Appendix F – Noise Analysis

Arizona Department of Transportation

Environmental Planning

Noise Analysis Technical Report

City of Douglas International Port of Entry Connector Road

ADOT Federal Aid No.: 999-A(561)T
ADOT Project No.: F0534 01L

Submittal Date
September 27, 2023

Submittal Number 3

The environmental review, consultation, and other actions required by applicable Federal environmental laws for this project are being, or have been, carried out by ADOT pursuant to 23 U.S.C. 326 and a Memorandum of Understanding dated January 4, 2021, and executed by the Federal Highway Administration and ADOT.

Noise Analysis Technical Report

FOR

City of Douglas International Port of Entry Connector Road

ADOT Federal Aid No.: 999-A(561)T
ADOT Project No.: F0534 01L

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EXECUTIVE SUMMARY

A new commercial international port of entry (IPOE) is planned for construction by the United States General Services Administration (GSA) in Douglas, Arizona by early 2028 on an 80.49-acre parcel that was donated to the GSA by the City of Douglas. The proposed new IPOE will be located approximately 4.5 miles west of the existing Raul Hector Castro IPOE.

The Arizona Department of Transportation (ADOT), in partnership with the Federal Highway Administration (FHWA), Cochise County, City of Douglas and other federal, state, tribal, and local agency stakeholders is conducting a Phase I - Engineering and Environmental Study which will develop alternatives, evaluate, and recommend the location of the Connector Road that will link the new IPOE to the state highway system at State Route 80 (SR 80). Phase I study will include the preparation of a Design Concept Report (DCR), 15% design plans, an Environmental Assessment (EA), and related studies and reports to define a set of recommendations and a recommended improvement alternative.

This Noise Analysis Technical Report presents the peak hour traffic noise level analysis and results for the project. Short-term noise level monitoring was conducted within the project limits on June 15, 2023, to describe the existing noise environment. Two measurement locations were chosen to both validate the noise model and to represent noise sensitive receptors adjacent to residences near the project corridor. Noise monitoring helps describe the existing noise environment throughout the project area and capture the contribution of traffic noise from surrounding roadways. Three 10-minute interval equivalent noise level measurements (Leq) were conducted at each site.

The FHWA approved Traffic Noise Model version 2.5 (TNM 2.5) was used to predict the traffic noise levels. Highway traffic noise levels are dependent on several variables such as roadway geometry, topography, traffic volume, vehicle type, vehicle speed, terrain types, and location of noise receptors.

ADOT considers mitigation for customers predicted to be impacted by highway traffic noise levels from ADOT's transportation improvement projects. The noise level impact determination used in this analysis is based on the ADOT Noise Abatement Requirements (NAR), dated May 2017. Table 1 below shows the summary of this noise analysis. Noise mitigation is not recommended.

TABLE 1
SUMMARY OF NOISE ANALYSIS
DOUGLAS PORT OF ENTRY CONNECTOR ROAD

Parameters	2050 No-Build	2050 Build Alternative 1	2050 Build Alternative 2	2050 Build Alternative 3
No. of Modeled Receivers (Category B)	29	29	29	29
No. of Representative Receptors (Category B)	90	90	90	90
No. of impacted Receivers (Receptors)	0	1 (1)	1 (1)	8 (30)
Range of Unmitigated Noise Levels (Category B), dBA	50 to 61	55 to 64	55 to 64	58 to 69
No. of Barriers Evaluated for Mitigation	N/A	1	1	1
Cost of Recommended Mitigation[1]	N/A	N/A	N/A	$3,047,555

1. Barrier cost is based on $35 per square foot.

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1.0 PROJECT INTRODUCTION

A new commercial international port of entry (IPOE) is planned for construction by the United States General Services Administration (GSA) in Douglas, Arizona by early 2028 on an 80.49-acre parcel that was donated to the GSA by the City of Douglas. The proposed new IPOE will be located approximately 4.5 miles west of the existing Raul Hector Castro IPOE. Once the new IPOE has been constructed, the existing Raul Hector Castro IPOE will be strictly dedicated to pedestrian, vehicular, and bus traffic, while the new IPOE will manage all commercial truck operations. The new IPOE will enhance trade between the United States and Mexico while reducing traffic and queue times and improving safety at the existing IPOE.

The Arizona Department of Transportation (ADOT), in partnership with the Federal Highway Administration (FHWA), Cochise County, City of Douglas and other federal, state, tribal, and local agency stakeholders is conducting a Phase I - Engineering and Environmental Study which will develop alternatives, evaluate, and recommend the location of the Connector Road that will link the new IPOE to the state highway system at State Route 80 (SR 80). This study will include the preparation of a Design Concept Report (DCR), 15% design plans, an Environmental Assessment (EA), and related studies and reports to develop a set of recommendations and a recommended improvement alternative.

The results of this study will then be used for the Phase II - Design, which will involve the preparation of final design construction documents to build the recommended alternative determined by the Phase I - Study. The project location west of Douglas and the alternative alignments under consideration are shown in Figure 1 and Figure 2, respectively.

