

Noise Technical Memorandum

**Page-Olive Connector
Route 340 to River Valley Drive**

**St. Louis County
Project AR-1236**

JACOBS™

October, 2010

Noise Technical Memorandum

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ST. LOUIS COUNTY, MO
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ADDENDUM DATE:

I. Introduction

A. Project Description

Missouri State Highway 141 is a major St. Louis area, north-south arterial linking Missouri State Highway 340 (Olive Blvd) in St. Louis County to I-55 in Jefferson County. This project will provide an extension of Highway 141 past Olive Blvd, north to the existing Maryland Heights Expressway. **Figure 1** shows the project's regional setting. The project will provide a six-lane divided roadway with a 50 mile per hour design speed from Olive Blvd through the interchange at Page Avenue, ending at the at-grade signal at River Valley Drive. Currently travel on Maryland Heights Expressway to Highway 141 requires drivers to use Creve Couer Mill Rd. and then access Highway 141 from Olive Blvd. By extending Highway 141 to the North, drivers will now have direct access to Page Avenue and Maryland Heights Expressway.

The plan consists of constructing a divided highway with six through lanes on new alignment north of the new Highway 141 alignment at Olive Blvd. This will locate the highway between the subdivisions of River Bend Estates to the west and Terra Vista and Mill Ridge Villas to the east. North of Waterworks Road the proposed highway ties in with the existing two-lane Maryland Heights Expressway, and continue on that alignment to its terminus at River Valley Drive. **Figure 2** shows the proposed improvements.

