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June 26, 2009

Mr. Rafael Cancino
Town of Sahuarita Engineer
14311-1 South Rancho Sahuarita Blvd
Sahuarita, AZ 85629

Re: Proposal for Phase 2 Wildlife Linkage Monitoring at Sahuarita Road between La Villita Road and Country Club Road, Pima County, Arizona

Dear Rafael:

SWCA Environmental Consultants (SWCA) appreciates the opportunity to provide you with our scope of work and cost estimate for wildlife linkage monitoring for the 2.5-mile portion of Sahuarita Road from La Villita Road to Country Club Road in Pima County, Arizona. It is our understanding that this project will require: 1) baseline monitoring of this stretch of Sahuarita Road, based on SWCA's recommendations from the Phase 1 wildlife linkage study; and 2) post-construction monitoring of road improvements along this same portion of roadway.

The cost to complete these tasks, as described in the attached scope of work, is a **Time and Materials (Not-to-Exceed)** total of **$135,000.00**. Thank you for providing us with the opportunity to work with you. Please contact me at (520) 325-9194 if you have any questions regarding this proposal.

Sincerely,

Geoffrey Soroka

Geoffrey Soroka
Biologist/Project Manager

Attachment

SCOPE OF WORK

Phase 2 Wildlife Linkage Monitoring At Sahuarita Road Between La Villita Road And Country Club Road

Task 1. Sahuarita Road Baseline Monitoring

Within the Town of Sahuarita, there is very little information as to the distribution, abundance, and movement routes of various wildlife species. We propose a coordinated effort to collect wildlife crossing-related datasets that will contribute to local and regional knowledge of wildlife movement along Sahuarita Road. Such an effort will include animal-vehicle collision (AVC) data collection, roadside track bed surveys, underpass monitoring, and visual surveys and will be conducted by qualified SWCA biologists from our Tucson office. Surveys will be focused along stretches of Sahuarita Road identified as providing the best long-term functionality to target species identified during the Phase I assessment; specific methodology is provided in Appendix A. All surveys will occur for one year prior to initiation of construction activities. We propose one year of monitoring in order to capture any seasonal variations in wildlife activity; monitoring could occur for a longer time frame, however the focal species identified during the Phase I assessment (bobcat) is less dependant on yearly environmental conditions compared to smaller bodied herpetofauna or small mammal species. Data obtained from these surveys will provide baseline information on the rate of wildlife activity along this stretch of Sahuarita Road. In addition, this data will serve to refine knowledge of where species are crossing roadways, where appropriate mitigation strategies can be directed to provide or enhance movement, and how such measure could be designed; such information would refine preliminary recommendations provided during Phase I of this study and could be incorporated into the final design phases of the Sahuarita Road widening project. Finally, this data will serve as baseline data for which to gauge future wildlife crossing activity in response to mitigation measures (e.g. crossing structures, wildlife fencing, vegetation treatments, methods to influence driver behavior) associated with transportation improvement projects and may contribute to regional datasets that could collectively analyze regional patterns of wildlife movement in response to various transportation-related infrastructure.

This component will address the following research/information topics posed by the RTA:

- **Topic 1:** Determine which types of culverts pass which types of wildlife species;
- **Topic 3:** Identify the major wildlife crossing areas within roadways identified on the Wildlife Corridors Priority List (Sahuarita Road);
- **Topic 4:** Identify areas within Pima County (Sahuarita Road) that warrant the placement of wildlife permeability structures;
- **Topic 5:** Establish techniques for identifying current wildlife pathways across roadways for multiple wildlife species and/or guilds of wildlife;
- **Topic 7:** Develop standards and guidelines for placement and design of wildlife crossing structures along roadways;
- **Topic 8:** Determine the necessary corridor width needed to pass wildlife safely to and from roadway wildlife crossings; and

- **Topic 9:** Determine if land use (i.e. degree of urbanization) on either side of the roadway determine the type of wildlife species and therefore crossing structures needed.

