

NEVADA DEPARTMENT OF TRANSPORTATION RESEARCH PROBLEM STATEMENT

Internal Submission Form (not to exceed 3 pages with font size 12)

I. **PROBLEM TITLE:** Development of Alternative Desert Tortoise Crossing Criteria and Designs

II. **PROBLEM DESCRIPTION (10 Points):**

While roadways have many effects on ecological resources, two primary concerns are fragmentation of suitable habitat for plants and wildlife and road-related mortality of wildlife species, specifically those whose populations are listed as threatened or endangered under the Endangered Species Act (ESA), such as the Mojave desert tortoise. The Nevada Department of Transportation (NDOT) maintains many hundreds of miles of highway in the habitat of the Mojave desert tortoise, 450 miles of which are protected by tortoise exclusionary fencing. While the exclusionary fencing protects desert tortoises from highway mortality, it does not address the issue of habitat fragmentation, and in fact may add to the problem. Since exclusionary fencing restricts desert tortoise movement even further than the highway itself, it can inhibit or prevent access to seasonal resources, alter tortoise behavior, and can be detrimental to the larger population through reduced gene flow.

In some areas, including along NDOT highways US 93, US 95, and I-15, drainage culverts that pass under roadways have been retrofitted into desert tortoise crossings by connecting tortoise exclusionary fencing to the culvert wingwalls. Desert tortoises have been documented using some of these crossings. However, it appears that the design requirements of these drainage features, especially those in high-flow areas, commonly conflict with the movement abilities of the desert tortoise. Many of these culverts have large rocks (rip rap) placed at the openings to minimize the potential for erosion, but the large voids within the rip rap are a major obstacle for tortoise movement, an entrapment hazard, and have been known to cause mortality. NDOT maintenance has attempted to mitigate this issue by backfilling the rip rap with a mix of native gravel and soil. This has limited utility as it does well on flat terrain but is regularly carried away in steeper areas by the voluminous water flows commonly observed in desert flood events. The native soil must be replaced often, which is a burden for NDOT maintenance. **Therefore, there is a need to develop criteria and plans for retrofitting culverts into desert tortoise crossings that can withstand multiple large hydraulic events while also being easily navigated by desert tortoises.**

The United States Fish and Wildlife Service is requiring NDOT and other transportation agencies to retrofit drainage culverts into tortoise crossings on federally funded projects as frequently as every two miles, even in high-flow areas where rip rap is suggested as a means of erosion control. These crossings are expensive to install and require inspection and maintenance after every major storm event, putting a strain on both NDOT biologists and maintenance crews. Currently, no research is being done within the range of the desert tortoise on developing alternative crossing designs to make maintenance easier and more cost-effective for the transportation agencies. It is imperative that NDOT find alternative crossing designs that can withstand multiple hydraulic events without requiring extensive maintenance, while also providing effective crossing opportunities for desert tortoises. If alternative designs can be developed through this research, NDOT can reduce construction and maintenance costs, save tax-payer money, reduce habitat fragmentation, and increase population viability for the desert tortoise.

- III. **OBJECTIVE (Required):** The goal of this research is to develop creative, state-of-the-art designs, including engineering plans, to retrofit at least four hydraulic culverts into desert tortoise crossings with low maintenance requirements. The culverts should be a grade 4 or 5 (utilizing the Clark County Desert Conservation Program’s Culvert Inspection for the Purposes of Desert Tortoise Passage project rating system) and would otherwise require rip rap as an erosion control measure. At least one selected culvert should have steep entrance and/or steep outlet conditions, which tend to present the greatest challenges in providing a stable design that does not pose risks to desert tortoises.

The designs would preferably utilize common, non-proprietary materials that are durable against the harsh desert environment with high day-time heat, expected hydraulic flow energy, and high impact potential from abrasion and debris. The designs must also be durable against and tolerant of typical maintenance activities, not unreasonably hinder maintenance of the structure, and must not depend on the establishment of vegetation (i.e. turf reinforcement mats).