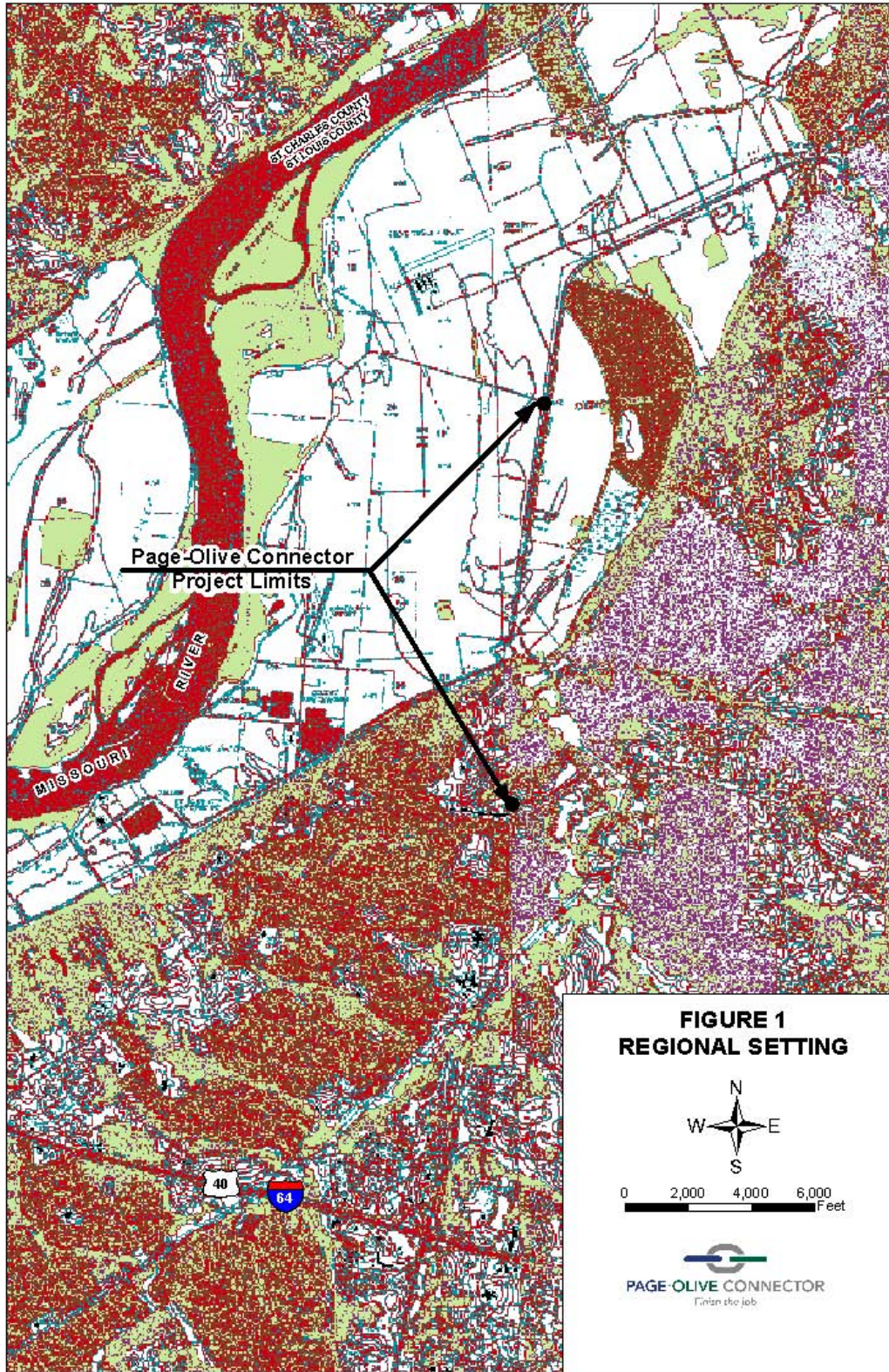
B. Scope of Services

This technical memorandum examines the existing and projected noise environment along the new Page-Olive Connector between River Valley Drive and Olive Blvd. It looks at various scenarios to determine if a reasonable and feasible solution can be found to mitigate for the impacted receptors along the new corridor.

C. Highway Noise Fundamentals

Per FHWA policy traffic noise is measured using the A-weighted equivalent sound level, L_{eq} , in units of dBA. This metric considers three factors of the sound measured: magnitude, frequency, and time variance.

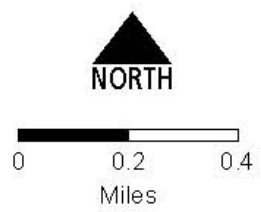
Sound magnitude relates to the sound pressure displacement created by the acoustic energy of the source. This displacement is quantified through the use of a logarithmic ratio, Sound Pressure Level, expressed in units of decibels (abbreviated dB). Since the human ear responds not only to sound magnitude, but also to frequency, an A-weighting curve is applied to the sound measurement. The A-weighting curve emphasizes the frequency ranges that humans hear best and de-emphasizes those they can't hear as well. The A-weighted decibel (dBA) describes the magnitude of a sound, emphasizing the frequencies best heard by humans, but only at one instant in time. Energy equivalent sound levels, L_{eq} , are employed to add a temporal aspect to the measurement. L_{eq} is the equivalent mean steady noise level containing the same acoustic energy as the actual time-varying noise level during a time period (usually one hour). L_{eq} is determined by averaging the acoustic energy of a number of instantaneous measurements.





Legend

- Proposed Page-Olive Connector Pavement
- MoDOT Route 141 Relocation Under Construction



**FIGURE 2
PROPOSED
IMPROVEMENTS**



Page - Olive Connector
St. Louis County, Missouri

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D. Noise Abatement Criteria

Requirements for traffic noise analysis and abatement are defined by FHWA and MODOT. The FHWA defines Noise Abatement Criteria (NAC) for various land uses, as shown in **Table 1**. The land use in this project falls under Category B with a 67 dBA NAC.

Table 1: FHWA Noise Abatement Criteria

Activity Category	$L_{eq}(h)$ (In dBA)	Description of Land Use Activity Area
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	67 (Exterior)	Picnic areas, recreation areas, playgrounds, active sports areas, parks, residences, motels, hotels, schools, churches, libraries, and hospitals.
C	72 (Exterior)	Developed lands, properties, or activities not included in Categories A or B above.
D	--	Undeveloped lands.
E	52 (Interior)	Residences, motels, hotels, public meeting rooms, schools, churches, libraries, hospitals, and auditoriums.

Source: *Procedures for Abatement of Highway Traffic Noise and Construction Noise, 23 Code of Federal Regulations (CFR) Part 772; December 1991.*

According to the FHWA's 23 CFR, Part 772, a traffic noise impact occurs when "the predicted traffic noise levels approach or exceed the noise abatement criteria (NAC), or when the predicted traffic noise levels substantially exceed the existing noise levels." MoDOT's *Traffic Noise Policy* further defines the phrase "approach or exceed," to mean within one dBA below the levels shown in **Table 1**, and defines the phrase "substantially exceed," to mean exceed by 15 dBA or more.

For example, for a receiver in Activity Category B, a noise impact will occur if the predicted noise level is 66 dBA or higher, or if the predicted noise level exceeds the existing noise level by 15 dBA or more.

