Crosstown Boulevard
Noise Analysis Technical Report
Oklahoma City, Oklahoma


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Summary of Findings

The purpose of this noise analysis is to assess traffic noise and its potential impact on noise-sensitive land uses near the Crosstown Boulevard study area in Oklahoma City, Oklahoma. The traffic noise study was conducted in accordance with the Oklahoma Department of Transportation (ODOT) Policy Directive "Highway Noise Abatement" C-201-3 (ODOT Noise Policy) (ODOT 2011) that follows Federal Highway Administration (FHWA) regulations as defined by 23 Code of Federal Regulations (CFR) 772 "Procedures for the Abatement of Highway Traffic Noise," (FHWA 2010). The regulations contain noise impact criteria that establish noise exposure limits for various land use activity categories to assess noise impacts of proposed roadway improvements under the future design year worst-case traffic conditions. The noise impact assessment was primarily considered at exterior areas of frequent human use.

Land uses within the study area consist of industrial and office (Activity Categories E and F) land uses with no exterior areas of frequent human use. In the noise analysis area, 13 sites were classified as either Activity Category B or C. No areas were classified as Activity Category A or D.

Noise measurements were conducted at 15 representative monitoring locations identified in the study area. Short-term measurements of 15 minutes duration were collected at 15 receptor sites. All the sites represent Activity Category B or C land uses except Site 4, which is Activity Category E, and Site 13, which is open space or Activity Category G. Only Sites 4 through 15 were carried forward and analyzed for future noise impact. Site 1, 2, and 3 were outside the project limits to the west.

Traffic counts were recorded simultaneously during each noise measurement at all the short-term monitoring sites. The noise measurements and traffic counts were used to validate the Traffic Noise Model 2.5 (TNM® 2.5) for its accuracy to reliably estimate noise levels at each of the 12 representative sites where traffic noise impacts were analyzed within the study area.

Noise levels were predicted using 10 percent of the Average Daily Traffic (ADT) for 2015 and 2040 to represent the peak-noise hour. The peak-noise hour occurs when the highest traffic volumes are able to travel at the posted speed limit.

Build Alternatives Findings

For Alternatives A, B, C, and D, Sites 7 and 8 have noise levels that approach, meet, or exceed the Noise Abatement Criteria (NAC). Alternative C also raises the noise levels at Site 8A to approach, meet or exceed the NAC. Sites 4, 5, 6, 9, 10, 11, 12, 13, 14, and 15 have no noise impacts.

Noise Abatement Criteria and Findings

The noise modeling identified three sites with noise impacts (Sites 7, 8 and 8A). Noise walls were only considered at the three sites where noise levels were affected by the project. ODOT noise policy states that noise mitigation must be considered for any receivers where there is a noise impact. However, only noise abatement measures that are determined feasible and reasonable will be recommended. Noise abatement in the form of noise walls was modeled for the three sites where there was a noise impact, as described below.

For Alternatives A, B and C, at Site 7, a noise wall was modeled along the right-of-way. It was determined that a 14-foot-tall, 399-foot-long noise wall would achieve a noise reduction goal of at least 7 A-weighted decibels (dBA), which is considered feasible. However, because the estimated cost of the wall is $139,755, the wall is deemed not reasonable since Site 7 only represents one receptor and the cost of the wall would be above the cost/benefit ratio of $30,000 per benefitted receptor.

For Alternative D, at Site 7, a noise wall was modeled along the right-of-way. It was determined that a 10-foot-tall, 399-foot-long noise wall would achieve a noise reduction goal of at least 7 A-weighted decibels (dBA), which is considered feasible. However, because the estimated cost of the wall is $99,750, the wall is deemed not reasonable since Site 7 only represents one receptor and the cost of the wall would be above the cost/benefit ratio of $30,000 per benefitted receptor.

For Alternatives A and B, at Site 8, a noise wall was modeled along the existing fence line and right-of-way. It was determined that a 14-foot-tall, 533-foot-long wall would achieve a noise reduction goal of at least 7 dBA, which is considered feasible. Site 8A was added as a benefitted receptor since the wall provided a 5 dBA reduction. However, because the estimated cost of the wall is $186,707, the wall is deemed not reasonable since Site 8 and 8A only represents two receptor and the cost of the wall would be above the cost/benefit ratio of $30,000 per benefitted receptor.

For Alternative C, at Site 8 and 8A, a noise wall was modeled along the existing fence line and right-of-way. It was determined that an 8-foot-tall, 533-foot-long noise wall would achieve a noise reduction goal of at least 7 dBA, which is considered feasible. Site 8A was added as a benefitted receptor since the wall provided a 5 dBA reduction. However, because the estimated cost of the wall is $106,609, the wall is deemed not reasonable since Site 8 and 8A only represents two receptor and the cost of the wall would be above the cost/benefit ratio of $30,000 per benefitted receptor.

For Alternative D, at Site 8, a noise wall was modeled along the existing fence line for all four alternatives. It was determined that a noise wall did not meet feasibility criteria because it did not provide 7dBA reduction.

1.0 Introduction

Noise, defined as unwanted or excessive sound, is an undesirable byproduct of modern life. Noise criteria have been established to help protect the public health and safety and prevent disruption of certain human activities. The criteria are based on known impacts of noise on people, such as interference with speech or sleep, physiological responses, hearing loss, and annoyance.

Highway traffic is a major contributor of noise and is considered to be a line source of energy from which energy levels dissipate vertically and laterally from the roadway. Traffic noise is not constant. It varies as each vehicle passes a point. The time-varying characteristics of environmental noise are analyzed statistically to determine the duration and intensity of noise exposure.

In an urban environment, noise is comprised of two distinct parts. One is ambient or existing background noise. Wind, other natural noise, distant traffic, and other human noise make up the acoustical environment surrounding the project. This background sound level varies throughout the day and is generally lowest at night and highest during the day. The other component of urban noise is intermittent and louder than background noise. Transportation noise and local industrial noise are examples of this type of noise. It is for these reasons that environmental noise is analyzed statistically.

Sound from highway traffic is generated primarily from a vehicle's tires, engine, and exhaust. This sound is commonly measured in decibels (dB) that are logarithmic units and do not add arithmetically like the more common linear units, such as degrees used to quantify temperature. Sound pressure levels from two equal sources add 3 dB to the sound pressure level of just one source. For example, two trucks producing 90 dB each combine to produce 93 dB, not 180 dB. In other words, a doubling of the noise sources produces only a 3-dB increase in the sound pressure level. Studies have shown that this increase is slightly perceptible by the human ear.