SWCA will provide a Final Report to the Town for this section of roadway corridor, including, at minimum, a summary of field survey results and evaluations; an analysis of AVC rates, underpass use, and roadway crossings by species and season; revisions to mitigation recommendations, as provided in the Phase I report; and additional mitigation recommendations (non-structural) to be utilized along this stretch of road, based on the findings of the monitoring results.

Assumptions

1. Access, if restricted, will be arranged by a client representative.
2. Ability to conduct fieldwork will be unimpeded by weather, road construction, landowner restrictions, *force majeure*, or any other factor(s) outside of SWCA's control.

Not-to-Exceed Cost to complete the baseline surveys: $72,000

Task 2. Sahuarita Road Post-Construction Monitoring and Adaptive Management

Although prior studies have evaluated underpass use in relation to landscape features, structural dimensions, and other variables after construction at several sites, less common are rigorous efforts to conduct pre-construction and post-construction monitoring of highway corridors and underpasses to determine the following: 1) where structural wildlife crossings might be most effectively used on existing highway corridors; 2) how installing structural wildlife crossings influence crossing locations, crossing frequencies, and AVCs along highway corridors where they are installed; and 3) how adaptive management strategies can provide measures to maintain and increase the safe passage of wildlife across roads (as determined by the establishment of mitigation success measures and significance criteria). Therefore, an important component to this process is an understanding of the strengths and weaknesses of recommended mitigation measures for any given transportation project. As such, continued monitoring is essential in understanding species responses to such mitigation measures, so as to provide transportation planners with the best solutions to addressing wildlife connectivity across roadways for future transportation projects. This component will include developing an interdisciplinary team to determine significance thresholds for various connectivity-related metrics, including successful passage through structures, reductions in AVCs, and reduction of the barrier effect for certain species. Monitoring will continue after project completion (for a minimum of one year; three years of post-construction monitoring is typically recommended) to ensure the success of mitigation measures; success will be measured by whether the significance thresholds are or are not met. Should significance thresholds not be met, appropriate steps (identified prior to project initiation) would be taken to promote the safe passage of wildlife across roadways and reduce AVCs.

This data will serve to ensure that mitigation measures, as proposed in Phase I and potentially refined in Phase II, are adequate in providing the safe passage of wildlife across roads that are subjected to highway improvement projects. Based on pre-construction monitoring efforts, SWCA will work with Sahuarita and other relevant entities (e.g. Arizona Department of Game and Fish) to develop significance thresholds that would trigger additional mitigation measures should the proposed mitigation measures not be adequate at reducing AVCs and at-grade crossings while simultaneously promoting the safe passage of wildlife across roadways.

We propose the continued (post-construction) monitoring of AVC rates, crossing structure use, and at-grade crossings to determine wildlife activity along the roadway. The determination of a baseline rate of wildlife activity along this stretch of Sahuarita Road (as proposed in Task 1 above) will in turn allow for the development of significance thresholds that will trigger adaptive management strategies (i.e. additional mitigation techniques) should AVC rates continue to be high, underpasses do not get used, or at-grade crossings continue. Examples may include:

- A reduction in AVCs by 75% after a 3-year period;
- A 50% increase in road crossings through structures after the first year of construction; and
- A 75% success rate of road crossings for species where no structures can be installed (e.g. for animal detection systems)

After construction, there would be continued monitoring of pre-construction metrics of crossing activities to assess the effectiveness of mitigation measures. If not successful, adaptive management strategies would be initiated. For an example of an adaptive management strategy, see Appendix B.

