RESEARCH

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Utah Department of Transportation - Research Division
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Report No. UT-26.18

UTAH SR 73 EAGLE MOUNTAIN MULE DEER CROSSWALK AND WILDLIFE-DETECTION DRIVER WARNING SYSTEM RESEARCH

Prepared For:

Utah Department of Transportation
Research & Innovation Division

Final Report
July 2026

DISCLAIMER

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DEDICATION

This research was begun in conjunction with Eagle Mountain's wildlife biologist, Todd Black. Todd was a driving force for installing this wildlife crosswalk, as well as current and future wildlife crossing structures. Sadly, Todd passed away in 2025 before the end of this study. The authors dedicate this report to his memory.

TECHNICAL REPORT ABSTRACT

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16. Abstract

The State Road (SR) 73 Eagle Mountain Wildlife Crosswalk (Crosswalk) and Wildlife-Detection Driver Warning System (the System) were part of wildlife accommodation efforts to reduce mule deer/wildlife-vehicle collisions (WVC) while allowing mule deer migrations to continue across SR 73. These included the 60-feet wide Crosswalk gap in wildlife exclusion fence, and the System. The posted speed limit at the Crosswalk was 55 mph, and the average annual daily traffic was over 10,000. Objectives were to evaluate if and by how much the System affected driver speeds at the Crosswalk and evaluate if the System, together with the wildlife fence and crosswalk, reduced WVC crashes and carcasses.

The greatest decreases in speeds in the Crosswalk occurred when the researchers activated the System and stayed out of view. Average speeds of motorists in the Crosswalk with the System activated were 1.4 to 2.8 mph less than speeds in the Crosswalk without System activation. In both tests, the reduced speeds were still above the posted 55 mph speed limit. When mule deer were documented at the Crosswalk and the System was activated, speeds were decreased on average 1.1 mph, to an average of 57.8 mph. There were genuine reductions in carcass and crash densities in the area of the Crosswalk after the completion of all wildlife accommodations. Carcasses were reduced by 83 percent and crashes were reduced by 60 percent. Immediately west of the south wildlife exclusion fence terminus, carcasses increased by 12 percent while crashes increased by 46 percent.

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UNIT CONVERSION FACTORS

SI* (MODERN METRIC) CONVERSION FACTORS				
APPROXIMATE CONVERSIONS TO SI UNITS				
Symbol	**When You Know**	**Multiply By**	**To Find**	**Symbol**
		LENGTH		
in	inches	25.4	millimeters	mm
ft	feet	0.305	meters	m
yd	yards	0.914	meters	m
mi	miles	1.61	kilometers	km
		AREA		
in^2	square inches	645.2	square millimeters	mm^2
ft^2	square feet	0.093	square meters	m^2
yd^2	square yard	0.836	square meters	m^2
ac	acres	0.405	hectares	ha
mi^2	square miles	2.59	square kilometers	km^2
		VOLUME		
fl oz	fluid ounces	29.57	milliliters	mL
gal	gallons	3.785	liters	L
ft^3	cubic feet	0.028	cubic meters	m^3
yd^3	cubic yards	0.765	cubic meters	m^3
		NOTE: volumes greater than 1000 L shall be shown in m^3		
		MASS		
oz	ounces	28.35	grams	g
lb	pounds	0.454	kilograms	kg
T	short tons (2000 lb)	0.907	megagrams (or "metric ton")	Mg (or "t")
		TEMPERATURE (exact degrees)		
°F	Fahrenheit	5 (F-32)/9 or (F-32)/1.8	Celsius	°C
		ILLUMINATION		
fc	foot-candles	10.76	lux	lx
fl	foot-Lamberts	3.426	candela/m^2	cd/m^2
		FORCE and PRESSURE or STRESS		
lbf	poundforce	4.45	newtons	N
lbf/in^2	poundforce per square inch	6.89	kilopascals	kPa
APPROXIMATE CONVERSIONS FROM SI UNITS				
Symbol	**When You Know**	**Multiply By**	**To Find**	**Symbol**
		LENGTH		
mm	millimeters	0.039	inches	in
m	meters	3.28	feet	ft
m	meters	1.09	yards	yd
km	kilometers	0.621	miles	mi
		AREA		
mm^2	square millimeters	0.0016	square inches	in^2
m^2	square meters	10.764	square feet	ft^2
m^2	square meters	1.195	square yards	yd^2
ha	hectares	2.47	acres	ac
km^2	square kilometers	0.386	square miles	mi^2
		VOLUME		
mL	milliliters	0.034	fluid ounces	fl oz
L	liters	0.264	gallons	gal
m^3	cubic meters	35.314	cubic feet	ft^3
m^3	cubic meters	1.307	cubic yards	yd^3
		MASS		
g	grams	0.035	ounces	oz
kg	kilograms	2.202	pounds	lb
Mg (or "t")	megagrams (or "metric ton")	1.103	short tons (2000 lb)	T
		TEMPERATURE (exact degrees)		
°C	Celsius	1.8C+32	Fahrenheit	°F
		ILLUMINATION		
lx	lux	0.0929	foot-candles	fc
cd/m^2	candela/m^2	0.2919	foot-Lamberts	fl
		FORCE and PRESSURE or STRESS		
N	newtons	0.225	poundforce	lbf
kPa	kilopascals	0.145	poundforce per square inch	lbf/in^2

*SI is the symbol for the International System of Units. (Adapted from FHWA report template, Revised March 2003)

LIST OF ACRONYMS

AADT	Average Annual Daily Traffic
FHWA	Federal Highway Administration
KDE	Kernel Density Estimate
MPH	Miles per hour
MP	Mile Post
SR	State Road
TDC	Traffic Data Counter
UDOT	Utah Department of Transportation
UDWR	Utah Division of Wildlife Resources
WVC	Wildlife-Vehicle Collision

EXECUTIVE SUMMARY

Introduction and Objectives

The State Road (SR) 73 Eagle Mountain Wildlife Crosswalk and Wildlife-Detection Driver Warning System were part of wildlife accommodation efforts by the Utah Department of Transportation (UDOT) and their partners including Eagle Mountain, to reduce mule deer Wildlife-Vehicle Collisions (WVCs) while allowing mule deer migrations to continue across SR 73. The wildlife accommodation efforts included: the Wildlife Crosswalk (Crosswalk), the Wildlife-Detection Driver Warning System (the System), and wildlife exclusion fence. The Crosswalk was located at Mile Post (MP) 30.35 where paired gaps in the wildlife exclusion fence allowed mule deer to move across SR 73. The speed limit at the Crosswalk was 55 mph during the study. Traffic volumes at the Crosswalk were recorded during the study as high as 12,000 vehicles per day. The System used infrared-camera technology to detect mule deer movements as they approached the Crosswalk gaps in the fence and then activated amber flashing lights and "SLOW DOWN" messages attached to two deer caution signs. There were two primary objectives in this study: 1. Evaluate if the System affected driver speeds at the Crosswalk, and if so, to what degree; and 2. Evaluate if the System, together with the wildlife accommodations, reduced WVC, as measured by reported crashes with wildlife and carcass data. Secondary objectives included quantitatively measuring the accuracy of the System for detecting wildlife and categorizing and tallying mule deer movements at the Crosswalk.

Methods

Vehicle speeds and traffic volumes at the Crosswalk, and at two locations on SR 73 were recorded with Stalker Traffic Data Counters (TDCs). Motorists' speeds at the three TDCs were analyzed. Carcass and crash data were examined using Two-Dimensional Kernel Density Estimates (2D KDEs). Mule deer movements at the Crosswalk were recorded with four Reconyx Professional series cameras on both sides of the crosswalk.

Results

The greatest decreases in speeds in the Crosswalk occurred when the researchers activated the System and stayed out of view; average speeds of motorists in the Crosswalk with the System activated were 1.4 to 2.8 mph less than speeds in the Crosswalk without System activation. In both tests, the reduced speeds were still above the posted 55 mph speed limit. When mule deer were documented at the Crosswalk and the System was activated, speeds were decreased on average 1.1 mph, to an average of 57.8 mph. There were genuine reductions in carcass and crash densities in the area of the Crosswalk after the completion of all wildlife accommodations. Carcasses were reduced by 83 percent and crashes were reduced by 60 percent. Immediately west of the south wildlife exclusion fence terminus, carcasses increased by 12 percent while crashes increased by 46 percent. These increases may be explained by "fence-end-effect" where a portion of the mule deer that previously crossed near MP 30 were attempting to move across SR 73 just west of the south fence terminus at MP 29.7. From November 2023 through February 2025, there were 2,279 mule deer Total Movements recorded at the Crosswalk. There were 1,257 mule deer Success Movements across SR 73. There were 675 Repellency Movements, 13 Parallel Movements, three Fatality Movements, and 331 Unknown Movements. The Success Rate (Success Movements divided by Total Movements) was 55 percent, and the Rate of Repellency (Repellency Movements divided by Total Movements) was 30 percent.