Sound is composed of many frequencies measured in Hertz (Hz). The healthy, young adult ear generally responds to sound in the range of 20 to 20,000 Hz. For highway traffic noise, because humans are not equally sensitive to all frequencies, noise is adjusted or weighted using an A-weighted scale. The A-weighting scale is widely used in environmental analysis because is closely resembles the nonlinearity of human hearing. The unit of A-weighted noise is dBA. Because highway traffic sounds fluctuate over time, an equivalent sound level is used to represent a single number to describe varying traffic sound levels. The term Leq(h) refers to the steady-state sound level that is stated period of time contains the same acoustic energy as the time varying sound level during the same period. All traffic noise levels in this analysis will be expressed in dBA Leq(h).

The purpose of this Noise Analysis Technical Report is to assess traffic noise and its potential impact on noise-sensitive land uses in the study area. The traffic noise study was conducted in accordance with the ODOT Noise Policy (ODOT 2011) that follows FHWA regulations as defined by 23 CFR 772 (FHWA 2010).

This Noise Analysis Technical Report was developed to support the analysis completed for the Environmental Assessment for the Crosstown Boulevard. The Environmental Assessment will include a summary of this technical report, which will be attached to the document when it is developed.

2.0 Analysis Methodology

2.1 Federal Regulations

FHWA's "Procedures for Abatement of Highway Traffic Noise" (FHWA 2010) states that a noise impact occurs when the predicted traffic noise levels for a project approach or exceed the NAC for the land use activity categories shown in Table 1 or there is a substantial increase in the noise level. FHWA does not define a "substantial" noise increase. Each state's noise policy is required to define what levels are considered "approaching" the NAC, and what levels are considered a "substantial" increase.

Table 1. FHWA Noise Abatement Criteria—Hourly Weighted Sound Level

Activity Category	Leq(h) dBA	Evaluation Locations	Description of Activity Category
A	57	Exterior	Lands on which serenity and quiet are of extraordinary significance and serve an important public need and where the preservation of those qualities is essential if the area is to continue to serve its intended purpose
B[1]	67	Exterior	Residential
C[1]	67	Exterior	Active sport 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[1]	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

[1] Includes undeveloped lands permitted for this activity category.

Leq(h) = hourly equivalent sound level

2.2 State Regulations

ODOT's Noise Policy (ODOT 2011) establishes the requirements for traffic noise analysis for all Type I projects whether they are federally funded or state-only funded. Type I projects are defined as a project for the construction of a highway at a new location or the physical alteration of an existing highway that significantly changes either the horizontal or vertical alignment or increases the number of through traffic lanes. The ODOT Noise Policy uses the same land use categories established in the FHWA NAC and has defined a traffic noise impact as follows:

- Design year (typically 20 years into the future) traffic noise levels are predicted to approach by 1 dB, meet, or exceed any of the FHWA NAC (Table 1), or
- Predicted traffic noise levels for the design year substantially exceed existing noise by 15 dBA or more.

2.3 Analysis Procedure

The procedures used in the analyses contained in this report are consistent with requirements and guidance provided in 23 CFR 772 and the ODOT Noise Policy. The following is a summary of the steps taken to determine whether implementation of the proposed project would result in traffic noise impacts:

- Identify receiver locations in the project area that could be exposed to traffic noise impacts.
- Measure existing sound levels at locations in potentially affected residential areas. If the source of noise is a highway facility, contemporaneously count traffic and document traffic speed. Note existing environmental conditions and other dominant or intrusive noise sources.
- Digitize geometric features, including roadway lanes, receiver locations, and existing terrain, into a three-dimensional, scaled reference coordinate system for both existing and future project conditions.
- Calibrate the traffic noise model (TNM® 2.5) using the measured sound level data, actual traffic counts/speeds, and digitized geometric features for existing conditions.
- Predict traffic noise levels using worst noise-hour traffic volumes under existing and design-year conditions inputted into the calibrated traffic noise model (TNM® 2.5).
- Determine whether traffic noise impacts would occur based on the traffic noise modeling results for existing and design-year conditions. Where traffic noise impacts were identified, a preliminary noise abatement design was evaluated.

2.3.1 Noise Measurement Procedure

Several noise-sensitive receivers in the study area were examined for future traffic noise impacts. It was not reasonable to examine impacts for all receiver locations. Therefore, as representative receivers, the first row of existing residential land uses located along the right-of-way were selected because they are expected to receive the highest future noise levels over the period covered by the analysis. Noise level measurements were conducted using the following equipment:

- Brüel and Kjær 2238 integrating sound level meter (SLM) with microphone model 4188: This is a Type 1, precision instrument that meets or exceeds the requirements for measurement equipment used in highway impact analysis. Calibration of meter and microphone was checked and certified on December 23, 2013, by Odin Metrology which issued certificates numbered: 20443-15 and 20443-16.
- Larson Davis Cal 200 calibrator: Calibration was certified on December 24, 2013, by Odin Metrology, certificate number 20443-17. It was used to field-verify the laboratory calibration of the measurement instruments before and after each measurement period. All pre- and post-field measurement calibration verification levels were at 94.0 dB, the nominal output level of the Cal 200. The SLM response was verified with the calibrator before and after, as well as several times during, the monitoring surveys.
- Kestrel 3000 pocket weather meter: This instrument was used to collect temperature, wind speed, wind direction, and relative humidity at each measurement location.

Traffic noise measurements were performed using the windscreen-equipped SLM mounted on a tripod 5 feet above the local ground and at least 10 feet from any reflecting surfaces, such as buildings, walls, or parked vehicles. Noise measurements were paused to avoid noise contamination, such as from barking dogs, lawn mowers, and aircraft overflights.

Traffic was simultaneously counted and vehicle speed was measured as part of the noise survey. Three vehicle classifications were counted: automobiles, medium trucks, and heavy trucks. A medium truck is defined as having six wheels on two axles and is designed for the transportation of cargo. Generally, the gross vehicle weight is more than 10,000 pounds but less than 26,000 pounds. A heavy truck has three or more axles. Generally, the gross weight is more than 26,000 pounds.

2.3.2 Noise Modeling Procedure

The existing and future year traffic noise levels were modeled using TNM® 2.5, which was developed for complex roadway and receiver geometrics, and followed methodology in the FHWA report, *Measurement of Highway-Related Noise* (FHWA 1996). TNM® 2.5 is a computer model that calculates a predicted noise level through a series of adjustments to a reference sound level. The source levels are calculated using the speed-dependent reference noise emissions levels. TNM® 2.5 uses traffic volume, vehicle mix, vehicle speed, and roadway geometry to compute the "hourly equivalent noise level."