The MoDOT policy also states:

- Any proposed mitigation should have a noise reduction goal of at least 5 dBA.
- More than one receptor must be benefited.
- A benefited residence is defined as a residence that is expected to receive noise reduction of 5 dBA or greater, whether it is a first-row residence or not.
- A reasonable mitigation cost per benefited residence is \$30,000.
- A noise wall must be 18 feet in height or less above normal grade, not interfere with normal access to the affected property and not pose a traffic safety hazard.
- The majority of affected residents must concur that a noise wall is desired.

II. Existing Noise Environment

A. Study Area Description

The area of interest for this noise analysis consists of lands along the new alignment from Olive Blvd. to Water Works Road as well as along the existing alignment from Water Works Road to River Valley Drive. Land use activity category B is predominate. Commercial uses are concentrated to one area at the south end of the project. Single and multi-household residential units are found south of Water Works Road. The new Page-Olive Connector alignment north of the Olive Blvd. interchange and south of Water Works Road follows the undeveloped flood plain of Creve Coeur Creek.

B. Ambient Noise Level Measurements

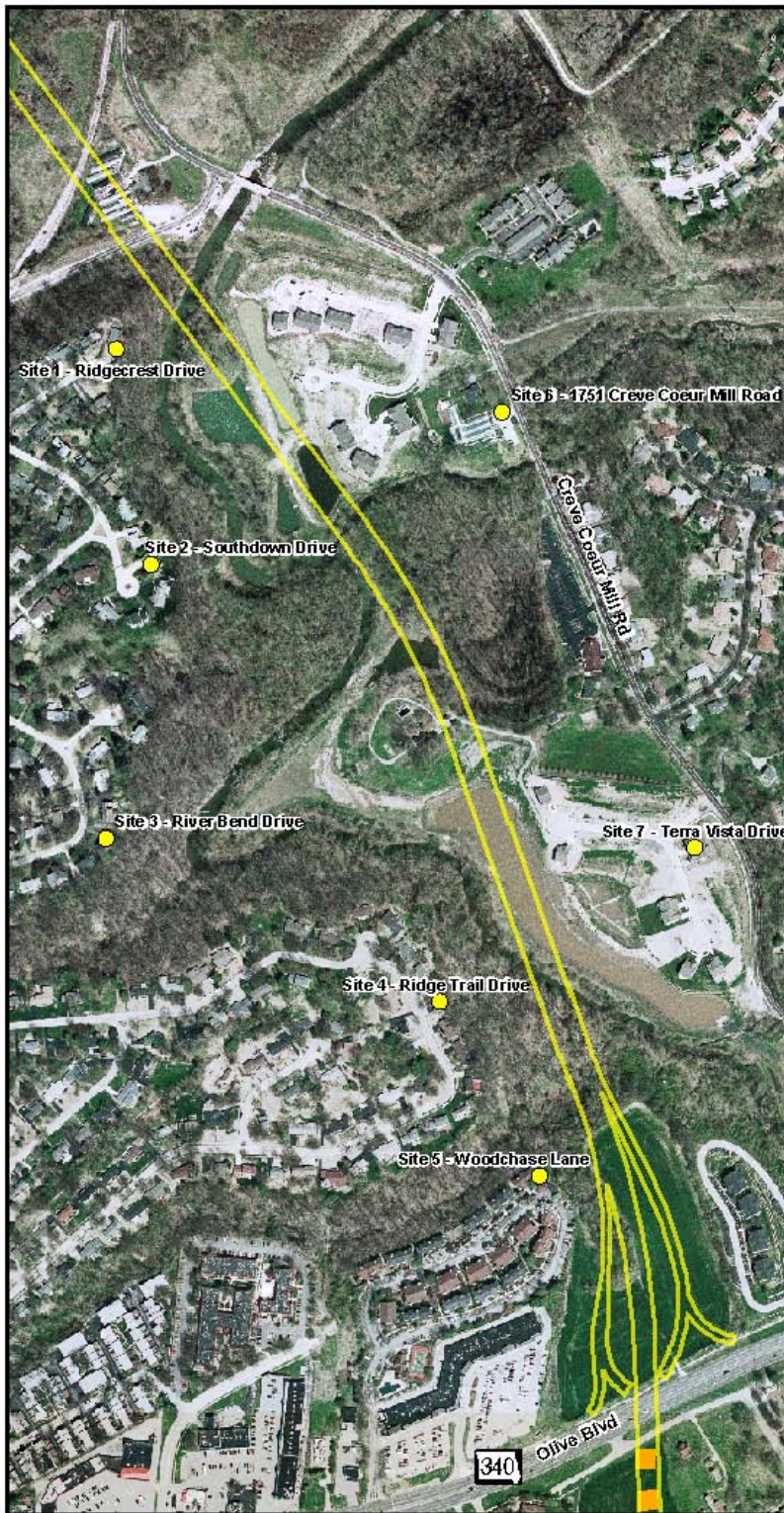
Existing ambient noise levels were obtained from the county's consultant and used in this study to calibrate the existing model. **Appendix A** contains the measured existing noise levels at the five sites, as well as the modeled existing noise levels for the remainder of the receptors. These five sites lie along the proposed Page Olive Connector alignment which is remote from any existing traffic noise generators. **Figure 3** provides the location of the sites for which noise measurements were taken. Sites 6 and 7 are not included in Appendix A, as these locations are not impacted by the new highway; however they were used to calibrate the existing model.

