 1 (MP 6.742), a distance of 3.64 miles. The purpose of the study was to provide documented environmental and engineering analyses to determine the type, location, and conceptual design of roadway improvements to Malabar Road (SR 514).

### 1.2 Project Description

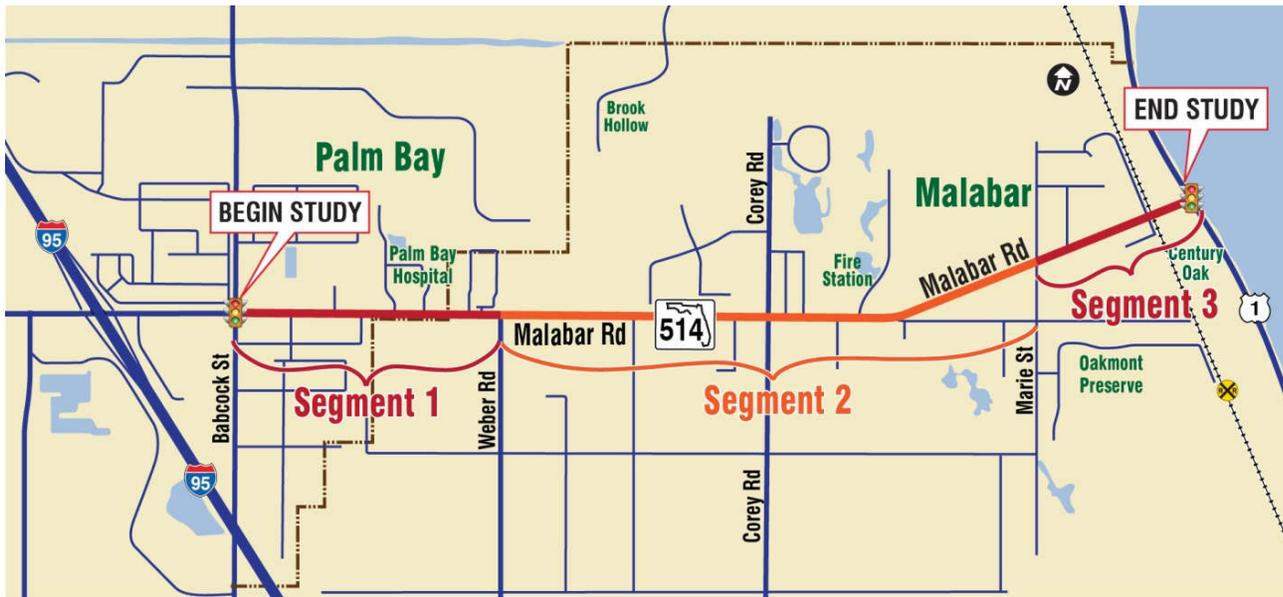
Malabar Road (SR 514) is an east-west urban minor arterial located in Brevard County that begins approximately 7.4 miles west of its interchange with I-95 and continues east to US 1. The section of Malabar Road (SR 514) from Babcock Street (SR 507) to US 1, which is the subject of this PD&E Study, traverses the City of Palm Bay and the Town of Malabar. East of Babcock Street, the Malabar Road is primarily a two-lane, undivided rural roadway. There are two signalized intersections within the project limits: at Babcock Street (SR 507) and at US 1. Land use within the corridor includes commercial, conservation, recreation, and low-density residential development. The Florida Division of Emergency Management has designated Malabar Road (SR 514) as an evacuation route. There is also a Florida East Coast (FEC) rail crossing approximately 600 feet west of US 1. **Figure 1-1** represents the project location map.

Three project segments were identified based on existing land use characteristics so appropriate context sensitive improvements can be identified and developed.

- Segment 1, from Babcock Street to Weber Road, is urban in nature with commercial land uses including the Life Center of Palm Bay and Palm Bay Hospital.
- Segment 2, from Weber Road to Marie Street, is less developed and more rural in nature, with the Malabar Scrub Sanctuary occupying a large portion of the lands abutting the roadway, some single-family homes on large parcels, the Malabar Disc Golf Park, Fern Creek Crossing Park, and some churches.
- Segment 3, like Segment 1, is more urban in nature, with smaller residential parcels, commercial land uses, downtown Malabar and Town Hall, the FEC railroad, and US 1 intersection.

**Figure 1-1: Project Location Map**

Figure 1-1: Project Location Map



Malabar Road (SR 514) is four-lanes from between Minton Road and Babcock Street (SR 507), after which it then transitions to a two-lane facility. Speed limits vary along the corridor, beginning at Babcock Street (SR 507) where it is 45 miles per hour (mph), transitioning to 55 mph just east of Weber Road, transitioning to 50 mph to east of Corey Road, then transitioning again to 45 mph west of Marie Street, and finally to 30 mph east of Marie Street to US 1. The existing right-of-way (ROW) width in the corridor varies: typically, 116 feet between Babcock Street (SR 507) and Enterprise Avenue, 83 feet from Enterprise Avenue to Weber Road, 66 feet from Weber Road to west of Marie Street feet, and 50 feet from west of Marie Street to US 1.

Roadway improvements to Malabar Road (SR 514) are identified in the *Town of Malabar Comprehensive Plan*<sup>1</sup> and the *City of Palm Bay Comprehensive Plan*<sup>2</sup>, and are part of the Space Coast Transportation Planning Organization’s *2040 Long Range Transportation Plan*<sup>3</sup>. The project is being considered to accommodate projected future traffic demand (Design Year 2045) along Malabar Road. The No-Build Alternative is also under consideration, and will remain a viable alternative through the Public Hearing phase of the project.

### 1.3 Existing Typical Sections

Malabar Road (SR 514), within the project corridor, consists of four existing typical sections (Figure 1-2).

**1. Babcock Street (SR 507) to West of Enterprise Avenue (MP 3.102 to MP 3.303)**

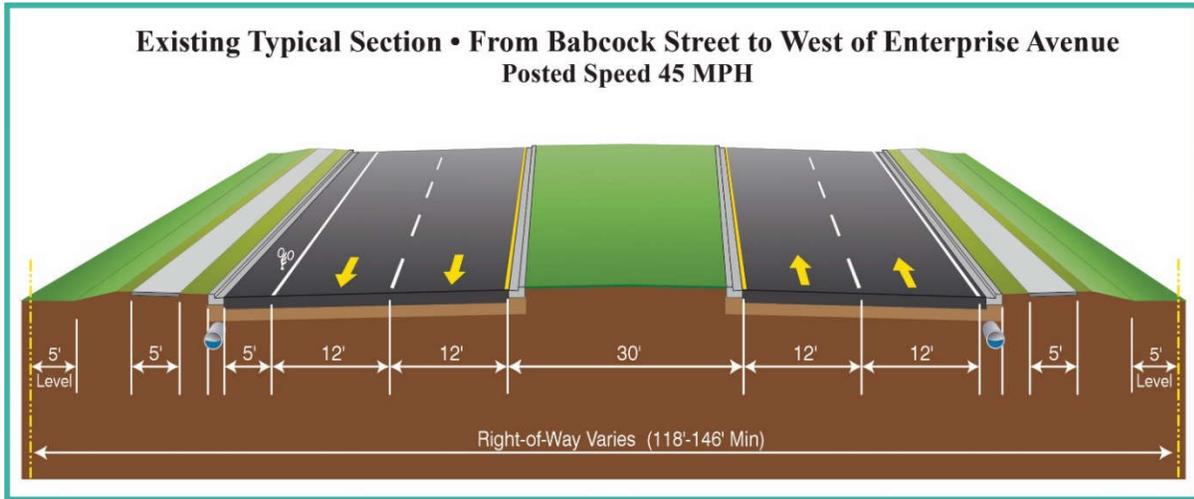
The intersection of Malabar Road (SR 514) and Babcock Street (SR 507), located within this segment, recently underwent intersection improvements and now contains four through lanes (two lanes in each direction, eastbound and westbound, respectively) along with turn lanes. The proposed improvements from this PD&E Study will tie into this recently improved intersection. Florida Power & Light Company (FP&L) has a distribution pole line on the north side of SR 514 from Babcock Street to Weber Road and continues east to US 1. FP&L also has a transmission pole line on south side of SR 514 from Babcock Street to 730 Malabar Road where it crosses over to north side of the roadway.

This typical section (**Figure 1-3**) consists of four 12-foot travel lanes separated by a 30-foot grass median. Two-foot curb and gutters exist on the inside and outside of the roadway. The posted speed limit is 45 mph. This is the only section within the study limits that contains sidewalks.

**Figure 1-2: Existing Typical Section Locations**



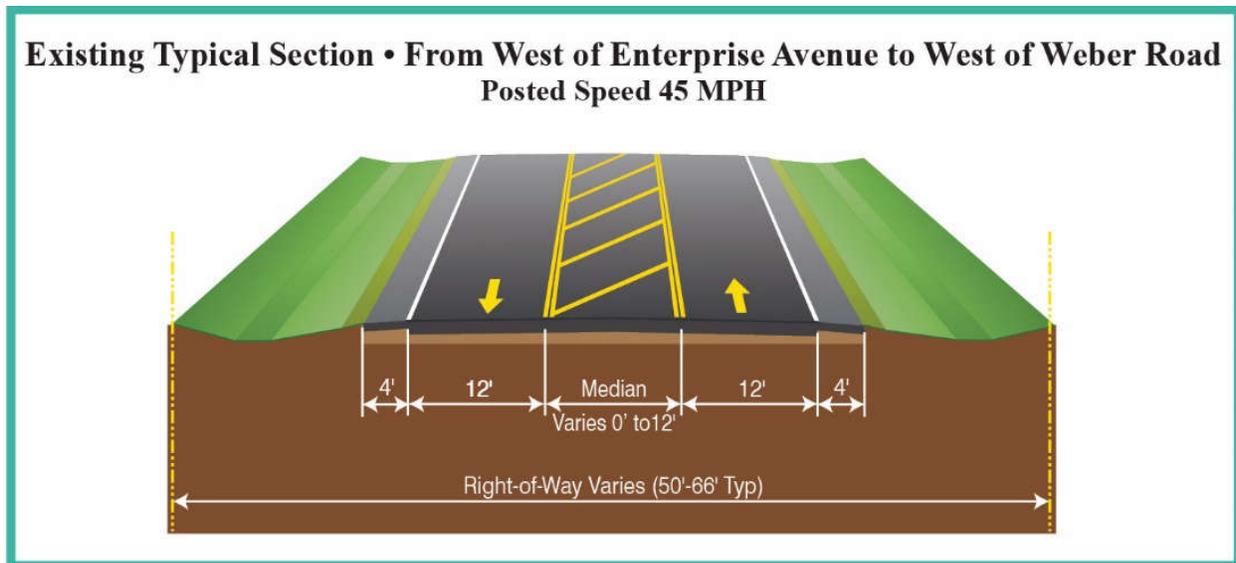
Figure 1-3: Existing Typical Section – Babcock Street to West of Enterprise Avenue



2. **West of Enterprise Avenue to West of Weber Road (MP 3.303 to MP 4.087)**

This typical section (**Figure 1-4**) consists of two 12-foot travel lanes, a variable width painted median, shallow ditches and a 45-mph posted speed limit. This section contains four-foot paved shoulders, two-foot grass shoulders, and ditches on both sides of the road. From west of Enterprise Avenue to west of Weber Road, there are large concrete transmission poles on the south side of the road just inside the ROW. The transmission poles switch to the north side 900 feet west of Weber Road.

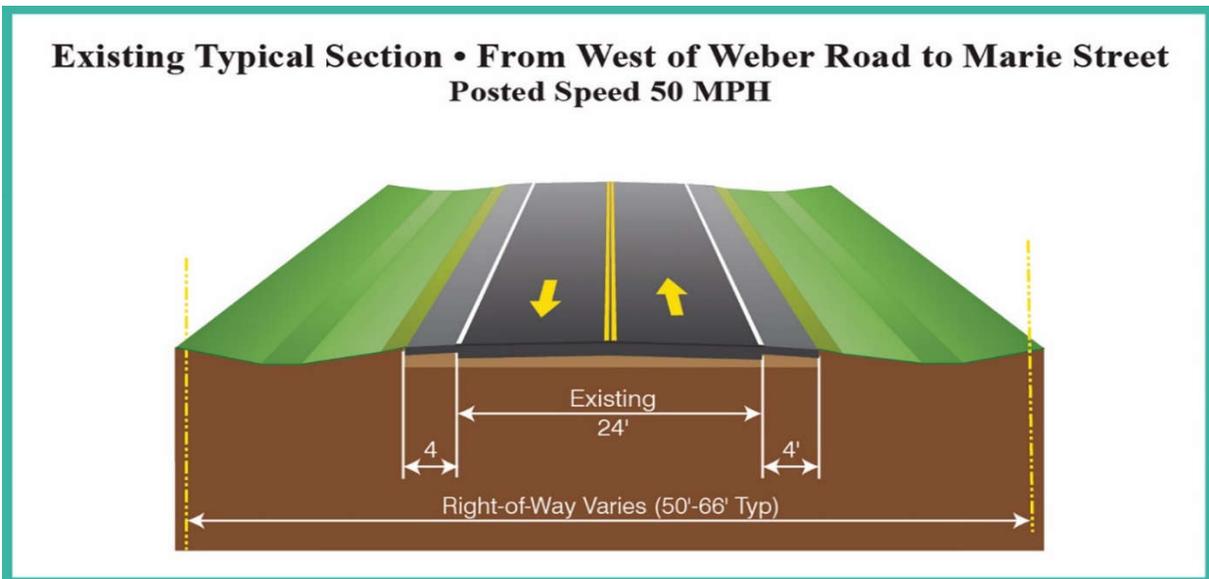
Figure 1-4: Existing Typical Section – West of Enterprise Avenue to West of Weber Road



**3. West of Weber Road to Marie Street (MP 4.087 to MP 6.129)**

Comprising the majority of the corridor (over two miles), this typical section (**Figure 1-5**) also consists of two 12-foot travel lanes, no median, six-foot shoulders (four-foot paved), shallow ditches and a 50-mph posted speed limit. The large concrete transmission poles are the primary utility on the north side of the road just inside the ROW from Weber Road to Glatter Road, where they follow Glatter Road on the north side.

