
# ADVANCED RAPID TRANSIT

## North/South Corridor Project

# Noise and Vibration Impact Assessment Report

April 2023

VIA

# VIA Advanced Rapid Transit

## North/South Corridor Project

## Noise and Vibration Impact Assessment Report

Prepared for:


Prepared by:

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# APPENDICES

# ACRONYMS

| Acronym/Abbreviation | Definition |
|---|---|
| ART | Advanced Rapid Transit |
| CFR | Code of Federal Regulations |
| dB | Decibel |
| dBA | A-weighted decibel |
| FHWA | Federal Highway Administration |
| FTA | Federal Transit Administration |
| GIS | Geographic Information System |
| in/sec | Inches Per Second |
| $L_{dn}$ | Day/Night Sound Level |
| $L_{eq}$ | Equivalent Noise Level |
| $L_{max}$ | Maximum Noise Level |
| mph | Miles Per Hour |
| N/S | North/South |
| NEPA | National Environmental Policy Act |
| PPV | Peak Particle Velocity |
| ROW | Right-of-Way |
| SR | State Route |
| TNM | Traffic Noise Model |
| VdB | Decibel Notation |
| VIA | VIA Metropolitan Transit |

# 1. INTRODUCTION

The Federal Transit Administration (FTA) has initiated National Environmental Policy Act (NEPA) compliance for VIA Metropolitan Transit's (VIA) North/South (N/S) Advanced Rapid Transit (ART) project. FTA has determined that the project, an approximately 12-mile bus rapid transit line, locally known as ART, in San Antonio, Texas, is a federal undertaking subject to NEPA. The project comprises 75 percent dedicated transit lanes and 25 percent mixed traffic operations and would include 26 branded stations with off-board fare collection, next bus messaging, public announcement systems, bike parking, and safety features such as security cameras and lighting.

The purpose of this technical memorandum is to assess future noise and vibration effects on the surrounding land uses as a result of the construction and operation of the proposed project. The potential effects of the project are noise from BRT operations at proposed bus stations and at roadway modifications resulting in a change in traffic volumes and/or distances from the traffic to existing sensitive land uses.

The guidance presented in the FTA *Transit Noise and Vibration Impact Assessment Manual* (2018) (FTA Manual) was used to predict and assess the potential noise and vibration effects of the areas of dedicated transit lane operations. The potential effects of construction were assessed using local agency noise ordinances.

Noise-sensitive land uses were identified using Geographic Information System (GIS), assessor's parcel maps and aerial photos. These sensitive land uses were verified through fieldwork.

# 2. NOISE AND VIBRATION BACKGROUND

## 2.1 Noise

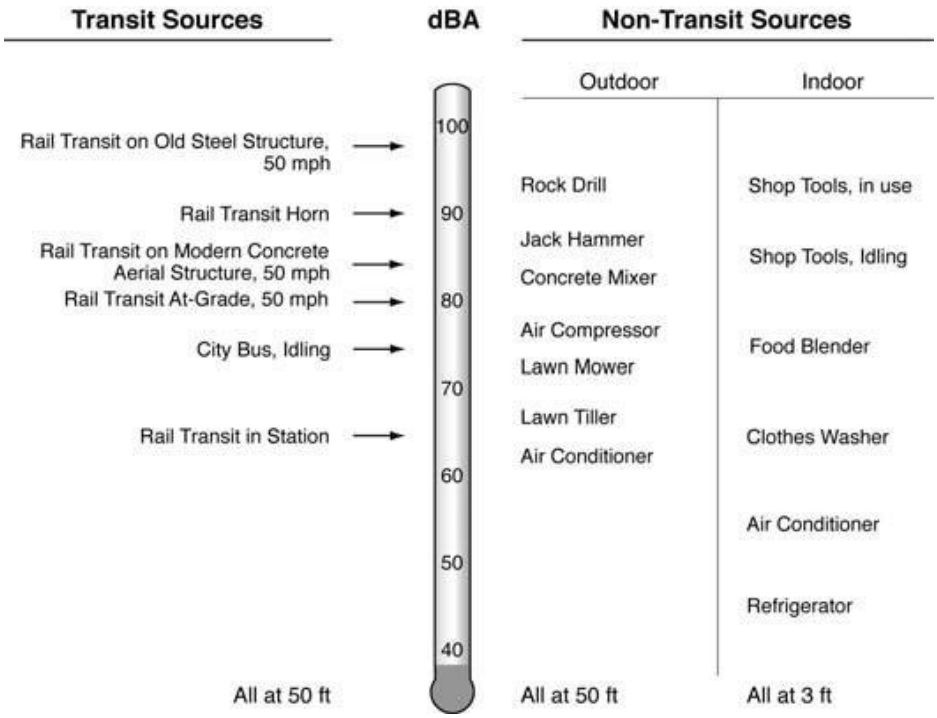
Noise is defined as unwanted sound; it is measured in terms of sound pressure level and is usually expressed in decibels (dB). The human ear is less sensitive to higher and lower frequencies than it is to midrange frequencies. To provide a measurement meaningful to humans, a weighting system was developed that reduces the sound level of higher and lower frequency sounds, similar to what the human ear does. This filtering system is used in virtually all noise ordinances. Measurements taken with this "A-weighted" filter are referred to as "dBA" readings.

The two primary noise measurement descriptors used to assess noise impacts from traffic and transit projects are the Leq, and the Ldn, which are defined below:

- Leq: The equivalent sound level (Leq) is the level of a constant sound for a specified period of time that has the same sound energy as an actual fluctuating noise over the same period of time. The peak-hour Leq is used for all traffic and transit noise analyses at locations with daytime use, such as schools and libraries.
- Ldn: The day-night sound level (Ldn) is a Leq over a 24-hour period, with 10 dBA added to nighttime sound levels (between 10 p.m. and 7 a.m.) as a penalty to account for the greater sensitivity and lower background sound levels during this time.

The Leq and Ldn are the primary noise-level descriptors for the assessment of FTA transit noise at sensitive noise receivers. Typical A-weighted sound levels are presented in **Figure 2-1**.

**Figure 2-1 Typical A-weighted Sound Levels**




*Source: FTA Manual (2018)*

## 2.2 Vibration

FTA does not consider vibration impacts to result from rubber tires and suspension systems of transit vehicles. These vehicles provide vibration isolation. It is unusual for them to cause noticeable ground borne vibration or ground borne noise. With transit vehicle-related vibration, such as rattling of adjacent building windows that may be noticed by building occupants, the cause is almost always airborne noise and directly related to running surface conditions such as potholes, bumps, expansion joints, or other discontinuities in the road surface (usually resolved by smoothing the discontinuities). The two types of vibration impact that may occur when buses operate over poor road surface conditions are:

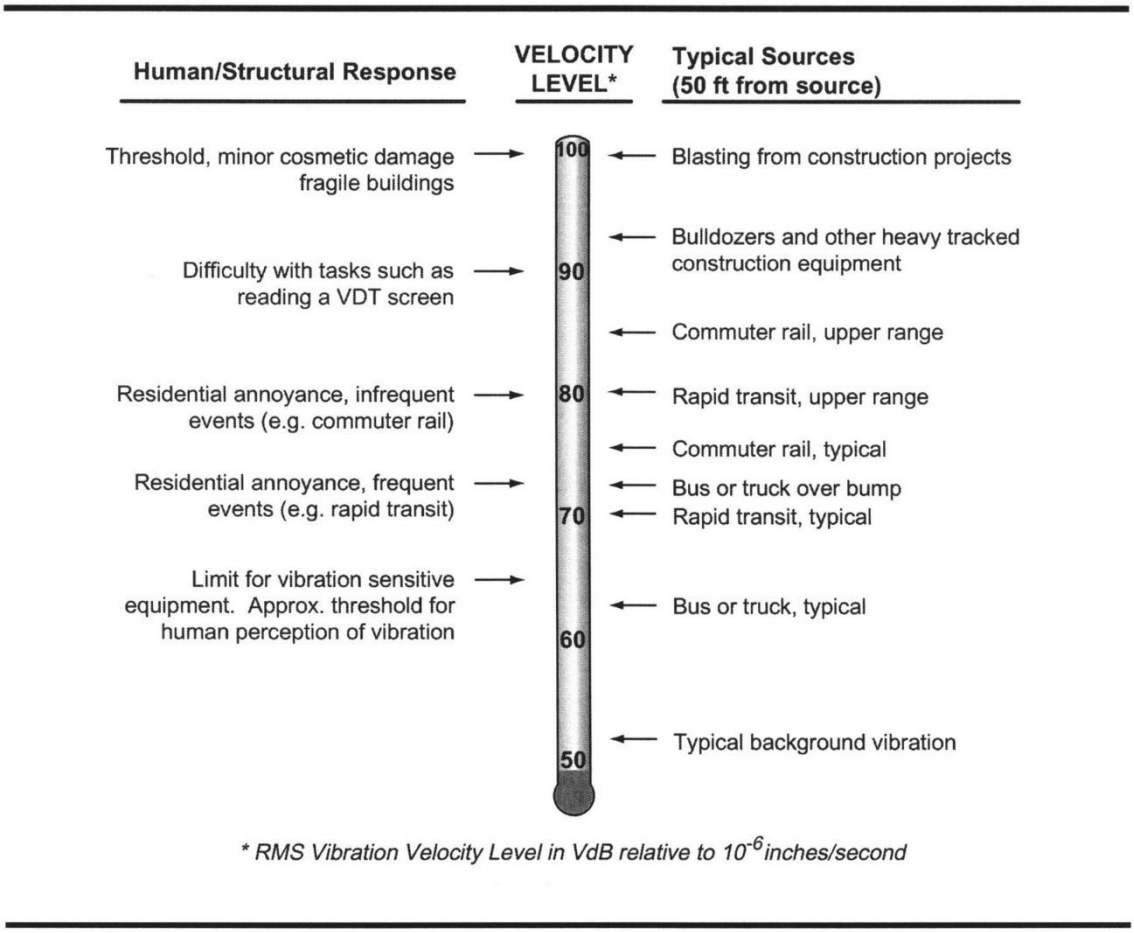
- Ground borne vibration: The movement of the ground (vibration can be experienced either outdoors or indoors)
- Ground borne noise: Noise generated by the movement of room surfaces, such as walls, resulting from vibration of a building (ground borne noise can only be experienced indoors)

Ground borne vibration can be described in terms of displacement, velocity, or acceleration when evaluating impacts from transit projects. Ground borne noise occurs as a perceptible rumble and is caused by the noise radiated from the vibration of room surfaces. Vibration above certain levels can damage buildings, disrupt sensitive operations, and cause annoyance to humans within buildings. The response of humans, buildings, and equipment to vibration is most accurately described using velocity or acceleration. Vibration velocity is used by FTA as the primary measurement to evaluate the effects of vibration.

Figure 2-2 illustrates typical ground borne vibration velocity levels for common sources, as well as thresholds for human and structural response to ground borne vibration. As shown, the range of interest

is from approximately 50 vibration velocity decibels (VdB) to 100 VdB (i.e., from imperceptible background vibration to the threshold of damage to structures). Although the threshold of human perception to vibration is approximately 65 VdB, annoyance does not usually occur unless the vibration exceeds 70 VdB.