Figure 1. State Location Map

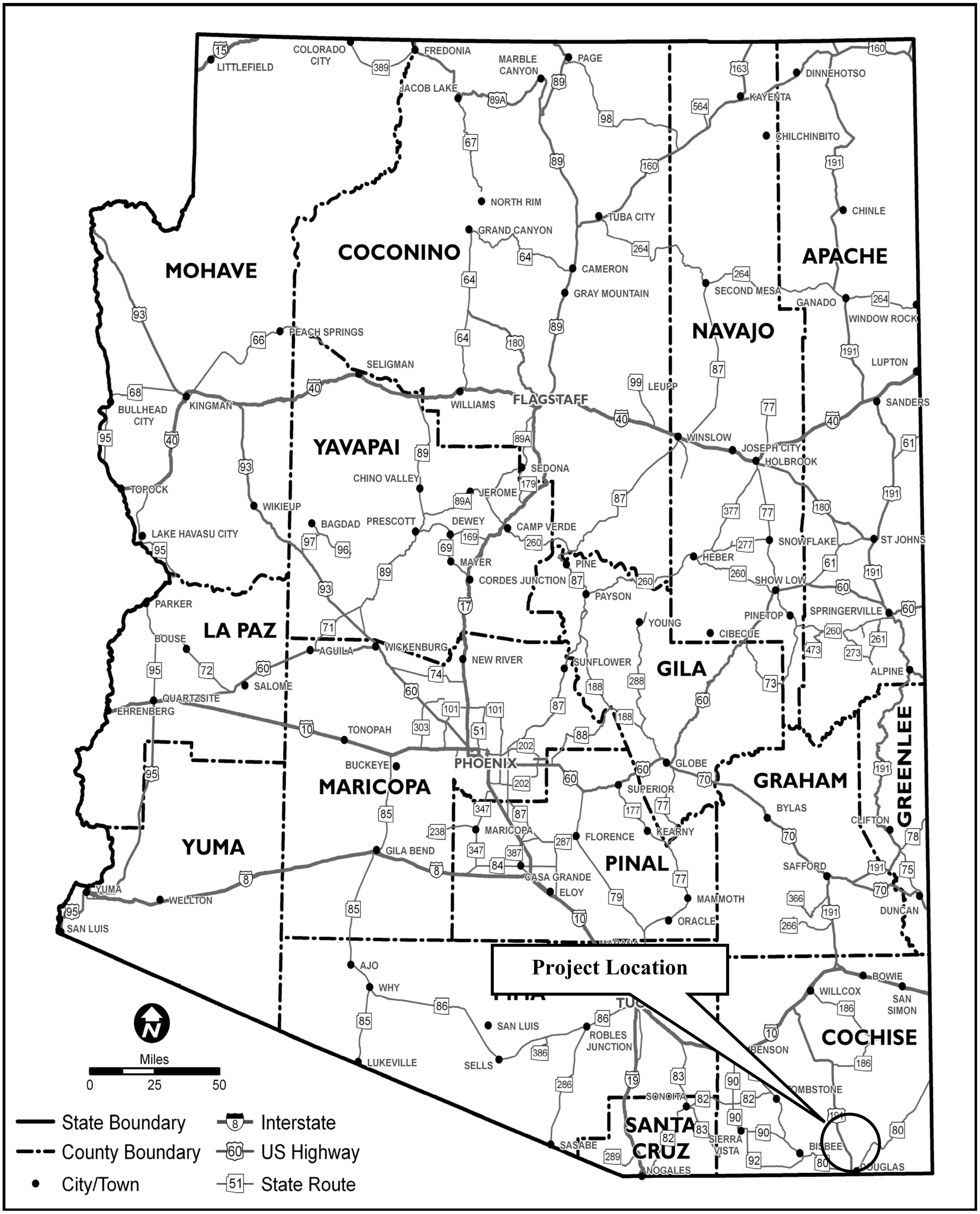
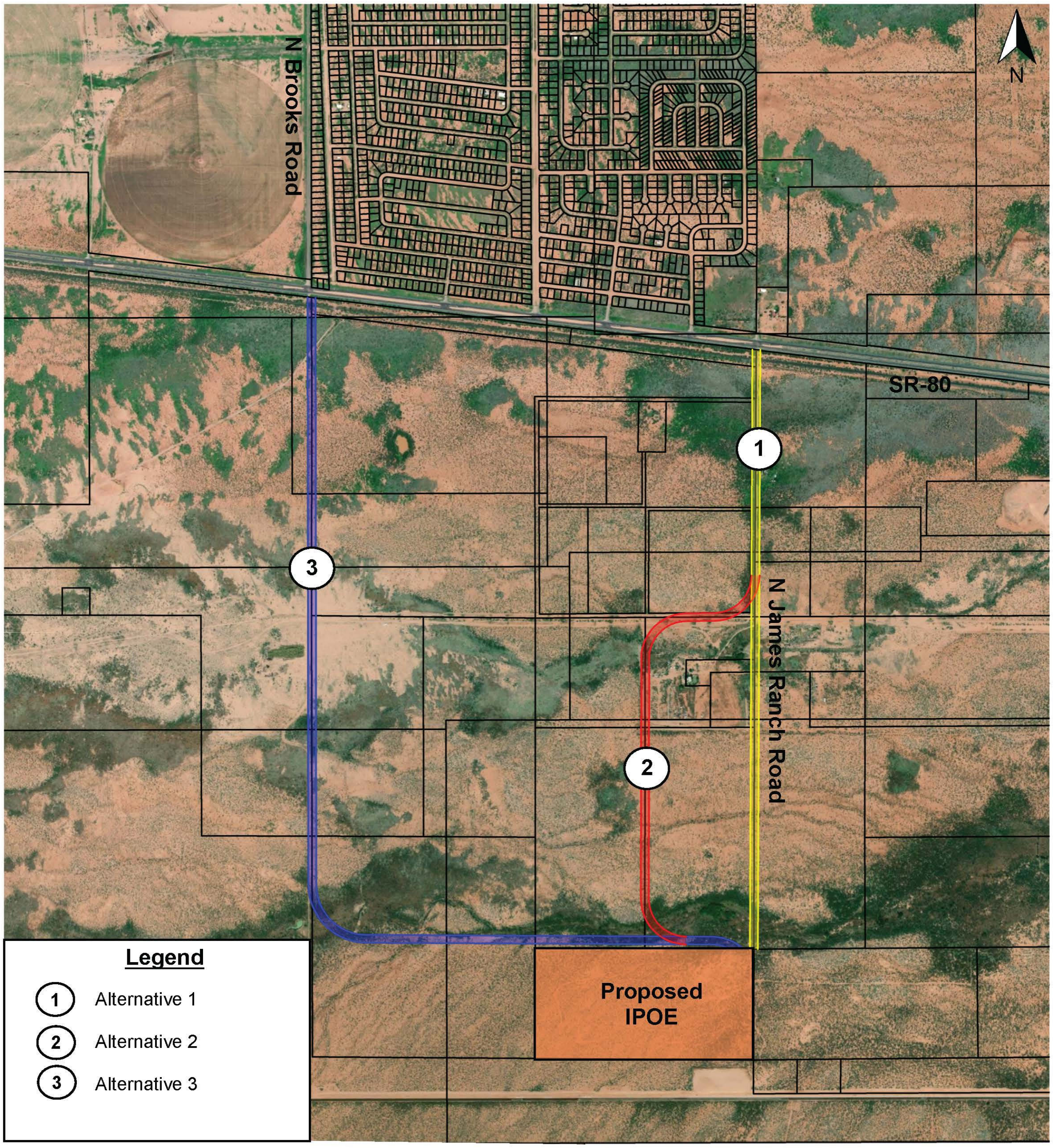


Figure 2. Project Alternatives



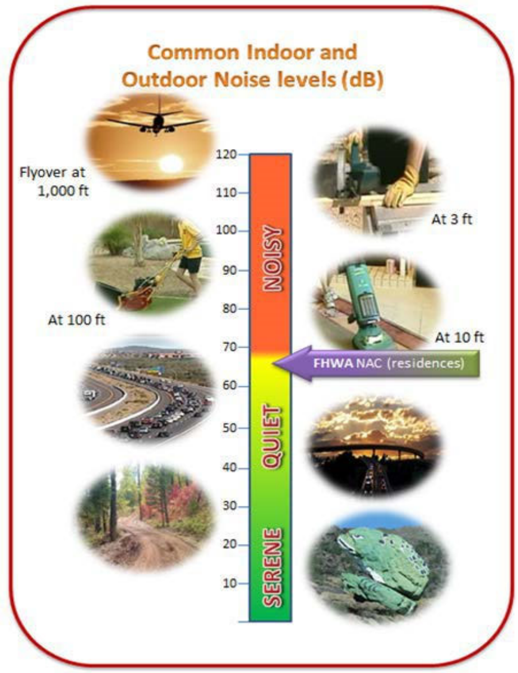
2.0 NOISE STUDY PROCEDURES

This noise study procedure, as specified by 23 C.F.R. § 772, follows a six-step process:

1. Identify noise-sensitive land uses,
2. Determine existing noise levels,
3. Predict future (Design Year) noise levels,
4. Determine traffic noise impacts at the noise-sensitive receptors by comparing future (Design Year) noise levels of the Proposed Alternatives with the existing noise levels,
5. Identify any noise impacts resulting from project construction activities, and
6. Provide and evaluate information from local land use planning agencies regarding predicted future (Design Year) noise levels for use in land development decisions.