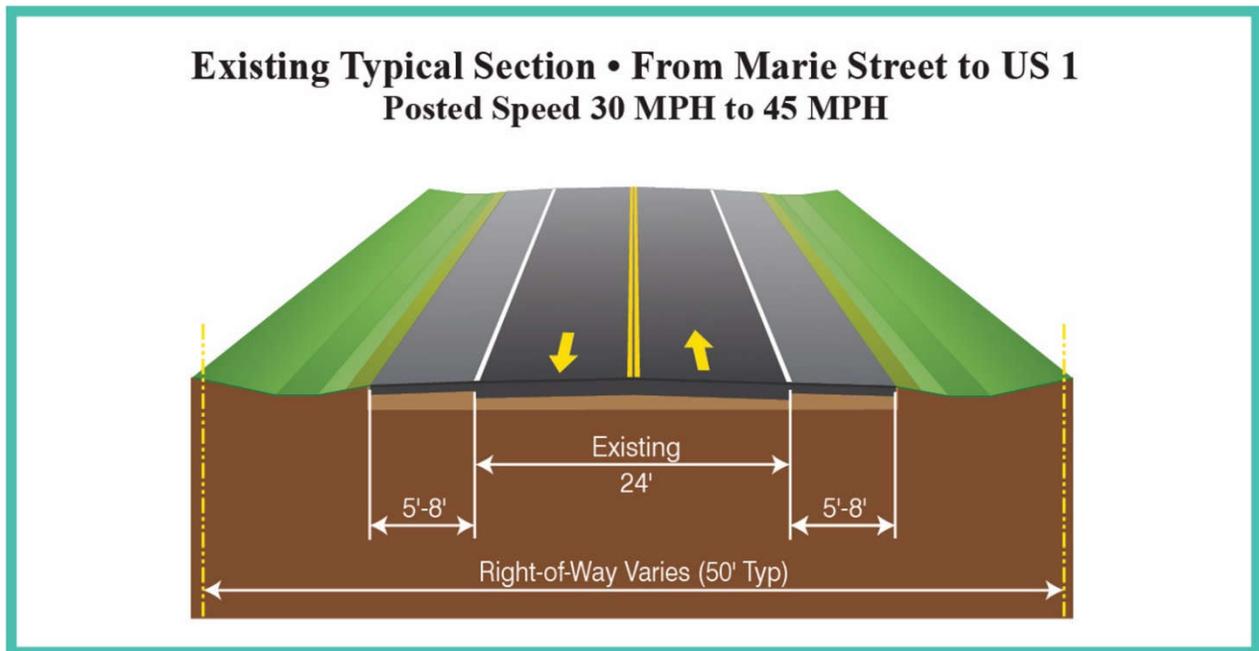
**Figure 1-5: Existing Typical Section – West of Weber Road to Marie Street**



#### 4. Marie Street to US 1 (MP 6.129 to MP 6.742)

Similar to the previous typical section, the fourth typical section also consists of two 12-foot undivided travel lanes, contains paved shoulders that vary between five-feet and eight-feet, gutter inlets on the south side of the road, and a 30 mph to 45 mph posted speed limit. The primary utility in this section of the road are wooden power poles on both sides of the road (Figure 1-6).

Figure 1-6: Existing Typical Section – Marie Street to US 1



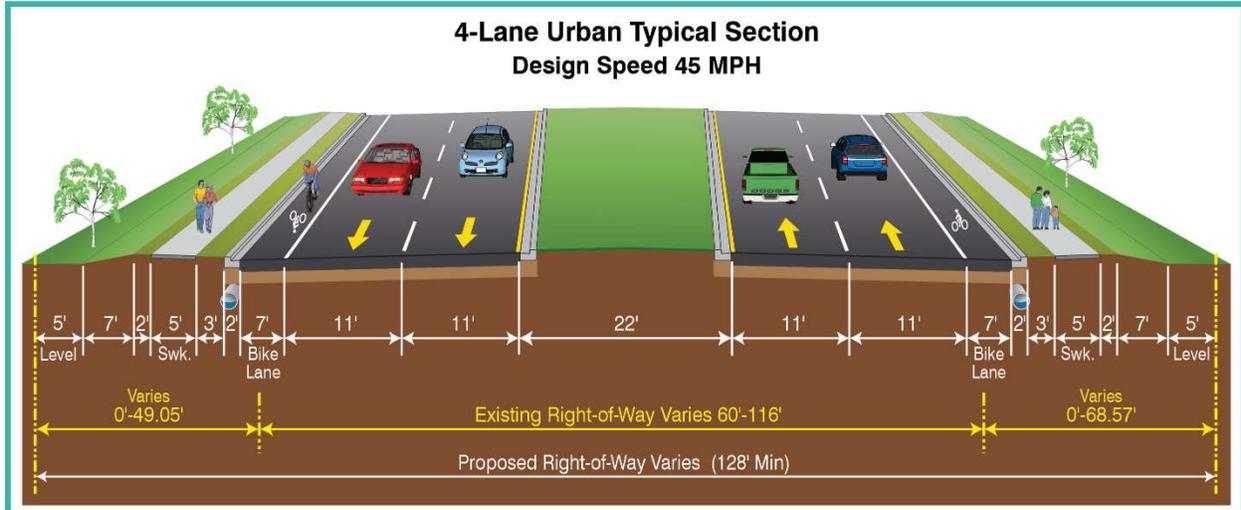
#### 1.4 Recommended Alternative

The Recommended Alternative consists of four different typical sections that vary from west to east, as follows.

**Segment 1: From East of Babcock Street (SR 507) to Weber Road.** Beginning east of Babcock Street (SR 507), the Recommended Alternative includes a four-lane urban typical section (Figure 1-7), providing two 11-foot travel lanes, a seven-foot bicycle lane and five-foot sidewalk in each direction with a 45-mph design speed and posted speed limit. Travel lanes are separated by a 22-foot wide raised grass median. Drainage is handled by curb-and-gutter and a closed drainage system to route stormwater runoff to offsite ponds. The alignment is a best-fit approach, starting to the north of the existing alignment and then transitioning south just west of a proposed roundabout at Weber Road. This segment ties into the Babcock Street intersection which was

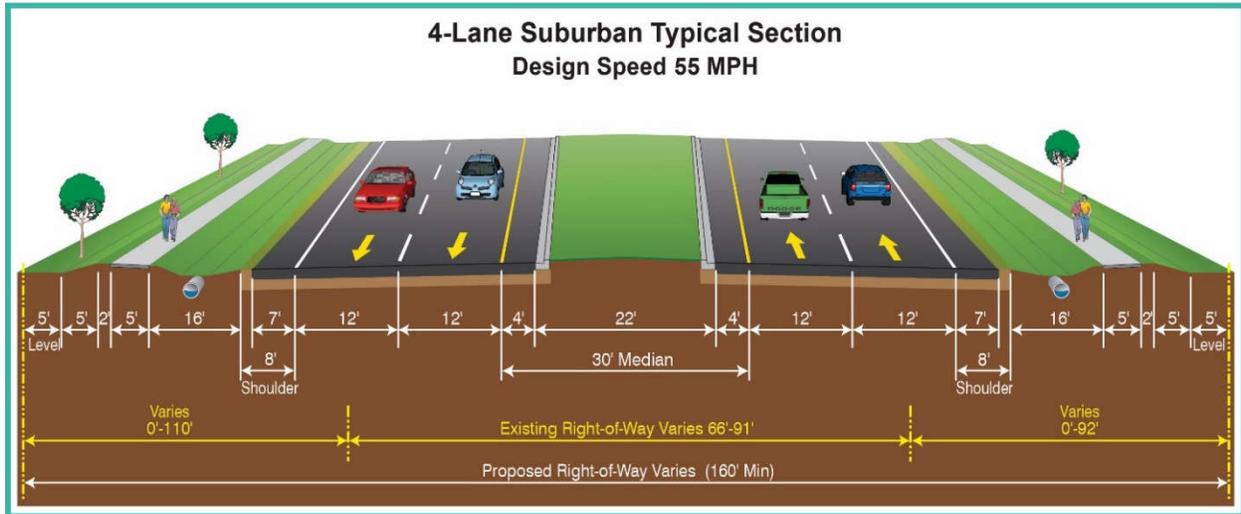
the subject of an improvement project (FPID 237650-3) completed in 2013 to widen for new turn lanes, improve the existing turn lanes, add mast arm signalization, and install new street lighting.

**Figure 1-7: Recommended Typical Section – Segment 1**



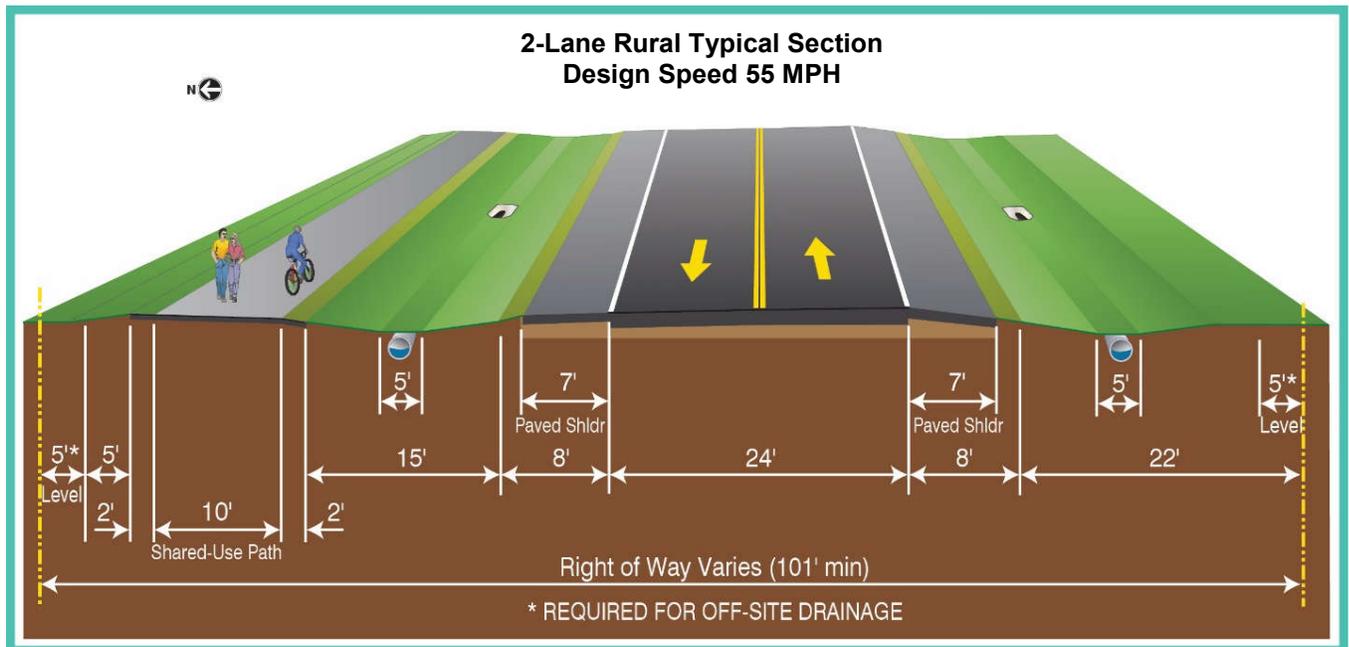
**Segment 2a: From Weber Road to Corey Road.** Just west of Weber Road, the Recommended Alternative transitions from a four-lane urban typical section to a four-lane suburban typical section (**Figure 1-8**). The four-lane suburban typical section provides two 12-foot travel lanes, an eight-foot shoulder (seven-foot paved which accommodates a bicycle lane), and a five-foot sidewalk in each travel direction. The design speed is 55 mph and the posted speed limit is 50 mph. Travel lanes are separated by a 30-foot wide median which includes a 22-foot raised grass area and two four-foot inside paved shoulders. Drainage swales/ditches are located on both sides of the roadway. Roundabouts are proposed at the Malabar Road (SR 514) intersections at Weber Road and Corey Road. The alignment is a best-fit concept. From west to east after the roundabout at Weber Road, the alignment shifts south then north to align with the proposed Corey Road roundabout. Additional right-of-way will be required from parcels on both sides of Malabar Road (SR 514) including approximately 0.38 acres from the Malabar Scrub Sanctuary and 0.02 acres from Fern Creek Crossing Park.

Figure 1-8: Recommended Typical Section – Segment 2a



**Segment 2b: From Corey Road to Marie Street.** East of the Corey Road intersection, the Recommended Alternative transitions from the four-lane suburban typical section into a two-lane rural roadway (Figure 1-9) including one 12-foot wide travel lane, an eight-foot shoulder (seven-foot paved which accommodates a bicycle lane) in each direction, and a 10-foot shared-use path along the north side of Malabar Road (SR 514), which provides a pedestrian and bicycle facility and connects the trailhead at Marie Street to the Malabar Community Park, the Malabar Scrub Sanctuary, and the Malabar Disc Golf Course Park. The design speed is 55 mph and the posted speed limit is 50 mph. The alignment is a best-fit concept. Between Corey Road and Shiflett Lane, parcels on both sides – with exception of the U.S. Post Office located on the north side – are impacted as the alignment transitions from a four-lane roadway to a two-lane roadway. Between Shiflett Lane and Marie Street the alignment has impacts to both the Malabar Scrub Sanctuary (0.34 acre) and Malabar Disc Golf Park (0.12 acre). The alignment shifts south of the existing roadway on the east side of the Disc Golf Park.

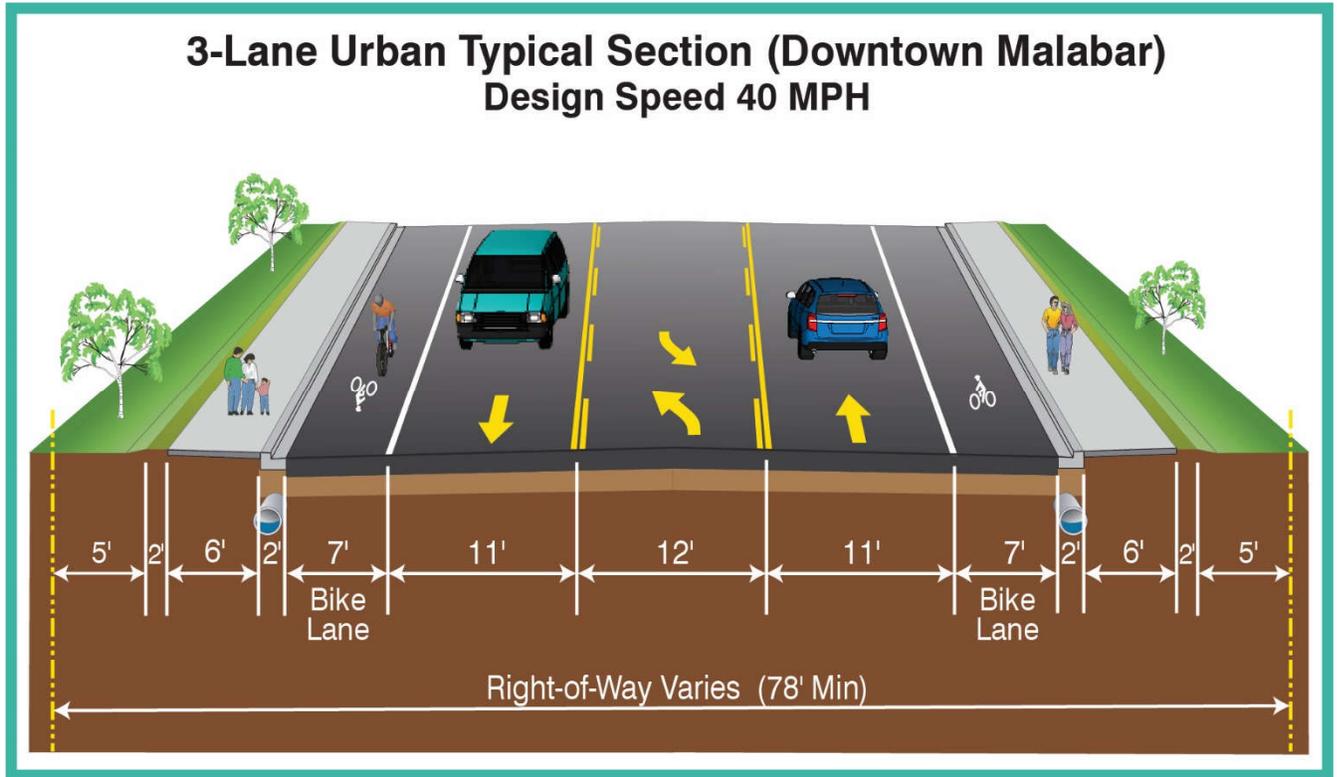
Figure 1-9: Recommended Typical Section – Segment 2b



**Segment 3: Marie Street to US 1.** East of Marie Street, the typical section transitions into a three-lane urban typical section (**Figure 1-10**). The recommended typical section includes one 11-foot travel lane in each direction, a 12-foot center bi-directional left-turn lane, and seven-foot bicycle lanes and six-foot sidewalks in each direction. Drainage is handled by curb-and-gutter and a closed drainage system to route stormwater runoff to offsite ponds. The design speed is 40 mph with a 35-mph posted speed limit. A best-fit alignment is centered on the existing roadway location, with ROW acquisition from both sides of the roadway. Additional lanes are proposed at the US 1 intersection as warranted by the traffic forecasts:

- A second northbound left turn lane and a second westbound receiving lane;
- A second eastbound left turn lane;
- Two northbound through lanes; the existing northbound signal bypass lane will be removed, and both northbound through lanes will be signal controlled.

