SONORAN DESERT TORTOISE (*GOPHERUS MORAFKAI*) CONSERVATION GUIDELINES

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Arizona Game and Fish Department

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1.0 INTRODUCTION

The Sonoran desert tortoise (*Gopherus morafkai*) can be found in both the United States and Mexico, with a distribution split approximately 60:40 between Arizona and Mexico (U.S. Fish and Wildlife Service [USFWS] 2015). In Arizona, its range includes a hybridization zone with the Mojave desert tortoise (*Gopherus agassizii*) in Mohave County, extending from the Black Mountains west of Kingman, south to at least the Buck Mountains, and east to the Hualapai Mountains' western foothills (McLuckie et al. 1999; Edwards et al. 2015; Dolby et al. 2021). The tortoise's range spans across southern Arizona beneath the Mogollon Rim, reaching as far southeast as the Pinaleno Mountains in Graham County and extending to the Pajarito and Atascosa mountains in Santa Cruz County (Babb et al. 2013). In Arizona, the Sonoran desert tortoise generally ranges from 155 to 1500 meters (500 to 5,000 feet) above sea level (ASL), but individuals have been recorded at near or over 1500 meters (m) ASL in several areas with a single report at over 2300 m in the Rincon Mountains, Pima County (Aslan et al. 2003; USFWS 2015). The management of suitable tortoise habitat involves various stakeholders, including federal agencies such as the U.S. Forest Service (USFS), U.S. Fish and Wildlife Service (USFWS), Bureau of Land Management (BLM), National Park Service (NPS), Department of Defense (DoD), as well as the Arizona State Land Department, Tribal Nations, and private landowners.

Zylstra et al. (2013) reported generally high rates of annual survival (~92%) among 15 large, long-term *G. morafkai* mark-recapture plots surveyed between 1987 and 2008. These plots were distributed throughout the species' range within Arizona. Survival of adult tortoises on the plots decreased with drought severity, especially in portions of the range that were most arid, and in plots nearest to cities (Zylstra et al. 2013). Re-surveys between 2008 and 2020 at 13 of those plots, revealed annual survival of adults at 95–96% and juveniles averaged 82%. (Zylstra and Steidl 2021). Drought and closer proximity to cities continued to affect survivorship negatively.

To maintain viability over the long term, the Sonoran desert tortoise requires populations of adequate size and distribution to support resiliency, redundancy, and representation (USFWS 2022). Populations need large numbers of individuals to improve the chances of withstanding stochastic events. Resilient populations need to be spread across its range in both Arizona and Sonora, Mexico, supported by suitable habitat quantity and quality, to provide for range-wide redundancy and representation.

The USFWS reviewed the Sonoran desert tortoise for listing under the Endangered Species Act (ESA) twice since its identification as a distinct species in 2011. Most recently the USFWS found that the species was not considered to be at risk of extinction and that ESA listing was not warranted (USFWS 2022). *Gopherus morafkai* is protected throughout its range in Arizona through state laws (Arizona Revised Statute Title 17) and regulations approved by the Arizona Game and Fish Commission. Under Arizona Game and Fish Commission Order 43, take from the wild is prohibited, and possession is prohibited by AZGFD Rules (Article 4), except under special license or exemption.