3.0 FUNDAMENTALS OF TRAFFIC NOISE

Sound is the sensation produced by stimulation of the hearing organs produced by continuous and regular vibrations of a longitudinal pressure wave that travels through an elastic medium (air, water, metal, wood) and can be heard when they reach a person's or animal's ear. When sound travels through air, the atmospheric pressure wave variations occur periodically. It travels in air at a speed of approximately 1087 feet per second at sea level and temperature of 32 °F. Noise is usually defined as any "unwanted sound," and consists of sounds that are perceived as interfering with communication, work, rest, and recreation. It is characterized as a non-harmonious or discordant group of sounds.



Sound Pressure Levels, Decibels, Frequencies and A-Weighted Decibels-dBA

Noise is measured in Pascals (Pa). A healthy human ear can detect a pressure variation of 20 µPa which is referred to as the threshold of hearing. A logarithmic scale is useful for reporting numbers over a wide scale, but for a smaller span, the decibel (dB) scale is used. Sound pressure level (SPL) is calculated using measured sound level and the hearing threshold of 20 µPa or 20 x 10-6 Pa as the reference level; this level can also be defined as 0 dB. The decibel alone is insufficient to describe how the human ear responds to sound pressures at all frequencies. The human ear has peak response in the range of 2,500 to 3,000 Hz and has a somewhat lower response at low and high frequencies. In response to the human ear sensitivity, the A-weighted noise level, referenced in units of dBA, was determined to better represent people's perception of sound levels. This dBA unit of measurement is used in noise studies and reporting. Changes in sound levels of less than 3 dBA are not perceptible to the human ear, while the human ear perceives a 10 dBA increase in sound level to be a doubling of sound.

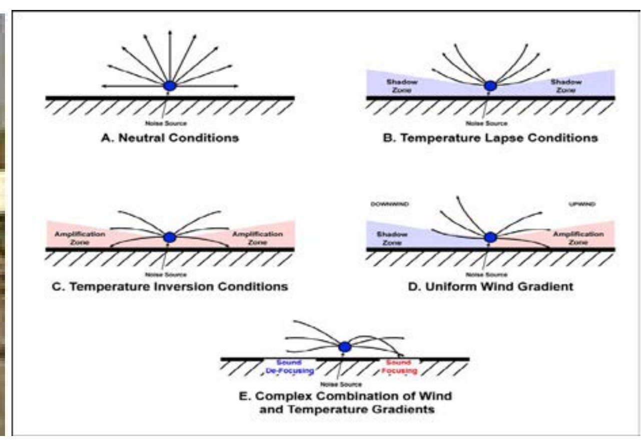
Noise Descriptors

The most commonly used noise descriptor in traffic noise analysis is the Equivalent Sound Level (Leq). Leq represents an average of the sound energy occurring over a specified period (for example, 1 hour). In effect, the Leq is the steady-state sound level containing the same acoustical energy as the time-varying sound that occurs during the same period. The 1-hour A-weighted equivalent sound level [LAeq(h)] is the energy average of A-weighted sound levels occurring during a one-hour period and is the basis for noise criteria used by ADOT.

What are source, receiver, receptor, and path when talking about traffic noise?

Traffic noise is a combination of the noises produced by vehicle engines, exhaust, and tires. The The source of highway traffic comes from vehicles traveling on highways. The noise level at the Source depends on pavement type, number of heavy trucks, traffic volumes, and traffic speeds. The predominant noise sources in vehicles at speeds less than 30 mph are engines and exhaust. At speeds greater than 30 mph, tire noise becomes the dominant noise source.

In the illustration below, the Receptor is any location where people are affected by the traffic noise. It can be a residence, park, school, playground and any other place where frequent human use occurs. An area between the source and the receptor (receiver represents a receptor(s) when modeled with the FHWA Traffic Noise Model) is considered a path. Depending on the path surface, propagation of sound may be reduced; such is the case for the soft ground and fresh snow. Doubling the distance between the source and receptor reduces noise by three dBA depending on the ground type.



Air changes its density due to variation of humidity and temperature, and wind influences refraction of sound waves. Wind, humidity, and temperature may have a significant impact, but only influences the receptors located a long distance from the source. As residents are usually much closer to the noise source, any atmospheric conditions are insignificant for consideration.

For more information on noise, please visit ADOT Environmental Planning Noise webpage at: https://azdot.gov/business/environmental-planning/noise

4.0 NOISE ABATEMENT CRITERIA

The ADOT NAR provides the guidelines used to assess the potential negative impacts from highway traffic noise levels and determines the need for noise abatement. The noise level impact methodology used for this analysis is based on the current ADOT NAR. The Federal Highway Administration (FHWA) has established Noise Abatement Criteria (NAC) and procedures to be used in the planning and design of highways. A summary of the NAC for various land uses is presented in **Table 2**.

The ADOT NAR is based on the noise levels approaching the FHWA NAC. ADOT defines "approaching" as within 1 dBA of the FHWA NAC for Activity Categories A, B, C, D, and E. There are no noise impact thresholds for Activity Category F or G. The ADOT NAR determines highway traffic noise level impacts and considers mitigation for residential land uses when the predicted noise level is equal to or greater than the noise impact threshold of 66 dBA. ADOT also indicated that noise levels should be rounded to the nearest integer prior to impact determination and in project reports.

TABLE 2
FHWA NOISE ABATEMENT CRITERIA[1]

Activity Category	dBA, L_{Aeq1h}[2]	Activity Description
A	57 (exterior)	Land 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, amphitheaters, auditoriums, campgrounds, cemeteries, day care centers, hospitals, libraries, medical facilities, parks, picnic areas, places of worship, playgrounds, public meeting rooms, public or nonprofit institutional structures, radio studios, recording studios, 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 structures, recording studios, schools, and television studios.
E	72 (exterior)	Hotels, motels, offices, restaurants/bars, and other developed lands, properties or activities not included in categories 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.

1. Sources: Federal Highway Administration (2011); 23 Code of Federal Regulations § 772.
2. The 1-hour equivalent loudness in A-weighted decibels, which is the logarithmic average of noise over a 1-hour period.

5.0 LAND USES WITHIN PROJECT AREA

The project area is comprised of Category B (residential), Category E (restaurants and offices), and Category F (retail facilities). This analysis focuses on representative noise sensitive receptors in Category B as shown in Figure 2. Representative land uses and receptors are shown in greater detail in Appendix A.

6.0 EXISTING NOISE ENVIRONMENT

Short-term noise level monitoring was conducted within the project limits on June 15, 2023, to describe the existing noise environment. As shown in **Appendix A**, two measurement locations were chosen to represent noise sensitive receptors in residential areas.