Discussion and Recommendations

The study results found that the fences, Crosswalk, and System did reduce reported crashes and carcasses in the area of the Crosswalk, and drivers' speeds were only slightly reduced when the System was activated. The problem of WVC was apparently partially moved westward to the end of the south fence at MP 29.7, albeit with reduced rates of carcasses and crashes. On average, when warned, motorists did not slow down appreciably to avoid collisions with wildlife. This quickly urbanizing community of Eagle Mountain has not and may not adapt to wildlife on the road and systems aimed at slowing driver speeds. The mule deer were severely restricted in their ability to cross SR 73. Recommendations include: 1. Replacing the Crosswalk with a wildlife crossing structure and possibly additional structures; 2. Moving the Crosswalk westward. This type of System is more appropriate for two-lane roads with far lower traffic volumes, less ingress and egress roads near the System site, and posted speeds of 55 mph or less.

1.0 INTRODUCTION

The State Road (SR) 73 Eagle Mountain Wildlife Crosswalk and Wildlife-Detection Driver Warning System were part of wildlife accommodation efforts by UDOT and their partners, the Utah Division of Wildlife Resources (UDWR), the City of Eagle Mountain, and the Mule Deer Foundation, to reduce mule deer Wildlife-Vehicle Collisions (WVC) while allowing spring and winter mule deer migrations to continue across SR 73. The wildlife accommodation efforts included: the Wildlife Crosswalk, the Wildlife-Detection Driver Warning System, and wildlife exclusion fence. Mule deer migrate across the two-lane SR 73 between their summer range in the Oquirrh Mountains north of SR 73 and their winter range in the Lake Mountains west of Utah Lake. The winter range includes lands managed by the Bureau of Land Management and State of Utah. The migration is threatened by development and WVC (Figure 1). UDWR placed the Eagle Mountain Mule Deer Migration on its list of top wildlife migration corridors important to the U.S. Department of Interior Secretarial Order 3362.

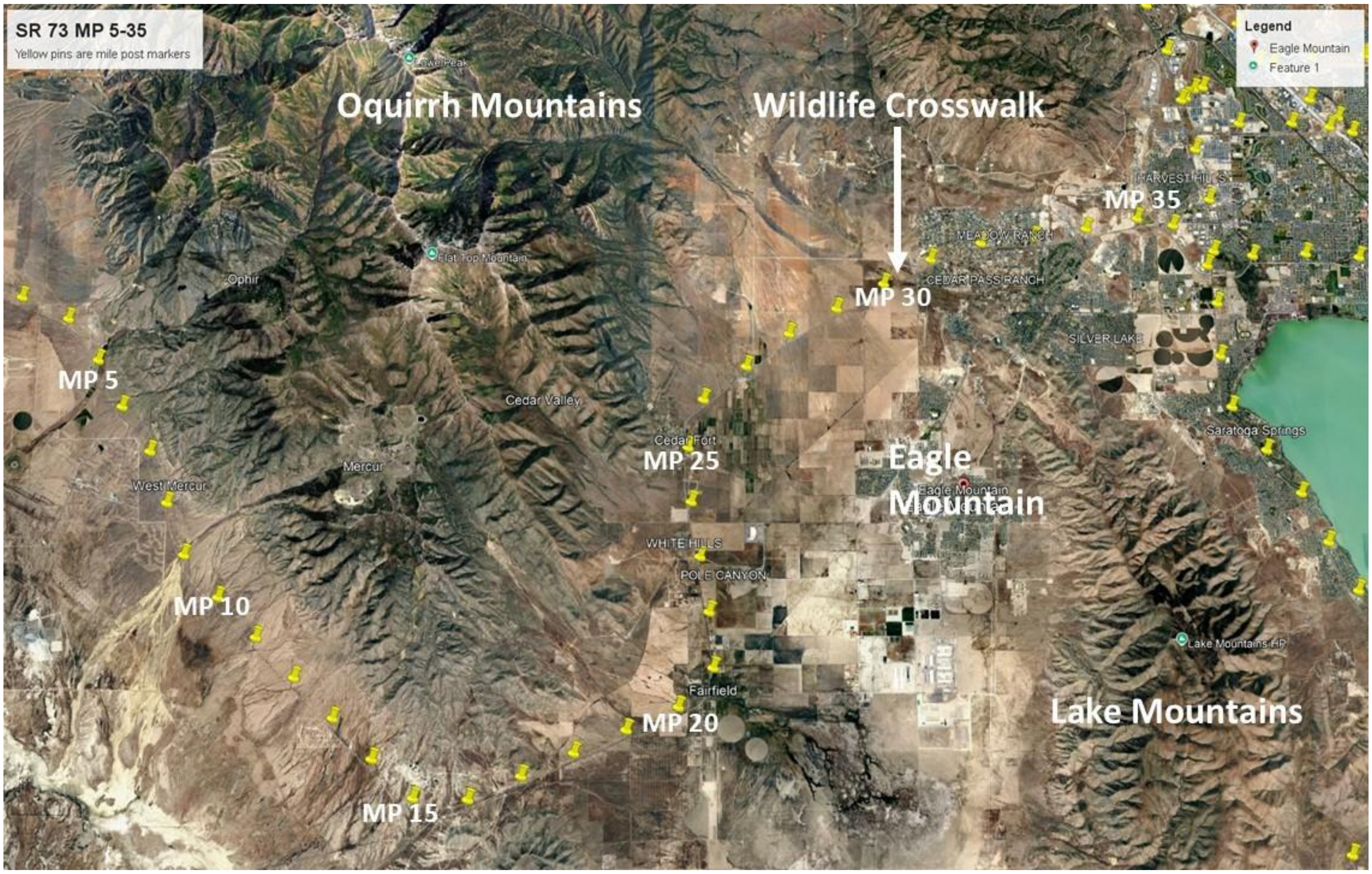

Figure 1. The landscape of the Study Area of State Road (SR) 73, Mile Posts (MP) and Wildlife Crosswalk at Eagle Mountain, Utah.

The Wildlife Crosswalk (Crosswalk) is located at Mile Post (MP) 30.35 where paired gaps in the wildlife exclusion fence allow mule deer to move across SR 73. The gap in the fence on the north side of the Crosswalk is 68 feet wide and the gap in the fence on the south side is 46 feet wide. (Figure 2).

The speed limit at the Crosswalk was 55 mph during the study. Traffic volumes at the crosswalk were recorded during the study as high as 12,000 vehicles per day (average annual daily traffic, AADT).

Figure 2. The Wildlife Crosswalk across SR 73 as viewed from the South. Photo credit: P. Cramer.

The Wildlife-Detection Driver Warning System (the System) was installed by CrossTek at the Wildlife Crosswalk between October 2022 and May 2023 (according to Google Earth images). The System uses infrared-camera technology to detect mule deer movements as they approach the Crosswalk gaps in the fence and then activates amber flashing lights and "SLOW DOWN" messages attached to two deer caution signs (Figure 3). The System remains activated while mule deer are being detected near the gaps or in the Crosswalk and deactivates approximately 120 seconds after detection stops. The System was the first advanced wildlife-detection driver warning system in Utah.

A

B

Figure 3. Motorists were warned when approaching the Crosswalk area with yellow diamond signs with a deer silhouette on them, with small LED lights around the perimeter (A). The System signs (B) located closer to the Crosswalk were yellow diamond signs with deer silhouette, two amber flashing lights above, static signs with the words, "WHEN FLASHING," and lighted white LED messages on black backgrounds that state "SLOW DOWN," all of which flash when activated. Photo credits: P. Cramer.

Wildlife exclusion fence consisted of eight-foot-high modified snow-fence on the north side of SR 73 and standard wildlife exclusion fence on the south side of SR 73. The modified snow fence on the north side was constructed with gaps for farm equipment in 2015 from MP 27.5 to MP 31.3. Gaps in the snow fence were closed by December 2020. The standard wildlife exclusion fence on the south side was constructed between June 2020 and June 2022 and stretched from MP 29.7 to MP 30.75. The Crosswalk and the exclusion fence are depicted in Figure 4.

