

PRELIMINARY INVESTIGATION

Caltrans Division of Research, Innovation, and System Information

Improved Exclusion Barriers for Desert Tortoises

Requested by

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May 20, 2014

Acknowledgement

I acknowledge all who have taken their time to discuss desert tortoise guards specifically and desert tortoise conservation in general. Their names are listed in the list of contacts. Thank you all very much for sharing your time and your expertise.

Introduction

Research Problem Statement

Caltrans lacks the means necessary to adequately exclude state and federally listed Agassiz's desert tortoises (*Gopherus agassizii*) from entering highway rights-of-way and being struck by vehicles. Currently designed tortoise turnarounds and gates installed as barriers to prevent desert tortoises from entering Caltrans rights-of-way have not proven to be 100% effective. Side roads that bisect tortoise fencing to allow vehicular access to highways need to remain open due to private access rights. On these roads tortoise proof gates are used as barriers for the animals while allowing vehicle movement. Unfortunately tortoise proof gates are left open on a regular basis, thus making this exclusionary method ineffective for protecting the listed species. Alternative tortoise exclusionary barrier designs are needed to allow Caltrans to implement means that are safe not only for the motoring public but also effective in preventing desert tortoise mortality.

Background

In California the desert tortoise is listed as a threatened species under both federal and state endangered species laws. This species occurs in Caltrans Districts 7, 8, 9, and 11. Roads can directly affect desert tortoises especially by vehicle caused mortality. The affects of vehicle induced mortality on desert tortoises are well known (See Grandmaison et al. 2012 for a summary and citations). Because of the life history of desert tortoises which have high mortality when young, require a long period to reach sexual maturity, and have a low natality rate but a long period of reproductive activity, maintaining high adult survival rates is important in maintaining or recovering populations (USFWS 2011). Even small increases in adult mortality can cause substantial population declines. Therefore, fencing is used to prevent highway related mortality. The U.S. Fish and Wildlife Service (USFWS) and Bureau of Land Management (BLM)

developed a design and specifications for desert tortoise fences that have been adapted by and are used by Caltrans. However, fences cannot be used when private driveways and roads cross Caltrans rights-of way and bisect the tortoise fencing. Tortoise proof gates have also been developed and are used by Caltrans when feasible. However, many times the private parties with access rights leave gates open making the rights-of-way accessible to tortoises. Other exclusionary devices such as tortoise guards may be able to solve the problem. Information is needed on the design, costs, success, and maintenance of these devices so that improved mitigation can be developed. Improved methods of excluding desert tortoises from Caltrans rights-of-way can help facilitate timely road maintenance and project development by improving environmental compliance. A comprehensive summary of the biology of desert tortoises is found in Ernst and Lovich (2009).

Recent work resulting in nomenclatural changes warrants a brief taxonomic note. For many years all desert tortoises in the Mojave Desert, Sonoran Desert, and adjacent portions of Mexico were classified as *Gopherus agassizii* (see Auffenberg and Franz 1978, Stebbins 2003). While recognizing distinctions among tortoise populations the U. S. Fish and Wildlife Service maintains this classification considering tortoises in California to be part of the Mojave Population of *Gopherus agassizii* (USFWS Species Profile Desert tortoise (*Gopherus agassizii*), USFWS 2011). Desert tortoise populations north and west of the Colorado River are listed as threatened. Populations south and east of the Colorado River are listed as Similarity of Appearance (Threatened). However, due to morphological, habitat, and genetic distinctions this widespread species has recently been split into two species: Agassiz's desert tortoise (*Gopherus agassizii*) occurring west and north of the Colorado River; and Morafka's desert tortoise (*Gopherus morafkai*) occurring east and south of the Colorado River (Murphy et al. 2011). This delimitation of species is widely accepted in the herpetological community (Turtle Taxonomy Working Group 2012). Thus all desert tortoises in California are classified Agassiz's desert tortoise and in this report this species will be referred to as desert tortoise or simply tortoises.

Because of the direction given at the Preliminary Investigation kickoff meeting this Preliminary Investigation is focused primarily on one-slot tortoise guards. The contents of this report reflect the views of the author who is responsible for the facts and the accuracy of the data presented herein. The contents do not necessarily reflect the official views or policies of the State of California. This report does not constitute a standard, specification or regulation.

Summary of Findings of Current Practice

Grandmaison et al. (Dec. 2012) note that preventing tortoise access to highway rights-of-way when roads connect with the main highway is challenging. They suggest that this problem can be handled by using either tortoise proof gates or tortoise guards. The language used in Grandmaison et al. (2012) page 85 follows:

6.1.3 Gates and Access Roads

Two additional challenges are associated with the implementation of effective mitigation fencing—gates and cattle guards. The gap between the bottom of a gate and the ground

should be no greater than 0.5 inch. Larger gaps will allow tortoise hatchlings access to the road surface. In addition, the footer below the gate should be constructed of concrete. Wooden footers will warp or degrade over time and may create large gaps that could be breached by tortoises.

On US 93, and in other areas where mitigation fencing has been installed, access roads connect with the main highway and require that fencing be opened to allow unobstructed travel by vehicles. Cattle guards with escape ramps (to prevent tortoises falling through the bars and becoming trapped) or other guard structures (Figure 41) can be installed to inhibit tortoise movement onto the main highway through the fence openings. Mitigation fencing should terminate at the guard structure so that tortoises cannot bypass the structures to access the road. In some cases, it might be preferable to install fencing along access roads to funnel tortoises to crossing structures that allow tortoises to move across the access road while inhibiting movement onto the main highway.