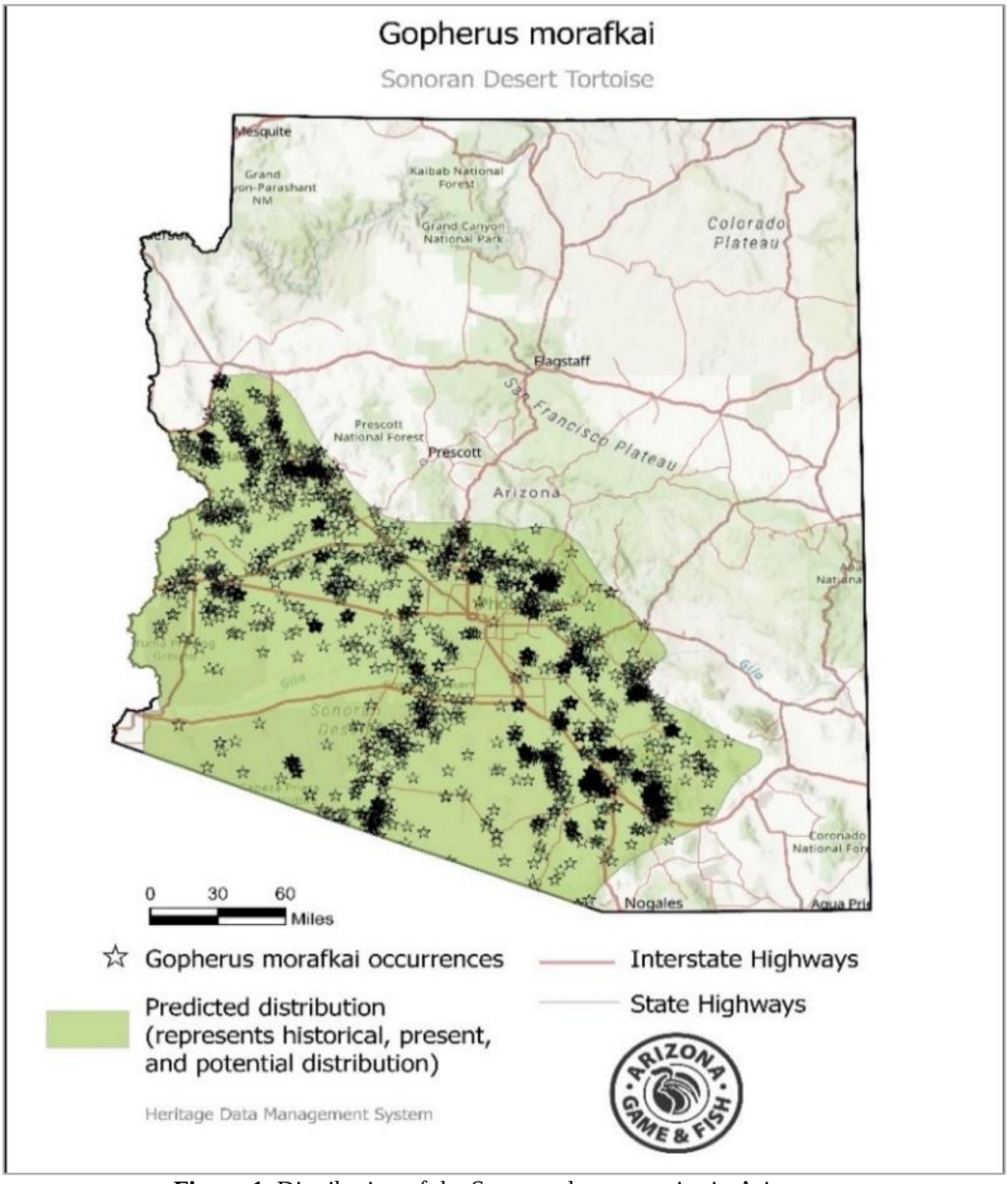

Figure 1. Distribution of the Sonoran desert tortoise in Arizona

The Arizona Interagency Desert Tortoise Team (AIDTT) completed a Candidate Conservation Agreement (CCA) for *G. morafkai* in Arizona to encourage, facilitate, and direct tortoise conservation actions across agencies (AIDTT 2015). Management actions in the agreement include reducing the spread of non-native grasses, reducing or mitigating dispersal barriers, reducing the risk and impact of desert wildfires, reducing the impact of off-highway vehicles, conducting population monitoring, and reducing illegal collection of tortoises. The Arizona Game and Fish Department has developed the following guidelines to reduce potential impacts to Sonoran desert tortoises, and to promote the continued existence of this species throughout the state.

2.0 General Biology

Gopherus morafkai is a large tortoise (up to 320 mm) with a dorsally flattened, pyriform carapace and an elongated, hingeless plastron with a deep posterior notch. Similar to other *Gopherus* species, substantial variability exists among individuals for many morphological features. The carapace is often widest behind the center and generally flares or becomes serrated over the posterior marginals. Paired gulars project anteriorly past the carapacial edge, and the species is sexually dimorphic with males having longer, more forked and upturned gulars. Body mass of adults can exceed 5 kg for large individuals, though 2.5–3.5 kg is more common (Dickinson et al. 2002).