**Figure 2-2 Typical Ground borne Vibration Levels**




*Source: FTA Manual (2018)*

# 3. REGULATORY REQUIREMENTS

## 3.1 Federal

FTA criteria were applied to the proposed project components. The ~~FTA~~ criteria found in the FTA guidance are ~~the~~ primary noise and vibration criteria by which transit-specific impacts are identified by FTA. FTA guidance provides performance standards or thresholds for project elements where only transit would operate, including ART operations and associated ancillary and support elements, such as at stations, garages, park-and-ride lots, and transit centers. The FHWA traffic noise impact criteria defined in 23 CFR 772 were not applied to this project.

## 3.2 Local

The local noise regulations that would apply to this project include city and local municipal noise ordinances within the project area. The local county and city noise standards in areas of all project components outline regulations to control construction noise and all are essentially the same. The updated City of San Antonio noise ordinance allows construction work on:

- Weekdays: 7 a.m. - 8 p.m.
- Saturdays: 8 a.m.- 8 p.m.
- Sundays: 9 a.m. - 5 p.m.

There are exceptions for pouring concrete and a limited amount of repair work on heavy machinery or construction equipment. Contractors can also apply for permission from the city to work outside of those hours, but they must inform nearby residents at least three days in advance. Multiple violations of the ordinance could result in the construction permit being suspended, or even revoked. Under the previous ordinance, citations were the only punishment.

## 3.3 Other Requirements

### 3.3.1 Construction

#### 3.3.1.1 Noise

Construction of the project would require the use of heavy equipment that generates relatively high noise levels. FTA reference noise levels were used to predict construction noise levels for a variety of construction operations based on a compilation of empirical data and the application of acoustical propagation formulas. FTA uses a database of noise levels for common pieces of construction equipment that would be expected to be used during construction of the project (FTA 2018). Variables that can be adjusted are distance from equipment to receiver, shielding, and equipment usage rates. Construction noise levels were predicted assessed as they would typically occur at the closest residential receivers. See Table 3-2 for typical construction noise levels.

#### 3.3.1.2 Vibration

Construction vibration was analyzed to evaluate the potential for damage to structures. Annoyance from ground borne noise and vibration is generally not an issue because of the short-term duration of most construction activities and is not included in this assessment. To evaluate potential vibration effects during construction, the FTA's recommendation on damage risk vibration levels was used because there are no state, county, or city vibration regulations.

The parameter normally used to assess potential construction vibration effects to structures is the peak particle velocity (PPV), which is the maximum velocity recorded during a particular event, such as from a jackhammer. The FTA's recommended limits for construction vibration for four building categories are as follows:

- Reinforced concrete, steel, or timber: 0.5 inch per second (in./sec) PPV
- Engineered concrete and masonry: 0.3 in./sec PPV
- Nonengineered timber and masonry buildings: 0.2 in./sec PPV
- Buildings extremely susceptible to vibration damage: 0.12 in./sec PPV

### 3.3.2 Operations

#### 3.3.2.1 Noise

Existing measured noise levels were used to predict the Ldn and peak-hour Leq for receivers used in the noise and vibration analysis. The Ldn is a 24-hour energy average noise level used to determine impacts where nighttime sensitive land use exists, such as residences, hotels and motels, and hospitals. The peak-hour Leq is used to determine noise impacts for institutional land use, such as schools, libraries, or churches. All noise levels are A-weighted to account for the hearing response of humans and referred to as sound levels in decibels (dBA).

The criteria in the FTA's *Transit Noise and Vibration Impact Assessment Manual* (2018) are founded on well-documented research on community reaction to noise and are based on changes in noise exposure using a sliding scale. The amount of change in the overall noise environment that the transit project is allowed to make is reduced with increasing levels of existing noise. The FTA noise impact criteria group noise-sensitive land uses into the following three categories:

- Category 1: Tracts of land where quiet is an essential element in their intended purposes. This category includes lands set aside for serenity and quiet, and such land uses as outdoor amphitheaters and concert pavilions, as well as National Historic Landmarks with significant outdoor use. Also included are recording studios and concert halls.
- Category 2: Residences and buildings where people normally sleep. This category includes residences, hospitals, and hotels where nighttime sensitivity is assumed to be of utmost importance.
- Category 3: Institutional land uses with primarily daytime and evening use. This category includes schools, libraries, theaters, and churches where it is important to avoid interference with such activities as speech, meditation, and concentration on reading material. Places for meditation or study associated with cemeteries, monuments, museums, campgrounds, and recreational facilities may also be in this category. Certain historical sites and parks are also included.

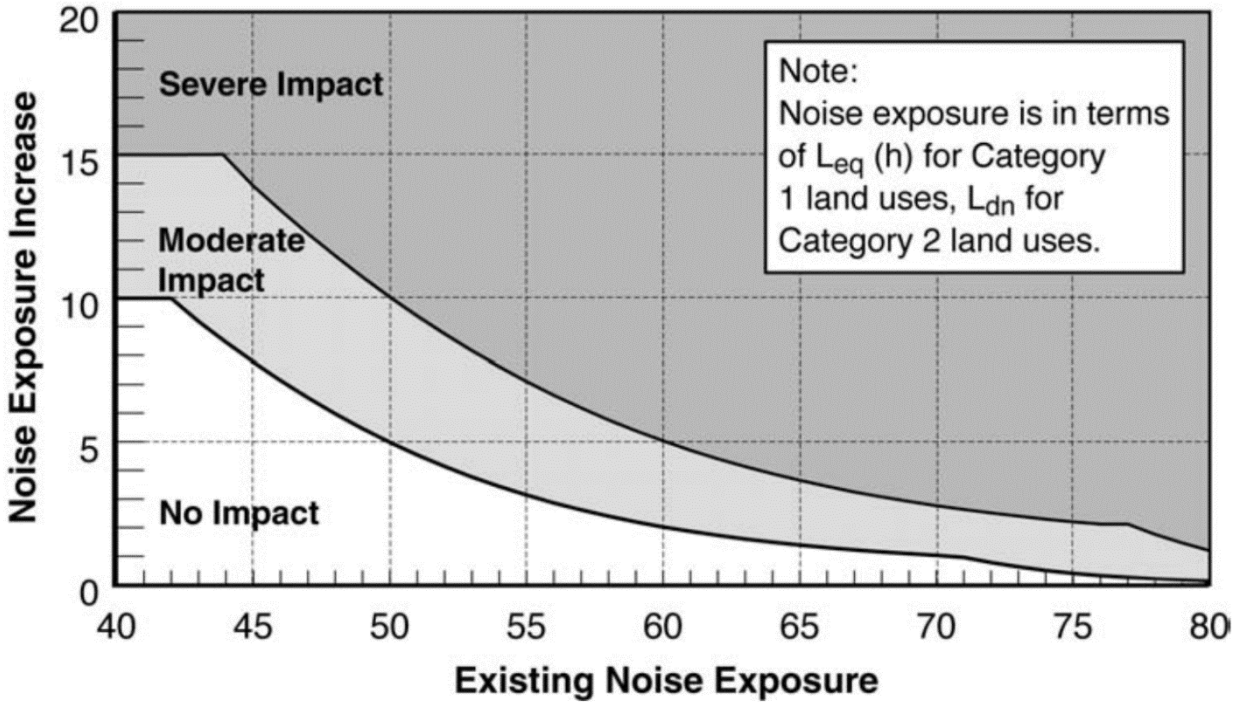
The Ldn is used to characterize noise exposure for residential areas (Category 2), and the peak 1-hour $L_{eq}$ is used to evaluate effects from other noise-sensitive land uses such as schools, libraries, and other noise-sensitive daytime uses (Categories 1 and 3) during project operation. There are no FTA impact criteria for commercial uses, such as offices, retail, or restaurants.

Two levels of impact are included in the FTA criteria. The interpretations of these two levels of impact are summarized below:

- Severe: Project-generated noise in this range is likely to cause a high level of community annoyance. Noise mitigation must be considered for severe impacts unless extenuating circumstances prevent mitigation.
- Moderate: Project-generated noise in this range is considered to cause impact at the threshold of measurable annoyance. Mitigation should be considered at this level of impact based on project specifics and details concerning the affected properties.

Note that both Severe and Moderate impacts are mitigated unless there is no reasonable or feasible mitigation. The FTA noise impact criteria are provided in **Figure 3-1**, which shows the existing noise exposure and the noise exposure increase that would result in either a moderate or severe impact. The future noise exposure, which is not shown in the table, would be the combination of the existing noise exposure and the additional noise exposure caused by the proposed project.

**Figure 3-1 FTA Noise Impact Criteria**




*Source:* FTA *(2018)*

Noise from ART operations was modeled using the FTA Noise Impact Assessment Spreadsheet described in the FTA Manual (2018). Inputs to the model were based on the operating plan, speed, and distances to the noise-sensitive land uses. Noise assessments were not prepared at those noise sensitive receptors where the future 2039 build is the same as the existing traffic.

#### 3.3.2.2 Vibration

Since there are no ground borne vibration impacts expected from the operation of the proposed project, the FTA Vibration Assessment would not apply.

# 4. AFFECTED ENVIRONMENT AND ENVIRONMENTAL IMPACTS

## 4.1 Noise Measurement Sites

This section summarizes land uses sensitive to noise and vibration located along the project corridor where existing noise level measurements were conducted. These land uses were identified through site reconnaissance, aerial maps, and GIS. Seven noise measurement locations were selected to best represent existing noise levels at the closest residential receiver to the proposed project improvements. Appendix B shows the locations of the noise measurements. The measurement sites were selected based on residential land use near the project alignment. Existing noise measurements were conducted during the week of May 9th and August 15th, 2022, at residential land uses along the corridor.

### Site 1: Isom Road & Wolfe Road

This measurement site represents residential properties between US 281 to San Pedro Avenue. Most of properties adjacent to Isom Road in this area are commercial, retail and light industrial uses. The residential properties that are adjacent to Isom Road are mainly apartments (multi-family residential units).

### Site 2: 6923 San Pedro Avenue (InTown Suites Extended Stay Hotel)

This measurement site represents residential properties between I-410 to Basse Road. Most properties adjacent to San Pedro Avenue in this area are retail and commercial properties. The measurements were taken at the sidewalk, in front of the InTown Suites Extended Stay Hotel on the west side of San Pedro Avenue.

### Site 3: San Pedro Avenue & Thorain Boulevard

This measurement site represents residential properties between Basse Road and West Mandalay Drive. A majority of the properties adjacent to San Pedro Avenue in this area are mainly retail and commercial properties. The measurements were taken at the sidewalk, in front of the residence on the northwest corner of San Pedro Avenue and Thorain Boulevard.

### Site 4: San Pedro Avenue & Wildwood Drive

This measurement site represents residential properties between West Mandalay Drive and Audubon Road. The properties adjacent to San Pedro Avenue in this area are a mix of residential, retail and commercial properties.

