Arizona Department of Transportation

Environmental Planning Group

Final Noise Report

Valencia Road: Wade Road to Mark Road

SS97501C
STP-PPM-0(230)A

October 2011

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October 28, 2011

Mr. Paul Bennett, Project Manager
Pima County Department of Transportation
201 N. Stone Avenue
Tucson, AZ 85701

RE: Final Traffic Noise Report
Valencia Road, Wade Road to Mark Road
4RTVMW
Federal Project No. STP-PPM-0(230)A
TRACS No. SS975 01C

Dear Mr. Bennett

HDR Engineering, Inc. is pleased to provide you with the *Final Traffic Noise Report* for the Valencia Road, Wade Road to Mark Road project. This report has been reviewed and approved by the Pima County Department of Transportation and the Arizona Department of Transportation.

HDR appreciates the opportunity to serve the Pima County Department of Transportation on this important project. If you have any questions or comments, please feel free to contact me by e-mail at catherine.silvester@hdrinc.com or by phone at (520) 584-3656. .

Sincerely,

HDR Engineering, Inc.

Catherine Silvester

Catherine Silvester
Environmental Planner

Attachments

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Valencia Road
Wade Road to Mark Road

Final Traffic Noise Report

October 2011

Prepared for:
Pima County Department of Transportation
201 N. Stone Avenue
Tucson, AZ 85701
Project No. 4RTVMW
Federal Project No. STP-PPM-0(230)A
TRACS No. SS975 01C

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1.0 Introduction

1.1 Study Location

The Pima County Department of Transportation (PCDOT), in conjunction with the Federal Highway Administration (FHWA), proposes to widen an approximately 3-mile long segment of Valencia Road in unincorporated Pima County, Arizona. The project extends from approximately 0.4 mile west of Wade Road to approximately 0.3 mile west of Mark Road. The project's location in the state is displayed in Figure 1, and the project vicinity is displayed in Figure 2.

1.2 Existing Roadway Conditions and Land Use

Valencia Road is a two-lane east-to-west roadway providing connectivity between Ajo Highway, Interstate (I)-19, I-10, and Houghton Road in the Tucson area. The project area is characterized by undeveloped land interspersed with medium- to low-density residential properties and two commercial properties. Medium-density single family homes are oriented along cross-streets located at the western project limits. The Casino del Sol and a gas station are located south of Valencia Road, near the eastern project limits. A hotel is currently under construction at the casino. The area south of Valencia Road between the residences and Casino del Sol is undeveloped. Single-family residential properties are located north of Valencia Road, between Wade Road and Camino Verde. The homes associated with the properties are irregularly spaced, and most of the homes are set back 200 feet or more from Valencia Road. One residential property has direct access to Valencia Road, and the home is located within 150 feet of the road. East of Camino Verde, two homes are within 400 feet of the north side of Valencia Road, and directly access the road. The remaining north side of Valencia Road to the eastern project limits is undeveloped.

1.3 Planned Project Improvements

The proposed improvements will involve:

- Reconstructing Valencia Road along its existing alignment from one lane in each direction to two lanes in each direction.
- Constructing a raised, landscaped median with openings at cross streets.
- Constructing drainage improvements at Black Wash and seven other drainage and wash crossings, as well as roadside ditches.
- Modifying the existing traffic signal at Camino Verde and installing a traffic signal at Wade Road.
- Constructing dedicated right- and left-turn lanes along Camino Verde and Wade Road at Valencia Road.
- Constructing paved driveway entrances to every property currently accessing Valencia Road.
- Constructing multi-use lanes in each direction on the new roadway, and sidewalks set back from the edge of pavement[1]

[1] Sidewalks will not be continuous within the project limits.

Figure 1. Project location in state

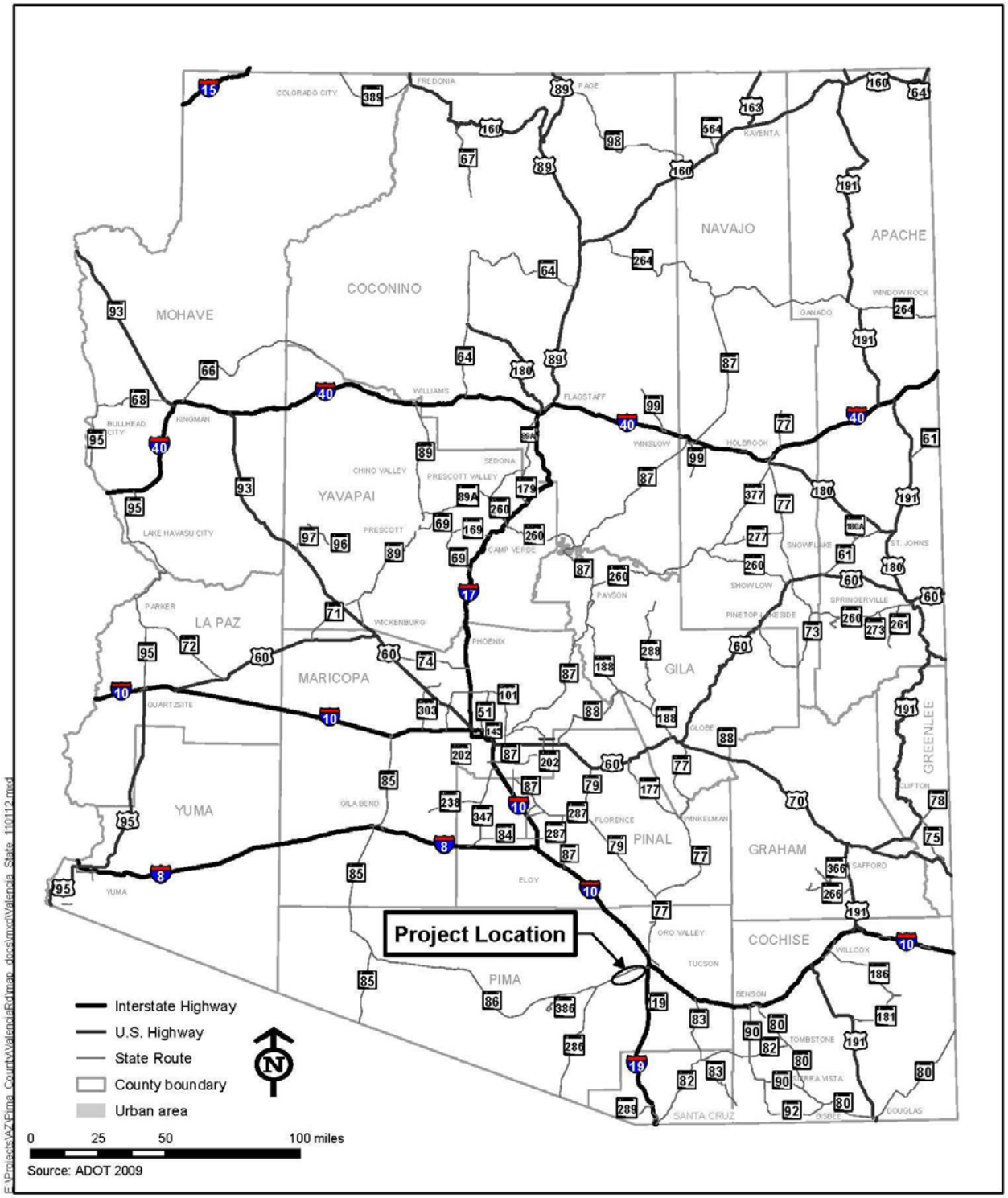
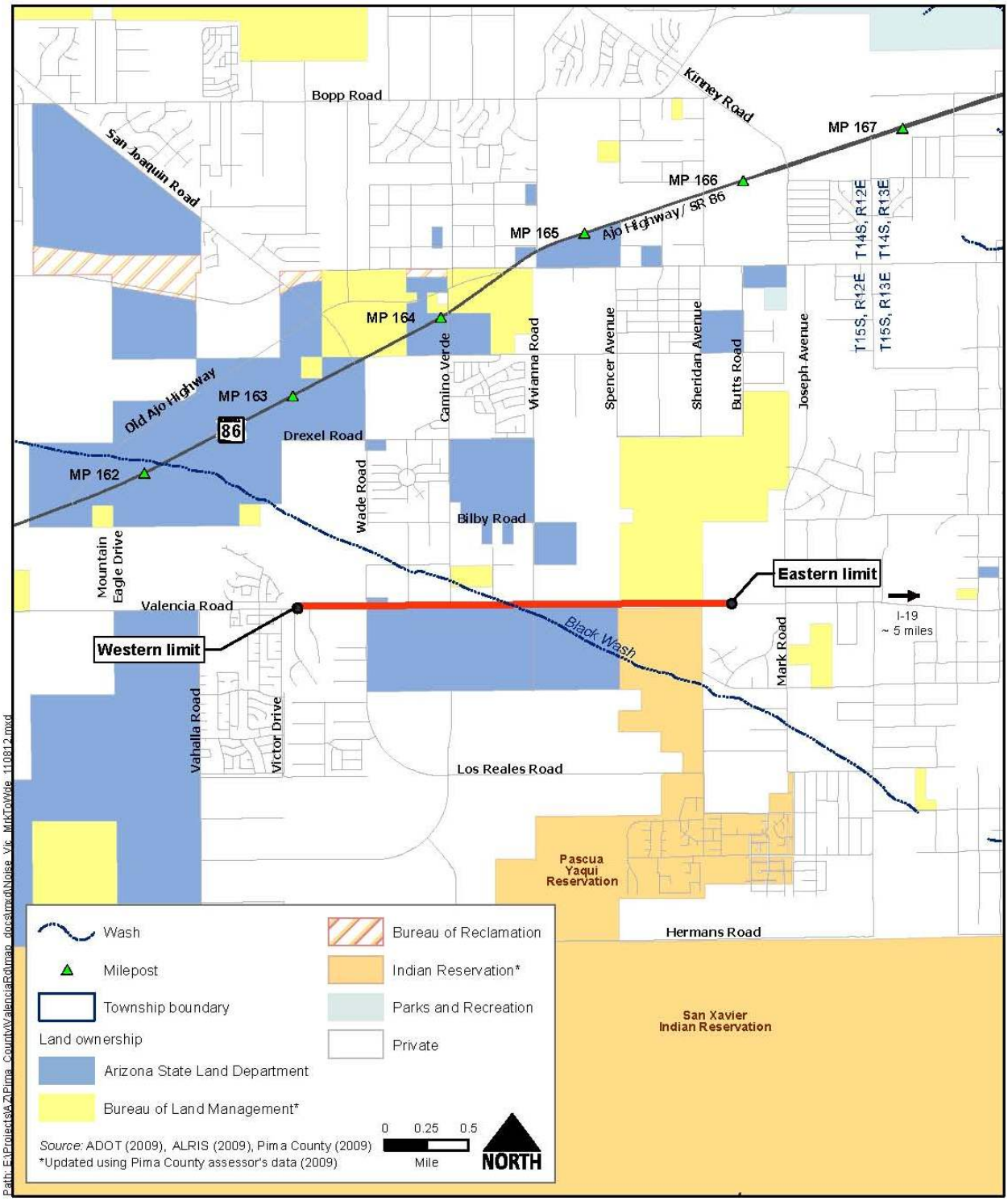