Criteria for successful tortoise crossings need to be identified in a final document with text and engineering plans, which should outline culvert flow rates, topography, existing infrastructure, and other features. This research will study the strengths and weaknesses of new erosion control designs compared to the rip rap currently used in many high-flow tortoise crossings in District 1.

- IV. **CURRENT PRACTICE and RELATED RESEARCH (10 Points):** Gene flow connectivity of the Mojave desert tortoise is a top priority for the U.S. Fish and Wildlife Service in the recovery of the species. As such, the Service is requesting that NDOT and other transportation agencies install tortoise crossings on Federal projects as frequently as every 2 miles. NDOT has considered alternative erosion control designs, such as turf reinforcement mats, but these types of systems come with too many downsides to implement. Some of these downsides are the use of plastic materials that break down over time due to UV degradation; materials that are easily torn apart from hydraulic forces, debris, and maintenance activities; materials that don’t tolerate abrasion well; and systems that rely on vegetation to help anchor the material, which is limited in the Mojave desert. With no viable, alternative designs on hand, most of the tortoise crossings incorporate backfilled rip rap. With storms, the soil and gravel wash away, the tortoise walkways get undercut, and in the most extreme circumstances, a tortoise may get trapped in the exposed rip rap. The NDOT biologists inspect the crossings regularly and report the deficiencies to the area’s maintenance crew. The crews are overburdened with public safety priorities, and it often takes several months to repair the tortoise crossings, leaving them both useless and dangerous to desert tortoises for most of the year.

Since connectivity is such a priority for the recovery of the species, there is an abundance of research on how to connect desert tortoise populations with crossings. Most of this research in Utah, California, Arizona, and Nevada is focused on identifying areas that would most benefit from tortoise crossings and how tortoises are using crossings. Clark County Desert Conservation Program completed their Culvert Inspection for the Purposes of Desert Tortoise Passage project in 2021, which gave a grade of 1 through 5 to each culvert tied into tortoise exclusionary fence in Clark County, based on the ability for a tortoise to pass through. This data will be useful in future research and project planning. Additionally, the NDOT research project for the Development for Dual-Purpose Desert Tortoise Crossings yielded a thorough literature review and monthly monitoring reports. The publications and data from these two projects may prove

valuable to this Development of Alternative Desert Tortoise Crossing Criteria and Designs project.

V. IMPLEMENTATION POTENTIAL (10 Points): The proposed research falls under the research deployment stage 3, Controlled Field Demonstration. The research will result in a final document containing design criteria for ideal desert tortoise crossings and engineering plans for at least four tortoise crossings that will be ready for implementation upon receipt. No institutional, political, or socio-economic barriers were identified that would interfere with implementation of the anticipated research results and products.

VI. URGENCY and PAYOFF POTENTIAL (10 Points each, Total 20 Points): It is extremely urgent to facilitate safe crossings for desert tortoises now in order to minimize the potential for inbreeding depression cause by habitat fragmentation. Without designs and design criteria that can guide NDOT to retrofit culverts into tortoise crossings that function well with minimal maintenance intervention, NDOT will continue to face challenges associated with project needs as well as commitments made through the Endangered Species Act consultations. It is imperative that this research be done as soon as possible, as the United States Fish and Wildlife Service is requesting tortoise crossings every two miles on new projects. These crossings are being installed even in high-flow areas where the suggested erosion control measure for culverts is rip rap which requires frequent maintenance. The result is hundreds of thousands of dollars spent on less-than-ideal designs that have limited function and put tortoises in danger. The sooner this research can be completed, the sooner NDOT can begin to save money by implementing more efficient tortoise crossing designs.

VII. DATE and SUBMITTED BY (Required):

April 6, 2023
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VIII. ADDITIONAL 10 POINTS TOTAL FOR MULTIPLE CHAMPIONS FROM MORE THAN ONE SECTION –

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