### Site 5: San Pedro Avenue & Elmwood Drive

This measurement site represents residential properties between Audubon Road and Hildebrand Avenue. Most properties adjacent to San Pedro Avenue in this area are retail and commercial properties. The measurements were taken on the sidewalk in front of the residence at 402 Elmwood Drive, which is a cul-du-sac on the west side of San Pedro Avenue.

### Site 6: San Pedro Avenue & Lynwood Avenue

This measurement site represents residential properties between Hildebrand Avenue to Mulberry Avenue. Most of properties adjacent to San Pedro Avenue in this area are residential properties with a mix of retail and commercial properties.

### Site 7: San Pedro Avenue and Mistletoe Avenue

This measurement site represents residential properties between Mulberry Avenue and Evergreen Street. Most properties adjacent to San Pedro Avenue in this area are commercial and retail uses. The residential properties that are adjacent to San Pedro Avenue are a mix of apartments (multi-family residential units) and single-family residential units. Other land uses adjacent to San Pedro Avenue include a park, university/college and theatre.

The measurements were limited to one-hour Leq noise levels and then converted to 24-hour day/night (Ldn) noise levels. The conversion from one-hour Leq to Ldn is based on the FTA Guidance in Appendix E, Determining Existing Noise, of the *Transit Noise and Vibration Impact Assessment Manual* (FTA 2018). In accordance with Option 4 of Appendix E a one-hour Leq measured between 7 a.m. and 7 p.m. is approximately 2 dB less than the Ldn (Eq. E-2). The existing noise measurements at sensitive receptors where there are changes in future 2039 build traffic are presented in Table 4-1.

**Table 4-1 Existing Noise-level Measurements**

| Site | Land Use | Location | Measured $L_{eq}$ (h), dBA | Time of Noise Measurement | Corrected Ldn, dBA |
|---|---|---|---|---|---|
| 1 | Residential | Isom Road & Wolfe Road | 66 | 10 AM | 64 |
| 2 | InTown Suites Extended Stay Hotel | 6923 San Pedro Avenue | 73 | 10 AM | 71 |
| 3 | Residential | San Pedro Avenue & Thorain Boulevard | 66 | 11 AM | 64 |
| 4 | Residential | San Pedro Avenue & Wildwood Drive | 71 | 3 PM | 69 |
| 5 | Residential | San Pedro Avenue & Elmwood Drive | 63 | 12 Noon | 61 |
| 6 | Residential | San Pedro Avenue & Lynwood Avenue | 57 | 4 PM | 55 |
| 7 | Residential | San Pedro Avenue and Mistletoe Avenue | 69 | 2 PM | 67 |

*Source: Project Team (2022)*

## 4.2 Construction

### 4.2.1 Noise

Construction of the project would require the use of heavy equipment that generates relatively high noise levels. FTA reference noise levels were used to predict construction noise for a variety of construction operations based on a compilation of empirical data and the application of acoustical propagation formulas. The FTA uses a database of noise levels for common pieces of construction equipment that would be expected to be used during construction of the project (FTA 2018). Variables that can be adjusted are distance from equipment to receiver, shielding, and equipment usage rates. The highest construction noise levels would typically occur at the closest residential receivers. See Table 4-2 for typical construction noise levels.

The proposed project construction noise would be temporary and intermittent and would cease once construction is complete. Table 4-2 presents typical construction equipment noise at 50 feet from the receiver that could be expected to be used for this project by typical construction equipment such as bulldozers, graders, and trucks.

**Table 4-2 Typical Construction Equipment Noise Levels**

| Equipment | Typical noise level 50 ft from source, dBA |
|---|---|
| Air Compressor | 80 |
| Backhoe | 80 |
| Compactor | 82 |
| Concrete Mixer | 85 |
| Concrete Pump | 82 |
| Concrete Vibrator | 76 |
| Crane, Mobile | 83 |
| Dozer | 85 |
| Generator | 82 |
| Grader | 85 |
| Loader | 80 |
| Paver | 85 |
| Pile Driving | 101 |
| Pneumatic Tool | 85 |
| Pump | 77 |
| Roller | 85 |
| Saw | 76 |
| Scarifier | 83 |
| Scraper | 85 |
| Shovel | 82 |
| Truck | 84 |

*Source: FTA Manual (2018)*

### 4.2.2 Vibration

The damage to structures is a potential vibration impact. Annoyance from ground borne vibration is generally not an issue because of the short-term duration of most construction activities and is not included in this assessment. To evaluate potential vibration effects during construction, the FTA's recommendation on damage risk vibration levels was used because there are no state, county, or city vibration regulations.

Construction of the project could result in temporary vibration from the use of heavy equipment and machinery. Pile driving, which could produce the highest levels of vibration at sensitive receivers, is not anticipated to occur during construction. Annoyance from ground borne noise and vibration is generally not an issue because of the short-term duration of most construction activities, and the main concern is potential damage to buildings. It is not expected that the construction of the project would result in ground borne vibration levels of 0.3 in./sec PPV or greater, resulting in a potential damage risk to the buildings along the corridor. The exception would be historic properties that are extremely susceptible to vibration damage. Locations of these properties within the study area can be found in the N/S ART Historic Resources Report. Further analysis at these historic properties would be required when the means and methods of construction have been established.

## 4.3 Operations

### 4.3.1 Noise

The predicted future 2039 noise levels with the proposed project are presented in Table 4-3. A moderate impact is predicted at Sites 3, 5, and 6. No impacts predicted at Sites 1, 2, 4, and 7.

**Table 4-3 Predicted Project Future Noise Levels**

| Site | Land Use | Location | Existing Noise Levels Ldn, dBA | Project 2039 Build Noise Levels Ldn, dBA | Total Future 2039 Build Noise Levels Ldn, dBA | FTA Impact Threshold |
|---|---|---|---|---|---|---|
| 1 | Residential | Isom Road & Wolfe Road | 64 | 60 | 65 | None |
| 2 | InTown Suites Extended Stay Hotel | 6923 San Pedro Avenue | 71 | 57 | 71 | None |
| 3 | Residential | San Pedro Avenue & Thorain Boulevard | 64 | 61 | 66 | Moderate |
| 4 | Residential | San Pedro Avenue & Wildwood Drive | 69 | 61 | 70 | None |
| 5 | Residential | San Pedro Avenue & Elmwood Drive | 61 | 60 | 63 | Moderate |
| 6 | Residential | San Pedro Avenue & Lynwood Avenue | 55 | 58 | 60 | Moderate |
| 7 | Residential | San Pedro Avenue and Mistletoe Avenue | 67 | 62 | 68 | None |

*Source: Project Team (2022)*

### 4.3.2 Vibration

Existing and future vehicle vibration generated by the proposed project are not anticipated to generate perceptible levels of vibration at surrounding land uses. As such, no vibration impacts are anticipated during operation of the project.

# 5. MITIGATION MEASURES

## 5.1 Operations Mitigation

The proposed project is predicted to result in a moderate impact at Sites 3, 5, and 6. Mitigation measures such as noise barriers would not be feasible at these sites because these measures would obstruct the flow of traffic and reduce the effectiveness of the proposed project. Therefore, noise mitigation measures would not be included as part of this project.

No vibration impacts are anticipated due to the proposed project; no operations mitigation is proposed.

## 5.2 Construction Mitigation

The following mitigation effort is proposed for potential noise-related construction impacts.

The contractor would develop a Noise Control Plan demonstrating how the local ordinance construction noise limits can be achieved. The Noise Control Plan must be approved by VIA prior to initiating construction. If construction is planned during nighttime hours from 10:00 p.m. and 7:00 a.m., Sundays or legal holidays, the contractor would need to obtain a noise variance. Construction noise-reducing methods that may be implemented, as necessary, include the following:

- Use low-noise emission equipment
- Use broadband backup warning devices on all vehicles
- Implement noise-deadening measures for truck loading and operations
- Conduct monitoring and maintenance of equipment to meet noise limits
- Use acoustic enclosures, shields, or shrouds for equipment and facilities
- Install high-grade engine exhaust silencers and engine-casing sound insulation
- Minimize the use of generators
- Use movable noise barriers at the source of the construction activity

### 5.2.1 Vibration

Building damage from construction vibration is not anticipated from the project due to the type of construction and distances between the site and any nearest receivers; therefore, no mitigation is anticipated to be needed.

# 6. REFERENCES

Federal Transit Administration (FTA). 2018. *Transit Noise and Vibration Impact Assessment Manual*. Retrieved from https://www.transit.dot.gov/sites/fta.dot.gov/files/docs/research-innovation/118131/transit-noise-and-vibration-impact-assessment-manual-fta-report-no-0123_0.pdf. Accessed May and June 2022.

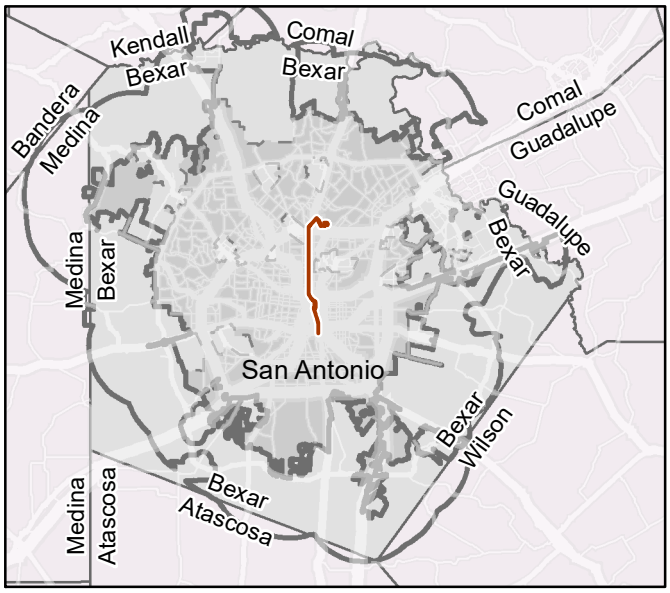
2018. Noise Impact Assessment Spreadsheet. Retrieved from https://www.transit.dot.gov/regulations-and-guidance/environmental-programs/noise-impact-assessment-spreadsheet. Accessed May and June 2022.