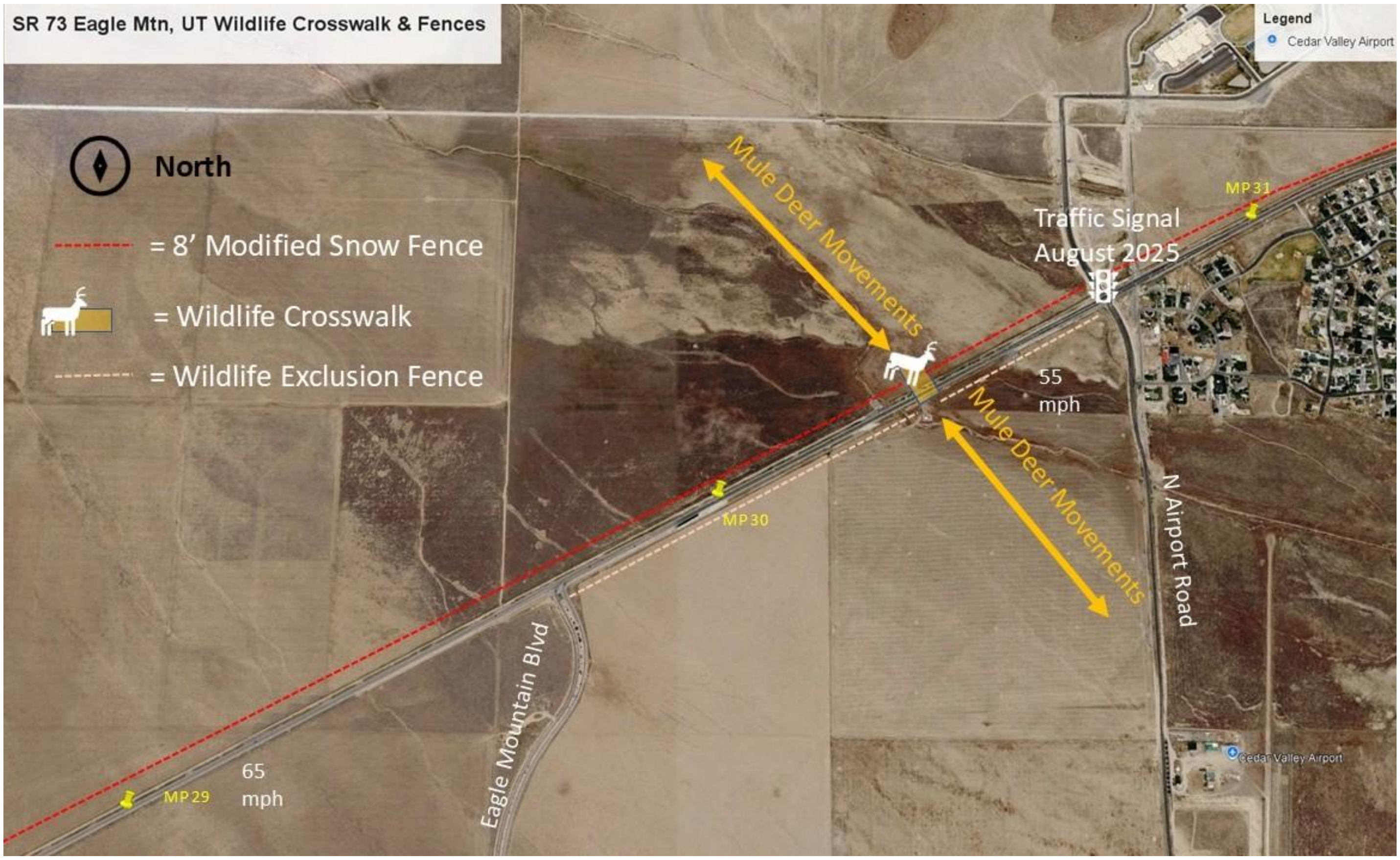

Figure 4. The wildlife crosswalk at SR 73 and the wildlife exclusion fence, at Eagle Mountain, Utah.

1.1 Past and Concurrent Studies on Detection Driver Warning Systems

Animal-Activated, or Wildlife-Detection Driver Warning systems (AADS, or WDS) have been placed in various road, traffic, and wildlife situations and tested for two decades across western North America. Different researchers used various methods to measure driver speeds before and after mitigation, making it difficult to make comparisons among studies on how driver speeds were affected. However, a brief literature review of these studies was helpful in setting expectations of this SR 73 Wildlife Crosswalk and Wildlife Detection System.

Past studies on AADS have found that drivers slow down minimally, from 3.1 mph in California (Huijser et al., 2014) to 0.7 – 4.4 mph in Idaho (Huijser et al., 2017), to 3-5 mph in Wyoming (Riginos et al., 2019), and up to 7 mph in Arizona (Gagnon et al., 2010 and 2019). This latter Arizona study was located at an AADS similar to the one at Eagle Mountain.

Rytwinski et al.'s 2016 review of AADS found the systems reduced wildlife-vehicle collisions by an average of 57%. In 2027, Cramer and Hamlin will complete a concurrent study on the efficacy of a WDS in Colorado (see Cramer and Hamlin, 2026 for the most recently completed study at the time of the writing of this report).

1.2 Study Objectives

There were two primary objectives in this study. The first objective was to evaluate if the System affected driver speeds at the Crosswalk, and if so, to what degree. The second of the primary objectives was to evaluate if the System, together with the wildlife accommodations, reduced WVC, as measured by reported crashes with wildlife and carcass data. Other objectives included categorizing and tallying mule deer movements at the Crosswalk, and quantitatively measuring the accuracy of the System for detecting wildlife.

The report is organized by the approaches used in the study to measure motorists' speeds, changes in WVC, evaluate mule deer movements across SR 73, and the ability of the System to activate when deer were present. This project began August 24, 2023, and ended July 31, 2026.

1.3 Outline of Report

This report is organized with this introduction, followed by four chapters that detail the four different approaches to evaluate the crosswalk and wildlife-detection driver warning system. Chapter 2 presents the methods, results and discussion of driver speeds. Chapter 3 presents the analysis, results, and discussion of changes in wildlife-related crashes and carcasses over time. Chapter 4 presents mule deer movements at the Crosswalk. Chapter 5 presents the accuracy of the wildlife-detection driver warning system. The final chapter provides the researchers' recommendations for future actions.

2.0 MOTORISTS' SPEEDS

The speeds of vehicles were recorded under various conditions and locations along SR 73 to better understand if the System was able to affect motorists' speeds. In this section, the methods used and motorists' speed results under various scenarios are presented along with a summary and discussion of each approach.

2.1 Stalker Traffic Data Collectors

Three Stalker Traffic Data Collectors (TDCs), posts, brackets, and solar panels were installed by UDOT Maintenance, Eagle Mountain City, and a Stalker Company representative on December 20, 2023 (Figure 5). The three TDCs were placed on the north side of SR 73 in the same east-facing orientation at the following designated locations: **West TDC** at MP 29.3, **Crosswalk TDC** at MP 30.35, and **East TDC** at MP 30.65. The three Stalker TDCs collected vehicle speeds inconsistently, were removed from the study area on March 15, 2024, and were returned to Stalker on June 12, 2024. Three new Stalker TDCs were installed with their new solar panels in the same locations on the existing three posts on November 1, 2024.

Figure 5. Posts and solar panels installed by UDOT and Stalker, left, and Stalker Traffic Data Collectors with solar panels, right. Photo credits: UDOT and P. Cramer.

2.2 Average Vehicle Speeds Over Time Along SR 73

Average vehicle speeds in miles per hour (mph) were calculated from 14 data sets collected by TDCs at the West TDC, Crosswalk TDC, and East TDC locations. Speed data were collected without regard to activation and deactivation of the System. The 14 data sets were selected from hundreds of data sets to best represent the average vehicle speeds over time along SR 73 in the study area. The West TDC produced complete data sets that spanned multiple months (Data Set 4 and Data Set 7). The Crosswalk TDC and East TDC produced multiple data sets that spanned a few days or weeks, and some of these data sets were recorded with a sampling schedule that the researchers did not program. Thus, the 14 data sets varied when speeds were recorded (duration and time of day) and the number (n) of speeds recorded. Time of day is in military time.

- Data Set 1, November 2 through November 17, 2024, from 02:00 to 05:00, n=1780,
- Data Set 2, November 18, 2024, through February 6, 2025, from 02:00 to 05:00, n=7700,
- Data Set 3, February 7 through February 11, 2025, from 02:00 to 05:00, n=410,
- Data Set 4, August 1 through November 1, 2025, from 00:00 to 23:59, n=372,819,
- Data Set 5, July 28 through September 24, 2025, 18:00 to 23:59, n=49,477
- Data Set 6, August 7 through September 25, 2025, 01:10 to 14:30, n=465,722
- Data Set 7, November 1, 2025, through April 18, 2026, 00:00 to 23:59, n=513,496,
- Data Set 8, November 5 through November 12, 2025, 00:00 to 23:59, n=77,754,
- Data Set 9, November 12, 2025, through February 6, 2026, 00:00 to 23:59, n=877,164,
- Data Set 10, February 6 through April 13, 2026, 00:00 to 23:59, n=785,913,
- Data Set 11, November 5 through November 12, 2025, 00:00 to 23:59, n=86,459,
- Data Set 12, November 12 through December 1, 2025, 00:00 to 23:59, n=233,946,
- Data Set 13, February 6 through March 24, 2026, 07:45 to 19:45, n=406,677, and
- Data Set 14, March 24 through April 9, 2026, 07:45 to 19:45, n=160,344.

Average vehicle speeds from these 14 data sets are presented in Table 1. The posted speed limits during the study were 65 mph at the West TDC and 55 mph at Crosswalk TDC. The speed limit at East TDC was 55 mph during the recording of Data Sets 1 and 3, and 50 mph during the recording of Data Sets 6, 11, 12, 13, and 14. Speed data from the East TDC was not available in Data Set 2.

Table 1. Average vehicle speeds at the East TDC, Crosswalk TDC, and West TDC for each of 14 Data Sets.

