FINAL DESIGN NOISE REPORT

City of Tucson
Kolb Road: Connection to Sabino Canyon Road

Tucson, Arizona

Federal Aid No. STP-TUC-0(233)A
TRACS No. 0000 PM TUC SS865 01C
City of Tucson Project No. SR8A

Prepared by:
HDR Engineering, Inc.
5210 E. Williams Circle, Suite 530
Tucson, AZ 85711-4459
HDR Project No. 142714

March 2013

HDR

March 5, 2013

Jennifer Donofrio
Environmental Coordinator
City of Tucson
Department of Transportation
201 N. Stone Ave.
Tucson, AZ 85701

RE: Final Design Noise Report
Kolb Road: Connection to Sabino Canyon Road
City of Tucson Project No. SR8A
HDR Project No. 142714

Dear Ms. Donofrio:

We are pleased to present the *Final Design Noise Report* for the above-referenced project. This report incorporates comments from Joe D'Onofrio at ADOT Environmental Planning Group.

Please feel free to contact me at (520) 584-3670 if you have any questions.

Sincerely,

HDR Engineering, Inc.

Scott Stapp
Environmental Project Manager

Attachments

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for
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1 Introduction

1.1 Study Location

The City of Tucson and the Federal Highway Administration (FHWA) propose to construct a new roadway connecting North Sabino Canyon Road to North Kolb Road in the city of Tucson, Pima County, Arizona. The project will take place entirely within Tucson's city limits. The project location is displayed in Figure 1, and the project vicinity is displayed in Figure 2.

Stage III (75%) engineering drawings were used for this traffic noise analysis. Peak-hour traffic volumes were obtained from the *Initial Traffic Engineering Report, Kolb Road/Sabino Canyon Road Connection Tucson, Arizona* (Psomas 2009).

1.2 Existing Roadway Conditions and Land Use

The project vicinity features a concentration of principal arterial roads providing connectivity between northeastern Tucson and Pima County and the rest of the city. Sabino Canyon Road, Tanque Verde Road, Speedway Boulevard, and Kolb Road are principal arterial roads within the project limits. The intersection of these roads and the properties within the immediate vicinity encompass the traffic noise study area. Pantano Wash is a major wash transecting the project area. See Figure 2 and refer to Appendix A, *Monitoring Sites, Receiver Locations, and Potential Barrier Locations,* for detailed maps.

Sabino Canyon Road is a north-to-south roadway currently terminating near Tanque Verde Road at the Morris K. Udall Regional Park (Udall Park). North of Tanque Verde Road, Sabino Canyon Road is an arterial road featuring four lanes with a raised median. South of Tanque Verde Road, Sabino Canyon Road reduces to two lanes and provides access to Udall Park east of Sabino Canyon Road and residential neighborhoods to the west. The road terminates approximately 0.3 mile south of Tanque Verde Road.

Tanque Verde Road is a six-lane arterial road with a raised median, running east-to-west through the project area. Tanque Verde Road intersects Kolb Road approximately 0.5 mile west of Sabino Canyon Road. Kolb Road runs north-to-south, featuring six lanes and a raised median.

Land use within the traffic noise study area is commercial, residential, park, and closed landfill (refer to Figure 2 for land uses). Development along Sabino Canyon Road, north of Tanque Verde Road, is primarily single-family residential. The northwestern, northeastern, and southwestern corners of the Sabino Canyon Road and Tanque Verde Road intersection feature commercial properties whose operations include strip malls with stores, banks, and restaurants. The City of Tucson-owned Udall Park is located at the southeastern corner of the intersection. Park amenities include trails, covered picnic areas, an outdoor pool, tennis courts, soccer fields, three baseball fields, and a proposed amphitheater.

A pet-boarding business, Sabino Canyon Pet Resort, is located within the single-family residential neighborhood west of the park, at the intersection of Crestline Drive and Sabino Canyon Road. Pantano II is a residential neighborhood of townhomes located at the Sabino Canyon Road terminus. Udall Park is directly east of the Pantano II townhomes, and Pantano Wash is directly to the west.

Figure 1. Project location

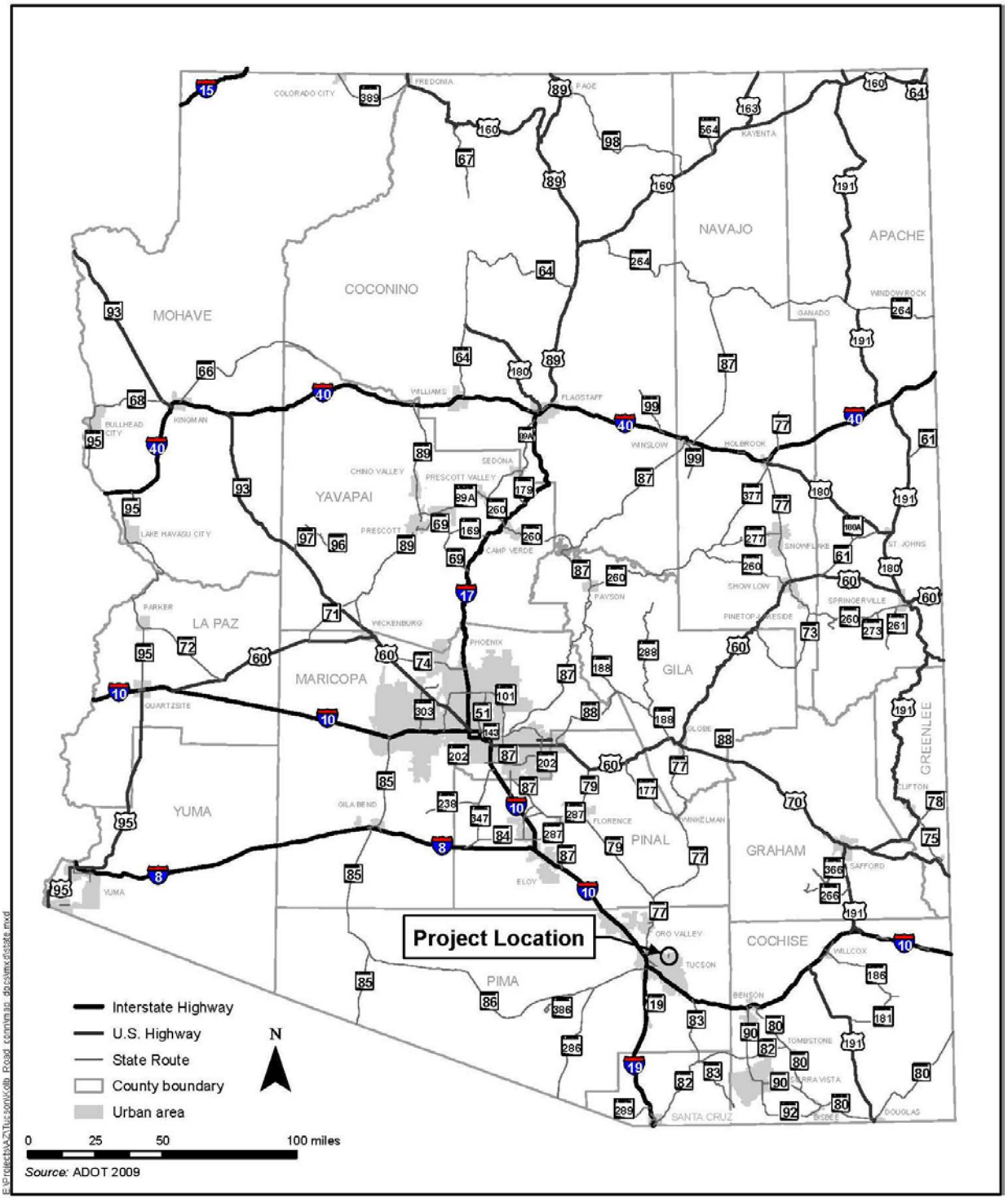
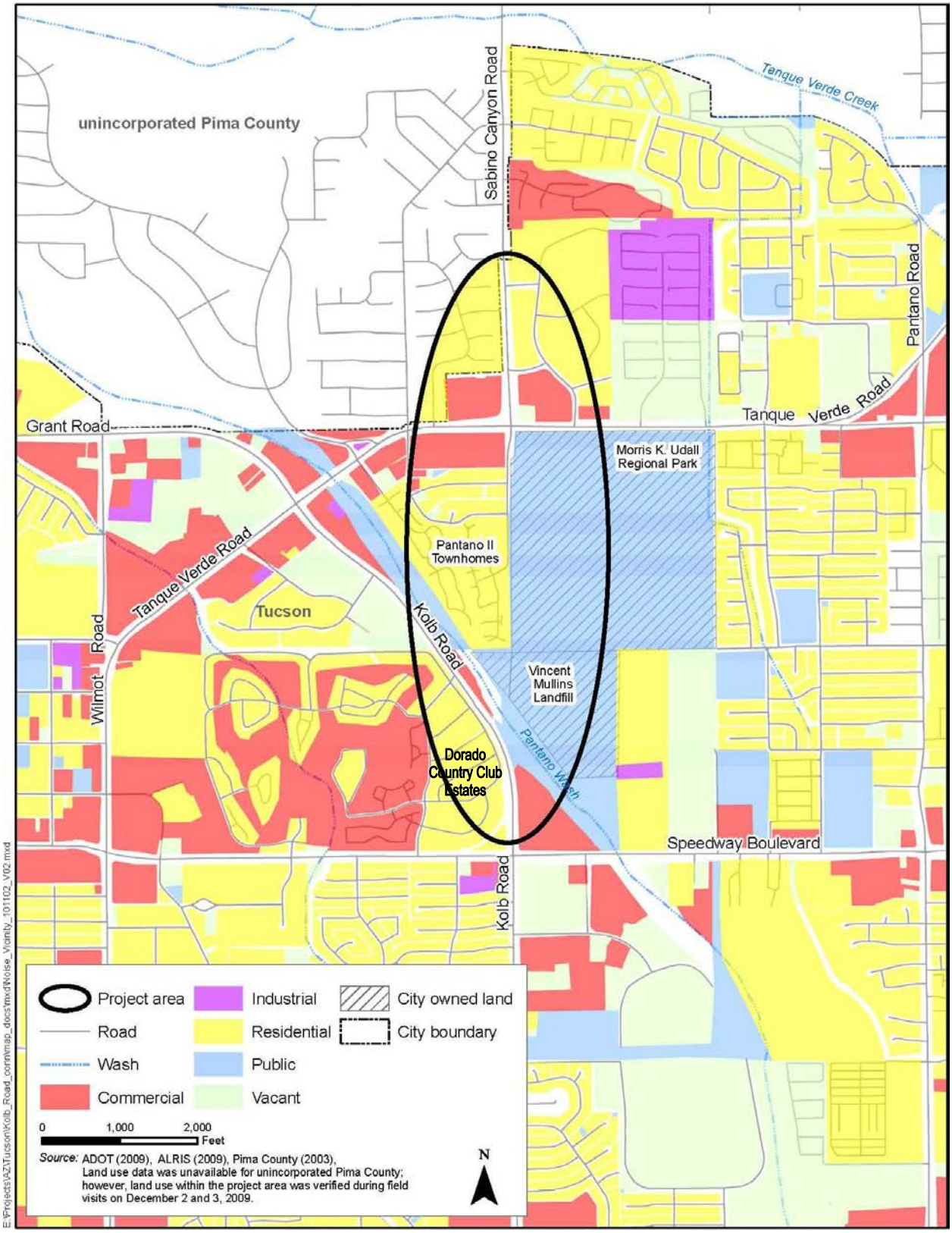


Figure 2. Project vicinity



The closed Vincent Mullens landfill is located south of the park and the Pantano II townhomes, and adjacent to the Pantano Wash, near the southern project terminus.

The residential neighborhood, Dorado Country Club Estates, is located west of Kolb Road at the proposed Kolb Road intersection with the new roadway. Commercial properties are located along the eastern side of Kolb Road near the proposed intersection.

1.3 Planned Project Improvements

The City of Tucson and FHWA propose to extend the existing Sabino Canyon Road from its current terminus near Udall Park to intersect with Kolb Road north of Speedway Boulevard. The project will involve:

- constructing a new four-lane road connecting the existing Sabino Canyon Road to Kolb Road
- reconstructing the Sabino Canyon Road and Tanque Verde Road intersection to accommodate the improved Sabino Canyon Road
- widening the existing Sabino Canyon Road north of Tanque Verde Road to accommodate the new road design
- relocating the existing two-bay bus pullout situated at the southeastern corner of Sabino Canyon Road and Tanque Verde Road
- constructing a bridge of the same travel lane, multiuse lane, and median configuration to carry the proposed road over Pantano Wash
- constructing an intersection at the proposed Sabino Canyon Road terminus at Kolb Road
- constructing multiuse paths, pedestrian signals, and other pedestrian and bicycle facilities providing access to Udall Park and the Pantano Wash Linear Park that is currently under construction

The proposed project would be implemented as two independent projects. The Sabino Canyon/Tanque Verde Intersection Improvements project (intersection improvements) was constructed in 2012 and involves reconstructing the intersection of Tanque Verde and Sabino Canyon Roads and relocating the existing two-bay bus pullout. The intersection improvements extend from approximately 1,500 feet north of the intersection of Tanque Verde and Sabino Canyon Roads south to the entrance of Udall Park at Crestline Drive and approximately 600 feet east and approximately 100 feet west from Sabino Canyon Road along Tanque Verde Road. The intersection improvements have been implemented by the City of Tucson and funded through the Regional Transportation Authority (RTA).

The connection project, which is the focus of this noise analysis, would involve constructing the new Sabino Canyon Road connection from approximately 300 feet south of the intersection of Tanque Verde and Sabino Canyon Roads to the south for approximately 0.5 mile to connect with Kolb Road north of Speedway Boulevard. The improvements would also encompass approximately 1,000 feet north and south of the proposed intersection with Sabino Canyon Road, along Kolb Road. Phase II improvements would be funded by FHWA (through federal Surface Transportation Funds), the RTA, and other local funding sources. The project's design is developed to accommodate projected traffic volumes for 2030.

2 Methods

A new or expanded roadway will increase traffic-generated noise in the surrounding area. 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 the Arizona Department of Transportation (ADOT).

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 examined 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*). Four conditions were modeled using TNM 2.5. The model estimated the peak-hour traffic noise levels for:

- existing condition (2009)
- projected no-build condition (2030)
- projected build condition without noise mitigation (2030)
- projected condition with noise barriers as mitigation (2030)

The 2030 projected conditions were compared with the criteria established in ADOT's *Noise Abatement Policy* (NAP) 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 barriers, including residential privacy walls, were included in the model. Existing and future roadway and residential elevations were provided by Psomas Engineering, Inc.[1] 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.

[1] Existing elevation contours were provided in digital file "c-kc01tb.dwg" on April 26, 2010, and a future elevation profile was provided in digital file "c-kc01pb.dwg" on October 29, 2010.

The vehicles were classified as automobiles (including motorcycles and two-axle vehicles such as passenger cars, pickup trucks, and vans), medium trucks (three-axle vehicles and city buses), and heavy trucks (four- or more-axle vehicles). 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 Criteria (NAC)

Title 23 Code of Federal Regulations, Part 772 (23 CFR 772), entitled *Procedures for Abatement of Highway Traffic Noise and Construction Noise* (FHWA NAC), and ADOT's NAP (ADOT 2011), were used for this study. These policies and criteria were developed to provide procedures for noise studies and noise abatement measures.

The FHWA NAC delineates noise-sensitive areas by land use categories and the noise levels in A-weighted decibels 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.

The FHWA NAC allows 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.

ADOT's NAP defines "approach" as within 3 dBA of the NAC for categories A, B, C, D, and E (e.g., noise levels of 64 dBA or higher for residential land uses will be considered for abatement). There is no noise impact threshold for Category F and G locations. Additionally, ADOT's NAP defines "substantially exceed" as a 15-dBA increase.

Table 1. FHWA noise abatement criteria (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)	Residential

[2] See the Web site, <www.fhwa.dot.gov/publications/publicroads/02mar/07.cfm>, accessed on June 17, 2010.

Land use category	NAC ($dBA L_{eq}$)	Description of land use category
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 studios, recording studios, schools, and television studios
E	72 (exterior)	Hotels, motels, offices, restaurants/bars, and other developed lands, properties or activities not included in A–D or F
F	—	Agriculture, airports, bus yards, emergency services, industrial, logging, maintenance facilities, manufacturing, mining, rail yards, retail facilities, shipyards, utilities (water resources, water treatment, electrical), and warehousing
G	—	Undeveloped lands that are not permitted

Source: 23 CFR 772

Land use categories known to occur within the project area are category B (residences), category C (a park), category E (restaurants), and category F (retail facilities). If noise levels at the category B, C, or E properties are predicted to warrant consideration for abatement, noise abatement measures must be feasible, reasonable, and desired by the affected individuals. 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 ADOT believes mitigation measures are prudent, based on consideration of the following conditions:

- The cost of the noise abatement shall not exceed $49,000 per benefited receiver.[3]
- The noise barrier will generally benefit more than one sensitive property.
- The noise barrier should be designed to reduce noise levels by at least 7 dBA for at least half of the first row receivers.
- The noise barrier should not be more than 20 feet in height.

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

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

[3] The cost of abatement was calculated using $35 per square foot, consistent with ADOT's 2011 NAP.

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.

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 project 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 (2009) and design year (2030) traffic volumes for the no-build and build conditions were obtained from the *Initial Traffic Engineering Report: Kolb Road/Sabino Canyon Road Connection Tucson, Arizona* (Psomas 2009). Traffic volumes and speeds used in the modeling for this project represent "worst case" peak-hour or LOS C traffic conditions. Vehicle mix, based on classification counts from February 2, 2010, and proposed speed limits were obtained by personal communication with Psomas (February 2010). 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 Potential Noise Abatement Measures

A number of noise abatement measures are available that may be applied independently or in combination to reduce or eliminate noise impacts. These involve elements of the roadway design, restrictions on the use of roadway, as well as construction of noise barriers. These noise abatement measures are introduced below and are discussed in relation to the project in Section 5.3 and Table 6.