# APPENDIX A PROJECT LOCATION MAP

# Project Location Map

## LEGEND

- ART North/South Project Alignment
- N/S Stations



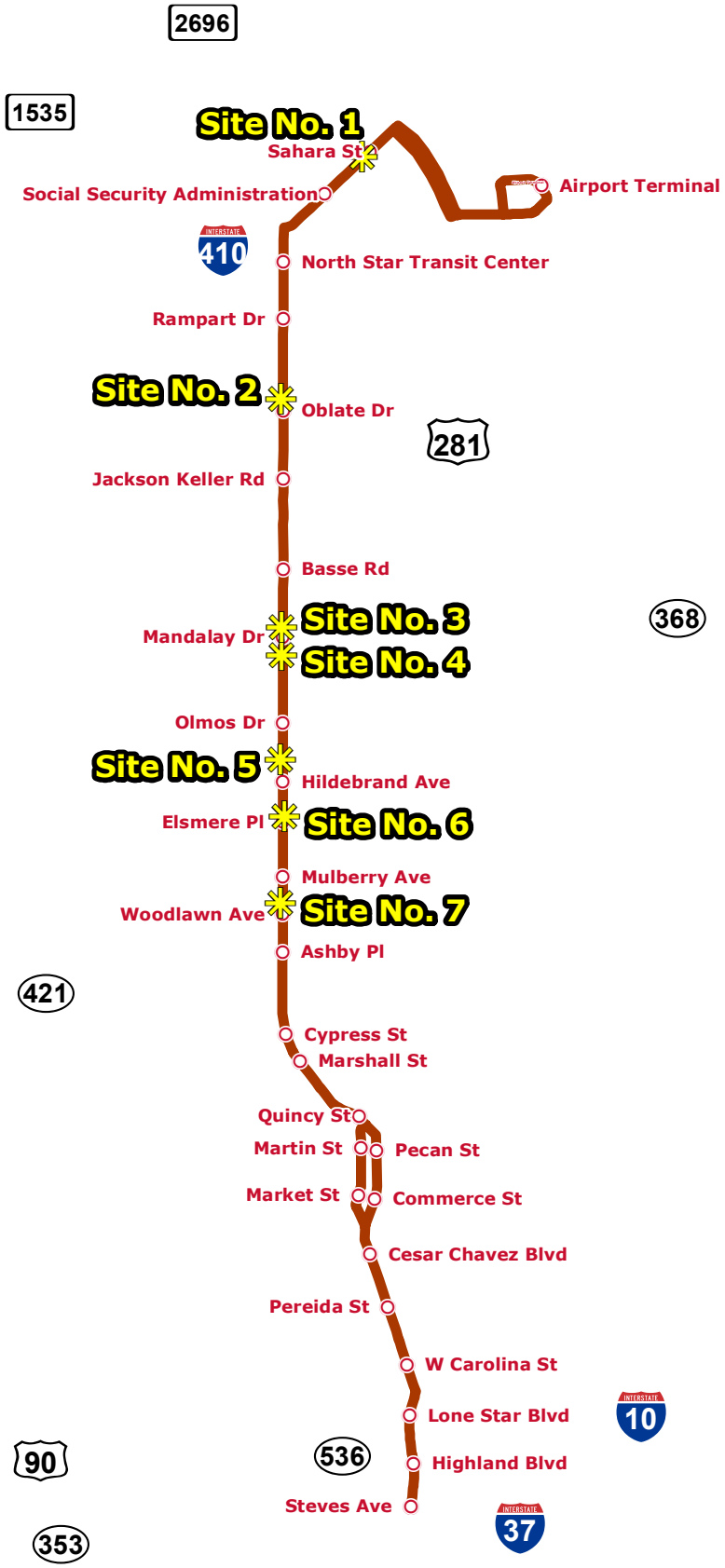

Sources: VIA (N/S proposed corridor and N/S Stations); TxDOT (city and county boundaries, roads, railroads); City of San Antonio (channels, central business district boundary)

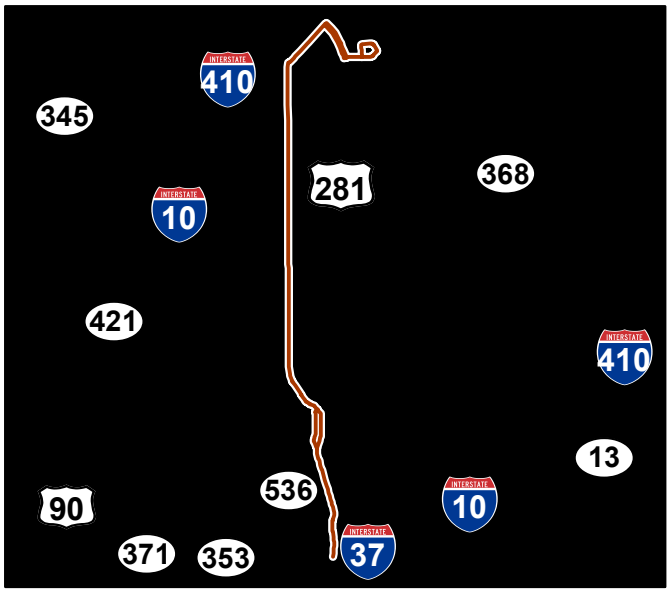

# APPENDIX B NOISE MEASUREMENT SITE MAPS AND DESCRIPTIONS

# Noise Measurement Overall Site Map

## LEGEND

- ART North/South Project Alignment
- N/S Stations
- Noise Measurement Site




Sources: VIA (N/S proposed corridor, N/S stations); TxDOT (roads, railroads); City of San Antonio (zoning)

0 2,650 5,300

Feet

# Noise Measurement Site Map



## LEGEND

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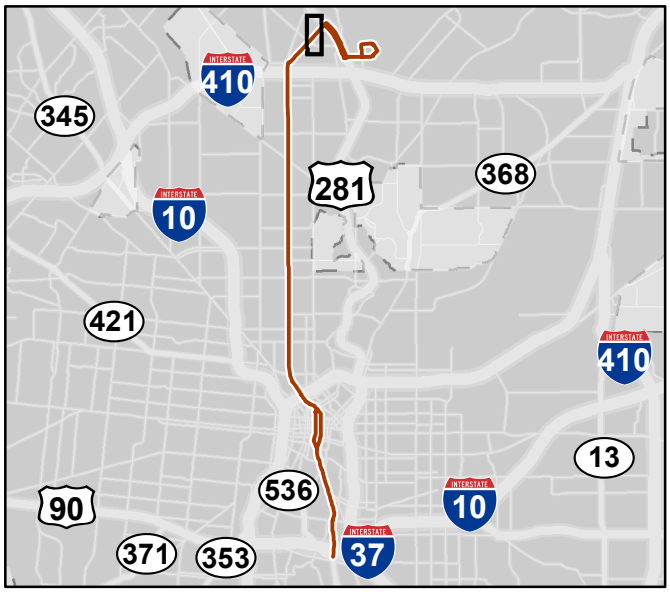
- Noise Measurement Site

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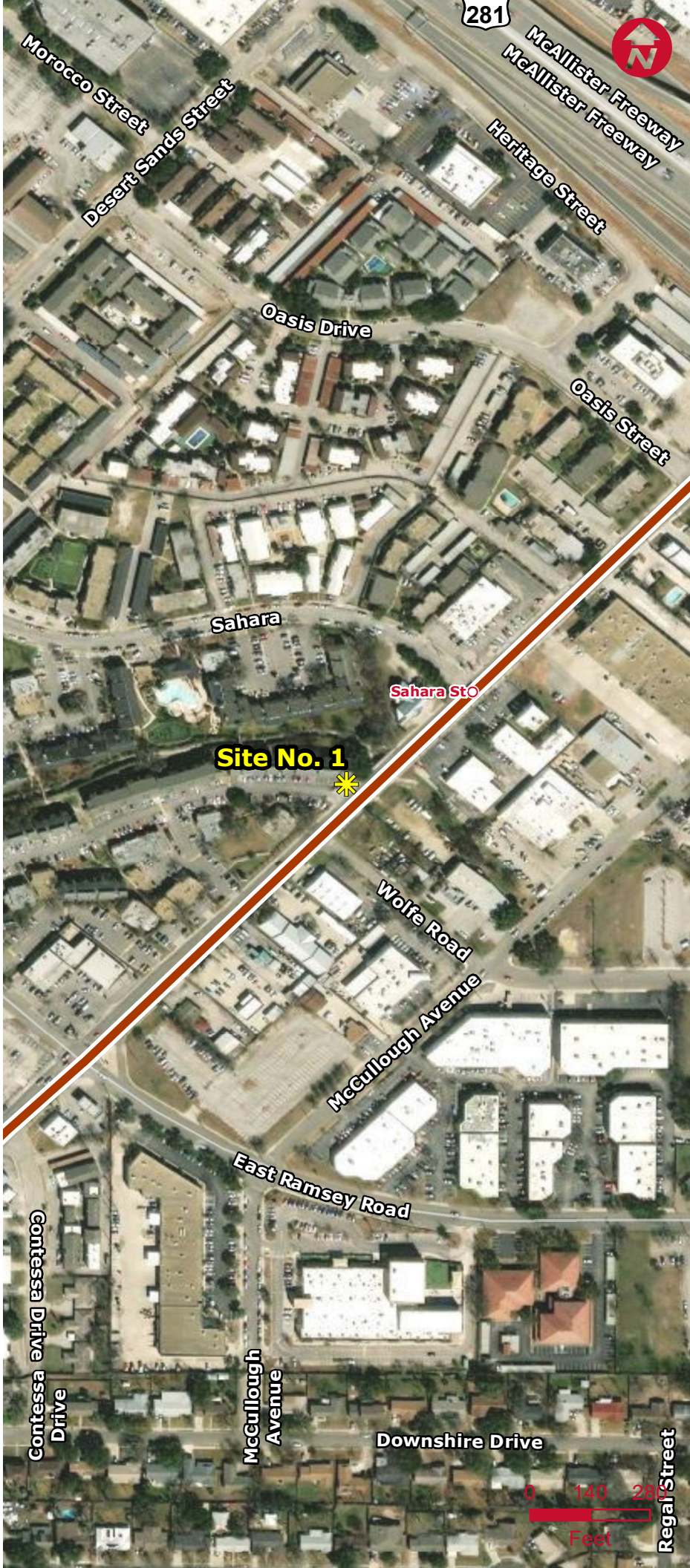

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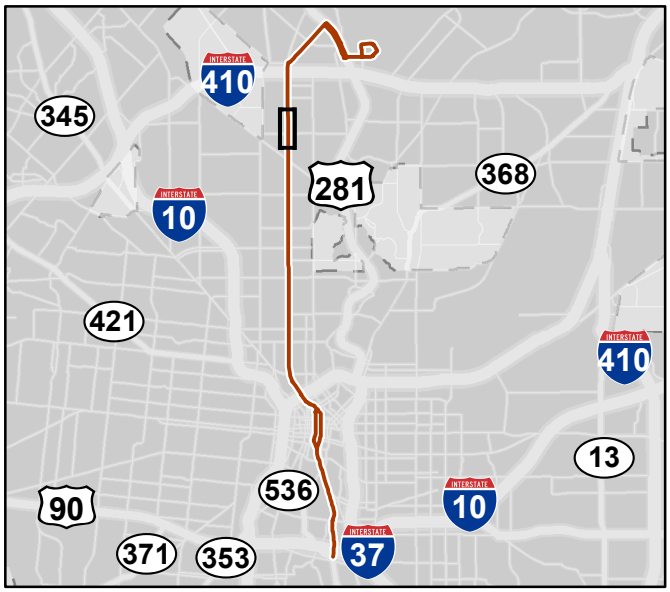