Figure 1-10: Recommended Typical Section – Segment 3



## Section 2.0 Noise Study Methodology

The traffic noise study is performed in accordance with the 23 CFR 772, *Procedures for Abatement of Highway Traffic Noise and Construction Noise* using FDOT policy and methodology established in the *Project Development and Environment Manual, Part 2, Chapter 18* (June 2017), and *Traffic Noise Modeling and Analysis Practitioners Handbook*<sup>3</sup>. Predicted noise levels are produced using the Federal Highway Administration (FHWA) Traffic Noise Model (TNM), version 2.5.

### 2.1 Noise Metrics

Noise levels developed for this analysis are expressed in decibels (dB) using an “A”-scale [dB(A)] weighting. This weighted scale most closely approximates the response characteristics of the human ear to typical traffic noise levels. All reported noise levels are hourly equivalent noise levels [Leq(h)]. The Leq(h) is defined as the equivalent steady-state sound level that, in an hourly period, contains the same acoustic energy as the time-varying sound level for the same hourly period. Use of these metrics is specified by 23 CFR 772.

### 2.2 Traffic Data

The amount of traffic noise is dependent on vehicle speed with the amount of noise generated by traffic increasing as the vehicle speed increases. Roadway geometrics for the existing and build alternative are reviewed to identify maximized traffic volumes that would allow vehicles to travel at speeds consistent with speed limits established for Malabar Road. A vehicle volume resulting in Level of Service (LOS) C operating conditions is considered the maximum volume that allows vehicles to travel at the speed limit and consequently, produces the worst-case traffic noise environment. Therefore, noise levels are predicted using LOS C conditions when forecasted demand volumes exceed LOS C conditions. If forecasted demand volumes are less than LOS C volumes, demand traffic volumes are used to predict noise levels. A comparison between demand volumes and LOS C volumes are provided in **Tables 2-1, 2-2** and **2-3**. The speed limit was used when assigning speeds to vehicles.

**Table 2-1: Existing Traffic Data**

Malabar Road Segment	AADT Demand Volume <sup>1</sup>	AADT LOS C Volume	Speed (mph)
From Babcock Street to Enterprise Avenue	18,000	37,900	45
From Enterprise Avenue to Weber Road	16,000	16,800	45

Malabar Road Segment	AADT Demand Volume <sup>1</sup>	AADT LOS C Volume	Speed (mph)
From Weber Road to Corey Road	15,000	16,800	50
From Corey Road to Marie Street	13,000	16,800	50
From Marie Street to US1	13,000	16,800	35

**Table 2-2: Design Year (2045) No-Build Traffic Data**

Malabar Road Segment	AADT Demand Volume <sup>1</sup>	AADT LOS C Volume	Speed (mph)
From Babcock Street to Enterprise Avenue	28,000	37,900	45
From Enterprise Avenue to Weber Road	24,000	16,800	45
From Weber Road to Corey Road	22,000	16,800	50
From Corey Road to Marie Street	19,000	16,800	50
From Marie Street to US1	19,000	16,800	35

**Table 2-3: Design Year (2045) Build Traffic Data**

Malabar Road Segment	AADT Demand Volume <sup>1</sup>	AADT LOS C Volume	Speed (mph)
From Babcock Street to Enterprise Avenue	31,000	37,900	45
From Enterprise Avenue to Weber Road	29,000	37,900	45
From Weber Road to Corey Road	26,000	37,900	50
From Corey Road to Marie Street	23,000	16,800	50
From Marie Street to US1	23,000	17,640	35

The Annual Average Daily Traffic (AADT) volume is reduced to an hourly volume using a peak-hour factor (K-factor). Using a directional factor (D-factor), the heavier directional traffic volume is always assigned to travel lanes in closest proximity to noise sensitive sites. The total traffic volume is categorized into vehicle types (i.e., cars, medium trucks, heavy trucks, buses and motorcycles) using vehicle classification factors (e.g., T-factor). The source of traffic volumes for existing conditions, Design Year (2045) no-build conditions and Design Year (2045) build conditions, including factors to reduce AADT to hourly volumes, is provided in **Appendix A**.

### **2.3 Noise Abatement Criteria**

FHWA has established noise levels at which noise abatement must be considered for various types of noise sensitive sites. These noise levels are referred to as the Noise Abatement Criteria (NAC). As shown in **Table 2-4**, the NAC vary by Activity Category. Noise Abatement measures are considered when predicted traffic noise levels for Design Year (2045) Build Alternative conditions approach or exceed the NAC. Following FDOT procedure, an “approach” is defined as within 1 dB(A) of the FHWA criteria. For comparison purposes, typical noise levels associated with common indoor and outdoor activities are provided in **Table 2-5**.

Abatement measures must also be considered when a substantial increase in traffic noise would occur as a direct result of the transportation project. Following FDOT procedure, a substantial increase is defined as 15 dB(A) or more above existing conditions. A substantial increase typically occurs in areas where traffic noise is a minor component of the existing noise environment but could become a major component after the project is constructed. Existing Malabar Road is the predominant source of noise at sensitive sites adjacent to the road. Therefore, a substantial increase in noise as a direct result of the transportation improvement project is not expected to occur.

### **2.4 Noise Abatement Measures**

Abatement is evaluated for all noise sensitive sites predicted to approach/exceed the NAC or predicted to experience a substantial increase in traffic noise attributable to the project. Abatement measures considered include traffic management, alignment modifications, noise buffer zones through application of land use controls, and noise barriers.

#### **Traffic Management**

The purpose of the proposed project is to improve the mobility along Malabar Road by relieving traffic congestion resulting in the safe and efficient accommodation of future projected traffic demand in the Design Year (2045). Traffic management measures such as a much-reduced speed limit or prohibition of truck traffic would not be consistent with the project objectives. Consequently, traffic management is not a viable abatement measure.

**Table 2-4: FHWA Noise Abatement Criteria**

<b>Activity Category</b>	<b>Leq(h)</b>	<b>Evaluation Location</b>	<b>Description of Land Use Activity Category</b>
A	57	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	67	Exterior	Residential.
C	67	Exterior	Active sports areas, amphitheatres, 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, recreation areas, Section 4(f) sites, schools, television studios, trails, and trail crossings.
D	52	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.
E	72	Exterior	Hotels, motels, offices, restaurants/bars, and other developed lands, properties or activities not included in A – D or F.
F	-----	-----	Agriculture, airports, bus yards, emergency services, industrial, logging, maintenance facilities, manufacturing, mining, rail yards, retail facilities, shipyards, utilities (water resources, water treatment, electrical), and warehousing.
G	-----	-----	Undeveloped lands that are not permitted.

Source: 23 CFR Part 772, *Procedures for Abatement of Highway Traffic Noise and Construction Noise*, FHWA, 2010

**Table 2-5: Typical Noise Levels**

Common Outdoor Activities	Noise Level dB(A)	Common Indoor Activities
Jet Fly-over at 1000 ft.	---110---	Rock Band
Gas Lawn Mower at 3 ft.	---100---	
Diesel Truck at 50 ft., at 50 mph	---90---	Food Blender at 1 m (3 ft)
Noise Urban Area (Daytime)	---80---	Garbage Disposal at 1 m (3 ft)
Gas Lawn Mower at 100 ft.	---70---	Vacuum Cleaner at 10 ft
Commercial Area	---60---	Normal Speech at 3 ft
Heavy Traffic at 300 ft.	---50---	Large Business Office
Quiet Urban Daytime	---40---	Dishwasher Next Room
Quiet Urban Nighttime	---30---	Theater, Large Conference Room (Background)
Quiet Suburban Nighttime	---20---	Library
Quiet Rural Nighttime	---10---	Bedroom at Night, Concert Hall (Background)
Lowest Threshold of Human Hearing	---0---	Lowest Threshold of Human Hearing

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

**Alignment Modification**

The proposed alignment of Malabar Road makes full use of existing ROW along Malabar Road. Consequently, alignment modification is not a viable abatement measure.

**Buffer Zones**

As properties in the vicinity of a highway are developed, providing a buffer between a highway and future noise sensitive development can minimize or eliminate noise impacts. This abatement measure can be implemented through local land use planning. The distance between the proposed highway and location where traffic noise levels approach the NAC for Activity Categories A, B, C and E is determined to facilitate future land use planning that is compatible with the traffic noise environment. For the proposed conceptual design, the distance between the nearest through lane of Malabar Road and the location where traffic noise levels would approach a particular NAC for design year (2045) traffic conditions are provided in **Table 2-6**. The distance does not account for any reduction in noise levels that may be provided by berms, privacy walls or intervening structures. For any new development occurring in the future, local officials can use the noise contour information to establish buffer zones thereby minimizing or avoiding noise impacts at sensitive land uses.

**Table 2-6: Noise Abatement Criteria Contours**

Roadway	Distance <sup>1</sup>		
	Activity Category A [56 dB(A)]	Activity Category B & C [66 dB(A)]	Activity Category E [71 dB(A)]
Malabar Road – Babcock Street to Weber Road	463 feet	120 feet	45 feet
Malabar Road – Weber Road to Gilmore Street	526 feet	140 feet	57 feet
Malabar Road –Gilmore Street to Marie Street	306 feet	110 feet	53 feet
Malabar Road –Marie Street to Marshall Drive	414 feet	113 feet	43 feet
Malabar Road – Marshall Drive to US 1	376 feet	78 feet	18 feet

<sup>1</sup>Distance referenced to the nearest proposed through lane. Distance does not account for any reduction in noise levels that may be provided by berms, privacy walls or intervening structures.

**Noise Barriers**

Noise barriers reduce noise levels by blocking the sound path between a roadway and a noise sensitive site. To effectively reduce traffic noise, a noise barrier must be relatively long, continuous (with no intermittent openings) and of sufficient height. Noise barriers located along the ROW line are evaluated for heights ranging from eight to 22 feet in two-foot increments. The maximum noise barrier height of 22 feet is specified in the *Plans Preparation Manual*<sup>3</sup>. For a noise barrier to be considered feasible and cost reasonable, the following minimum conditions should be met:

- A noise barrier must provide a minimum noise reduction of 5 dB(A) for at least two impacted noise sensitive sites with at least one benefited noise sensitive site provided a noise reduction of 7 dB(A) (noise reduction design goal) or more.
- The cost of the noise barrier should not exceed \$42,000 per benefited residence. For non-residential uses, the cost of the noise barrier should not exceed \$995,935/person-hour of use/square foot of noise barrier. A benefited residence or noise sensitive site is defined as a residence or area where at least a 5 dB(A) reduction would occur as a result of providing a noise barrier. The current unit cost used to evaluate cost reasonableness is \$30 per square foot of noise barrier, which covers barrier materials and labor.

Noise barriers are evaluated based on the benefit provided to noise sensitive sites with predicted noise levels that approach/exceed the NAC or experience a substantial increase in traffic noise attributable to the proposed project. Noise barrier lengths and heights are optimized as part of a barrier analysis. Optimization involves reducing barrier length, thereby minimizing cost, for a

particular barrier height while maintaining at least a 5 dB(A) reduction at impacted noise sensitive sites where possible. The purpose of optimization is to maximize the number of impacted noise sensitive sites that can be benefited with a noise barrier that is cost reasonable.

At some locations, a noise barrier for impacted noise sensitive sites may also benefit additional sites with predicted noise levels that do not approach the NAC. Since abatement consideration at the additional non-impacted sites is not required, noise barrier lengths or heights are not increased to specifically benefit non-impacted sites. However, if experiencing an incidental benefit because of proximity to an impacted noise sensitive site, the additional non-impacted sites are included when determining cost reasonableness.

## Section 3.0 Traffic Noise Analysis

The traffic noise analysis includes noise model validation and prediction of noise levels for existing conditions, Design Year (2045) no build conditions and Design Year (2045) build conditions. Receptor points representing noise sensitive sites were established by a field review performed on July 23, 2013.

### 3.1 Noise Model Validation

To validate the accuracy of the computer noise model for the project area, field measurements were taken following procedures documented in FHWA's *Measurement of Highway-Related Noise*<sup>4</sup>. Noise monitoring was performed on July 23, 2013, using a Quest Technologies Q-300 noise monitor. All monitoring events were ten minutes in duration consistent with FDOT procedures. Prior to taking noise measurements, the noise monitor was calibrated using a QC-10 calibrator.

The validation sites were located in the vicinity of noise sensitive areas (i.e., residential communities) where traffic could be observed. Traffic volumes by vehicle classification were noted during each monitoring event. Average vehicle speeds were taken with a radar gun. Field notes for each monitoring event are provided in **Appendix B**.

The results for each monitoring event are provided in **Table 3-1**. The variance between measured and predicted noise levels was less than or equal to 3 dB(A). Therefore, the noise model is predicting within the level of accuracy specified in FDOT's PD&E Manual.

**Table 3-1: Malabar Road Noise Model Validation**

Location	Trial #	Date	Time	Field Measured Level dB(A)	Computer Predicted Level dB(A)	Decibel Difference dB(A)
<b>Monitoring Site # 1 (Monitor 58 feet South of edge of pavement)</b> South of Malabar Rd. and west of Brevard Health Alliance Inc. parking lot	1	7-23-2013	11:08 AM	65.7	65.7	0.0
	2	7-23-2013	11:20 AM	65.8	67.1	1.3
	3	7-23-2013	11:31 AM	64.9	66.1	1.2
<b>Monitoring Site # 2 (Monitor 73 feet South of edge of pavement)</b> South of Malabar Rd. and near Baseball field at First Baptist Church of Malabar	1	7-23-2013	11:54 AM	62.3	65.3	3.0
	2	7-23-2013	12:05 AM	62.4	65.0	2.6
	3	7-23-2013	12:16 AM	63.1	65.7	2.6

### 3.2 Noise Sensitive Sites

Within the project limits, noise sensitive land uses that are specified in the NAC include:

Activity Category B (residential areas) – Within the project limits, one residential community (Enchanted Lake Estates) is located along Malabar Road along with other residences scattered along the length of the corridor at varying densities of residential development.

Activity Category C – Within the project limits, six recreational uses (community swimming pool at Enchanted Lakes Estates, Malabar Park baseball facilities, Little Impressions Academy playground, Berri Patch Preschool playground, First Baptist Church baseball field and Town of Malabar Disc Golf Park) are located along Malabar Road. Picnic tables at the Moose Lodge and outdoor tables at Palm Bay Hospital are also located along Malabar Road.