C. Calibration of the FHWA Traffic Noise Model

The first step in noise analysis is the calibration of existing field measurements with modeled output using FHWA's Traffic Noise Model (TNM 2.5) software. TNM generates three-dimensional computer models of specific sites considering topography, roadway geometry, traffic volumes and speeds, ground surfaces, and existing walls and buildings to predict traffic noise levels at user-specified receiver locations. Models of the noise environments at the sites were created using the traffic counted during the ambient noise measurement and calibrated with the measured existing noise levels. The noise levels calculated by TNM were compared by the county's consultant to the measured noise levels to confirm the accuracy of the TNM in characterizing the site's noise environment.

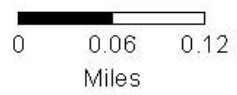
III. Prediction of Traffic Noise Levels

Design year traffic noise predictions were made to determine the traffic noise impacts that will be created by construction of the Page-Olive Connector. As noted earlier, MoDOT's *Traffic Noise Policy* defines a noise impact as a predicted noise level at or above the NAC, or a predicted noise level that substantially exceeds (by 15 dBA or more) the existing noise level.



Legend

- Noise Measurement Locations
- Proposed Page-Olive Connector Pavement
- MoDOT Route 141
- Relocation Under Construction



**FIGURE 3
NOISE MEASUREMENT
LOCATIONS**



Page - Olive Connector
St. Louis County, Missouri

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A. Predicted Noise Levels At or Above NAC

2035 noise levels along Page-Olive Connector were predicted using TNM software. This software builds a three dimensional model that incorporates topography, proposed highway grades and peak hour traffic. The resulting noise model was also used to locate noise walls. **Appendix A** shows the existing measured L_{eq} at each sensitive site and the average projected peak-hour L_{eq} for the impacted receptors at that site. (Existing L_{eq} provided in Appendix A were measured, modeled or estimated depending on their proximity to the existing roadways and measurement sites.)

The 66 dBA absolute impact criterion is exceeded at four properties within Terra Vista and three properties within Mill Ridge, as well as at one property on Ridgecrest Drive. The relative impact criterion (an increase in noise levels of 15 dBA or more) is met or exceeded at four properties within Terra Vista, six properties within Mill Ridge Villas, nine properties along Ridge Trail Drive and at one apartment building within Woodchase Apartments. Three properties in Terra Vista and six properties in Mill Ridge exceed both the absolute and relative impact criteria. All impacted sites are along the undeveloped Creve Coeur Creek valley; therefore they are distant from existing traffic noise sources, but close to the proposed Page-Olive Connector alignment. Properties showing no results for the build scenarios will be taken as part of the project.

IV. Traffic Noise Impact Mitigation

In the area where the impacted receivers are located, the proposed alignment will be located on bridge and fill areas with steep slopes. Receivers are located primarily below the elevation of the roadway and therefore the most effective mitigation is to place the noise barrier at the edge of shoulder attached to the proposed Type B barrier.

Table 2 shows the projected noise mitigation for those sites exceeding either the absolute 66 dBA impact criterion or the relative impact measure. **Appendix A** provides a more detailed analysis for each individual receptor under the column labeled “Bridge Wall”.