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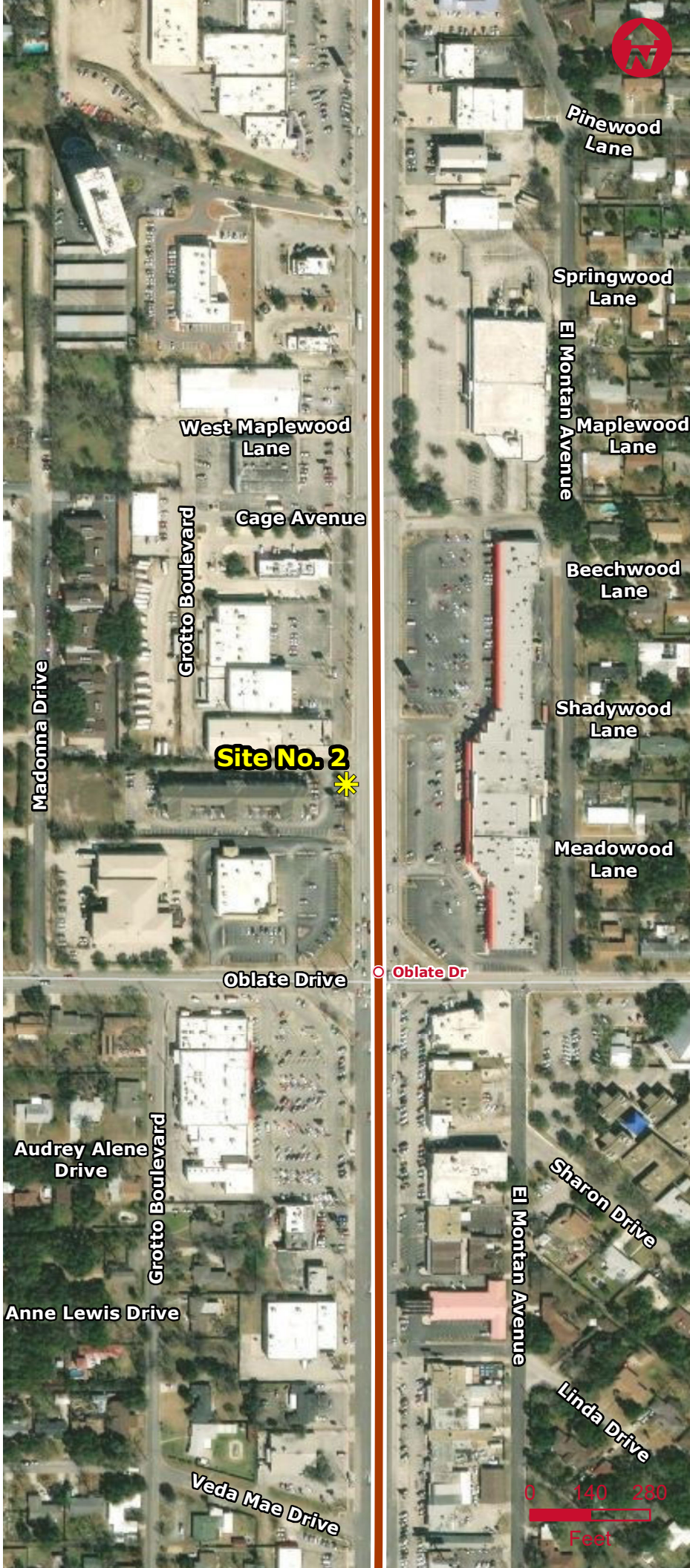

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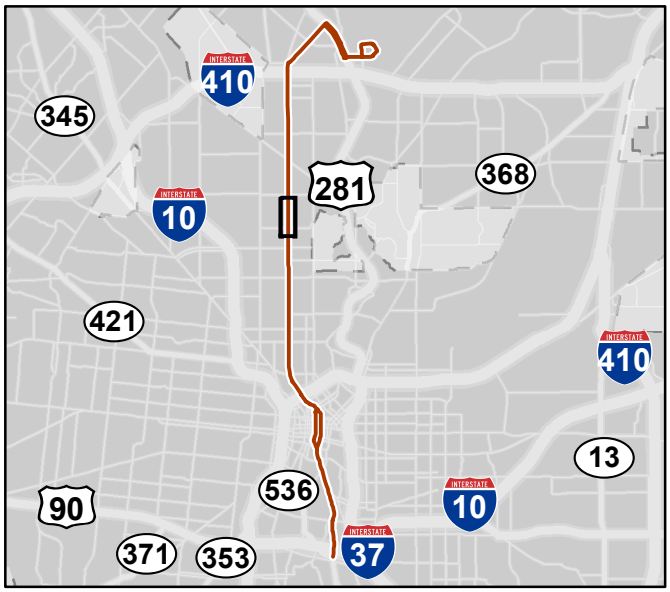
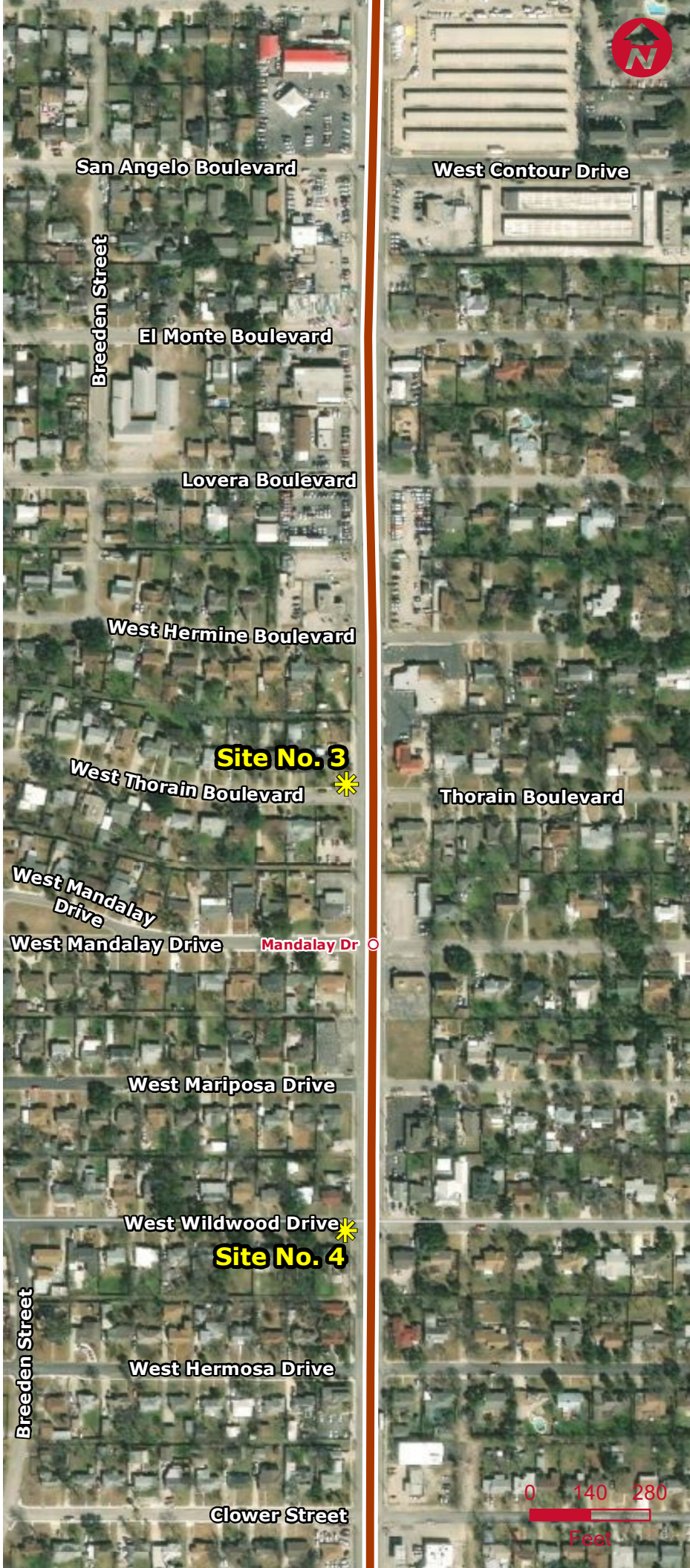



Sources: VIA (N/S proposed corridor, N/S stations); TxDOT (roads, railroads); City of San Antonio (zoning)



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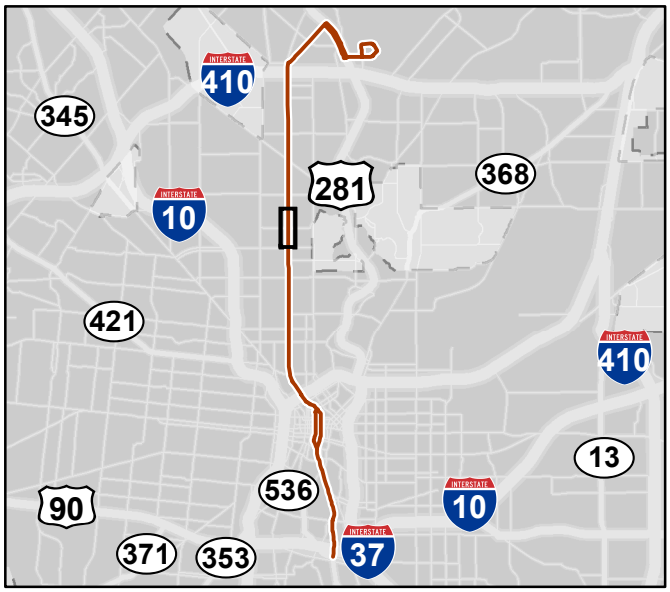


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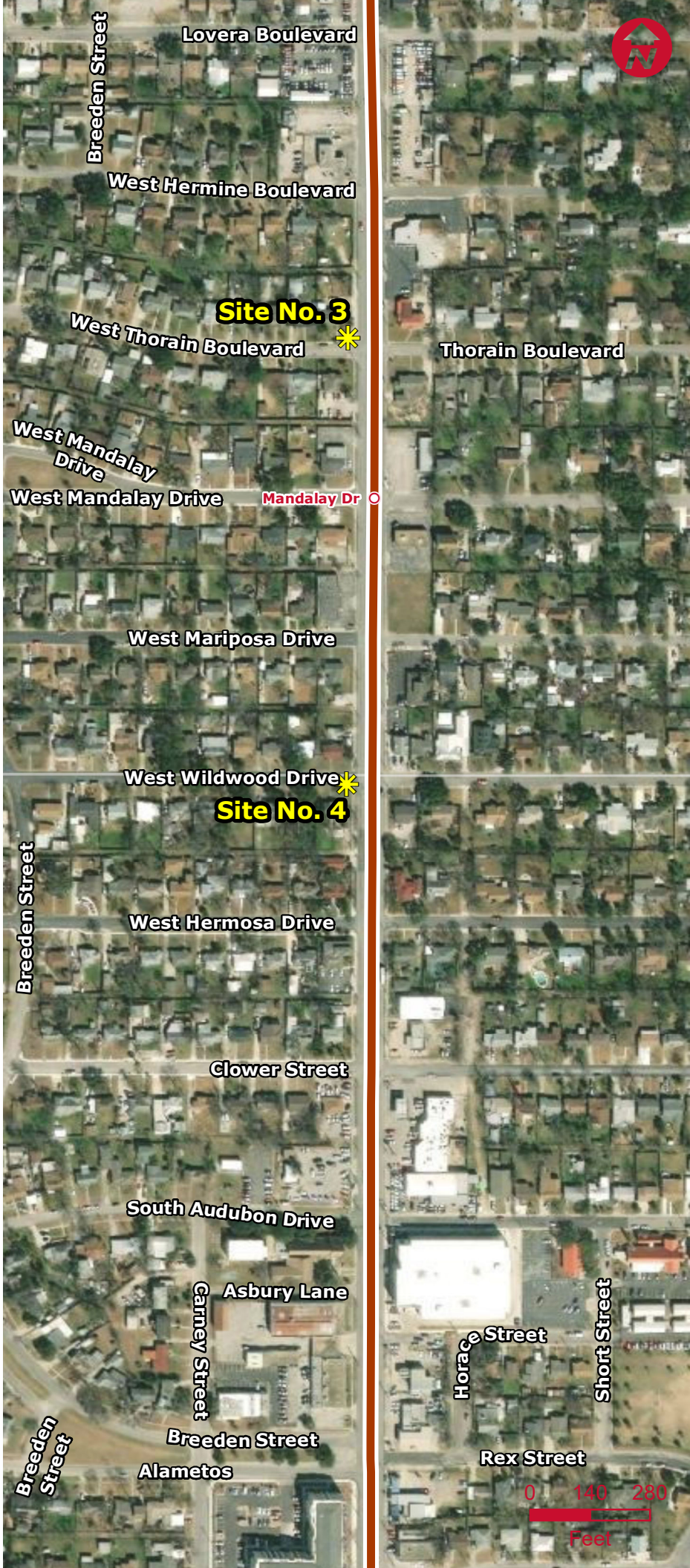