Activity Category D – Within the project limits, seven institutional uses (Old Malabar School House, New Testament Bethel Ministries, Hope Ministries, Church for All Nations, Little Impressions Academy, Berri Patch Preschool and First Baptist Church of Malabar) and three medical facilities (Palm Bay Hospital, Internal Medicine and Brevard Health Alliance Inc.), are located along Malabar Road.

Activity Category E – Outdoor dining is provided at one restaurant (Malabar Mo's Bar and Grill) located in Malabar along Malabar Road.

Activity Category F (retail facilities) were also noted. Activity Category F land uses do not require a noise analysis as stipulated in 23 CFR 772. Some properties along Malabar Road are undeveloped (Activity Category G). When considering development of currently undeveloped property, the noise contour information provided in Section 2.4.3 can be applied to minimize or eliminate development that is incompatible with traffic noise.

As specified in FDOT's procedures, all noise sensitive land uses that have received a building permit prior to the project's Date of Public Knowledge (DPK) must be evaluated. The DPK is defined as the date the environmental document is approved. This date will be established after the PD&E noise analysis is complete; therefore, a specific commitment to review land use in the Design phase will be made. Notably, there was no ongoing construction observed during the field review performed to establish existing land use (July 23, 2013).

Receptor points representing noise sensitive sites are located in accordance with FDOT's PD&E Manual, *Part 2, Chapter 18* (June 2017) as follows:

- Residential and institutional (e.g., schools, churches) receptor points are located at the edge of the building closest to Malabar Road.

- Receptor points representing noise sensitive sites in Activity Categories C and E are located in exterior areas of potential frequent human use.
- Ground floor receptor points are positioned 5 feet above the ground elevation. Second floor receptor points are positioned 15 feet above the ground elevation.

All noise sensitive sites within the project limits along Malabar Road from Babcock Road to US 1 were evaluated for traffic noise. Noise levels are predicted at 78 receptor points representing 57 residences and other non-residential noise sensitive sites previously identified by activity category. Predicted noise levels at the receptor points are provided in **Appendix C**. The locations of the receptor points identified in **Appendix C** are depicted on aerials found in **Appendix D**. An electronic copy of the TNM modeling files is found in **Appendix E**. The alphanumeric identification for each receptor point was formulated as follows:

- Receptor points to the north of Malabar Road are specified by “N” and receptor points to the south of Malabar Road are specified by “S” in the receptor identification.
- For two story buildings, the first floor is specified by “A” and the second floor is specified by “B” at the end of the receptor identification.
- The numeric portion of the receptor identification identifies a specific receptor point.

### **3.3 Predicted Noise Levels and Abatement Analysis**

For Design Year (2045) build conditions, exterior noise levels are predicted to approach or exceed the NAC at 21 residences, the playground at Little Impressions Academy, the baseball field at the First Baptist Church of Malabar and the Town of Malabar Disc Golf Course. Compared to existing conditions, traffic noise levels for Design Year (2045) build conditions are not predicted to substantially increase at any noise sensitive site. At some receptors, the Design Year (2045) build conditions show a small decrease in the predicted noise level compared to existing conditions. The decrease is a result of minor shifts in the alignment of Malabar Road proposed with the conceptual design.

#### **North side of Malabar Road:**

##### **Moose Lodge**

The Moose Lodge is located north of Malabar Road at Station 111. The lodge has an outdoor use area with picnic tables. With a predicted exterior traffic noise level of 62.1 dB(A) for Design Year (2045) build conditions, the traffic noise level at the outdoor use area does not approach or exceed the NAC. Compared to existing conditions, the traffic noise level for Design Year (2045) build conditions is predicted to increase 3.5 dB(A). Therefore, the traffic noise level at the outdoor use area is not expected to substantially increase above existing conditions.

The traffic noise level is not predicted to approach or exceed the NAC. Furthermore, the existing traffic noise level is not predicted to substantially increase as a direct result of the transportation improvement project. Therefore, a noise barrier is not considered for the picnic tables at the Moose Lodge.

### **Palm Bay Hospital**

The Palm Bay Hospital is also analyzed as an Activity Category D (interior) use. Following FHWA procedures documented in *Highway Traffic Noise: Analysis and Abatement Guidance*<sup>5</sup> (FHWA, December 2011), the traffic noise level for the interior of the hospital is determined by applying a 25 dB(A) reduction to the exterior traffic noise prediction. The 25 dB(A) decrease accounts for the noise reduction from the masonry building. With a predicted interior traffic noise level of 34.8 dB(A) for Design Year (2045) build conditions, the interior traffic noise level at the hospital does not approach or exceed the NAC. Compared to existing conditions, traffic noise levels for Design Year (2045) build conditions are predicted to increase 2.2 dB(A) or less. Therefore, traffic noise levels at the hospital are not expected to substantially increase above existing conditions.

Traffic noise levels are not predicted to approach or exceed the NAC. Furthermore, existing traffic noise levels are not predicted to substantially increase as a direct result of the transportation improvement project. Therefore, a noise barrier is not considered for the Palm Bay Hospital.

### **Enchanted Lakes Estates Mobile Home and RV Resort**

The Enchanted Lakes Estates Mobile Home and RV Resort is a mobile home park located north of Malabar Road between Station 145 and Station 153. With predicted exterior traffic noise levels ranging from 55.1 to 70.3 dB(A) for Design Year (2045) build conditions, traffic noise levels at six of the residences in the Enchanted Lakes Estates Mobile Home and RV Resort exceed the NAC. Predicted exterior traffic noise levels at all other residences are 63.3 dB(A) or less. Compared to existing conditions, traffic noise levels for Design Year (2045) build conditions are predicted to increase 1.1 dB(A) or less. Therefore, traffic noise levels at the residences are not expected to substantially increase above existing conditions.

A noise barrier must be divided into three segments to accommodate existing access roads connecting to Malabar Road. The eastern extent of each of evaluated noise barrier was extended 71 feet in order to complete the neighborhood. Barriers with heights of 20 and 22 feet were not extended because they were not considered cost effective, and therefore not a reasonable abatement measure. An evaluation of noise barriers at the ROW line is summarized in **Table 3-2**. At a noise barrier height of 10 feet or greater, a noise barrier system would potentially provide at least a 5 dB(A) reduction at all six impacted residences while meeting the noise reduction design goal of 7 dB(A) for at least one of the benefitted residences.

Noise barriers at heights from eight to 16 feet, are under the cost-effective limit of \$42,000 per benefitted residence. However, due to heavy truck traffic on Malabar Road, noise barriers higher than 14 feet are recommended due to the exhaust stacks from these trucks. The recommended barrier alternative is in the Barrier Evaluation Table (Table 4-1).

**Table 3-2: Noise Barrier Analysis – Enchanted Lakes Mobile Home Park**

Barrier Height (feet)	Barrier Length <sup>1</sup> (feet)	Number of Impacted Residences	Number of Impacted Residences Within a Noise Reduction Range			Number of Benefitted Residences				Total Estimated Cost <sup>4</sup>	Cost Per Benefitted Residence
			5-5.9 dB(A)	6-6.9 dB(A)	≥ 7 dB(A)	Impacted <sup>2</sup>	Other <sup>3</sup>	Total	Average Reduction dB(A)		
8	220	6	0	2	3	5	0	5	7.5	\$190,800	\$38,160
	241										
	334										
10	200		1	1	4	6	2	8	7.4	\$216,900	\$27,112
	189										
	334										
12	99		1	1	4	6	1	7	8.4	\$216,720	\$30,960
	169										
	334										
14	79		2	0	4	6	1	7	8.5	\$238,980	\$34,140
	169										
	321										
16	79		2	1	3	6	1	7	8.7	\$263,520	\$37,645
	149										
	321										
18	99		3	0	3	6	0	6	7.6	\$297,000	\$49,500
	130										
	321										
20	99		3	0	3	6	0	6	7.8	\$287,400	\$47,900
	130										
	250										
22	79	3	1	2	6	3	6	7.8	\$302,940	\$50,490	
	130										
	250										

**Residences just East of the Transmission Corridor**

Two residences are located north of Malabar Road between Station 158 and Station 164. With predicted exterior traffic noise levels of 65.8 and 66.4 dB(A) for Design Year (2045) build conditions, traffic noise levels at one of the residences approaches or exceeds the NAC.

Compared to existing conditions, traffic noise levels for Design Year (2045) build conditions are predicted to decrease 1.5 dB(A) or more. Therefore, traffic noise levels at the two residences are not expected to substantially increase above existing conditions.

FDOT policy requires that two or more impacted receptors benefit (i.e., be provided a noise reduction of 5 dB(A) or greater) for a noise barrier to be considered feasible. Since there is only one impacted residence in this area that may benefit, a noise barrier cannot be a feasible abatement measure. No further abatement evaluation is required.

#### **Residences between Corey Road and Gilmore Street**

Two residences are located north of Malabar Road between Station 205 and Station 211. With a predicted exterior traffic noise level of 56.9 and 65.3 dB(A) for Design Year (2045) build conditions, the traffic noise level does not approach or exceed the NAC at either residence. Compared to existing conditions, traffic noise levels for Design Year (2045) build conditions are predicted to increase 6.0 dB(A) or less. Therefore, traffic noise levels at the two residences are not expected to substantially increase above existing conditions.

The traffic noise level is not predicted to approach or exceed the NAC. Furthermore, the existing traffic noise level is not predicted to substantially increase as a direct result of the transportation improvement project. Therefore, a noise barrier is not considered for the residence.

#### **Residences between Gilmore Road and Malabar Woods Boulevard**

Two residences are located north of Malabar Road between Station 216 and Station 220. With predicted exterior traffic noise levels of 62.8 and 64.3 dB(A) for Design Year (2045) build conditions, the traffic noise level does not approach or exceed the NAC at either residence. Compared to existing conditions, traffic noise levels for Design Year (2045) build conditions are predicted to decrease 2 dB(A) or more. Therefore, traffic noise levels at the two residences are not expected to substantially increase above existing conditions.

The traffic noise level is not predicted to approach or exceed the NAC. Furthermore, the existing traffic noise level is not predicted to substantially increase as a direct result of the transportation improvement project. Therefore, a noise barrier is not considered for the residence.

#### **Malabar Park**

Malabar Park is located north of Malabar Road at Station 224. The recreational facility provides outdoor baseball fields and practice facilities. With a predicted exterior traffic noise level of 51.1 dB(A) for Design Year (2045) build conditions, the traffic noise level at the baseball field closest to Malabar Road does not approach or exceed the NAC. Compared to existing conditions, the traffic noise level for Design Year (2045) build conditions is predicted to decrease 0.3 dB(A).

Therefore, the traffic noise level at the baseball facilities is not expected to substantially increase above existing conditions.

The traffic noise level is not predicted to approach or exceed the NAC. Furthermore, the existing traffic noise level is not predicted to substantially increase as a direct result of the transportation improvement project. Therefore, a noise barrier is not considered for Malabar Park.

#### **Residence between Malabar Woods Boulevard and Marie Street**

A single residence is located north of Malabar Road at Station 244. With a predicted exterior traffic noise level of 52.1 dB(A) for Design Year (2045) build conditions, the traffic noise level at the residence does not approach or exceed the NAC. Compared to existing conditions, the traffic noise level for Design Year (2045) build conditions is predicted to decrease 2.1 dB(A). Therefore, the traffic noise level at the residence is not expected to substantially increase above existing conditions.

The traffic noise level is not predicted to approach or exceed the NAC. Furthermore, the existing traffic noise level is not predicted to substantially increase as a direct result of the transportation improvement project. Therefore, a noise barrier is not considered for the residence.

#### **Old Malabar School House**

The Old Malabar School House is located north of Malabar Road at Station 260. There is no exterior area of frequent human use near Malabar Road. Therefore, the school is analyzed as an Activity Category D (interior) use. Following FHWA procedures documented in *Highway Traffic Noise: Analysis and Abatement Guidance* (FHWA, December 2011), the traffic noise level for the interior of the school is determined by applying a 25 dB(A) reduction to the exterior traffic noise prediction. The 25 dB(A) decrease accounts for noise reduction from the masonry building. With a predicted interior traffic noise level of 31.4 dB(A) for Design Year (2045) build conditions, the traffic noise level at the school does not approach or exceed the NAC. Compared to existing conditions, the traffic noise level for Design Year (2045) build conditions is predicted to decrease 0.3 dB(A). Therefore, the traffic noise level at the school is not expected to substantially increase above existing conditions.

The traffic noise level is not predicted to approach or exceed the NAC. Furthermore, the existing traffic noise level is not predicted to substantially increase as a direct result of the transportation improvement project. Therefore, a noise barrier is not considered for the Old Malabar School House.

#### **Iglesia Christiana Elohim Church**

The Iglesia Christiana Elohim Church is located north of Malabar Road at Station 245. There is no exterior area of frequent human use near Malabar Road. The Iglesia Christiana Elohim Church is

also analyzed as an Activity Category D (interior) use. Following FHWA procedures documented in *Highway Traffic Noise: Analysis and Abatement Guidance*<sup>5</sup> (FHWA, December 2011), the traffic noise level for the interior of the church is determined by applying a 25 dB(A) reduction to the exterior traffic noise prediction. The 25 dB(A) decrease accounts for the noise reduction from the masonry building. With a predicted interior traffic noise level of 34.8 dB(A) for Design Year (2045) build conditions, the interior traffic noise level at the church does not approach or exceed the NAC. Therefore, a noise barrier is not considered for the Iglesia Christiana Elohim Church.

#### **Residences between Marie Street and West Railroad Street**

Thirteen residences are located north of Malabar Road between Station 263 and Station 276. With a predicted exterior traffic noise level of 66.4 dB(A) for one residence between Marie Street and Blanche Street and 68.1 dB(A) for one residence between Florence Street and Marshal Drive, and 67.2 dB(A) for one residence between Marshall Drive and West Railroad Street for Design Year (2045) build conditions, the traffic noise level at three of the 13 residences exceeds the NAC. The predicted exterior traffic noise level at the other 10 residences is 65.3 dB(A) or less. Compared to existing conditions, traffic noise levels for Design Year (2045) build conditions are predicted to increase 0.9 dB(A) or more at six residences and decrease 1.1 dB(A) at seven residences. Therefore, traffic noise levels at the four residences are not expected to substantially increase above existing conditions.

Each of the three impacted receptors is separated by over 500-feet and multiple street and driveway openings. Therefore, each impacted receptor is an isolated residence.

FDOT policy requires that two or more impacted receptors benefit (i.e., be provided a noise reduction of 5 dB(A) or greater) for a noise barrier to be considered feasible. Since there is only one impacted residence in this area that may benefit, a noise barrier cannot be a feasible abatement measure. No further abatement evaluation is required.

#### **Residence between W. Railroad Street and US-1**

One residence located north of Malabar Road between Station 286 and Station 289. With a predicted exterior traffic noise level of 59.2 the traffic noise level at the residence does not approach or exceed the NAC. Compared to existing conditions, the traffic noise level for Design Year (2045) build conditions is predicted to decrease 0.9 dB(A). Therefore, the traffic noise level at the residence is not expected to substantially increase above existing conditions.

The traffic noise level is not predicted to approach or exceed the NAC. Furthermore, the existing traffic noise level is not predicted to substantially increase as a direct result of the transportation improvement project. Therefore, a noise barrier is not considered for the residence.