Three 10-minute interval equivalent noise level measurements (Leq) were conducted at each monitoring site. Noise level monitoring helps describe the existing noise environment throughout the project area and capture the contribution of traffic noise from surrounding roadways. Existing noise measurements are also used to validate the Traffic Noise Model (TNM). Measured noise levels may also include contributions from other noise sources, including but not limited to, airplanes, wind, birds, insects, and landscaping equipment, among others.

The equipment used for the noise level monitoring was a Larson Davis Model LXT Class 1 integrating sound level meter (SLM). The SLM was calibrated in the field before each measurement using a Larson Davis Model CAL200. Existing noise measurements were collected under meteorologically acceptable conditions when the pavement was dry, and winds were calm or light. Additional data collected at each monitoring location included atmospheric conditions such as general wind speed and direction, humidity, dewpoint, barometric pressure, and ambient temperature. Measurements were collected based on the acceptable collection of existing noise level readings per FHWA Report number FHWA-PD-96-046, and “Measurement of Highway Related Noise.”

The measured noise levels ranged from 47 dBA to 56 dBA. **Appendix A** shows the location of the noise level monitoring sites, and **Table 3** shows the summary of the noise level measurements. **Appendix B** shows the measured noise level data.

Model Validation

Model validation is a process for testing a model to ensure that it produces reliable results and to confirm that traffic noise is the predominant noise source at the receptor locations. In general, validation involves comparing actual noise measurements with the noise levels predicted by the model for existing conditions at the same location. The model is validated if the model results are within ±3 dBA of the arithmetic average of the three 10-minute interval field measurements recorded at the site for the same conditions. The monitoring site was modeled within ±3 dBA measured at site Mon 1. Therefore, the model is considered valid.

TABLE 3 SUMMARY OF SOUND LEVEL MEASUREMENTS June 15, 2023						
Site Number	Description	Modeled Validation Noise Levels (Leq), dBA	10-Minute Interval Measured Noise Levels (Leq), dBA			
			Interval 1	Interval 2	Interval 3	Arithmetic Average
MON 1	31°21’37.75”N/109°39’10.64”W	53.1	53.9	56.1	53.9	54.6
MON 2	31°21’44.03”N/109°39’35.20”W	--	47.3	46.8	49.3	47.8

7.0 NOISE MODELING METHODOLOGY AND TNM 2.5 VARIABLES

The FHWA-approved Traffic Noise Model version 2.5 (TNM 2.5) is the computer noise model used for the prediction of highway and roadway traffic noise levels. The output of the model is dependent upon variables, which include atmospheric conditions, roadway geometries, topographic data, ground types, noise receiver locations, traffic volumes, vehicle speed, and vehicle mix.

Atmospheric Conditions

Noise levels are affected by temperature and humidity. Temperature gradients cause refraction effects. For example, in the morning, when the ground is still cool from the night before, but the upper air is warming due to the sun, noise can bounce between the gradient and the ground, forming regions of higher and lower noise intensity. Noise attenuation is also affected by humidity. Dry air absorbs more acoustical energy than moist air because dry air has a higher density than moist air at a given temperature. For noise modeling with TNM2.5, FHWA recommends the default values of 68 degrees Fahrenheit for the temperature and 50 percent humidity. Though actual temperatures and humidity aren’t used in the TNM2.5 noise model, temperatures on June 15, 2023 during the monitoring periods were 87 to 89 degrees Fahrenheit with 8% to 9% humidity.

Roadway Geometry & Topographic Data and Ground2023,,e

The roadway geometries and topographic data for the project were based on preliminary design plans provided by the design engineer (Stantec). Loose soil was used to approximate the ground type between the roadway and receptors.

Receptor and Receiver Locations

The ADOT NAR defines a “receptor” as a discrete or representative location of a noise sensitive area(s) for any of the land uses listed in **Table 2** on page 7. A “Receiver” is defined as a location used in noise modeling to represent the measured and predicted noise level at a particular point. The noise-sensitive receptors are located in the backyard or common outdoor areas of use.

Traffic Volumes

The ADOT NAR provides guidelines on the traffic volumes for use in the noise model, using a “worst-case” approach. The “worst-case” approach under ADOT guidelines include using Level of Service (LOS) C traffic volumes (that is, “free-flowing traffic) during the peak hour, with traffic moving at 5 miles per hour (mph) above the posted speed limit. If, however, the future traffic volumes are less than the LOS C volumes, then ADOT guidelines specify that that the lower future year traffic volumes be used in the model. If no other traffic information is available, then 10 percent of the annual average daily traffic (AADT) volume is used in the noise model. The 2050 Build traffic volumes are shown in **Appendix C**. Traffic information for this project was obtained from the *Final Traffic Report: City of Douglas International Port of Entry Connector Road (*June 2023).

Vehicle Speed

See **Appendix C** For the No-Build and Build Condition modeled speeds which are 5 mph higher than the posted speed limit. The speed limit on SR 80 is 65 mph and the proposed connector road speed limit will be 50 mph.

Vehicle Mix

The percentages of vehicles by type (vehicle mix) is an important input for the noise model, because different vehicle types exhibit different base or reference noise emission levels, such as with trucks that produce higher reference levels than cars, and larger trucks that produce higher reference levels than smaller trucks. Vehicle types are defined as follows:

- Cars (Auto): All vehicles with two axles and four wheels designed primarily for passenger transportation or cargo (light trucks). Generally, the gross vehicle weight is less than 10,000 pounds.
- Medium Trucks: All vehicles having two axles and six wheels designed for the transportation of cargo. Generally, the gross vehicle weight is greater than 10,000 pounds but less than 26,400 pounds.
- Heavy Trucks: All vehicles having three or more axles and designed for the transportation of cargo. Generally, the gross weight is greater than 26,400 pounds.

This noise analysis focuses on automobile, medium truck, and heavy truck usage on all roadways. The vehicle mix used in this analysis is shown in **Appendix C**.

8.0 FUTURE NOISE ENVIRONMENT AND IMPACT DETERMINATION

Table 4 shows the results of the predicted traffic noise levels, based on the TNM 2.5 input assumptions described in the preceding section. A total of 29 Category B receivers were modeled to represent 90 receptors adjacent to the proposed residential development on SR 80 between Brooks Road and James Ranch Road. **Table 4** shows the 2050 No-Build and three Build Alternative modeled noise levels. As discussed in the traffic report, it is expected that truck traffic from the connector road will intersect SR 80 and proceed east to the ADOT Commercial Inspection Facility at the intersection of SR 80 and US 191 for additional processing.

As shown in Figure 2, the connector road under Alternatives 1 and 2 intersect SR 80 from James Ranch Road east of the proposed residential development adjacent to SR 80. Truck traffic entering or exiting the connector road from James Ranch Road would not result in substantial traffic increases on SR 80 adjacent to the proposed residential development. Under Alternative 3, the connector road would intersect SR 80 at Brooks Road about 1 mile west of James Ranch Road. As a result, traffic that would have entered or existed at James Ranch Road would now enter and exit at Brooks Road increasing the traffic volumes on westbound SR 80 adjacent to the proposed residential development.

