Progress Report

Habitat Establishment Evaluation of Tangerine Road Phase I: Road Mortality and Crossing Structure Utilization

Presented to the: Regional Transportation Authority

Submitted by the:
Arizona Game and Fish Department
Wildlife Contracts Branch

In collaboration with:

INTRODUCTION

Roads are a significant source of mortality for large and small species alike. Additionally, roadways are proven barriers to wildlife permeability (Forman and Alexander 1998, Spellerberg 1998, Trombulak and Frissell 2000, Forman et al. 2003, Coffin 2007) and mitigation structures such as culverts and underpasses can greatly enhance connectivity and reduce wildlife-vehicle collisions (Clevenger et al. 2001, Gagnon et al. 2011).

With the impending upgrade of Tangerine Road from I-10 to SR 77 to facilitate increasing traffic volumes, increasing wildlife-vehicle collisions and habitat fragmentation became a concern. To address these concerns, AGFD, with support from the Towns of Marana and Oro Valley and funding from the RTA conducted intensive road kill and track surveys along Tangerine and La Cholla Roads (Lowery et al. 2011). Between May and September 2010 5,152 road mortalities representing 88 species were documented, helping to identify hot spots for future implementation of fencing and wildlife crossing structures. Individual taxonomic group hotspot locations were used to guide the most effective placement of wildlife crossings along the Tangerine Road (and La Cholla Boulevard) transportation corridor. The report recommended that the structures for medium-sized mammals be at least 6.0 ft. in height with an Openness Index of 0.40 (calculated as height x width / length, in meters). Recommendations in the report also included post-construction monitoring to determine whether any adjustments need to be made to improve effectiveness of the crossing structures and fencing.

With this information, the Tangerine Road Technical Committee worked to accommodate wildlife based on open space connectivity, considering existing and future development on either side of the structures, traffic signals, necessary hydraulic design, and fill restrictions. Once these locations were determined, the Town of Marana applied to RTA for the *Tangerine Road Corridor Project, Phase I, La Canada to Dove Mountain Boulevard, Project No. ST021, Wildlife Linkages Structure Construction.*

The objectives of this construction project were to:

- Increase the size of five drainage structures and modify inlets/outlets to accommodate medium-sized mammals.
- Add funnel fencing at the crossings.
- Conduct habitat establishment evaluations, for three seasons, beginning one year after project completion, to determine whether any adaptive management measures are necessary to improve the effectiveness of the wildlife crossing structures.

Our habitat establishment assessment project will address the last bullet of the above objectives to monitor the effectiveness of the Tangerine Rd mitigation design. Post-construction habitat evaluations are the best means of evaluating the species that benefit from the crossing structures and fencing (Forman et al. 2003, Mata et al. 2003, Waltho and Clevenger 2003). Within the context of adaptive management, the data collected from this effort will inform future decisions to increase effectiveness (if necessary). These data will also help quantify post-construction landscape permeability for local wildlife populations and allow for comparisons with other mitigation sites in Arizona. Finally, we intend to learn from

the efforts put forth by the Town of Marana, Pima County and the Regional Transportation Authority so that future mitigation efforts benefit from information gained on Tangerine Road.