## **South side of Malabar Road:**

### **New Testament Bethel Ministries**

New Testament Bethel Ministries is located south of Malabar Road at Station 103. The facility has no outdoor areas of frequent human use. Therefore, the ministry is analyzed as an Activity Category D (interior) use. Following FHWA procedures documented in *Highway Traffic Noise: Analysis and Abatement Guidance* (FHWA, December 2011), the traffic noise level for the interior of the building is determined by applying a 25 dB(A) reduction to the exterior traffic noise prediction. The 25 dB(A) decrease accounts for noise reduction from the masonry building. With a predicted interior traffic noise level of 42.4 dB(A) for Design Year (2045) build conditions, the traffic noise level does not approach or exceed the NAC. Compared to existing conditions, the traffic noise level for Design Year (2045) build conditions is predicted to increase 0.1 dB(A). Therefore, the traffic noise level at the ministry building is not predicted to substantially increase above existing conditions.

The traffic noise level is not predicted to approach or exceed the NAC. Furthermore, the existing traffic noise level is not predicted to substantially increase as a direct result of the transportation improvement project. Therefore, a noise barrier is not considered for the New Testament Bethel Ministries.

### **Internal Medicine**

Internal Medicine is a medical facility located south of Malabar Road at Station 108. The facility has no outdoor areas of frequent human use. Therefore, the medical facility is analyzed as an Activity Category D (interior) use. Following FHWA procedures documented in *Highway Traffic Noise: Analysis and Abatement Guidance* (FHWA, December 2011), the traffic noise level for the interior of the building is determined by applying a 25 dB(A) reduction to the exterior traffic noise prediction. The 25 dB(A) decrease accounts for noise reduction from the masonry building. With a predicted interior traffic noise level of 39.5 dB(A) for Design Year (2045) build conditions, the traffic noise level at this medical facility does not approach or exceed the NAC. Compared to existing conditions, the traffic noise level for Design Year (2045) build conditions is predicted to increase 1.5 dB(A). Therefore, the traffic noise level at the medical facility is not predicted to substantially increase above existing conditions.

The traffic noise level is not predicted to approach or exceed the NAC. Furthermore, the existing traffic noise level is not predicted to substantially increase as a direct result of the transportation improvement project. Therefore, a noise barrier is not considered for the Internal Medicine medical facility.

### **Hope Ministries**

Hope Ministries is located south of Malabar Road at Station 112. The church has no outdoor areas of frequent human use along Malabar Road. Therefore, the church is analyzed as an Activity Category D (interior) use. Following FHWA procedures documented in *Highway Traffic Noise: Analysis and Abatement Guidance* (FHWA, December 2011), the traffic noise level for the interior of the church is determined by applying a 25 dB(A) reduction to the exterior traffic noise prediction. The 25 dB(A) decrease accounts for noise reduction from the masonry building. With a predicted interior traffic noise level of 30.9 dB(A) for Design Year (2045) build conditions, the traffic noise level at the church does not approach or exceed the NAC. Compared to existing conditions, the traffic noise level for Design Year (2045) build conditions is predicted to increase 1.0 dB(A). Therefore, the traffic noise level at the church is not predicted to substantially increase above existing conditions.

The traffic noise level is not predicted to approach or exceed the NAC. Furthermore, the existing traffic noise level is not predicted to substantially increase as a direct result of the transportation improvement project. Therefore, a noise barrier is not considered for the Hope Ministries.

### **Church for All Nations**

Church for All Nations is located south of Malabar Road at Station 112. There is no exterior area of frequent human use. Therefore, the ministry is analyzed as an Activity Category D (interior) use. Following FHWA procedures documented in *Highway Traffic Noise: Analysis and Abatement Guidance* (FHWA, December 2011), the traffic noise level for the interior of the ministry is determined by applying a 25 dB(A) reduction to the exterior traffic noise prediction. The 25 dB(A) decrease accounts for noise reduction from the masonry building. With a predicted interior traffic noise level of 28.3 dB(A) for Design Year (2045) build conditions, the traffic noise level at the ministry does not approach or exceed the NAC. Compared to existing conditions, the traffic noise level for Design Year (2045) build conditions is predicted to increase 1.3 dB(A). Therefore, the traffic noise level at the ministry is not expected to substantially increase above existing conditions.

The traffic noise level is not predicted to approach or exceed the NAC. Furthermore, the existing traffic noise level is not predicted to substantially increase as a direct result of the transportation improvement project. Therefore, a noise barrier is not considered for the Hope Ministries.

### **Little Impressions Academy**

The Little Impressions Academy is located south of Malabar Road at Station 112+50. The academy has an outdoor playground. With a predicted exterior traffic noise level of 67.4 dB(A) for Design Year (2045) build conditions, the traffic noise level at the playground exceeds the NAC. Compared to existing conditions, the traffic noise level for Design Year (2045) build conditions is predicted

to increase 0.9 dB(A). Therefore, the traffic noise level at the preschool facility is not expected to substantially increase above existing conditions.

The Little Impression Academy is also analyzed as an Activity Category D (interior) use. Following FHWA procedures documented in *Highway Traffic Noise: Analysis and Abatement Guidance* (FHWA, December 2011), the traffic noise level for the interior of the preschool is determined by applying a 25 dB(A) reduction to the exterior traffic noise prediction. The 25 dB(A) decrease accounts for the noise reduction from the masonry building. With a predicted interior traffic noise level of 41.9 dB(A) for Design Year (2045) build conditions, the interior traffic noise level at the preschool facility does not approach or exceed the NAC.

The playground at the Little Impressions Academy is located adjacent to the main building. A noise barrier was evaluated following procedures documented in *A Method to Determine Reasonableness and Feasibility of Noise Abatement at Special Use Locations*<sup>6</sup> (FDOT 2009). Due to a gap in the barrier needed for a driveway and line-of-sight constraints for vehicles accessing Malabar Road, the minimum noise reduction of 5 dB(A) could not be achieved at the playground. Consequently, a noise barrier is not a feasible abatement measure at the playground. No further abatement evaluation is required.

### **Berri Patch Preschool and Playground**

The Berri Patch Preschool is located south of Malabar Road at Station 137. The preschool has an outdoor playground. With a predicted exterior traffic noise levels of 62.6 dB(A) for Design Year (2045) build conditions, the traffic noise level at the playground does not approach or exceed the NAC. Compared to existing conditions, the traffic noise level for Design Year (2045) build conditions is predicted to increase 3.5 dB(A). Therefore, the traffic noise level at the preschool facility is not expected to substantially increase above existing conditions.

The Berri Patch Preschool is also analyzed as an Activity Category D (interior) use. Following FHWA procedures documented in *Highway Traffic Noise: Analysis and Abatement Guidance*<sup>5</sup> (FHWA, December 2011), the traffic noise level for the interior of the preschool is determined by applying a 25 dB(A) reduction to the exterior traffic noise prediction. The 25 dB(A) decrease accounts for the noise reduction from the masonry building. With a predicted interior traffic noise level of 42.5 dB(A) for Design Year (2045) build conditions, the interior traffic noise level at the preschool facility does not approach or exceed the NAC.

Traffic noise levels are not predicted to approach or exceed the NAC. Furthermore, existing traffic noise levels are not predicted to substantially increase as a direct result of the transportation improvement project. Therefore, a noise barrier is not considered for the Berri Patch Preschool.

### **Brevard Health Alliance Inc.**

Brevard Health Alliance Inc. is located south of Malabar Road at Station 151. There is no exterior area of frequent human use. Therefore, the medical facility is analyzed as an Activity Category D (interior) use. Following FHWA procedures documented in *Highway Traffic Noise: Analysis and Abatement Guidance*<sup>5</sup> (FHWA, December 2011), the traffic noise level for the interior of the facility is determined by applying a 25 dB(A) reduction to the exterior traffic noise prediction. The 25 dB(A) decrease accounts for the noise reduction from the masonry building. With a predicted interior traffic noise level of 40.4 dB(A) for Design Year (2045) build conditions, the traffic noise level at the medical facility does not approach or exceed the NAC. Compared to existing conditions, the traffic noise level for Design Year (2045) build conditions is predicted to increase 1.2 dB(A). Therefore, the traffic noise level at the medical facility is not expected to substantially increase above existing conditions.

Traffic noise levels are not predicted to approach or exceed the NAC. Furthermore, existing traffic noise levels are not predicted to substantially increase as a direct result of the transportation improvement project. Therefore, a noise barrier is not considered for the Brevard Health Alliance medical facility.

### **Residence just East of Eva Lane**

A single residence is located south of Malabar Road at Station 180+50. With a predicted exterior traffic noise level of 66.0 dB(A) for Design Year (2045) build conditions, the traffic noise level at the residence exceeds the NAC. Compared to existing conditions, the traffic noise level for Design Year (2045) build conditions is predicted to increase 1.5 dB(A). Therefore, the traffic noise level at the residence is not expected to substantially increase above existing conditions.

FDOT policy requires that two or more impacted receptors benefit (i.e., be provided a noise reduction of 5 dB(A) or greater) for a noise barrier to be considered feasible. Since there is only one impacted residence in this area that may benefit, a noise barrier cannot be a feasible abatement measure. No further abatement evaluation is required.

### **Residences from East of Eva Lane to Corey Road**

Four residences are located south of Malabar Road between Station 184 and Station 206. With predicted exterior traffic noise levels at the four residences of 61.3 dB(A) or less, the traffic noise level at the residences does not approach or exceed the NAC. Compared to existing conditions, traffic noise levels for Design Year (2045) build conditions are predicted to decrease 0.5 dB(A) or more at the residences. Therefore, traffic noise levels at the four residences are not expected to substantially increase above existing conditions.

### **First Baptist Church of Malabar and Baseball Field**

The First Baptist Church of Malabar is located south of Malabar Road at Station 208. The church has an associated baseball field. With a predicted exterior traffic noise level of 65.7 dB(A) for Design Year (2045) build conditions, the traffic noise level at the baseball field does not approach or exceed the NAC. Compared to existing conditions, the traffic noise level for Design Year (2045) build conditions is predicted to decrease 2.5 dB(A). Therefore, the traffic noise level at the church is not expected to substantially increase above existing conditions.

The First Baptist Church of Malabar is also analyzed as an Activity Category D (interior) use. Following FHWA procedures documented in *Highway Traffic Noise: Analysis and Abatement Guidance*<sup>5</sup> (FHWA, December 2011), the traffic noise level for the interior of the church is determined by applying a 25 dB(A) reduction to the exterior traffic noise prediction. The 25 dB(A) decrease accounts for the noise reduction from the masonry building. With a predicted interior traffic noise level of 35.6 dB(A) for Design Year (2045) build conditions, the interior traffic noise level at the church does not approach or exceed the NAC.

### **Isolated Residence across from Gilmore Street**

A single residence is located south of Malabar Road at Station 215. With a predicted exterior traffic noise level of 70.6 dB(A) for Design Year (2045) build conditions, the traffic noise level at the residence exceeds the NAC. Compared to existing conditions, the traffic noise level for Design Year (2045) build conditions is predicted to increase 2.9 dB(A). Therefore, the traffic noise level at the residence is not expected to substantially increase above existing conditions.

FDOT policy requires that two or more impacted receptors benefit (i.e., be provided a noise reduction of 5 dB(A) or greater) for a noise barrier to be considered feasible. Since there is only one impacted residence in this area that may benefit, a noise barrier cannot be a feasible abatement measure. No further abatement evaluation is required.

### **Residences just West of Malabar Woods Boulevard**

Two residences are located south of Malabar Road between Station 220 and Station 221. With a predicted exterior traffic noise level of 66.2 dB(A) for Design Year (2045) build conditions, the traffic noise level at one of the residences does approach or exceed the NAC. With predicted exterior traffic noise levels at the other residence of 57.1 dB(A), the traffic noise level at the residence does not approach or exceed the NAC. Compared to existing conditions, traffic noise levels for Design Year (2045) build conditions are predicted to decrease 0.4 dB(A) or more. Therefore, traffic noise levels are not expected to substantially increase above existing conditions.

FDOT policy requires that two or more impacted receptors benefit (i.e., be provided a noise reduction of 5 dB(A) or greater) for a noise barrier to be considered feasible. Since there is only

one impacted residence in this area that may benefit, a noise barrier cannot be a feasible abatement measure. No further abatement evaluation is required.

**Town of Malabar Disc Golf Course and Gazebo**

The Town of Malabar Disc Golf Course is located south of Malabar Road between Station 222 and Station 225. A portion of the recreational facility is within the proposed right-of-way and would be acquired to accommodate the conceptual design. With predicted exterior traffic noise levels of 73.5 dB(A) or more for Design Year (2045) build conditions, traffic noise levels in some remaining portions of the Town of Malabar Disc Golf Course approach or exceed the NAC. Noise impacts yield an impact area of about 0.47 acres. Compared to existing conditions, traffic noise levels for Design Year (2045) build conditions are predicted to decrease 0.3 dB(A). Therefore, traffic noise levels at the Town of Malabar Disc Golf Course are not predicted to substantially increase above existing conditions.

A noise barrier is evaluated for the Town of Malabar Disc Golf Course following procedures documented in *A Method to Determine Reasonableness and Feasibility of Noise Abatement at Special Use Locations* (FDOT 2009). An evaluation of a noise barrier at the ROW line is summarized in **Table 3-3**.

**Table 3-3: Noise Barrier Analysis – Town of Malabar Disc Golf Course**

Barrier Height (feet)	Total Barrier Length (feet)	Acres of Impact Area provided a benefit	Percentage of Impacted Area Benefitted	Average Reduction in Benefited Area [(dB(A)]	Required person-hours of Use Within Benefited Area <sup>2</sup>	Number of Person Hours of Daily Use in the entire facility that are needed to be under the cost reasonable limit of \$995,935
8	305	.17	36.17	7.2	37.25	103
10	305	.26	55.31	7.7	71.34	129
12	305	.36	82.97	7.7	128.60	155
14	305	.39	82.98	7.7	150.19	181
16	305	.39	82.98	7.8	170.93	206
18	305	.39	82.98	7.9	192.51	232
20	305	.39	82.98	7.9	214.08	258
22	305	.39	82.98	7.9	234.83	283

<sup>1</sup> Unit cost of \$30 per sq. ft. of noise barrier.

<sup>2</sup> Based on \$995,935/person-hour/ft<sup>2</sup> of barrier as the limit for cost reasonableness.

At a noise barrier height of eight feet or greater, a noise barrier would potentially provide at least a 5 dB(A) reduction at some portion of the impacted area with some portion of the benefited area meeting the noise reduction design goal of 7 dB(A). An eight-foot high noise barrier would potentially benefit only about 36 percent of the impacted area. To not exceed the cost reasonable limit, 37.25 person-hours of use need to occur within the benefited area of 0.17 acres on an average day. Noise barriers greater than 12-feet in height are able to benefit approximately 83% of the impacted area, or 0.39 acres. To not exceed the cost reasonable limit, 128.60 person-hours of use need to occur within the benefited area of 0.39 acres on an average day.

The recreational facility has a limited parking area measuring about 130 feet by 45 feet; no people were observed in the Town of Malabar Disc Golf Course during the field review and the park closes at dusk. Considering these factors and assuming an even distribution of people throughout the recreational facility with each individual occupying the benefited area for a matter of minutes, this amount of use within the benefitted area is not expected to occur on a daily basis. Consequently, a noise barrier is not a cost reasonable abatement measure at this location.

#### **Residences between Glatter Road and Pine Street**

Five residences are located south of Malabar Road between Station 242 and Station 274. With predicted exterior traffic noise levels of 61.3 dB(A) or less for Design Year (2045) build conditions, the traffic noise levels do not approach or exceed the NAC. Compared to existing conditions, traffic noise levels for Design Year (2045) build conditions are predicted to increase 1.1 dB(A) at one residence and decrease 0.5 dB(A) or more at the other four residences. Therefore, traffic noise levels at the five residences are not expected to substantially increase above existing conditions.