This component will address the following research/information topics posed by the RTA:

- **Topic 1:** Determine which types of culverts pass which types of wildlife species;

- **Topic 5:** Establish techniques for identifying current wildlife pathways across roadways for multiple wildlife species and/or guilds of wildlife;

- **Topic 7:** Develop standards and guidelines for placement and design of wildlife crossing structures along roadways;

- **Topic 8:** Determine the necessary corridor width needed to pass wildlife safely to and from roadway wildlife crossings;

- **Topic 9:** Determine if land use (i.e. degree of urbanization) on either side of the roadway determine the type of wildlife species and therefore crossing structures needed; and

- **Topic 10:** Employ Monitoring and Adaptive Management principles when implementing wildlife crossing projects.

SWCA will first work with relevant agencies to develop a series of significance thresholds which, if exceeded, would trigger further adaptive management strategies. SWCA will also provide a Final Report to the Town for this section of roadway corridor, including, at minimum, a post-construction analysis of field survey results, including any significant changes in AVC rates, underpass use, or road crossing activity; revisions to mitigation strategies based on the adaptive management process conducted at the onset of post-construction monitoring; and additional mitigation recommendations (non-structural) to be utilized along this stretch of road, based on the findings of the post-construction monitoring results.

Assumptions

1. Access, if restricted, will be arranged by a client representative.

2. Ability to conduct fieldwork will be unimpeded by weather, road construction, landowner restrictions, *force majeure*, or any other factor(s) outside of SWCA's control.

Not-to-Exceed Cost to complete the post-construction monitoring surveys: $63,000 (post-construction monitoring Year 1)

Appendix A. Sampling strategies for Phase 2

Underpass monitoring

Underpass usage rates can be monitored using two methods. First, remotely-triggered digital cameras (Cuddeback) will be stationed at each underpass. These cameras will be secured to the structure or to a post (preferably telspar) driven into the ground to prevent theft. The post and attached camera will be placed either along the headwall of the structures or, for span bridges, at the midpoint of each bridge. Cameras will be checked at least every four weeks, with more frequent camera maintenance occurring at underpasses with higher wildlife activity. However, depending on the storage capacity of the flash cards in the digital cameras, provided that batteries are functional across the entire sampling session, fewer visits will be needed, thus reducing the presence of project personnel at the structures, which may potentially influence species use. Standard flash cards can store up to 800 images of wildlife. Cameras will record the species' direction of travel and time of pass, and an index of activity will be calculated.

A second method that would collect more information of smaller species use of underpasses would be track beds. Track beds consist of gypsum powder, which is a finely-grated powder that allows for easy identification of imprints left by wildlife. Tracks left by individuals passing through the underpass could be identified to species. Direction of travel would also be documented, and species usage would be recorded as the number of times a given species used the underpass divided by the number of days the underpass was sampled. This method is typically used if focal species are smaller-bodied and therefore less likely to be detected, however medium-bodied mammals (e.g. rabbits, squirrels, and rats) and herpetofauna species (e.g. lizards and some snakes) have previously been recorded by motion-triggered cameras.

Species usage of each underpass would be recorded through three different indices: 1) an index for species recorded at underpasses monitored by track stations, 2) an index for species recorded at underpasses monitored by cameras, and 3) an index for species recorded at underpasses that were monitored by both track and camera stations. By monitoring several select underpasses with both track and camera methods, we can test each index obtained from the respective sampling technique to see whether they result in statistically significant indices. If the indices obtained for each monitoring technique are not different, we can use each technique at underpasses where one technique may be preferable over another. Our previous research efforts regarding this monitoring strategy revealed no difference in index values for pooled species obtained by either track or camera methods. If our sampling methodologies for this study reveal the same relationship between track and camera indices, index values obtained by combining both methods could be used in the statistical analyses.

Species probability and frequency of underpass use will be correlated against multiple landscape and underpass dimension variables. Landscape variables will include % open space surrounding the underpass, % residential area surrounding the underpass, road density, and corridor width. Underpass dimension variables will include structural variables (i.e. length, width, height, and openness) and vegetation variables (% natural cover at entrance, % landscaped cover at entrance).