Roadway Design

Roadway design measures include altering the roadway alignment or depressing roadway sections. Altering the roadway alignment could involve realigning the roadway along a new centerline to move the roadway away from a sensitive receiver. Depressing the roadway lowers the roadway below grade, also moving traffic farther away from affected receivers.

Traffic Management

Traffic management measures include restricting truck traffic entirely or during certain hours of the day and reducing the posted speed limit. Both strategies would reduce the noise levels at adjacent properties

because trucks produce more noise than automobiles and because higher vehicle speeds generate more noise than lower vehicle speeds (FHWA 1976).

Noise Barriers

Construction of noise barriers between the roadways and the affected receivers reduces noise levels by physically blocking the transmission of traffic-generated noise. Barriers can be constructed as walls or earthen berms. Noise barriers should be high enough to break the line-of-sight between the noise source and the receiver. They must also be long enough to prevent noise from transmitting around the ends of the barrier. Openings in a barrier, for driveways or sidewalks, can significantly reduce the barrier's effectiveness. Earthen berms require more R/W than do walls. They are usually constructed at a 3-to-1 slope in each direction. Thus, a berm 8 feet high would slope 24 feet in each direction, for a total width of 48 feet.

2.6 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 land uses 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 yards, 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 above ground.
- 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 TNM 2.5 Noise Model Validation

Traffic noise measurements were taken at six 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, Receiver Locations, and Potential Barrier Locations*). Roadway geometry and topography, traffic volumes, existing barriers, 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 December 2 and 3, 2009, 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 December 2 and 3, 2009

Meteorological attribute	Condition
Temperature	≅ 42° to 69° Fahrenheit
Humidity	≅ 26 to 55 percent
Wind	≅ 0 to 2 miles per hour
Weather conditions	Clear to partly cloudy

Noise monitoring was conducted using a Larson Davis 812 (SLM) Type I integrating sound level meter. The meter and calibrator were laboratory calibrated and tested for accuracy on April 7, 2009. 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. 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 conduct of the study.
- 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 the nearest visible major arterial road (Sabino Canyon Road or Kolb Road) during each of the noise measurement readings. For monitoring sites not adjacent to Sabino Canyon Road or Kolb Road, traffic data were collected from the local road most affecting ambient noise levels at that site. 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)
Sabino Canyon Road, north of Tanque Verde Road	a.m.	3,270	3,194	66	10	40
	p.m.	3,254	3,212	24	18	40
Sabino Canyon Road, Tanque Verde Road to the entrance of Udall Park	a.m.	16	14	0	2	20
	p.m.	16	14	0	2	20
Sabino Canyon Road, south of Redbud Road	a.m.	0	0	0	0	n/a
	p.m.	4	4	0	0	15
Camino Sabadell	a.m.	0	0	0	0	n/a
	p.m.	4	4	0	0	15
Kolb Road, Tanque Verde Road to Speedway Boulevard	a.m.	2,734	2,684	42	8	40
	p.m.	3,320	3,298	14	8	40

The results of the field monitoring 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. 7080 Taos Place – approximately 95 feet from the Sabino Canyon Road centerline	a.m.	71	68	-3
	p.m.	67	68	+1
2. 7043 Redbud Road – approximately 240 feet from the Sabino Canyon Road centerline	a.m.	52	49	-3
	p.m.	53	49	-4
3. (a.m.) Alley between 7057 Crestline Drive and 7058 E. Redbud Road – approximately 50 feet from the Sabino Canyon Road centerline	a.m.	47	50	+3
	p.m.	n/a	n/a	n/a
3. (p.m.) 2001 Sabino Canyon Road – approximately 50 feet from the Sabino Canyon Road centerline	a.m.	n/a	n/a	n/a
	p.m.	51	49	-2
4. 1872 Camino Sabadell – approximately 375 feet from the Sabino Canyon Road centerline and 1,155 feet from the Kolb Road centerline	a.m.	44	50	+6
	p.m.	48	51	+3
5. Morris K. Udall Regional Park baseball field – approximately 235 feet from the Sabino Canyon Road centerline	a.m.	48	49	+1
	p.m.	47	49	+2
6. 7042 Calle Hermosa – approximately 130 feet from the Kolb Road centerline	a.m.	60	58	-2
	p.m.	61	59	-2

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, Receiver Locations, and Potential Barrier Locations,* for the location of each monitoring site in the project area.

For monitoring sites adjacent to the existing and proposed Sabino Canyon Road, ambient noise levels ranged from 44 dBA L_{eq1h} to 71 dBA L_{eq1h}. Monitoring site 4 was approximately 375 feet south of the existing Sabino Canyon Road terminus. Monitoring sites 1, 2, 3, and 5 ranged from 50 to 235 feet from Sabino Canyon Road. An alternate location was chosen for site 3 during the a.m. monitoring period to avoid construction noise not associated with the project. The p.m. location was selected to be equidistant from Sabino Canyon Road as the a.m. location. Monitoring site 6 was located in the neighborhood adjacent to Kolb Road (Dorado Country Club Estates), near the proposed Sabino Canyon Road and Kolb Road intersection. The site was approximately 130 feet from Kolb Road. Ambient noise at this location was 60 dBA L_{eq1h} during the morning reading and 61 dBA L_{eq1h} during the evening reading.

TNM 2.5 predicted existing peak-hour a.m. and p.m. noise levels within 3 dBA of the monitoring noise levels at monitoring sites 1, 3, 5, and 6. This is within an acceptable range of accuracy for TNM 2.5 to predict existing and future traffic noise levels at these locations.

The p.m. predicted noise level at monitoring site 2 was 4 dBA less than the ambient noise level. This site was directly adjacent to a commercial shopping center, and approximately 530 feet south of the six-lane arterial road, Tanque Verde Road. Sabino Canyon Road is a two-lane road approximately 235 feet east of monitoring site 2. At this location, Tanque Verde Road is the primary source for traffic noise levels, not Sabino Canyon Road. Ambient noise at this location is also affected by the proximity to a commercial shopping center.

The a.m. predicted noise level at monitoring site 4 was 6 dBA greater than the ambient noise level. This site was not directly adjacent to an arterial road, but was chosen for its proximity to the proposed Sabino Canyon Road. TNM 2.5 loses predicting accuracy as the receiver is located farther away from the noise source. Additionally, ambient traffic noise at this location was likely a combination of Kolb Road, Sabino Canyon Road, and local traffic affecting the ability of TNM 2.5 to accurately predict traffic noise levels solely from Sabino Canyon Road. In this case, TNM 2.5 predicted traffic noise levels higher than the ambient levels, showing that the predictions at this location are conservative.

4 Existing Noise Environment

4.1 Description of Evaluated Properties

Properties within the project area are residential properties, Udall Park, restaurants, and retail facilities. The residential properties included in the traffic noise study were the single-family residential properties adjacent to Sabino Canyon Road (Receivers 1–8, 13–16, 19, and 20), the Pantano II townhome properties adjacent to the proposed road (Receivers 21–24), and the single-family properties in Dorado Country Club Estates closest to Kolb Road (Receivers 26–32). Second-row residential properties in Indian Ridge Estates (Receivers 1s–5s) were included in the noise study. At Udall Park, a picnic area (Receiver 17a), baseball field (Receiver 17b), and the location of a proposed amphitheatre (Receiver 18) were included in the study. Restaurant and retail properties in the project area were also evaluated in the traffic noise study. The Gaslight Square Shopping Center (Receivers 8 and 10), Tanque Verde Shopping Center (Receivers 9 and 11), and Colonia Verde Shopping Center (Receiver 12) are located at the Sabino Canyon Road and Tanque Verde Road intersection. Office buildings along the eastern side of Kolb Road are located near the proposed Sabino Canyon Road intersection with Kolb Road and were included in the study (Receiver 25). Retail properties located at the Kolb Road intersection with Speedway Boulevard were also included in the study (Receiver 33). Refer to Appendix A, *Monitoring Sites, Receiver Locations, and Potential Barrier 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 and fences within the project area 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, Receiver Locations, and Potential Barrier Locations*, for a detailed map showing the streets described below):

- 6-foot block wall located along the eastern side of Sabino Canyon Road between Portal Airosa and Camino Bacelar
- 6-foot block wall at 7080 Acoma Place
- 6-foot block wall at 7080 and 7081 Opatas Place
- 5-foot block wall along the northern property line of the Gaslight Square Shopping Center
- 5.5- to 6-foot block wall with two driveway openings at 2001 Sabino Canyon Road
- 5- to 6-foot block wall located along the western side of Kolb Road between the commercial properties at 1849 Kolb Road and Speedway Boulevard

4.2 Existing Noise Levels

Existing noise levels were modeled using TNM 2.5 for each of the 41 receiver locations. Predicted existing peak-hour noise levels within the project area ranged from 47 dBA L_{eq1h} to 69 dBA L_{eq1h} at the receivers (see Appendix D, *Noise Analysis Summary*).

The model's results show that noise levels at three receiver locations exceed ADOT's noise threshold criteria for the 2009 existing conditions. Receivers 1 and 4—representing 7080 Acoma Place, 7080 and 7081 Taos Place, and 7081 Opatas Place—experience traffic noise levels of 68 dBA L_{eq1h} under existing conditions. Receiver 7—representing 7080 Opatas Place—experiences traffic noise levels of 64 dBA L_{eq1h} under existing conditions.

5 Future Conditions

5.1 Future Noise Levels

Future (2030) peak-hour noise levels were modeled using TNM 2.5 at the 41 receiver locations for the no-build condition and the proposed build condition. Future noise levels were compared to existing noise levels and ADOT'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.

By 2030, properties adjacent to Sabino Canyon Road, first-row properties north of the Tanque Verde Road intersection (Receivers 1–11), are expected to experience a 1- to 2-dBA increase in traffic noise levels over 2009 noise levels under the no-build condition and under the build condition. This increase is barely perceptible by the human ear (FHWA 1995). The second-row properties (Receivers 1s–5s) are expected to experience a 0- to 1-dBA reduction in traffic noise levels over existing under the no-build condition and no change from existing traffic noise levels under the build condition.

Properties adjacent to the proposed Sabino Canyon Road improvements south of Tanque Verde Road (Receivers 12–25) will experience a 1- to 2-dBA increase in traffic noise levels by 2030 under the no-build condition; however, the proposed build condition is expected to result in traffic noise increasing between 4 and 15 dBA at these locations. Noise-sensitive properties in the Dorado Country Club Estates west of Kolb Road (Receivers 26–32) are expected to experience a 1-dBA increase in traffic noise levels under the no-build condition and a 0- to 1-dBA increase under the proposed build condition. The

commercial properties at the Kolb Road and Speedway Boulevard intersection would experience a 1-dBA increase in traffic noise levels over existing noise levels under the no-build condition and under the proposed build condition.

5.2 Noise Impact Analysis

The 41 receiver locations were evaluated for traffic noise impacts resulting from the proposed build 2030 peak-hour conditions. The following criteria designate a noise impact according to the ADOT's policy:

- The predicted design year (2030) noise level approaches (falls within 3 dBA of) or exceeds 67 dBA for the Category B properties (residential), Category C (park) properties, and Category E (restaurants) properties.
- There is no noise impact threshold for Category F (retail) or Category G (undeveloped) 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.

Abatement measures must be considered for noise-sensitive properties meeting these criteria.

Predicted noise levels for the evaluated future conditions (2030) were below the NAP threshold for 28 of the 41 receivers. The predicted noise levels exceeded the NAP threshold at eleven receivers: three receivers representing five residential properties west of and adjacent to Sabino Canyon Road, north of Tanque Verde Road; two receivers representing two residential properties west of and adjacent to Sabino Canyon Road, south of Tanque Verde Road; one receiver representing 28 equivalent receivers at the baseball field at Udall Park; four receivers representing 19 residential properties in the Pantano II neighborhood (see Appendix D, *Noise Analysis Summary*), and one receiver representing an office complex (category E) on the northern side of the future intersection of Kolb and Sabino Canyon Roads. No restaurant or retail facilities were predicted to meet or exceed ADOT's NAP threshold at category E and F land use properties. The predicted noise levels did not meet or exceed ADOT's NAP threshold for residential properties at the second-row receivers evaluated in Indian Ridge Estates (Receivers 1s–5s).

5.3 Evaluation of Noise Abatement Measures

Several noise abatement measures may be considered by the City of Tucson and FHWA as a means to reduce or eliminate traffic noise impacts associated with the proposed Kolb Road connection with Sabino Canyon Road. The discussion of these measures in this report does not obligate the City of Tucson to implement them.

Predicted future (2030) noise levels identified traffic noise impacts to 24 residential properties, the baseball field at Udall Park, and an office building. Noise abatement measures were evaluated for these receivers. These measures were introduced in Section 2.5, *Potential Noise Abatement Measures*. They have been individually analyzed for feasibility, reasonability, and desirable qualities as they relate to this project. This analysis is presented in Table 6.

Table 6. Analysis of potential noise abatement measures

Mitigation	Feasibility	Reasonability
Roadway alignment changes	Design plans can be developed to shift roadway away from the sensitive receivers on one side.	May be reasonable where changing the roadway alignment can move traffic far enough away from sensitive receivers to achieve an adequate noise reduction. Project planning has moved the roadway alignment as far to the east as possible without requiring acquisitions in Udall Park. Park acquisitions are discouraged by Section 4(f) of the Department of Transportation Act (23 CFR 774).
Truck restrictions	May be feasible if surrounding arterial roads are designed to handle additional truck traffic. However, it is not feasible because displacing the truck traffic may conflict with the planned function of the roadway. An arterial road such as Sabino Canyon Road generally carries truck traffic.	May be reasonable if an adequate noise reduction can be achieved. However, it is unlikely that the level of truck traffic on Sabino Canyon Road is high enough for truck restrictions to be effective in reducing noise levels. Displacing truck traffic may shift noise impacts to another area.
Noise walls	Not feasible where the walls would limit sight distances for motorists.	May be reasonable where noise reduction is adequate and cost effective.
Earthen berms	Not feasible to construct berms within the space limitations of Sabino Canyon Road.	May be reasonable where noise reduction is adequate and cost effective. Not reasonable where homes would need to be removed to provide the necessary space and the required costs would be unreasonable, or if park property would be acquired.

Based on this evaluation, noise barriers (walls) are the most reasonable and feasible form of noise mitigation for the proposed project.

The City of Tucson will apply rubberized asphalt to the improved roadway. Although rubberized asphalt may result in a 3-dBA or greater reduction in traffic noise levels, 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.

5.4 Noise Abatement Evaluation

Noise levels at receiver 25, which is an office building north of the future intersection of Kolb Road and the extended Sabino Canyon Road, result primarily from traffic on Kolb Road. As shown in Appendix D, *Noise Analysis Summary*, predicted future build condition noise levels are the same as the no-build condition noise levels, and both are only 1 dBA higher than existing noise levels. This demonstrates that the project does not contribute to the projected noise impact at this category E office building. Also, any noise abatement feature incorporated into the project along Sabino Canyon Road would not provide any noise reduction at this receiver. Therefore, in accordance with the acoustic feasibility provisions contained in Section 7(b) of the 2011 ADOT NAP, noise abatement is not feasible for the offices represented by receiver 25.

Twelve receivers (Receivers 1, 4A, 4B, 7A, 7B, 13, 14, 17a, and 26–32) representing 25 noise-sensitive properties warrant consideration for traffic noise abatement. Five noise barriers were evaluated for effectiveness in reducing traffic noise levels by 7 dBA for at least half of first row. Appendix E, *Evaluation of Noise Barriers as Mitigation*, describes the noise reduction resulting from constructing noise barriers as mitigation and the barrier dimensions required to reach the reduction. ADOT's NAP

does not consider it reasonable to construct barriers exceeding $49,000 per benefited property. Consistent with ADOT's NAP, the cost per benefited property was calculated using $35 per square foot of barrier, and a benefited property is one that receives at least a 5-dBA reduction from the barrier.

- Barrier 1 is located on the western side of Sabino Canyon Road, between Acoma Place and the Gaslight Square Shopping Center. This barrier meets ADOT criteria and would benefit five residential properties, at an approximate cost of $44,604 per property. This barrier, however, was rejected by the homeowners who would have benefited by the barrier. According to ADOT's NAP, property owners benefiting from the barrier may vote to reject the barrier. As a result of the property owners' preferences, Barrier 1 is eliminated from consideration.
- Barrier 2 is located along the western side of the proposed Sabino Canyon Road, extending from the entrance to Redbud Road northward for approximately 148 feet. This barrier would benefit one residential property (7057 Redbud Road) at an approximate cost of $51,800.
- Barrier 3 is located along the western side of the proposed Sabino Canyon Road, extending from the entrance to Redbud Road southward for approximately 200 feet. This barrier would be located between the proposed Sabino Canyon Road and the existing Sabino Canyon Road frontage road. This barrier would reduce traffic noise levels at one property (7058 Redbud Road) by 4 dBA at an approximate cost of $84,000.
- Barriers 2 and 3 were reevaluated together as part of some neighborhood access options developed subsequent to the earlier Traffic Noise Report. Although Receiver 15 was not projected to experience a noise impact from the project, it was included in the reevaluation because it would receive some benefit from various options for Barrier 3. The redesigned Barriers 2 and 3 for Access Option 1 would benefit two residential properties (Receivers 13 and 15), at a cost of approximately $107,608 per property. The redesigned Barriers 2 and 3 for Access Option 2 would benefit only one residential property (Receiver 13), at a cost of $162,470.
- Barrier 4 is located along the eastern side of Sabino Canyon Road, extending from the entrance to Udall Park southward for approximately 570 feet. This barrier meets ADOT criteria and would benefit the patrons of the Udall Park baseball field at an approximate total cost of $199,500. Using ADOT's guidelines for calculating receivers and costs for non-residential land uses, which factors in type of use and use intensity, the average cost of this barrier would amount to $7,125 per receiver. This cost meets ADOT criteria for cost-effectiveness. Barrier 4 is supported by the City of Tucson Parks and Recreation Department, which operates the park.
- Barrier 5 is located between the Sabino Canyon Road terminus and the Vincent Mullins landfill. This barrier meets ADOT criteria and would benefit 19 residential properties at an approximate cost of $22,216 per property.