Table 2
Projected 2035 L_{eq} (in dBA)
with and without Barriers

Location	Projected 2035 L_{eq}	Change (in dBA)	Projected 2035 L_{eq} With Barrier	Barrier Height*	Number of Benefited Dwelling Units	Cost per Benefited Dwelling Unit
Ridge Trail	65.5	+17.4	58.8	7-13 ft	11	\$52,250
Terra Vista	70.0	+19.5	63.6	6.5-10 ft	5	\$105,600
Mill Ridge	67.2	+17.0	61.8	6 ft	6	\$70,605
Ridge Crest	68.2	+14.8	No Barrier	NA	1	NA

*Barrier height is measured above the proposed Type B barrier and varies along its length.

It is apparent from **Table 2** that none of the walls meet the reasonable mitigation cost per benefited residence of \$30,000 established by MoDOT. This is due in part to the increased cost of placing the wall on top of bridge structure. The cost for the wall is high and relatively few dwelling units are benefited.

Because of the increased cost, ground walls were studied even though it was assumed that due to the relative elevation of receivers and roadway they would be ineffective. On the west side of the roadway it was determined that a model was not required to show that the wall would be ineffective. Receptor heights are above the roadway and steep slopes exist from the property lines of residence. The ground line is approximately 20 – 30’ below the ground level for residences. Building an 18’ wall at this location would not block the line of site from the roadway, and would therefore not block any of the noise. A ground wall noise model was built to analyze the areas to the east of the roadway. This model’s results show that an 18’ wall does not provide the required benefit for any receivers. **Appendix A** provides a more detailed analysis for each individual receptor under the column labeled “Ground Wall”. Only those receivers impacted by the proposed ground wall were analyzed.

During the ground wall analysis it was acknowledged that receiver heights for both Terra Vista and Mill Ridge were analyzed at 15’ above ground level. This was done to account for the outdoor living space in these units being 2nd floor decks. Because mitigation was not reasonable for these receivers, it was decided to analyze the ground wall again with receiver heights at the standard 5’ above ground level.

Table 3 shows the projected noise mitigation for those sites exceeding either the absolute 66 dBA impact criterion or the relative impact measure. **Appendix A** provides a more detailed analysis for each individual receptor under the columns highlighted in grey. Only the modified locations were analyzed.

Table 3
Projected 2035 Leq (in dBA)
with and without Barriers

Location	Projected 2035 L _{eq}	Change (in dBA)	Projected 2035 L _{eq} With Barrier	Barrier Height	Number of Benefited Dwelling Units	Cost per Benefited Dwelling Unit
Terra Vista	66.9	+20.3	59.8	16-18 ft	3	\$117,000
Mill Ridge	64.3	+18.4	58.5	16-18 ft	6	\$38,250

Table 2 again shows that none of the walls meet the reasonable mitigation cost per benefited residence of \$30,000 established by MoDOT. In this case this is due to the height of wall required to reach the level of the roadway in order to block the line of site, as well as the minimal number of impacted receivers due to sound being blocked by the Type B barrier with the decreased receiver height resulting in decreased noise levels as compared to those for the 15’ receiver height.

V. Conclusion


The noise studies conducted for this project show that noise barriers are not able to reasonably mitigate the noise impacts of the new roadway. Because the new roadway in this area will primarily be built on structure, costs for a noise barrier are increased and the limit of \$30,000 per benefited receptor cannot be achieved. A ground wall scenario was also tested however, due to the elevation of the roadway, as well as the steep slopes of the existing terrain, this scenario also proved to be ineffective or unreasonable.