Data Set	West TDC (mph)	Crosswalk TDC (mph)	East TDC (mph)
1	63.1	58.9	57.2
2	62.1	58.4	-
3	64.1	59.4	58.7
4	63.1	-	-
5	-	60.1	-
6	-	-	45.8
7	63.3	-	-
8	-	56.8	-
9	-	56.8	-
10	-	56.6	-
11	-	-	45.9
12	-	-	45.9
13	-	-	46.0
14	-	-	46.2

Average vehicle speeds at the West TDC remained constant during the study, at approximately 63 mph, just below the posted speed limit of 65 mph (Data Sets 1, 2, 3, 4, and 7). Average speeds at the Crosswalk TDC decreased slightly from mid-2025 to early 2026, from approximately 59 mph to approximately 57 mph, however, average speeds were always greater than the posted 55-mph speed limit (Data Sets 1, 2, 3, 5, 8, 9, and 10). Average vehicle speeds at the East TDC (Data Sets 1, 3, 6, 11, 12, 13, and 14) greatly decreased with the change in the posted speed limit, from around 57 mph (above the original 55 mph speed limit) to around 46 mph (below the newly posted speed limit in 2025 of 50 mph).

The posted speed limit change and the changes in average speeds at the Crosswalk TDC and the East TDC were related to the extension and realignment of Airport Road and its intersection with SR 73 at MP 30.75. The intersection includes left-turn lanes, through lanes, and right-turn lanes on all four sides. A 50-mph speed limit sign and a "Traffic Signal Ahead" warning sign with beacon lights were installed near MP 30.6, just west of the East TDC. Both the beacon lights and the speed limit sign are visible to east-bound vehicles while passing through the Crosswalk. The intersection and its traffic signals appeared to be fully functional on August 4, 2025.

2.2.1 Speed Density Plots

Changes in speed limit and average speed are visually represented in speed density plots for the East TDC in early August 2025 (Figure 6), Data Set 10 (Crosswalk TDC, Figure 7) and Data Set 14 (East TDC, Figure 8). The consistency of speeds at the West TDC is demonstrated by the speed density plot in Figure 9. Low speed densities are represented by green, moderate speed densities are represented by orange, and high speed densities are represented by red.

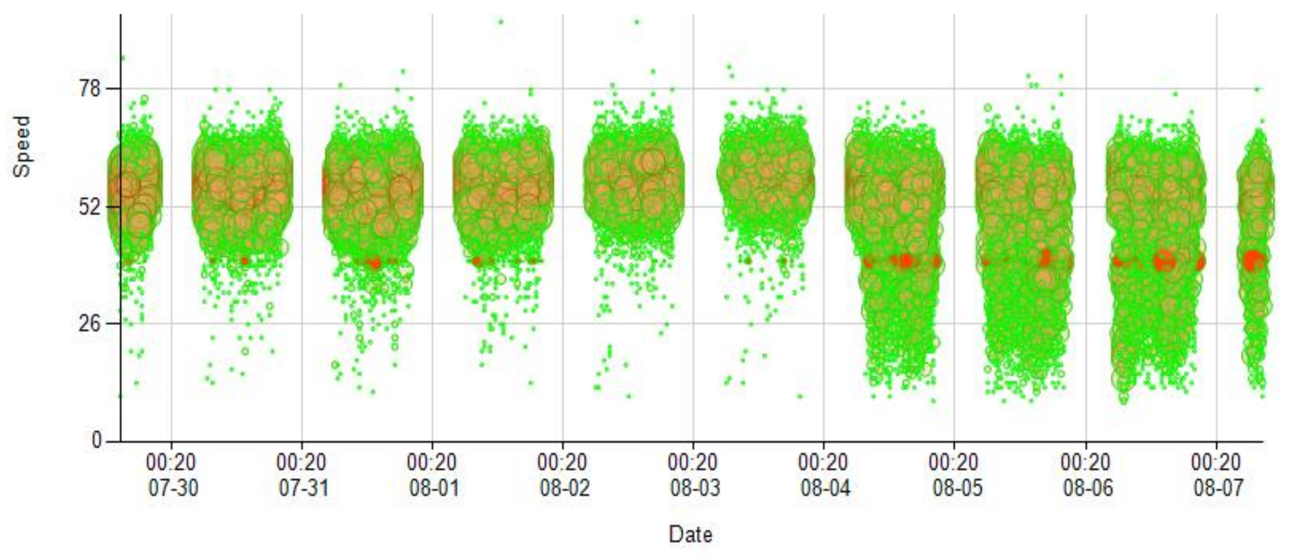

Figure 6. Speed density plot of the East TDC, showing average speed changes beginning on August 4, 2025.

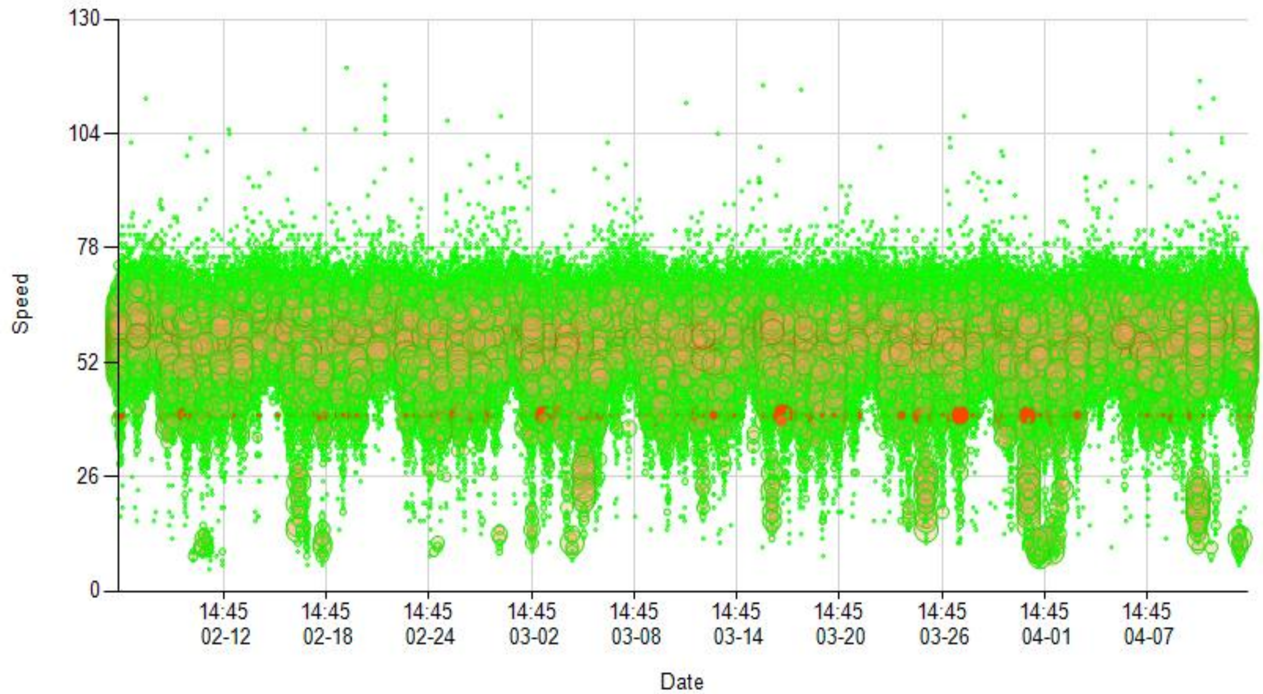

Figure 7. Speed density plot of Data Set 10, Crosswalk TDC, February 6 through April 13, 2026. Note: vertical grid lines are placed for every six days.