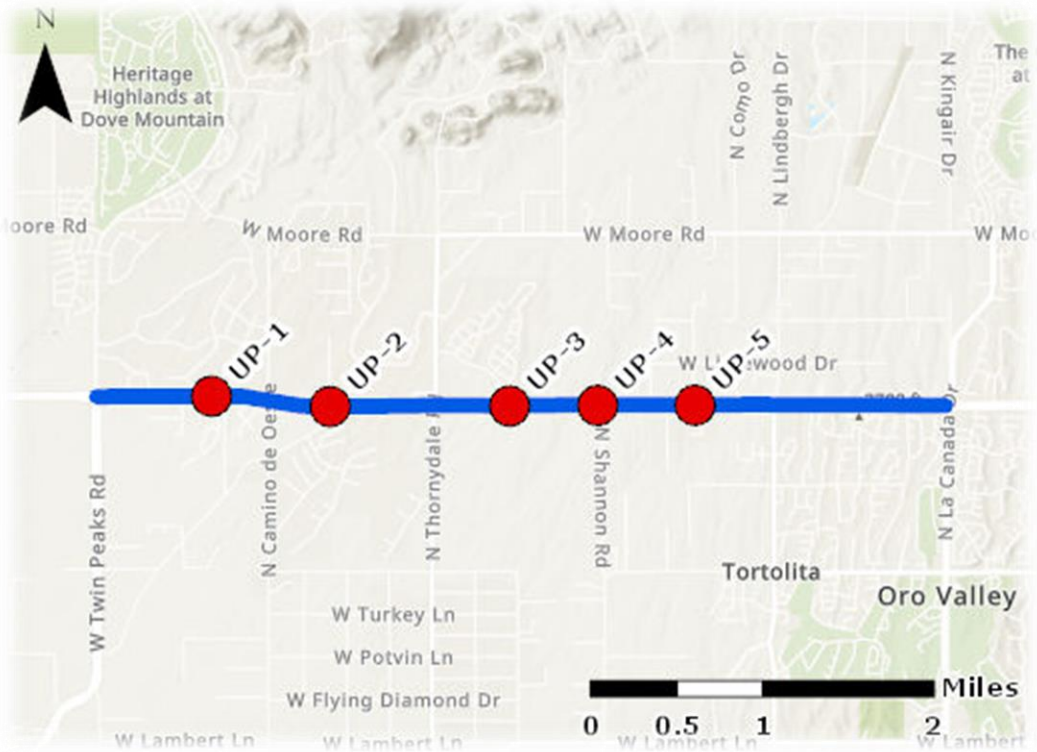

Figure 1. Overview of post-construction monitoring study area, structure locations are represented by red circles, road mortality survey extent is represented by the blue line.

Table 1. Structure names and coordinates.

Reference Name	Lat	Long	Construction Descriptor
UP-1	32.424592	-111.068975	735 + 63.11
UP-2	32.423728	-111.057144	772 + 32.00
UP-3	32.423775	-111.039250	828 + 05.50
UP-4	32.423826	-111.030462	855 + 03.66
UP-5	32.423849	-111.020766	885+ 40.00

For the purposes of clarity, the five structures under monitoring have been designated by the research team as UP-1 through UP-5 from west to east. Figure 1 provides a spatial overview of their relative locations with respect to the project area, Table 1 lists their reference name, latitude and longitude in decimal minutes, WGS 84, and construction names. The completed structures can be seen in Figures 2 thru 6, a variety of designs and dimensions are represented.

Figure 2. UP-1 viewed from the south.

Figure 3. UP-2 viewed from the north.

Figure 4. UP-3 viewed from the south.

Figure 5. UP-4 viewed from the south.

Figure 6. UP-5 viewed from the south

RESEARCH OBJECTIVES

This project will follow the methodology implemented by Lowery and Blackman (2006) for conducting road mortality surveys in an effort to make post-construction data directly comparable to pre-construction data collected in the same study area. In addition, we will install still cameras to document wildlife use of the newly constructed underpass structures.

1. Determine the effectiveness of mitigation fencing for minimizing wildlife-vehicle collisions (WVCs).
2. Determine the effectiveness of wildlife crossing structures for allowing safe passage across Tangerine Road.

Objective 1: Determine the effectiveness of mitigation fencing for minimizing wildlife-vehicle collisions (WVCs).

Because of the extensive dataset collected by Lowery et al. (2011) we are presented with the unique opportunity of a pre- and post-construction mortality comparison. We will compare the frequency of road mortalities for several taxonomic groups (i.e., amphibians, lizards, snakes, small mammals, carnivores, and ungulates) with the expectation that the frequency of road mortality should be lower on the segment of road where wildlife fencing has been installed than it is where fencing was not installed. Further, if the newly constructed fencing is effective in decreasing wildlife access to the roads we should see a significant decrease in mortalities in areas that were not previously fenced. Focusing our data collection efforts on

the peak roadkill months (May and August) will allow for maximized potential to capture multiple species in a shorter time frame, reducing costs.