Because gates have not proven to be a workable solution in the circumstances faced by District 8 this discussion will focus on tortoise guards which can allow unobstructed access by motor vehicles while preventing access by desert tortoises. When tortoise guards are used there is no need for a driver to take any action to maintain tortoise exclusion.

According to contacts with the USFWS and BLM (Catherine “Cat” Darst, Ray Bransfield, and Lawrence LaPre) there are two basic designs for tortoise guards to use in lieu of gates. One is a cattle guard that is modified so that if a small animal falls into the guard it can escape via a dirt ramp leading away from the road or other excluded area. The other is a one-slot guard consisting of two I beams that are held apart and thus separated by an open space. Discussion at the kickoff meeting focused this Preliminary Investigation on the one-slot guard. Pictures and engineering drawings of cattle guard type tortoise barriers are included in the appendix of this PIR.

A brief review of the documents on solar power projects revealed a third approach to desert tortoise barriers. This approach is to use automatically opening and closing tortoise gates. The following language is taken from the Modified Blythe Solar Power Project Draft EIS (2014):

Security Gates. Security gates shall be designed with minimal ground clearance to deter ingress by tortoises. The gates may be electronically activated to open and close immediately after the vehicle(s) have entered or exited to prevent the gates from being kept open for long periods of time.

Automatically opening and closing gates have utility only where they are closely watched and easy maintenance is available. Caltrans locations needing tortoise barriers are usually remote enough that the automatically opening and closing gates would not be practical. Therefore, they are not considered further in this report.

One-slot tortoise guards form a trench which is deep enough and wide enough to prevent tortoises from crossing, but narrow enough to allow vehicles and people to easily pass. Thus, these tortoise guards serve to prevent desert tortoises from entering highway rights-of-way while simultaneously maintaining access rights. Because tortoise guards will be crossed by intermittent traffic they need to be robust enough to support the weight of the vehicles. These requirements are met by using two steel I-beams set to match the roadway crown to form the trench that tortoises cannot cross. The trench is eight inches wide and a minimum of eight inches deep to the top of the substrate. Medium density closed cell polyethylene foam

or soft soil is used as the top inch to two inches of the substrate to provide a cushion for any animal that falls into the tortoise guards' trench. The surface of the substrate needs to be bumpy to facilitate a tortoise in righting itself if it falls in. An escape ramp leading back away from the isolated road with a maximum slope of 3:1 and at least three feet in length is constructed at each end of the guard. Tortoise exclusion fences are built up to the edge of the guards to provide a continuous barrier to the tortoises to prevent the animals from having access to the road. In some circumstances providing a tortoise passage underneath the access road and fencing to guide tortoises to the passage may be useful for maintaining tortoise connectivity while preventing access to the main highway. See figures 1-4 below for details of one-slot tortoise guards.

The only scientific study on desert tortoise guards discovered during this PIR is EnviroPlus Consulting (1996). This is a gray literature consultant report which is not peer reviewed and particular care must be taken in its interpretation. Work pertaining to tortoise guard deterrent structures is summarized here.

Initially the researchers tested captive desert tortoises using a visual cliff to determine basic tortoise behavior in relation to falling. They noted that tortoises are deterred by a visual cliff. However some of the tortoises tested learned to cross the visual cliff by using a perceived ledge or by testing the surface and discovering that there was no actual trench. The observation that tortoises are deterred by a perceived chance of falling is the keystone for all tortoise guard design.

The researchers also tested tortoises on mockups of tortoise barrier devices. Despite the small number of tortoises used the study's methodology does appear to be sufficient to inform tortoise guard design. The authors concluded that "In contrast to the pacing diversion experiment, we learned enough from the experiment to suggest an effective crossing deterrent design." The tortoise barrier devices used were a standard cattle guard design, a modified cattle guard design specifically for desert tortoises, and a creosote olfactory barrier. The specific details of the barriers tested are found in the original report. The researchers used a 10X30 m test pen bisected by a wall to divide the test pen in two. The dividing wall had a two meter wide gap containing the different treatments to determine their efficacy as tortoise barriers. A time lapse video system recorded the movements of the tested tortoises. Experimentation occurred in two pens for each test run. Each pen contained two adult female tortoises at a time, so four tortoises were tested during each test run. There were two test runs so that a total of eight adult female tortoises were used in testing. Each test run lasted for eighteen days. Based on their experimental work the authors of the EnviroPlus report provided the following characteristics for tortoise guards:

- The desert tortoise proof fence should be attached to the tortoise guard in such a way as to not form a ledge. Tortoises will use ledges at the edge of a structure to try a crossing.
- The gap between the rails of the tortoise guard should be about 12 cm (4.72 in) wide.
- There should be no structural elements crossing the gap at the surface parallel to the tortoises direction of travel.
- The trench should have a higher wall on the highway side than on the habitat side. A 90 cm (35.4 in) wall on the highway side and a 30 cm (11.8 in) "would likely be effective".

One drawback to this work is that the authors did not actually test their ideal tortoise guard design but inferred the characteristics from the designs they tested. They call for the experimental confirmation of the design prior to implementation.