#### **Residence between Pine Street and W. Railroad Street**

One residence is located south of Malabar Road at Station 279. With a predicted exterior traffic noise levels of 68.4 dB(A) for Design Year (2045) build conditions, the traffic noise level approaches or exceeds the NAC at the residence. Compared to existing conditions, traffic noise levels for Design Year (2045) build conditions are predicted to increase 2.9 dB(A). Therefore, traffic noise levels at the four residences are not expected to substantially increase above existing conditions.

FDOT policy requires that two or more impacted receptors benefit (i.e., be provided a noise reduction of 5 dB(A) or greater) for a noise barrier to be considered feasible. Since there is only one impacted residence in this area that may benefit, a noise barrier cannot be a feasible abatement measure. No further abatement evaluation is required.

### **Residences between W. Railroad Street and US-1**

Three residences are located south of Malabar Road between Station 286 and Station 290. With predicted exterior traffic noise levels of 67.0, 65.8, and 65.5 dB(A) for Design Year (2045) build conditions, the traffic noise level at one residence approaches or exceeds the NAC. Compared to existing conditions, traffic noise levels for Design Year (2045) build conditions are predicted to decrease 0.4 dB(A) or less at all three residences. Therefore, traffic noise levels at the three residences are not expected to substantially increase above existing conditions.

FDOT policy requires that two or more impacted receptors benefit (i.e., be provided a noise reduction of 5 dB(A) or greater) for a noise barrier to be considered feasible. Since there is only one impacted residence in this area that may benefit, a noise barrier cannot be a feasible abatement measure. No further abatement evaluation is required.

### **Malabar Mo's**

Malabar Mo's is located south of Malabar Road at Station 290. The restaurant provides outdoor dining areas. With the highest predicted exterior traffic noise level of 65.3 dB(A) for Design Year (2045) build conditions, traffic noise levels at the outdoor dining areas do not approach or exceed the NAC. Compared to existing conditions, traffic noise levels for Design Year (2045) build conditions are not predicted to decrease 1.8 dB(A) or more. Therefore, traffic noise levels at the outdoor dining areas are not predicted to substantially increase above existing conditions.

Traffic noise levels are not predicted to approach or exceed the NAC. Furthermore, existing traffic noise levels are not predicted to substantially increase as a direct result of the transportation improvement project. Therefore, a noise barrier is not considered for outdoor dining areas at Malabar Mo's.

## Section 4.0 Conclusions

### 4.1 Traffic Noise Impacts

Exterior noise levels are predicted to approach or exceed the NAC for Design Year (2045) build conditions at 15 residences, the Little Impressions Preschool playground and the Town of Malabar Disc Golf Park. Compared to existing conditions, traffic noise levels for Design Year (2045) build conditions are predicted to increase 6.0 dB(A) or less. Therefore, traffic noise levels at noise sensitive sites are not predicted to substantially increase as a direct result of the transportation improvement project.

### 4.2 Noise Abatement Considerations

Abatement is evaluated for all noise sensitive sites identified as impacted and meeting the criteria for consideration of noise abatement by the build alternative. Traffic management and alignment modifications are determined to not be viable abatement measures. Consideration of buffer zones during planning of future development is identified as a viable abatement measure that can be implemented by local officials responsible for land use planning. Noise barriers are evaluated for the amount of noise reduction that could potentially be provided and cost reasonableness on the north side of Malabar Road at six residences in the Enchanted Lakes Estates Mobile Home and RV Resort. Noise barriers were evaluated on the south side of Malabar Road at the Town of Malabar Disc Golf Course.

### 4.3 Statement of Likelihood

Noise barriers are feasible and reasonable abatement measures for six impacted residents at Enchanted Lakes Mobile Home Park and RV Resort.

The Florida Department of Transportation is committed to the construction of feasible and reasonable noise abatement measures at the noise impacted locations identified in **(Table 4-1)** contingent upon the following conditions:

1. Final recommendations on the construction of abatement measures is determined during the project's final design and through the public involvement process;
2. Detailed noise analyses during the final design process support the need, feasibility and reasonableness of providing abatement;
3. Cost analysis indicates that the cost of the noise barrier(s) will not exceed the cost reasonable criterion;

**Table 4-1: Noise Barrier Evaluation Summary**

Residential Area	Barrier segment	Barrier Type	Barrier Length (ft)	Barrier Height (ft)	Barrier Approx. Begin Station <sup>1</sup>	Barrier Approx. End Station <sup>1</sup>	Estimated Cost <sup>2</sup>	Number of Residences approaching or exceeding NAC	Number of Benefited Residences <sup>3</sup>		Average Reduction <sup>4</sup> (dBA)
		Right of Way, Shoulder, or Barrier							Impacted	Total	
<b>Noise Barriers North of Malabar Road</b>											
Enchanted Lakes MHP and RV Resort	1	Right of Way	79	14	144+40	145+19	\$238,980.00	6	6	7	8.5
	2	Right of Way	169	14	145+73	147+42					
	3	Right of Way	321	14	148+77	151+78					

<sup>1</sup> The barrier begins and end stations were estimated by using a perpendicular line from the center line of the roadway to the barrier.

<sup>2</sup> Unit cost of \$30 per sq. ft. for all barriers.

<sup>3</sup> Total includes benefited residences with a predicted noise level that does not approach or exceed 66 dBA.

<sup>4</sup> Average reduction includes all residences that would benefit 5 dBA or more.

4. Community input supporting types, heights, and locations of the noise barrier(s) is provided to the District Office; and
5. Safety and engineering aspects as related to the roadway user and the adjacent property owner have been reviewed and any conflicts or issues resolved.

Noise barriers are not feasible at nine impacted residences because the impact is at an isolated residence, gaps in a noise barrier to accommodate driveways limited noise reduction to less than 5 dB(A), gaps in a noise barrier to accommodate driveways limited noise reduction to less than 7 dB(A) for one impacted residence (noise reduction design goal), or noise barriers are not cost reasonable.

Noise barriers are not feasible at one impacted non-residential site (Little Impressions Preschool playground) because the minimum noise reduction of 5 dB(A) could not be achieved. Noise barriers are not cost reasonable at two impacted non-residential sites (First Baptist Church of Malabar baseball field, and the Town of Malabar Disc Golf Course) because the noise sensitive site would not generate the person-hours of use on an average day required to meet the cost reasonable limit.

Some properties adjacent to Malabar Road are undeveloped. A land use review will be performed during the design phase of the project to ensure that all noise-sensitive land uses that have received a building permit prior to the project's DPK (i.e., date the environmental document is approved) are evaluated. Notably, there was no ongoing construction observed during the field review performed when establishing existing land use (July 23, 2013).

## **Section 5.0      Construction Noise and Vibration**

Land uses adjacent to Malabar Road are identified on the FDOT listing of noise and vibration sensitive sites (e.g., residences, medical facilities). Construction of the proposed roadway improvements is not expected to have any significant noise or vibration impact. If sensitive land uses develop adjacent to the roadway prior to construction, increased potential for noise or vibration impacts could result. It is anticipated that the application of the *FDOT Standard Specifications for Road and Bridge Construction*<sup>7</sup> will minimize or eliminate potential construction noise and vibration impacts. However, should unanticipated noise or vibration issues arise during the construction process, the Project Engineer, in coordination with the District Noise Specialist and the Contractor, will investigate additional methods of controlling these impacts.

## **Section 6.0      Community Coordination**

Land use controls are a means of preventing or minimizing traffic noise impacts in areas of future development. The predicted distances to an approach of the NAC (Activity Categories A, B, C and E) for Design Year (2045) build conditions are provided in Table 2-6. The distances do not account for any shielding of noise provided by structures or the effects of site specific topographic features.

Local planning officials will be provided a copy of the Noise Study Report to promote compatibility between land development and highways. The predicted distances that noise levels would approach the NAC and other predicted noise levels provided in this report can be used to determine areas where noise sensitive land uses would be incompatible with traffic noise generated from Malabar Road. When considering development of currently undeveloped properties, this information can be applied to establish buffers between the roadways and noise sensitive development or used to determine when noise abatement should be provided as part of a noise sensitive development.

## Section 7.0      References

1.     *Procedures for Abatement of Highway Traffic Noise and Construction Noise*; Title 23 Code of Federal Regulations Part 772; Federal Highway Administration; July 2010.
2.     *Project Development and Environment Manual*, Part 2, Chapter 18; Florida Department of Transportation; June 2017.
3.     *Traffic Noise Modeling and Analysis Practitioners Handbook*, Florida Department of Transportation; Tallahassee, Florida; January 1, 2016
4.     *Plans Preparation Manual*; Florida Department of Transportation; 2014
5.     *Measurement of Highway-Related Noise*; Federal Highway Administration; May 1996.
6.     *Highway Traffic Noise: Analysis and Abatement Guidance*; Federal Highway Administration; December 2011.
7.     *A Method to Determine Reasonableness and Feasibility of Noise Abatement at Special Use Locations*; Florida Department of Transportation; 2009
8.     *Standard Specification for Road and Bridge Construction*; Florida Department of Transportation; 2014.

## ***APPENDICES***

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<b><i>Appendix A</i></b>	<b><i>Traffic Data</i></b>
<b><i>Appendix B</i></b>	<b><i>Noise Model Validation Notes</i></b>
<b><i>Appendix C</i></b>	<b><i>Predicted Noise Levels</i></b>
<b><i>Appendix D</i></b>	<b><i>Aerials</i></b>
<b><i>Appendix E</i></b>	<b><i>TNM Modeling Files</i></b>



### Traffic-Hourly Vehicle Volume by Lane

Existing																					
Traffic Segment	Number of Lanes	LOS C ADT	Demand ADT	Peak Direction Hourly Volumes by Lane					Off-Peak Direction Hourly Volumes by Lane					% MT	% HT	% Bus	%Moto	K-factor	D-factor	Bi-directional Hourly	Speed
				Cars	MT	HT	Buses	Moto	Cars	MT	HT	Buses	Moto								
Babcock St to Enterprise Ave	4	37,900	18,000	458	17	7	2	3	305	11	5	1	2	3.41%	1.39%	0.43%	0.54%	9.00%	60.00%	1620	45
Enterprise Ave to Weber Rd	2	16,800	16,000	814	29	12	4	5	543	20	8	2	3	3.41%	1.39%	0.43%	0.54%	9.00%	60.00%	1440	45
Weber Rd to Corey Rd	2	16,800	15,000	763	28	11	3	4	509	18	8	2	3	3.41%	1.39%	0.43%	0.54%	9.00%	60.00%	1350	55
Corey Rd to Marie St	2	16,800	13,000	661	24	10	3	4	441	16	7	2	3	3.41%	1.39%	0.43%	0.54%	9.00%	60.00%	1170	55
Marie St to US 1	2	16,800	13,000	661	24	10	3	4	441	16	7	2	3	3.41%	1.39%	0.43%	0.54%	9.00%	60.00%	1170	45-30

Notes:

1. D-factor for the ramps is 100% to represent one-way peak traffic volumes.
2. Traffic data was received from Henry Pinzon via e-mail on 3/30/07. Original file is Stirling Road Interchange \_ Noise Analysis.xls  
 pw to edit data = TRAFFIC  
 pw to edit sheet = FORMULA

## No Build Traffic-Hourly Vehicle Volume by Lane

### Design Year 2025

Traffic Segment	Number of Lanes	LOS C ADT	Demand ADT	Peak Direction Hourly Volumes by Lane					Off-Peak Direction Hourly Volumes by Lane					% MT	% HT	% Bus	%Moto	K-factor	D-factor	Bi-directional Hourly	Speed
				Cars	MT	HT	Buses	Moto	Cars	MT	HT	Buses	Moto								
Babcock St to Enterprise Ave	4	37,900	22,000	560	20	8	3	3	373	14	6	2	2	3.41%	1.39%	0.43%	0.54%	9.00%	60.00%	1980	45
Enterprise Ave to Weber Rd	2	16,800	19,000	855	31	13	4	5	570	21	8	3	3	3.41%	1.39%	0.43%	0.54%	9.00%	60.00%	1512	45
Weber Rd to Corey Rd	2	16,800	17,000	855	31	13	4	5	570	21	8	3	3	3.41%	1.39%	0.43%	0.54%	9.00%	60.00%	1512	55
Corey Rd to Marie St	2	16,800	15,000	763	28	11	3	4	509	18	8	2	3	3.41%	1.39%	0.43%	0.54%	9.00%	60.00%	1350	55
Marie St to US 1	2	16,800	15,000	763	28	11	3	4	509	18	8	2	3	3.41%	1.39%	0.43%	0.54%	9.00%	60.00%	1350	45-30

Notes:

1. D-factor for the ramps is 100% to represent one-way peak traffic volumes.
2. Traffic data was received from Henry Pinzon via e-mail on 3/30/07. Original file is Stirling Road Interchange \_ Noise Analysis.xls  
pw to edit data = TRAFFIC  
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## No Build Traffic-Hourly Vehicle Volume by Lane

### Design Year 2045

Traffic Segment	Number of Lanes	LOS C ADT	Demand ADT	Peak Direction Hourly Volumes by Lane					Off-Peak Direction Hourly Volumes by Lane					% MT	% HT	% Bus	%Moto	K-factor	D-factor	Bi-directional Hourly	Speed
				Cars	MT	HT	Buses	Moto	Cars	MT	HT	Buses	Moto								
Babcock St to Enterprise Ave	4	37,900	28,000	712	26	11	3	4	475	17	7	2	3	3.41%	1.39%	0.43%	0.54%	9.00%	60.00%	2520	45
Enterprise Ave to Weber Rd	2	16,800	24,000	855	31	13	4	5	570	21	8	3	3	3.41%	1.39%	0.43%	0.54%	9.00%	60.00%	1512	45
Weber Rd to Corey Rd	2	16,800	22,000	855	31	13	4	5	570	21	8	3	3	3.41%	1.39%	0.43%	0.54%	9.00%	60.00%	1512	55
Corey Rd to Marie St	2	16,800	19,000	855	31	13	4	5	570	21	8	3	3	3.41%	1.39%	0.43%	0.54%	9.00%	60.00%	1512	55
Marie St to US 1	2	16,800	19,000	855	31	13	4	5	570	21	8	3	3	3.41%	1.39%	0.43%	0.54%	9.00%	60.00%	1512	45-30

Notes:

1. D-factor for the ramps is 100% to represent one-way peak traffic volumes.
2. Traffic data was received from Henry Pinzon via e-mail on 3/30/07. Original file is Stirling Road Interchange \_ Noise Analysis.xls  
pw to edit data = TRAFFIC  
pw to edit sheet = FORMULA