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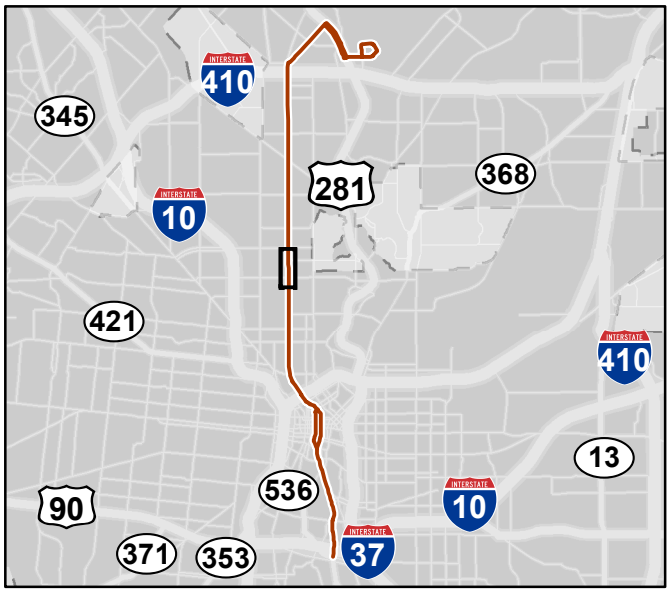
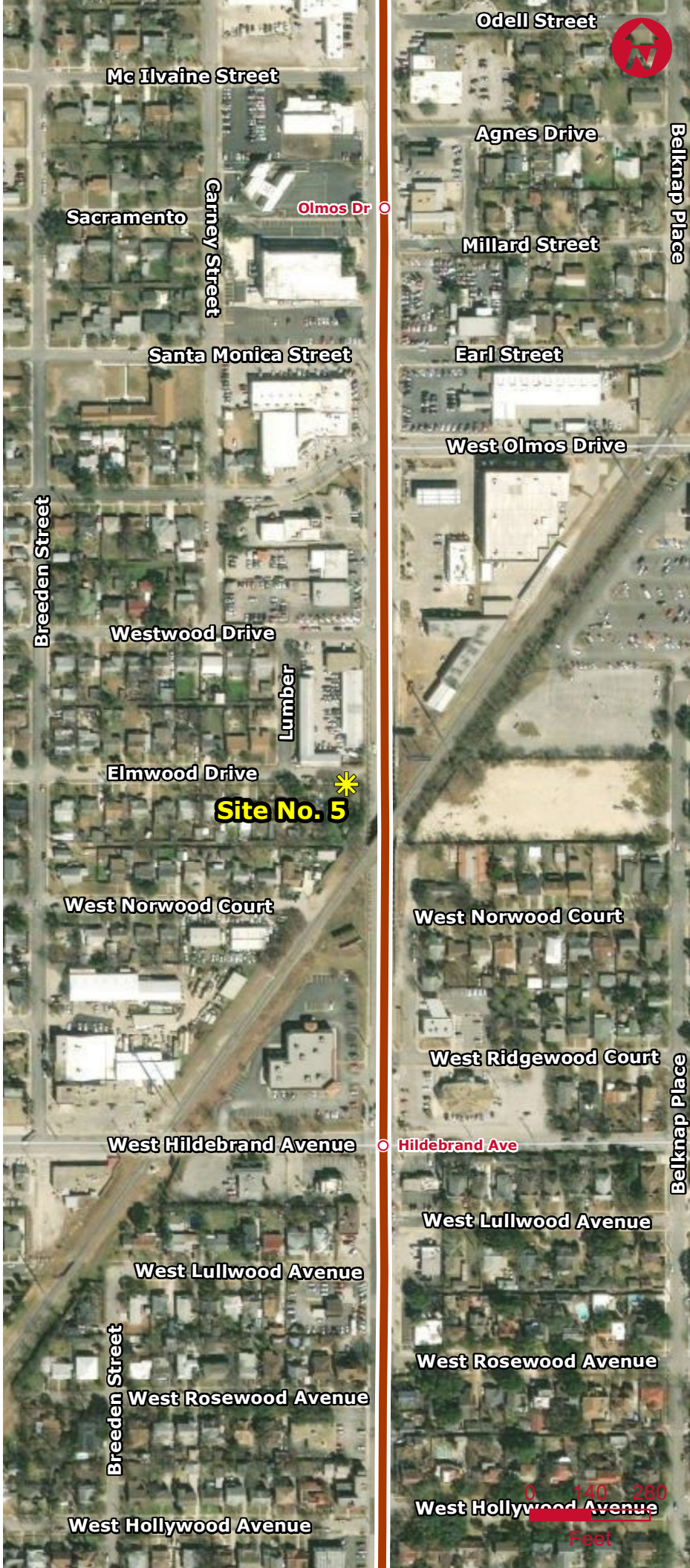
- N/S Stations
- Noise Measurement Site




Sources: VIA (N/S proposed corridor, N/S stations); TxDOT (roads, railroads); City of San Antonio (zoning)

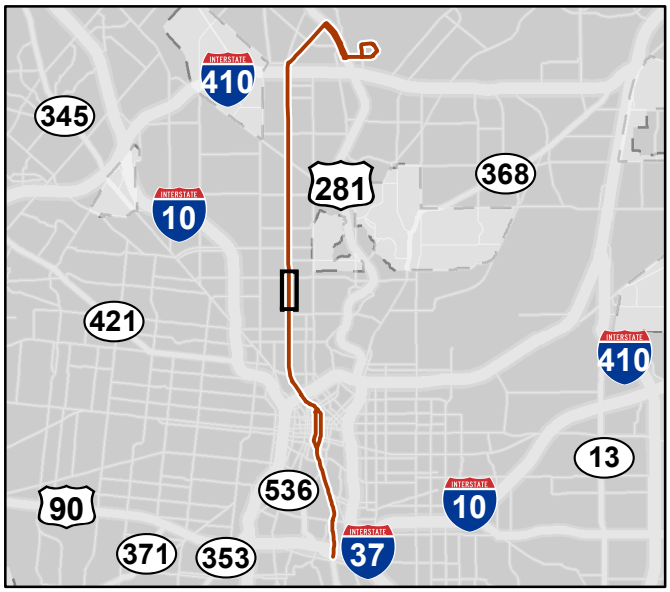


# Noise Measurement Site Map

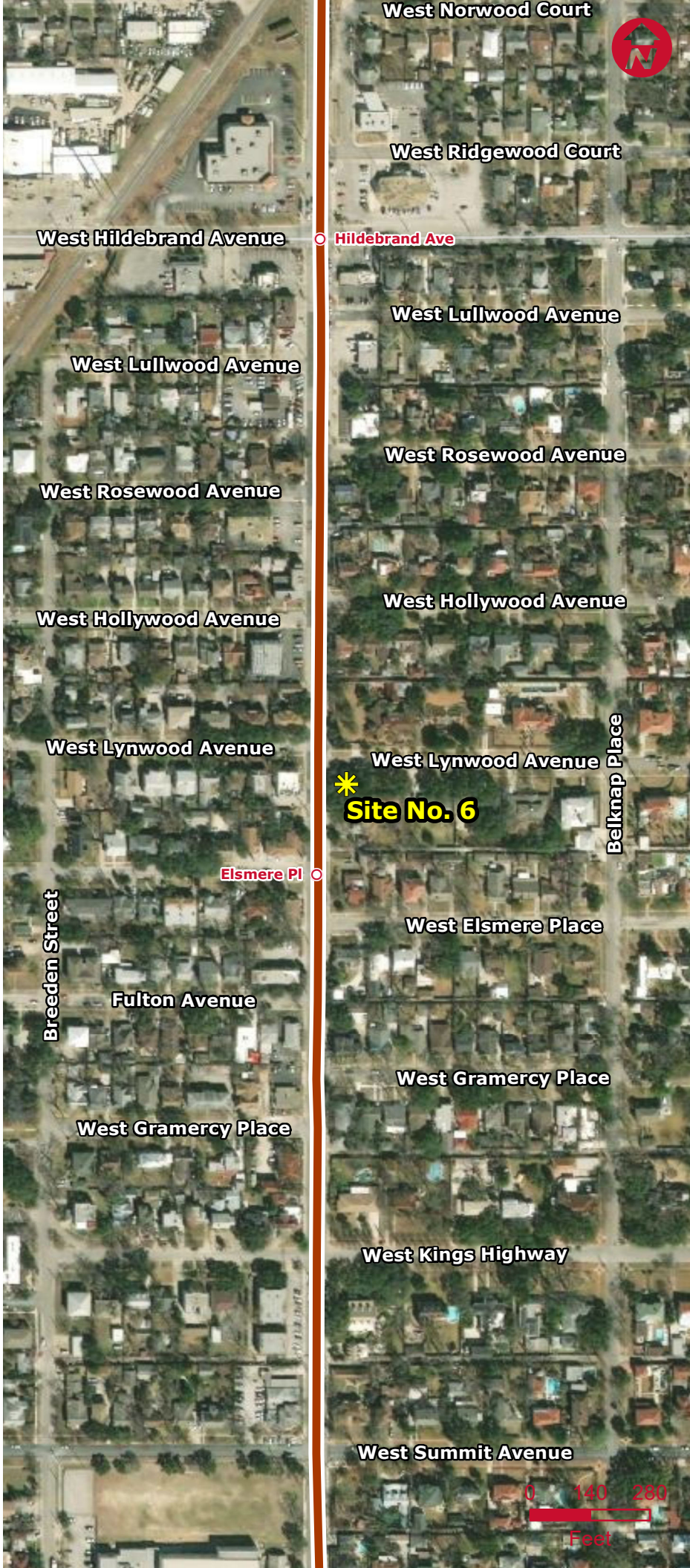


## LEGEND

- ART North/South Project Alignment
- N/S Stations
- Noise Measurement Site




Sources: VIA (N/S proposed corridor, N/S stations); TxDOT (roads, railroads); City of San Antonio (zoning)