The Sonoran desert tortoise occurs in various habitat types, mainly mixed cactus-paloverde associations along rocky slopes of mountain ranges and, to a lesser degree, they use incised washes with adequate caliche sheltersites draining into intervening lands. *Gopherus morafkai* is slow-growing, taking 18-20 years to reach sexual maturity, and is long-lived (living more than 50 years in the wild; Curtin et al. 2009). Tortoises feed on a variety of vegetation and spend the majority of their time in underground shelters, emerging mainly in the relatively cooler morning and evening hours of the summer or following precipitation events at any time of year. During the spring months, reproductive females emerge to take advantage of new growth following winter rains which provide important energy reserves for subsequent egg development. The most active season is from July through October, coinciding with the summer monsoon and the arrival of new growth in perennial plants and the germination of summer annuals. For the Sonoran desert tortoise, summer is key for feeding, movement, and reproduction.

As temperatures decline in October and November, tortoises reduce their surface activity, contract their movements, and shift their active periods to the warmer temperatures of midday (Averill-Murray et al. 2002; Woodman et al. 2002). The onset of winter inactivity among tortoises varies widely, with some starting to become inactive when daily high temperatures can still reach 30° C, while others may remain active. Tortoises in southern Arizona primarily used overwintering shelters on steep south-facing slopes, and males used deeper, more thermally buffered shelters than females (Bailey et al. 1995). Strong shelter site fidelity has also been noted, with some individuals using the same overwintering shelters for several consecutive years (Rubke and O'Donnell 2020).

2.1 Reproduction

Sonoran desert tortoises have relatively low fecundity. Females lay about 4–6 eggs (observed range 1-9; Averill-Murray et al. 2018), and roughly 50% of females reproduce each year, though this proportion is highly variable (Campbell et al. 2018).

Egg development is correlated with heat accumulation in the spring, with ovarian eggs formed earlier in warmer springs, and egg-laying varying from mid-May through late August (Lovich et al. 2017). Females that emerge earlier from hibernation are more likely to produce eggs, and early-emerging females also produce larger eggs than females that emerge later. The smallest gravid female was measured at 22.0 cm carapace length (CL). The smallest mature male was observed at 21.0 cm CL. Large females are more likely to reproduce in a given year and produce larger eggs than smaller females, but body size does not affect clutch size (Averill-Murray et al. 2018).

2.2 Movement

During their active period, tortoises may travel considerable distances. Home ranges vary from 3–112 hectares (ha) (Riedle et al. 2008; Sullivan et al. 2016; Rubke and Leavitt 2016; Averill-Murray et al. 2020). Long-distance movements of 14–32 km also have been recorded (Edwards et al. 2004; Rubke and Leavitt 2017), though movements of this magnitude typically span more than one season. Within-season movements of >1.5 km have been frequently documented (Barrett 1990; Sullivan et al. 2016; Rubke and O'Donnell 2018). These forays may be prompted by a lack of resources or potential mates in an area, or dispersal of younger tortoises to new territory. Immature tortoises are reported to be 47% more likely to disperse than mature tortoises and movements lasted 5–26 weeks in duration (Averill-Murray et al. 2020). Once established, female *G. morafkai* may overlap significantly in their home range with other females, while males appear less likely to do so (Sullivan et al. 2016). Females, on average, have smaller home ranges than males (Averill-Murray et al. 2020).

2.3 Habitat Requirements

Throughout most of its range *G. morafkai* occurs in subdivisions of the Sonoran Desert (summarized in USFWS 2021). It is a common inhabitant of the Arizona Upland Subdivision. Numerous populations also exist in the Lower Colorado River Subdivision in western Arizona, but it occurs in very low abundance at scattered localities in the hot and dry lower Gila Valley region of extreme southwestern Arizona. Populations are found marginally in Semi-desert Grassland and Madrean Evergreen Woodland (Martin 1995; Babb et al. 2013) in southeastern Arizona. Populations where *G. morafkai* coexists or hybridizes with *G. agassizii* in western Arizona occur in or have influences from the Mojave Desert. Range-wide geospatial modeling of habitat based on vegetation, slope, and elevation resulted in an estimate of approximately 79,000 km^2 of potential habitat in Arizona (USFWS 2021; Figure 2).