## No Build Traffic-Hourly Vehicle Volume by Lane

### Design Year 2025

Traffic Segment	Number of Lanes	LOS C ADT	Demand ADT	Peak Direction Hourly Volumes by Lane					Off-Peak Direction Hourly Volumes by Lane					% MT	% HT	% Bus	%Moto	K-factor	D-factor	Bi-directional Hourly	Speed
				Cars	MT	HT	Buses	Moto	Cars	MT	HT	Buses	Moto								
Babcock St to Enterprise Ave	4	37,900	24,000	611	22	9	3	3	407	15	6	2	2	3.41%	1.39%	0.43%	0.54%	9.00%	60.00%	2160	45
Enterprise Ave to Weber Rd	4	37,900	22,000	560	20	8	3	3	373	14	6	2	2	3.41%	1.39%	0.43%	0.54%	9.00%	60.00%	1980	45
Weber Rd to Corey Rd	4	37,900	19,000	483	17	7	2	3	322	12	5	1	2	3.41%	1.39%	0.43%	0.54%	9.00%	60.00%	1710	55
Corey Rd to Marie St	2	16,800	17,000	855	31	13	4	5	570	21	8	3	3	3.41%	1.39%	0.43%	0.54%	9.00%	60.00%	1512	55
Marie St to US 1	2	17,640	17,000	865	31	13	4	5	577	21	9	3	3	3.41%	1.39%	0.43%	0.54%	9.00%	60.00%	1530	45-30

Notes:

1. D-factor for the ramps is 100% to represent one-way peak traffic volumes.
2. Traffic data was received from Henry Pinzon via e-mail on 3/30/07. Original file is Stirling Road Interchange \_ Noise Analysis.xls  
pw to edit data = TRAFFIC  
pw to edit sheet = FORMULA

## Build Traffic-Hourly Vehicle Volume by Lane

### Design Year 2045

Traffic Segment	Number of Lanes	LOS C ADT	Demand ADT	Peak Direction Hourly Volumes by Lane					Off-Peak Direction Hourly Volumes by Lane					% MT	% HT	% Bus	%Moto	K-factor	D-factor	Bi-directional Hourly	Speed
				Cars	MT	HT	Buses	Moto	Cars	MT	HT	Buses	Moto								
Babcock St to Enterprise Ave	4	37,900	31,000	789	29	12	4	5	526	19	8	2	3	3.41%	1.39%	0.43%	0.54%	9.00%	60.00%	2790	45
Enterprise Ave to Weber Rd	4	37,900	29,000	738	27	11	3	4	492	18	7	2	3	3.41%	1.39%	0.43%	0.54%	9.00%	60.00%	2610	45
Weber Rd to Corey Rd	4	37,900	26,000	661	24	10	3	4	441	16	7	2	3	3.41%	1.39%	0.43%	0.54%	9.00%	60.00%	2340	50
Corey Rd to Marie St	2	16,800	23,000	855	31	13	4	5	570	21	8	3	3	3.41%	1.39%	0.43%	0.54%	9.00%	60.00%	1512	50
Marie St to US 1	2	17,640	23,000	898	32	13	4	5	598	22	9	3	3	3.41%	1.39%	0.43%	0.54%	9.00%	60.00%	1588	35

Notes:

1. D-factor for the ramps is 100% to represent one-way peak traffic volumes.
2. Traffic data was received from Henry Pinzon via e-mail on 3/30/07. Original file is Stirling Road Interchange \_ Noise Analysis.xls  
pw to edit data = TRAFFIC  
pw to edit sheet = FORMULA

***APPENDIX B***

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***NOISE MODEL VALIDATION NOTES***

## Noise Model Validation

**Personnel:** Bob Finck, Phillip Still

**Date:** July 23, 2013

**Project:** Malabar Road PDE

**FPID:** 430136-1-22-01

**Validation Site:** Brevard Health Alliance Pediatrics, 62 feet south of nearest Malabar Road travel lane

**Weather:** Temperature – 85°F, Humidity – 72%, Wind Speed – 2 to 5 mph,  
Wind Dir. – West, Cloud Cover – 80%

**Noise Monitor:** Quest Technologies Q300  
**Serial Number:** QC2060111

**Noise Calibrator:** Quest Technologies QC10  
**Serial Number:** QIB070010

### Replicate 1

**Time:** 1108 to 1118    **Duration:** 10 minutes    **Measured Leq:** 65.7 dB(A)

### Replicate 2

**Time:** 1120 to 1130    **Duration:** 10 minutes    **Measured Leq:** 65.8 dB(A)

### Replicate 3

**Time:** 1131 to 1141    **Duration:** 10 minutes    **Measured Leq:** 64.9 dB(A)

### Traffic Data

Vehicle Type	Malabar Road Westbound			Malabar Road Eastbound			Speed
	Rep 1	Rep 2	Rep 3	Rep 1	Rep 2	Rep 3	
Autos	69	72	72	50	61	61	45
Medium Truck	1	3	3	3	2	0	45
Heavy trucks	3	4	2	0	4	2	45
Buses	0	0	0	0	0	0	45
Motorcycles	0	0	0	0	0	0	45

**Comments:** Cicada's could be heard in the distance for all three repetitions.

## Noise Model Validation

**Personnel:** Bob Finck, Phillip Still

**Date:** July 23, 2013

**Project:** Malabar Road PDE

**FPID:** 430136-1-22-01

**Validation Site:** First Baptist Church of Malabar, 77 feet south of nearest Malabar Road travel lane

**Weather:** Temperature – 87°F, Humidity – 74%, Wind Speed – 5 to 7 mph,  
Wind Dir. – West, Cloud Cover – 80%

**Noise Monitor:** Quest Technologies Q300  
**Serial Number:** QC2060111

**Noise Calibrator:** Quest Technologies QC10  
**Serial Number:** QIB070010

### Replicate 1

**Time:** 1154 to 1204    **Duration:** 10 minutes    **Measured Leq:** 62.3 dB(A)

### Replicate 2

**Time:** 1205 to 1215    **Duration:** 10 minutes    **Measured Leq:** 62.4 dB(A)

### Replicate 3

**Time:** 1216 to 1226    **Duration:** 10 minutes    **Measured Leq:** 63.1 dB(A)

### Traffic Data

Vehicle Type	Malabar Road Westbound			Malabar Road Eastbound			Speed
	Rep 1	Rep 2	Rep 3	Rep 1	Rep 2	Rep 3	
Autos	65	51	53	41	43	48	55
Medium Truck	2	1	4	2	0	4	55
Heavy trucks	3	3	3	0	2	1	55
Buses	0	0	0	0	0	0	55
Motorcycles	0	0	0	0	0	0	55

**Comments:** Cicada's could be heard in the distance for all three repetitions.



Receiver Identification	Aerial Sheet Number	Number of Residences Represented	2015 Existing Condition (dBA)	2045 No Build Condition (dBA)	2045 Build Condition (dBA)	Difference between Build and No Build (dBA)	NAC Approached or Exceeded	
<b>West Bound</b>								
Moose Lodge								
RN1	1	0	Picnic Table	58.6	59.3	62.1	2.8	No
Palm Bay Hospital								
RN2	2	0	Medical Facility	32.6	32.8	34.8	2	No
Enchanted Lakes Estates Mobile Home and RV Resort								
RN3	2	1	Residence	54.6	54.8	55.9	1.1	No
RN4	2	1	Residence	54.5	54.7	55.6	0.9	No
RN5	2	1	Residence	55	55.3	55.1	-0.2	No
RN6	2	1	Residence	54.5	54.8	55.9	1.1	No
RN7	2	1	Residence	56.5	56.7	57.5	0.8	No
RN8	2	0	Pool	59.2	59.4	60.2	0.8	No
RN9	2	1	Residence	58.2	58.5	58.6	0.1	No
RN10	2	1	Residence	59.6	59.8	60.3	0.5	No
RN11	2	1	Residence	60	60.2	60.9	0.7	No
RN12	2	1	Residence	61.2	61.4	62	0.6	No
RN13	2	1	Residence	60.1	60.3	60.7	0.4	No
RN14	2	1	Residence	62.6	62.8	63.3	0.5	No
RN15	2	1	Residence	60.8	61	61.8	0.8	No
RN16	2	1	Residence	63.4	63.6	62.9	-0.7	No
RN17	2	1	Residence	68.2	68.4	67.9	-0.5	Yes
RN18	2	1	Residence	67.6	67.8	67.3	-0.5	Yes
RN19	2	1	Residence	69.8	70.1	70.3	0.2	Yes
RN20	2	1	Residence	69.4	69.7	69	-0.7	Yes
RN21	2	1	Residence	69.6	69.9	69.1	-0.8	Yes
RN22	2	1	Residence	68.9	69.1	67.9	-1.2	Yes
Scattered Residences between Weber Road and Malabar Woods Boulevard								
RN23	3	1	Residence	66.9	67.3	65.8	-1.5	No
RN24	3	1	Residence	69.1	69.6	66.4	-3.2	Yes
RN26	4	1	Residence	59.9	60.8	56.9	-3.9	No
RN27	4	1	Residence	58.3	59.3	65.3	6	No
RN29	4	1	Residence	69.5	70.5	62.8	-7.7	No
RN30	4&5	1	Residence	65.2	66.3	64.3	-2	No
Malabar Park								
RN31	5	0	Baseball Field	50.4	51.4	51.1	-0.3	No
Single Residence between Malabar Woods Boulevard and Marie Street								
RN32	5	1	Residence	53.2	54.2	52.1	-2.1	No
Scattered Residences between Marie Street and West Railroad Street								
RN33	6	1	Residence	52.4	53.5	52.4	-1.1	No
RN34	6	1	Residence	49.9	50.9	49.6	-1.3	No

Receiver Identification	Aerial Sheet Number	Number of Residences Represented	2015 Existing Condition (dBA)	2045 No Build Condition (dBA)	2045 Build Condition (dBA)	Difference between Build and No Build (dBA)	NAC Approached or Exceeded	
RN35	6	1	Residence	52.9	53.9	52.5	-1.4	No
RN36	6	1	Residence	57.8	58.9	56.6	-2.3	No
RN37	6	1	Residence	68.9	70	66.4	-3.6	Yes
RN38	6	1	Residence	67	68.1	65.3	-2.8	No
RN39	6	1	Residence	69.9	71	68.1	-2.9	Yes
RN40	6	1	Residence	63	64.1	65	0.9	No
RN41	6	1	Residence	64.6	65.7	67.2	1.5	Yes
RN42	6	1	Residence	61.2	62.2	64.1	1.9	No
RN43	6	1	Residence	56.6	57.7	58.6	0.9	No
RN44	6	1	Residence	53.7	54.8	55.7	0.9	No
RN45	6	1	Residence	60	61.1	62.6	1.5	No
Residences between West Railroad Street and US-1								
RN46	7	1	Residence	57.2	58.3	59.2	0.9	No
Old Malabar School House (interior)								
RN50	6	0	School	30.6	31.7	31.4	-0.3	No
RN51	5	0	Church	NA <sup>1</sup>	NA <sup>1</sup>	34.8	NA <sup>1</sup>	No
East Bound								
New Testament Bethel Ministry (interior)								
RS1	1	0	Church	40.9	42.5	42.4	-0.1	No
Internal Medicine (interior)								
RS2	1	0	Medical	36.9	38	39.5	1.5	No
Hope Ministries (interior)								
RS3	1	0	Church	29.3	29.9	30.9	1	No
Little Impressions Academy (interior at Daycare)								
RS4	1	0	Playground	66.2	66.5	67.4	0.9	Yes
RS5	1	0	Daycare	40.5	40.8	41.9	1.1	No
Berri Patch Preschool (interior at Daycare)								
RS6	2	0	Daycare	38.4	38.6	42.5	3.9	No
RS7	2	0	Playground	58.9	59.1	62.6	3.5	No
Brevard Health Alliance, Inc. (interior)								
RS8	2	0	Medical	39	39.2	40.4	1.2	No
Scattered Residences between Eva Lane and Weir Street								
RS9	3	1	Residence	64	64.5	66	1.5	Yes
RS10	3	1	Residence	54.3	54.8	58.5	3.7	No
RS11	4	1	Residence	60.7	61.2	61	-0.2	No
RS12	4	1	Residence	62	62.6	60.8	-1.8	No
RS13	4	1	Residence	62.9	63.9	58.7	-5.2	No
First Baptist Church of Malabar								
RS14	4	0	Baseball Field	67.2	68.2	65.7	-2.5	No
RS15	4	0	Church	35.8	36.8	35.6	-1.2	No
Isolated Residences between Gilmore Street and Malabar Woods Boulevard								
RS16	4	1	Residence	66.6	67.7	70.6	2.9	Yes
RS17	5	1	Residence	66	67.1	66.2	-0.9	Yes
RS18	5	1	Residence	56.4	57.5	57.1	-0.4	No
Disc Golf Course								

Receiver Identification	Aerial Sheet Number	Number of Residences Represented	2015 Existing Condition (dBA)	2045 No Build Condition (dBA)	2045 Build Condition (dBA)	Difference between Build and No Build (dBA)	NAC Approached or Exceeded	
RS19	5	0	Disc Golf	72.7	73.8	73.5	-0.3	Yes
RS20	5	0	Gazebo	67.2	68.3	67.7	-0.6	Yes
Scattered Residences between Glatter Road and Pine Street								
RS22	5	1	Residence	59.2	60.2	61.3	1.1	No
RS23	6	1	Residence	58	59	56.9	-2.1	No
RS24	6	1	Residence	56.6	57.7	55.8	-1.9	No
RS25	6	1	Residence	57.3	58.3	56.4	-1.9	No
RS26	6	1	Residence	53.8	54.8	54.3	-0.5	No
Residences between Pine Street and West Railroad Street								
RS27	6	1	Residence	64.5	65.5	67.5	2	Yes
Residences between West Railroad Street and US-1								
RS31	7	1	Residence	66.5	67.5	67	-0.5	Yes
RS32	7	1	Residence	65.1	66.2	65.8	-0.4	No
RS33	7	1	Residence	65.7	66.8	65.5	-1.3	No
Malabar Mo's								
RS34A	7	0	Outdoor Dining	66	67.1	64.9	-2.2	No
RS34B	7	0	Outdoor Dining	66	67.1	65.3	-1.8	No
Church For All Nations (interior)								
RS36	1	0	Church	26.3	27	28.3	1.3	No

<sup>1</sup> Church was not identified in original noise study. It was built afterwards however it meets the *Date of Public Knowledge*