Figure 2. Project vicinity



2.0 Methods

A widened roadway will increase traffic-generated noise in the surrounding area where it brings the noise source (traffic) closer to noise-sensitive properties. For this study, the methods for determining the future noise levels and identifying possible mitigation measures to address those increased noise levels included using the FHWA Traffic Noise Model version 2.5 (TNM 2.5) and following noise abatement criteria established by FHWA and PCDOT. Stage I (15%) engineering drawings were used for this traffic noise analysis. Peak-hour traffic volumes were obtained from PCDOT on March 9, 2011.

To assess the potential change in noise levels, the existing noise environment was evaluated. Representative sites within the project area were chosen and ambient noise levels were measured at each site. Roadway geometry and topography, traffic volumes, existing barriers, land features, and the representative sites were entered into TNM 2.5 to replicate the conditions under which the noise level measurements were taken. Noise levels were calculated and compared with the ambient levels. This process examines the accuracy of the traffic noise model in performing noise level calculations for this project. Discrepancies in the model's calculations, if any, were addressed prior to using the model for predicting existing and design year noise levels (see Section 3, *TNM 2.5 Noise Model Validation*). Three conditions were modeled using TNM 2.5. The model estimated the peak-hour traffic noise levels for:

- existing condition (2011)
- projected no-build condition (2030)
- projected build condition without noise mitigation (2030)

The 2030 projected conditions were compared with the criteria established in PCDOT's noise abatement policy to determine whether noise mitigation was warranted.

2.1 TNM 2.5 Modeling

The TNM 2.5 model translated the roads in the project area into a series of endpoints on a three-dimensional X, Y, and Z coordinate system. This computer model was developed to comply with FHWA noise regulations and is considered the current standard for roadway noise analyses.

The TNM model requires input data regarding the geometry of roadways in the project area, vehicle mix, traffic volumes, and vehicle speeds. The proposed roadway and the surrounding arterial roads were defined by a series of roadway segment endpoints. Existing topographic contours for the roadway and surrounding properties were obtained from Sun Mapping on March 28, 2011. Roadway elevations under the proposed build condition were developed by HDR Engineering, Inc., and provided for the noise study on June 3, 2011. Noise-sensitive properties were represented in TNM as single points (receivers) and assigned an elevation of 5 feet above the ground to simulate the average height of human hearing. The sound levels were modeled using the A-weighted decibel (dBA), which is the measurement of sound that most closely approximates the sensitivity of the human ear. The noise level results—discussed in Section 4, *Existing Noise Environment*, and Section 5, *Future Conditions*—are presented in L_{eq1h}, the continuous sound level that would contain the same acoustical energy for 1 hour as the fluctuating sound levels during the same period.

The vehicles were classified as automobiles (two-axle vehicles such as passenger cars, pickup trucks, and vans), medium trucks (two-axle vehicles with six tires, three-axle vehicles, and city buses), heavy trucks (four- or more-axle vehicles), and motorcycles. Each of these vehicle types generates noise from a different height above the roadway, called the source height.

TNM 2.5 uses the above-described information to calculate the noise contribution from each roadway segment to each receiver and then determine the cumulative effect of all roadway noise sources for each receiver. Ongoing validation studies conducted at the Volpe National Transportation Systems Center, a facility of the United States Department of Transportation Research and Innovative Technology Administration, show that the TNM 2.5 model typically predicts noise levels within an acceptable range of accuracy.[2]

2.2 Noise Abatement Policy

Title 23 Code of Federal Regulations, Part 772 (23 CFR 772), entitled *Procedures for Abatement of Highway Traffic Noise and Construction Noise* (FHWA 2011), and Pima County's *Traffic Noise Analysis and Mitigation Guidance for Major Roadway Projects* (PCDOT 2003), were used for this study. These policies and criteria were developed to provide procedures for noise studies and noise abatement measures.

The FHWA noise abatement criteria (NAC) delineates noise-sensitive areas by land use categories and the noise levels in dBA at which abatement should be considered (see Table 1). Abatement should be considered when noise levels "approach" or exceed the NAC, or when future noise levels "substantially increase" over existing levels.

Table 1. FHWA NAC

Land use category	NAC (dBA L_{eq})	Description of land use category
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)	Picnic areas, recreation areas, playgrounds, active sports areas, parks, residences, motels, hotels, schools, churches, libraries, RV parks, day care centers, and hospitals
C	72 (exterior)	Developed land, properties, or activities not included in Categories A and B above
D	Not applicable	Undeveloped land
E	52 (interior)	Residences, motels, hotels, public meeting rooms, schools, churches, libraries, hospitals, and auditoriums

Source: 23 CFR 772

[2] See the Web site, <www.fhwa.dot.gov/publications/publicroads/02mar/07.cfm>, accessed on June 16, 2011

The FHWA NAC allow individual states and local governments to define the level at which traffic noise "approaches" the noise abatement criteria, and at which point design year (2030) traffic noise levels "substantially increase" over existing traffic noise levels.

Pima County's noise abatement policy (NAP) defines "approach" as within 1 dBA of the NAC (i.e. noise levels of 66 dBA or higher for category B land uses) and defines "substantially exceed" as a 15-dBA increase.

Land use categories known to occur within the project area are categories B (residences), C (commercial businesses), and D (undeveloped land). If noise levels at the category B and C properties are predicted to warrant consideration for abatement, noise abatement measures must be feasible, reasonable, and desired by the affected individuals. The 23 CFR 772 does not establish a noise abatement level for category D properties unless a building permit has been issued prior to approval of the final environmental documentation. The undeveloped land in the project area is not slated for development.

Feasibility considers whether it is structurally and acoustically possible to provide the noise abatement, (i.e., whether the topography allows a barrier to be built and whether a substantial noise reduction will be achieved). An analysis of feasibility also takes into account drainage issues, safety considerations, maintenance requirements, and whether or not other noise sources are present in the area. Reasonability means that PCDOT believes mitigation measures are prudent, based on consideration of the following conditions:

- The cost of the noise abatement shall not exceed $35,000 per benefited receiver.[3]
- The noise barrier will benefit two or more noise sensitive properties.
- The noise barrier will provide a 5-dBA or greater noise reduction at the impacted properties.

Noise barriers meeting feasibility and reasonability criteria will be constructed unless the majority of the affected residents are opposed to their construction.

PCDOT will apply rubberized asphalt to the improved roadway, which may result in a 3-dBA or greater reduction in traffic noise levels. However, FHWA does not consider rubberized asphalt as a noise mitigation measure. Therefore, the additional reduction in traffic noise levels from the use of rubberized asphalt is not considered in the noise abatement evaluation for this project.