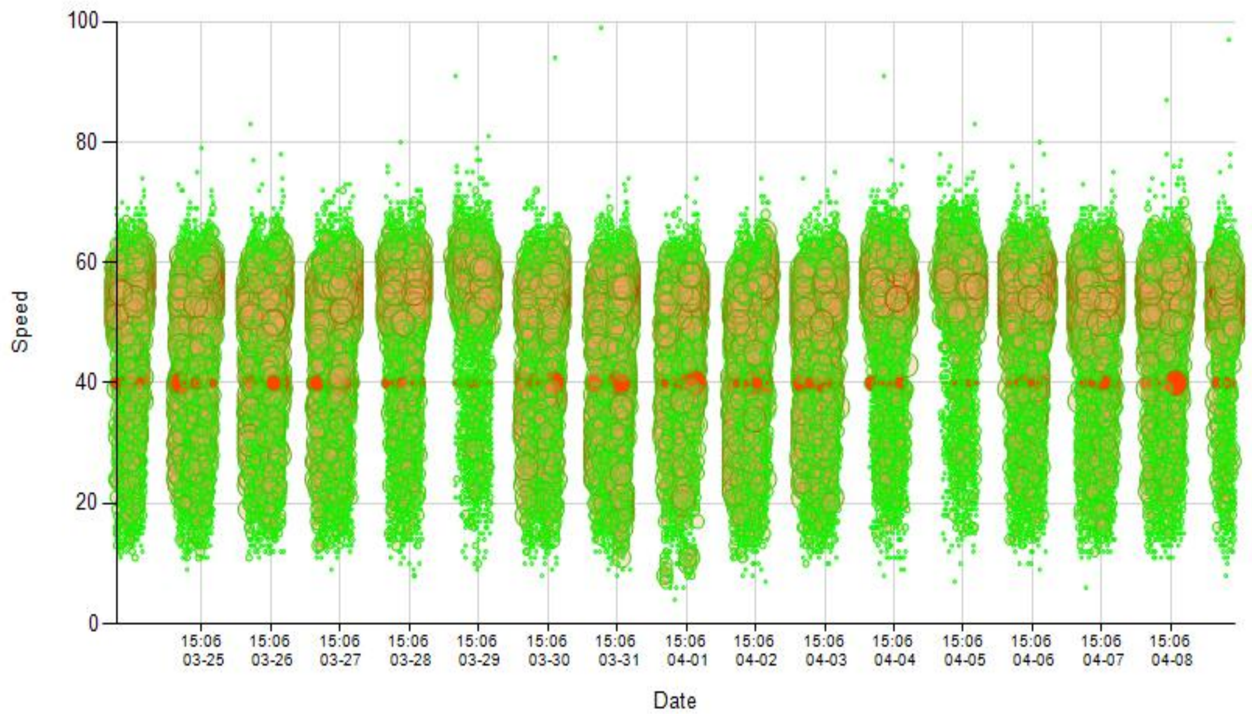

Figure 8. Speed density plot of Data Set 14, East TDC, March 24 through April 9, 2026, 07:45 to 19:45. Note: vertical grid lines are placed for every day.

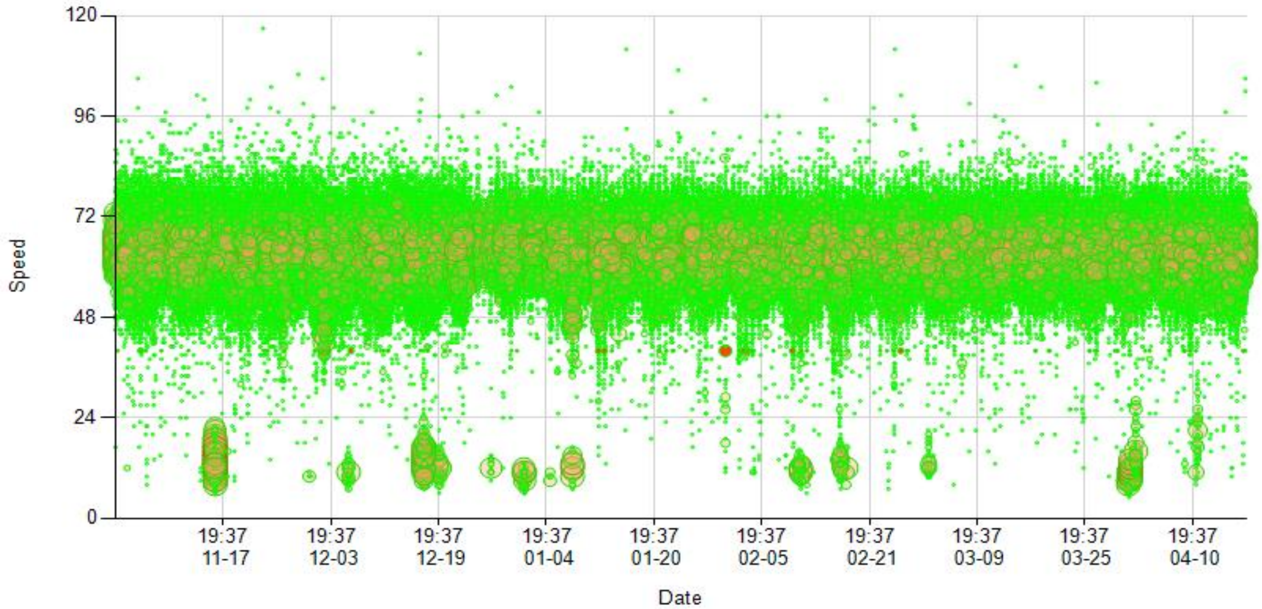

Figure 9. Speed density plot of Data Set 7, West TDC, November 1, 2025 through April 18, 2026. Note: vertical grid lines are placed for every 16 days.

2.2.2 Discussion of Average Speeds

Figure 6 demonstrates that beginning on August 4, 2025, there was a much wider range of speeds, a slightly lower average speed, and a slightly high density of speeds (in red) around 40 mph in the East TDC. The speed density plot for the Crosswalk TDC (Figure 7) during February to April 7, 2026, displays a moderately wide range of speeds around the average of 57 mph, and moderately high density of speeds (in red) around 38 mph. The speed density plot for the East TDC from late March to early April 2026 (Figure 8), shows the widest range of speeds around an average of 46 mph, and a strong high density of speeds (in red) around 40 mph. It is important to note that speeds in Figure 8 were collected from 07:45 to 19:45. The high density of speeds (in red) in Figures 6, 7, and 8 were possibly an effect of traffic signal cycling at the N. Airport Road. The speed density plot for the West TDC in Figure 9 shows a relatively narrow range of speeds, with the exception of speeds around 20 mph, probably from westbound traffic that were slowed by or entered SR 73 from the Eagle Mountain Blvd intersection. The effect of traffic signal cycling was minimal at the West TDC location.

2.3 Were Average Vehicle Speeds Reduced at the Wildlife Crosswalk While the Wildlife-Detection Driver Warning System was Activated?

Three different tests were carried out to determine if vehicle speeds changed within the Crosswalk with activation of the System: Manual Activation, Natural Activation, and Mule Deer Activation.

2.3.1 Manual Activation-Deactivation Cycles of the System

On May 9, 2025, and on April 18, 2026, we conducted 10 manually controlled activation-deactivation cycles of the Wildlife-Detection Driver Warning System by walking into the detection zone to activate the System, then moving out of sight of motorists. Each cycle consisted of the System being activated for 120 seconds and deactivated for 180 seconds. The two experiments were conducted between approximately 17:00 and 17:45. Wildlife were not present at the Crosswalk during the experiments. We buffered speeds at the beginning of each activation cycle by 15 seconds.

On May 9, 2025, the average speed at the Crosswalk TDC while the System was activated (System on) was 56.2 miles per hour (n = 166 vehicles). The average speed at the Crosswalk while the WDS was not activated (System off) was 59.0 miles per hour (n = 330 vehicles). This test resulted in a 2.8 mph reduction in average speed. A t-test showed there was very good evidence that the average speeds were different (p-value < 0.001).

On April 18, 2026, the average speed at the Crosswalk TDC while the System was activated was 56.8 miles per hour (n = 268 vehicles). The average speed at the Crosswalk while the WDS was not activated was 58.2 miles per hour (n = 416 vehicles). This test resulted in a 1.4 mph reduction in average speed. A t-test showed there was very good evidence that the average speeds were different (p-value = 0.0015). As a note of explanation, if two average vehicle speeds being compared were in fact equal (the null hypothesis in the t-test), the p-value reported for that comparison represents the probability that the observed difference in average vehicle speeds resulted from random chance. When p-values are extremely low, the null hypothesis can be rejected.

In both tests, the average speed within the Crosswalk with the System activated was greater than the 55-mph speed limit.

2.3.2 Natural Activation of the System

We used data collected and stored by CrossTek that provided specific activation and deactivation timestamps for the System between February 3 and April 18, 2026. These activations occurred naturally when the System detected motion in the Crosswalk caused by wildlife, humans (not the researchers), domesticated animals, vehicles, or other factors. We then manually paired the System timestamps with the Crosswalk TDC timestamps in order to categorize individual Crosswalk TDC speeds as either System activated or System deactivated, and conducted two tests.

In the first test, from 10:15 on February 6 to 17:22 on February 24, 2026, there were 208,293 speeds with paired timestamps. The average speed ($n = 2,321$) with the System activated was 57.0 mph; the average speed ($n = 205,972$) with the System deactivated was 57.2 mph. This test resulted in a 0.2 mph reduction in speed. A t-test showed moderate evidence that the average speeds were different (p-value = 0.11).

In the second test, from 14:00 on April 13 to 13:40 on April 18, 2026, there were 65,818 speeds with paired timestamps. The average speed ($n = 1,081$) with the System activated was 56.0 mph; the average speed ($n = 64,737$) with the System deactivated was 55.0 mph. This test resulted in a 1.0 mile per hour increase in average speed. A t-test showed very good evidence that the average speeds were different ($p < 0.001$). In both tests, the average speeds with the System activated were greater than the 55-mph speed limit.