Habitat characteristics are influenced more by topographic and geomorphologic features than vegetation communities (Riedle et al. 2008; Zylstra and Steidl 2009). *Gopherus morafkai* most typically occupies steep slopes with boulders and bedrock outcrops in and under which individuals shelter and burrow (Burge 1979, 1980; Barrett 1990; Rosen et al. 2014). However, they are also closely associated with dry washes, extending more than 1.7 km away from rock slopes, where they often shelter in cavities in consolidated alluvial rock such as caliche (Averill-Murray and Averill-Murray 2005; Riedle et al. 2008). Desert washes are an important component of *G. morafkai* habitat, as they provide access to shelter sites outside of rocky bajadas and serve as

linkages between disjunct populations on the various desert mountain ranges throughout its distribution (Edwards et al. 2004; Grandmaison et al. 2010). Populations and individuals are rarely observed in deep, sandy loam soils in semi-desert grassland and Sonoran desert scrub.

2.4 Sheltersite Use

Gopherus morafkai typically emerges from overwintering shelters with the warming temperatures of early spring (Martin 1995; Sullivan et al. 2014). While their activity is reduced in winter, opportunities to drink, forage, and bask prompt individuals to leave shelters briefly, even during cool winter months (Sullivan et al. 2014; Rubke and O'Donnell 2021). Male *G. morafkai* terminate hibernation on average in late April, and females emerge one month earlier in March (Vaughan 1984). Tortoise activity in the spring is variable as temperatures increase. The earlier emergence by females may provide reproductive advantages as access to spring forage is gained (Averill-Murray 2002). Male tortoises have been recorded leaving overwintering shelters as late as June (Bailey et al. 1995).