Address	# DU	Rec.	Existing	Build	Increase	Bridge Wall	Ground Wall	Rec.	Existing	Build	Increase	Ground Wall
		Ht.	dBA	dBA	dBA	dBA	dBA	Ht.	dBA	dBA	dBA	dBA
13339 Olive Boulevard	1	5	59.6	63.2	3.6	63.1						
1100 Woodchase Lane	4	5	51.3	60.5	9.2	58.7						
1100 Woodchase Lane	4	5	52.2*	63.1	10.9	61.0						
1100 Woodchase Lane	4	5	47.9	64.0	16.1	59.0						
1100 Woodchase Lane	4	5	49.4	60.7	11.3	57.2						
344 Ridgemoor Drive	1	5	46.4	62.4	16.0	55.9						
345 Ridgemoor Drive	1	5	45.3	59.7	14.4	53.9						
346 Ridgemoor Drive	1	5	45.7	58.2	12.5	53.1						
259 Ridge Trail Drive	1	5	45.3	63.0	17.7	58.0						
260 Ridge Trail Drive	1	5	48.7	65.5	16.8	59.9						
338 Ridge Trail Drive	1	5	48.6	65.6	17.0	59.6						
339 Ridge Trail Drive	1	5	48.1	65.5	17.4	58.8						
340 Ridge Trail Drive	1	5	47.5	65.2	17.7	57.2						
341 Ridge Trail Drive	1	5	49.4*	64.9	15.5	58.0						
342 Ridge Trail Drive	1	5	47.5	65.2	17.7	57.9						
343 Ridge Trail Drive	1	5	47.1	64.6	17.5	56.1						
254 Ridge Trail Drive	1	5	43.5	54.3	10.8	53.5						
255 Ridge Trail Drive	1	5	44.7	56.0	11.3	54.9						
256 Ridge Trail Drive	1	5	45.6	57.9	12.3	55.7						
257 Ridge Trail Drive	1	5	46.6	59.9	13.3	56.8						
258 Ridge Trail Drive	1	5	47.9	61.2	13.3	57.8						
210 River Bend Drive	1	5	44.5	56.9	12.4	55.4						
211 River Bend Drive	1	5	45.5	58.6	13.1	57.1						
212 River Bend Drive	1	5	46.6	58.7	12.1	57.2						
213 River Bend Drive	1	5	45.7	56.5	10.8	54.4						
214 River Bend Drive	1	5	45.5	56.6	11.1	54.7						
215 River Bend Drive	1	5	45.2	56.7	11.5	54.8						
216 River Bend Drive	1	5	48.2*	56.7	8.5	54.8						
160 Southdown Drive	1	5	46.6	59.1	12.5	58.7						
161 Southdown Drive	1	5	47.8	61.0	13.2	60.7						
162 Southdown Drive	1	5	48.3	62.3	14.0	62.0						
163 Southdown Drive	1	5	48.4	62.2	13.8	61.9						
164 Southdown Drive	1	5	48.4	61.7	13.3	61.3						
165 Southdown Drive	1	5	46.9	60.2	13.3	59.5						
166 Southdown Drive	1	5	48.4*	60.1	11.7	59.3						
167 Southdown Drive	1	5	43.8	56.4	12.6	54.6						
139 Ridgecrest Drive	1	5	55.3	58.6	3.3	58.4						
140 Ridgecrest Drive	1	5	54.8	58.8	4.0	58.5						
141 Ridgecrest Drive	1	5	56.5	60.7	4.2	60.6						
142 Ridgecrest Drive	1	5	56.6	61.5	4.9	61.4						