2.3.3 Mule Deer Activation of the System

Mule Deer were photographed at the Crosswalk by Reconyx Professional cameras on 23 separate occasions from November 2, 2024, through February 11, 2025 between the hours of

2:00 AM and 5:00 AM (the cameras were installed by the researchers, installation methods and settings are detailed below in the section below titled "Mule Deer Movements at the Wildlife Crosswalk"). The Wildlife-Detection Driver Warning System was activated 96 percent of the time while mule deer were present at the Crosswalk (22 of 23 occasions). Mule deer crossed SR 73 on 18 of the 23 occasions. We manually paired Reconyx camera timestamps with the Crosswalk TDC timestamps in order to categorize individual Crosswalk TDC speeds as either mule deer present or mule deer absent. The average speed of westbound vehicles at the Crosswalk TDC when mule deer were present and the System was activated was 57.8 mph. The average speed of westbound vehicles at the Crosswalk TDC when mule deer were absent and the System was not activated was 58.9 mph. This average was calculated from speeds 30 minutes before and 30 minutes after the mule deer movements at the Crosswalk. This test resulted in a 1.1 mph reduction in average speed. A t-test could not be conducted because of the small number of speeds recorded during mule deer presence compared to the large number of speeds recorded when mule deer were absent. The result should also be questioned because the timestamps on the four Reconyx cameras varied by as much as one minute and 45 seconds, and the Reconyx timestamps were not electronically tied to the timestamp on the Crosswalk TDC. In addition, we could not attribute the difference in average speeds to the System. Drivers may have been driving slower because of deer in the right-of-way and moving across SR 73, the activated System with its beacons and warning signs, or a combination of both. However, the average speed when mule deer were present was well above the 55-mph speed limit.

2.4 Summary and Discussion of Motorists' Speeds

A summary of the changes in average speeds at the Crosswalk while the System was activated as compared to speeds at the Crosswalk when the System was not activated within the same timeframes is provided in Table 2. While several of the tests showed reductions in average speed that were statistically significant, in every test average speed in the Crosswalk while the System was activated was greater than the 55-mph speed limit. During multiple visits to the study area, we observed that high traffic volumes at the Crosswalk may cause drivers to simply follow the speed of the vehicle in front of them rather than responding to the activated System. Another factor may be that drivers do not understand that the System is dynamically detecting mule deer so they interpret the flashing beacons as static warning signs.

Table 2. Summary of changes in average motorist speeds at the Crosswalk during activation of the System.

Type of Activation	**Date**	**Change in Average Speed (mph)**	**Direction of Change**	**p-value**
Manual, Test 1	May 9, 2025	-2.8	Reduction	<0.001
Manual, Test 2	April 18, 2026	-1.4	Reduction	0.0015
Natural, Test 1	February 6-24, 2026	-0.2	Reduction	0.11
Natural, Test 2	April 13-18, 2026	+1.0	Increase	<0.001
Mule Deer	November 2, 2024-February 11, 2025	-1.1	Reduction	Not Applicable

3.0 CHANGES IN WILDLIFE-VEHICLE COLLISIONS OVER TIME AND SPACE USING CARCASS AND REPORTED CRASH DATA

The carcass data and reported crashes with wildlife data for SR 73 were plotted and compared in time and space to evaluate if there were reductions in the crashes and carcasses at the Crosswalk once the System was installed, or if the collisions were just moved to other areas along SR 73.

3.1 Methods

Wildlife carcass and wildlife-related crash data for SR 73 were received from UDWR and UDOT, respectively. Wildlife carcass data from 2018 through April 10, 2026, for MP 0 to MP 36 were filtered for mule deer, elk, and pronghorn, resulting in 455 carcasses (99 percent mule deer). Wildlife-related vehicle crash data from 2017 through 2025 for MP 5 to MP 36 totaled 164 crashes.

Two-dimensional Kernel Density Estimates (2D KDEs) of the 455 wildlife carcasses and the 164 reported crashes are presented in Figures 10 and 11, respectively. The 2D KDEs illustrate carcass and crash densities over time (year) and space (mile post), before and after the wildlife accommodation efforts were installed. Higher densities are represented by brighter colors (yellow is the highest) and lower densities are represented by darker colors (purple is the lowest). The Crosswalk, the System, and the wildlife exclusion fence are represented by the vertical red hashing and dashed lines. The November 30, 2022, installation date of the accommodation efforts is represented by the horizontal black dashed lines. This date was chosen for the purpose of this report because we do not know the actual construction start and stop dates of the accommodation efforts.

3.2 Results

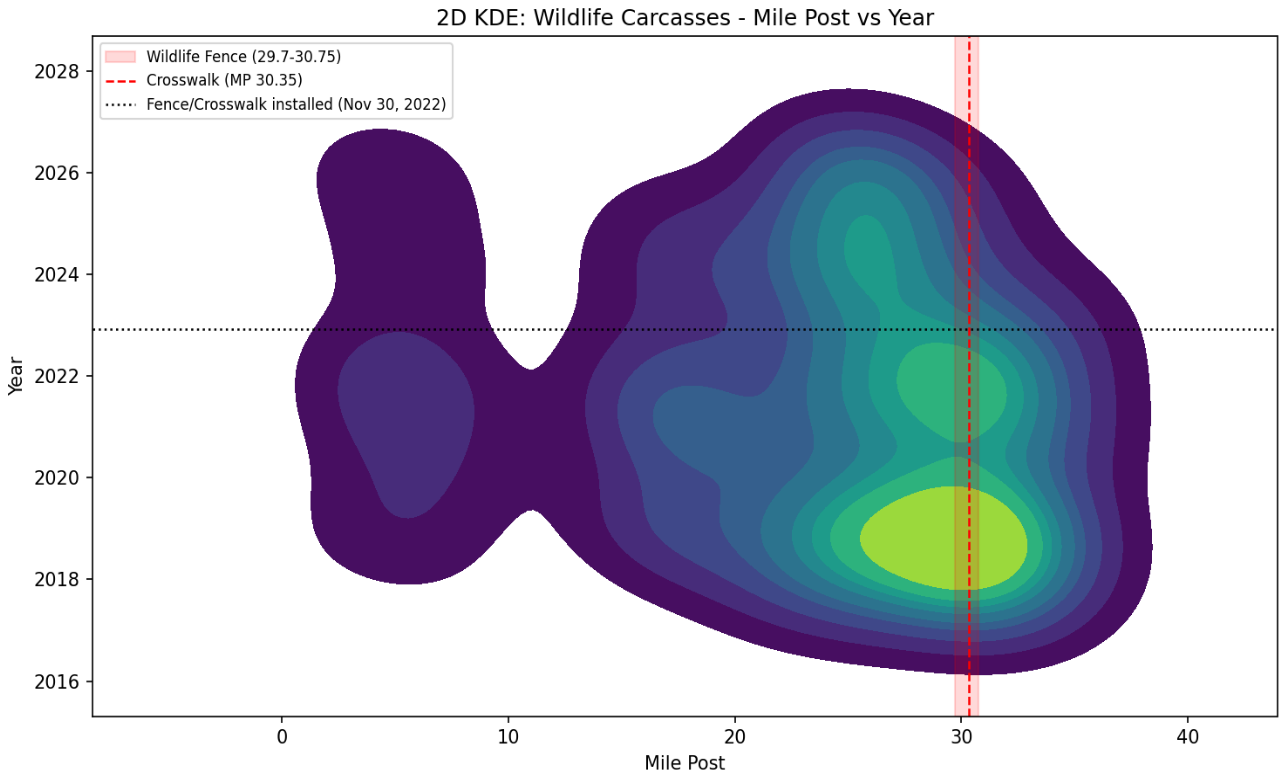

Figure 10. 2D KDE of wildlife carcasses 2017-2026.