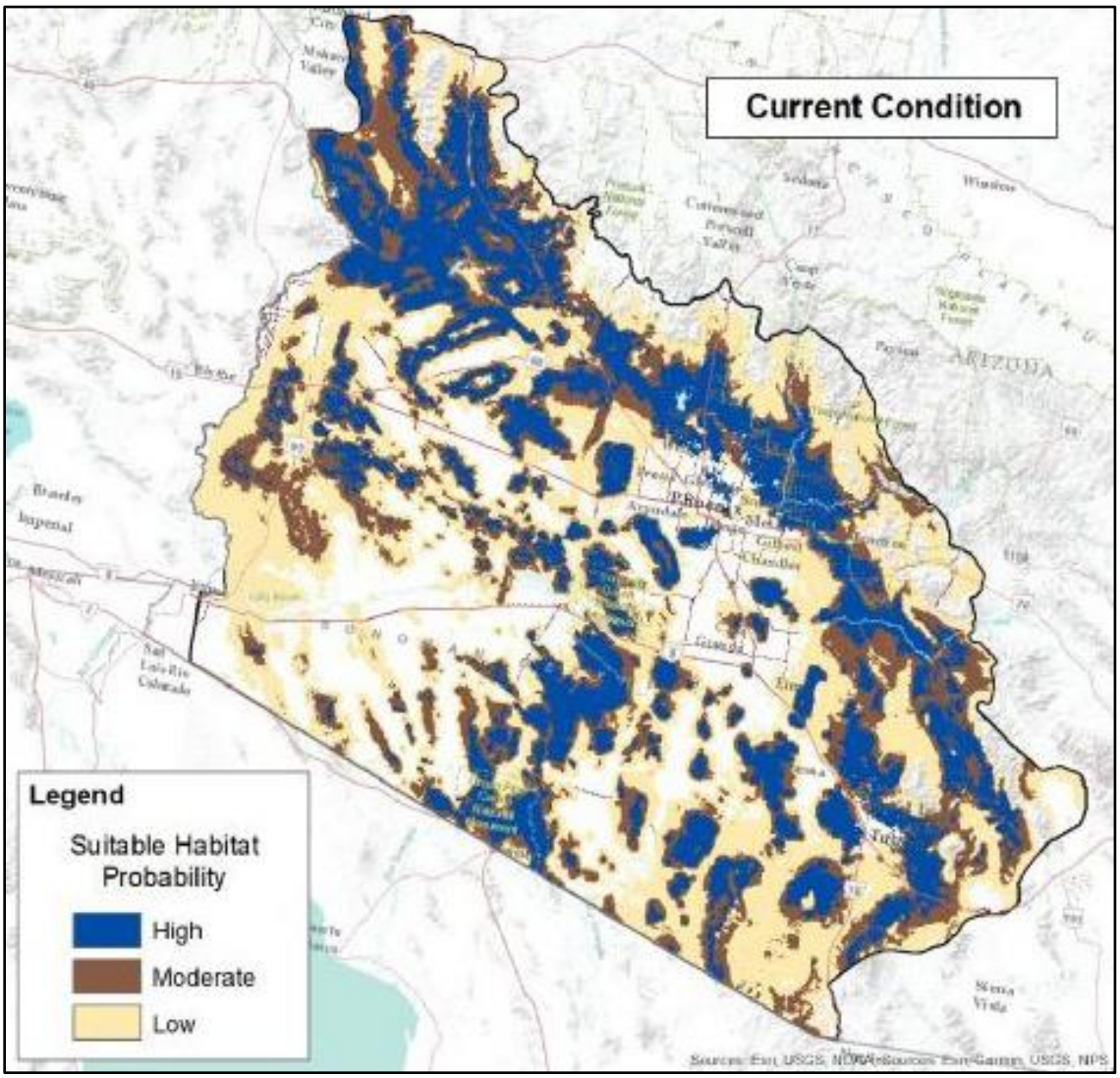

Figure 2. Suitable Sonoran desert tortoise habitat probability, current condition, as modeled by USFWS Species Status Assessment, 2021.

The arrival of summer rainfall, typically beginning in July, rouses tortoises to emerge from deep, thermally insulated shelters to which most individuals retreated during the hot, dry period of mid-May through June. These shelters often consist of caliche caves, rock overhangs, soil burrows, or even *Neotoma* sp. (wood rat) nests. Shelters frequently extend greater than a meter in depth (Grandmaison et al. 2010; Sullivan et al. 2016). When monsoon rains begin, tortoises begin surface activity behaviors and are primarily diurnal, but as critical thermal maxima are regularly reached by mid-morning at the height of summer, they may shift active periods to become more crepuscular and even be sporadically active into the night.

2.5 Food Habits

In Arizona's Sonoran Desert, the distinct winter and summer rainfall patterns provide *Gopherus morafkai* with greater access to food and water than its counterpart, *G. agassizzi*. An analysis of scat fragments collected from seven locations across *G. morafkai*'s range in Arizona identified 104 plant species, with herbaceous annuals making up nearly half of this diversity (Van Devender et al. 2002). Perennial shrubs and trees, herbaceous perennials, succulents, and both annual and perennial grasses were also present. Data from Van Devender et al. (2002) resulted in over 200 plant species in the diet of *G. morafkai*. Spring-season diets encompass a broad spectrum of herbaceous annuals, leading to greater diversity. Diets in the summer are less diverse, but include a wider, more balanced selection across different growth forms.

Gopherus morafkai diets are diverse when considered as a group, but each tortoise usually focuses on a few species, and similarly each location where tortoise diets are studied has a subset of species that comprise the majority of their diets. Summer staples included mallows (desert rose-mallow [*Hibiscus coulteri*], globe-mallow [*Sphaeralcea ambigua*], bladder-mallow [*Herissantia crispa*], Indian mallow [*Abutilon incanum*]), and spreading fanpetals (*Sida abutifolia*), as well as desert vine (*Janusia gracilis*), and a wide variety of grasses. There are also invasive species in the diets of *G. morafkai*, such as *Erodium cicutarium* (redstem filaree) (Van Devender et al. 2002).

Many plant species contain potassium. Sonoran desert tortoises lose water in the process of metabolizing potassium (Oftedal 2002). The potassium excretion potential (PEP) is an index of water, nitrogen, and potassium levels in a plant that affects the ability of all desert tortoises to efficiently excrete potassium. Sonoran desert tortoises have been documented selectively foraging on high PEP plant species (Oftedal 2002; Oftedal 2007) such as certain species of primroses, filaree, legumes, mustards, and spurges (Ernst and Lovich 2009). Selecting for PEP plant species may be especially important for Sonoran desert tortoises to overcome the effects of drought (Ernst and Lovich 2009).

Summer rains bring opportunities to drink from small pools occurring in natural depressions and to forage on new plant growth. Natural and artificially induced drinking behavior in free-ranging tortoises reveals their ability to rapidly and efficiently drink from very small catchments, in part because of the suction they generate using the nares to drink (Sullivan and Sullivan 2016). Individuals will often completely submerge their head in order to effectively imbibe water.

2.6 Predators and Disease

The most commonly documented mammalian predator of *G. morafkai* is *Puma concolor* (Mountain Lion). Predation by *P. concolor* on adult *G. morafkai* was documented or suspected at

several demographic plots across Arizona, often repeatedly. Chew marks indicative of attempted canid predation, most likely by *Canis latrans* or *Urocyon cinereoargenteus* (Coyote, Gray Fox), have been reported on adult tortoises at numerous populations, and a *C. latrans* scat included remains of a juvenile tortoise in at least one case (*e.g.*, Shields and Woodman 1987; Woodman et al. 2001). Domestic dogs are also known to kill tortoises (*e.g.*, Woodman et al. 1993).