Barriers 2 and 3 were evaluated for effectiveness in providing traffic noise abatement to residential properties 7057 and 7058 Redbud Road (Receivers 13 and 14). Predicted traffic noise levels at Receiver 15 (63 dBA L_{eq1h}) did not warrant consideration for noise abatement, but the receiver was included in the evaluations because it would benefit from Barrier 3. Receivers 13 and 14 are separated by Redbud Road, so two barriers were evaluated. Barrier 3 was evaluated for placement in the median between the proposed Sabino Canyon Road and the existing Sabino Canyon Road frontage road to provide abatement to Receiver 14, and Barrier 2 was evaluated for placement west of Sabino Canyon Road, north of Redbud Road. In both the original evaluations and the subsequent evaluations, the noise

barriers were unable to provide a 5- to 7-dBA noise reduction without exceeding the cost per benefited receiver and, therefore, are not recommended for construction as traffic noise barriers.

The two barriers meeting ADOT's criteria (Barriers 4 and 5) would amount to approximately 17,760 square feet of barrier. At $35 per square foot, the total cost of noise mitigation would be approximately $621,600. Please refer to Appendix A, *Monitoring Sites, Receiver Locations, Potential Barrier Locations,* for the locations of the potential barriers.

6 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.

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. Construction-related noise impacts would be temporary and would cease at the completion of construction. Construction noise would be minimized to the greatest extent practicable.

The City of Tucson will apply the following standard specifications consistent with ADOT's *Standard Specifications for Road and Bridge Construction*, Section 104.08 (2008):

- The contractor shall comply with all local sound control and noise level rules, regulations, and ordinances that apply to any work performed 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 of a type recommended by the manufacturer. No internal combustion engine shall be operated on the work without its muffler being in good working condition.

7 Conclusions and Recommendations

Noise mitigation for the Kolb Road: Connection to Sabino Canyon Road project has been evaluated in this report. Potential mitigation measures were evaluated for reasonability and feasibility with consideration of the existing conditions of the project area and the proposed roadway design. The most reasonable and feasible mitigation measures for this project are the construction of noise walls where they meet ADOT's NAP. The City of Tucson 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, and the anticipated reduction in traffic noise levels from the use of rubberized asphalt was not considered in the noise abatement evaluation.

Future noise levels were predicted using TNM 2.5 for the no-build and proposed build conditions—see Appendix F, *Traffic Noise Model (TNM 2.5) Output Files*. An increase in noise levels for the design year (2030) proposed build condition is expected to range from 0 dBA to 15 dBA above existing noise levels. Noise impacts resulting from the proposed build alternative were evaluated for traffic noise abatement.

Three noise walls meet the reasonability criteria of ADOT's NAP; however, one of those walls was rejected by the homeowners. The remaining two walls would benefit 19 individual residences at Pantano Townhomes II and 28 equivalent receivers representing the patrons of Udall Park at an approximate cost of $621,600, and they are recommended. The Udall Park wall is supported by the City of Tucson.

Construction-related noise would be minimized to the greatest extent practicable. The contractor will be responsible for complying with all local sound control and noise level rules, regulations, and ordinances that apply to any work performed pursuant to the contract. Additionally, each internal combustion engine used for any purpose on the work or related to the work shall be equipped with a muffler of a type recommended by the manufacturer. No internal combustion engine shall be operated on the work without its muffler being in good working condition.

The results of the traffic noise study are based on the final design plans available at the time of the study (75% plans). Actual wall lengths may need to be adjusted to accommodate safety requirements, such as ensuring the barriers do not obscure sight distance needed for drivers. A final decision on the installation of the barriers would be made by ADOT and the City of Tucson in conjunction with the public/agency involvement process.

8 References

Arizona Department of Transportation (ADOT). 2008. *Standard Specifications for Road and Bridge Construction*.

———. 2011. *Arizona Department of Transportation Noise Abatement Policy*.

Psomas. 2009. *Initial Traffic Engineering Report: Kolb Road/Sabino Canyon Road Connection Tucson, Arizona*.

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.

———. 1995. *Highway Traffic Noise Analysis and Abatement, Policy and Guidance*.

———. 1996. *Measurement of Highway-Related Noise*. FHWA Report Number FHWA-PD-96-046.

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

9 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.

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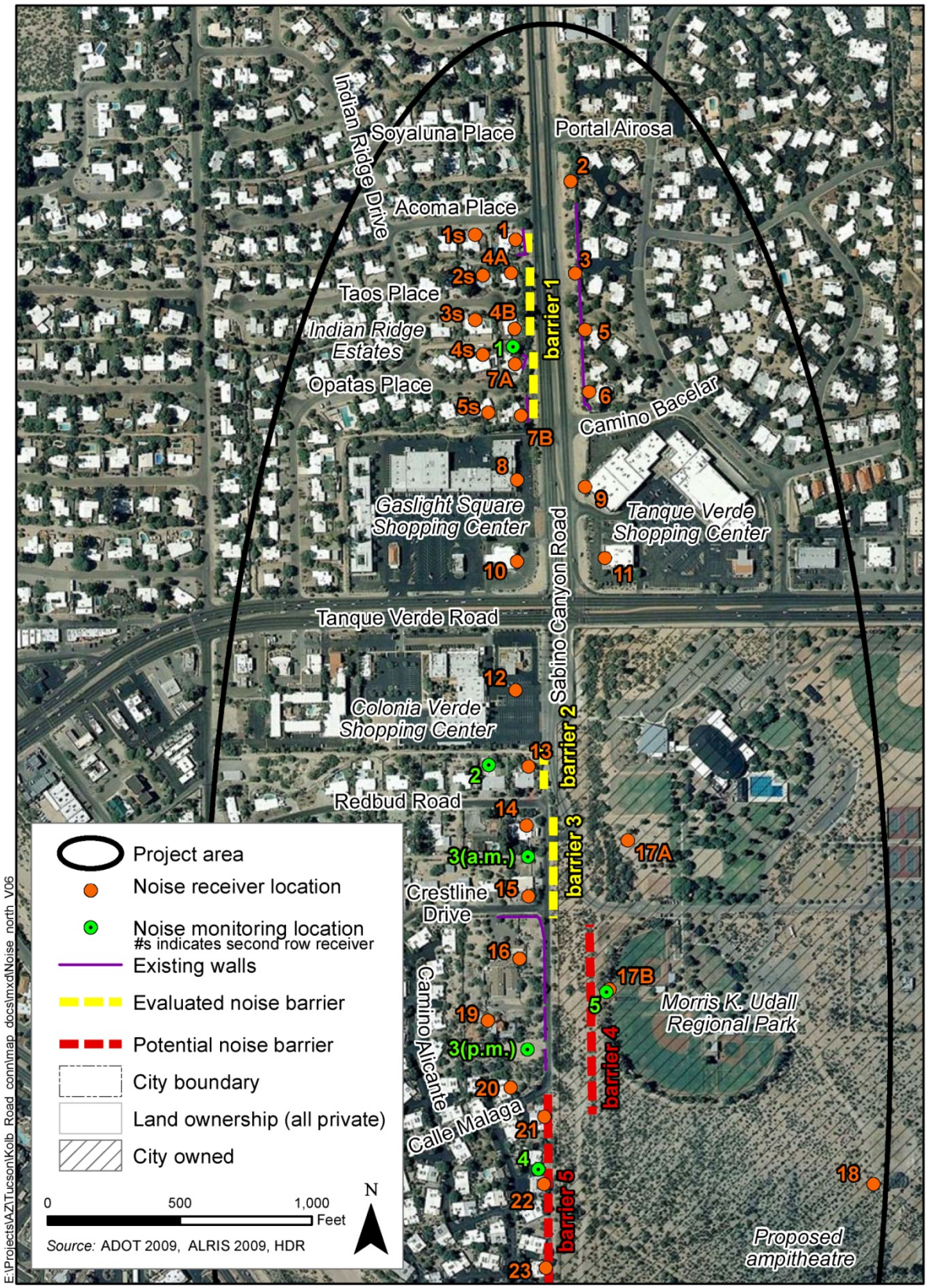
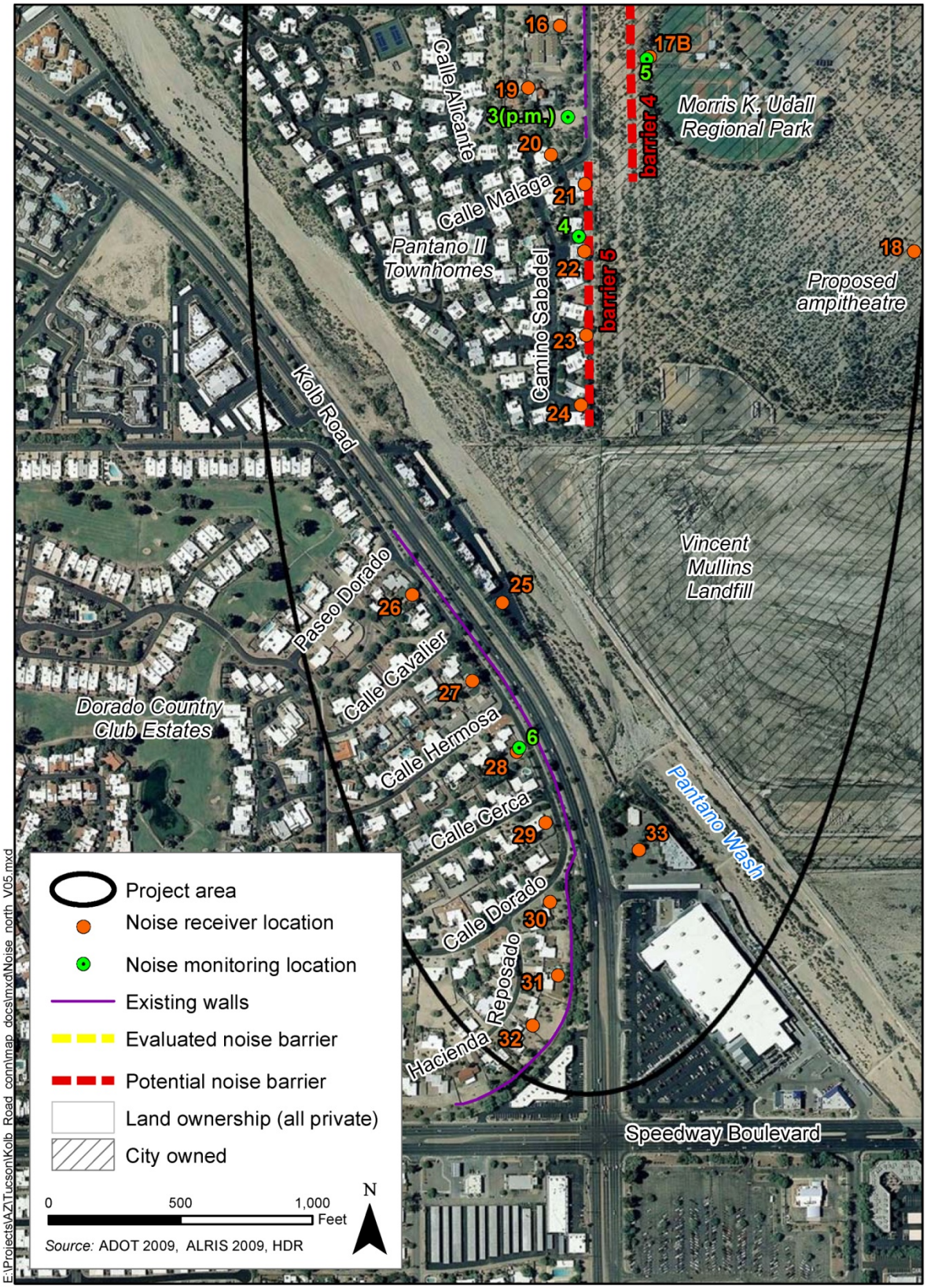
Appendix A

Monitoring Sites, Receiver Locations, and Potential Barrier Locations

MONITORING SITES, RECEIVER LOCATIONS, AND POTENTIAL BARRIER LOCATIONS – NORTH



MONITORING SITES, RECEIVER LOCATIONS, AND POTENTIAL BARRIER LOCATIONS – SOUTH



Appendix B

Traffic Data

Traffic Data

Existing and projected traffic volumes were obtained from the *Initial Traffic Engineering Report; Kolb Road/Sabino Canyon Road Connection Tucson, Arizona*, October 2009. Existing peak-hour traffic volumes are as follows:

Table B-1. 2009 existing peak-hour traffic volumes

Location	Northbound vehicles	Southbound vehicles
Sabino Canyon Road, north of Tanque Verde Road	1,980	1,728
Sabino Canyon Road, south of Tanque Verde Road	191	170
Kolb Road, Tanque Verde Road to Speedway Boulevard	1,393	1,550

Source: Psomas (2009)

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.

Table B-2. 2030 forecast no-build condition peak-hour traffic volumes

Location	Northbound vehicles	Southbound vehicles
Sabino Canyon Road, north of Tanque Verde Road	2,491	2,174
Sabino Canyon Road, south of Tanque Verde Road	240	214
Kolb Road, Tanque Verde Road to Speedway Boulevard	1,745	1,950

Source: Psomas (2009)

Table B-3. 2030 forecast proposed build condition peak-hour traffic volumes

Location	Northbound vehicles	Southbound vehicles
Sabino Canyon Road, north of Tanque Verde Road	2,489	2,174
Sabino Canyon Road, south of Tanque Verde Road	943	953
Kolb Road, Tanque Verde Road to proposed Sabino Canyon Road	1,171	1,394
Kolb Road, proposed Sabino Canyon Road to Speedway Boulevard	1,897	2,295

Source: Psomas (2009)

The vehicle mix was measured in February 2010.

Table B-4. Vehicle mix

Location	Vehicle class type percentage		
	Automobiles	Medium trucks	Heavy trucks
Project area	98	1	1

Source: Personal communication with Psomas on February 5, 2010

Table B-5. Traffic speeds

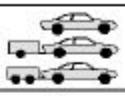
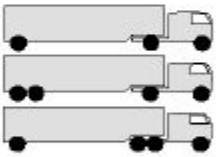
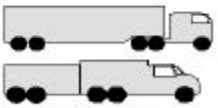
Location	Existing	No-build (2030)	Build (2030)
Sabino Canyon Road, north of Tanque Verde Road	45 mph	45 mph	45 mph
Sabino Canyon Road, south of Tanque Verde Road	25 mph	25 mph	40 mph
Kolb Road, Tanque Verde Road to Speedway Boulevard	40 mph	40 mph	40 mph

Source: Personal communication with Psomas on March 22, 2010

Table B-6. Vehicle classification field counts

SABINO CANYON RD NORTH OF TANQUE VERDE RD

Classification Count on 02/02/10

Class	Type	Vehicle Type		Class Percentage
1	Cars		Motorcycles	0.11%
2			Passenger cars, cars with 1- or 2-axle trailers	78.61%
3	LT (Light Truck)		Pick-ups, vans	19.25%
4	Bus		Buses	0.11%
5	MT (Medium Trucks)		2-axle Single Unit Truck	0.37%
6			3-axle Single Unit Truck	0.70%
7			4-axle Single Unit Truck	0.20%
8	TS (Tractor Semi-Trailer)		4 or fewer axle, single trailer	0.17%
9	TT (Tractor-Trailer)		5-axle single trailer	0.44%
10			6 or more axles, single trailer	0.03%
11	TST (Tractor Semi-Trailer Trailer)		5-axle multi-trailer	0.00%
12			6-axle multi-trailer	0.00%
			TOTAL	100.0%

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Appendix C

Field Monitoring Data Sheets

FIELD NOISE MEASUREMENT DATA

PROJECT: Kolb Road Connection to Sabino Canyon Road PROJ. # 111168

SITE IDENTIFICATION: monitoring site 1 OBSERVER(S): C. Bolm, C. Jacobs-Donoghue
START DATE / TIME: 12/2/2009 7:31 am END DATE / TIME: 12/2/2009 8:06 am
ADDRESS: Sabino Canyon Road, north of Tanque Verde Road

METEROLOGICAL CONDITIONS:
TEMP: 42.7 °F HUMIDITY: 33.4 %R.H. WIND: CALM (LIGHT) MODERATE VARIABLE
WINDSPEED: <1.0 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 71.7 dBA SPL WINDSCREEN Yes
↳ didn't use emitter to calibrate
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	7:31	7:41	70.8	82.7	62.5	67.0	70.4	73.2			
2	7:44	7:54	71.4	76.3	63.4	68.1	71.1	73.5			
3	7:56	8:06	70.5	79.9	60.0	66.2	70.0	72.7			

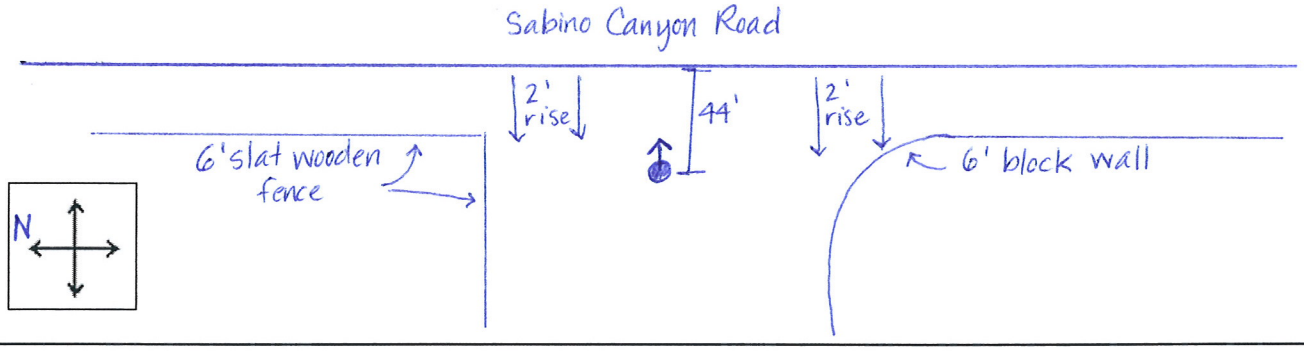
COMMENTS:

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

	#1 COUNT NB / EB	#1 COUNT 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:	697	900	40	40				
MED. TRUCKS:	19	14	40	40				
HVY TRUCKS:	4	1	40	40				
BUSES:								
MOTORCYCLES:								

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: 216 - W facing receiver, 217 - N in R/W, 218 - N facing meter, 219 - S facing meter, 220 - E. facing road
OTHER COMMENTS / SKETCH:



FIELD NOISE MEASUREMENT DATA

PROJECT: Kolb Road Connection to Sabino Canyon Road PROJ. # 111168

SITE IDENTIFICATION: monitoring site 1 OBSERVER(S): C. Bolm, C. Jacobs-Donoghue
START DATE / TIME: 12/2/2009 4:26 pm END DATE / TIME: 12/2/2009 5:05pm
ADDRESS: Sabino Canyon Road, north of Tanque Verde Road

METEROLOGICAL CONDITIONS:
TEMP: 61.5 °F HUMIDITY: 28.0 %R.H. WIND: (CALM) LIGHT MODERATE VARIABLE
WINDSPEED: <1.0 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 113.9 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	4:26	4:36	66.1	72.1	59.2	62.0	65.3	68.8			
2	4:42	4:52	67.2	77.6	56.5	61.9	66.4	70.3			
3	4:55	5:05	67.9	75.2	61.7	63.6	67.6	70.1			

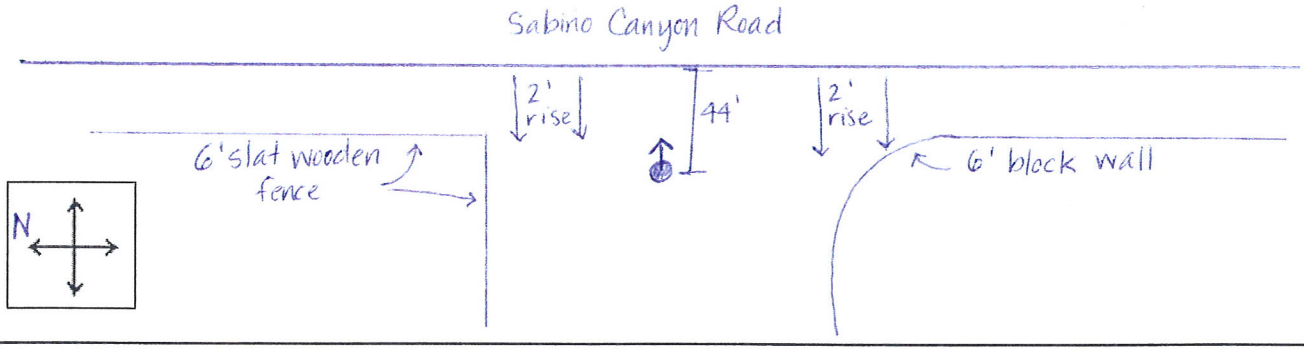
COMMENTS:

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

	#1 COUNT NB / EB	#1 COUNT 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:	832	774	40	40				
MED. TRUCKS:	5	7	40	40				
HVY TRUCKS:	6	3	40	40				
BUSES:								
MOTORCYCLES:								

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: 216 - W facing receiver, 217 - N in R/W, 218 - N facing meter, 219 - S facing meter, 220 - E facing road
OTHER COMMENTS / SKETCH:



FIELD NOISE MEASUREMENT DATA

PROJECT: Kolb Road Connection to Sabino Canyon Road PROJ. # 111168

SITE IDENTIFICATION: monitoring site 2 OBSERVER(S): C. Bolm, C. Jacobs, Donoghue
START DATE / TIME: 12/2/09 9:04 a.m. END DATE / TIME: 12/2 9:36
ADDRESS: 7043 Redbud Avenue

METEROLOGICAL CONDITIONS:
TEMP: 55.5 °F HUMIDITY: 31.0 %R.H. WIND: (CALM) LIGHT MODERATE VARIABLE
WINDSPEED: 0 MPH DIR: N/A 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 113.9 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	9:04	9:14	55.8	66.2	48.8	49.8	51.6	59.5			
2	9:15	9:25	51.4	63.9	45.9	47.5	49.3	52.3			
3	9:26	9:36	48.8	61.9	44.6	46.0	47.9	50.4			

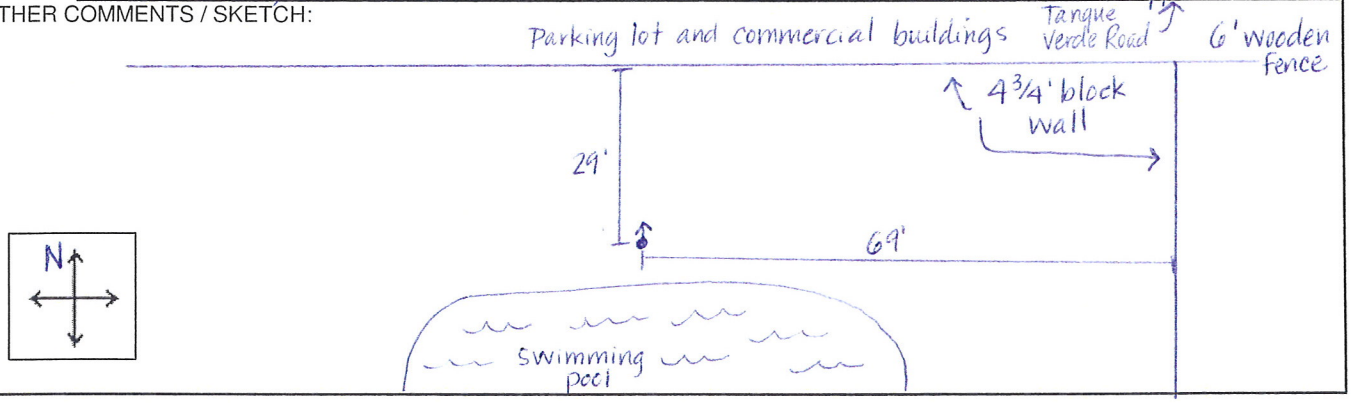
COMMENTS: Primary noise sources (traffic) were from Tanque Verde Road, and the commercial businesses - parking lot between the property and Tanque Verde. Traffic-related noises from Sabino Canyon Road were primarily associated with the bus/transit center. Idling buses were audible.

SOURCE INFO AND TRAFFIC COUNTS:
PRIMARY NOISE SOURCE: (TRAFFIC) AIRCRAFT RAIL INDUSTRIAL AMBIENT OTHER:
ROADWAY TYPE: N/A. The road has not yet been built.
TRAFFIC COUNT DURATION: -MIN

	#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:						
MED. TRUCKS:						
HVY TRUCKS:						
BUSES:						
MOTORCYCLES:						

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: 224 - West, 225 - east
OTHER COMMENTS / SKETCH:



FIELD NOISE MEASUREMENT DATA

PROJECT: Kolb Road Connection to Sabino Canyon Road PROJ. # 111168

SITE IDENTIFICATION: monitoring site 2 OBSERVER(S): C. Bolm, C. Jacobs, Donoghue
START DATE / TIME: 12/2/2009 5:22pm END DATE / TIME: 12/2/2009 5:55pm
ADDRESS: 7043 Redbud Avenue

METEROLOGICAL CONDITIONS:
TEMP: 57.2 °F HUMIDITY: 37.5 %R.H. WIND: (CALM) LIGHT MODERATE VARIABLE
WINDSPEED: 0 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 113.9 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	5:22	5:32	53.3	65.5	47.0	48.5	51.3	54.8			
2	5:34	5:44	53.2	67.1	47.9	50.1	52.2	54.5			
3	5:45	5:55	53.2	62.4	47.6	49.8	52.3	55.3			

COMMENTS: Primary traffic noise source is from Tanque Verde Road and the parking lots at the commercial businesses located between the Property and Tanque Verde Road. Traffic-related ~~business~~ noises from Sabino Canyon Road were largely associated with the bus/ transit center buses idling.

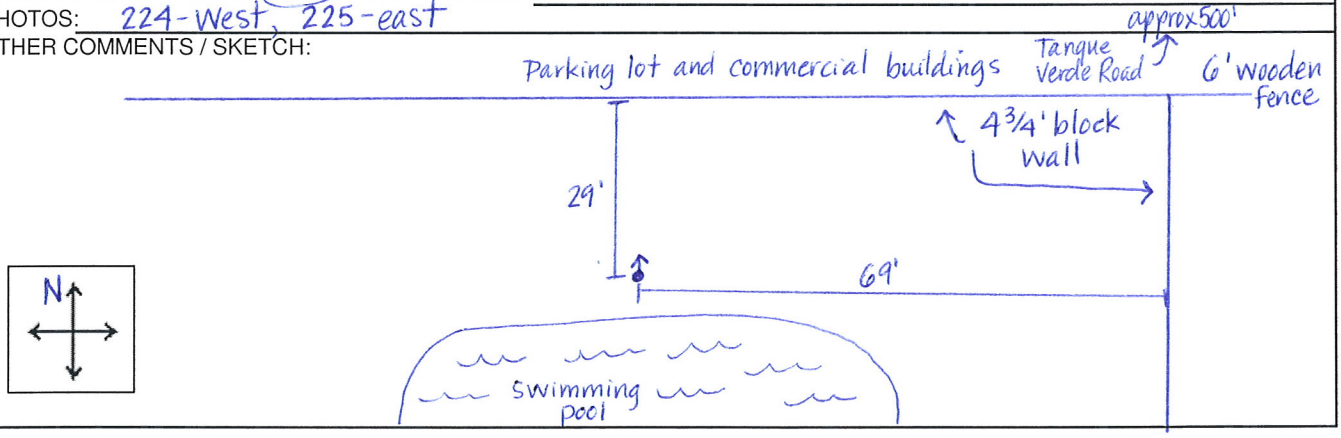
SOURCE INFO AND TRAFFIC COUNTS:
PRIMARY NOISE SOURCE: (TRAFFIC) AIRCRAFT RAIL INDUSTRIAL AMBIENT OTHER:
ROADWAY TYPE: N/A. The road has not yet been built.

TRAFFIC COUNT DURATION: ___-MIN	#1 COUNT		#1 SPEED		#2 COUNT		#2 SPEED	
	NB / EB	SB / WB	NB / EB	SB / WB	NB / EB	SB / WB	NB / EB	SB / WB
AUTOS:								
MED. TRUCKS:								
HVY TRUCKS:								
BUSES:								
MOTORCYCLES:								

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: 224-West, 225-east
OTHER COMMENTS / SKETCH:



FIELD NOISE MEASUREMENT DATA

PROJECT: Kolb / Sabino Canyon connection PROJ. # 111168

SITE IDENTIFICATION: 3 OBSERVER(S): C. Bolm, C. Jacobs-Donoghue
START DATE / TIME: 12/2 @ 9:54 am END DATE / TIME:
ADDRESS: between 7057 Crestline Dr. and 7058 Redbud Rd.

METEROLOGICAL CONDITIONS:

TEMP: 68.5 °F HUMIDITY: 26.7 %R.H. WIND: (CALM) LIGHT MODERATE VARIABLE
WINDSPEED: <1 MPH DIR: N NE E SE S SW W NW STEADY GUSTY
SKY: (SUNNY) CLEAR OVRCST (PRTLY CLOUDY) FOG RAIN OTHER:

ACOUSTIC MEASUREMENTS:

INSTRUMENT: 812 TYPE: (1) 2 SERIAL #:
CALIBRATOR: CAL200 SERIAL #: 0640
CALIBRATION CHECK: PRE-TEST 114.0 dBA SPL POST-TEST 113.9 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?)	
am 1 ~~pm~~	9:54	10:04	47.9	61.7	41.3	42.6	45.3	50.2			
am 2 pm	10:05	10:15	45.7	58.0	42.3	43.3	44.6	47.2			
am 3 pm	10:16	10:26	48.8	61.3	39.3	41.3	44.3	52.4			
1 ~~pm~~ am											
2 am											
3 ~~pm~~											

COMMENTS:
Unable to count traffic - road not yet built
moved evening monitoring location due to excessive noise at this monitoring location. residents were using a back hoe in their yard.

SOURCE INFO AND TRAFFIC COUNTS:

PRIMARY NOISE SOURCE: (TRAFFIC) AIRCRAFT RAIL INDUSTRIAL AMBIENT OTHER:
ROADWAY TYPE:
TRAFFIC COUNT DURATION: ____-MIN

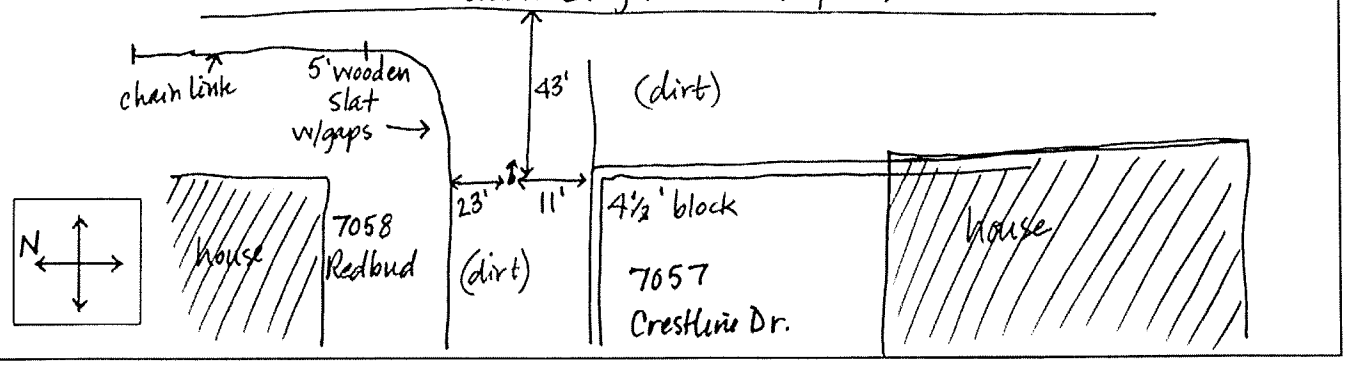
	#1 SPEED NB / EB	#1 SPEED SB / WB	#1 SPEED NB / EB	#1 SPEED SB / WB	#2 COUNT NB / EB	#2 COUNT SB / WB	#2 SPEED NB / EB	#2 SPEED SB / WB
AUTOS:	3				6			
MED. TRUCKS:								
HVY TRUCKS:								
BUSES:								
MOTORCYCLES:								

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:
birds, traffic from local road.

DESCRIPTION / SKETCH:

TERRAIN: HARD SOFT (MIXED) FLAT OTHER:
PHOTOS: 221-N, 222-E, 223-W
OTHER COMMENTS / SKETCH:



FIELD NOISE MEASUREMENT DATA

PROJECT: Sabino Canyon / Kolb connection PROJ. # 111168

SITE IDENTIFICATION: 3 alternate OBSERVER(S): C. Bolm, C. Jacobs-Donoghue
START DATE / TIME: 12/3 - 3:56pm END DATE / TIME:
ADDRESS: 2001 N. Sabino Canyon Rd.