TABLE 4
MODELED NOISE LEVEL RESULTS
DOUGLAS PORT OF ENTRY CONNECTOR ROAD

Receiver ID	NAC Category	No of Dwelling Units	Description of Receiver	2050 No-Build (dBA)	2050 Build Alternative 1 (dBA)	2050 Build Alternative 2 (dBA)	2050 Build Alternative 3 (dBA)
R1	G	--	Undeveloped land	31	61	61	61
R2	G	--	Undeveloped land	33	62	50	48
R3	G	--	Undeveloped land	36	62	52	45
R4	B	1	Residential (to be removed)	52	---	---	---
R5	B	1	Residential	57	63	63	63
R6	B	1	Residential	59	62	62	58
R7	B	3	Residential	60	63	63	**69**
R8	B	2	Residential	53	57	57	61
R9	B	2	Residential	50	55	55	58
R10	B	3	Residential	54	57	57	62
R11	B	3	Residential	51	56	56	60
R12	B	3	Residential	55	59	59	64
R13	B	3	Residential	56	60	60	65
R14	B	3	Residential	52	55	56	60
R15	B	3	Residential	56	60	60	65
R16	B	4	Residential	56	59	59	64
R17	B	3	Residential	53	56	56	60
R18	B	3	Residential	54	57	57	61
R19	B	3	Residential	52	55	55	60
R20	B	5	Residential	61	64	64	**69**
R21	B	4	Residential	55	57	57	62
R22	B	4	Residential	61	63	63	**68**
R23	B	4	Residential	61	63	63	**68**
R24	B	4	Residential	54	57	57	62

TABLE 4
MODELED NOISE LEVEL RESULTS
DOUGLAS PORT OF ENTRY CONNECTOR ROAD

Receiver ID	NAC Category	No of Dwelling Units	Description of Receiver	2050 No-Build (dBA)	2050 Build Alternative 1 (dBA)	2050 Build Alternative 2 (dBA)	2050 Build Alternative 3 (dBA)
R25	B	4	Residential	61	63	63	**68**
R26	B	4	Residential	55	57	58	62
R27	B	5	Residential	61	63	63	**68**
R28	B	4	Residential	61	63	63	**68**
R29	B	4	Residential	55	58	58	62
R30	B	1	Residential	60	63	63	**68**
R31	B	3	Residential	57	60	60	64
R32	B	3	Residential	52	55	55	60
R33	G	--	Undeveloped land	33	54	62	51
R34	G	--	Undeveloped land	35	49	62	48
R35	B	1	Residential	37	56	60	46
R36	G	--	Undeveloped land	40	52	61	47
R37	G	--	Undeveloped land	31	45	49	61
R38	G	--	Undeveloped land	31	41	43	61
R39	G	--	Undeveloped land	33	41	42	61
R40	G	--	Undeveloped land	41	45	46	62

Note: **Bolded** values are equal to or greater than ADOT NAR noise impact threshold of **66** dBA for Category B.

Under the 2050 No-Build Alternative, the modeled noise levels at Category B receivers range from 50 dBA to 61 dBA at residences in the proposed development adjacent to SR 80. Under the 2050 Build Alternatives 1 and 2, the modeled noise levels at Category B receivers range from 55 dBA to 64. For Alternative 3, modeled noise levels at Category B receivers range from 58 dBA to 69 dBA at residences in the proposed development adjacent to SR 80. Modeled noise levels are higher under Alternative 3 due to the relocation of the connector road to Brooks Road from James Ranch Road.

Under the 2050 Build Alternative 1 and Alternative 2, modeled noise levels for Receiver 35 (R35) have a substantial increase in noise levels, therefore mitigation evaluation is required. Build Alternative 3, modeled noise levels for Category B receivers is equal to or greater than the ADOT NAR noise impact threshold of 66 dBA at eight receptors representing 30 dwelling units. Therefore, mitigation evaluation is required for this area**. Appendix A** shows the locations of the modeled noise receivers from **Table 4**.

9.0 MITIGATION ANALYSIS

The ADOT NAR provides guidelines for noise abatement analysis. These guidelines have two components, feasibility, and reasonableness. The feasibility components consist of the engineering and acoustic features which address safety, barrier height, topography, drainage, utilities, maintenance requirements, property access and overall project purpose, and encompasses the constructability of the noise abatement. To be acoustically feasible, the noise abatement must achieve at least a 5 dBA reduction at 50 percent of the impacted receptors.

There are three factors that must be met for a noise abatement action to be considered reasonable. The first factor is based on the viewpoints or preferences of the property owners and residents. The viewpoints of the property owners and residents shall be taken into account when determining whether the barrier should be constructed or not. The second is based on the noise reduction design goal; the ADOT NAR states that the noise barrier should be designed to reduce the projected unmitigated noise levels by at least 7 dBA for 50 percent of the benefited receptors closest to the transportation facility. The third factor is based on the cost effectiveness of the noise abatement. The maximum reasonable cost of abatement is $49,000 per benefited receptor (cost-per-benefited-receptor) with barrier costs calculated at $35 per square foot, $85 per square foot if constructed on a structure.

The ADOT NAR defines “benefited receptor” as the recipient of an abatement measure that receives a noise reduction of at least 5 dBA. This would allow a receptor that is not impacted to be considered as a “benefited receptor” if it receives a noise reduction of at least 5 dBA from the noise abatement. The “benefited receptor” would be included in the determination of the cost of the noise abatement.

Lands and proposed residential developments permitted after the Date of Public Knowledge for this project will not be eligible for abatement (noise barriers). The Date of Public Knowledge is the date of approval of the National Environmental Policy Act (NEPA) document for this project, as defined in the ADOT NAR. Permitted is defined as a definite commitment to develop land with an approved specific design of land use activities as evidenced by the issuance of a building permit.

Under the 2050 Build Alternative 1 and Alternative 2 there is a substantial increase in noise (greater than 15 dBA) at R35 adjacent to SR 80, therefore mitigation considered for those alternatives. Under the 2050 Build Alternative 3, peak-hour traffic noise levels were predicted to range from 58 dBA to 69 dBA and would exceed ADOT’s Category B noise impact threshold at eight receiver locations (representing 30 receptors). Mitigation was evaluated for the 2050 Build Alternative 3 and **Table 5** shows the results of the noise level mitigation analysis.