The experimental work performed by EnviroPlus included a variety of aspects in addition to testing desert tortoise barriers (EnviroPlus 1996). The pacing diversion experiment described in the report was designed to determine fencing configurations that would discourage the animals from pacing along a fence looking for a location where the fence could be crossed. The researchers wished to discourage pacing because tortoises that remain in close proximity to fences can find locations to cross the fence where there are gaps or where the fence ends. A specific example used by the authors is where a fenced roadway meets an unfenced roadway. This PIR is concerned specifically with one-slot guards that prevent desert tortoises from using a roadway that bisects a fence from having access to a highway where they may be crushed by vehicles. When desiring tortoises to use a tortoise passage that crosses a roadway it can be useful to encourage the animals to pace along the fence to guide them to the crossing facility (see for instance Boarman et al 1997). Tortoise guards should be used by Caltrans as part of an integrated strategy that prevents the tortoises from facing the perils of crossing the pavement while maintaining habitat connectivity for individual tortoises and genetic connectivity for desert tortoise populations.

The one-slot tortoise guard differs from the characteristics suggested in the EnviroPlus report in three important ways. First, is the adoption of a single gap rather than a series of parallel gaps as in a cattle guard. The 8 in (20.32 cm) gap in the one-slot guard is wider than the recommendation in the report. Second, is use of one inch bars as cross supports. These are too small for tortoises to use in crossing and they are attached to the lower surfaces of the I beams. Third is the 8 in minimum trench depth. Tortoises are precluded from climbing out of the trench toward the road by the overhangs formed by using steel I beams. Overhangs are a standard way for deterring reptiles from climbing walls. Escape ramps provides exits.

PERMANENT TORTOISE GUARD

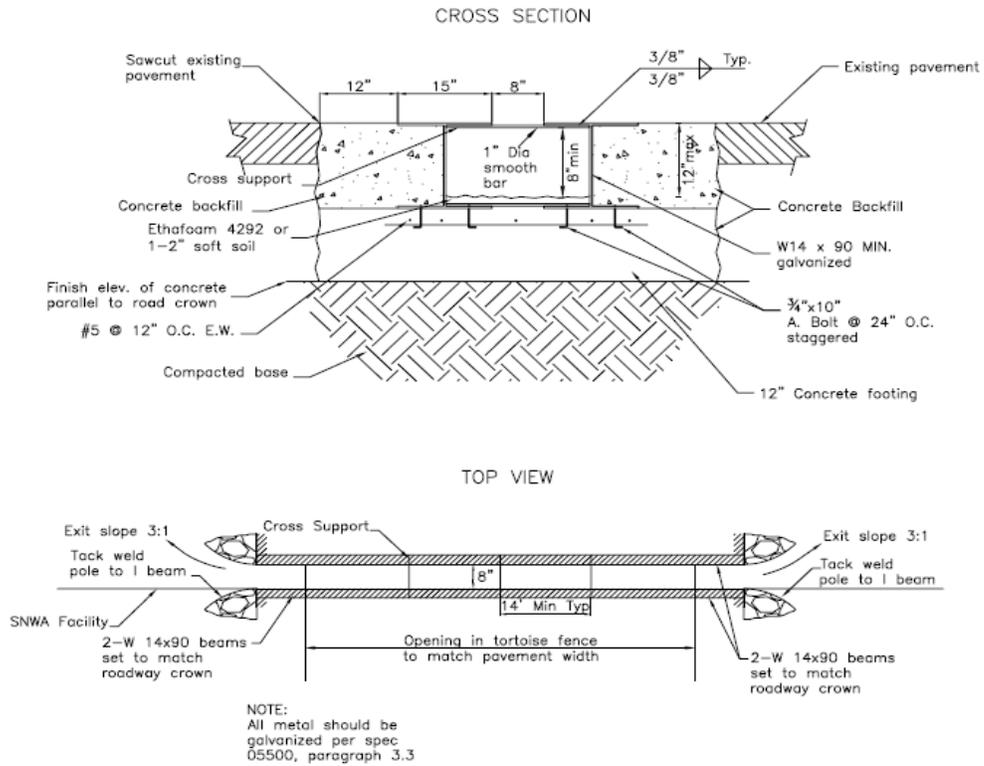


Figure 1. Design drawing for a permanent one-slot tortoise guard. Source: Clark County, NV and others. Note that the exit slope (escape ramp) needs to be a minimum three feet long, robustly constructed and properly maintained. A more complete description of the escape ramp is found in Figure 3.



Figure 2. Permanent one-slot tortoise guard installed on a dirt road in Nevada. Note the escape route and connection to tortoise proof fence on the far side of the guard. Source: Clark County, NV.

One-slot guards may either be permanently or temporarily installed. Permanent guards are constructed more robustly and fixed to a concrete foundation while temporary guards are installed on a temporary foundation. The robustness of the foundation for a tortoise guard depends on the on the traffic volume and the types of vehicles that are expected to cross it. Where traffic volumes are high or more heavy vehicles are expected the installation needs to be more robust. Details of construction for a permanent one-slot tortoise guard are in Figure 1. This same figure is also presented in Grandmaison et al. (2012) on page 86 as well as Attachment B of the Ivanpah Biological Assessment (CH2MHill 2009). A permanent one-slot tortoise guard emplaced across a dirt road in Nevada is shown in Figure 2. Construction details for a temporary tortoise guard are shown in Figure 3, while a picture of a temporary installation is Figure 4.