2.3 Level of Service Traffic and Noise Levels

Traffic engineers describe the flow of traffic with a series of conditions called levels of service (LOS). LOS A describes free-flowing traffic that is able to travel at or above the posted speed limit with little or no difficulty in changing lanes. The conditions become more congested as the LOS progresses through the alphabet to LOS F, which represents stop-and-go traffic. From a noise perspective, the LOS C condition usually represents the worst hourly traffic noise impacts because traffic speeds are at or near the posted speed limit and lane capacity is high. Although more vehicles may be accommodated when LOS D is achieved, the lower speeds reduce tire noise, a major source of traffic noise.

[3] A benefited receiver is one who receives at least a 5 dBA reduction in noise levels as a result of the noise abatement measure.

2.4 Noise Analysis Overview

Aerial photographs and field reconnaissance were used to determine the locations and land use activities of potential noise-sensitive properties near the roadway. Field measurements were used to determine the existing noise levels throughout the Study Area, as described in Section 3, *TNM 2.5 Noise Model Validation*. The TNM 2.5 model was used to predict the noise levels that would occur with the proposed improvements. Standard English units of measurement were used for this study.

As noted earlier, traffic-generated noise levels are affected by traffic volumes, traffic speeds, and vehicle mix (the percentage of automobiles, medium trucks, and heavy trucks). These variables were used in the TNM 2.5 model to predict future noise levels within the project area. Existing (2011) and design year (2030) traffic volumes for the no-build and build conditions were provided by PCDOT in an e-mail dated March 9, 2011. Traffic volumes and speeds used in the modeling for this project represent "worst case" peak-hour or LOS C traffic conditions. Refer to Appendix B, *Traffic Data*, for traffic information used in this noise study.

Unmitigated noise levels for the 2030 traffic and roadway conditions were determined and compared with the appropriate noise abatement criterion to determine whether traffic noise mitigation should be considered. Generally, the mitigation considerations consist of noise barriers in the right-of-way (R/W). Although other mitigation considerations are possible, noise barriers are considered the most cost-effective and accepted technique when they are warranted. These barriers may consist of earthen berms or concrete/masonry walls, or combinations of the two barrier types.

2.5 Analysis Limitations

This noise analysis was based on design and traffic information available at the time of the analysis. The following assumptions were made to reach conclusions during the analysis phase:

- The project designs as evaluated in this report will not change.
- Future traffic volumes, vehicle mix, and speed will remain consistent with those predicted in the traffic study for this project.
- The nature of the land use will remain consistent with current use and planned development (i.e., industrial businesses will not be constructed where retail and professional offices are currently planned).
- The area where people are most likely to spend time outside of their homes is in their backyards, near their homes.

While the TNM 2.5 model has been calibrated and tested against actual noise measurements for several years, it should be noted that it is still a noise prediction model. The results of this analysis assume the predicting capabilities of TNM are sufficient.

Assumptions have been made to simplify the calculations for TNM:

- The receiver (representing human hearing) is 5 feet aboveground.
- The angle of view from the receiver to the road is 180 degrees.

- The terrain between the roadway and the receiver is relatively flat.
- The ground type is consistent throughout the project area.

The noise levels used in the noise analysis are reported in L_{eq1h}. As stated in Section 2.1, this represents the steady noise level over 1 hour that would produce the same energy as the noise level being analyzed during the same period. Instantaneous noises (e.g., a police siren, a particularly noisy truck, or unusually high traffic volumes) may cause noise levels to fluctuate above and below the L_{eq} during the prediction period. The use of L_{eq1h} for predicting noise levels and conducting the noise evaluation does not represent instantaneous noise levels as they might be experienced by a listener. However, instantaneous noise levels cannot be anticipated; therefore, they cannot be used in the noise analysis.

3.0 TNM 2.5 Noise Model Validation

Prior to using the model to predict traffic noise levels used in the study, it was validated for accuracy by comparing modeled traffic noise levels against traffic noise levels measured in the field. Traffic noise measurements were taken at two field monitoring sites. These sites were selected to be representative of areas of differing land uses and traffic characteristics within the project area (refer to Appendix A, *Monitoring Sites and Receiver Locations*). Roadway geometry and topography, traffic volumes, existing walls, land features, and the field monitoring sites were entered into TNM 2.5 to replicate the conditions under which the traffic noise measurements were taken. Existing traffic noise levels from the field measurements were then compared against TNM's predictions to verify the accuracy of the computer model. If the predicted and measured levels were within 3 dBA (above or below) of one another, this indicated the model was operating within the accepted level of accuracy.

3.1 Field Measurements

On April 21, 2011, HDR Engineering, Inc., staff measured traffic noise levels at the field monitoring sites. The data sheets are included in Appendix C, *Field Monitoring Data Sheets*. Traffic noise measurements were conducted in accordance with FHWA-PD-96-046, *Measurement of Highway Related Noise* (FHWA 1996). The meteorological conditions during the monitoring are shown in Table 2.

Table 2. Meteorological conditions for April 21, 2011

Meteorological attribute	Condition	
	A.M.	P.M.
Temperature	≅ 63 to 67° Fahrenheit	≅ 81 to 84° Fahrenheit
Humidity	≅ 27 to 34 percent	≅ 7 to 14 percent
Wind	≅ 1 mile per hour	≅ 9 to 11 miles per hour
Weather conditions	Sunny and clear	

Noise monitoring was conducted using a Larson Davis 812 (SLM) Type I integrating sound level meter. Table 3 summarizes the instruments that were used to collect the monitoring data for this noise analysis report.

Table 3. Noise analysis instrument summary

Instrument	Make	Model	Serial number
Type 1 sound level meter	Larson Davis	812	0221
Calibrator	Larson Davis	CAL200	0640

The sound level meter was programmed to compute the hourly equivalent sound level (L_{eq1h}). The following procedures were used for conducting the field measurements:

- Three 10-minute-long noise level recordings were taken during both a.m. and p.m. peak-hour traffic conditions at each field monitoring site with the sound level meter.
- The sound level meter was field calibrated before and after monitoring. No significant calibration drifts were detected during the recordings.
- The microphone was mounted on a tripod 5 feet above the ground to simulate the average height of human hearing.
- The microphone was covered with a windscreen.

Traffic data were also collected from Valencia Road during each of the noise measurement readings. Traffic traveling in both directions was counted manually and classified by vehicle type. Traffic speeds were estimated by driving with the traffic before and after measurement periods. Refer to Appendix C, *Field Monitoring Data Sheets*, for specific times, field conditions, and vehicle counts and mixes for each 10-minute-long noise level recording. Table 4 presents the total number of vehicles, vehicle mix, and traffic speeds documented during field monitoring.

Table 4. Field monitoring vehicle counts, mix, and estimated speeds

Roadway	Time of day	Total vehicles per hour	Number of automobiles	Number of medium trucks	Number of heavy trucks	Estimated vehicle speed (mph)
Valencia Road, Wade Road to Camino Verde Road	a.m.	778	748	12	18	50
	p.m.	1,212	1,200	8	4	50
Valencia Road, Camino Verde Road to Mark Road	a.m.	912	882	14	16	50
	p.m.	878	854	14	10	50

Ambient noise levels, as reflected in Table 5, are the average of the three noise level readings taken at each monitoring site during the morning and evening peak traffic hours. TNM 2.5 was used to predict peak morning and evening traffic noise levels by replicating the conditions during the noise measurement readings. The traffic data used matched the traffic conditions during the noise measurement readings (Table 4). The ambient noise levels were compared with predicted sound levels from the modeled

conditions to validate the model was able to accurately reflect site conditions and predict traffic noise levels for this project.

The results of the field monitoring and the modeled noise levels are shown in Table 5.

Table 5. Ambient noise levels compared with modeled noise levels

Monitoring site	Time of day	Average measured ambient noise level (dBA L_{eq1h})	Modeled noise level (dBA L_{eq1h})	Difference (dBA L_{eq1h})
1. 6784 Valencia Road Approximately 52 feet north of the existing edge of pavement at Valencia Road	a.m.	68.7	66.7	-2.0
	p.m.	70.9	68.2	-2.7
2. Sol Casinos Approximately 45 feet south of the existing edge of pavement at Valencia Road	a.m.	68.9	67.6	-1.3
	p.m.	67.7	66.4	-1.3

3.2 Model Validation Results

Ambient noise levels, as shown in Table 5, are the average of three noise level readings from each monitoring site during the morning and in the evening. These levels were compared with sound levels predicted by TNM 2.5 representing the field conditions. This comparison was used to make any necessary adjustments to the model input to most accurately reflect site conditions. Refer to Appendix A, *Monitoring Sites and Receiver Locations* for the location of each monitoring site in the project area.

TNM 2.5 predicted existing peak-hour a.m. and p.m. noise levels within 3 dBA of the monitoring noise levels at the monitoring sites. This is within an acceptable range of accuracy for TNM 2.5 to predict existing and future traffic noise levels at these locations.