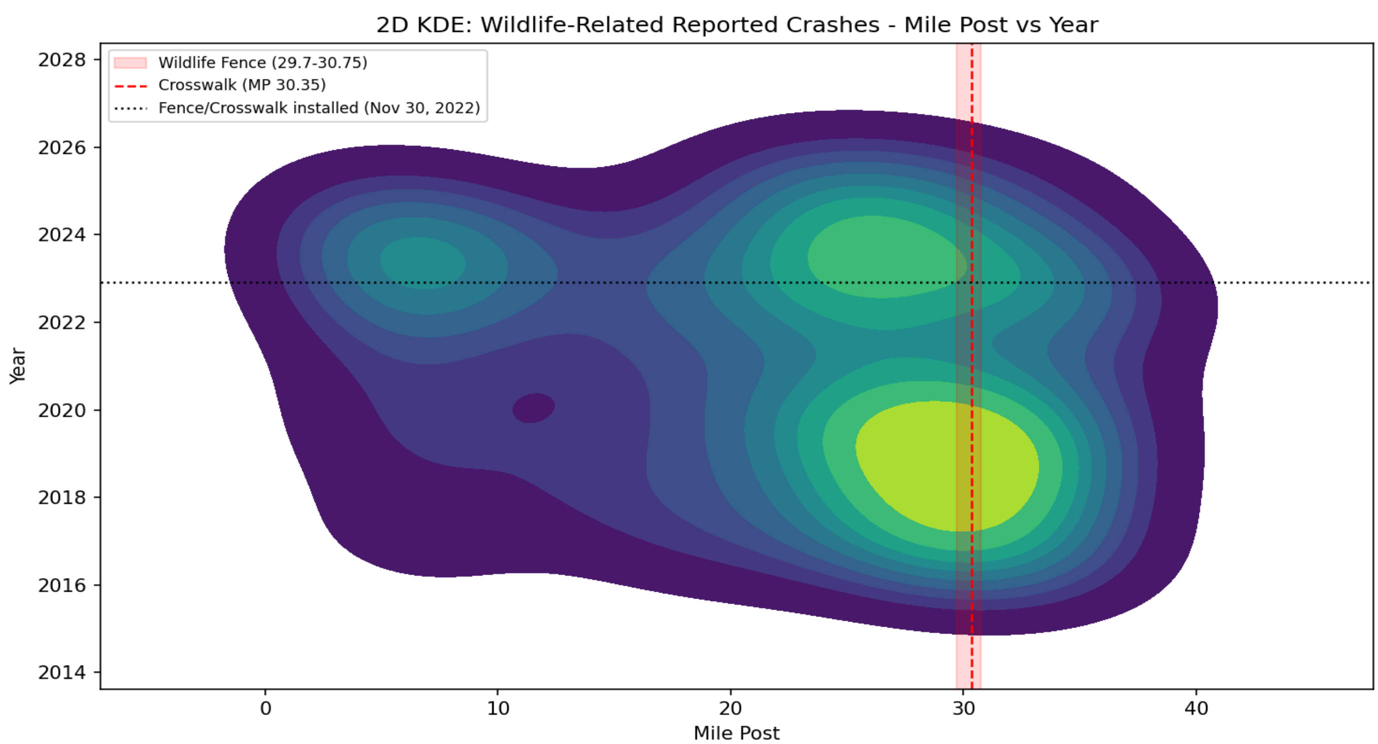

Figure 11. 2D KDE of wildlife-related reported crashes 2017-2025.

3.3 Discussion

The analysis of the changes in Wildlife-Vehicle Collisions over time and space is very complicated because there are many variables that determine WVC rates. In this study, these variables include: traffic volume, vehicle speed, wildlife population density, mule deer seasonal migrations, topography and water features, land use changes (urbanization), unequal effort in carcass collection along highways, and the rate that crashes are reported (higher in urban areas). Traffic volume ranged from 4,000 Average Annual Daily Traffic (AADT) west of Eagle Mountain Blvd, to 12,000 AADT at the Crosswalk, to 16,000 east of N. Ranches Parkway. These AADT are based on UDOT data and data from our TDCs. Vehicle speeds and posted speed limits varied in the study area and changed during the study. Mule deer numbers have declined slightly between 2017 and 2024 according to UDWR data. Mule deer have historically followed the Canyon Wash that crosses SR 73 near MP 30.0 during their migrations, and urbanization is rapidly expanding toward Canyon Wash from the east. In general, the number of carcasses is much greater than the number of crashes. Olson (2013) found that carcasses were greater than crashes by a factor of 5.6 in Utah. However, carcass collection efforts have proven to be inaccurate and unequal in many states while reported crashes appear to be more reliable and consistent.

Taking the uncontrollable nature of most of these variables into account, we can make some clear generalizations within individual mile post bands. Figure 10 and Figure 11 show a genuine reduction in carcass and crash density from MP 29.7 to MP 30.75 after the completion of the Crosswalk, the System, and the exclusion fence. Carcasses were reduced by 83 percent and crashes were reduced by 60 percent. From MP 30.75 to MP 36, carcasses were reduced by 70 percent and crashes increased by five percent. The increase in crashes may be explained by higher reporting rates in an area with increasing urbanization and traffic volume. From MP 20 to MP 29.7, immediately west of the wildlife exclusion fence end on the south side of SR 73, carcasses increased by 12 percent while crashes increased substantially by 46 percent. These increases may be explained by “fence-end-effect” where a portion of the mule deer that previously crossed near MP 30 are now attempting to move across SR 73 just west of the fence terminus at MP 29.7. Both Figure 10 and Figure 11 strongly show that the areas of high carcass and crash densities (hot spots) near MP 30 have moved slightly to the west and decreased to some degree over time. With the urbanization to the east, this fence-end-effect seems reasonable.

From MP 10 to MP 20, carcasses and crashes declined by 54 percent and 24 percent, respectively. We do not have an explanation for this change. From MP 0 to MP 10, carcasses decreased by 34 percent, yet crashes (MP 5 to MP 10) more than doubled, increasing 135 percent. A minor crash hot spot is clear in this band in Figure 11. Fence-end-effect is certainly not an explanation. It is possible that carcass collection efforts, or a combination of other variables between MP 0 and MP 20 changed during the study. Again, the analysis of the changes in Wildlife-Vehicle Collisions over time and space is very complicated, driven by many variables.

A summary of the changes in WVC between pre- and post-installation of the wildlife accommodations within individual mile post bands is provided in Table 3. Pre- and post-durations, counts, and rates are listed for carcasses and crashes. These values are used to calculate percent change for each of the milepost bands. The general formula is:

Percent change = (post-rate − pre-rate) divided by pre-rate × 100.

Table 3. Summary of changes in WVC between pre- and post-installation of wildlife accommodations within individual milepost bands.

Mile post band	Pre count	Pre rate (carcasses/year/mile)	Post count	Post rate (carcasses/year/mile)	% change
Wildlife carcasses · pre = 4.91 yrs · post = 3.36 yrs					
5 – 10	33	1.34	15	0.89	**−34%**
10 – 20	44	0.90	14	0.42	**−54%**
20 – 29.7	111	2.33	85	2.61	**+12%**
29.7 – 30.75 ⊕	84	16.29	10	2.83	**−83%**
30.75 – 36	49	1.90	10	0.57	**−70%**
Reported wildlife crashes · pre = 5.91 yrs · post = 3.09 yrs					
0 – 10	13	0.22	16	0.52	**+135%**
10 – 20	15	0.25	6	0.19	**−24%**
20 – 29.7	34	0.59	26	0.87	**+46%**
29.7 – 30.75 ⊕	19	3.06	4	1.23	**−60%**
30.75 – 36	20	0.64	11	0.68	**+5%**

⊕ Fence zone (MP 29.7–30.75). Wildlife fence and at-grade crosswalk installed November 30, 2022. Green = decrease, red = increase.

4.0 MULE DEER MOVEMENTS AT THE WILDLIFE CROSSWALK

Mule deer movements at the north and south areas of the Crosswalk were evaluated to determine how the animals could move across SR 73, and other important factors related to their migrations north and south of the highway.

4.1 Methods

4.1.1 Reconyx Camera Placement

Four Reconyx Professional cameras were installed at the Wildlife Crosswalk on SR 73 at Mile Post (MP) 30.35 on November 14, 2023. Two cameras were installed at the north entrance of the Crosswalk (NW and NE Cameras) and two cameras were installed at the south entrance of the Crosswalk (SE and SW Cameras). The cameras were triggered by motion and continuously recorded mule deer movements with the following Reconyx settings: five photographs per trigger, no delay, and nighttime maximum range (Figure 12). The cameras were checked on November 20, December 5, 2023, January 8, March 15, June 12, October 27, 2024, and February 6, 2025, at which time the cameras were pulled. All photographs and videos were downloaded, stored, and analyzed.

Figure 12. Reconyx cameras were placed with the assistance of Eagle Mountain City personnel (left). Right, a monitoring camera mounted to the fence northeast pole.

<u>4.1.2 Photo Analysis Methods</u>

Photographs were analyzed by categorizing and tallying all individual mule deer movements. Mule-deer movement categories included: Success Movements (over SR 73), Repellency Movements, Parallel Movements, Fatality Movements, and Unknown Movements.

Total Movements = Success + Repellency + Parallel + Fatality + Unknown.

4.2 Mule-Deer Movement Results

From November 14, 2023, through February 6, 2025, there were 2,279 mule deer Total Movements at the Wildlife Crosswalk. There were 1,598 mule deer movements from the north (70 percent) and 681 mule deer movements from the south (30 percent). There were 1,257 mule deer Success Movements across SR 73. There were 675 Repellency Movements, 13 Parallel Movements, three Fatality Movements, and 331 Unknown Movements. The Success Rate (Success Movements divided by Total Movements) was 55 percent, and the Rate of Repellency (Repellency Movements divided by Total Movements) was 30 percent.

Weekly mule deer Repellency Movements, Success Movements, and Total Movements are presented in Figure 13. Three distinct peak-migration periods were observed: the 2024 peak winter migration (weeks 3, 4, and 5), the 2024 peak spring migration (weeks 14, 15, 16, and 17), and the 2025 peak winter migration (weeks 1, 2, and 3). Smaller, yet distinct fall migrations were observed in November and December of 2023 and 2024.