TEMPORARY TORTOISE GUARD

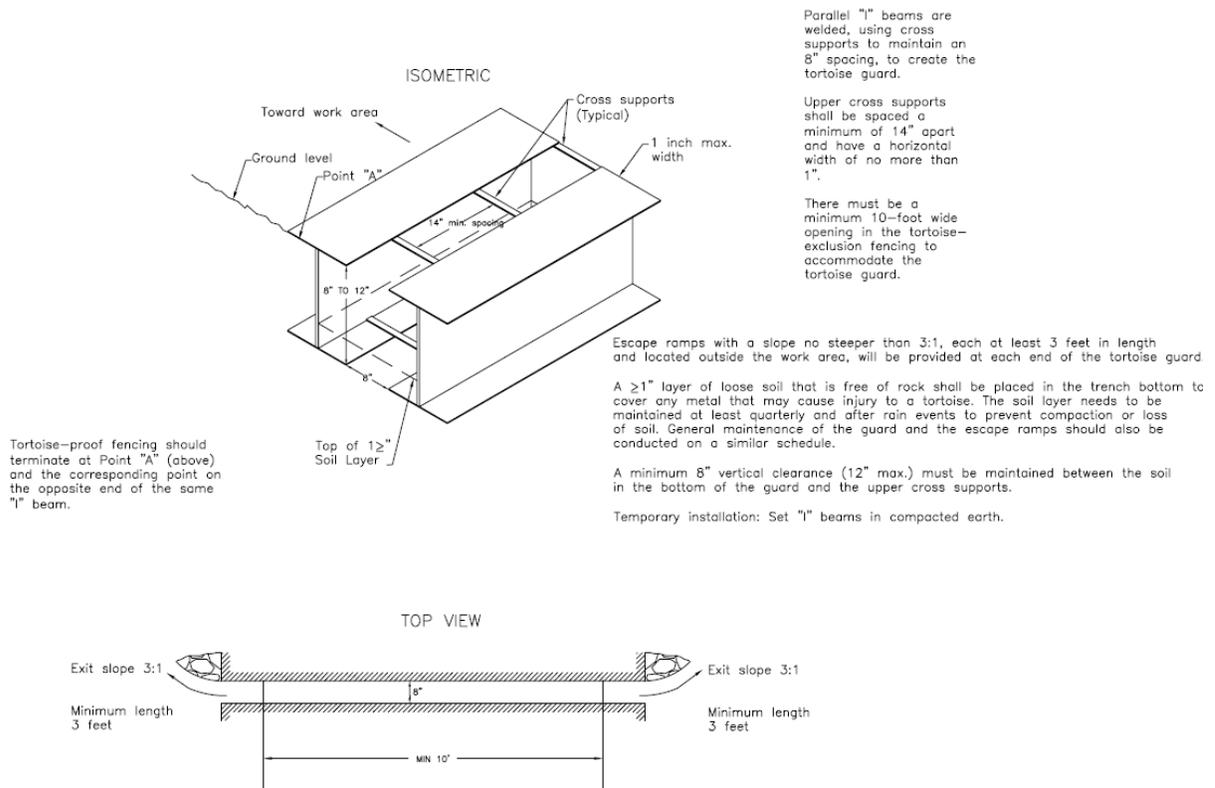


Figure 3. Design drawing for a temporary one-slot tortoise guard. Source USGS

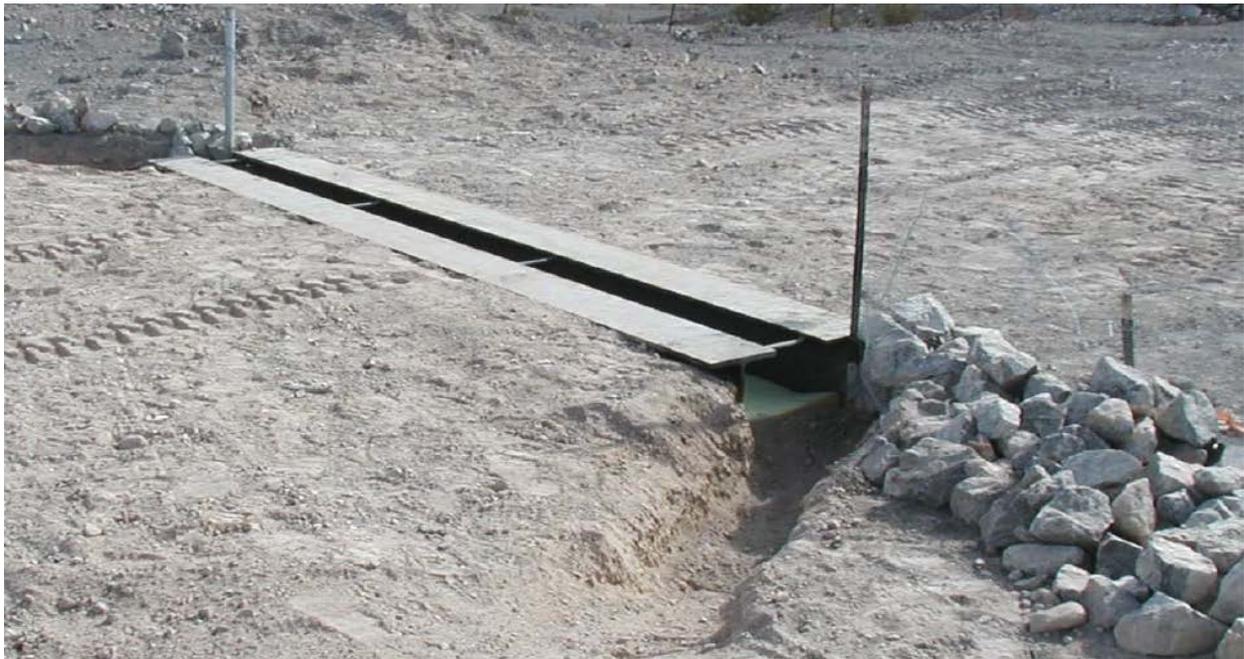


Figure 4. Installed temporary one-slot tortoise guard and fence. Note the escape ramps. Source: USGS