Despite the fact that *Corvus corvax* (Common Raven) commonly preys on juvenile *G. agassizii* in the Mojave Desert (Boarman and Berry 1995), evidence of avian predation on juvenile *G. morafkai* has only occasionally been documented (*e.g.*, Woodman et al. 1999). Predation by ravens on *G. morafkai* was never confirmed during surveys of 22 demographic plots between 1980 and 2020. Minimal impact on *G. morafkai* likely results from the more complex habitat and less dense raven populations in the Sonoran Desert (Averill-Murray et al. 2002; Howland and Rorabaugh 2002).

Even though *Mycoplasma agassizii* (the causative agent of Upper Respiratory Tract Disease [URTD]) has been detected in captive *G. morafkai* in Arizona (Jones 2008), prevalence has been low to undetected in wild populations, and population declines in Arizona have not been observed in conjunction with disease (Dickinson et al. 2002, 2005). The shell disease cutaneous dyskeratosis has been reported at variable frequencies between 0% and 65% in *G. morafkai* populations in Arizona (Dickinson et al. 2002). Two populations that suffered marked declines had relatively high frequencies of cutaneous dyskeratosis, but this association was correlated with concurrent periods of severe drought (Averill-Murray et al. 2002, Dickinson et al. 2002, Zylstra et al. 2013). Soft-bodied ticks (*Ornithodorus* spp.) and sandflies (*Lutzomyia* spp.) also have been reported from *G. morafkai*, although without observed detrimental effects (*e.g.*, Woodman et al. 2009; Gray and Steidl 2015).

2.7 Legal Protections

Legal protections pertaining to collection are afforded to the Sonoran desert tortoise in Arizona by state laws (i.e., Arizona Revised Statute Title 17) and regulations imposed by the Arizona Game and Fish Commission. Unless otherwise prescribed in Title 17, it is unlawful to "take, possess, transport, buy, sell, or offer to expose for sale wildlife except as expressly permitted by this title" (ARS 17-309). As restricted live wildlife (R12-4-406), Sonoran desert tortoises cannot be imported, exported, or possessed without special license or lawful exemption. Individuals must be permitted by Arizona Game and Fish Department (AZGFD) in order to conduct scientific research and perform other activities for the Sonoran desert tortoise. Personnel should obtain a Scientific Activities License from AZGFD to allow handling and temporary possession of tortoises. For additional permitting information contact scpermits@azgfd.gov. There are currently no laws prohibiting the incidental take of Sonoran desert tortoises by otherwise lawful activities, nor are there any legal protections afforded to occupied habitat.

It is important to note that private citizens throughout Arizona can legally adopt and hold in their possession Sonoran desert tortoises if they are acquired through state-sanctioned adoption programs operated by AZGFD and the Arizona-Sonora Desert Museum.

3.0 General Handling Guideline For Sonoran Desert Tortoises

If a tortoise is located within an area of potential harm, it should be moved out of harm's way to

adjacent appropriate habitat. If an occupied shelter is determined to be in jeopardy of destruction, the tortoise should be relocated to the nearest shelter of appropriate size and depth, as determined by a qualified biologist. Tortoises should be moved less than 48 hours in advance of the habitat disturbance so they do not return to the area in the interim. A tortoise may be moved up to one kilometer, but no farther than necessary from its original location. If a release site or alternate burrow is unavailable within this distance, and ambient air temperature exceeds 40° Celsius (105° Fahrenheit), contact the Department for guidance.

Tortoises have little effective physiological capacity to dissipate heat, so it is the handler's responsibility to guard against over-heating. Desert tortoises should not be exposed to direct sunlight. Keep tortoises in the shade of a shrub or your body. Ground temperatures are much hotter than air temperatures, so minimize tortoise/ground contact when temperatures are hot. The critical maximum body temperature of desert tortoises is between 40° C and 44° C (103° F and 112° F). Tortoises must not be moved if ambient air temperature exceeds 40° C (105° F) unless an alternate shelter is available or the tortoise is in imminent danger.