Address	# DU	Rec.	Existing	Build	Increase	Bridge Wall	Ground Wall	Rec.	Existing	Build	Increase	Ground Wall
		Ht.	dBA	dBA	dBA	dBA	dBA	Ht.	dBA	dBA	dBA	dBA
143 Ridgecrest Drive	1	5	57.5	62.5	5.0	62.5						
144 Ridgecrest Drive	1	5	58.4	65.0	6.6	65.0						
145 Ridgecrest Drive	1	5	53.4*	68.2	14.8	68.2						
158 Ridgecrest Drive	1	5	49.2	63.9	14.7	63.8						
159 Ridgecrest Drive	1	5	48.2	59.5	11.3	59.1						
1202 Creve Coeur Crossing Lane	4	15	64.0	64.2	0.2	64.2						
1210 Creve Coeur Crossing Lane	4	15	60.7	60.4	-0.3	60.3						
1231 Creve Coeur Crossing Lane	4	15	55.0	60.3	5.3	59.7						
1239 Creve Coeur Crossing Lane	4	15	56.8	60.7	3.9	60.3						
1247 Creve Coeur Crossing Lane	4	15	49.6	61.5	11.9	61.2						
1255 Creve Coeur Crossing Lane	4	15	61.4	63.6	2.2	63.5						
13406 Terra Vista Drive	1	15	51.8	62.1	10.3	58.8						
13410 Terra Vista Drive	1	15	51.6	62.4	10.8	59.0						
13414 Terra Vista Drive	1	15	51.2	62.9	11.7	59.3						
13418 Terra Vista Drive	1	15	50.4	63.8	13.4	59.6	62.7	5	46.6	62.2	15.6	59.6
13419 Terra Vista Drive	1	15	55.0	62.1	7.1	58.9	60.5	5	51.0	57.0	6.0	55.8
13422 Terra Vista Drive	1	15	49.7	64.9	15.2	59.9	63.5	5	45.8	63.0	17.2	59.3
13423 Terra Vista Drive	1	15	54.0	62.4	8.4	59.3	60.7	5	50.0	57.0	7.0	55.5
13426 Terra Vista Drive	1	15	49.5	66.8	17.3	60.7	65.1	5	45.7	64.4	18.7	58.4
13427 Terra Vista Drive	1	15	52.7	64.2	11.5	60.1	61.8	5	48.7	58.6	9.9	56.7
13430 Terra Vista Drive	1	15	48.9	69.9	21.0	61.2	69.2	5	45.7	66.6	20.9	57.6
13431 Terra Vista Drive	1	15	51.9	66.7	14.8	61.7	64.1	5	48.1	62.1	14.0	59.3
13435 Terra Vista Drive	1	15	50.5	70.0	19.5	63.6	68.2	5	47.4	67.2	19.8	62.0
1559 Terra Vista Court	1	15	60.2	60.9	0.7	60.1						
1563 Terra Vista Court	1	15	54.4	61.6	7.2	59.7						
1566 Terra Vista Court	1	15	62.2	61.3	-0.9	60.8						
1567 Terra Vista Court	1	15	52.6	61.9	9.3	59.5						
1570 Terra Vista Court	1	15	62.7	61.7	-1.0	61.2						
1571 Terra Vista Court	1	15	52.3	62.0	9.7	59.4						
1575 Terra Vista Court	1	15	52.5	62.0	9.5	59.2						
1579 Terra Vista Court	1	15	52.6	62.1	9.5	59.3						
1583 Terra Vista Court	1	15	52.6	62.0	9.4	59.0						
1587 Terra Vista Court	1	15	52.5	62.3	9.8	59.2						
1700 & 1704 Ridgemont Court	2	15	51.1	64.4	13.3	61.4	64.4	5	47.6	61.9	14.3	60.7
1701 & 1705 Ridgemont Court	2	15	50.2	67.2	17.0	61.8	67.2	5	46.9	64.2	17.3	59.1
1711 & 1715 Ridgemont Court	2	15	50.4	67.0	16.6	61.9	67.0	5	45.9	64.3	18.4	58.5
137, 141, 145 & 149 Amiot Court	4	15	55.7	62.8	7.1	60.9	62.5	5	51.6	60.4	8.8	60.3
152 & 156 Amiot Court	2	15	48.0	65.9	17.9	60.7	64.1	5	44.1	63.2	19.1	56.8
153 & 157 Amiot Court	2	15	53.6	64.2	10.6	61.7	56.7	5	50.3	61.8	11.5	61.7
1819, 1823, 1827 & 1831 Mill Ridge Ct	4	15	55.3	63.4	8.1	61.4	62.5	5	49.8	61.2	11.4	61.2

Address	# DU	Rec.	Existing	Build	Increase	Bridge Wall	Ground Wall	Rec.	Existing	Build	Increase	Ground Wall
		Ht.	dBA	dBA	dBA	dBA	dBA	Ht.	dBA	dBA	dBA	dBA
1824 & 1828 Mill Ridge Court	2	15	61.1	62.6	1.5	62.0	62.5	5	58.7	60.2	1.5	60.2
1832 & 1836 Mill Ridge Court	2	15	60.8	62.6	1.8	62.3	62.5	5	58.3	60.7	2.4	60.7
1835 Mill Ridge Court	1	15	55.4	64.2	8.8	62.8	63.9	5	52.3	62.1	9.8	62.1
1848 & 1852 Mill Ridge Court	2	15	57.1	63.7	6.6	63.1	63.5	5	53.9	61.7	7.8	61.7
2160 Creve Coeur Mill Road	1	5	62.2	61.0	-1.2	60.9						
2160 Creve Coeur Mill Road	1	5	64.3	63.3	-1.0	63.2						
1555 Creve Coeur Mill Road	1	5	44.6									
1915 Creve Coeur Mill Road	1	5	62.3									
15660 Maryland Heights Expressway	1	5	54.4									
15660 Maryland Heights Expressway	1	5	56.0									
15660 Maryland Heights Expressway	1	5	56.0									

* Measured noise levels

 Noise level or increase meet criteria for "impacted" receiver

 Noise reduction through addition of noise barrier meets criteria for "benefited" receiver