Clark County, Nevada's Desert Conservation Program constructed three one-slot tortoise guards in the Boulder City Conservation Easement (BCCE). The BCCE is an 86,423 acre area being preserved for sensitive species including desert tortoises. Driving in this area is limited to specific open roadways (<http://www.clarkcountynv.gov/Depts/dcp/Pages/BCCE.aspx>). The tortoise guards replaced three previously existing gates. The guards are to prevent tortoises from accessing the open roads with traffic while providing an escape route for animals that may fall into the trap (Clark County Desert Conservation Program). The total contract cost for the installation of the tortoise guards was \$28,056.75 or \$9352.25 per tortoise guard. The cost of fences was not included in this figure. The contract end date was September 30, 2013 and the contractor was Soil-Tech Company. The closeout report for this contract is appended to this PIR. Dr. Lawrence LaPre indicated that the first one-slot tortoise guard installation cost around \$20,000 (pers. com.). The cost of installing tortoise guards will vary depending on the specifics of the project but, these costs are illustrative. One-slot tortoise guards were installed at the Ivanpah Solar Electric site (Ivanpah Solar Electric Generating System March 2014). They have also either been installed or will be installed at other projects in southern California.

Beyond the installation of one-slot tortoise guards in southern Nevada and the solar electric projects in the Mojave Desert there appears to be only limited experience with them. Several of the desert tortoise experts contacted during this study indicated that they are not familiar with one-slot tortoise guards. However, one-slot tortoise guards are acceptable to the California Department of Fish and Wildlife and the USFWS. There is one anecdotal observation of a desert tortoise falling into a one-slot tortoise guard, righting itself, and escaping via the exit ramp (LaPre pers. com.).

No records of actual maintenance costs for one-slot tortoise guards were found during this preliminary investigation. Not enough time has passed to determine maintenance costs in the case of the one-slot tortoise guards installed in the BCCE in Clark County, Nevada, or in the Mohave Desert installations. The following discussion on maintenance is based on contacts with the USFWS and Clark County, Nevada; and on Grandmaison et al. (2012), the USFWS Desert Tortoise Field Manual (2009), personal contacts with Dr. Lawrence LaPre, and the USFWS Revised Recovery Plan (2011).

It is clear that tortoise guards require regular maintenance to fulfill their purpose as barriers preventing tortoise access to highways and reducing highway related mortality. They cease to function as barriers when they become filled with sediment, the escape ramps are obstructed, or they are otherwise damaged in such a way as to fill the trench or block the escape passages.

Guidance for the frequency and type of maintenance required for one-slot tortoise guards is found in the desert tortoise Field Manual (USFWS 2009), Grandmaison et al. (2012), and the Revised Recovery Plan (USFWS 2011). The language related to maintenance of tortoise guards is virtually identical in these documents. The only differences among the sources are editorial and do not change the meaning of the language. The language below is copied from the Revised Recovery Plan (USFWS 2011 p.184-185).

Inspection of Desert Tortoise Barriers

The risk level for a desert tortoise encountering a breach in the fence is greatest in the spring and fall, particularly around the time of precipitation including the period during which precipitation occurs and at least several days afterward. All desert tortoise fences

and cattle guards should be inspected on a regular basis sufficient to maintain an effective barrier to tortoise movement. Inspections should be documented in writing and include any observations of entrapped animals; repairs needed including bent T-posts, leaning or non-perpendicular fencing, cuts, breaks, and gaps; cattle guards without escape paths for tortoises or needed maintenance; tortoises and tortoise burrows including carcasses; and recommendations for supplies and equipment needed to complete repairs and maintenance.

All fence and cattle guard inventories should be inspected at least twice per year. However, during the first 2 to 3 years all inspections will be conducted quarterly at a minimum, to identify and document breaches, and problem areas such as wash-outs, vandalism, and cattle guards that fill-in with soil or gravel. GPS coordinates and mileages from existing highway markers should be recorded in order to pinpoint problem locations and build a database of problem locations that may require more frequent checking. Following 2 to 3 years of initial inspection, subsequent inspections should focus on known problem areas which will be inspected more frequently than twice per year. In addition to semi-annual inspections, problem areas prone to wash-outs should be inspected following precipitation that produces potentially fence damaging water flow. A database of problem areas will be established whereby checking fences in such areas can be done efficiently.

Repair and Maintenance of Desert Tortoise Barriers

...Similarly, cattle guards will be cleaned out of deposited material underneath them in a timely manner. In addition to periodic inspections, debris that accumulates along the fence should be removed. All cattle guards that serve as tortoise barriers should be installed and maintained to ensure that any tortoise that falls underneath has a path of escape without crossing the intended barrier.

The language above can be used to develop a maintenance program for one-slot tortoise guards. Clearly, sufficient maintenance assets need to be made available to assure proper functioning of tortoise guards. The cost of tortoise guard maintenance will depend in part on the number tortoise guards, the distance that maintenance personnel have to travel, and the frequency of tortoise guard problems.