To avoid transmission of diseases between tortoises, do not allow tortoises to come into contact with clothing or skin. A fresh pair of non-porous disposable gloves must be used for each tortoise (e.g. latex, nitrile, vinyl, or similar material). Keep gloves on during the entire time you handle a tortoise. If your glove is torn during handling of a tortoise, put a new one over the torn glove. Once used, gloves and any other disposable materials must be contained so as not to come into contact with disinfected materials, fresh gloves, equipment, or any other item that might come into contact with a tortoise. All non-disposable equipment that comes into contact with any part of a tortoise, or any instrument or item that has been in contact with a tortoise, must be treated with an approved disinfectant. Currently, trifectant or chlorhexidine diacetate (or chlorhexidine gluconate) are approved for use, prepared according to manufacturers' instructions. A 30% bleach solution is acceptable, but not preferred.

It is important to minimize risk to tortoises when they are handled in the course of data collection. Special precautions must be taken to prevent or minimize the fluid loss that occurs if tortoises void their bladder during handling. Do not handle the tortoise more than necessary. Always use two hands when picking up a tortoise, and do not turn it on its back or move it rapidly. Sudden movements can cause the tortoise to void (urinate), which can result in dehydration and increases risk of death. Tortoises found in shelters should only be extracted if deemed necessary (see 8.3 Methods section of Clearance Survey Protocol, below, for more details on approved extraction methods).

If the tortoise urinates, it should be rehydrated. To rehydrate a tortoise, you may either soak it in a shallow tub or offer fluids via a shallow bowl and a syringe (without needle attached). For the soak method, soak the tortoise at the release location in a tub with a clean, unused plastic disposable liner for a minimum of 10 to 20 minutes in a quiet protected area. An unused paint tray often works well for this application. Water level shall not be higher than the lower jaw of the animal; the water temperature should be tepid. Desert tortoises must be soaked individually. After each soaking, change the water and disinfect the tub to prevent the transmission of disease between individual tortoises. When offering fluids using an oral syringe, avoid touching the syringe to the tortoise. Instead, create a slow, steady flow that moves over the tortoise's nares and mouth and drips into

the shallow bowl below the tortoise's head (Figure 3). The dripping water will often stimulate the tortoise to take up water from the bowl. Offer fluids while positioning yourself away from the tortoise's line of sight; standing behind the tortoise and holding the syringe behind the tortoise's face is best. This may minimize the stress response from the tortoise and should avoid pushing material back into the nares. Offer at least a full [50 ml] syringe of fluids and as many as 2 more if the tortoise appears to be accepting fluids. Discard the syringe if it touches the tortoise.

Figure 3. Offering fluids to a Sonoran desert tortoise via the syringe and bowl method.

4.0 Projects Occurring Within Sonoran Desert Tortoise Habitat

Presence of Sonoran desert tortoises can often be confirmed by contacting biologists with AZGFD, the Bureau of Land Management, or other local biologists that have knowledge of specific areas or access to AZGFD's Heritage Data Management System or other databases that list locality data for desert tortoises. Sonoran desert tortoises can be expected to occur in desert mountains, rocky areas, washes cut through caliche, and bajadas in desert scrub vegetation communities. Tortoises typically inhabit areas with elevations ranging from sea level to 5,000 feet. Presence surveys and mitigation for Sonoran desert tortoise will generally not be needed above 5,000 feet.

4.1 Disturbance Type

The selection of appropriate conservation measures will depend on whether the disturbance is temporary or permanent:

- Temporary action – leaves no permanent structures and results in no permanent habitat loss.

- Permanent action –causes a loss of tortoise habitat or permanently displaces tortoises through the creation of permanent structures.

This guidance closely follows many aspects of the Mojave Desert Tortoise Pre-project Survey Protocol (USFWS 2018) and the Clearance Survey Protocol for the Mojave Desert Tortoise (USFWS 2020). The purpose of this guidance is to:

1. Offer instruction on how to approach projects within desert tortoise habitat;
2. Determine whether desert tortoises are present in a project area; and
3. Provide measures to reduce potential impacts to desert tortoises.