TABLE 5
NOISE MITIGATION SUMMARY
DOUGLAS PORT OF ENTRY CONNECTOR ROAD

Receiver ID	No of Dwelling Units	2050 Alternative 3 Unmitigated (dBA)	2050 Alternative 3 Mitigated (dBA)	Insertion Loss (dBA)	Mitigation
R1	--	--	---	---	---
R2	--	---	---	---	---
R3	--	---	---	---	---
R4	1	---	---	---	---
R5	1	63	63	0	Noise Barrier 1 was evaluated under Alternative 3 and is recommended
R6	1	58	57	1	
R7	3	**69**	62	7	
R8	2	61	57	4	
R9	2	58	54	4	
R10	3	62	58	4	
R11	3	60	54	6	
R12	3	64	59	5	
R13	3	65	59	6	
R14	3	60	55	5	
R15	3	65	60	5	
R16	4	64	59	5	
R17	3	60	55	5	
R18	3	61	59	2	
R19	3	60	55	5	
R20	5	**69**	61	8	
R21	4	62	56	6	
R22	4	**68**	60	8	
R23	4	**68**	61	7	
R24	4	62	56	6	
R25	4	**68**	63	5	
R26	4	62	56	6	
R27	5	**68**	60	8	
R28	4	**68**	60	8	
R29	4	62	56	6	
R30	1	**68**	60	8	
R31	3	64	59	5	
R32	3	60	56	4	
R33	--	---	---	---	---
R34	--	---	---	---	---
R35	1	56	60	---	Barrier 2 and Barrier 3 are not recommended
R36	--	---	---	---	
R37	--	61	---	---	---
R38	--	61	---	---	---
R39	--	--	---	---	---
R40	--	--	---	---	---

Note: **Bolded** values are equal to or greater than ADOT NAR noise impact threshold of 66 dBA.

Summary of Evaluated Noise Barriers

Table 6 summarizes the evaluated noise barriers under the 2050 Build Alternatives 1, 2, and3.

TABLE 6
DOUGLAS PORT OF ENTRY CONNECTOR ROAD
EVALUATED NOISE BARRIER SUMMARY

Noise Barrier Description	Barrier Height Range, ft	Length, ft	Area, ft^2	Cost	Number of Benefited Receptors	Cost per Benefited Receptor
Barrier 1 (evaluated for Alternative 3)	16	5,442	87,073	$3,047,555	74	$41,183
Barrier 2 (evaluated for Alternative 1)	20	1,000	20,000	$700,000	0	N/A
Barrier 3 (evaluated for Alternative 2)	20	1,600	32,000	$1,120,000	0	N/A

Note: Barrier cost is based on $35 per square foot. Barrier 1 meets 7 dBA design goal for more than half of first row receptors (26 out of 52 receptors meet 7 dBA design goal) and meets 5 dBA noise reduction for more than half of the impacted receptors (30 out of 30 impacted receptors meet 5 dBA noise reduction).

10.0 CONSTRUCTION NOISE AND VIBRATION

Construction noise is anticipated for roadway improvement projects and lasts for the duration of the construction. Construction activities are generally of a short-term nature. Depending on the nature of construction operations, the duration of the noise could last from seconds (e.g., a truck passing a customer) to months (e.g., constructing a bridge). Construction noise is also intermittent and depends on the type of operation, location, and function of the equipment and the equipment usage cycle. **Table 7** shows the overall predicted maximum noise level (L_{max}) of the construction equipment at 50 feet for different phases of roadway construction.

TABLE 7
CONSTRUCTION EQUIPMENT NOISE[1]

Phase	Equipment	Noise Limit (L_{max}) At 50 feet, dBA
Site Clearing	Dozer	85
	Concrete saw	90
	Chainsaw	85
	Excavator	85
Grading & Earthwork	Scraper	85
	Bobcat	85
	Grader	85
Foundation	Backhoe	80
	Front End Loader	80
	Crane	85
Base Preparation	Post Pounder	85
	Trucks (concrete, fuel, haul, water, bucket, dump)	85

1. Source- FHWA Highway Construction Noise Handbook; August 2006

ADOT has set forth guidelines for construction noise in the Standard Specifications for Road and Bridge Construction, 2008. Per ADOT specifications 104.08, Prevention of Air and Noise Pollution:

"The contractor shall comply with all local sound control and noise rules, regulations and ordinances which apply to any work pursuant to the contract.

Each internal combustion engine used for any purpose on the work or related to the work shall be equipped with a muffler or a type recommended by the manufacturer. No internal combustion engine shall be operated on the work without its muffler being in good working condition."

Ground vibration and ground-born noise can also be a source of annoyance to individuals who live or work close to vibration-generating activities. Pile driving, demolition activity, blasting, and crack-and-seat operations are the primary sources of vibration, while the impact pile driving can be the most significant source of vibration at construction sites. It is recommended to apply methods that may be practical and appropriate in specific situations, to reduce vibration to an acceptable level.