One-slot tortoise guard inspections are being carried out at solar electric installations (Ivanpah Solar Electric Generating System March 2014, LaPre pers. com.). At this point there are no easily obtainable records for the costs of maintaining one-slot tortoise guards. Where they are installed tortoise guards are performed on a regular basis and also occur immediately after significant rainstorms. Caltrans circumstances are different from those of solar electric plants because of the long linear nature of highways compared to the relatively small discrete perimeter of power plants. Consequently, maintenance costs for Caltrans will differ from those of the electrical generating installations.

NCHRP 25-25/Task 84 Development of Construction Guidelines for Wildlife Fencing and Associated Escape and Lateral Access Control Measures

The National Cooperative Highway Research Program (NCHRP) is currently conducting research on wildlife fences and other barriers. Administered by the Transportation Research Board and sponsored by the member departments (i.e., individual state departments of transportation), the American Association of

State Highway and Transportation Officials, in cooperation with the Federal Highway Administration, the NCHRP conducts research in acute problem areas that affect highway planning, design, construction, operation, and maintenance nationwide.

NCHRP 25-25/Task 84 is an ongoing research effort with the following objectives:

- conduct a thorough review and synthesis of past wildlife fence, escape and lateral access control measure, and end run prevention applications, and
- develop guidelines to ensure effective future applications (including appropriateness in terms of where and when to use fencing), aesthetics, and cost effectiveness with regard to initial construction *and* long-term maintenance costs.

Reptiles are expressly part of this task. The final report is expected to be complete in August 2014 (<http://apps.trb.org/cmsfeed/TRBNetProjectDisplay.asp?ProjectID=3509>). Patrick McGowen of the research team has been made aware of one-slot desert tortoise guards. But, it is not known if the research team will develop and include any information about these guards in the project's final report.

Gaps in Findings

While there is good information on the design of one-slot tortoise guards and some information on the cost of their installation, there appears to be a dearth of studies on their effectiveness and on their long term costs which includes the cost of maintenance. No synthesis of the experience of agencies, or individuals, with one-slot tortoise guards appears to exist. Also, no peer reviewed literature was found that deals with the effectiveness of this type of guard to prevent desert tortoise crossing.

Next Steps

Based on the information collected in this Preliminary Investigation Caltrans can consider taking the following actions:

- Obtain the final report for NCHRP 25-25/Task 84 when it is published and extract all information pertinent to one-slot tortoise guards.
- Expand discussions with the appropriate people in the USFWS and BLM about using and maintaining one-slot tortoise guards.
- Gather more information about the tortoise guard installations at the Mojave Desert solar projects and in southern Nevada. Of particular interest are the effectiveness of the one-slot desert tortoise guards as barriers and matters pertaining to maintenance.
- Develop pooled fund research along with FHWA, USFWS, DOT's and wildlife agencies in Arizona and Nevada (and perhaps others) to statistically examine the effectiveness of one-slot tortoise guards as barriers for desert tortoises. The methods used by EnviroPlus can be adapted for use with a larger number of tortoises, for current electronics, and for the one-slot design. There are inherent difficulties in doing research with listed organisms and close cooperation with the USFWS is essential.
- Develop a comprehensive list of Caltrans locations where it would be beneficial to install one-slot tortoise guards.

- Develop a code of safe practices including a hazard review and safe operating procedures for tortoise guard maintenance. This will help in being able to safely maintain tortoise guards and estimate the cost of maintenance.

Resources Cited

Auffenberg, Walter and Richard Franz. 1978. *Gopherus agassizii* (Cooper) Desert tortoise. Catalogue of American Amphibians and Reptiles, Society for the Study of Amphibians and Reptiles: 212.1 – 212.2.

Available at:

<https://www.zenscientist.com/index.php/filedrawer/Open-Access-Journals/caar/Gopherus-agassizii/>

Summary: This older reference provides information on the on the taxonomy, biology and range of the desert tortoise (sensu lato).

Boarman, William I., Marc Sazaki, and W. Bryan Jennings. 1997. The effect of roads, barrier fences, and culverts on desert tortoise populations in California, USA, p. 54-58. *In Proceedings: conservation, restoration, and management of tortoises and turtles. New York Turtle and Tortoise Society.*

Summary: This paper discusses desert tortoise fence, gate and crossing work done during the 1990's on State Route 58 in San Bernardino County.

CH2MHill. 2009. Biological assessment for the Ivanpah Solar Electric Generating System. Attachment B. Prepared for the Bureau of Land Management, California Desert District, Moreno Valley, California. Sacramento, California.

Available at:

http://www.blm.gov/pgdata/etc/medialib/blm/ca/pdf/needles/lands_solar.Par.36490.File.dat/BA%20attachment%20B%20DT%20fencing%20specs.pdf

Clark County Desert Conservation Program. December 23, 2013. Project completion notification: Boulder City Conservation Easement desert tortoise guards installation 2011-SoilTech-920B.

Available at:

<http://www.clarkcountynv.gov/Depts/dcp/Documents/Project%20Close%20Out%20Rpts/BCCE%20Desert%20Tortoise%20Guards%20Installation%20%202011-Soiltech-920B.pdf>

Summary: This report provides information about the cost of installing three one-slot desert tortoise guards in the Boulder City Conservation Easement. This document is appended to this report.

Clark County Desert Conservation Program. ND. 2011-2013 biennium progress report. P. 37ff

Available at: http://www.clarkcountynv.gov/Depts/dcp/Library/dcp%20reports/2013/2011-2013_BPR.pdf

Summary: This report provides information on the activities and costs of managing the Boulder City Conservation Easement including installation of three one-slot desert tortoise guards.