Track bed surveys

The rationale behind conducting track bed surveys along the road shoulder is to determine the existing rate of at-grade crossing activity by wildlife. Perhaps the biggest issue in establishing a sampling design that can adequately determine whether at-grade crossing rates change after installation of wildlife connectivity mitigation measures is to sample a large enough stretch of roadway. Prior to any sampling, a power analysis would be conducted to determine what sampling effort would be needed in order to detect such changes.

Track beds will consist of transects of graded sand occurring along the paved portion of Sahuarita Road. Sampling sessions will consist of weekly visits, with each week consisting of two consecutive sampling days. For each visit to the track bed, we will record the following data: previous precipitation levels, ambient air temperature, track bed condition, species leaving a track, certainty of track, crossing behavior, and direction of track relative to the roadway. Surveys will occur for 6 consecutive weeks for four seasons, including July/August, October/November, January/February, and April/May.

Crossing frequencies will be determined for both the control and impact sites and compared before and after construction.

Animal-vehicle collision surveys

Animal-vehicle collision surveys will be conducted along stretches of road identified during the Phase I assessment. Surveys will consist of weekly visits, with each week consisting of two consecutive sampling days. For each visit, we will record the following data: species, age/sex (if known), vegetation type, land use, slope, % cover, and distance to nearest underpass. Surveys will occur for 6 consecutive weeks for four seasons, including July/August, October/November, January/February, and April/May.

To determine whether there are AVC hotspots, we will map significant AVCs hot-spots using the Getis-Ord G_i^* statistic in ArcMap 9.0 spatial statistics tools. Getis and Ord (1992) define G_i^* as:

$$G_i^* = \frac{\sum_j w_{ij}(d)x_j}{\sum_j x_j}$$

j may equal *I* where G_i^* compares the degree of association in variable *x* between all points within the study extent, and all points located within a neighborhood distance *d* of the focal point *i*, including *i*. In this study, we will measure the degree of association for the AVC count (*x)* summarized for the pre-construction years span for each mile marker combinations (*i*), within a distance band of 2.5-miles (*d*). We will use a binary weight matrix w_{ij} to determine if the value of *xj* is summed, in which w_{ij} resumes a value of one if *j* lies within distance *d* of *i*, or zero if it is not. Once G_i^* is calculated for each point, it will be redefined as a standard deviate value by subtracting the mean, or expected G_i^*, and dividing it by the standard deviation. The resulting G_i^* statistic will assume positive or negative values when clustering is higher or lower than expected, respectively, and significant hot spots can be defined if they are within more than ±2 standard deviations (SD) of the mean (the two-sigma rule). All counts for mile markers within the distance band will be included in the calculations.

Several variables will be measured to try to develop associations with road kill locations. We will measure traffic volume quarterly along both freeways over the course of the entire study by using traffic volume data.

Appendix B. Example adaptive management strategy

AVC rates

Significance threshold:	Reduction in mule deer AVCs by 50% 3 years after construction
Monitoring:	AVC surveys for 3 years post-construction
Adaptive management strategy:	Adding, extending, or reconfiguring fencing
	Providing additional crossing opportunities
	Planting palatable vegetation or installing salt licks at underpass entrances

Underpass use

Significance threshold:	Increase in bobcat underpass use by 75%
Monitoring:	Track and camera surveys at underpass
Adaptive management strategy:	Plant cover leading to underpass entrances
	Control for other potential impacts (e.g. noise, light)
	Install fencing above underpass to direct animals below

Proportion of successful to unsuccessful crossing events

Significance threshold:	75% of surface crossing result in success
Monitoring:	Ratio of successful (track beds) to unsuccessful (AVCs) crossings
Adaptive management strategy:	Nighttime speed limit reductions (big game; carnivores)
	Install animal detection systems/driver warning systems (big game; carnivores)
	Vegetation controls along shoulder to increase driver visibility (big game; carnivores) and reduce the probability of wildlife along shoulder (herpetofauna, small mammals)
	Drift fencing to direct animals to suitable crossing structures (herpetofauna, small mammals)