TNM® 2.5 was calibrated using the existing roadway/traffic and receiver locations. Traffic volumes counted during the short-term measurement period were scaled up to one hour and entered into the model. A summary of the measured and modeled noise levels used for the model calibration is provided in Table 2. The modeled levels in TNM® 2.5 were within ±3 dBA of the measured sound levels; therefore, the TNM® 2.5 model is considered valid for predicting future noise levels.

The TNM® 2.5 was run with the roadway/receiver geometry and site parameters using the hourly traffic volumes and speeds observed during the noise measurements. Only Sites 4 through 15 were carried forward and analyzed for future noise impact. Sites 1, 2, and 3 were outside the project limits to the west. Sites 14 and 15 are analyzed, but there are no roadways near these sites currently, so sites 14 and 15 were not used to valid the TNM model and are not included in Table 2.

Table 2. Comparison of Measured to Modeled Sound Levels in the TNM® 2.5 Model

Measurement Site	Activity Category	Measured Sound Level dBA	Modeled Sound Level dBA	Measured minus Predicted dBA
4	E	58.5	56.1	2.4
5	C	59.4	58.3	1.1
6	B	59.4	57.7	1.7
7	B	57.4	58.4	-1.0
8	C	63.6	61	2.6
9	C	57.4	55.9	1.5
10	B	59.3	58.9	0.6
11	C	59.2	56.9	2.3
12	C	58.3	58.9	-0.6
13	G	59.3	57.1	2.2

dBA = A-weighted decibel

The TNM® 2.5 was run using the same roadway/receiver geometry and traffic volumes and speeds associated with the peak-noise-hour traffic volumes (i.e., 10 percent of the ADT on each roadway). The 2015 ADT was used to model existing peak-noise-hour levels; the 2040 ADT was used to predict the peak-noise-hour levels for Alternatives A, B, C, and D. The traffic sheets with ADT volumes are provided in Appendix A.

3.0 Existing Conditions

Land use along the Crosstown Boulevard consists primarily of industrial and office (Activity Categories E and F) land uses with no exterior areas of frequent human use. In the entire project area only eight sites were classified as either Activity Category B or C. No sites were classified as Activity Category A or D.

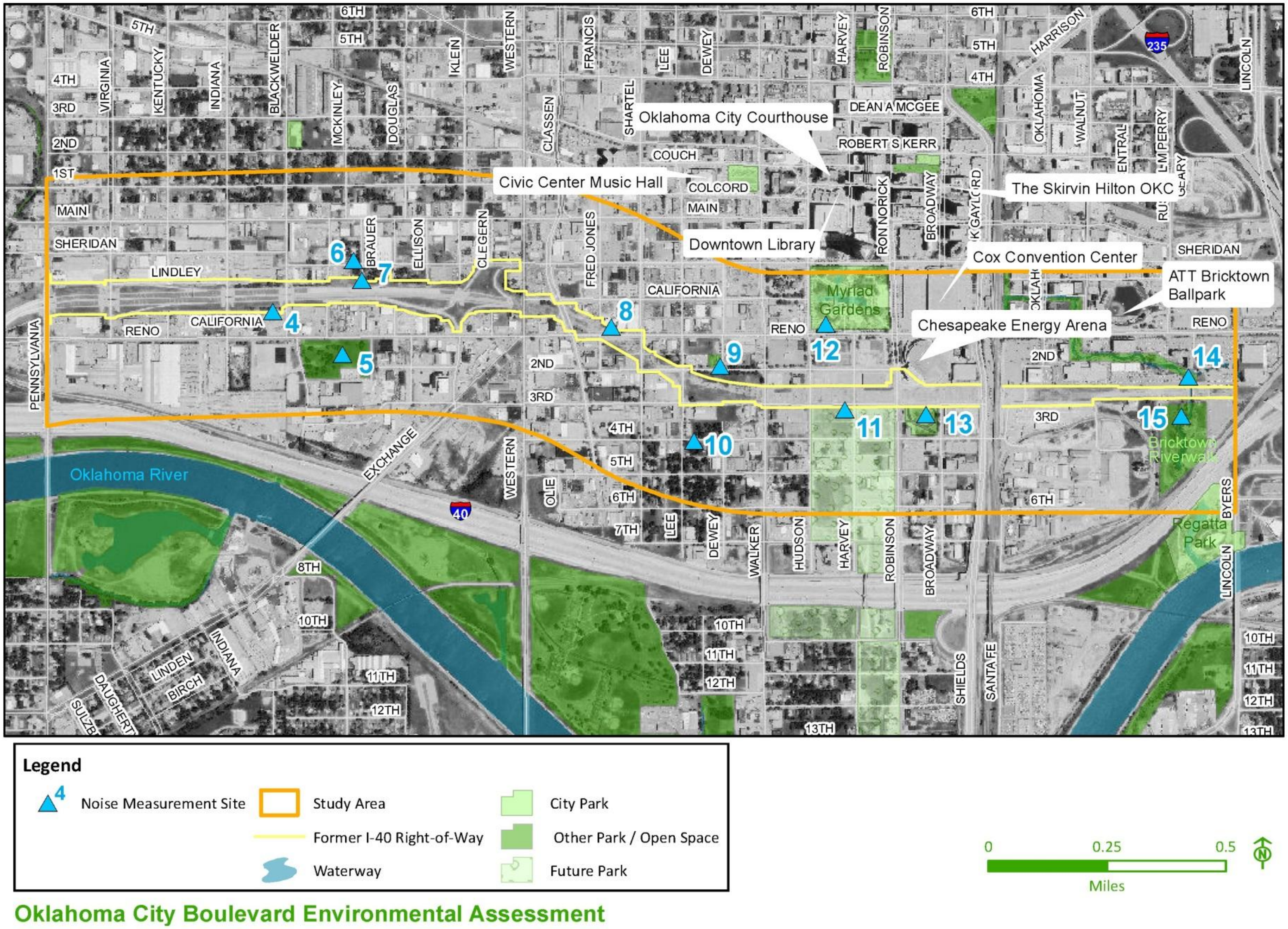
Traffic noise is due primarily to local street traffic (two-to-four-lane streets). Currently, no street exists in the location proposed for Alternatives A, B, and C. Figure 1 shows the location of the noise measurement and modeling sites listed below:

- Site 4—Southwest corner of California Street and Blackwelder Avenue; the area is an industrial and office space. Currently, the site is an empty lot just south of the existing connection between Western Avenue and the I-40 right-of-way. The measurement was conducted on January 7, 2014, from 10:00 to 10:15 a.m. and an Leq of 58.5 dBA was recorded. This site is listed as a NAC Activity Category E.
- Site 5—Totom Park, south of Reno Avenue between Mckinley Avenue and Douglas Avenue. The measurement was conducted on January 7, 2014, from 10:40 to 10:55 a.m. and an Leq of 59.4 dBA was recorded. This site is listed as a NAC Activity Category C.
- Site 6—1335 West Sheridan Avenue, a two-story residential housing unit. The site is the only occupied residential building in the area. The measurement was conducted on January 7, 2014, from 11:30 to 11:40 a.m. and an Leq of 59.4 dBA was recorded. This site is listed as a NAC Activity Category B.
- Site 7—Single-family home on North Barauer Avenue between Sheridan Avenue and the Crosstown Boulevard. This is the only residential land use in the area, the rest of the area is either vacant or industrial land use. The home may no longer be occupied. The measurement was conducted on January 7, 2014, from 11:10 to 11:25 a.m. and an Leq of 57.4 dBA was recorded. This site is listed as a NAC Activity Category B.
- Site 8—800 West California Avenue, City Rescue Mission, corner of Reno Avenue and Classen Avenue. The measurement location was near the play area on Reno Avenue. The measurement was conducted on January 7, 2014, from 12:50 to 1:05 p.m. and an Leq of 63.6 dBA was recorded. This site is listed as a NAC Activity Category C.
- Site 9—517 Southwest 2nd Street, Halfway House, corner of 2nd Street and Dewey Avenue. The measurement location was near the play area on Dewey Avenue. The measurement was conducted on January 7, 2014, from 1:20 to 1:35

p.m. and an Leq of 57.4 dBA was recorded. This site is listed as a NAC Activity Category C.

- Site 10—622 4th Street, single-family residences. The site is in the backyard of a residence on the corner of 4th Street and Lee Avenue. The area is a mix of several single-family residences and industrial land uses. The measurement was conducted on January 7, 2014, from 1:40 to 1:55 p.m. and an Leq of 59.3 dBA was recorded. This site is listed as a NAC Activity Category B.
- Site 11—3rd Street between Hudson Street and Harvey Street, future city park. The land use in the area is currently open space and parking lots. The measurement was conducted on January 7, 2014, from 2:05 to 2:20 p.m. and an Leq of 59.2 dBA was recorded. This site is listed as a NAC Activity Category C.
- Site 12—Myriad Botanical Garden. Land use in the area is the Botanical Garden and office spaces and parking lots. The measurement was conducted approximately 100 feet from Reno Avenue between Harvey Avenue and Hudson Avenue on January 8, 2014, from 10:10 to 10:25 a.m. and an Leq of 58.3 dBA was recorded. This site is listed as a NAC Activity Category C.
- Site 13—Open space between 3rd and 4th Streets to the north and south, and Broadway and Robinson Avenues to the east and west. Land use in the area is the Chesapeake Energy Arena and office spaces and parking lots. The measurement was conducted on January 8, 2014, from 2:30 to 2:45 p.m. and an Leq of 59.3 dBA was recorded. This site is listed as a NAC Activity Category G.
- Site 14—Walking trail area of the Centennial Land Run Monument along the Bricktown Riverwalk (north of the proposed project). Land use in the area is park. The measurement was conducted on January 7, 2014, from 3:30 to 3:45 p.m. and an Leq of 62.2 dBA was recorded. This site is listed as a NAC Activity Category C.
- Site 15—Walking trail area of the Centennial Land Run Monument along the Bricktown Riverwalk (south of the proposed project). Land use in the area is park. The measurement was conducted on January 7, 2014, from 3:05 to 3:20 p.m. and an Leq of 64.6 dBA was recorded. This site is listed as a NAC Activity Category C.

Figure 1. Noise Measurement Locations



4.0 Existing Noise Environment

Existing peak-hour noise levels were calculated at the 10 sites using the TNM® 2.5 model that was validated using the field measurements listed in Table 2. The traffic volumes used 10 percent of the 2015 ADT, as shown in Appendix A.

The existing peak-noise-hour levels are listed in Table 3. Four of the 13 sites—7, 8, 11, and 12—are above the NAC, which is expected because all are on busy local streets in an urban environment. Site 13 is currently not designated for any land uses and is being treated as open space. Thus, this area is classified as Activity Category G.

Table 3. Existing Peak-Noise-Hour Level

Receptor	Description	Activity Category	NAC Level dBA	Existing Peak-Noise-Hour Level (Leq dBA)
Site 4	Empty commercial lot	E	71	64.9
Site 5	Park	C	66	62.6
Site 6	Multi-residential	B	66	64.8
Site 7	Single-family residential	B	66	70.5
Site 8	City Rescue Mission	C	66	66.7
Site 8A*	City Rescue Mission-2	C	66	65.4
Site 9	Halfway house	C	66	63.4
Site 10	Single-family residential	B	66	61.2
Site 11	Park	C	66	65.0
Site 12	Park	C	66	65.9
Site 13	Open space	G	NA	66.4
Site 14	Trail/park	C	66	62.2
Site 15	Trail/park	C	66	64.6

dBA = A-weighted decibel; Leq = equivalent sound level; NAC = Noise Abatement Criteria; * = Modeling Site

5.0 Future Noise Environment

Future peak-noise-hour levels were predicted at the 13 sites for Alternatives A, B, C, and D. The traffic volumes used 10 percent of the 2040 ADT, as shown in Appendix A.

5.1 Alternative A

Between 2015 and 2040, with no changes to the roadway system, the ADT was assumed to grow by 1 percent. Table 4 shows the predicated 2040 peak-noise-hour levels and the increase from 2015 peak-noise-hour levels for the 13 measurement sites. Noise levels are predicted to increase in the range of -0.8 to 2.8 dBA. Site 7 and 8 exceeds the NAC category B and C.