The ambient noise level readings resulted in traffic noise levels exceeding PCDOT's threshold noise level indicating a traffic noise impact.

4.0 Existing Noise Environment

4.1 Description of Evaluated Properties

Properties within the project area are residential properties, undeveloped land, Casino del Sol, and a service station. The residential properties included in the traffic noise study were the single-family residential properties adjacent to Valencia Road (Receivers 1–10). The Sol Casinos and service station were evaluated in the traffic noise study (Receiver 11). The receivers were placed at locations representing areas of greatest outdoor use: at residential properties, the receivers were placed in the yard, near the home; and the receiver representing the casino and service station was placed between the two uses equidistant from the road as the nearest built structures (the parking lots).

The western project limits extend nearly to Star Ridge Place; therefore, the *logical termini* for evaluated properties included the properties adjacent to Valencia Road, on either side of Star Ridge Place (Receivers 1 and 2). Refer to Appendix A, *Monitoring Sites and Receiver Locations*, for a detailed map showing the locations of the receivers, and to Appendix D, *Noise Analysis Summary*, for properties associated with each receiver.

Existing walls were examined to determine whether they would reduce sound transmission. The walls needed to be tall enough to break the line-of-site between the receiver and the traffic, and be constructed without gaps or breaks. Existing walls at the following locations were included in the traffic noise model (refer to Appendix A, *Monitoring Sites and Receiver Locations* for a detailed map showing the streets described below):

- a 5.5-foot block wall at 6531 S. Star Ridge Place (Receiver 2)
- a 5.5-foot block wall at 6517 S. Start Diamond Place (Receiver 3)

4.2 Existing Noise Levels

Existing noise levels were modeled using TNM 2.5 for each of the 11 receiver locations. Predicted existing peak-hour noise levels within the project area ranged from 53 dBA L_{eq1h} to 61 dBA L_{eq1h} at the receivers (see Appendix D, *Noise Analysis Summary*). The model's results show that existing noise levels do not exceed PCDOT's noise threshold criteria at any of the receivers.

5.0 Future Conditions

5.1 Future Noise Levels

Future (2030) peak-hour noise levels were modeled using TNM 2.5 at the 11 receiver locations for the no-build condition and the proposed build condition. Future noise levels were compared to existing noise levels and PCDOT's NAP.

Predicted noise levels for the existing, no-build, and proposed build conditions are included in Appendix D, *Noise Analysis Summary*. The distance from the proposed centerline and differences between existing noise levels and future noise levels for both alternatives are listed for each receiver location.

Under the no-build condition, properties adjacent to Valencia Road are expected to experience a 2- to 5-dBA increase in traffic noise levels over 2011 noise levels by 2030. Traffic noise levels were predicted to range from 58 dBA L_{eq1h} to 64 dBA L_{eq1h}, during peak-hour traffic. The model's results show that traffic noise levels under the no-build condition would not exceed PCDOT's noise threshold criteria at any of the receivers.

Under the proposed build condition, traffic noise levels at the receivers were predicted to increase 2- to 6-dBA over 2011 noise levels by 2030. Traffic noise levels were predicted to range from 58 dBA L_{eq1h} to 64 dBA L_{eq1h}, during peak-hour traffic. The model's results show that traffic noise levels under the build condition would not exceed PCDOT's noise threshold criteria at any of the receivers.

The no-build and proposed build conditions would result in generally similar increases in traffic noise levels, with a 0- to 1-dBA difference in traffic noise levels between the two conditions. These differences in 2030 traffic noise levels would be barely perceptible by the human ear.[4] Although a widened roadway under the proposed build condition would carry lanes of traffic closer to the receivers, proposed medians would separate the lanes of opposing traffic, thus countering the effects of the closer lane of traffic on the nearest receiver. Further, adjustments to the roadway profile in the proposed roadway design would contribute to additional changes in noise levels at adjacent properties.

5.2 Noise Impact Analysis

The 11 receiver locations were evaluated for traffic noise impacts resulting from the proposed build 2030 peak-hour traffic conditions. The following criteria designate a noise impact according to the PCDOT's policy:

- The predicted design year (2030) noise level approaches (falls within 1 dBA of) or exceeds 67 dBA for the Category B properties (residential) and approaches (falls within 1 dBA of) or exceeds 72 dBA for the Category C (commercial) properties.
- The difference between the existing condition and the predicted design year noise level is 15 dBA or greater, resulting in a "substantial increase" in noise levels.

Noise abatement measures must be considered for noise-sensitive properties meeting either or both of these criteria.

The predicted noise levels did not exceed the noise abatement policy threshold at any of the receivers (see Appendix D, *Noise Analysis Summary*). Additionally, no properties were predicted to experience a substantial increase in traffic noise levels. No evaluation of noise abatement measures is warranted.

PCDOT will apply rubberized asphalt to the improved roadway. Although FWHA does not consider rubberized asphalt to be a noise mitigation measure, the rubberized asphalt may result in a 3-dBA or greater traffic noise reduction from the traffic noise levels predicted under the build condition.

6.0 Construction Noise

Construction of any part of the proposed improvements may cause temporary noise impacts. The quantification of such impacts is difficult without data on this project's construction schedule and equipment use. Therefore, certain assumptions were made to predict the approximate noise level at the edge of the R/W. These predictions are based on the loudest equipment expected to be used during each construction stage of a typical roadway project. Data on construction equipment noise are available from FHWA's *Highway Construction Noise Handbook* (2006).

An analysis was conducted during a freeway construction project in Arizona that assessed the collective impact of construction noise. The distance between the edge of the R/W and the construction activity was estimated based on the type of work being performed.

[4] A change in noise levels of 3 dBA or less is barely perceptible by the human ear (FHWA 1995).

The results of the preliminary estimates, shown in Table 7, indicate that noise-sensitive receivers adjacent to the R/W would be affected by construction noise. The highest noise levels would occur during the grading/earthwork phase.

Table 7. Construction equipment noise

Phase	Equipment	Equipment L_{max}[a]	Number of feet to right-of-way	L_{max} at right-of-way
Site clearing	Dozer	84	50	88
	Backhoe	85	50	
Grading/earthwork	Scraper	92	75	93
	Grader	91	75	
Foundation	Backhoe	85	100	85
	Loader	84	100	
Base preparation	Compressor	85	100	85
	Dozer	84	100	

[a] maximum instantaneous sound level in decibels

Project-related noise and vibration would be generated primarily from heavy equipment used in hauling materials and building the roadway improvements. Noise-sensitive areas located close to construction may temporarily experience increased noise and vibration levels. Noise impacts from construction equipment may be minimized through use of properly designed equipment, good maintenance of equipment, and placement of equipment away from noise-sensitive properties.

The Pima County Noise Code (Chapter 9.30.070) limits construction activities to between 5 a.m. and 7 p.m. from April 15 to October 15 and between 6 a.m. and 7 p.m. from October 16 to April 14. The contractor would be required to obtain a permit from Pima County if construction would need to occur outside of the allowed times.

7.0 Conclusions and Recommendations

Traffic noise impacts as a result of the proposed Valencia Road, Wade Road to Mark Road project have been evaluated in this report. Future traffic noise levels were predicted to result no traffic noise impacts at the adjacent properties. The difference in future (2030) traffic noise levels whether the project is constructed or not is anticipated to be negligible and would be barely detectible by the human ear (the no-build and proposed build conditions are within 3 dBA of each other). Due to the lack of traffic noise impacts resulting from the project, no consideration of noise abatement measures are warranted.

FHWA does not consider rubberized asphalt as a noise mitigation measure, and the anticipated reduction in traffic noise levels from the use of rubberized asphalt was not considered in the noise abatement evaluation. However, PCDOT will apply rubberized asphalt to the improved roadway which may result in a 3-dBA or greater reduction in traffic noise levels.

Construction-related noise would be minimized to the greatest extent practicable through use of properly designed and maintained equipment. The contractor would be responsible for complying with Pima County's Noise Ordinance which has established daily construction start and stop times to avoid nighttime noise disruptions. If nighttime work is unavoidable, the contractor would be responsible for obtaining a permit from Pima County.

8.0 References

Pima County Department of Transportation (PCDOT). 2003. *Traffic Noise Analysis and Mitigation Guidance for Major Roadway Projects.* Procedure No. 03-5.

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United States Department of Transportation, Federal Highway Administration (FHWA). 1976. *The Audible Landscape: A Manual for Highway Noise and Land Use.* Prepared by the Office of Research and Development. Washington, D.C.

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———. 2006. *FHWA Highway Construction Noise Handbook*.

———. 2011. *Highway Traffic Noise Analysis and Abatement, Policy and Guidance* effective July 2011.