Roadway Walking Surveys

We will conduct roadkill surveys along the approximately 4-mile long alignment between Twin Peaks Road and La Cholla Blvd (Figure 1). Additionally, we will include approximately one mile of control beyond the eastern termini of wildlife fencing near La Cholla Blvd. We will conduct road mortality surveys in May and August as these months exhibited the highest frequencies of roadkill of all species types (mammal, bird, reptile, and amphibian). We will conduct these road mortality surveys 1 year following construction and then again 3 years following construction to assess any adaptive management strategies that may be incorporated and assess long-term roadkill reduction. Because animals are often thrown from the road surface when hit by passing vehicles or move off the pavement before dying, we will survey the vegetated median and the area between the pavement and the right-of-way fencing for complete coverage within the study area. We will begin road mortality surveys thirty minutes before sunrise to minimize the loss of wildlife carcasses to scavenger activity. Two biologists will walk the alignment and document all WVCs to the most specific taxonomic level possible given the condition of the carcass (Lowery and Blackman 2006). Because Tangerine Rd will now be divided, the two field crew members will walk up one side of the road and in the median for the section of road being surveyed that day and then both return on the opposite side of the road. The field crew will alternate paths during the following survey for that segment to reduce observer bias. This will allow an evaluation of east and westbound lanes separately and combined. We will record geographic coordinates and photos of WVCs with a mobile data collection application which feeds directly into GIS layers. We will remove and/or mark all carcasses detected during surveys to prevent duplicate records being collected during subsequent surveys.

Roadway Driving Surveys

Daily walking surveys will complement daily driving surveys along the remainder of the project area. A single surveyor will drive along the edge of the paved roadway at 25 – 30 mph and scan for larger-sized mortalities (i.e., rabbit and larger) or unusual (e.g. snakes, Gila monsters, desert tortoises, etc.) wildlife that otherwise might go undetected between alternating survey segments which were not scheduled to be intensively walked until the following days. This strategy will minimize loss of detections due to scavenger removal of animal remains across the project area. In addition, this method will allow for the collection of data points which would be removed by passers-by, degraded by repeated friction by passing vehicles, and extreme environmental conditions. Roadway driving survey data will then be added to the overall road mortality database prior to analysis.

- **Road mortality surveys will follow the protocols established during recent surveys on SR77 which were in turn derived from the pre-construction surveys conducted by Lowery and Blackman 2006. Four survey cycles will be conducted**

in the spring and three during the monsoon to coincide with observed peaks in road mortality for herps, and small mammals.

- **1-year post-construction surveys are scheduled to commence Monday, April 29th. Survey cycles will be completed over four days, Monday to Thursday during which the full study area will be covered. The four spring survey cycles will be conducted during consecutive weeks. Monsoon surveys are scheduled to commence Monday, August 29th and consist of three consecutive weeks of survey.**

Objective 2: Determine the effectiveness of wildlife crossing structures for allowing safe passage across Tangerine Road.

Given the tremendous commitment by RTA to provide wildlife crossing structures and fencing to reduce motorist collisions with wildlife and mitigate the impact of Tangerine Rd barrier effects, it is essential to evaluate their level of acceptance by Sonoran Desert wildlife. To accomplish this objective, we will utilize rapid-still frame cameras (e.g., Reconyx®) at the five crossing structures to document wildlife use patterns. Still cameras can provide detailed documentation of wildlife use and behavior in and near the newly constructed wildlife crossings along Tangerine Rd. At all structures cameras will be oriented in a manner that will allow us to evaluate the passage rate over time and compare use between structures (Dodd et al. 2007, Gagnon et al. 2011).

We will quantify species/taxonomic group-specific passage rates for each of the structures monitored and produce a species list for animals that successfully utilized the structures to move across Tangerine Road. Passage rate data will inform future implementation of similar crossing structures and can be compared with other connectivity conservation projects being conducted in the region. If passage rates for some species prove to be lower than desired, we will identify measures that could be taken to increase passage rates and promote greater permeability across the roadway.

Long-term evaluation of the wildlife crossings is essential for a proper evaluation and future recommendations (Gagnon et al. 2011), thus we will conduct three years of camera monitoring to assess learning curves. AGFD will provide all camera equipment which will be considered as a contribution to the overall monitoring project.