METEROLOGICAL CONDITIONS:
TEMP: 69.0 °F HUMIDITY: 28.4 %R.H. WIND: CALM (LIGHT) MODERATE VARIABLE
WINDSPEED: 2.4 MPH DIR: N NE E SE S (SW) W NW STEADY GUSTY
SKY: (SUNNY) (CLEAR) OVRCST PRTLY CLOUDY FOG RAIN OTHER:

ACOUSTIC MEASUREMENTS:
INSTRUMENT: 812 TYPE: (1) 2 SERIAL #:
CALIBRATOR: CAL 200 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	3:56	4:06	51.1	64.4	45.3	47.3	48.9	52.1			
2	4:07	4:17	51.0	64.3	46.3	47.8	49.7	52.2			
3	4:18	4:28	51.6	64.5	45.8	48.1	50.6	53.2			

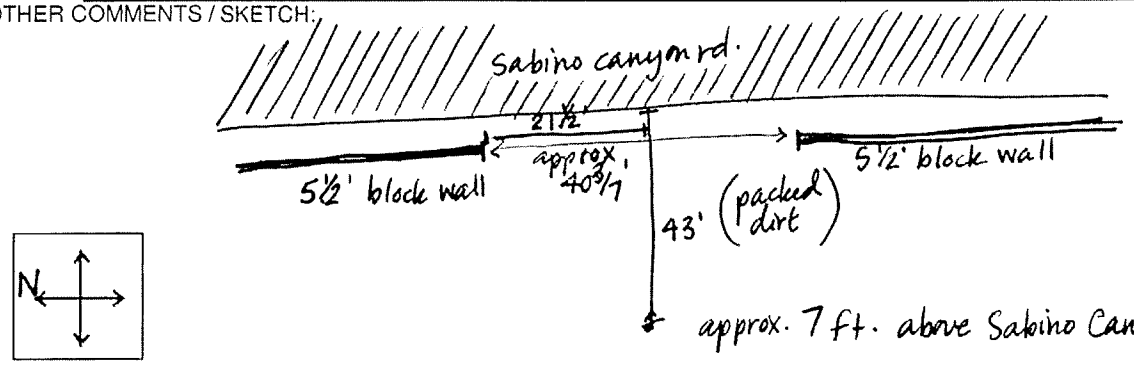
COMMENTS:
unable to count traffic - road not yet built
See notes on site identification 3

SOURCE INFO AND TRAFFIC COUNTS:
PRIMARY NOISE SOURCE: (TRAFFIC) AIRCRAFT RAIL INDUSTRIAL (AMBIENT) OTHER: backhoe at nearby property, birds
ROADWAY TYPE: (local) Concrete asphalt
TRAFFIC COUNT DURATION: -MIN

	#1 COUNT NB / EB	#1 COUNT 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:								
MED. TRUCKS:								
HVY TRUCKS:								
BUSES:								
MOTORCYCLES:								

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:
OTHER COMMENTS / SKETCH:



	1st	Auto III	
local traffic	2nd	Auto III	distant airplane II
			backhoe
			backhoe

FIELD NOISE MEASUREMENT DATA

PROJECT: Kolb Road Connection to Sabino Canyon Road PROJ. # 111168

SITE IDENTIFICATION: monitoring site 4 OBSERVER(S): C. Bolm, C. Jacobs-Donoghue
START DATE / TIME: 12/3/2009 9:05 am END DATE / TIME: 12/3/2009
ADDRESS: 1872 N. Camino Sabadell

METEROLOGICAL CONDITIONS:
TEMP: 45.6 °F HUMIDITY: 53.6 %R.H. WIND: (CALM) LIGHT MODERATE VARIABLE
WINDSPEED: 21 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 113.9 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	9:05	9:15	45.9	65.3	40.8	41.4	42.8	47.4			
2	9:16	9:26	43.3	54.2	40.4	41.4	42.4	45.3			
3	9:27	9:37	63.9	79.4	39.4	40.2	42.8	66.8			
4	9:38	9:48	42.3	54.4	38.5	39.5	40.4	43.9			

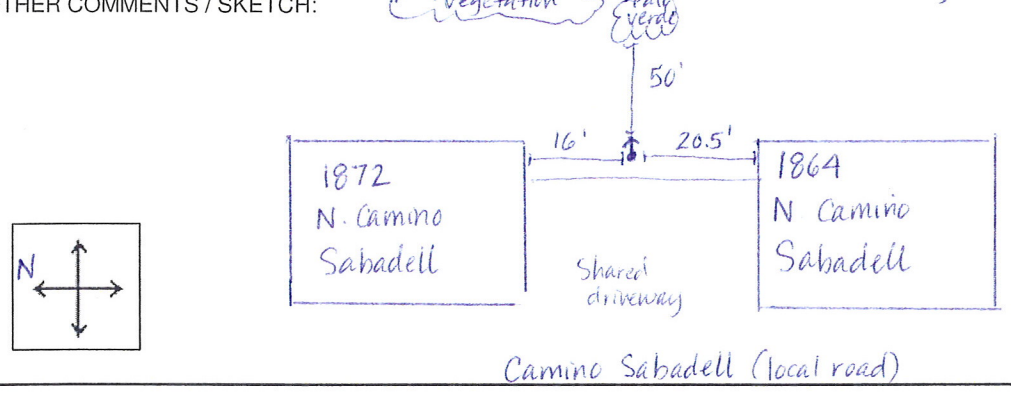
COMMENTS:
Near location of proposed road - no existing road being evaluated for noise. Traffic was not the dominant noise source. Two aircrafts overhead during the third reading raised reading levels.

SOURCE INFO AND TRAFFIC COUNTS:
PRIMARY NOISE SOURCE: TRAFFIC AIRCRAFT RAIL INDUSTRIAL (AMBIENT) OTHER:
ROADWAY TYPE: N/A
TRAFFIC COUNT DURATION: 40 -MIN

LOCAL ROAD	#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:	4	15				
MED. TRUCKS:						
HVY TRUCKS:						
BUSES:						
MOTORCYCLES:						

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: 226 - East towards proposed road, 227 - West towards existing local road, 228 - South 229 - North
OTHER COMMENTS / SKETCH:



FIELD NOISE MEASUREMENT DATA

PROJECT: Kolb Road Connection to Sabino Canyon Road PROJ. # 111168

SITE IDENTIFICATION: monitoring site 4 OBSERVER(S): C. Bolm, C. Jacobs-Donoghue
START DATE / TIME: 12/2/2009 2:17 pm END DATE / TIME: 12/2/2009 2:50 pm
ADDRESS: 1872 N. Camino Sabadell

METEROLOGICAL CONDITIONS:
TEMP: 64.0 °F HUMIDITY: 25.5 %R.H. WIND: (CALM) LIGHT MODERATE VARIABLE
WINDSPEED: <1 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 113.9 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	2:17	2:27	48.1	64.5	40.2	42.9	45.4	49.0			
2	2:29	2:39	49.4	68.6	38.8	41.0	44.9	47.5			
3	2:40	2:50	45.8	52.4	39.7	41.9	45.3	48.3			

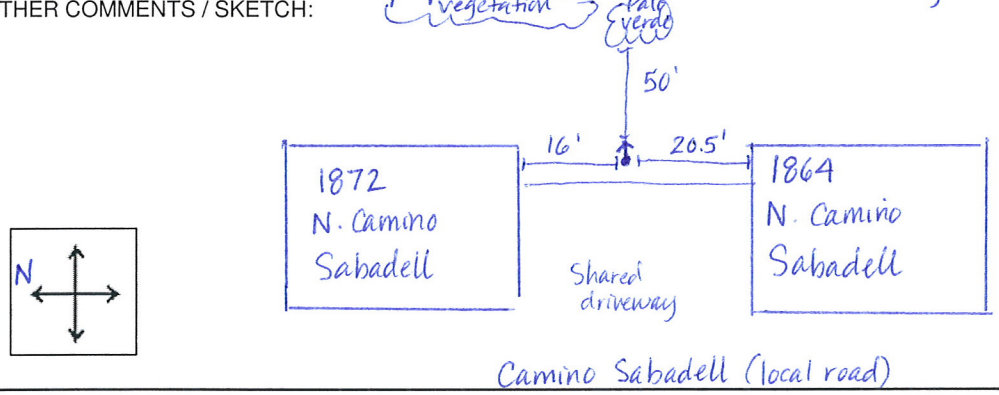
COMMENTS:
Near location of proposed road - no existing road being evaluated for noise
Traffic is not the dominant noise source.

SOURCE INFO AND TRAFFIC COUNTS:
PRIMARY NOISE SOURCE: TRAFFIC AIRCRAFT RAIL INDUSTRIAL (AMBIENT) OTHER:
ROADWAY TYPE: N/A
TRAFFIC COUNT DURATION: 10 -MIN

LOCAL ROAD	#1 COUNT NB / EB	#1 COUNT 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:	5		15					
MED. TRUCKS:								
HVY TRUCKS:								
BUSES:								
MOTORCYCLES:								

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:
Some traffic from the local road.

DESCRIPTION / SKETCH:
TERRAIN: HARD SOFT MIXED FLAT OTHER:
PHOTOS: 226 - East towards proposed road, 227 - West towards existing local road, 228 - South 229 - north
OTHER COMMENTS / SKETCH:



FIELD NOISE MEASUREMENT DATA

PROJECT: Kolb Road Connection to Sabino Canyon Road PROJ. # 111168

SITE IDENTIFICATION: monitoring site 5 OBSERVER(S): C. Balm, C. Jacobs-Donoghue
START DATE / TIME: 12/3/2009 10:01 END DATE / TIME: 12/3/2009 10:33
ADDRESS: Udall Park baseball field

METEROLOGICAL CONDITIONS:
TEMP: 62.7 °F HUMIDITY: 32.4 %R.H. WIND: (CALM) LIGHT MODERATE VARIABLE
WINDSPEED: — 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 CAL 200 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	10:01	10:11	47.8	62.5	41.6	43.3	45.8	50.6			
2	10:12	10:22	45.7	59.1	39.5	40.3	42.8	48.5			
3	10:23	10:33	48.2	60.3	39.6	40.9	43.0	52.3			

COMMENTS:

Near location of proposed road - no existing road being evaluated for noise.

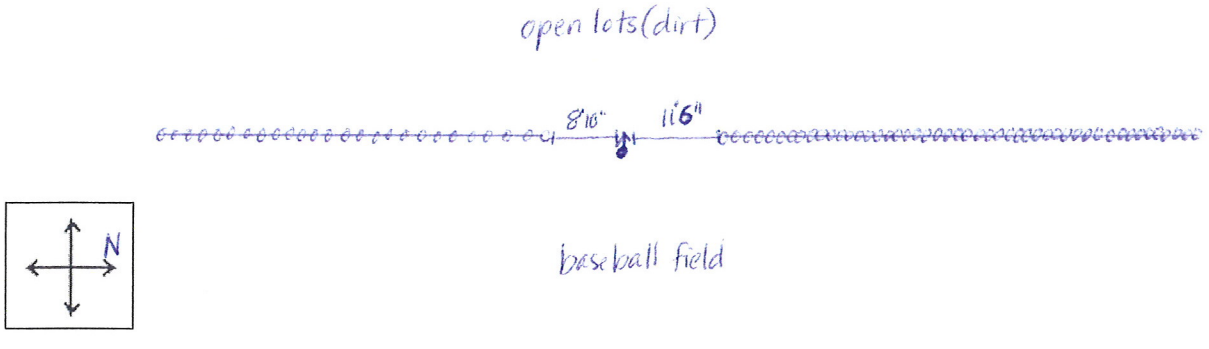
SOURCE INFO AND TRAFFIC COUNTS:
PRIMARY NOISE SOURCE: TRAFFIC AIRCRAFT RAIL INDUSTRIAL (AMBIENT) OTHER:
ROADWAY TYPE: N/A
TRAFFIC COUNT DURATION: 30 -MIN

LOCAL TRAFFIC	#1 SPEED NB / EB	#1 SPEED 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:	13		15					
MED. TRUCKS:	4		15					
HVY TRUCKS:	0							
BUSES:								
MOTORCYCLES:								

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:
Airplanes (1)

DESCRIPTION / SKETCH:
TERRAIN: HARD (SOFT) MIXED FLAT OTHER:
PHOTOS: 226 - west facing, 227 - west, 228 - north, 229 - south
OTHER COMMENTS / SKETCH:



FIELD NOISE MEASUREMENT DATA

PROJECT: Kolb Road Connection to Sabino Canyon Road PROJ. # 111168

SITE IDENTIFICATION: monitoring site 5 OBSERVER(S): C. Bolm, C. Jacobs-Donoghue
START DATE / TIME: 12/2/2009 3:05 pm END DATE / TIME: 12/2/2009 3:38 pm
ADDRESS: Udall Park baseball field

METEROLOGICAL CONDITIONS:
TEMP: 66.7 °F HUMIDITY: 26.1 %R.H. WIND: CALM (LIGHT) MODERATE VARIABLE
WINDSPEED: 1.5 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 CAL 200 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	3:05	3:15	47.6	61.4	42.8	44.7	46.6	49.7			
2	3:16	3:26	47.8	61.2	43.3	45.1	47.1	49.8			
3	3:27	3:38	49.6	64.9	43.9	46.3	48.1	51.3			

COMMENTS:
Near location of proposed road - no existing road being evaluated for noise.

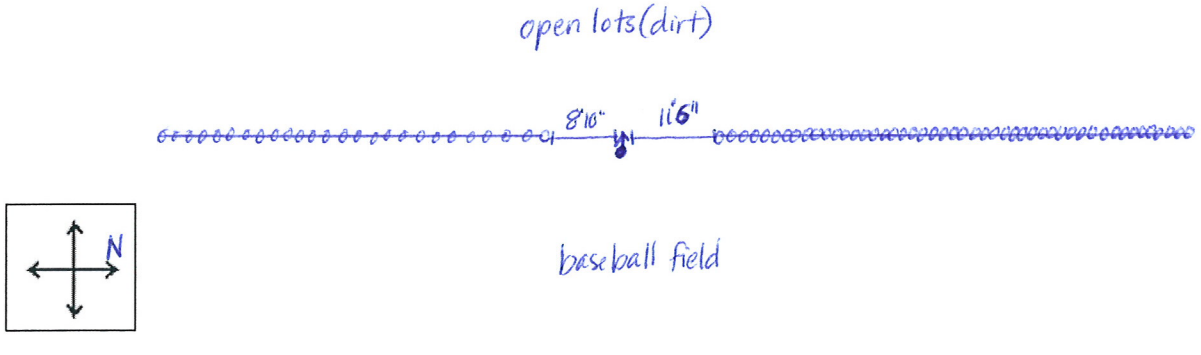
SOURCE INFO AND TRAFFIC COUNTS:
PRIMARY NOISE SOURCE: TRAFFIC AIRCRAFT RAIL INDUSTRIAL (AMBIENT) OTHER:
ROADWAY TYPE: N/A
TRAFFIC COUNT DURATION: 30 -MIN

	#1 COUNT NB / EB	#1 COUNT 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:								
MED. TRUCKS:								
HVY TRUCKS:								
BUSES:								
MOTORCYCLES:								

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:
1st reading - helicopter, 2nd reading - truck with loud braking in park, 3rd reading - children playing, traffic on local road/park, rustling leaves

DESCRIPTION / SKETCH:
TERRAIN: HARD (SOFT) MIXED FLAT OTHER:
PHOTOS: 226 - west facing, 227 - west, 228 - north, 229 - south
OTHER COMMENTS / SKETCH:



FIELD NOISE MEASUREMENT DATA

PROJECT: Kolb Road Connection to Sabino Canyon Road PROJ. # 111168

SITE IDENTIFICATION: monitoring site 6
START DATE / TIME: 12/3/2009 7:38am
ADDRESS: 7042 E. Calle Hermosa

OBSERVER(S): C. Bdm, C. Jacobs-Donoghue
END DATE / TIME: 12/3/2009 8:20am

METEROLOGICAL CONDITIONS:
TEMP: 41.7 °F HUMIDITY: 55.4 %R.H. WIND: (CALM) LIGHT MODERATE VARIABLE
WINDSPEED: 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: 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	7:38	7:48	59.6	64.3	52.6	56.8	59.1	61.9			
2	7:56	8:06	59.9	66.0	53.6	56.4	59.6	62.2			
3	8:10	8:20	59.0	65.6	50.9	55.1	58.6	61.4			

COMMENTS:
the top of the block wall is about equal to the roof of the houses.

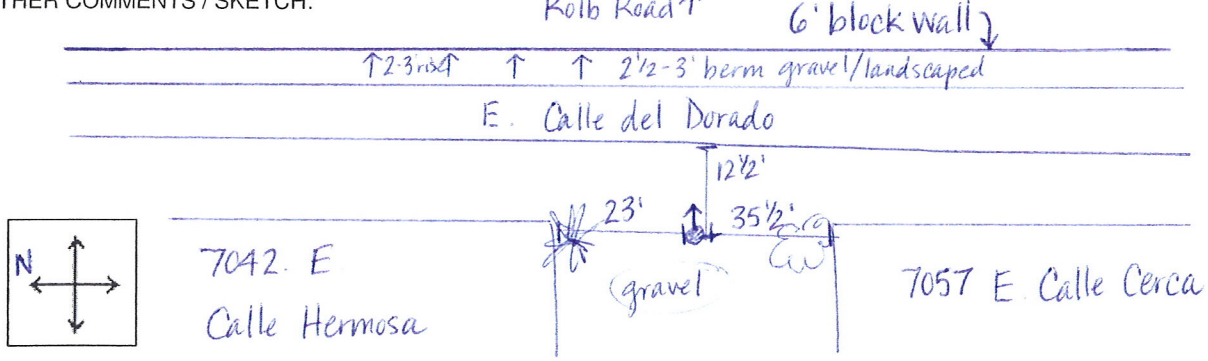
SOURCE INFO AND TRAFFIC COUNTS:
PRIMARY NOISE SOURCE: (TRAFFIC) AIRCRAFT RAIL INDUSTRIAL AMBIENT OTHER:
ROADWAY TYPE: asphalt concrete
TRAFFIC COUNT DURATION: 30 -MIN

Kolb Road	#1 COUNT NB / EB	#1 COUNT 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:	791	551	40	40				
MED. TRUCKS:	14	7	↓	↓				
HVY TRUCKS:	1	3						
BUSES:								
MOTORCYCLES:								

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:
No local traffic during readings

DESCRIPTION / SKETCH:
TERRAIN: (HARD) SOFT MIXED FLAT OTHER:
PHOTOS: 230 - south, 231 - east, 232 - west, 233 - north
OTHER COMMENTS / SKETCH:



FIELD NOISE MEASUREMENT DATA

PROJECT: Kolb Road Connection to Sabino Canyon Road PROJ. # 111168

SITE IDENTIFICATION: monitoring site 6 OBSERVER(S): C. Bolm, C. Jacobs-Donoghue
START DATE / TIME: 12/3/2009 4:56pm END DATE / TIME: 12/3/2009 5:30pm
ADDRESS: 7042 E. Calle Hermosa

METEROLOGICAL CONDITIONS:
TEMP: 61.2 °F HUMIDITY: 35.5 %R.H. WIND: CALM (LIGHT) MODERATE VARIABLE
WINDSPEED: 2mph ~~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	4:56	5:06	60.7	67.1	53.7	57.1	60.2	62.8			
2	5:09	5:19	60.6	67.2	55.5	57.6	60.5	62.3			
3	5:20	5:30	60.5	65.7	54.6	57.1	60.3	62.5			

COMMENTS:
the top of the block wall is about equal to the roof of the houses.