Table 4. Alternative A Peak-Noise-Hour Level

Receptor	Description	2015Existing Peak-Noise-Hour Level (Leq dBA)	2040 Peak-Noise Hour-Level (Leq dBA)	Change in Peak-Noise-Hour Level (dBA)	Impact Type
Site 4	Empty commercial lot	64.9	65.8	0.9	None
Site 5	Park	62.6	64.3	1.7	None
Site 6	Multi-residential	64.8	65.3	0.5	None
Site 7	Single-family residential	70.5	71.1	0.6	Exceeds NAC B
Site 8	City Rescue Mission	66.7	68.5	1.8	Exceeds NAC C
Site 8A*	City Rescue Mission-2	65.4	65.1	- 0.3	None
Site 9	Halfway house	63.4	64.6	1.8	None
Site 10	Single-family residential	61.2	61.1	- 0.1	None
Site 11	Park	65.0	65.4	0.4	None
Site 12	Park	65.9	65.6	- 0.3	None
Site 13	Open space	66.4	67.2	0.8	None
Site 14	Trail/park	62.2	65.0	2.8	None
Site 15	Trail/park	64.6	63.8	- 0.8	None

5.2 Alternative B

Table 5 shows the predicted 2040 peak-noise-hour levels for Alternative B and the increase from 2015 peak-noise-hour levels for the 13 measurement sites. Noise levels are predicted to increase in the range of -0.8 to 2.8 dBA. Site 7 and 8 exceeds the NAC category B and C.

Table 5. Alternative B Peak-Noise-Hour Level

Receptor	Description	2015Existing Peak-Noise-Hour Level (Leq dBA)	2040 Peak-Noise Hour-Level (Leq dBA)	Change in Peak-Noise-Hour Level (dBA)	Impact Type
Site 4	Empty commercial lot	64.9	65.6	0.7	None
Site 5	Park	62.6	63.9	1.3	None
Site 6	Multi-residential	64.8	65.3	0.5	None
Site 7	Single-family residential	70.5	71.1	1.1	Exceeds NAC B
Site 8	City Rescue Mission	66.7	68.8	2.1	Exceeds NAC C
Site 8A*	City Rescue Mission-2	65.4	65.3	- 0.1	None
Site 9	Halfway house	63.4	64.0	0.6	None
Site 10	Single-family residential	61.2	61.2	0	None
Site 11	Park	65.0	65.7	0.7	None
Site 12	Park	65.9	65.7	- 0.2	None
Site 13	Open space	66.4	67.0	0.6	None
Site 14	Trail/park	62.2	65.0	2.8	None
Site 15	Trail/park	64.6	63.8	- 0.8	None

* = Modeling Site

5.3 Alternative C

Table 6 shows the predicted 2040 peak-noise-hour levels for Alternative C and the increase from 2015 peak-noise-hour levels for the 13 measurement sites. Noise levels are predicted to increase in the range of -0.8 to 4.7 dBA. Site 7, 8 and 8A exceeds the NAC category B and C.

Table 6. Alternative C Peak-Noise-Hour Level

Receptor	Description	2015 Existing Peak-Noise-Hour Level (Leq dBA)	2040 Peak-Noise Hour- Level (Leq dBA)	Change in Peak-Noise-Hour Level (dBA)	Impact Type
Site 4	Empty commercial lot	64.9	65.7	0.8	None
Site 5	Park	62.6	63.9	1.3	None
Site 6	Multi-residential	64.8	64.5	- 0.3	None
Site 7	Single-family residential	70.5	70.3	- 0.2	Exceeds NAC B
Site 8	City Rescue Mission	66.7	71.4	4.7	Exceeds NAC C
Site 8A*	City Rescue Mission-2	65.4	68.5	3.1	Exceeds NAC C
Site 9	Halfway house	63.4	65.3	1.9	None
Site 10	Single-family residential	61.2	61.9	0.7	None
Site 11	Park	65.0	65.8	0.8	None
Site 12	Park	65.9	65.8	- 0.1	None
Site 13	Open space	66.4	67.0	0.6	None
Site 14	Trail/park	62.2	65.0	2.8	None
Site 15	Trail/park	64.6	63.8	- 0.8	None

* = Modeling Site

5.4 Alternative D

Table 7 shows the predicted 2040 peak-noise-hour levels for Alternative D and the increase from 2015 peak-noise-hour levels for the 13 measurement sites. Noise levels are predicted to increase in the range of -0.8 to 0.2 dBA. Site 7 and 8 exceeds the NAC category B and C.

Table 7. Alternative D Peak-Noise-Hour Level

Receptor	Description	2015 Existing Peak-Noise-Hour Level (Leq dBA)	2040 Peak-Noise Hour Level (Leq dBA)	Change in Peak-Noise-Hour Level (dBA)	Impact Type
Site 4	Empty commercial lot	64.9	64.9	0.0	None
Site 5	Park	62.6	62.7	0.1	None
Site 6	Multi-residential	64.8	64.1	- 0.7	None
Site 7	Single-family residential	70.5	69.7	- 0.8	Exceeds NAC B
Site 8	City Rescue Mission	66.7	66.9	0.2	Exceeds NAC C
Site 8A*	City Rescue Mission-2	65.4	65.6	0.2	None
Site 9	Halfway house	63.4	63.4	0	None
Site 10	Single-family residential	61.2	61.2	0	None
Site 11	Park	65.0	65.0	0	None
Site 12	Park	65.9	65.9	0	None
Site 13	Open space	66.4	66.5	0.1	None
Site 14	Trail/park	62.2	62.2	0	None
Site 15	Trail/park	64.6	64.6	0	None

* = Modeling Site

6.0 Traffic Noise Impact

The noise impacts for each build alternative are as follows:

- **Alternative A**—Sites 7 and 8 have noise levels that approach, meet, or exceed the NAC Activity Categories B and C. Sites 4, 5, 6, 9, 10, 11, 12, 13, 14, and 15 have no noise impact.

- **Alternative B**— Sites 7 and 8 have noise levels that approach, meet, or exceed the NAC Activity Categories B and C. Sites 4, 5, 6, 9, 10, 11, 12, 13, 14, and 15 have no noise impact.

- **Alternative C**— Sites 7, 8 and 8A have noise levels that approach, meet, or exceed the NAC Activity Categories B and C. Sites 4, 5, 6, 9, 10, 11, 12, 13, 14, and 15 have no noise impact.

- **Alternative D**— Sites 7 and 8 have noise levels that approach, meet, or exceed the NAC Activity Categories B and C. Sites 4, 5, 6, 9, 10, 11, 12, 13, 14, and 15 have no noise impact.

7.0 Consideration of Abatement

The noise modeling identified three sites with noise impacts (Sites 7 and 8, and 8A with Alternative C, as shown in Tables 4-7). Noise walls were only considered at the two sites where noise levels were affected by the project. ODOT noise policy states that noise mitigation must be considered for any receivers where there is a noise impact. However, only noise abatement measures that are determined feasible and reasonable will be recommended. Noise abatement in the form of noise walls was modeled for the three sites where there was a noise impact, as described below.