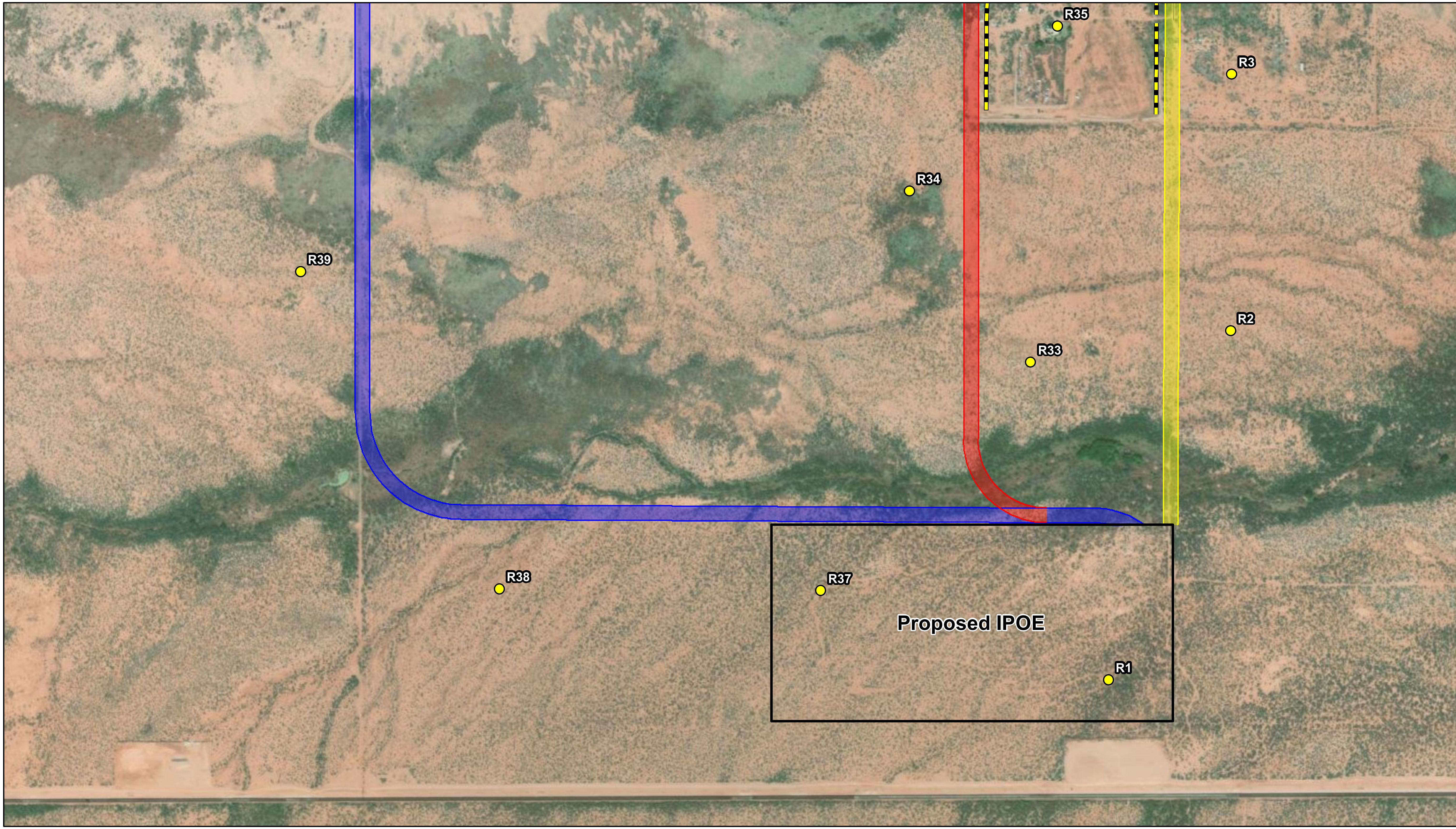
11.0 COORDINATION WITH LOCAL OFFICIALS

The representatives of the City of Douglas were involved throughout the course of conducting the analysis. The analysis and the results will be included in the environmental assessment and presented to the public and the local officials with planning responsibility as a part of the public involvement process of the environmental analysis. Upon request of the local land use planning agency or local public agency, noise contour lines may be produced during the noise analysis process for project alternative screening and planning purposes only, as per ADOT NAR, Section 4, Point (e).

12.0 STATEMENT OF LIKELIHOOD

The FHWA-approved TNM2.5 was used to evaluate traffic noise for the 2050 No-Build and three Build Alternatives. Traffic noise levels would exceed ADOT's threshold for noise abatement consideration at eight receiver locations (representing 30 receptors). Under the 2050 Build Alternative for Alternative 3, Barrier 1 meets the feasibility and reasonability criteria and is recommended. Under the 2050 Build Alternative for Alternative 2 and Alternative 3, Barrier 2 and Barrier 3 affect one receiver (R35), provide no acoustic benefit (that is, insertion loss) and do not meet feasibility and reasonability criteria. Barrier 2 (evaluated for Alternative 1) and Barrier 3 (evaluated for Alternative 2) are not recommended. A final determination of noise abatement measures will be made upon completion of the project design, the public involvement process, and concurrence with ADOT NAR.

APPENDIX A – RECEIVER, MONITORING, AND EVALUATED BARRIER LOCATIONS



N

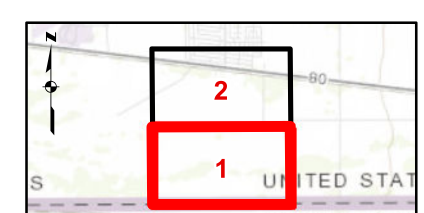
0 300 600

FEET

Revised: 8/19/2023
SOURCE: World Imagery

Legend

Evaluated Barrier | Noise Receiver | Monitoring Site | Alternative 1 | Alternative 2 | Alternative 3



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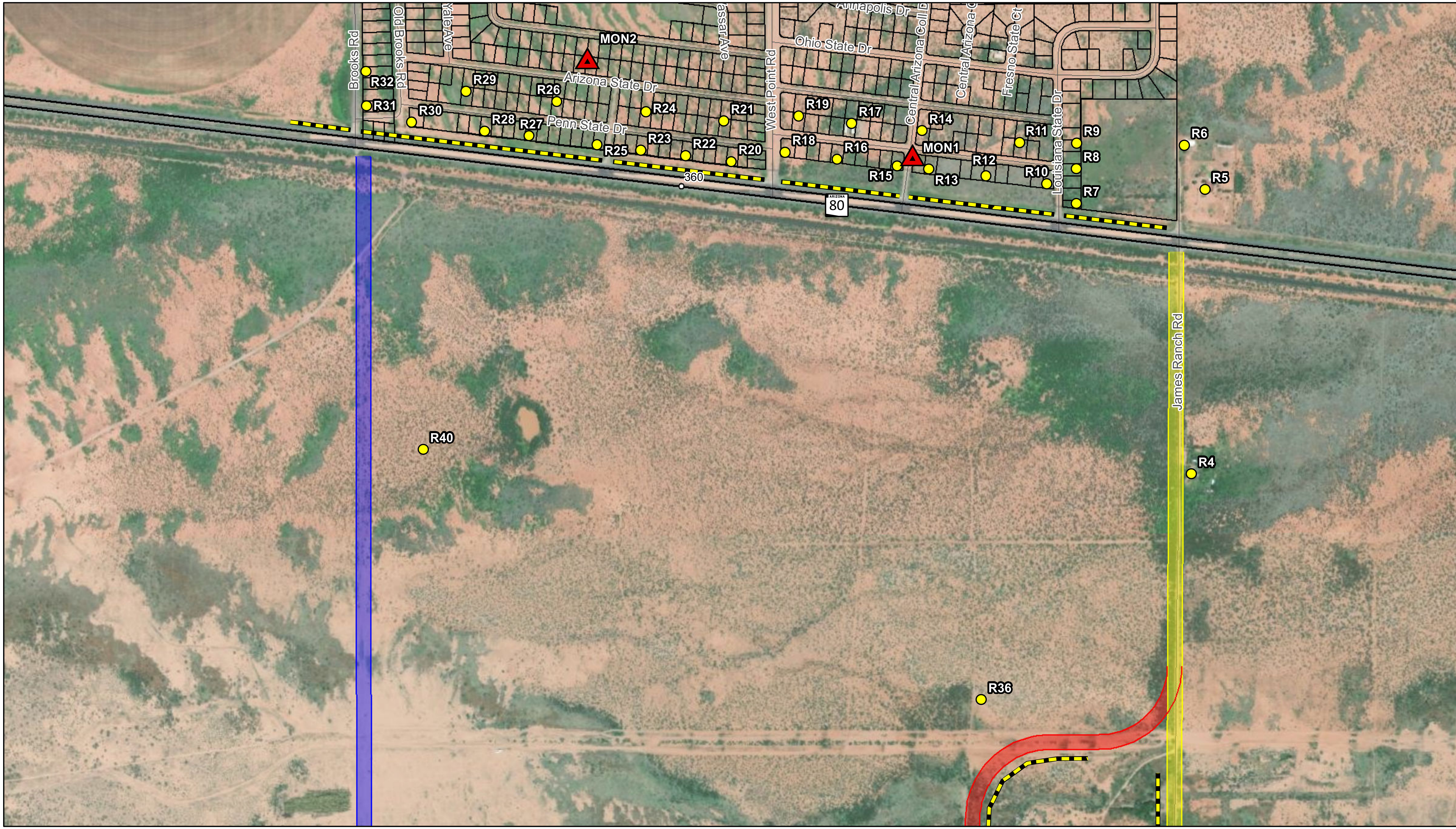