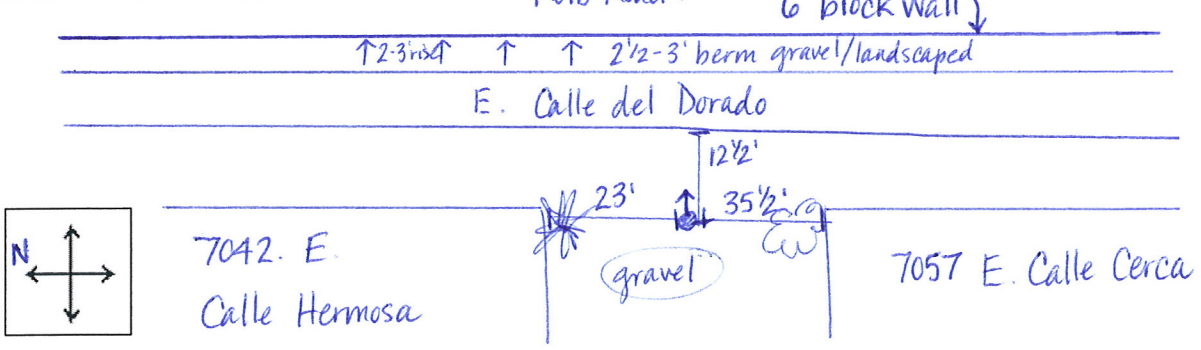
SOURCE INFO AND TRAFFIC COUNTS:
PRIMARY NOISE SOURCE: (TRAFFIC) AIRCRAFT RAIL INDUSTRIAL AMBIENT OTHER:
ROADWAY TYPE: asphalt concrete

TRAFFIC COUNT DURATION: 30 -MIN

	#1 COUNT NB / EB	#1 COUNT 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:	758	891	40	40				
MED. TRUCKS:	5	2	40	40				
HVY TRUCKS:	0	4	40	40				
BUSES:								
MOTORCYCLES:								

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: 230- South, 231- east, 232- west, 233- north
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 (2009) (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
								Yes	No	
1	Residential (1) 7080 Acoma Place	95	**68**	**69**	**69**	1	1	x		Meets ADOT criteria for abatement consideration. See potential noise barrier 1 (Appendix E).
2	Residential (2) 2641 Camino Valley Verde 2621 Camino Valley Verde	150	60	61	61	1	1		x	None warranted; levels below ADOT criteria for abatement.
3	Residential (2) 2571 Camino Valley Verde 2561 Camino Valley Verde	140	62	63	63	1	1		x	None warranted; levels below ADOT criteria for abatement.
4A	Residential (1) 7081 Taos Place	125	**69**	**70**	**70**	1	1	x		Meets ADOT criteria for abatement consideration. See potential noise barrier 1 (Appendix E).
4B	Residential (1) 7080 Taos Place	125	**68**	**69**	**70**	1	2	x		Meets ADOT criteria for abatement consideration. See potential noise barrier 1 (Appendix E).
5	Residential (1) 2535 Camino Valley Verde	130	62	63	63	1	1		x	None warranted; levels below ADOT criteria for abatement.
6	Residential (2) 2569 Camino Valley Verde 7111 Camino Bacelar	130	62	63	63	1	1		x	None warranted; levels below ADOT criteria for abatement.
7A	Residential (1) 7081 Opatas Place	125	**65**	**66**	**66**	1	1	x		Meets ADOT criteria for abatement consideration. See potential noise barrier 1 (Appendix E).
7B	Residential (1) 7080 Opatas Place	135	**64**	**65**	**66**	1	2	x		Meets ADOT criteria for abatement consideration. See potential noise barrier 1 (Appendix E).
1s	Residential (1) – second row 7050 Acoma Place	250	61	61	61	0	0		x	None warranted; levels below ADOT criteria for abatement.
2s	Residential (1) – second row 7051 Taos Place	250	63	63	63	0	0		x	None warranted; levels below ADOT criteria for abatement.
3s	Residential (1) – second row 7040 Taos Place	250	62	62	62	0	0		x	None warranted; levels below ADOT criteria for abatement.
4s	Residential (1) – second row 7061 Opatas Place	250	62	61	62	-1	0		x	None warranted; levels below ADOT criteria for abatement.
5s	Residential (1) – second row 7060 Opatas Place	250	62	62	62	0	0		x	None warranted; levels below ADOT criteria for abatement.
8	Restaurants Gaslight Square Shopping Center (north of entrance)	135	67	68	68	1	1		x	None warranted; levels below ADOT criteria for abatement for Category E.

NOISE ANALYSIS SUMMARY *(CONTINUED)*

Receiver ID	Property represented and address(es)	Distance from proposed centerline (feet)	Existing condition (2009) (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
								Yes	No	
9	Retail Facility Tanque Verde Shopping Center (north of entrance)	135	69	70	70	1	1		x	None warranted; no impact criteria for Category F.
10	Retail Facility Gaslight Square Shopping Center (south of entrance)	150	66	67	67	1	1		x	None warranted; no impact criteria for Category F.
11	Restaurants Tanque Verde Shopping Center (south of entrance)	180	66	67	68	1	2		x	None warranted; levels below ADOT criteria for abatement for Category E.
12	Retail Facility Colonia Verde Shopping Center	175	59	60	64	1	5		x	None warranted; no impact criteria for Category F.
13	Residential (1) 7057 Redbud Road	145	57	58	**64**	1	7	x		Meets ADOT criteria for abatement consideration. See potential noise barrier 2 (Appendix E).
14	Residential (1) 7058 Redbud Road	145	54	56	**64**	2	10	x		Meets ADOT criteria for abatement consideration. See potential noise barrier 3 (Appendix E).
15	Residential (1) 7057 Crestline Drive	155	52	54	63	2	11		x	None warranted; levels below ADOT criteria for abatement.
16	Sabino Canyon Pet Resort/residential (1) 2001 Sabino Canyon Road	190	50	51	59	1	9		x	None warranted; levels below ADOT criteria for abatement.
17A	Morris K. Udall Regional Park (picnic area)	165	54	55	63	1	9		x	None warranted; levels below ADOT criteria for abatement.
17B	Morris K. Udall Regional Park (baseball field)	130	51	52	**64**	1	13	x		Meets ADOT criteria for abatement consideration. See potential noise barrier 4 (Appendix E).
18	Morris K. Udall Regional Park (proposed amphitheatre)	1,100	47	48	51	1	4		x	None warranted; levels below ADOT criteria for abatement.
19	Residential (1) 2001 Sabino Canyon Road	250	51	52	60	1	9		x	None warranted; levels below ADOT criteria for abatement.
20	Residential (1) 1950 Camino Sabadell	250	51	52	59	1	8		x	None warranted; levels below ADOT criteria for abatement.
21	Residential (1) 7080 Calle Malaga	115	50	51	**65**	1	15	x		Meets ADOT criteria for abatement consideration. See potential noise barrier 5 (Appendix E).

NOISE ANALYSIS SUMMARY *(CONTINUED)*

Receiver ID	Property represented and address(es)	Distance from proposed centerline (feet)	Existing condition (2009) (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
								Yes	No	
22	Residential (6) 1840 –1880 Camino Sabadell	115	52	53	**64**	1	12	x		Meets ADOT criteria for abatement consideration. See potential noise barrier 5 (Appendix E).
23	Residential (6) 1770–1780 Camino Sabadell	115	53	54	**65**	1	12	x		Meets ADOT criteria for abatement consideration. See potential noise barrier 5 (Appendix E).
24	Residential (6) 7081–7092 Corto Caravaca	115	55	56	**64**	1	9	x		Meets ADOT criteria for abatement consideration. See potential noise barrier 5 (Appendix E).
25	Offices	90*	**69**	**70**	**70**	1	1	x		Meets ADOT criteria for abatement consideration for Category E, but barrier not feasible. See discussions in Section 5.4.
26	Residential (2) 6978 Paseo Dorado 7000 Via Dorado	150*	61	62	62	1	1		x	None warranted; levels below ADOT criteria for abatement
27	Residential (2) 7014 Calle Cavalier 7035 Calle Hermosa	150*	61	62	62	1	1		x	None warranted; levels below ADOT criteria for abatement
28	Residential (2) 7042 Calle Hermosa 7057 Calle Cerca	150*	61	62	61	2	0		x	None warranted; levels below ADOT criteria for abatement
29	Residential (2) 7050 Calle Cerca 7063 Calle Dorado	150*	59	60	60	1	1		x	None warranted; levels below ADOT criteria for abatement
30	Residential (1) 7050 Calle Dorado	150*	57	58	58	1	1		x	None warranted; levels below ADOT criteria for abatement
31	Residential (2) 7040 Hacienda Reposo 7034 Hacienda Reposo	175*	56	57	57	1	1		x	None warranted; levels below ADOT criteria for abatement
32	Residential (3) 7028 Hacienda Reposo 7022 Hacienda Reposo 7016 Hacienda Reposo	260*	56	57	56	1	0		x	None warranted; levels below ADOT criteria for abatement
33	Offices	175*	65	66	66	1	1		x	None warranted; levels below ADOT criteria for abatement for Category E.

Note: Gray shading indicates a noise impact.

*Distance from proposed centerline at Kolb Road

Appendix E

Evaluation of Noise Barriers as Mitigation

EVALUATION OF NOISE BARRIERS AS MITIGATION

Receiver ID	Number of noise-sensitive properties	2030 unmitigated build alternative noise level (dBA L_{eq1h})	2030 mitigated build alternative noise level (dBA L_{eq1h})	Noise reduction achieved (dBA L_{eq1h})	Number of benefited noise-sensitive properties[a]	Potential barrier dimensions			Potential barrier costs: total cost at $35/ft^2 (cost per benefited receiver)	Comments
						Noise barrier and approximate length	*Height*[b]	*Potential barrier square footage (ft^2)*		
1	5	69	61	8	5	Noise barrier 1 708 feet	9 feet	6,372	$223,020 $44,604	Noise barrier 1 meets ADOT policy. Barrier 1 rejected by homeowners.
4A		70	62	8						
4B		69	61	8						
7A		66	60	6						
7B		66	61	5						
13	1	64	59	5	1	Noise barrier 2 148 feet	10 feet	1,480	$51,800 $51,800	Exceeds cost per benefited receiver.
14	1	64	60	4	0	Noise barrier 3 200 feet	12 feet	2,400	$84,000 $84,000	Unable to achieve 7 dBA noise reduction while meeting cost per benefited receiver.
13	3	64	59	5	2	**Access Option 1** Noise barriers 2 and 3 473 feet	13 feet	6,149	$215,215 $107,608	Exceeds cost per benefited receiver.
14		64	60	4						
15		63	58	5						
13	3	64	59	5	1	**Access Option 2** Noise barriers 2 and 3 422 feet	11 feet	4,642	$162,470 $162,470	Exceeds cost per benefited receiver.
14		64	60	4						
15		63	60	3						
17b(Morris K. Udall Regional Park baseball field)	baseball field (28)	64	57	7	baseball field (28)	Noise barrier 4[b] 570 feet	10 feet	5,700	$199,500 $7,125	Noise barrier 4 meets ADOT policy.
21	19	65	58	7	19	Noise barrier 5 1,005 feet	12 feet	12,060	$422,100 $22,216	Noise barrier 5 meets ADOT policy.
22		64	57	7						
23		65	57	8						
24		64	59	5						

[a] Noise barriers should be designed to achieve a 7-dBA reduction at 75% of first-row homes; however, a receiver is considered benefited when the noise barrier is able to provide at least a 5-dBA noise reduction.

[b] The Barrier 2 dimensions were calculated assuming 220 feet of the barrier length would be constructed on a proposed retaining wall. The proposed barrier dimension and cost are not inclusive of the retaining wall; therefore, should the retaining wall not be constructed, the noise barrier would need to be reevaluated for the dimensions necessary to provide the noise abatement.

Appendix F

Traffic Noise Model (TNM 2.5) Output Files

HDR Engineering
C. Bolm
21 June 2010
TNM 2.5
Calculated with TNM 2.5

RESULTS: SOUND LEVELS
PROJECT/CONTRACT: Kolb Road Connection
RUN: Existing Conditions
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	Increase over existing Crit'n Sub'l Inc	With Barrier Type Impact	With Barrier Calculated LAeq1h	Noise Reduction Calculated	Noise Reduction Goal	Noise Reduction Calculated minus Goal
			dBA	dBA	dBA	dB	dB		dBA	dB	dB	dB
Monitoring 1	26	1	0.0	67.7	66	67.7	10	Snd Lvl	67.7	0.0	8	-8.0
Monitoring 2	27	1	0.0	48.6	66	48.6	10	----	48.6	0.0	8	-8.0
Monitoring 3	29	1	0.0	50.4	66	50.4	10	----	50.4	0.0	8	-8.0
Monitoring 4	30	1	0.0	49.5	66	49.5	10	----	49.5	0.0	8	-8.0
Monitoring 5	31	1	0.0	48.7	66	48.7	10	----	48.7	0.0	8	-8.0
Monitoring 6	32	1	0.0	57.7	66	57.7	10	----	57.7	0.0	8	-8.0

Dwelling Units	# DUs	Noise Reduction Min	Noise Reduction Avg	Noise Reduction Max
		dB	dB	dB
All Selected	6	0.0	0.0	0.0
All Impacted	1	0.0	0.0	0.0
All that meet NR Goal	0	0.0	0.0	0.0

HDR Engineering
C. Bolm
21 June 2010
TNM 2.5
Calculated with TNM 2.5

RESULTS: SOUND LEVELS
PROJECT/CONTRACT: Kolb Road Connection
RUN: Existing Conditions
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	Increase over existing Crit'n Sub'l Inc	With Barrier Type Impact	With Barrier Calculated LAeq1h	Noise Reduction Calculated	Noise Reduction Goal	Noise Reduction Calculated minus Goal
			dBA	dBA	dBA	dB	dB		dBA	dB	dB	dB
Monitoring 1	26	1	0.0	67.5	66	67.5	10	Snd Lvl	67.5	0.0	8	-8.0
Monitoring 2	27	1	0.0	48.8	66	48.8	10	----	48.8	0.0	8	-8.0
Monitoring 3 PM	29	1	0.0	49.2	66	49.2	10	----	49.2	0.0	8	-8.0
Monitoring 4	30	1	0.0	50.6	66	50.6	10	----	50.6	0.0	8	-8.0
Monitoring 5	31	1	0.0	49.1	66	49.1	10	----	49.1	0.0	8	-8.0
Monitoring 6	32	1	0.0	58.9	66	58.9	10	----	58.9	0.0	8	-8.0

Dwelling Units	# DUs	Noise Reduction Min	Noise Reduction Avg	Noise Reduction Max
		dB	dB	dB
All Selected	6	0.0	0.0	0.0
All Impacted	1	0.0	0.0	0.0
All that meet NR Goal	0	0.0	0.0	0.0

HDR Engineering
13 March 2011
C. Bolm
TNM 2.5
Calculated with TNM 2.5

RESULTS: SOUND LEVELS
PROJECT/CONTRACT: Kolb Road Connection
RUN: 2030 Build - with mitigation
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	Goal	Calculated minus Goal
			dBA	dBA	dBA	dB	dB		dBA	dB	dB	dB
Receiver1	1	1	0.0	68.6	66	68.6	10	Snd Lvl	63.7	4.9	8	-3.1
Receiver2	2	1	0.0	61.1	66	61.1	10	----	61.1	0.0	8	-8.0
Receiver3	3	1	0.0	62.5	66	62.5	10	----	62.5	0.0	8	-8.0
Receiver4	4	1	0.0	69.6	66	69.6	10	Snd Lvl	63.0	6.6	8	-1.4
Receiver5	5	1	0.0	62.7	66	62.7	10	----	62.7	0.0	8	-8.0
Receiver6	6	1	0.0	63.0	66	63.0	10	----	63.0	0.0	8	-8.0
Receiver7B	7	1	0.0	65.5	66	65.5	10	----	61.3	4.2	8	-3.8
Receiver8	8	1	0.0	67.9	66	67.9	10	Snd Lvl	67.9	0.0	8	-8.0
Receiver9	9	1	0.0	70.2	66	70.2	10	Snd Lvl	70.2	0.0	8	-8.0
Receiver10	10	1	0.0	67.0	66	67.0	10	Snd Lvl	67.0	0.0	8	-8.0
Receiver11	11	1	0.0	67.7	66	67.7	10	Snd Lvl	67.7	0.0	8	-8.0
Receiver 12	12	1	0.0	63.9	66	63.9	10	----	63.9	0.0	8	-8.0
Receiver13	13	1	0.0	63.9	66	63.9	10	----	60.0	3.9	8	-4.1
Receiver14	14	1	0.0	63.5	66	63.5	10	----	60.8	2.7	8	-5.3
Receiver15	15	1	0.0	63.2	66	63.2	10	----	61.4	1.8	8	-6.2
Receiver16	16	1	0.0	59.3	66	59.3	10	----	59.2	0.1	8	-7.9
Receiver 17a-picnic table	17	1	0.0	62.8	0	62.8	0	Snd Lvl	62.7	0.1	0	0.1
Receiver17b-baseball field	18	1	0.0	64.0	66	64.0	10	----	58.1	5.9	8	-2.1
Receiver 18-ampitheatre	19	1	0.0	50.8	66	50.8	10	----	50.4	0.4	8	-7.6
Receiver19	20	1	0.0	60.1	66	60.1	10	----	60.0	0.1	8	-7.9
Receiver20	21	1	0.0	59.2	66	59.2	10	----	58.0	1.2	8	-6.8
Receiver21	22	1	0.0	65.0	66	65.0	10	----	58.7	6.3	8	-1.7
Receiver22	23	1	0.0	63.7	66	63.7	10	----	60.5	3.2	8	-4.8
Receiver23	24	1	0.0	64.5	66	64.5	10	----	59.1	5.4	8	-2.6