Ernst, Carl H. and Jeffrey E. Lovich. 2009. Turtles of the United States and Canada. Johns Hopkins University Press. Baltimore MD. Pp. 540-570.

Summary: This reference provides a comprehensive summary of the literature about the desert tortoise to the time of publication.

EnviroPlus Consulting. February 15, 1996. Methods of reducing desert tortoise mortality along roadways. Final Report. EnviroPlus Consulting 1660 West Franklin Avenue, Ridgecrest California.

Available from: Harold Hunt Caltrans Division of Research, Innovation, and System Information.

Summary: This gray anonymous literature report was sent to Caltrans for this PIR by Gilbert Goodlett of EnviroPlus Consulting. This consultant tested a variety of fence and cattle guard designs to determine their efficacy in preventing desert tortoises from accessing to highways and other sensitive areas. The experimental design was adequate enough to provide information on tortoise guards. One-slot tortoise guards using the design provided to Caltrans by the USFWS and others were not tested. Rather the authors tested a visual cliff and cattle guard type designs. This study is discussed in the text above.

Grandmaison, David D., Raymond E. Schweinsburg, and Michael F. Ingraldi. December 2012. Assessment of Desert Tortoise Movement, Permeability, and Habitat along the Proposed State Route 95 Realignment. FHWA-AZ-12-650. Research Center, Arizona Department of Transportation, 206 S. 17th Avenue, MD075R, Phoenix, AZ 85007.

Available at: http://www.azdot.gov/adotlibrary/publications/project_Reports/PDF/AZ650.PDF

Summary: This research was performed by the Research Branch of the Arizona Department of Fish and Game for the Arizona Department of Transportation. The report provides a summary of information for excluding tortoises from highways as part of work relating to specific highways in Arizona. While dealing specifically with Morafka's desert tortoise rather than Agassiz's desert tortoise the close similarities between the two species allow for extrapolation of the exclusion information to Agassiz's desert tortoise. The authors present recommendations for construction and maintenance of tortoise exclusion devices. Specifications for a permanent tortoise guard developed by the Southern Nevada Water Authority are provided in the text. The tortoise guard design is actually for Agassiz's desert tortoise which ranges west and north of the Colorado River. The pages of the Arizona report that deal with tortoise exclusion have been extracted and placed in this PIR.

Ivanpah Solar Electric Generating System. March 2014. Monthly compliance report number 42. Prepared by: Mary Huizar ISEGS Site Compliance. 100302 Yates Well Road, Nipton, CA 92364.

Available at:

<http://docketpublic.energy.ca.gov/PublicDocuments/Forms/AllItems.aspx?RootFolder=%2fPublicDocuments%2f07%2dAFC%2d05C&FolderCTID=0x012000854EBC55F6E2AC47926325FA751AA84F>

Murphy, Robert W., Kristin H. Berry, Taylor Edwards, Alan E. Leviton, Amy Lathrop, and J. Daren Riedle. 2011. The dazed and confused identity of Agassiz's land tortoise, *Gopherus agassizii* (Testudines, Testudinidae) with the description of a new species, and its consequences for conservation. ZooKeys 113: 39-71.

Available at: <http://www.ncbi.nlm.nih.gov/pmc/articles/PMC3187627/>

Summary: This open source paper describes *Gopherus morafkai* and distinguishes it from its congener *Gopherus agassizii*. Some conservation aspects relating to the recognition of two species rather than one are discussed.

Stebbins, Robert C. 2003. A field guide to western reptiles and amphibians. 3rd ed. Peterson field guide series. Houghton Mifflin Co., New York, NY. 533 p.

Turtle Taxonomy Working Group [van Dijk, P.P., Iverson, J.B., Shaffer, H.B., Bour, R., and Rhodin, A.G.J.]. 2012. Turtles of the world, 2012 update: annotated checklist of taxonomy, synonymy, distribution, and conservation status. In: Rhodin, A.G.J., Pritchard, P.C.H., van Dijk, P.P., Saumure, R.A., Buhlmann, K.A., Iverson, J.B., and Mittermeier, R.A. (Eds.). Conservation Biology of Freshwater Turtles and Tortoises: A Compilation Project of the IUCN/SSC Tortoise and Freshwater Turtle Specialist Group. Chelonian Research Monographs No. 5, pp. 000.243–000.328, doi:10.3854/crm.5.000.checklist.v5.2012.

Available at: www.iucn-tftsg.org/cbft/

Summary: The most recent update of a comprehensive reference on turtle taxonomy.

U.S. Department of the Interior Bureau of Land Management. February 2014. Modified Blythe Solar Power Project. Proposed amendment to right-of-way grant CACA 048811. Draft Environmental Impact Statement. Volume 1. Publication Index Number #: BLM/CA/PL-2014/010+1793. P. 2-61.

Available at:

http://www.blm.gov/ca/st/en/fo/palmsprings/Solar_Projects/Blythe_Solar_Power_Project.html

U. S. Fish and Wildlife Service Species Profile Desert tortoise (*Gopherus agassizii*). Updated April 16, 2014. Accessed by Harold G. Hunt 17 Apr. 2014.