9.0 Glossary

ambient noise level: The noise level existing in an area before the introduction of a proposed roadway improvement project. This quantity is measured in dBA and expressed as L_{eq} ambient noise levels.

at-grade roadway: A roadway that is level with the immediate surrounding terrain.

automobiles: All vehicles with two axles and four wheels, designed primarily for passenger transportation of cargo (light trucks). Generally, the gross vehicle weight is less than 10,000 pounds.

barrier: A solid wall or earthen berm that breaks the line-of-sight between the roadway and noise receiver location, reducing the noise level at the receiver.

decibel (dB): A logarithmic unit that indicates the amount of sound energy.

decibel, A-weighted (dBA): The A-weighted decibel scale approximates the sensitivity of the human ear. The approximate threshold of hearing is 0 dBA, while the approximate threshold of pain is 140 dBA. Most suburban areas have daytime noise levels ranging from 50 to 70 dBA.

design year: The future year used to determine the probable traffic volume for which a highway is designed.

existing noise levels: The noise resulting from the natural and mechanical sources and human activity usually present in a particular area.

heavy trucks: All vehicles having three or more axles and eight or more wheels that are designed for cargo transportation. Generally, the gross vehicle weight is greater than 26,400 pounds.

L_{eq}: The equivalent steady-state that, in a stated period of time, would contain the same acoustical energy as the time-varying sound levels during the same period.

L_{eq1h}: The L_{eq} for 1 hour.

level of service (LOS): The operating performance of a freeway, roadway, or intersection. Level of service is a qualitative description of operation based on the degree of delay and maneuverability.

light trucks: All vehicles with two axles and four wheels designed primarily for transportation of passengers and cargo. Generally, the gross vehicle weight is equal to or 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.

noise level reduction: The process of removing noise from an observer by the application of noise mitigation.

peak hour: The single morning or evening hour when the maximum traffic volume occurs.

receiver: The location at which noise levels are measured, modeled, and analyzed. Receivers of interest are typically residences, schools, parks, or other noise-sensitive properties.

right-of-way: Publicly owned land used or intended to be used for transportation and other purposes.

rubberized asphalt: This material consists of regular asphalt paving mixed with ground-up, used tires. Rubberized asphalt is generally smoother and quieter, helping to reduce tire noise.

sound level (noise level): Weighted sound level measured with a sound-level meter having metering characteristics and a frequency weighting of A, B, or C, as specified in the sound-level meter standard.

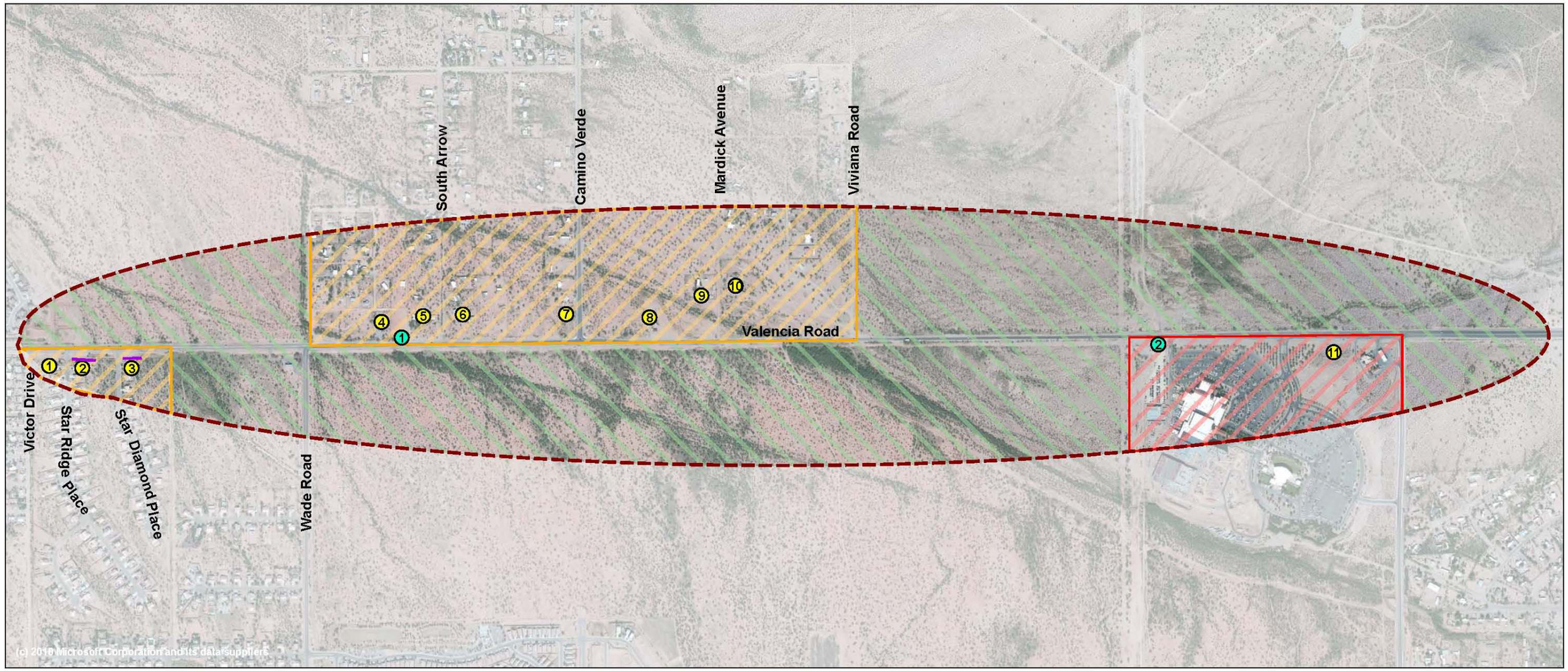
speed: The rate of movement of vehicular traffic, in miles per hour (mph).

traffic noise impacts: Impacts that occur when the predicted traffic noise equals or exceeds the noise abatement criteria levels.

Appendix A

Monitoring Sites and Receiver Locations

Monitoring Sites and Receiver Locations



Valencia Road, Wade Road to Mark Road

Noise monitoring location
Noise receiver location
Existing wall
Project area

Land Use*
Commercial
Residential
Undeveloped

1 inch = 1,000 feet
0 500 1,000 1,500 2,000
Feet
NORTH

*Land use within project area was field verified on April 21, 2011

Appendix B

Traffic Data

Traffic Data

Existing (2011) and future (2030) traffic volumes, vehicle mix and speeds were obtained from the *Traffic Engineering Report* (PCDOT 2011) prepared for this project. The future conditions were calculated based on traffic projections from the Pima Association of Governments (PAG) regional model. The PAG model is based on the *Adopted 2030 Regional Transportation Plan*, which considers conditions resulting from all future roadway projects included in the plan.

The existing and future peak hour traffic data were calculated by applying the percentage of daily traffic occurring during the peak traffic volume hour to the average daily traffic volume for the morning and evening peak traffic hours. The evening peak hour traffic volumes were used in the traffic noise analysis because they were equal to or greater than the morning peak hour traffic volumes for all roadway segments under existing and future conditions.

The peak hour traffic data used in the traffic noise analysis are presented in Table A–1.

Table A-1. Evening peak-hour traffic volumes by segment

Roadway Segment	Total peak hour vehicles	
	2011 existing	2030 future (predicted)
west of Wade Road	361	997
Wade Road to Camino Verde	739	1,421
Camino Verde to Viviana Road	496	951
Viviana Road to Mark Road	691	1,326

Source: PCDOT 2011

The vehicle mix and speeds remain the same for the existing and future conditions. Autos include vehicles with two axles and four tires, medium trucks include two or three axle vehicles with six tires, and heavy trucks include vehicles with eight or more tires. The data used in the traffic noise analysis are presented in Table A–2.

Table A-2. Peak hour vehicle mix and speeds

Direction	Vehicle mix*				Speed (mph)
	Percent autos	Percent medium trucks	Percent heavy trucks	Percent motorcycle	
Westbound	92	6	1	1	45
Eastbound	97	1	2	0	45

Source: PCDOT 2011

Appendix C

Field Monitoring Data Sheets

FIELD NOISE MEASUREMENT DATA

PROJECT: Valencia Road, Wade Road to Mark Road PROJ. #

SITE IDENTIFICATION: Site 1 OBSERVER(S): C. Bolm, K. Monsen
START DATE / TIME: 4/21/2011 7:50 a.m. END DATE / TIME: 4/21/2011 8:30 a.m.
ADDRESS: 6784 Valencia Road

METEROLOGICAL CONDITIONS:
TEMP: 67 °F HUMIDITY: 27 %R.H. WIND: (CALM) LIGHT MODERATE VARIABLE
WINDSPEED: 0.9 MPH DIR: N NE E SE S SW W (NW) STEADY GUSTY
SKY: (SUNNY) CLEAR OVRCST PRTLY CLOUDY FOG RAIN OTHER:

ACOUSTIC MEASUREMENTS:
INSTRUMENT: Larson Davis 812 TYPE: (1) 2 SERIAL #: 0221
CALIBRATOR: Larson Davis CAL200 SERIAL #: 0640
CALIBRATION CHECK: PRE-TEST 114.0 dBA SPL POST-TEST 114.1 dBA SPL WINDSCREEN Yes