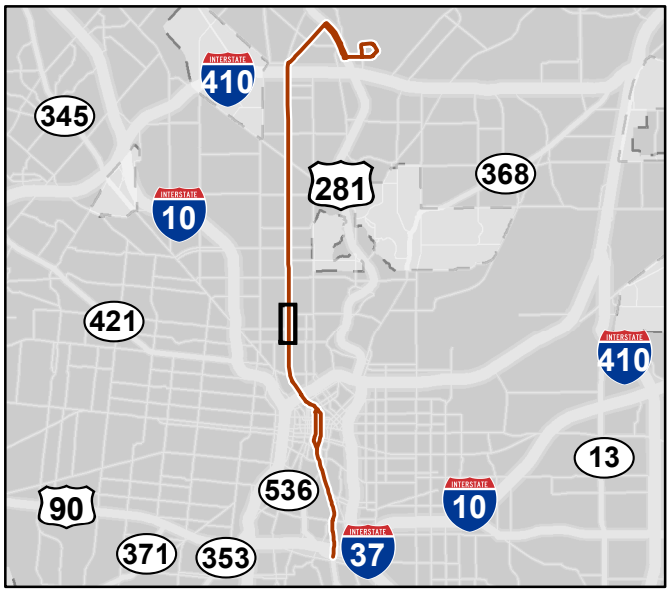


# Noise Measurement Site Map

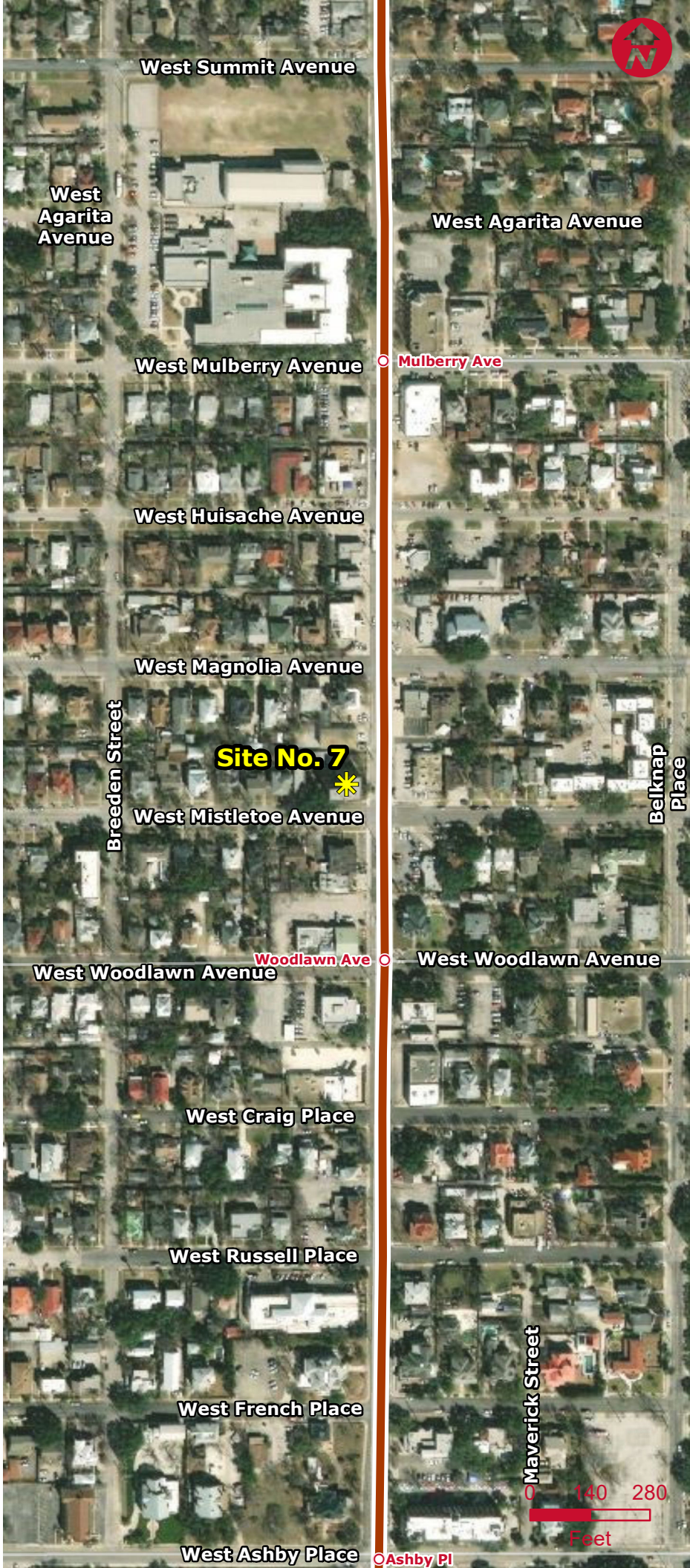


## LEGEND

- ART North/South Project Alignment
- N/S Stations
- Noise Measurement Site




Sources: VIA (N/S proposed corridor, N/S stations); TxDOT (roads, railroads); City of San Antonio (zoning)



# Noise Measurement Location Descriptions

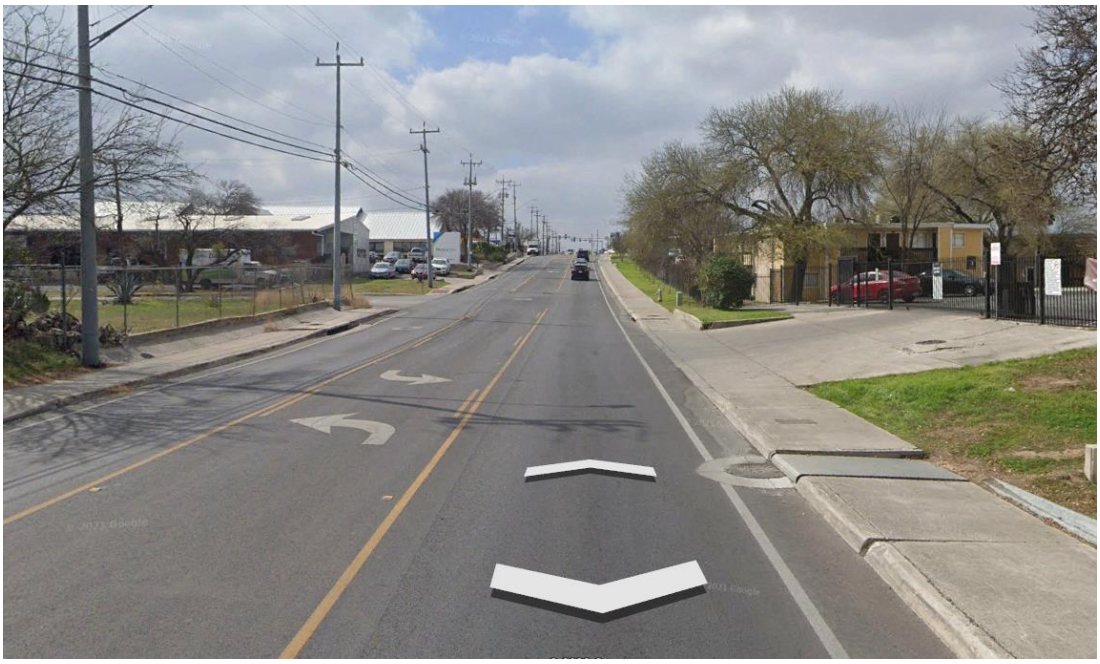
## Site 1: Isom Road & Wolfe Road

This measurement site represents residential properties between HWY 281 and San Pedro Avenue. Most properties adjacent to Isom Road in this area are commercial, retail and light industrial uses. The residential properties that are adjacent to Isom Road are mainly apartments (multi-family residential units). The measurement site near the fence line, in front of the apartment complex on the northwest side of Isom Road, is approximately 17 ft from the edge of pavement and 37 ft from the center of Isom Road. The closest building setback is 67 ft from the center of Isom Road.

***Measurement Location (Source: WSP Team)***

***Measurement Site - Facing Northeast at Isom & Wolfe Rd. (Source: Google Earth)***

*Measurement Site - Facing South at San Pedro & Lynwood (Source: Google Earth)*

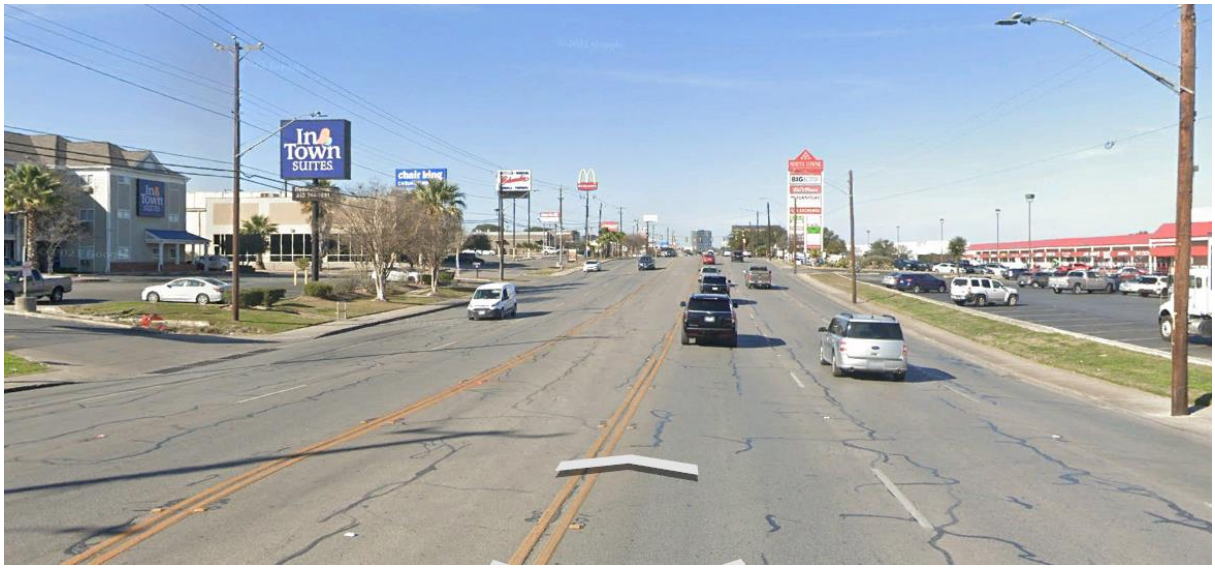


## Site 2: 6923 San Pedro Avenue (InTown Suites Extended Stay Hotel)

This measurement site represents residential properties between I-410 and Basse Road. Most properties adjacent to San Pedro Avenue in this are area retail and commercial properties. The measurement site at the sidewalk, in front of the InTown Suites Extended Stay Hotel on west side of San Pedro Avenue, is approximately 12 ft from the edge of pavement and 54 ft from the center of San Pedro Avenue. The closest building setback is 140 ft from the center of San Pedro Avenue.