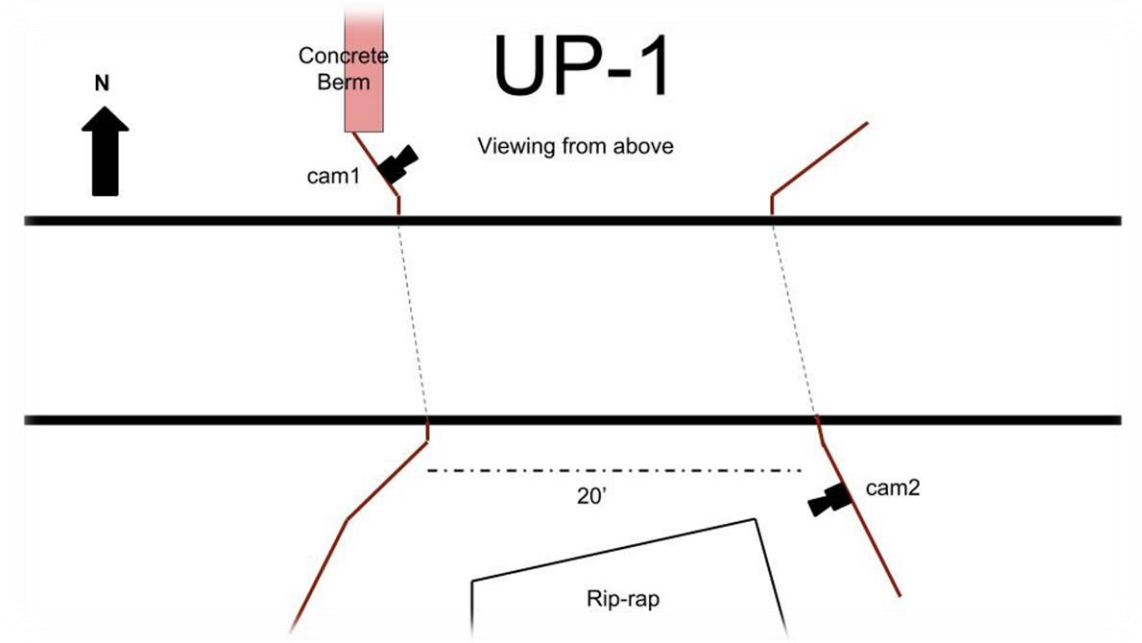

Figure 7. Plan view of UP-1 representing camera monitoring setup and approximate width of span.

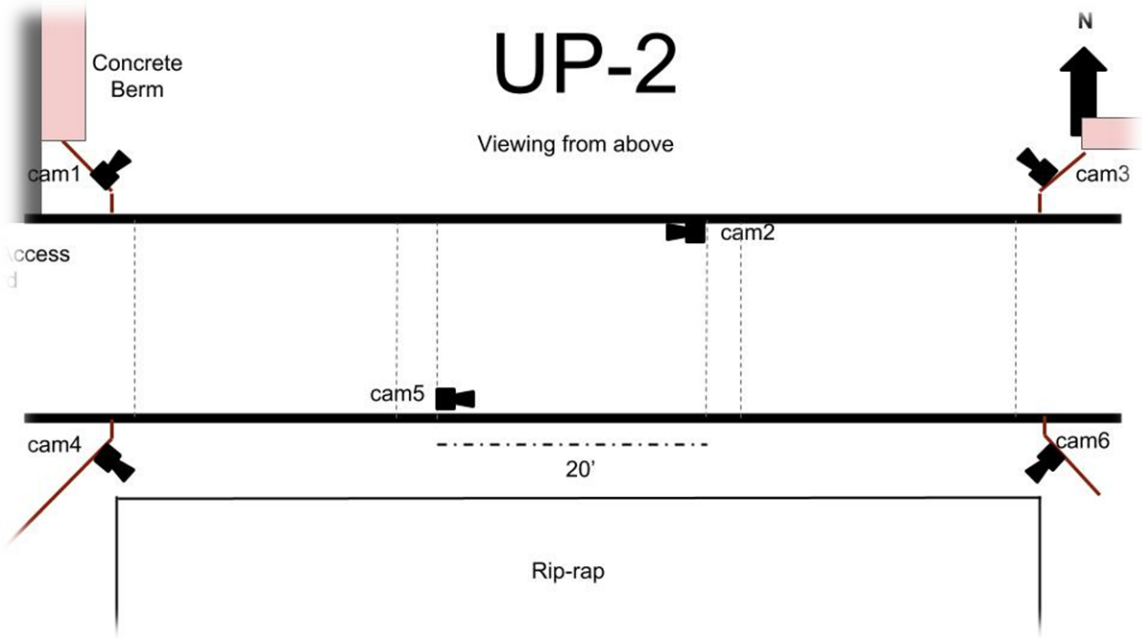

Figure 8. Plan view of UP-2 representing camera monitoring setup and approximate width of spans.