SETTINGS: (A-WEIGHTED) (SLOW) FAST FRONTAL RANDOM ANSI OTHER:

REC #	START	END	L_{eq}	L_{max}	L_{min}	L_{90}	L_{50}	L_{10}	OTHER:	(TYPE?)	
1	7:50	8:00	67.9	77.0	49.6	57.1	66.0	71.8			
2	8:05	8:15	69.4	80.4	48.8	57.8	66.9	73.5			
3	8:20	8:30	68.8	78.7	46.0	55.2	66.2	73.1			

COMMENTS:

SOURCE INFO AND TRAFFIC COUNTS:
PRIMARY NOISE SOURCE: (TRAFFIC) AIRCRAFT RAIL INDUSTRIAL AMBIENT OTHER:
ROADWAY TYPE: asphalt concrete

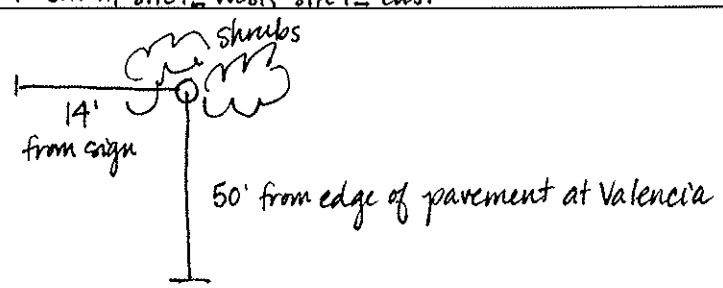
TRAFFIC COUNT DURATION: 30 MIN

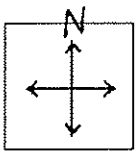
	NB / (EB)	SB / (WB)	#1 SPEED NB / EB	#1 SPEED SB / WB	#2 COUNT NB / EB	#2 COUNT SB / WB	#2 SPEED NB / EB	#2 SPEED SB / WB
AUTOS:	281	91						
MED. TRUCKS:	0	6	50mph					
HVY TRUCKS:	5	4						
BUSES:	—	—						
MOTORCYCLES:	2	0						

SPEED ESTIMATED BY: RADAR / (DRIVING) / (OBSERVER)

OTHER SOURCES: DIST. AIRCRAFT / RUSTLING LEAVES / DIST. BARKING DOGS / BIRDS / DIST. INDUSTRIAL
DIST. CHILDREN PLAYING / DIST. TRAFFIC / DIST. LANDSCAPING ACTIVITIES / OTHER:

DESCRIPTION / SKETCH:
TERRAIN: (HARD) (SOFT) MIXED FLAT OTHER:
PHOTOS: site 1 - north, site 1 - south, site 1 - west, site 1 - east
OTHER COMMENTS / SKETCH:





FIELD NOISE MEASUREMENT DATA

PROJECT: Valencia Road, Wade Road to Mark Road PROJ. #

SITE IDENTIFICATION: site 1 OBSERVER(S): C. Bolm, K. Monsen
START DATE / TIME: 4/21/2011 5:50 p.m. END DATE / TIME: 4/21/2011 6:30
ADDRESS: 6784 Valencia Road

METEROLOGICAL CONDITIONS:
TEMP: 84 °F HUMIDITY: 14 %R.H. WIND: CALM LIGHT MODERATE VARIABLE
WINDSPEED: 9 MPH DIR: N NE E SE S SW W NW STEADY GUSTY
SKY: SUNNY CLEAR OVRCST PRTLY CLOUDY FOG RAIN OTHER:

ACOUSTIC MEASUREMENTS:
INSTRUMENT: Larson Davis 812 TYPE: 1 2 SERIAL #: 0221
CALIBRATOR: Larson Davis CAL200 SERIAL #: 0640
CALIBRATION CHECK: PRE-TEST 114.0 dBA SPL POST-TEST 114.0 dBA SPL WINDSCREEN Yes

SETTINGS: A-WEIGHTED SLOW FAST FRONTAL RANDOM ANSI OTHER:

REC #	START	END	L_{eq}	L_{max}	L_{min}	L_{90}	L_{50}	L_{10}	OTHER:	(TYPE?)
1	5:50	6:00	71.5	78.5	52.1	63.7	70.8	74.5		
2	6:05	6:15	70.8	78.0	51.3	60.8	70.5	73.8		
3	6:19	6:29	70.5	78.2	51.2	60.4	69.2	74.2		

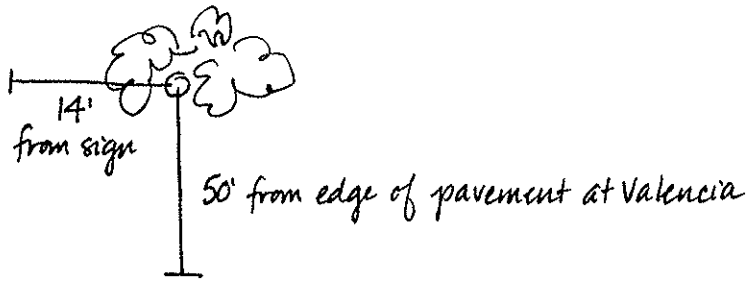
COMMENTS:

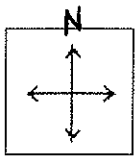
SOURCE INFO AND TRAFFIC COUNTS:
PRIMARY NOISE SOURCE: TRAFFIC AIRCRAFT RAIL INDUSTRIAL AMBIENT OTHER:
ROADWAY TYPE: asphalt concrete
TRAFFIC COUNT DURATION: 30 MIN

	NB / EB	SB / WB	#1 SPEED NB / EB	#1 SPEED SB / WB	#2 COUNT NB / EB	#2 COUNT SB / WB	#2 SPEED NB / EB	#2 SPEED SB / WB
AUTOS:	212	382						
MED. TRUCKS:	2	2						
HVY TRUCKS:	0	2						
BUSES:	–	–						
MOTORCYCLES:	2	4						

SPEED ESTIMATED BY: RADAR / DRIVING / OBSERVER
OTHER SOURCES: DIST. AIRCRAFT / RUSTLING LEAVES / DIST. BARKING DOGS / BIRDS / DIST. INDUSTRIAL
DIST. CHILDREN PLAYING / DIST. TRAFFIC / DIST. LANDSCAPING ACTIVITIES / OTHER:

DESCRIPTION / SKETCH:
TERRAIN: HARD SOFT MIXED FLAT OTHER:
PHOTOS: see a.m. sheet
OTHER COMMENTS / SKETCH:





FIELD NOISE MEASUREMENT DATA

PROJECT: Valencia Road, Wade Road to Mark Road PROJ. #

SITE IDENTIFICATION: site 2 OBSERVER(S): C. Bolm, K. Monsen
START DATE / TIME: 4/21/2011 6:50 am END DATE / TIME: 4/21/2011 7:30 am
ADDRESS: South of Valencia, near west entrance to Casino

METEROLOGICAL CONDITIONS:
TEMP: 62.6 °F HUMIDITY: 34 %R.H. WIND: CALM (LIGHT) MODERATE VARIABLE
WINDSPEED: 1.4 MPH DIR: N NE (E) SE S SW W NW STEADY GUSTY
SKY: (SUNNY) CLEAR OVRCST PRTLY CLOUDY FOG RAIN OTHER:

ACOUSTIC MEASUREMENTS:
INSTRUMENT: Larson Davis 812 TYPE: (1) 2 SERIAL #: 0221
CALIBRATOR: CAL200 SERIAL #: 0640
CALIBRATION CHECK: PRE-TEST 114.0 dBA SPL POST-TEST 114.0 dBA SPL WINDSCREEN Yes

SETTINGS: (A-WEIGHTED) (SLOW) FAST FRONTAL RANDOM ANSI OTHER:

REC #	START	END	L_{eq}	L_{max}	L_{min}	L_{90}	L_{50}	L_{10}	OTHER:	(TYPE?)	
1	6:50	7:00	68.3	77.3	49.4	55.3	67.2	71.8			
2	7:05	7:15	69.1	77.5	51.5	56.7	68.0	72.5			
3	7:20	7:30	69.2	78.3	51.4	55.9	67.5	72.9			

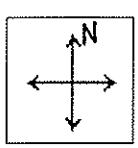
COMMENTS:

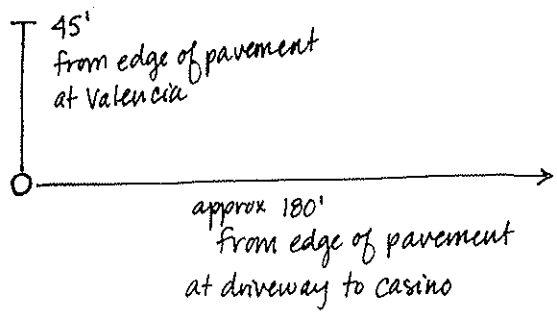
SOURCE INFO AND TRAFFIC COUNTS:
PRIMARY NOISE SOURCE: (TRAFFIC) AIRCRAFT RAIL INDUSTRIAL AMBIENT OTHER:
ROADWAY TYPE: asphalt
TRAFFIC COUNT DURATION: 30 -MIN