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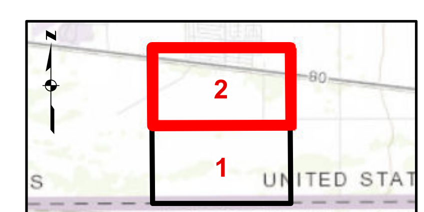
Revised: 8/19/2023
SOURCE: World Imagery

Legend

Evaluated Barrier | Noise Receiver | Monitoring Site | Alternative 1 | Alternative 2 | Alternative 3



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APPENDIX B – NOISE MEASUREMENT DATA

Roadway Noise Level Measurement Data Sheet

Project Number: F0534 01L
Date: 6/15/2023
Project Name: Douglas Port of Entry Connector Road
Site Number: Mon 1
Site Description: Central Arizona Drive – 350' North of SR 80
Coordinates: 31°21'37.75"N 109°39'10.64"W
Posted Speed: 65 MPH
Observed Speed: 65 MPH

SLM: LD LXT
Response: Slow
Weighting: A
Calibrator: CAL200
Begin ±: 0.0
End ±: 0.0
Battery >50%: X

Weather Condition: Clear/Sunny
Temperature: 89ºF
Humidity: 8%
Wind: E 10 mph

Measurement Data						Traffic Data – SR 80									
Sample	Time		Decibel (dB)			Auto		Medium Truck		Heavy Truck		Bus		Motorcycle	
	Begin	Duration	Leq	Lmax	Lmin	EB	WB	EB	WB	EB	WB	EB	WB	EB	WB
1	5:51 pm	10:01 min	53.9	65.5	35.0	33	10	0	2	0	0	0	0	1	0
2	6:03 pm	10:00 min	56.1	64.4	36.3	39	15	2	0	3	0	0	0	0	0
3	6:14 pm	10:00 min	53.9	67.1	36.2	19	14	0	1	0	0	0	0	0	0

Site Sketch

Notes:

Sample	Background Noise	Unusual Noise Events
1		
2		
3		

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Roadway Noise Level Measurement Data Sheet

Project Number: F0534 01L **Date:** 6/15/2023
Project Name: Douglas Port of Entry Connector Road **Site Number:** Mon 2
Site Description: East of Point Road – 700' North of SR 80 **Coordinates:** 31°21'44.03"N 109°39'35.20"W
Posted Speed: 65 MPH **Observed Speed:** 65 MPH

SLM: LD LXT **Response:** Slow **Weighting:** A
Calibrator: CAL200 **Begin ±:** 0.0 **End ±:** 0.0 **Battery >50%:** X

Weather Condition: Clear/Sunny
Temperature: 87ºF **Humidity:** 9% **Wind:** E 10 mph

Measurement Data						Traffic Data – SR 80									
Sample	Time		Decibel (dB)			Auto		Medium Truck		Heavy Truck		Bus		Motorcycle	
	Begin	Duration	Leq	Lmax	Lmin	EB	WB	EB	WB	EB	WB	EB	WB	EB	WB
1	6:31 pm	10:29 min	47.3	58.6	31.0										
2	6:43 pm	10:00 min	46.8	56.2	29.4										
3	6:54 pm	10:00 min	49.3	57.8	31.7										

Site Sketch

Notes:

Sample	Background Noise	Unusual Noise Events
1		
2		
3		

APPENDIX C – TNM 2.5 TRAFFIC VOLUMES

Douglas Port of Entry Connector Road TNM Traffic Volumes

Roadway Segment	AM Peak Volume	Auto%	MT%	HT%	Modeled Hourly Auto	Modeled Hourly MT	Modeled Hourly HT
WB SR80 (east of James Ranch Rd)	1,344.00	80%	6%	14%	1075	81	188
EB SR80 (east of James Ranch Rd)	674.00	80%	6%	14%	539	40	94
WB SR80 (west of James Ranch Rd)	565.00	83%	6%	11%	469	34	62
EB SR80 (west of James Ranch Rd)	369.00	83%	6%	11%	306	22	41
NB James Ranch Rd (south of SR80)	557.00	76%	6%	19%	423	33	106
SB James Ranch Rd (south of SR80)	1,031.00	76%	6%	19%	784	62	196
NB James Ranch Rd (north of SR80)	30.00	98%	0%	2%	29	0	1
SB James Ranch Rd (north of SR80)	30.00	98%	0%	2%	29	0	1

Speed limits: SR80 65 mph; James Ranch Rd 50 mph

Source: Final Traffic Report, City of Douglas International Port of Entry Connector Road, June 2023

Table 7.4 – 2050 Build Noise Report Vehicle Classification Percentages

Roadway Segment	Passenger Cars	Medium Vehicles	Heavy Vehicles
James Ranch Road south of SR 80	76%	6%	19%
James Ranch Road north of SR 80	98%	0%	2%
SR 80 west of James Ranch Road	83%	6%	11%
SR 80 east of James Ranch Road	80%	6%	14%
Chino Road south of SR 80	95%	0%	5%
US 191 north of SR 80	76%	6%	18%
SR 80 west of US 191	79%	6%	15%
SR 80 east of US 191	83%	8%	9%

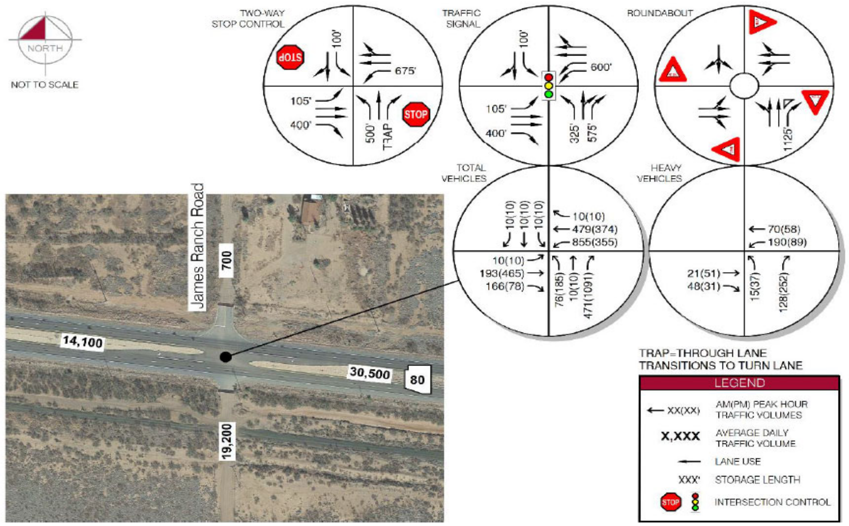

Figure 3.6 – SR 80 / James Ranch Road: 2050 Build Traffic Volumes & Lane Configuration

Appendix D - List of TNM Runs

- Build_Alt1 - 2050 Alternative 1 Build
- Build_Alt2 - 2050 Alternative 2 Build
- Build_Alt3_v2 - 2050 Alternative 3 Build
- MON1 – Validation file for Monitoring Site #1
- NoBuild_rev – 2050 No-Build