***Measurement Location*** *(Source: WSP Team)*

*Measurement Site - Facing North along San Pedro Avenue (Source: Google Earth)*

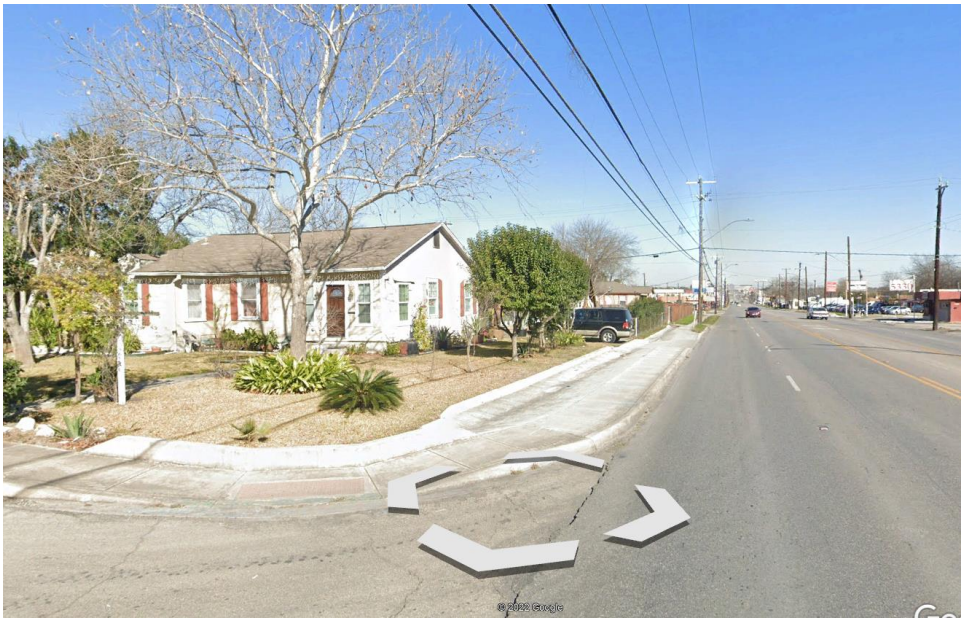


*Measurement Site - Facing South along San Pedro Avenue (Source: Google Earth)*

## Site 3: San Pedro Avenue & Thorain Boulevard

This measurement site represents residential properties between Basse Road and West Mandalay Drive. A majority of the properties adjacent to San Pedro Avenue in this area are mainly retail/commercial properties. The measurement site at the sidewalk, in front of the residence on the northwest corner of San Pedro Avenue and Thorain Boulevard, is approximately 15 ft from the edge of pavement and 47 ft from the center of San Pedro Avenue. The closest building setback is 62 ft from the center of San Pedro Avenue.

*Measurement Site - Facing North at San Pedro Avenue & Thorain Boulevard (Source: Google Earth)*



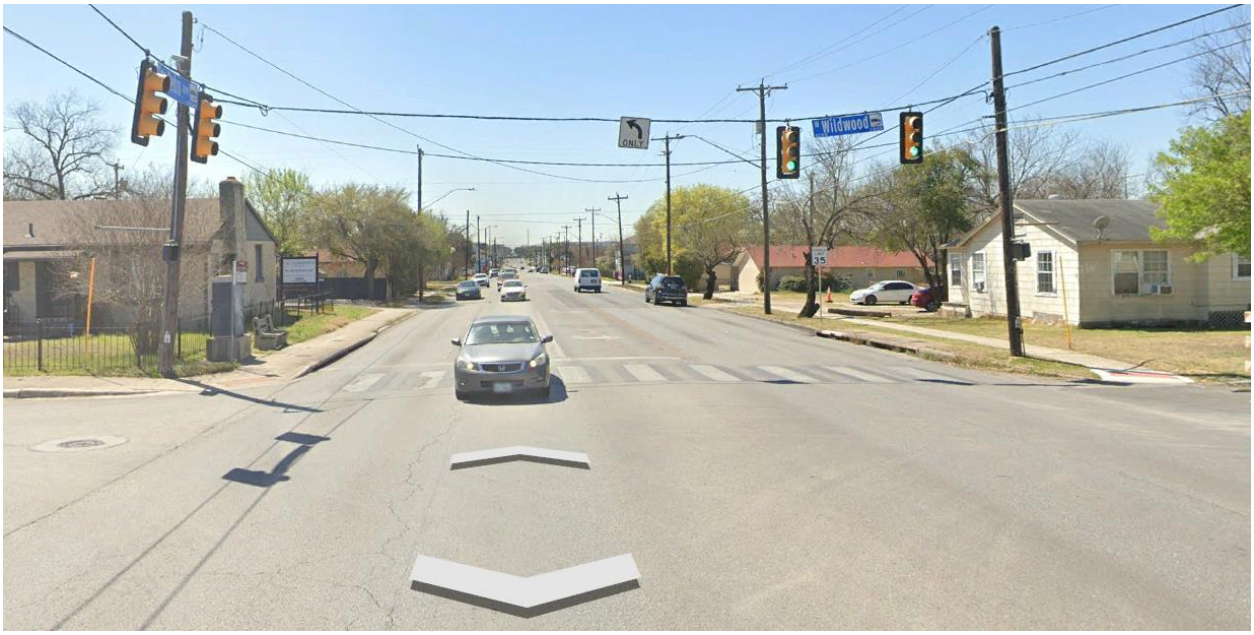
*Measurement Site - Facing South at San Pedro Avenue & Thorain Boulevard (Source: Google Earth)*

## Site 4: San Pedro Avenue & Wildwood Drive

This measurement site represents residential properties between West Mandalay Drive and Audubon Road. The properties adjacent to San Pedro Avenue in this area are a mix of residential and retail commercial properties. The measurement site at the sidewalk, in front of the residence on the southwest corner of San Pedro Avenue and Wildwood Drive, is approximately 20 ft from the edge of pavement and 48 ft from the center of San Pedro Avenue. The closest building setback is 63 ft from the center of San Pedro Avenue.

*Measurement Site - Facing North at San Pedro Avenue & Wildwood Drive (Source: Google Earth)*


*Measurement Site - Facing South at San Pedro Avenue & Wildwood Drive (Source: Google Earth)*



## Site 5: San Pedro Avenue & Elmwood Drive

This measurement site represents residential properties between Audubon Road and Hildebrand Avenue. Most properties adjacent to San Pedro Avenue in this area are retail and commercial properties. The measurement site on the sidewalk is in front of the residence at 402 Elmwood Drive, which is a cul-du-sac on the west side of San Pedro Avenue. The measurement site is approximately 22 ft from the edge of pavement and 44 ft from the center of San Pedro Avenue. The site is elevated approximately 15-20 ft above San Pedro Avenue. The closest building setback is 80 ft from the center of San Pedro Avenue.

*Measurement Location (Source: WSP Team)*

*Measurement Site - Facing North along San Pedro Avenue (Source: Google Earth)*

*Measurement Site - Facing South along San Pedro Avenue (Source: Google Earth)*

## Site 6: San Pedro Avenue & Lynwood Avenue

This measurement site represents residential properties between Hildebrand Avenue and Mulberry Avenue. Most properties adjacent to San Pedro Avenue in this area are residential properties with a mix of retail/commercial properties. The measurement site at the sidewalk, in front of the residence on the southeast corner of San Pedro Avenue and Lynwood Avenue, is approximately 40 ft from the edge of pavement and 58 ft from the center of San Pedro Avenue. The closest building setback is 102 ft from the center of San Pedro Avenue.

*Measurement Site - Facing North at San Pedro Avenue & Lynwood Avenue (Source: Google Earth)*

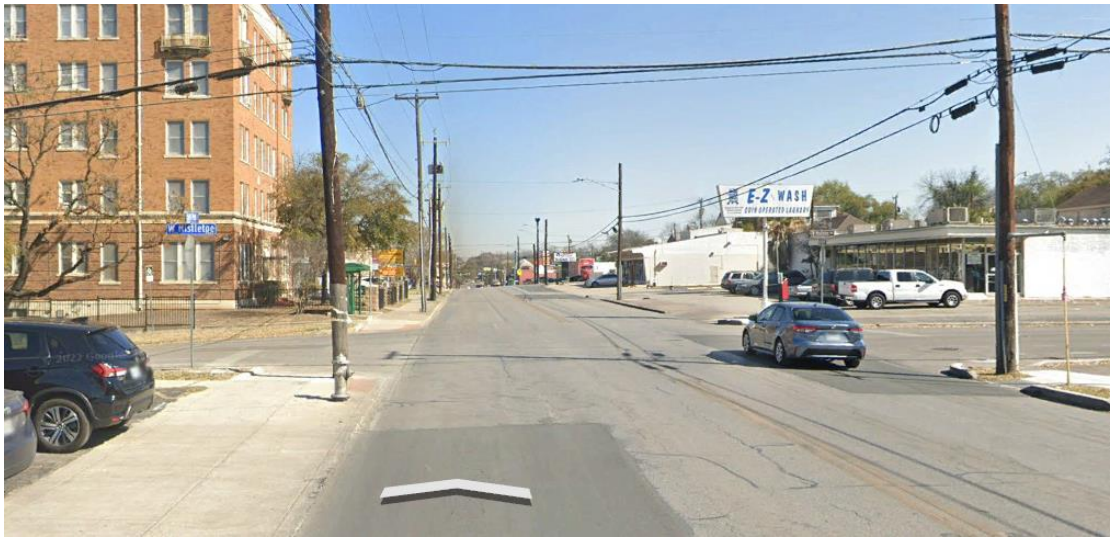
*Measurement Site - Facing South at San Pedro Avenue & Lynwood Avenue (Source: Google Earth)*

## Site 7: San Pedro Avenue and Mistletoe Avenue

This measurement site represents residential properties between Mulberry Avenue and Evergreen Street. Most properties adjacent to San Pedro Avenue in this area are commercial and retail uses. The residential properties that are adjacent to San Pedro Avenue are a mix of apartments (multi-family residential units) and single-family residential units. Other land uses adjacent to San Pedro Avenue include a park, university/college and theatre. The measurement site between the apartment building and sidewalk, on the west side of San Pedro Avenue, is approximately 16 ft from the edge of pavement and 39 ft from the center of San Pedro Avenue. The closest building setback is 57 ft from the center of San Pedro Avenue.

*Measurement Location (Source: WSP Team)*

*Measurement Site - Facing North at San Pedro Avenue & Mistletoe Avenue (Source: Google Earth)*



*Measurement Site - Facing South at San Pedro Avenue & Mistletoe Avenue (Source: Google Earth)*


KeepSAmoving@viainfo.net

www.KeepSAmoving.com
210-362-2389