	NB / (EB)	SB / (WB)	#1 SPEED NB / EB	#1 SPEED SB / WB	#2 COUNT NB / EB	#2 COUNT SB / WB	#2 SPEED NB / EB	#2 SPEED SB / WB
AUTOS:	349	86						
MED. TRUCKS:	2	6						
HVY TRUCKS:	4	4	50mph					
BUSES:	–	–						
MOTORCYCLES:	4	2						

SPEED ESTIMATED BY: RADAR / ~~DRIVING~~ / (OBSERVER)
OTHER SOURCES: DIST. AIRCRAFT / RUSTLING LEAVES / DIST. BARKING DOGS / BIRDS / DIST. INDUSTRIAL
DIST. CHILDREN PLAYING / (DIST. TRAFFIC) / DIST. LANDSCAPING ACTIVITIES / OTHER:
traffic entering and leaving casino driveway

DESCRIPTION / SKETCH:
TERRAIN: HARD (SOFT) MIXED FLAT OTHER:
PHOTOS: site 2 - north, site 2 - west, site 2 - south, site 2 - east
OTHER COMMENTS / SKETCH:





FIELD NOISE MEASUREMENT DATA

PROJECT: Valencia Road, Wade Road to Mark Road PROJ. #

SITE IDENTIFICATION: site 2 OBSERVER(S): C. Bolm, K. Monsen
START DATE / TIME: 4/21/2011 5:00 pm END DATE / TIME: 4/21/2011 5:37pm
ADDRESS: South of Valencia, near west entrance to Casino

METEROLOGICAL CONDITIONS:
TEMP: 81 °F HUMIDITY: 7 %R.H. WIND: CALM LIGHT MODERATE (VARIABLE)
WINDSPEED: 11 MPH DIR: N NE E SE S SW W NW STEADY (GUSTY)
SKY: (SUNNY) CLEAR OVRCST PRTLY CLOUDY FOG RAIN OTHER:

ACOUSTIC MEASUREMENTS:
INSTRUMENT: Larson Davis 812 TYPE: (1) 2 SERIAL #: 0221
CALIBRATOR: Larson Davis CAL200 SERIAL #: 0640
CALIBRATION CHECK: PRE-TEST 114.0 dBA SPL POST-TEST 114.0 dBA SPL WINDSCREEN Yes

SETTINGS: (A-WEIGHTED) (SLOW) FAST FRONTAL RANDOM ANSI OTHER:

REC #	START	END	L_{eq}	L_{max}	L_{min}	L_{90}	L_{50}	L_{10}	OTHER:	(TYPE?)	
1	5:00	5:10	68.3	78.0	48.5	54.4	66.2	71.9			
2	5:15	5:25	67.3	74.9	44.2	52.8	65.7	71.1			
3	5:27	5:37	67.5	75.8	46.2	52.2	66.2	71.2			

COMMENTS:

SOURCE INFO AND TRAFFIC COUNTS:
PRIMARY NOISE SOURCE: (TRAFFIC) AIRCRAFT RAIL INDUSTRIAL AMBIENT OTHER:
ROADWAY TYPE: asphalt

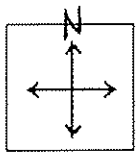
TRAFFIC COUNT DURATION: 30 MIN

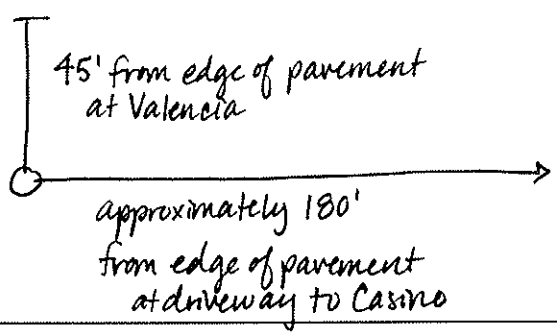
	NB / (EB)	SB / (WB)	#1 SPEED NB / EB	#1 SPEED SB / WB	#2 COUNT NB / EB	#2 COUNT SB / WB	#2 SPEED NB / EB	#2 SPEED SB / WB
AUTOS:	117	309						
MED. TRUCKS:	3	4						
HVY TRUCKS:	3	2	50mph					
BUSES:	—	—						
MOTORCYCLES:	0	1						

SPEED ESTIMATED BY: RADAR / (DRIVING) / (OBSERVER)

OTHER SOURCES: DIST. AIRCRAFT / RUSTLING LEAVES / DIST. BARKING DOGS / BIRDS / DIST. INDUSTRIAL
DIST. CHILDREN PLAYING / DIST. TRAFFIC / DIST. LANDSCAPING ACTIVITIES / OTHER:

DESCRIPTION / SKETCH:
TERRAIN: (HARD) (SOFT) MIXED FLAT OTHER:
PHOTOS: see a.m. sheet
OTHER COMMENTS / SKETCH:





Appendix D

Noise Analysis Summary

Noise Analysis Summary

Receiver ID	Property represented and address(es)	Distance from proposed centerline (feet)	Existing condition (2011) (dBA L_{eq1h})	No-build alternative (2030) (dBA L_{eq1h})	Proposed build alternative (2030) (dBA L_{eq1h})	Difference between existing and no-build (dBA L_{eq1h})	Difference between existing and proposed build (dBA L_{eq1h})	Noise impact*	Mitigation consideration
1	Residential (1) 6516 S. Star Ridge Place	145	58	62	63	4	5	no	None warranted; below noise abatement criteria
2	Residential (1) 6531 S. Star Ridge Place	145	53	58	59	5	6	no	None warranted; below noise abatement criteria
3	Residential (1) 6517 S. Star Diamond Place	135	53	58	59	5	6	no	None warranted; below noise abatement criteria
4	Residential (1) 6886 W. Valencia Road	175	60	63	64	3	4	no	None warranted; below noise abatement criteria
5	Residential (2) 6802 W. Valencia Road	245	58	61	61	3	3	no	None warranted; below noise abatement criteria
6	Residential (2) 6784 W. Valencia Road 6750 W. Valencia Road	245	58	61	60	3	2	no	None warranted; below noise abatement criteria
7	Residential (1) 6452 S. Camino Verde	265	57	60	58	3	5	no	None warranted; below noise abatement criteria
8	Residential (1) 6452 W. Valencia Road	125	61	64	63	3	2	no	None warranted; below noise abatement criteria
9	Residential (1) 6440 S. Mardick Avenue	480	53	56	56	3	3	no	None warranted; below noise abatement criteria
10	Residential (1) 6445 S. Mardick Avenue	460	53	56	56	3	3	no	None warranted; below noise abatement criteria
11	Commercial Casino del Sol and Chevron Station 5655 W. Valencia Road	175	60	62	63	2	3	no	None warranted; below noise abatement criteria

*The receiver is determined to experience a noise impact when the traffic noise levels reach 66 dBA or greater at category B properties (residences) and 71 dBA or greater at category C properties (commercial) for the proposed build alternative.

Appendix E

Traffic Noise Model (TNM 2.5) Output Files

Pima County DOT 16 June 2011
C. Bolm HDR Engineering, Inc. TNM 2.5
Calculated with TNM 2.5

RESULTS: SOUND LEVELS
PROJECT/CONTRACT: Valencia Road, Wade Road to Mark Road
RUN: Field Monitoring (AM peak hour)
BARRIER DESIGN: INPUT HEIGHTS
ATMOSPHERICS: 68 deg F, 50% RH

Average pavement type shall be used unless a State highway agency substantiates the use of a different type with approval of FHWA.

Receiver Name	No.	#DUs	Existing LAeq1h	No Barrier LAeq1h Calculated	Crit'n	Increase over existing Calculated	Crit'n Sub'l Inc	Type Impact	With Barrier Calculated LAeq1h	Noise Reduction Calculated	Noise Reduction Goal	Calculated minus Goal
			dBA	dBA	dBA	dB	dB		dBA	dB	dB	dB
Monitoring site 2	1	1	0.0	67.6	66	67.6	10	Snd Lvl	67.6	0.0	8	-8.0
Monitoring site 1	2	1	0.0	66.7	66	66.7	10	Snd Lvl	66.7	0.0	8	-8.0

Dwelling Units	# DUs	Noise Reduction Min dB	Avg dB	Max dB
All Selected	2	0.0	0.0	0.0
All Impacted	2	0.0	0.0	0.0
All that meet NR Goal	0	0.0	0.0	0.0

Pima County DOT 16 June 2011
C. Bolm HDR Engineering, Inc. TNM 2.5
Calculated with TNM 2.5

RESULTS: SOUND LEVELS
PROJECT/CONTRACT: Valencia Road, Wade Road to Mark Road
RUN: Field Monitoring (PM peak hour)
BARRIER DESIGN: INPUT HEIGHTS
ATMOSPHERICS: 68 deg F, 50% RH

Average pavement type shall be used unless a State highway agency substantiates the use of a different type with approval of FHWA.