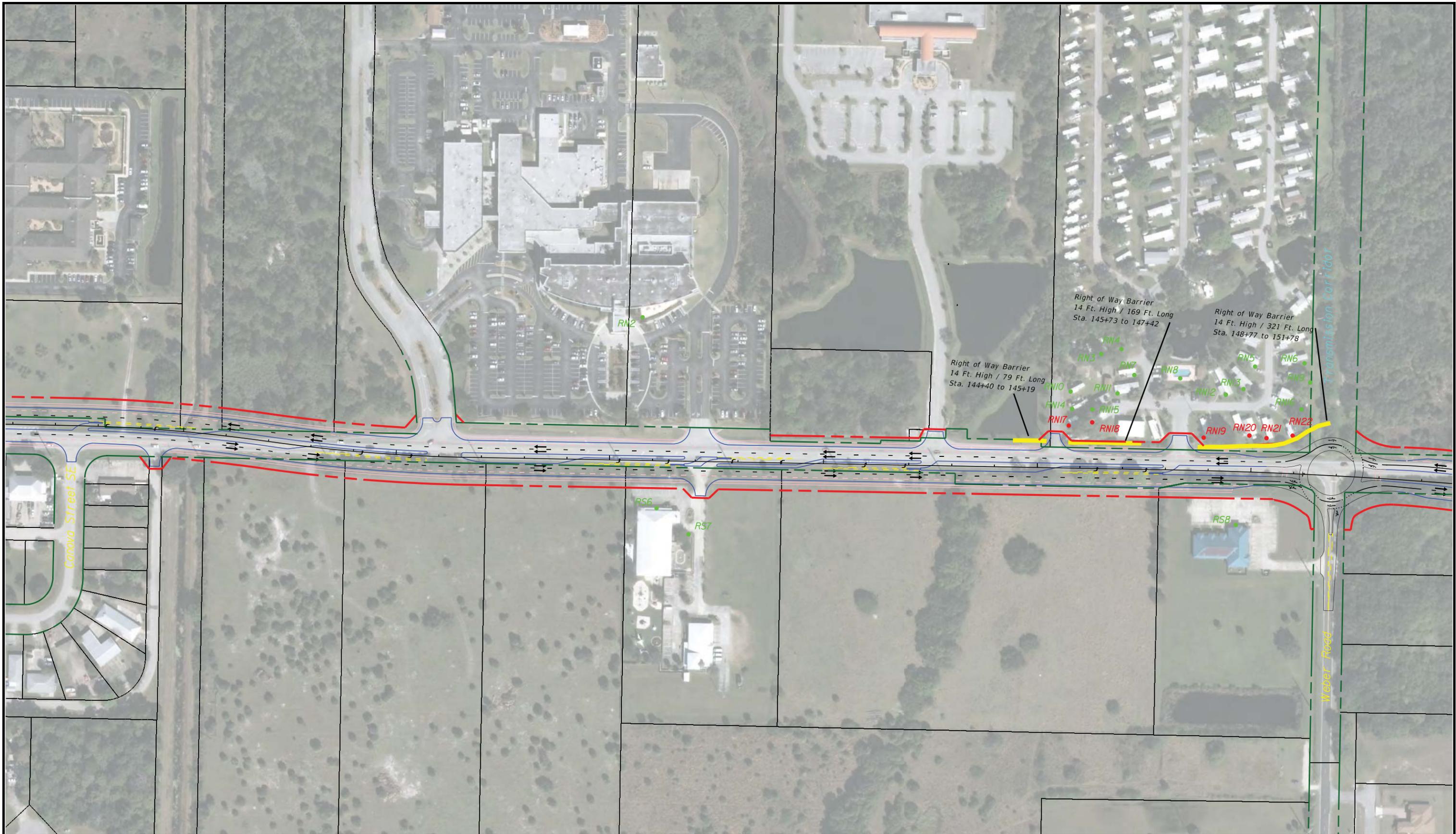


——— RIGHT-OF-WAY  
——— FEASIBLE AND COST REASONABLE NOISE BARRIER LOCATION

120  
 ——— CENTER LINE CONSTRUCTION  
• RE15 NOISE ANALYSIS RECEIVER LOCATION - IMPACTED  
• RE15 NOISE ANALYSIS RECEIVER LOCATION - NON-IMPACTED

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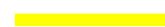
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— FEASIBLE AND COST REASONABLE NOISE BARRIER LOCATION

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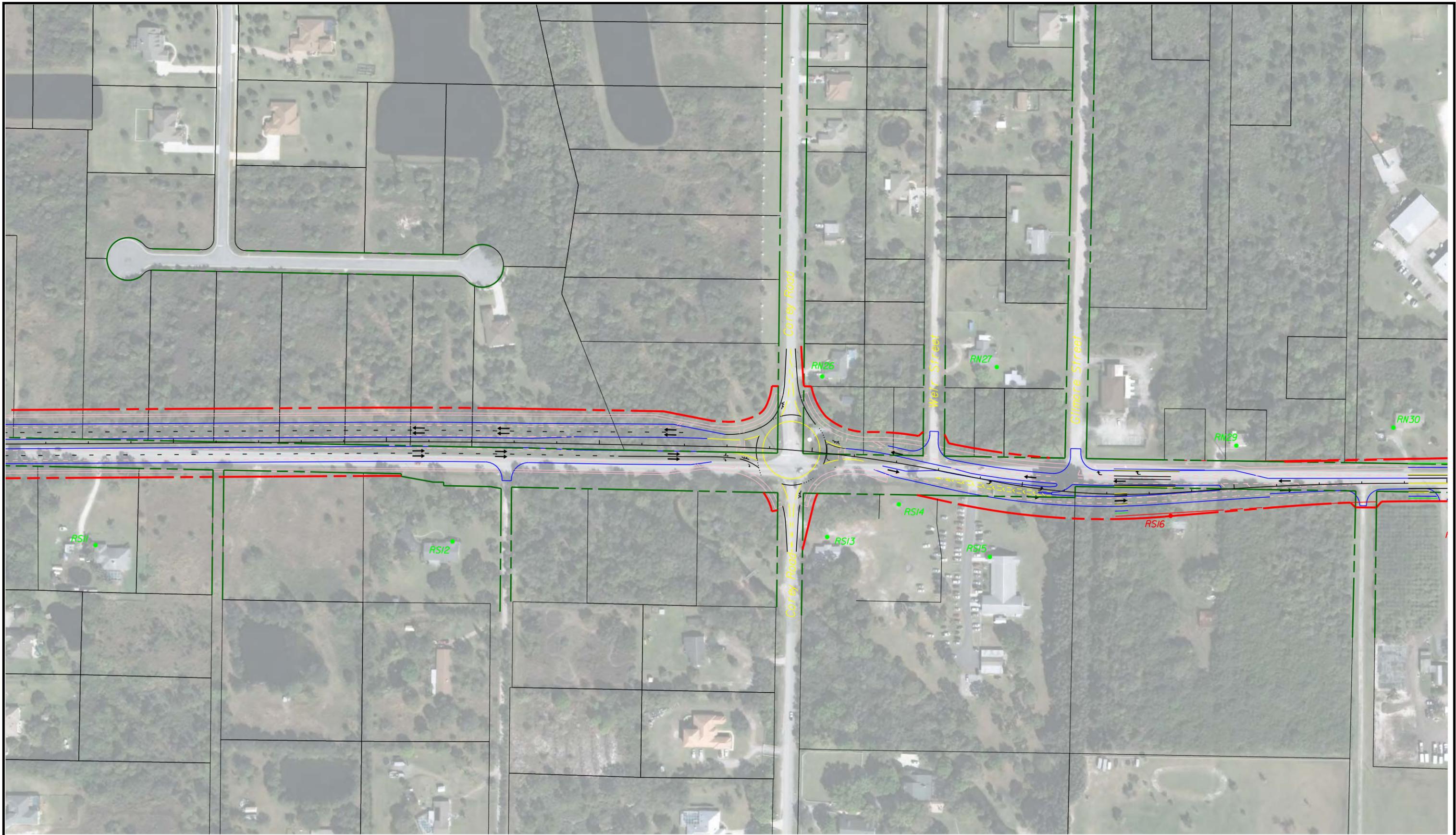


 RIGHT-OF-WAY  
 FEASIBLE AND COST REASONABLE NOISE BARRIER LOCATION

 120 CENTER LINE CONSTRUCTION  
 .RE15 NOISE ANALYSIS RECEIVER LOCATION - IMPACTED  
 .RE15 NOISE ANALYSIS RECEIVER LOCATION - NON-IMPACTED

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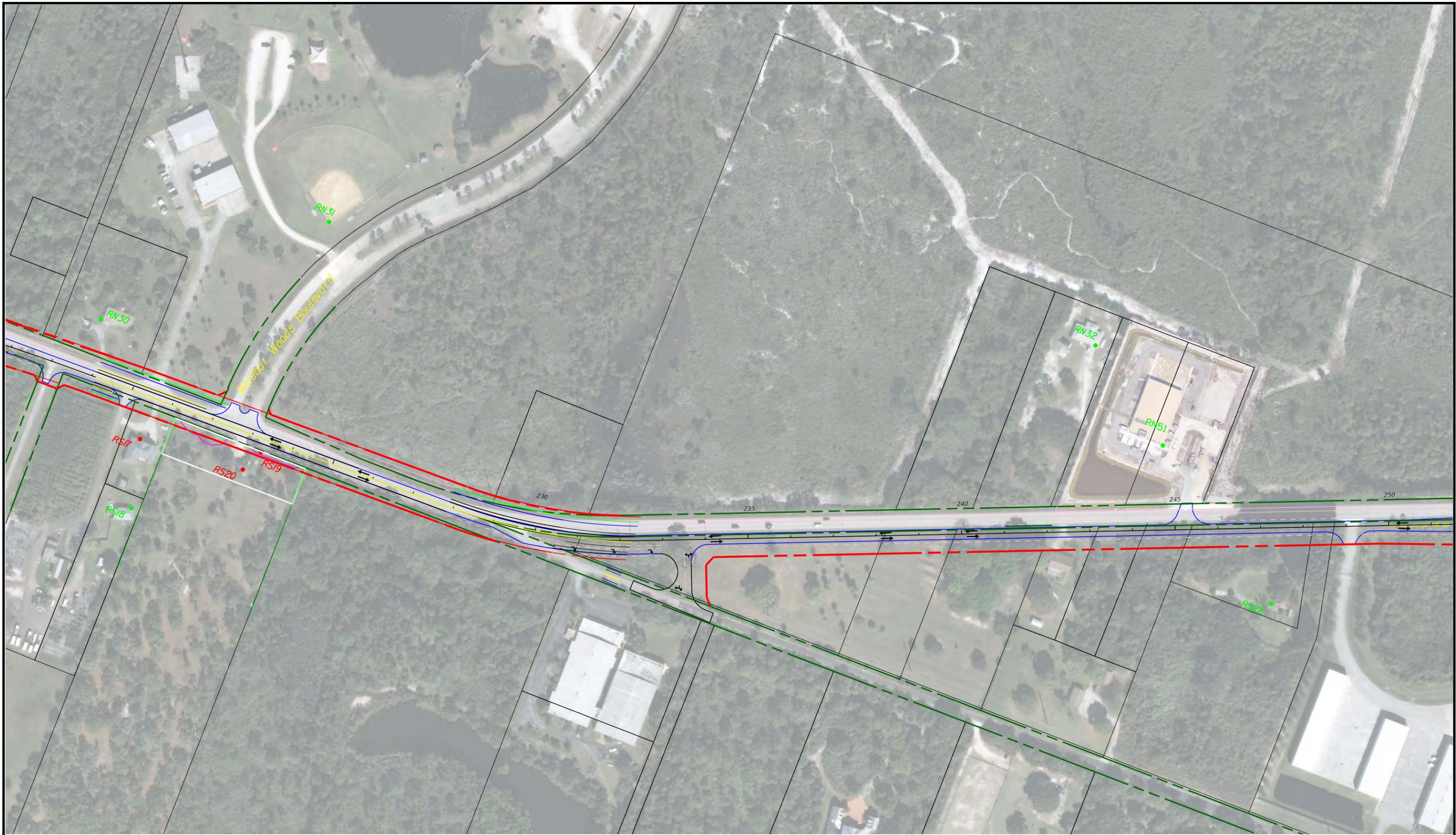
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——— FEASIBLE AND COST REASONABLE NOISE BARRIER LOCATION

$\frac{1}{20}$  CENTER LINE CONSTRUCTION  
● RE15 NOISE ANALYSIS RECEIVER LOCATION - IMPACTED  
● RE15 NOISE ANALYSIS RECEIVER LOCATION - NON-IMPACTED

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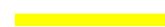
— RIGHT-OF-WAY  
— FEASIBLE AND COST REASONABLE NOISE BARRIER LOCATION

120  
 — CENTER LINE CONSTRUCTION  
• RE15 NOISE ANALYSIS RECEIVER LOCATION - IMPACTED  
• RE15 NOISE ANALYSIS RECEIVER LOCATION - NON-IMPACTED

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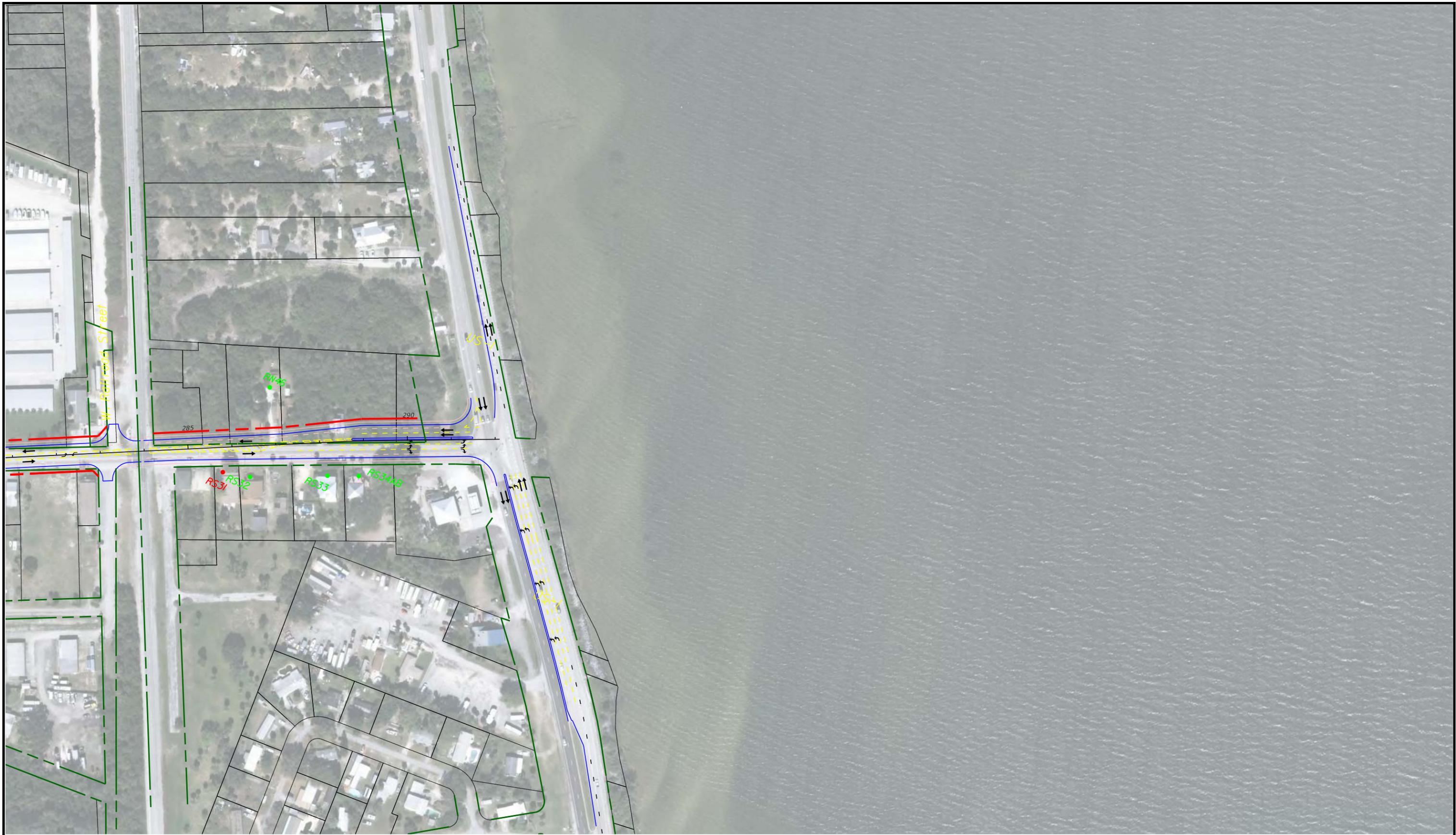
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 .RE15 NOISE ANALYSIS RECEIVER LOCATION - NON-IMPACTED

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— RIGHT-OF-WAY  
— FEASIBLE AND COST REASONABLE NOISE BARRIER LOCATION

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***APPENDIX E***

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***TNM Modeling Files  
(Provided on CD)***