Available at: <http://ecos.fws.gov/speciesProfile/profile/speciesProfile.action?sPCODE=C04L>

U. S. Fish and Wildlife Service. 2011. Revised recovery plan for the Mojave Population of the desert tortoise (*Gopherus agassizii*). Region 8, Pacific Southwest Region, U. S. Fish and Wildlife Service, Sacramento, CA.

Available at:

http://www.fws.gov/nevada/desert_tortoise/documents/recovery_plan/rrp%20for%20the%20mojave%20desert%20tortoise%20-%20may%202011.pdf

U. S. Fish and Wildlife Service. 2011. Biological Opinion on BrightSource Energy's Ivanpah Solar Electric Generating System Project, San Bernadino County, California [CACA-48668, 49502, 49503, 49504] (8-8-10-F-24R). Ventura Fish and Wildlife Office, Ventura CA.

Available at:

http://www.blm.gov/pgdata/etc/medialib/blm/ca/pdf/needles/lands_solar.Par.71302.File.dat/ISEGS_Reinitiation,%20Final%20BO.pdf

U.S. Fish and Wildlife Service. 2009. Desert Tortoise (Mojave Population) Field Manual: (*Gopherus agassizii*). Region 8, Sacramento, California.

Available at: http://www.fws.gov/nevada/desert_tortoise/documents/field_manual/ACK_TOCDT_Field_Manual.pdf

NCHRP 25-25/Task 84 [Active] Development of Construction Guidelines for Wildlife Fencing and Associated Escape and Lateral Access Control Measures

Link: <http://apps.trb.org/cmsfeed/TRBNetProjectDisplay.asp?ProjectID=3509>

The objectives of this research are to: (1) conduct a thorough review and synthesis of past wildlife fence, escape and lateral access control measure, and end run prevention applications, and (2) develop guidelines to ensure effective future applications (including appropriateness in terms of where and when to use fencing), aesthetics, and cost effectiveness with regard to initial construction *and* long-term maintenance costs. Research is underway and a final report is expected in August 2014. The PI is Dr. Marcel Pieter Huijser. The dates of the research are: 6/17/2013 – 8/16/2014

List of Contacts

The following people provided information for this Preliminary Investigation:

Catherine “Cat” Darst, USFWS

Ray Bransfield, USFWS

Lawrence LaPre BLM

Cristina A. Jones, Arizona Game and Fish

Daniel Leavitt, Arizona Game and Fish

Lisa Andersen, Arizona DOT

Norris Dodd, Arizona DOT

Julie Alpert, Arizona DOT

Scott Cambrin, Clark County, Nevada

Paul West, Utah DOT

Krissy Wilson, Utah Division of Wildlife Resources

Patrick McGowen, Western Transportation Institute, Montana State University

Gilbert Goodlett, EnviroPlus Consulting, Ridgecrest, California

Search and Contact Methodology

I acquired pertinent literature by searching the Research in Progress (RIP), TRID, JSTOR, and EBSCO databases available through links at the Caltrans Transportation Library website using search terms related to “desert tortoise guard”. Additional searches utilized Google and Google Scholar. The U.S. Fish and Wildlife Service website: Desert Tortoise (*Gopherus agassizii*) [

<http://ecos.fws.gov/speciesProfile/profile/speciesProfile.action?spcode=C04L>] was also reviewed.

Email Contacts

Potential contacts with an email address or an internet contact page available online were sent the following email:

Subject: Request for information on desert tortoise guards

I am with the California Department of Transportation’s Division of Research, Innovation, and System Information. We are looking into reducing the potential for road related desert tortoise mortality by using

permanently installed tortoise guards to prevent the animals from entering highway rights-of-way by using roads with highway access. Therefore, I am contacting practitioners who may have experience with tortoise guards. The specific information that I am seeking includes:

- locations where tortoise guards have been used;
- the effectiveness of tortoise guards in restricting tortoise movement;
- the monitoring and maintenance required to ensure tortoise guard effectiveness; and
- the costs of constructing, monitoring, and maintaining tortoise guards.

If you have any information on tortoise guards, or if you know of anyone who has experience with them, please contact me.

Sincerely,
Harold Hunt

Harold G. Hunt
Senior Environmental Planner
Division of Research, Innovation, and System Information
Office of Materials and Infrastructure
California Department of Transportation
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When it was required, additional emails and/or phone calls were made to obtain information.

RIP Search

I searched the Transportation Research Board's Research in Progress database on April 24, 2014 using the keywords Desert Tortoise and a separate search using the keywords Wildlife to identify current and recently completed research performed or sponsored by transportation agencies. The use of the keywords desert tortoise produced no returns. The use of the keyword wildlife produced 111 returns. The returns were reviewed to determine relevance to this Preliminary Investigation. Two of these projects warranted further review. One project deals with wildlife guards but the research pertains primarily to ungulates and not to tortoises. The other project deals with sensitive Blanding's turtles and spotted turtles in Maine and is specific to those species and circumstances. Neither of these projects is expected to produce results that will inform Caltrans research into one-slot tortoise guards.

TRID Search

I searched the Transportation Research Board's TRID database on April 24, 2014 using the key words Desert Tortoise. There were 21 returns. These returns were reviewed to determine relevance to this Preliminary Investigation. Three returns pertained to the current work. These reports had already been obtained as part of this project.

Appendices

[Appendix 1: Desert Conservation Program Project Completion Notification: Boulder City Conservation Easement Desert Tortoise Guards Installation 2011-SOILTECH-920B](#)

[Appendix 2: Design Drawing and Photograph of Cattle Guard Style Desert Tortoise Guards](#)