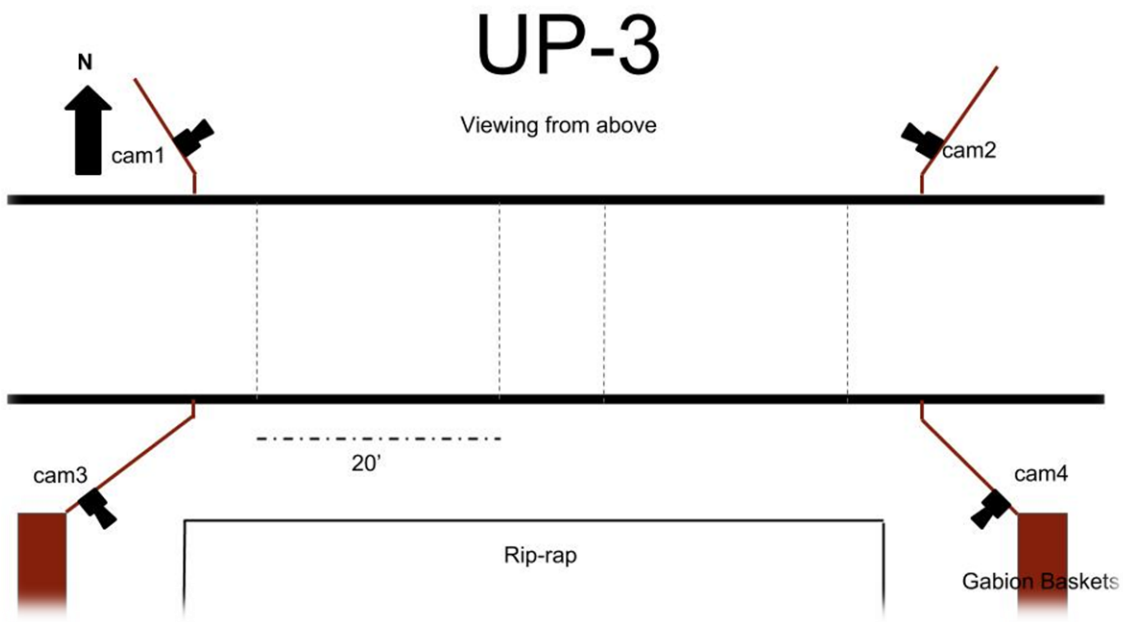

Figure 9. Plan view of UP-3 representing camera monitoring setup and approximate width of spans.