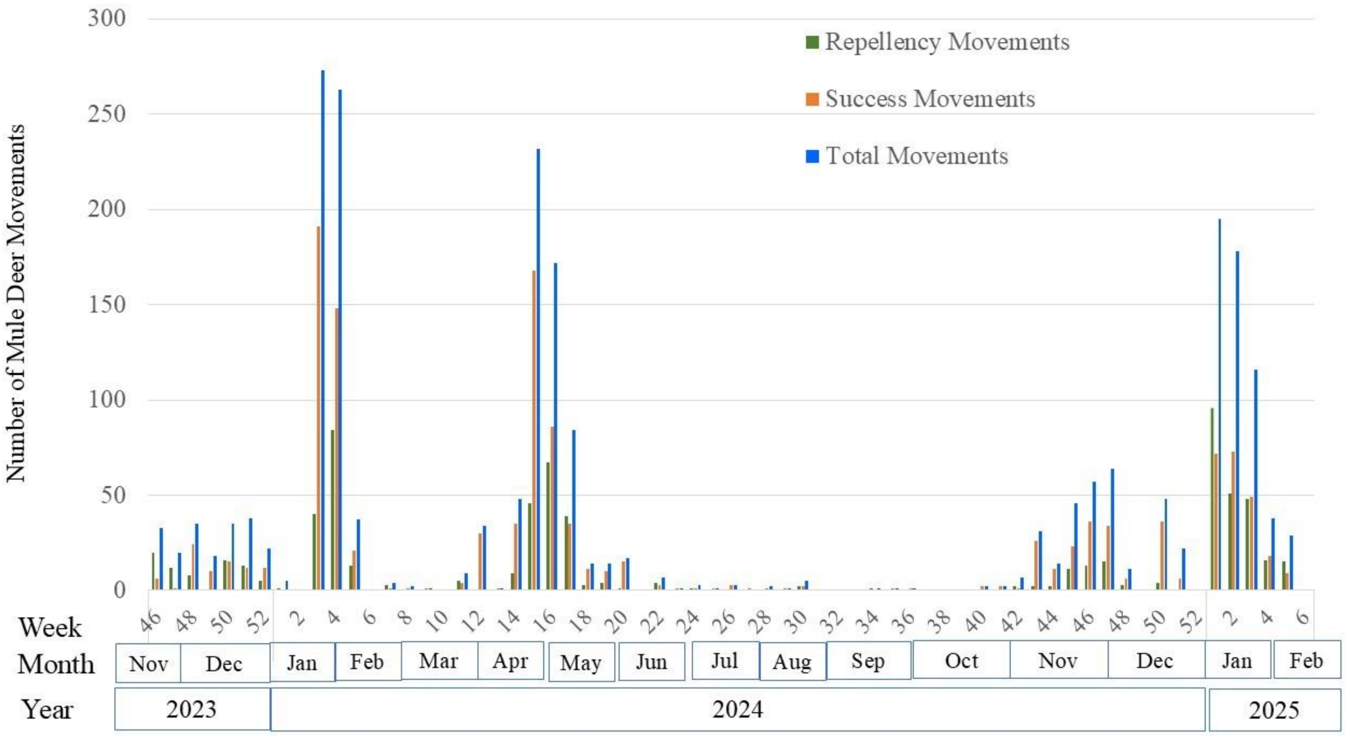

Figure 13. Mule deer Repellency, Success, and Total Movements at the SR 73 Wildlife Crosswalk.

4.3 Discussion

In 2023 and early 2024 mule deer were recorded attempting to cross SR 73 more often in daylight hours than in late 2024 and 2025 when more movements were recorded at night. It appears the animals may have been adapting to lower traffic volumes at night. SR 73's AADT of 12,000 vehicles at the Crosswalk is far too high for herds of animals to successfully cross the road. The higher the traffic volume, the less gaps in the flow of traffic there are that mule deer may use to run between vehicles. Riginos et al. (2018) found that 90 percent of failed mule deer crossing attempts along western Wyoming roads occurred when there was less than a 45-second gap in traffic. They also found strong evidence that demonstrated mule deer consistently did not attempt to cross roads or attempts resulted in collisions when traffic gaps were less than 30 seconds long. When gaps were greater than 60 seconds long, deer almost always crossed the highways successfully (Riginos et al., 2018). The traffic volume affects these gaps, and Riginos et al (2018) stated their results indicated that traffic volumes above 2,000 AADT will be unsafe for mule deer and the motoring public for more than half of the 24-hour day cycle. The SR 73 Crosswalk is not an appropriate location for expecting herds of mule deer to move across the highway, with its AADT of 12,000. However, if a wildlife crossing structure cannot be placed there in a timely manner, the Crosswalk should be moved to a location with lower AADT, such as west of Eagle Mountain Boulevard, where the AADT was estimated at 4,000, which is still too high to ensure herds of animals may cross over the highway safely.

Reducing posted speed limits in the current Crosswalk may prove to be unsuccessful in reducing WVC. Our results demonstrate the motorists in the Crosswalk, when the System lights were activated, slowed down less than 5 mph under any given circumstance, and were still traveling above the speed limit. Riginos et al. (2021) experimented with reducing nighttime speed limits along western Wyoming roads from 70 mph to 55 mph, but found drivers consistently reduced their speeds by only 3-5 mph. They found little benefit of speed reduction for mule deer or motorists.

The overall results of this study found that the fences, Crosswalk, and Wildlife-Detection Driver Warning System did reduce reported crashes and carcasses in the area of the Crosswalk. However, the problem of WVC was apparently somewhat moved westward to the end of the south fence at MP 29.7, albeit with reduced rates of carcasses and crashes. The mule deer were severely restricted in their ability to cross SR 73 with its 12,000 vehicles per day. On average, the drivers along SR 73 did not reduce their speeds in the Crosswalk to conform to the posted speed limits even when the System was activated to warn them to slow down. This study demonstrates the difficult nature of both funneling wildlife to a crosswalk on a highway with traffic volumes over 2,000 AADT and expecting them to be able to cross while also expecting drivers to slow their vehicles more than 5 mph.

4.4 Picture Availability

The project manager, UDOT's Kevin Nichol created a shared Google Drive for pics/videos from the cameras for the Technical Advisory Team. Videos and photos were uploaded to the project's Pictures and Videos folder: https://drive.google.com/drive/folders/1pDT_gvbKQ7PAZW7UasUJvb6cblNv2ZHj.

5.0 ACCURACY OF THE WILDLIFE-DETECTION DRIVER WARNING SYSTEM IN DETECTING MULE DEER

Illumination from the Wildlife Detection System's amber warning lights was observed on the landscape in nighttime photographs recorded by the NW, NE, and SW Reconyx Cameras (Figure 14) during 1,485 of 1,584 nighttime individual mule deer movements (94 percent). There were no observed delays in the nighttime illumination of the System's warning lights as mule deer approached the Crosswalk. The duration of the System's warning appeared appropriate; the warning lights remained illuminated during most nighttime mule-deer success movements. On many occasions, these success movements lasted more than five minutes with numerous false starts as mule deer negotiated the Crosswalk, and in most instances, the System's warning lights remained illuminated.

The System was down for extended periods of time in portions of 2025 and 2026. In April of 2026, we observed the System's infrared camera on the south side of SR 73 was out of position, and did not readily activate the System when we walked through the Crosswalk from the south. The system will need continued care and maintenance over its lifetime.

Figure 14. Example of mule deer photographed with the glow of the System warning lights.

6.0 RECOMMENDATIONS

Our recommendations include:

1. Replacing the Crosswalk with a wildlife crossing structure near MP 30;
2. Possibly moving the Crosswalk to west of Eagle Mountain Road, and adding wildlife exclusion fence to the south side of the highway until a wildlife underpass can be constructed; and
3. Building several additional wildlife crossing structures between MP 30 and MP 20 west of Eagle Mountain Boulevard where traffic volumes are lower and urbanization pressures are lower.

This quickly urbanizing community of Eagle Mountain has not and may not adapt to wildlife on the road and systems aimed at slowing driver speeds. However, this type of Wildlife Detection Driver Warning System may be more appropriate for two-lane roads with far lower traffic volumes in a more rural setting, less ingress and egress roads near the System site, and posted speeds of 55 mph or less.

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7.0 APPENDIX A: SELECT BEST PHOTOS FROM THE STUDY


2024-12-13 3:32:48 AM M 3/5 31°F
© Utah Department of Transportatin, Eagle Mountain City, Wildlife Connectivity Institute
UDOT-CRAMER-73SW
RECONYX


2025-01-10 14:00:33 M 1/5 46°F
© Utah Department of Transportatin, Eagle Mountain City, Wildlife Connectivity Institute
UDOT CRAMER 73NE


2025-01-04 06:52:26 M 5/5 32°F
© Utah Department of Transportatin, Eagle Mountain City, Wildlife Connectivity Institute
UDOT CRAMER 73NE


2025-01-02 02:01:58 M 4/5 32°F
© Utah Department of Transportatin, Eagle Mountain City, Wildlife Connectivity Institute
UDOT CRAMER 73NE


2025-01-01 12:09:30 PM M 4/5
36°F
© Utah Department of Transportatin, Eagle Mountain City, Wildlife Connectivity Institute
UDOT-CRAMER-73SW
RECONYX


2024-01-18 07:40:46 M 5/5
22°F
UDOT CRAMER EAGMTNNE


2024-01-18 10:16:21
M 2/5
49°F


2024-11-04 10:08:16
M 2/5
37°F
© Utah Department of Transportatin, Eagle Mountain City, Wildlife Connectivity Institute
UDOT CRAMER 73NE