Receiver Name	No.	#DUs	Existing LAeq1h	No Barrier LAeq1h Calculated	Crit'n	Increase over existing Calculated	Crit'n Sub'l Inc	Type Impact	With Barrier Calculated LAeq1h	Noise Reduction Calculated	Noise Reduction Goal	Calculated minus Goal
			dBA	dBA	dBA	dB	dB		dBA	dB	dB	dB
Monitoring site 2	1	1	0.0	66.4	66	66.4	10	Snd Lvl	66.4	0.0	8	-8.0
Monitoring site 1	2	1	0.0	68.2	66	68.2	10	Snd Lvl	68.2	0.0	8	-8.0

Dwelling Units	# DUs	Noise Reduction Min dB	Avg dB	Max dB
All Selected	2	0.0	0.0	0.0
All Impacted	2	0.0	0.0	0.0
All that meet NR Goal	0	0.0	0.0	0.0

Pima County DOT 11 August 2011
C. Bolm HDR Engineering, Inc. TNM 2.5
Calculated with TNM 2.5

RESULTS: SOUND LEVELS
PROJECT/CONTRACT: Valencia Road, Wade Road to Mark Road
RUN: Existing Conditions 2011
BARRIER DESIGN: INPUT HEIGHTS
ATMOSPHERICS: 68 deg F, 50% RH

Average pavement type shall be used unless a State highway agency substantiates the use of a different type with approval of FHWA.

Receiver Name	No.	#DUs	Existing LAeq1h	No Barrier LAeq1h Calculated	Crit'n	Increase over existing Calculated	Crit'n Sub'l Inc	Type Impact	With Barrier Calculated LAeq1h	Noise Reduction Calculated	Noise Reduction Goal	Calculated minus Goal
			dBA	dBA	dBA	dB	dB		dBA	dB	dB	dB
Receiver1	1	1	0.0	57.7	66	57.7	10	----	57.7	0.0	8	-8.0
Receiver2	2	1	0.0	53.2	66	53.2	10	----	53.2	0.0	8	-8.0
Receiver3	3	1	0.0	53.4	66	53.4	10	----	53.4	0.0	8	-8.0
Receiver4	4	1	0.0	60.4	66	60.4	10	----	60.4	0.0	8	-8.0
Receiver 5a	5	1	0.0	58.2	66	58.2	10	----	58.2	0.0	8	-8.0
Receiver 5b	6	1	0.0	57.5	66	57.5	10	----	57.5	0.0	8	-8.0
Receiver 6a	7	1	0.0	57.4	66	57.4	10	----	57.4	0.0	8	-8.0
Receiver 6b	8	1	0.0	57.9	66	57.9	10	----	57.9	0.0	8	-8.0
Receiver7	9	1	0.0	57.4	66	57.4	10	----	57.4	0.0	8	-8.0
Receiver8	10	1	0.0	60.8	66	60.8	10	----	60.8	0.0	8	-8.0
Receiver9	11	1	0.0	52.9	66	52.9	10	----	52.9	0.0	8	-8.0
Receiver10	12	1	0.0	53.3	66	53.3	10	----	53.3	0.0	8	-8.0
Receiver11	13	1	0.0	59.5	66	59.5	10	----	59.5	0.0	8	-8.0

Dwelling Units	# DUs	Noise Reduction Min	Avg	Max
		dB	dB	dB
All Selected	13	0.0	0.0	0.0
All Impacted	0	0.0	0.0	0.0
All that meet NR Goal	0	0.0	0.0	0.0

Pima County DOT 15 August 2011
C. Bolm HDR Engineering, Inc. TNM 2.5
Calculated with TNM 2.5

RESULTS: SOUND LEVELS
PROJECT/CONTRACT: Valencia Road, Wade Road to Mark Road
RUN: No Build Conditions 2030
BARRIER DESIGN: INPUT HEIGHTS
ATMOSPHERICS: 68 deg F, 50% RH

Average pavement type shall be used unless a State highway agency substantiates the use of a different type with approval of FHWA.

Receiver Name	No.	#DUs	Existing LAeq1h	No Barrier LAeq1h Calculated	Crit'n	Increase over existing Calculated	Crit'n Sub'l Inc	Type Impact	With Barrier Calculated LAeq1h	Noise Reduction Calculated	Noise Reduction Goal	Calculated minus Goal
			dBA	dBA	dBA	dB	dB		dBA	dB	dB	dB
Receiver1	1	1	0.0	62.1	66	62.1	10	----	62.1	0.0	8	-8.0
Receiver2	2	1	0.0	57.6	66	57.6	10	----	57.6	0.0	8	-8.0
Receiver3	3	1	0.0	57.8	66	57.8	10	----	57.8	0.0	8	-8.0
Receiver4	4	1	0.0	63.3	66	63.3	10	----	63.3	0.0	8	-8.0
Receiver 5a	5	1	0.0	61.1	66	61.1	10	----	61.1	0.0	8	-8.0
Receiver 5b	6	1	0.0	60.4	66	60.4	10	----	60.4	0.0	8	-8.0
Receiver 6a	7	1	0.0	60.2	66	60.2	10	----	60.2	0.0	8	-8.0
Receiver 6b	8	1	0.0	60.7	66	60.7	10	----	60.7	0.0	8	-8.0
Receiver7	9	1	0.0	60.3	66	60.3	10	----	60.3	0.0	8	-8.0
Receiver8	10	1	0.0	63.6	66	63.6	10	----	63.6	0.0	8	-8.0
Receiver9	11	1	0.0	55.7	66	55.7	10	----	55.7	0.0	8	-8.0
Receiver10	12	1	0.0	56.1	66	56.1	10	----	56.1	0.0	8	-8.0
Receiver11	13	1	0.0	62.3	66	62.3	10	----	62.3	0.0	8	-8.0

Dwelling Units	# DUs	Noise Reduction Min	Avg	Max
		dB	dB	dB
All Selected	13	0.0	0.0	0.0
All Impacted	0	0.0	0.0	0.0
All that meet NR Goal	0	0.0	0.0	0.0

Pima County DOT 11 August 2011
C. Bolm, HDR Engineering, Inc. TNM 2.5
Calculated with TNM 2.5

RESULTS: SOUND LEVELS
PROJECT/CONTRACT: Valencia Road, Wade Road to Mark Road
RUN: Proposed Build Condition 2030
BARRIER DESIGN: INPUT HEIGHTS
ATMOSPHERICS: 68 deg F, 50% RH

Average pavement type shall be used unless a State highway agency substantiates the use of a different type with approval of FHWA.

Receiver Name	No.	#DUs	Existing LAeq1h	No Barrier LAeq1h Calculated	Crit'n	Increase over existing Calculated	Crit'n Sub'l Inc	Type Impact	With Barrier Calculated LAeq1h	Noise Reduction Calculated	Noise Reduction Goal	Calculated minus Goal
			dBA	dBA	dBA	dB	dB		dBA	dB	dB	dB
Receiver1	1	1	0.0	62.5	66	62.5	10	----	62.5	0.0	8	-8.0
Receiver2	2	1	0.0	58.5	66	58.5	10	----	58.5	0.0	8	-8.0
Receiver3	3	1	0.0	58.9	66	58.9	10	----	58.9	0.0	8	-8.0
Receiver4	4	1	0.0	63.5	66	63.5	10	----	63.5	0.0	8	-8.0
Receiver 5a	5	1	0.0	60.8	66	60.8	10	----	60.8	0.0	8	-8.0
Receiver 5b	6	1	0.0	60.0	66	60.0	10	----	60.0	0.0	8	-8.0
Receiver 6a	7	1	0.0	59.8	66	59.8	10	----	59.8	0.0	8	-8.0
Receiver 6b	8	1	0.0	60.1	66	60.1	10	----	60.1	0.0	8	-8.0
Receiver7	9	1	0.0	58.4	66	58.4	10	----	58.4	0.0	8	-8.0
Receiver8	10	1	0.0	63.4	66	63.4	10	----	63.4	0.0	8	-8.0
Receiver9	11	1	0.0	55.8	66	55.8	10	----	55.8	0.0	8	-8.0
Receiver10	12	1	0.0	56.4	66	56.4	10	----	56.4	0.0	8	-8.0
Receiver11	13	1	0.0	63.0	66	63.0	10	----	63.0	0.0	8	-8.0

Dwelling Units	# DUs	Noise Reduction Min	Avg	Max
		dB	dB	dB
All Selected	13	0.0	0.0	0.0
All Impacted	0	0.0	0.0	0.0
All that meet NR Goal	0	0.0	0.0	0.0