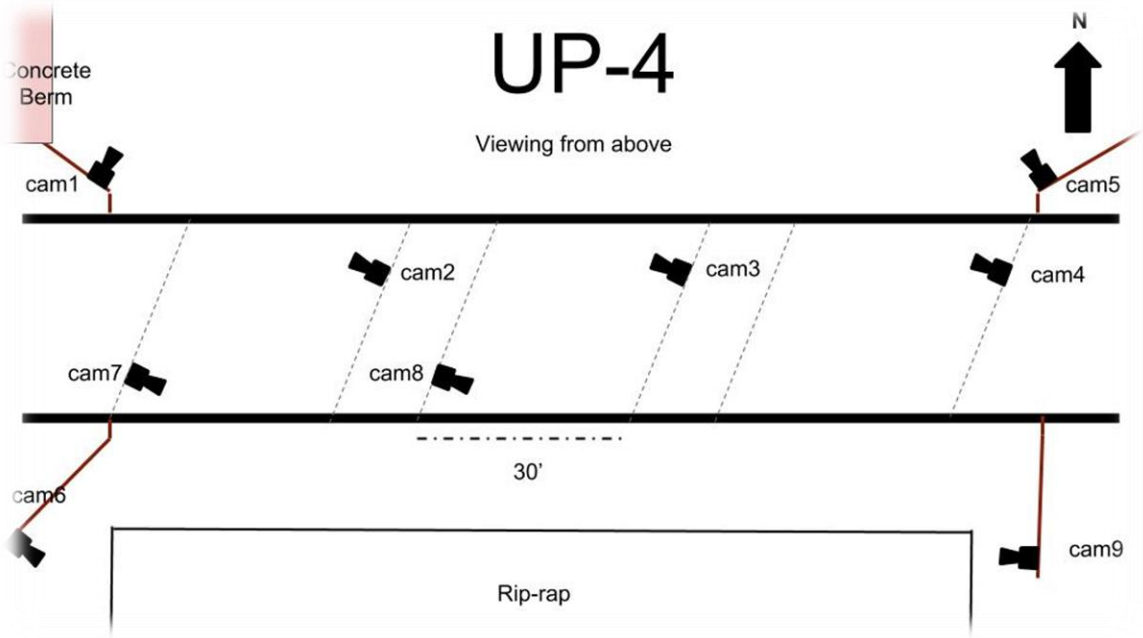

Figure 10. Plan view of UP-4 representing camera monitoring setup and approximate width of spans.

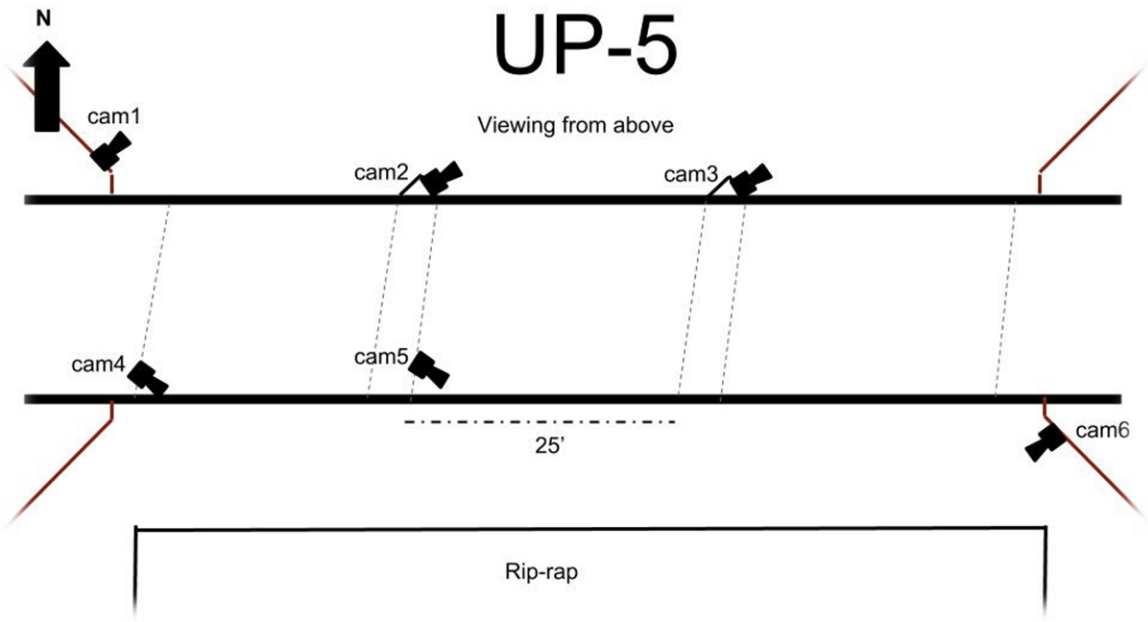

Figure 11. Plan view of UP-5 representing camera monitoring setup and approximate width of spans.

Camera installations were planned and adapted to provide full field-of-view coverage of all entry and exit paths for species larger than a rabbit. Installations were also designed to provide a view of approach zones beyond the physical bounds of the structures to allow for the calculation of passage rates for larger species. Figures 7 thru 11 provide an overview of the camera placements and orientation at each of the five wildlife underpasses. Individual cameras were placed at 12 to 18 inches above ground level (Figure 12) to minimize flood immersion events while allowing for the detection of smaller species such as mesocarnivores.