For Alternatives A, B and C, at Site 7, a noise wall was modeled along the right-of-way. It was determined that a 14-foot-tall, 399-foot-long noise wall would achieve a noise reduction goal of at least 7 A-weighted decibels (dBA), which is considered feasible. However, because the estimated cost of the wall is $139,755, the wall is deemed not reasonable since Site 7 only represents one receptor and the cost of the wall would be above the cost/benefit ratio of $30,000 per benefitted receptor.

For Alternative D, at Site 7, a noise wall was modeled along the right-of-way. It was determined that a 10-foot-tall, 399-foot-long noise wall would achieve a noise reduction goal of at least 7 A-weighted decibels (dBA), which is considered feasible. However, because the estimated cost of the wall is $99,750, the wall is deemed not reasonable since Site 7 only represents one receptor and the cost of the wall would be above the cost/benefit ratio of $30,000 per benefitted receptor.

For Alternatives A and B, at Site 8, a noise wall was modeled along the existing fence line and right-of-way. It was determined that a 14-foot-tall, 533-foot-long noise wall would achieve a noise reduction goal of at least 7 dBA, which is considered feasible. Site 8A was added as a benefitted receptor since the wall provided a 5 dBA reduction. However, because the estimated cost of the wall is $186,707, the wall is deemed not reasonable since Site 8 and 8A only represents two receptor and the cost of the wall would be above the cost/benefit ratio of $30,000 per benefitted receptor.

For Alternative C, at Site 8 and 8A, a noise wall was modeled along the existing fence line and right-of-way. It was determined that an 8-foot-tall, 533-foot-long noise wall would achieve a noise reduction goal of at least 7 dBA, which is considered feasible. Site 8A was added as a benefitted receptor since the wall provided a 5 dBA reduction. However, because the estimated cost of the wall is $106,609, the wall is deemed not reasonable since Site 8 and 8A only represents two receptor and the cost of the wall would be above the cost/benefit ratio of $30,000 per benefitted receptor.

For Alternative D, at Site 8, a noise wall was modeled along the existing fence line and right-of-way. It was determined that a noise wall did not meet feasibility criteria because it did not provide 7dBA reduction.

8.0 Construction Noise

In general, construction noise related to highway project is not a major issue. Sources of noise include heavy machinery such as backhoes and scrapers, cranes, pile drivers, and trucks transporting materials. Typically, construction noise can be minimized by implementing time-of-day restrictions for construction operations adjacent to noise-sensitive areas. ODOT is concerned about any special noise-sensitive land uses or activities that could be affected by construction noise from the Crosstown Boulevard. Any special measures that are feasible and reasonable will be added to the project plans and specifications. No special noise-sensitive land uses or activities that could be affected by construction noise are in proximity to the project.

9.0 Statement to Local Officials

Traffic noise approaching and exceeding the sound levels specified in the ODOT Noise Policy resulting from the Crosstown Boulevard have been identified. For most projects using the TNM® 2.5 model, and in order to aid in compatible land use planning, the approximate distance from the centerline of the proposed roadway to the 66 dBA and 71 dBA future noise contour lines is determined and plotted on a map. However, because this project is located in an urban environment where noise levels from the Crosstown Boulevard and local existing roadways will combine and will both determine future noise levels, providing distances from the project center line to the 66 or 71 dBA project noise contour lines would not provide actual future noise levels. Thus, providing the distances or plotting these contours would not aid in the planning process and would likely be misleading. Therefore, they have not been provided herein.

10.0 References

Oklahoma Department of Transportation (ODOT). 2011. Policy Directive "Highway Noise Abatement" C-201-3 (ODOT Noise Policy). July 13, 2011.

Federal Highway Administration (FHWA), Department of Transportation. 1996. *Measurement of Highway-Related Noise.* Document number: FHWA-PD-96-046 DOT-VNTSC-FHWA-96-5. May 1996.

Federal Highway Administration (FHWA), Department of Transportation. 2010. Code of Federal Regulations, Title 23 Part 772, "Procedures for the Abatement of Highway Traffic Noise," Document 23 CFR 772. July 2010.

Appendix A: ADT Traffic Sheets

Alternate A - 2040 TNM Traffic

New Boulevard

		%	Virginia to Klein	Klein to Walker	Walker to Hudson	Hudson to Robinson	Robinson to Gaylord
WB	Cars	**0.88**	1650	1012	1435	893	1452
	Medium Trucks	**0.10**	188	115	163	102	165
	Heavy Trucks	**0.02**	38	23	33	20	33
EB	Cars	**0.95**	1781	1093	1463	1378	1568
	Medium Trucks	**0.04**	75	46	62	58	66
	Heavy Trucks	**0.01**	19	12	15	15	17

Reno

		%	%	Virginia to Klein	Klein to Walker	Walker to Hudson	Hudson to Robinson	Robinson to Gaylord
WB	Cars	**0.85**	**0.94**	512	675	746	752	831
	Medium Trucks	**0.12**	**0.05**	72	95	40	40	44
	Heavy Trucks	**0.03**	**0.01**	16	21	8	8	9
EB	Cars	**0.89**	**0.96**	532	982	1064	1017	847
	Medium Trucks	**0.09**	**0.03**	52	96	37	35	29
	Heavy Trucks	**0.03**	**0.01**	16	30	11	11	9

Western

		%	to Reno	new to sheridan
NB	Cars	**0.99**	1688	1409
	Medium Trucks	**0.01**	17	14
	Heavy Trucks	**0.00**	0	0
SB	Cars	**0.99**	1800	1329
	Medium Trucks	**0.01**	18	13
	Heavy Trucks	**0.00**	0	0

Walker

		%	3rd to New	new to 2nd	2nd to Reno
NB	Cars	**0.99**	693	1070	1116
	Medium Trucks	**0.01**	7	11	11
	Heavy Trucks	**0.00**	0	0	0
SB	Cars	**0.99**	693	980	1031
	Medium Trucks	**0.01**	7	10	10
	Heavy Trucks	**0.00**	0	0	0

Hudson

		%	4rd to New	new to 2nd	2nd to Reno
NB	Cars	**0.99**	248	802	804
	Medium Trucks	**0.01**	3	8	8
	Heavy Trucks	**0.00**	0	0	0
SB	Cars	**0.99**	248	892	894
	Medium Trucks	**0.01**	3	9	9
	Heavy Trucks	**0.00**	0	0	0

Robinson

		%	4rd to New	new to Reno
NB	Cars	**0.99**	1287	1089
	Medium Trucks	**0.01**	13	11
	Heavy Trucks	**0.00**	0	0
SB	Cars	**0.99**	990	792
	Medium Trucks	**0.01**	10	8
	Heavy Trucks	**0.00**	0	0