Receiver24	25	1	0.0	63.6	66	63.6	10	----	60.9	2.7	8	-5.3
Receiver 25	26	4	0.0	69.7	0	69.7	0	Snd Lvl	69.7	0.0	0	0.0
Receiver26	27	1	0.0	61.9	66	61.9	10	----	61.9	0.0	8	-8.0
Receiver27	28	1	0.0	61.7	66	61.7	10	----	61.7	0.0	8	-8.0
Receiver28	29	1	0.0	61.3	66	61.3	10	----	61.3	0.0	8	-8.0
Receiver29	30	1	0.0	59.8	66	59.8	10	----	59.8	0.0	8	-8.0
Receiver30	31	1	0.0	57.7	66	57.7	10	----	57.7	0.0	8	-8.0
Receiver31	32	1	0.0	56.8	66	56.8	10	----	56.8	0.0	8	-8.0
Receiver32	33	1	0.0	56.2	66	56.2	10	----	56.2	0.0	8	-8.0
Receiver 33	34	4	0.0	65.5	0	65.5	0	Snd Lvl	65.5	0.0	0	0.0
Receiver 8a	35	1	0.0	56.0	66	56.0	10	----	54.9	1.1	8	-6.9
Receiver 7A	36	1	0.0	66.1	66	66.1	10	Snd Lvl	61.9	4.2	8	-3.8
Receiver 1s	37	1	0.0	61.1	66	61.1	10	----	59.6	1.5	8	-6.5
4B	38	1	0.0	62.2	66	62.2	10	----	62.1	0.1	8	-7.9
Receiver3s	39	1	0.0	62.0	66	62.0	10	----	57.9	4.1	8	-3.9
Receiver5s	40	1	0.0	62.2	66	62.2	10	----	60.3	1.9	8	-6.1
Receiver2s	41	1	0.0	62.9	66	62.9	10	----	60.1	2.8	8	-5.2
Receiver4A	42	1	0.0	70.0	66	70.0	10	Snd Lvl	66.6	3.4	8	-4.6
Receiver4B	43	1	0.0	69.3	66	69.3	10	Snd Lvl	62.2	7.1	8	-0.9
Receiver4s	44	1	0.0	61.5	66	61.5	10	----	58.9	2.6	8	-5.4

Dwelling Units	**# DUs**	**Noise Reduction**		
		Min	**Avg**	**Max**
		dB	**dB**	**dB**
All Selected	50	0.0	1.8	7.1
All Impacted	18	0.0	2.2	7.1
All that meet NR Goal	9	0.0	0.0	0.1

HDR Engineering
C. Bolm
RESULTS: SOUND LEVELS
PROJECT/CONTRACT: Kolb Road Connection
RUN: 2030 No Build
BARRIER DESIGN: INPUT HEIGHTS
ATMOSPHERICS: 68 deg F, 50% RH

13 March 2011
TNM 2.5
Calculated with TNM 2.5

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	Goal	Calculated minus Goal
			dBA	dBA	dBA	dB	dB		dBA	dB	dB	dB
Receiver1	1	1	0.0	68.5	66	68.5	10	Snd Lvl	68.5	0.0	8	-8.0
Receiver2	2	1	0.0	61.1	66	61.1	10	----	61.1	0.0	8	-8.0
Receiver3	3	1	0.0	62.5	66	62.5	10	----	62.5	0.0	8	-8.0
Receiver4	4	1	0.0	69.4	66	69.4	10	Snd Lvl	69.4	0.0	8	-8.0
Receiver5	5	1	0.0	62.7	66	62.7	10	----	62.7	0.0	8	-8.0
Receiver6	6	1	0.0	63.0	66	63.0	10	----	63.0	0.0	8	-8.0
Receiver7B	7	1	0.0	65.4	66	65.4	10	----	65.4	0.0	8	-8.0
Receiver8	8	1	0.0	67.9	66	67.9	10	Snd Lvl	67.9	0.0	8	-8.0
Receiver9	9	1	0.0	70.1	66	70.1	10	Snd Lvl	70.1	0.0	8	-8.0
Receiver10	10	1	0.0	66.7	66	66.7	10	Snd Lvl	66.7	0.0	8	-8.0
Receiver11	11	1	0.0	67.4	66	67.4	10	Snd Lvl	67.4	0.0	8	-8.0
Receiver 12	12	1	0.0	59.5	66	59.5	10	----	59.5	0.0	8	-8.0
Receiver13	13	1	0.0	57.6	66	57.6	10	----	57.6	0.0	8	-8.0
Receiver14	14	1	0.0	55.7	66	55.7	10	----	55.7	0.0	8	-8.0
Receiver15	15	1	0.0	54.0	66	54.0	10	----	54.0	0.0	8	-8.0
Receiver16	16	1	0.0	51.0	66	51.0	10	----	51.0	0.0	8	-8.0
Receiver 17a-picnic table	17	1	0.0	55.3	0	55.3	0	Snd Lvl	55.3	0.0	0	0.0
Receiver17b-baseball field	18	1	0.0	52.1	66	52.1	10	----	52.1	0.0	8	-8.0
Receiver 18-ampitheatre	19	1	0.0	48.3	66	48.3	10	----	48.3	0.0	8	-8.0
Receiver19	20	1	0.0	51.6	66	51.6	10	----	51.6	0.0	8	-8.0
Receiver20	21	1	0.0	51.7	66	51.7	10	----	51.7	0.0	8	-8.0
Receiver21	22	1	0.0	51.4	66	51.4	10	----	51.4	0.0	8	-8.0
Receiver22	23	1	0.0	52.7	66	52.7	10	----	52.7	0.0	8	-8.0
Receiver23	24	1	0.0	53.8	66	53.8	10	----	53.8	0.0	8	-8.0

Receiver24	25	1	0.0	55.6	66	55.6	10	----	55.6	0.0	8	-8.0
Receiver 25	26	4	0.0	69.7	0	69.7	0	Snd Lvl	69.7	0.0	0	0.0
Receiver26	27	1	0.0	62.4	66	62.4	10	----	62.4	0.0	8	-8.0
Receiver27	28	1	0.0	62.0	66	62.0	10	----	62.0	0.0	8	-8.0
Receiver28	29	1	0.0	61.6	66	61.6	10	----	61.6	0.0	8	-8.0
Receiver29	30	1	0.0	60.4	66	60.4	10	----	60.4	0.0	8	-8.0
Receiver30	31	1	0.0	58.2	66	58.2	10	----	58.2	0.0	8	-8.0
Receiver31	32	1	0.0	57.3	66	57.3	10	----	57.3	0.0	8	-8.0
Receiver32	33	1	0.0	56.7	66	56.7	10	----	56.7	0.0	8	-8.0
Receiver 33	34	4	0.0	65.7	0	65.7	0	Snd Lvl	65.7	0.0	0	0.0
Receiver 8a	35	1	0.0	51.4	66	51.4	10	----	51.4	0.0	8	-8.0
Receiver 7A	36	1	0.0	65.9	66	65.9	10	----	65.9	0.0	8	-8.0
Receiver 1s	37	1	0.0	61.1	66	61.1	10	----	61.1	0.0	8	-8.0
Receiver3s	39	1	0.0	61.9	66	61.9	10	----	61.9	0.0	8	-8.0
Receiver5s	40	1	0.0	62.0	66	62.0	10	----	62.0	0.0	8	-8.0
Receiver2s	41	1	0.0	62.9	66	62.9	10	----	62.9	0.0	8	-8.0
Receiver4A	42	1	0.0	69.9	66	69.9	10	Snd Lvl	69.9	0.0	8	-8.0
Receiver4B	43	1	0.0	69.2	66	69.2	10	Snd Lvl	69.2	0.0	8	-8.0
Receiver4s	44	1	0.0	61.4	66	61.4	10	----	61.4	0.0	8	-8.0

Dwelling Units	**# DUs**	**Noise Reduction**		
		Min	**Avg**	**Max**
		dB	**dB**	**dB**
All Selected	49	0.0	0.0	0.0
All Impacted	17	0.0	0.0	0.0
All that meet NR Goal	9	0.0	0.0	0.0

HDR Engineering
13 March 2011
C. Bolm
TNM 2.5
Calculated with TNM 2.5
RESULTS: SOUND LEVELS
PROJECT/CONTRACT: Kolb Road Connection
RUN: 2030 Build - with mitigation
BARRIER DESIGN: INPUT HEIGHTS
Average pavement type shall be used unless a State highway agency substantiates the use of a different type with approval of FHWA.
ATMOSPHERICS: 68 deg F, 50% RH

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	Goal	Calculated minus Goal
			dBA	dBA	dBA	dB	dB		dBA	dB	dB	dB
Receiver1	1	1	0.0	68.6	66	68.6	10	Snd Lvl	63.7	4.9	8	-3.1
Receiver2	2	1	0.0	61.1	66	61.1	10	----	61.1	0.0	8	-8.0
Receiver3	3	1	0.0	62.5	66	62.5	10	----	62.5	0.0	8	-8.0
Receiver4	4	1	0.0	69.6	66	69.6	10	Snd Lvl	63.0	6.6	8	-1.4
Receiver5	5	1	0.0	62.7	66	62.7	10	----	62.7	0.0	8	-8.0
Receiver6	6	1	0.0	63.0	66	63.0	10	----	63.0	0.0	8	-8.0
Receiver7B	7	1	0.0	65.5	66	65.5	10	----	61.3	4.2	8	-3.8
Receiver8	8	1	0.0	67.9	66	67.9	10	Snd Lvl	67.9	0.0	8	-8.0
Receiver9	9	1	0.0	70.2	66	70.2	10	Snd Lvl	70.2	0.0	8	-8.0
Receiver10	10	1	0.0	67.0	66	67.0	10	Snd Lvl	67.0	0.0	8	-8.0
Receiver11	11	1	0.0	67.7	66	67.7	10	Snd Lvl	67.7	0.0	8	-8.0
Receiver 12	12	1	0.0	63.9	66	63.9	10	----	63.9	0.0	8	-8.0
Receiver13	13	1	0.0	63.9	66	63.9	10	----	60.0	3.9	8	-4.1
Receiver14	14	1	0.0	63.5	66	63.5	10	----	60.8	2.7	8	-5.3
Receiver15	15	1	0.0	63.2	66	63.2	10	----	61.4	1.8	8	-6.2
Receiver16	16	1	0.0	59.3	66	59.3	10	----	59.2	0.1	8	-7.9
Receiver 17a-picnic table	17	1	0.0	62.8	0	62.8	0	Snd Lvl	62.7	0.1	0	0.1
Receiver17b-baseball field	18	1	0.0	64.0	66	64.0	10	----	58.1	5.9	8	-2.1
Receiver 18-ampitheatre	19	1	0.0	50.8	66	50.8	10	----	50.4	0.4	8	-7.6
Receiver19	20	1	0.0	60.1	66	60.1	10	----	60.0	0.1	8	-7.9
Receiver20	21	1	0.0	59.2	66	59.2	10	----	58.0	1.2	8	-6.8
Receiver21	22	1	0.0	65.0	66	65.0	10	----	58.7	6.3	8	-1.7
Receiver22	23	1	0.0	63.7	66	63.7	10	----	60.5	3.2	8	-4.8
Receiver23	24	1	0.0	64.5	66	64.5	10	----	59.1	5.4	8	-2.6

Receiver24	25	1	0.0	63.6	66	63.6	10	----	60.9	2.7	8	-5.3
Receiver 25	26	4	0.0	69.7	0	69.7	0	Snd Lvl	69.7	0.0	0	0.0
Receiver26	27	1	0.0	61.9	66	61.9	10	----	61.9	0.0	8	-8.0
Receiver27	28	1	0.0	61.7	66	61.7	10	----	61.7	0.0	8	-8.0
Receiver28	29	1	0.0	61.3	66	61.3	10	----	61.3	0.0	8	-8.0
Receiver29	30	1	0.0	59.8	66	59.8	10	----	59.8	0.0	8	-8.0
Receiver30	31	1	0.0	57.7	66	57.7	10	----	57.7	0.0	8	-8.0
Receiver31	32	1	0.0	56.8	66	56.8	10	----	56.8	0.0	8	-8.0
Receiver32	33	1	0.0	56.2	66	56.2	10	----	56.2	0.0	8	-8.0
Receiver 33	34	4	0.0	65.5	0	65.5	0	Snd Lvl	65.5	0.0	0	0.0
Receiver 8a	35	1	0.0	56.0	66	56.0	10	----	54.9	1.1	8	-6.9
Receiver 7A	36	1	0.0	66.1	66	66.1	10	Snd Lvl	61.9	4.2	8	-3.8
Receiver 1s	37	1	0.0	61.1	66	61.1	10	----	59.6	1.5	8	-6.5
4B	38	1	0.0	62.2	66	62.2	10	----	62.1	0.1	8	-7.9
Receiver3s	39	1	0.0	62.0	66	62.0	10	----	57.9	4.1	8	-3.9
Receiver5s	40	1	0.0	62.2	66	62.2	10	----	60.3	1.9	8	-6.1
Receiver2s	41	1	0.0	62.9	66	62.9	10	----	60.1	2.8	8	-5.2
Receiver4A	42	1	0.0	70.0	66	70.0	10	Snd Lvl	66.6	3.4	8	-4.6
Receiver4B	43	1	0.0	69.3	66	69.3	10	Snd Lvl	62.2	7.1	8	-0.9
Receiver4s	44	1	0.0	61.5	66	61.5	10	----	58.9	2.6	8	-5.4

Dwelling Units	**# DUs**	**Noise Reduction**		
		Min	**Avg**	**Max**
		dB	**dB**	**dB**
All Selected	50	0.0	1.8	7.1
All Impacted	18	0.0	2.2	7.1
All that meet NR Goal	9	0.0	0.0	0.1

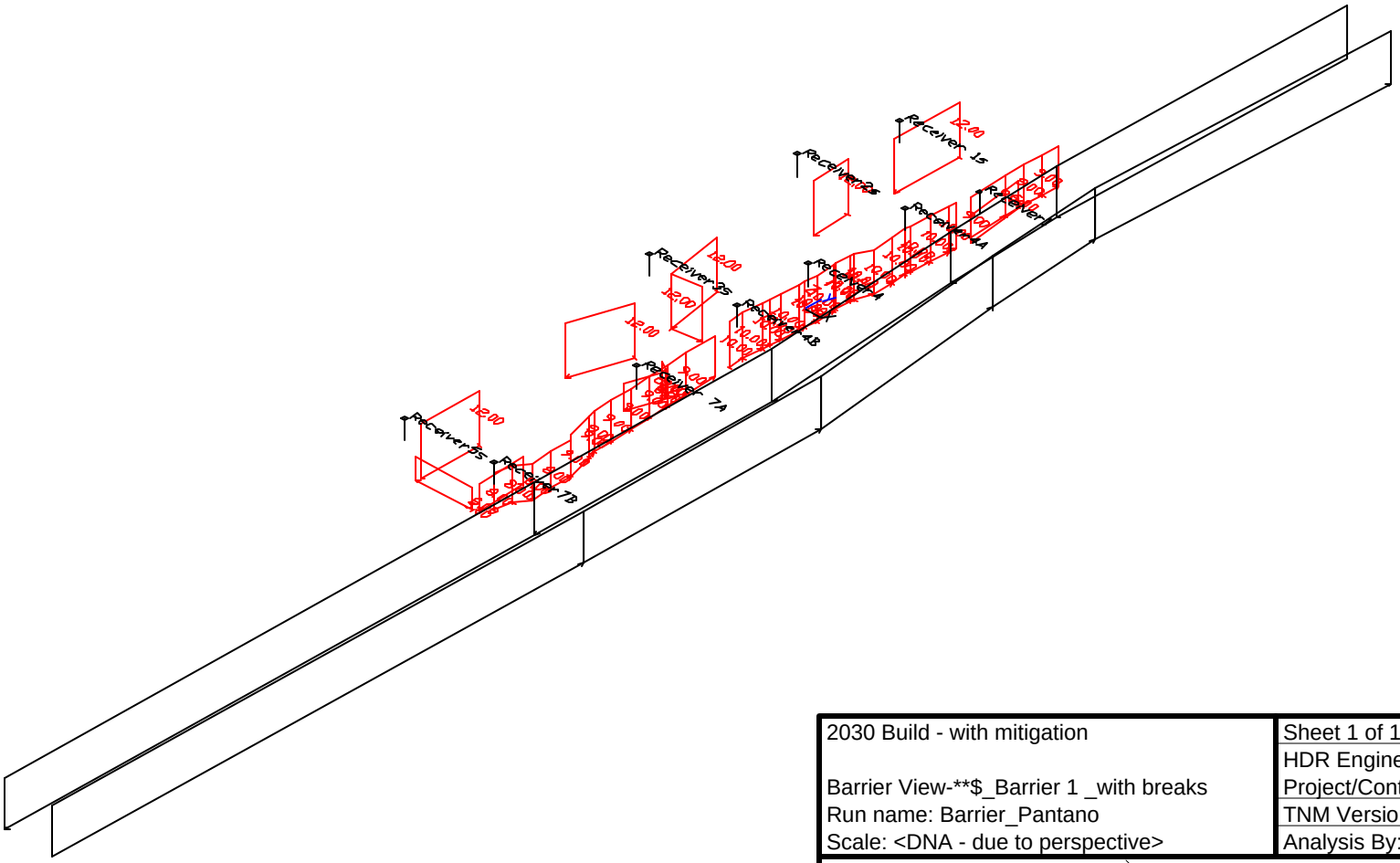
HDR Engineering
C. Bolm
13 March 2011
TNM 2.5
Calculated with TNM 2.5

RESULTS: SOUND LEVELS
PROJECT/CONTRACT: Kolb Road Connection
RUN: 2030 Build - with mitigation
BARRIER DESIGN: **$_Barrier 1 _with breaks
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	Increase over existing Crit'n Sub'l Inc	With Barrier Type Impact	With Barrier Calculated LAeq1h	Noise Reduction Calculated	Noise Reduction Goal	Noise Reduction Calculated minus Goal
			dBA	dBA	dBA	dB	dB		dBA	dB	dB	dB
Receiver1	1	1	0.0	68.6	66	68.6	10	Snd Lvl	62.9	5.7	8	-2.3
Receiver4	4	1	0.0	69.6	66	69.6	10	Snd Lvl	61.0	8.6	8	0.6
Receiver7B	7	1	0.0	65.5	66	65.5	10	----	61.2	4.3	8	-3.7
Receiver 7A	36	1	0.0	66.1	66	66.1	10	Snd Lvl	61.4	4.7	8	-3.3
Receiver 1s	37	1	0.0	61.1	66	61.1	10	----	59.2	1.9	8	-6.1
Receiver3s	39	1	0.0	62.0	66	62.0	10	----	56.9	5.1	8	-2.9
Receiver5s	40	1	0.0	62.2	66	62.2	10	----	60.1	2.1	8	-5.9
Receiver2s	41	1	0.0	62.9	66	62.9	10	----	58.4	4.5	8	-3.5
Receiver4A	42	1	0.0	70.0	66	70.0	10	Snd Lvl	64.4	5.6	8	-2.4
Receiver4B	43	1	0.0	69.3	66	69.3	10	Snd Lvl	61.1	8.2	8	0.2