Camera installation at UP-1, UP-2, UP-3, and UP-5 was completed on June 20th, 2018. Staging operations for construction activities continued to be hosted at UP-4 until late October and regular construction related disturbances continued to be recorded at all structures until November 1st, 2018. Camera installation at UP-4 was completed on October 31st, 2018. Given the ongoing construction activities to November 1st the research team will consider this date to be the beginning of monitoring activities and will report passage rates, and cumulative use accordingly. However, crossing numbers and species lists will represent all data available since camera installation.

Figure 12. Structure surveillance system components: Still camera mounted directly to the walls of a wildlife underpass using concrete wedge anchors with anti-theft box and lock.

Data has been analyzed to January 7th, 2019, this represents two full months of monitoring data for all five structures. A combined total of 1049 crossings by 17 wildlife species have been documented across all 5 structures to date. Coyote, javelina, and bobcat constitute the most commonly recorded species with 475, 365, and 130 crossings respectively, representing 93% of all documented crossings. Figure 13 shows a selection of the images collected so far. It is noteworthy that despite the lack of deer fence along the ROW and the comparatively low ceiling heights of the monitored structures a total of 16 mule deer crossings have been observed across three of the wildlife underpasses.

A total of 23 wildlife species have been detected across the five structures to date (Table 2). The greatest diversity has been observed at UP-2 where 15 species have been recorded. Six species have been detected at UP-4, however the delayed camera installation at this structure has contributed to the reduced species diversity observed.

Figure 13. Examples of wildlife events documented at the Tangerine Rd wildlife underpasses.

Table 2. Species detections by structure at each of the Tangerine Rd wildlife underpasses. Observed presence is denoted by an X

Species	UP-1	UP-2	UP-3	UP-4	UP-5	Overall
American Badger		X	X		X	X
Bobcat	X	X	X	X	X	X
Coyote	X	X	X	X	X	X
Kit Fox	X					X
Gray Fox			X			X
Raccoon	X					X
Unidentifiable Skunk	X					X
Javelina	X	X	X	X	X	X
Mule Deer		X	X	X	X	X
Antelope Jackrabbit		X	X			X
Black-tailed Jackrabbit		X	X			X
Desert Cottontail	X	X	X		X	X
Rock Squirrel			X			X
Unidentifiable Bat					X	X
Cactus Wren		X	X		X	X
Common Raven		X		X		X
Gambel's Quail			X		X	X
Great Horned Owl		X				X
Greater Roadrunner	X	X	X		X	X
Mourning Dove		X	X	X	X	X
American Kestrel	X					X
Zebra-tailed Lizard		X				X
Sonoran Desert Toad		X				X

Since passage rate monitoring began on November 1st, 2018, a total of 494 wildlife crossings have been documented at the wildlife underpasses. Coyote, javelina, and bobcat account for 94% of crossings. Passage rate reporting focuses upon these three species and mule deer given their prevalence in the dataset, high detectability by the installed monitoring systems, and their importance for population connectivity and wildlife vehicle collision mitigation.

Table 3. Observed crossings, failed crossings, and approaches with calculated passage rates for four target species at UP-1.

Species	Total Crossings	Total Not Crossed	Total Approaches	Passage Rate
Bobcat	8	0	8	100%
Coyote	99	8	107	93%
Javelina	40	4	44	91%
Mule Deer	0	0	0	NA

Table 4. Observed crossings, failed crossings, and approaches with calculated passage rates for four target species at UP-2.

Species	Total Crossings	Total Not Crossed	Total Approaches	Passage Rate
Bobcat	6	0	6	100%
Coyote	26	6	32	81%
Javelina	2	1	3	67%
Mule Deer	2	1	3	67%

Table 5. Observed crossings, failed crossings, and approaches with calculated passage rates for four target species at UP-3.

Species	Total Crossings	Total Not Crossed	Total Approaches	Passage Rate
Bobcat	12	1	13	92%
Coyote	39	31	70	56%
Javelina	55	3	58	95%
Mule Deer	2	0	2	100%

Table 6. Observed crossings, failed crossings, and approaches with calculated passage rates for four target species at UP-4.

Species	Total Crossings	Total Not Crossed	Total Approaches	Passage Rate
Bobcat	21	0	21	100%
Coyote	42	21	63	67%
Javelina	22	2	24	92%
Mule Deer	3	0	3	100%

Table 7. Observed crossings, failed crossings, and approaches with calculated passage rates for four target species at UP-5.