Broadway

		%	4rd to New	new to Reno
NB	Cars	**0.99**	10	10
	Medium Trucks	**0.01**	1	1
	Heavy Trucks	**0.00**	0	0
SB	Cars	**0.99**	10	10
	Medium Trucks	**0.01**	1	1
	Heavy Trucks	**0.00**	0	0

Gaylord

		%	4rd to New	new to Reno
NB	Cars	**0.97**	1562	1193
	Medium Trucks	**0.03**	48	37
	Heavy Trucks	**0.00**	0	0
SB	Cars	**0.97**	1610	1193
	Medium Trucks	**0.03**	50	37
	Heavy Trucks	**0.00**	0	0

Alternate B - 2040 TNM Traffic

New Boulevard

		%	Virginia to Klein	Klein to Walker	Walker to Hudson	Hudson to Robinson	Robinson to Gaylord
WB	Cars	**0.88**	1650	1012	1435	893	1452
	Medium Trucks	**0.10**	188	115	163	102	165
	Heavy Trucks	**0.02**	38	23	33	20	33
EB	Cars	**0.95**	1781	1093	1463	1378	1568
	Medium Trucks	**0.04**	75	46	62	58	66
	Heavy Trucks	**0.01**	19	12	15	15	17

Reno

		%	%	Virginia to Klein	Klein to Walker	Walker to Hudson	Hudson to Robinson	Robinson to Gaylord
WB	Cars	**0.85**	**0.94**	512	675	746	752	831
	Medium Trucks	**0.12**	**0.05**	72	95	40	40	44
	Heavy Trucks	**0.03**	**0.01**	16	21	8	8	9
EB	Cars	**0.89**	**0.96**	532	982	1064	1017	847
	Medium Trucks	**0.09**	**0.03**	52	96	37	35	29
	Heavy Trucks	**0.03**	**0.01**	16	30	11	11	9

Western

		%	to Reno	new to sheridan
NB	Cars	**0.99**	1688	1409
	Medium Trucks	**0.01**	17	14
	Heavy Trucks	**0.00**	0	0
SB	Cars	**0.99**	1800	1329
	Medium Trucks	**0.01**	18	13
	Heavy Trucks	**0.00**	0	0

Walker

		%	3rd to New	new to 2nd	2nd to Reno
NB	Cars	**0.99**	693	1070	1116
	Medium Trucks	**0.01**	7	11	11
	Heavy Trucks	**0.00**	0	0	0
SB	Cars	**0.99**	693	980	1031
	Medium Trucks	**0.01**	7	10	10
	Heavy Trucks	**0.00**	0	0	0

Hudson

		%	4rd to New	new to 2nd	2nd to Reno
NB	Cars	**0.99**	248	802	804
	Medium Trucks	**0.01**	3	8	8
	Heavy Trucks	**0.00**	0	0	0
SB	Cars	**0.99**	248	892	894
	Medium Trucks	**0.01**	3	9	9
	Heavy Trucks	**0.00**	0	0	0

Robinson

		%	4rd to New	new to Reno
NB	Cars	**0.99**	1287	1089
	Medium Trucks	**0.01**	13	11
	Heavy Trucks	**0.00**	0	0
SB	Cars	**0.99**	990	792
	Medium Trucks	**0.01**	10	8
	Heavy Trucks	**0.00**	0	0

Broadway

		%	4rd to New	new to Reno
NB	Cars	**0.99**	10	10
	Medium Trucks	**0.01**	1	1
	Heavy Trucks	**0.00**	0	0
SB	Cars	**0.99**	10	10
	Medium Trucks	**0.01**	1	1
	Heavy Trucks	**0.00**	0	0

Gaylord

		%	4rd to New	new to Reno
NB	Cars	**0.97**	1562	1193
	Medium Trucks	**0.03**	48	37
	Heavy Trucks	**0.00**	0	0
SB	Cars	**0.97**	1610	1193
	Medium Trucks	**0.03**	50	37
	Heavy Trucks	**0.00**	0	0

Alternate C - 2040 TNM Traffic

New Boulevard

		%	Virginia to Klein	Klein to Reno	Reno to Walker	Walker to Hudson	Hudson to Robinson	Robinson to Gaylord
WB	Cars	**0.88**	1650	1012	603	1096	1144	1452
	Medium Trucks	**0.10**	188	115	69	125	125	165
	Heavy Trucks	**0.02**	38	23	14	25	14	33
EB	Cars	**0.95**	1781	1093	1207	1463	1378	1568
	Medium Trucks	**0.04**	75	46	51	62	58	66
	Heavy Trucks	**0.01**	19	12	13	15	15	17

Reno

		%	%	Virginia to Klein	Western to New	New to Shartell	Shartell to Walker	Walker to Hudson	Hudson to Robinson	Robinson to Gaylord
WB	Cars	**0.85**	**0.94**	512	673	1062	1062	1173	1181	1260
	Medium Trucks	**0.12**	**0.05**	72	95	149	149	62	63	67
	Heavy Trucks	**0.03**	**0.01**	16	21	33	33	12	13	13
EB	Cars	**0.89**	**0.96**	532	1044	798	798	864	818	784
	Medium Trucks	**0.09**	**0.03**	52	102	78	78	30	28	27
	Heavy Trucks	**0.03**	**0.01**	16	31	24	24	9	9	8

Western

		%	to Reno	new to sheridan
NB	Cars	**0.99**	1688	1409
	Medium Trucks	**0.01**	17	14
	Heavy Trucks	**0.00**	0	0
SB	Cars	**0.99**	1800	1329
	Medium Trucks	**0.01**	18	13
	Heavy Trucks	**0.00**	0	0

Shartel

		%	to Reno	new to sheridan
NB	Cars	**0.99**	50	30
	Medium Trucks	**0.01**	1	0
	Heavy Trucks	**0.00**	0	0
SB	Cars	**0.99**	99	30
	Medium Trucks	**0.01**	1	0
	Heavy Trucks	**0.00**	0	0

Walker

		%	3rd to New	new to 2nd	2nd to Reno
NB	Cars	**0.99**	594	1031	1031
	Medium Trucks	**0.01**	6	10	10
	Heavy Trucks	**0.00**	0	0	0
SB	Cars	**0.99**	693	881	897
	Medium Trucks	**0.01**	7	9	9
	Heavy Trucks	**0.00**	0	0	0