Dwelling Units	# DUs	Noise Reduction Min	Noise Reduction Avg	Noise Reduction Max
		dB	dB	dB
All Selected	10	1.9	5.1	8.6
All Impacted	5	4.7	6.6	8.6
All that meet NR Goal	2	8.2	8.4	8.6



2030 Build - with mitigation		Sheet 1 of 1	13 Mar 2011
		HDR Engineering	
Barrier View-**$_Barrier 1 _with breaks		Project/Contract No. Kolb Road Connection	
Run name: Barrier_Pantano		TNM Version 2.5, Feb 2004	
Scale: <DNA - due to perspective>		Analysis By: C. Bolm	
Roadway:		Ground Zone:	polygon
Receiver:		Tree Zone:	dashed polygon
Barrier:		Contour Zone:	polygon
Building Row:		Parallel Barrier:	
Terrain Line:		Skew Section:	

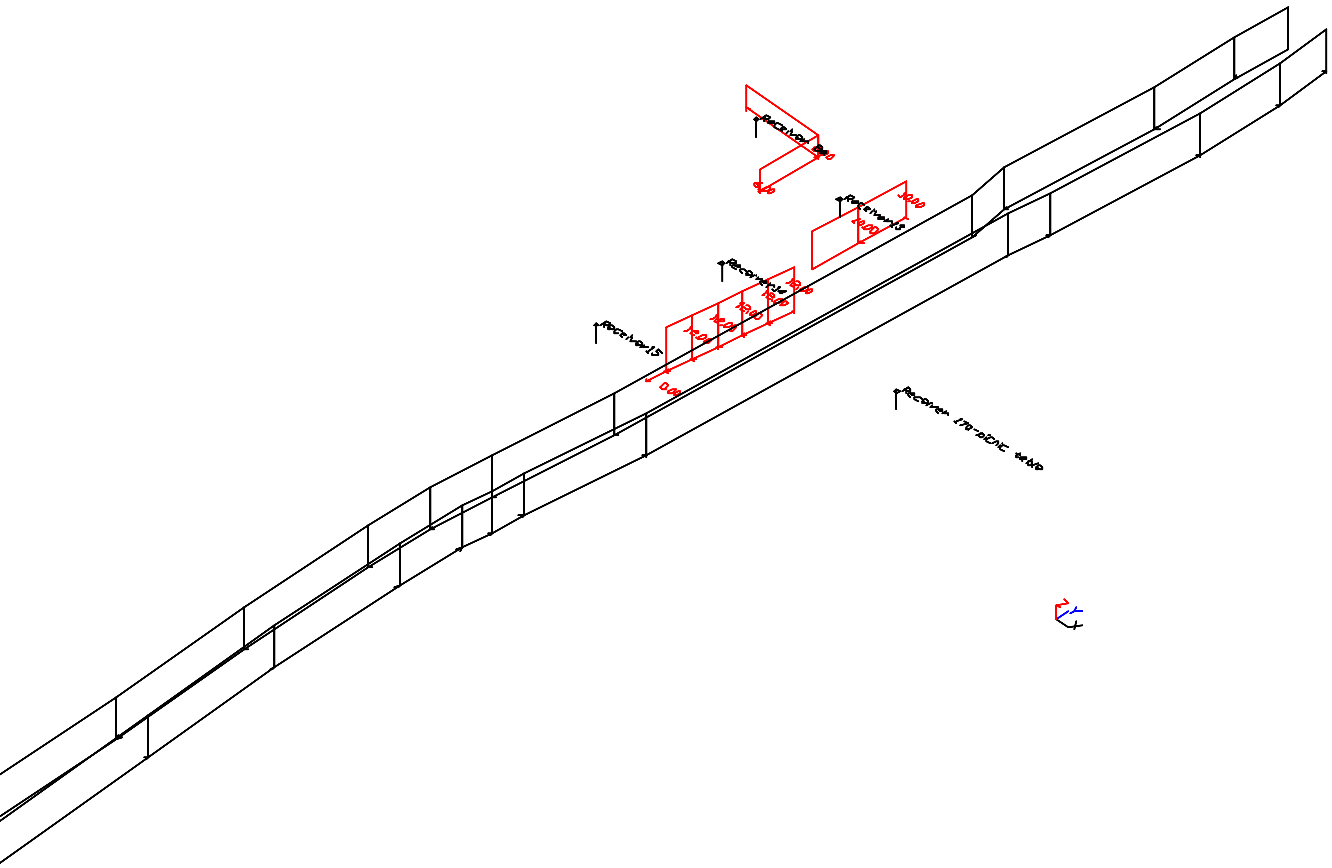
HDR Engineering
C. Bolm
13 March 2011
TNM 2.5
Calculated with TNM 2.5

RESULTS: SOUND LEVELS
PROJECT/CONTRACT: Kolb Road Connection
RUN: 2030 Build - with mitigation
BARRIER DESIGN: Crestline/Redbud Barrier
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	Increase over existing Crit'n Sub'l Inc	With Barrier Type Impact	With Barrier Calculated LAeq1h	Noise Reduction Calculated	Noise Reduction Goal	Calculated minus Goal
			dBA	dBA	dBA	dB	dB		dBA	dB	dB	dB
Receiver13	13	1	0.0	63.9	66	63.9	10	----	59.4	4.5	8	-3.5
Receiver14	14	1	0.0	63.5	66	63.5	10	----	60.4	3.1	8	-4.9
Receiver15	15	1	0.0	63.2	66	63.2	10	----	61.9	1.3	8	-6.7
Receiver 17a-picnic table	17	1	0.0	62.8	0	62.8	0	Snd Lvl	62.8	0.0	0	0.0
Receiver 8a	35	1	0.0	56.0	66	56.0	10	----	54.9	1.1	8	-6.9

Dwelling Units	# DUs	Noise Reduction Min	Noise Reduction Avg	Noise Reduction Max
		dB	dB	dB
All Selected	5	0.0	2.0	4.5
All Impacted	1	0.0	0.0	0.0
All that meet NR Goal	1	0.0	0.0	0.0



2030 Build - with mitigation	Sheet 1 of 1 — 13 Mar 2011
	HDR Engineering
Barrier View-Crestline/Redbud Barrier	Project/Contract No. Kolb Road Connection
Run name: BARRIER_PANTANO	TNM Version 2.5, Feb 2004
Scale: <DNA - due to perspective>	Analysis By: C. Bolm

Roadway:		Ground Zone:	polygon
Receiver:		Tree Zone:	dashed polygon
Barrier:		Contour Zone:	polygon
Building Row:		Parallel Barrier:	
Terrain Line:		Skew Section:	

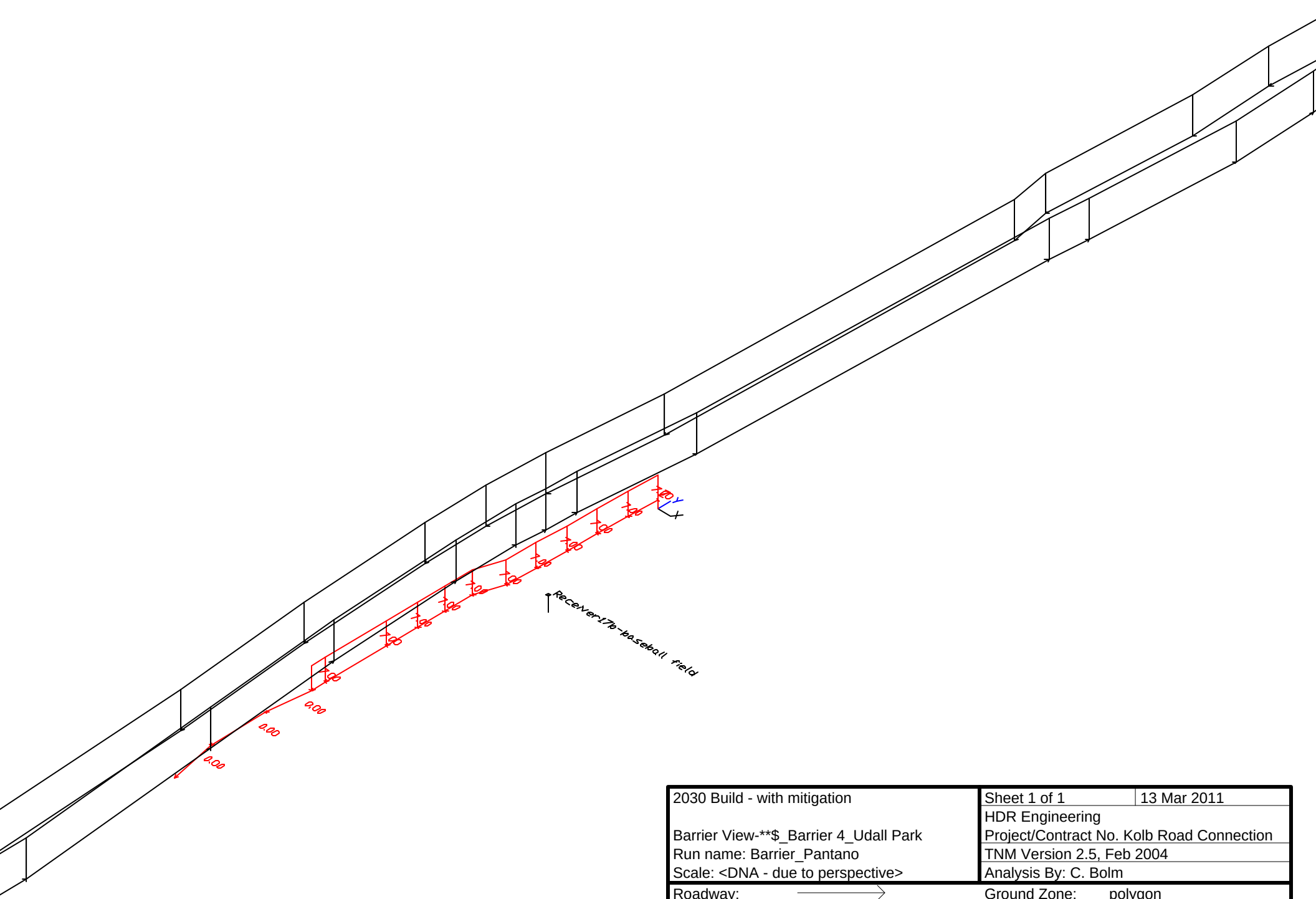
HDR Engineering
C. Bolm
13 March 2011
TNM 2.5
Calculated with TNM 2.5

RESULTS: SOUND LEVELS
PROJECT/CONTRACT: Kolb Road Connection
RUN: 2030 Build - with mitigation
BARRIER DESIGN: **$_Barrier 4_Udall Park
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	Increase over existing Crit'n Sub'l Inc	Type Impact	With Barrier Calculated LAeq1h	Noise Reduction Calculated	Noise Reduction Goal	Noise Reduction Calculated minus Goal
			dBA	dBA	dBA	dB	dB		dBA	dB	dB	dB
Receiver17b-baseball field	18	1	0.0	64.0	66	64.0	10	----	59.0	5.0	8	-3.0

Dwelling Units	# DUs	Noise Reduction Min	Noise Reduction Avg	Noise Reduction Max
		dB	dB	dB
All Selected	1	5.0	5.0	5.0
All Impacted	0	0.0	0.0	0.0
All that meet NR Goal	0	0.0	0.0	0.0



2030 Build - with mitigation		Sheet 1 of 1	13 Mar 2011
		HDR Engineering	
Barrier View-**$_Barrier 4_Udall Park		Project/Contract No. Kolb Road Connection	
Run name: Barrier_Pantano		TNM Version 2.5, Feb 2004	
Scale: <DNA - due to perspective>		Analysis By: C. Bolm	
Roadway:		Ground Zone:	polygon
Receiver:		Tree Zone:	dashed polygon
Barrier:		Contour Zone:	polygon
Building Row:		Parallel Barrier:	
Terrain Line:		Skew Section:	

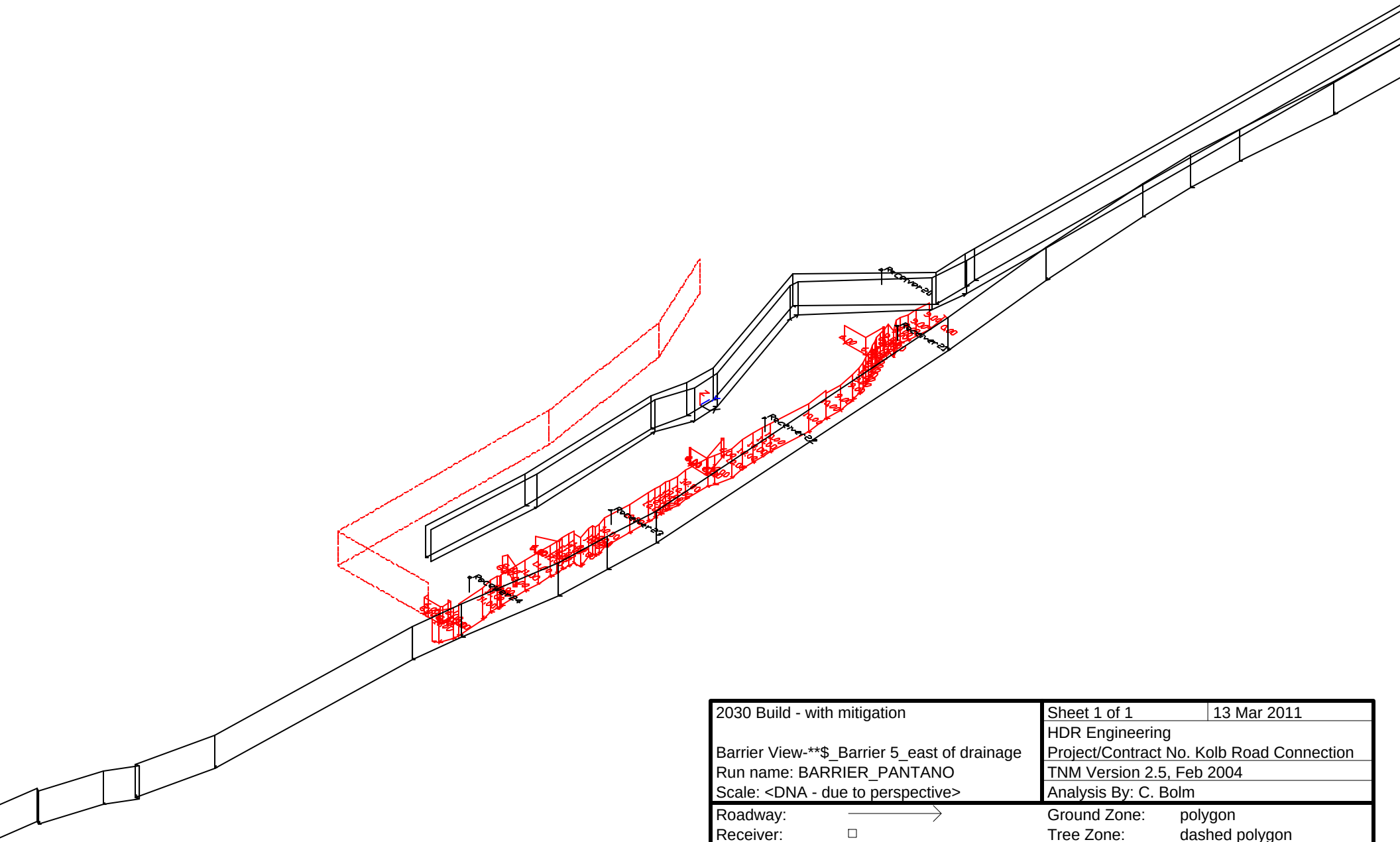
HDR Engineering
C. Bolm
13 March 2011
TNM 2.5
Calculated with TNM 2.5

RESULTS: SOUND LEVELS
PROJECT/CONTRACT: Kolb Road Connection
RUN: 2030 Build - with mitigation
BARRIER DESIGN: **$_Barrier 5_east of drainage
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	Increase over existing Crit'n Sub'l Inc	With Barrier Type Impact	With Barrier Calculated LAeq1h	Noise Reduction Calculated	Noise Reduction Goal	Calculated minus Goal
			dBA	dBA	dBA	dB	dB		dBA	dB	dB	dB
Receiver20	21	1	0.0	59.2	66	59.2	10	----	58.3	0.9	8	-7.1
Receiver21	22	1	0.0	65.0	66	65.0	10	----	59.8	5.2	8	-2.8
Receiver22	23	1	0.0	63.7	66	63.7	10	----	58.6	5.1	8	-2.9
Receiver23	24	1	0.0	64.5	66	64.5	10	----	57.6	6.9	8	-1.1
Receiver24	25	1	0.0	63.6	66	63.6	10	----	59.3	4.3	8	-3.7

Dwelling Units	# DUs	Noise Reduction Min	Noise Reduction Avg	Noise Reduction Max
		dB	dB	dB
All Selected	5	0.9	4.5	6.9
All Impacted	0	0.0	0.0	0.0
All that meet NR Goal	0	0.0	0.0	0.0



2030 Build - with mitigation		Sheet 1 of 1	13 Mar 2011
		HDR Engineering	
Barrier View-**$_Barrier 5_east of drainage		Project/Contract No. Kolb Road Connection	
Run name: BARRIER_PANTANO		TNM Version 2.5, Feb 2004	
Scale: <DNA - due to perspective>		Analysis By: C. Bolm	
Roadway:		Ground Zone:	polygon
Receiver:		Tree Zone:	dashed polygon
Barrier:		Contour Zone:	polygon
Building Row:		Parallel Barrier:	
Terrain Line:		Skew Section:	