Species	Total Crossings	Total Not Crossed	Total Approaches	Passage Rates
Bobcat	25	2	27	93%
Coyote	17	10	27	63%
Javelina	9	3	12	75%
Mule Deer	0	0	0	NA

Tables 3 thru 7 display the total recorded approaches, crossings, and failed crossings by structure for the four target species since the beginning of monitoring. Passage rates are calculated for each species at each structure as the percentage of total crossings from the total approaches. While the short timeframe contributes to small sample sizes which produce greater variability it can still be seen that passage rates for bobcat and javelina are generally high, particularly where sample sizes are larger. Passage rates for coyote are seen to be quite variable, while too few mule deer have been detected to make meaningful comment. Passage rates for each target species detected at a given structure exceed 50%.

PROJECT SCHEDULE AND DELIVERABLES

Project Deliverable	**Completion date(s)**
Install still cameras at crossings	Completion of Phase I
Conduct weekly road mortality surveys during peak mortality periods	May and August 1 year and 3 years following completion of project
Collect, review, and enter camera data	Continuous – 3 years
Summarize data, prepare and submit draft final report for review, submit revised final report	Year 4-5

PROJECT IMPLEMENTATION CONTACTS

Arizona Game and Fish Department will oversee implementation of mitigation monitoring with the following team members:

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LITERATURE CITED

Clevenger, A. P., B. Chruszcz, K. E. Gunson. 2001. Highway Mitigation Fencing Reduces Wildlife-Vehicle Collisions. Wildlife Society Bulletin 29:646-653.

Clevenger, A. P., and N. Waltho. 2000. Factors Influencing the Effectiveness of Wildlife Underpasses in Banff National Park, Alberta, Canada. Conservation Biology 14:47-56.

Clevenger, A. P., and N. Waltho. 2003. Long-term, Year-round Monitoring of Wildlife Crossing Structures and the Importance of Temporal and Spatial Variability in Performance Studies. ICOET 2003 Proceedings:293-302.

Coffin, A. W. 2007. From Roadkill to Road Ecology: A Review of the Ecological Effects of Roads. Journal of Transport Geography 15:396-406.

Dodd, N. L., J. W. Gagnon, A. L. Manzo, and R. E. Schweinsburg. 2007b. Video Surveillance to Assess Highway Underpass Use by Elk in Arizona. Journal of Wildlife Management 71:637-645.

Forman, R. T. T., L. E. Alexander. 1998. Roads and Their Major Ecological Effects. Annual Review of Ecology and Systematics 29 (1998):207-231+C2.

Forman, R. T. T., D. Sperling, J. A. Bissonette, A. P. Clevenger, C. D. Cutshall, V. H. Dale, L. Fahrig, R. France, C. R. Goldman, K. Heanue, J. A. Jones, F. J. Swanson, T. Turrentine, and T. C. Winter. 2003. Road Ecology; Science and Solutions. Island Press, Covelo, CA.

Gagnon, J. W., N. L. Dodd, K. S. Ogren, and R. E. Schweinsburg. 2011. Factors associated with use of wildlife underpasses and importance of long-term monitoring. Journal of Wildlife Management 75:1477-1487.

Lowery, S. F., S. T. Blackman, and D. D. Grandmaison. 2011. Tangerine Road and La Cholla Boulevard mortality hotspot evaluation. Prepared for Town of Oro Valley Public Works Operations Division and Town of Marana Environmental Engineering Division, Pima County, Arizona. Arizona Game and Fish Department. January 2011.

Mata, C., I. Hervas, J. Herranz, F. Suarez, J. E. Malo. 2003. Effectiveness of Wildlife Crossing Structures and Adapted Culverts in a Highway in Northwest Spain. ICOET 2003 Proceddings:265-276.

Spellerberg, I. F. 1998. Ecological Effects of Roads and Trafic: A Literature Review. Global Ecology and Biogeography Letters 7:317-333.

Trombulak, S. C., C. A. Frissell. 2000. Review of Ecological Effects of Roads on Terrestrial and Aquatic Communities. Conservation Biology 14:18-30.