Hudson

		%	4rd to New	new to 2nd	2nd to Reno
NB	Cars	**0.99**	248	718	749
	Medium Trucks	**0.01**	3	7	8
	Heavy Trucks	**0.00**	0	0	0
SB	Cars	**0.99**	248	574	592
	Medium Trucks	**0.01**	3	6	6
	Heavy Trucks	**0.00**	0	0	0

Robinson

		%	4rd to New	new to Reno
NB	Cars	**0.99**	1287	1081
	Medium Trucks	**0.01**	13	11
	Heavy Trucks	**0.00**	0	0
SB	Cars	**0.99**	990	644
	Medium Trucks	**0.01**	10	7
	Heavy Trucks	**0.00**	0	0

Broadway

		%	4rd to New	new to Reno
NB	Cars	**0.99**	10	10
	Medium Trucks	**0.01**	1	1
	Heavy Trucks	**0.00**	0	0
SB	Cars	**0.99**	10	10
	Medium Trucks	**0.01**	1	1
	Heavy Trucks	**0.00**	0	0

Gaylord

		%	4rd to New	new to Reno
NB	Cars	**0.97**	1562	1193
	Medium Trucks	**0.03**	48	48
	Heavy Trucks	**0.00**	0	0
SB	Cars	**0.97**	1610	1193
	Medium Trucks	**0.03**	50	37
	Heavy Trucks	**0.00**	0	0

Alternate D - 2040 TNM Traffic

California

		%	Western to Classen	Classen to Shartel	Shartel to Walker
WB	Cars	**0.88**	1241	906	642
	Medium Trucks	**0.10**	141	103	73
	Heavy Trucks	**0.02**	28	21	15
EB	Cars	**0.95**	1314	978	694
	Medium Trucks	**0.04**	55	41	29
	Heavy Trucks	**0.01**	14	10	7

New Boulevard

		%	Virginia to Klein	Klein to Western
WB	Cars	**0.88**	1473	1224
	Medium Trucks	**0.10**	167	139
	Heavy Trucks	**0.02**	33	28
EB	Cars	**0.95**	1590	1321
	Medium Trucks	**0.04**	67	56
	Heavy Trucks	**0.01**	17	14

Reno (West of Shartel)

		%	Virginia to Klein	Klein to Western	Western to Classen	Classen to Shartel
WB	Cars	**0.85**	604	479	457	428
	Medium Trucks	**0.12**	32	67	64	60
	Heavy Trucks	**0.03**	6	15	14	13
EB	Cars	**0.89**	517	660	555	445
	Medium Trucks	**0.09**	18	64	54	44
	Heavy Trucks	**0.03**	5	20	17	13

Reno (East of Shartel)

		%	Shartel to Walker	Walker to Hudson	Hudson to Robinson	Robinson to Gaylord
WB	Cars	**0.94**	511	993	935	828
	Medium Trucks	**0.05**	27	53	50	44
	Heavy Trucks	**0.01**	5	11	10	9
EB	Cars	**0.96**	616	1012	952	844
	Medium Trucks	**0.03**	21	35	33	29
	Heavy Trucks	**0.01**	6	11	10	9

2nd

		%	Lee to Walker
WB	Cars	**0.99**	110
	Medium Trucks	**0.01**	1
	Heavy Trucks	**0.00**	0
EB	Cars	**0.99**	129
	Medium Trucks	**0.01**	1
	Heavy Trucks	**0.00**	0

3rd

		%	Lee to Walker
WB	Cars	**0.99**	1460
	Medium Trucks	**0.01**	15
	Heavy Trucks	**0.00**	0
EB	Cars	**0.99**	1284
	Medium Trucks	**0.01**	13
	Heavy Trucks	**0.00**	0

Western

		%	new to Reno	Reno to CA	CA to Sheridan
NB	Cars	**0.99**	1093	1067	1027
	Medium Trucks	**0.01**	11	11	10
	Heavy Trucks	**0.00**	0	0	0
SB	Cars	**0.99**	1185	1068	832
	Medium Trucks	**0.01**	12	11	8
	Heavy Trucks	**0.00**	0	0	0

Classen

		%	new to Reno	Reno to CA
NB	Cars	**0.99**	248	548
	Medium Trucks	**0.01**	3	6
	Heavy Trucks	**0.00**	0	0
SB	Cars	**0.99**	222	548
	Medium Trucks	**0.01**	2	6
	Heavy Trucks	**0.00**	0	0

Shartel

		%	new to Reno	Reno to CA	CA to Sheridan
NB	Cars	**0.99**	395	533	189
	Medium Trucks	**0.01**	4	5	2
	Heavy Trucks	**0.00**	0	0	0
SB	Cars	**0.99**	394	533	409
	Medium Trucks	**0.01**	4	5	4
	Heavy Trucks	**0.00**	0	0	0

Lee

		%	new to Reno	Reno to CA

NB	Cars	**0.99**	126	131
	Medium Trucks	**0.01**	1	1
	Heavy Trucks	**0.00**	0	0
SB	Cars	**0.99**	125	132
	Medium Trucks	**0.01**	1	1
	Heavy Trucks	**0.00**	0	0

Walker

		%	3rd to 2nd	2nd to Reno	Reno to CA	Ca to Sheridan
NB	Cars	**0.99**	658	861	1072	1044
	Medium Trucks	**0.01**	7	9	11	11
	Heavy Trucks	**0.00**	0	0	0	0
SB	Cars	**0.99**	657	677	1080	926
	Medium Trucks	**0.01**	7	7	11	9
	Heavy Trucks	**0.00**	0	0	0	0

Hudson

		%	3rd to 2nd	Reno to Sheridan
NB	Cars	**0.99**	546	782
	Medium Trucks	**0.01**	6	8
	Heavy Trucks	**0.00**	0	0
SB	Cars	**0.99**	686	1093
	Medium Trucks	**0.01**	7	11
	Heavy Trucks	**0.00**	0	0

Robinson

%	3rd to Reno	Reno to Sheridan

NB	Cars	**0.99**	974	1060
	Medium Trucks	**0.01**	10	11
	Heavy Trucks	**0.00**	0	0
SB	Cars	**0.99**	887	886
	Medium Trucks	**0.01**	9	9
	Heavy Trucks	**0.00**	0	0

Gaylord

		%	3rd to Reno	Reno to Sheridan
NB	Cars	**0.99**	1301	1314
	Medium Trucks	**0.01**	13	13
	Heavy Trucks	**0.00**	0	0
SB	Cars	**0.99**	1345	1344
	Medium Trucks	**0.01**	14	14
	Heavy Trucks	**0.00**	0	0