4.2 Coordination

This document provides general guidance but you are encouraged to contact the appropriate land management or resource management agencies when planning surveys so that any site-specific issues can be addressed. Complete results of work should be reported so that a full understanding of the project-specific circumstances are conveyed. Reports should include the conditions under which the surveys were conducted (e.g., weather, experience of surveyors, access to the survey area, degree of disturbance of the land, etc.). Complete results allow for a more thorough understanding of the potential effects of a project. Using desert tortoise surveyors with appropriate qualifications and previous Sonoran desert tortoise experience will improve confidence in the survey results. Note that handling Sonoran desert tortoises is not required to implement pre-project surveys. When planning projects, we recommend working with AZGFD and the other appropriate agencies concurrently to ensure a consistent approach to work planning.

Arizona Game and Fish Department (AZGFD)
5000 W. Carefree Highway
Phoenix, Arizona 85086
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4.3 Site Assessment

If tortoises have been found in the project area or nearby areas of similar habitat, the species can be presumed present, and appropriate mitigation must be included in the proposed project (see 9.0 Mitigation Measures section, below). If presence is questionable, surveys by qualified biologists should be conducted. Often, casual surveys by qualified biologists that focus on microsites with the greatest potential for supporting tortoises can confirm the presence of the species. More intensive work is needed to suggest absence of tortoises.

AZGFD strongly recommends that pre-project surveys cover the entire area of the proposed action. For each action, we also recommend that you discuss with AZGFD the extent of the action area prior to beginning surveys; this is to reduce the likelihood of requests for additional surveys later. Action areas (all areas that may be affected directly or indirectly by the action) frequently include the project site, access routes, and the areas into which desert tortoises may need to be translocated. If the entire action area cannot be accessed at the time of surveys, make note of that in the survey report. Pre-project surveys are valid for 1 year.

4.4 Assessing Habitat Conditions in the Action Area

Being aware of the habitat conditions in the action area allows AZGFD to more effectively assess the results of the surveys and to consider the effects of the proposed action on suitable habitat. Descriptions of the plant communities, level of disturbance, elevation, general soils, and proximity to humans will be advantageous.

- Factors to consider for habitat physical and biological features:
    - Does the action area contain any natural or anthropogenic features that would preclude desert tortoises from residing or moving through the area?
    - Does the action area support native annual plants upon which desert tortoises forage? Are the soil conditions appropriate to support these species?
    - Is the substrate appropriate for desert tortoises to burrow, nest, and overwinter?
    - Does the action area support burrows, rock overhangs, caliche caves, and other sheltersites or have the ability to support such sites
    - Is there an area with a slope >5% or a deeply incised wash crossing the area that might contain tortoises or their shelters?
    - What is the status of the perennial plant community? Are shrubs large enough to provide shelter to desert tortoises? Are they too dense or too sparse to allow for desert tortoises to reside in the area?
    - What evidence is there of past or ongoing disturbance as a result of human activities? Does the area show evidence (i.e., garbage, targets) of past recreational shooting in the area? Do common ravens seem to be overly abundant? Are feral or free-roaming dogs present?

The primary purpose of these surveys is to provide information on whether desert tortoises are likely to be present. Determining whether desert tortoises are present based primarily on sign (rather than live animals) requires biologists to be diligent in observing and describing sign. When evaluating survey results, AZGFD considers other factors, including type and condition of habitat, the general location of the survey area, the experience of the surveyors, the time and weather when the survey was conducted, how much time surveyors spent at the site, and whether they were conducting a focused survey for tortoises or looking for a suite of biological and/or cultural resources.

5.0 TYPES OF PROJECT SURVEYS – LINEAR PROJECT

5.1 Linear Project Surveys

If an action area is elongated and less than 600 m wide, linear project surveys are appropriate. The narrower action areas associated with linear projects, like rights-of-way, are less likely to include the entire home ranges of desert tortoises, so that animals that use the area may not be present during surveys. The primary purpose of surveys for linear projects is to provide information on where most tortoises may be encountered along the project. We recommend that surveys be done during the summer monsoon season (July – September) when possible. Tortoise surveys conducted before April or after October may not be accepted as a suitable survey and could necessitate return visits to the site. Contact AZGFD regarding sections of the proposed right-of-way where surveys may not be necessary or appropriate.

5.2 Field Methods

For linear projects, the action area is the right-of-way, and the adjacent areas on both sides of the right-of-way where tortoises may be moved from harm's way during implementation of the project. To adequately determine where most tortoises may be found, complete at least one 10-m-wide belt transect for every 100 m of the width of the action area or portion thereof. For example, if the right-of-way is 50 m wide and tortoises will be moved no more than 200 m from either edge of the right-of-way, the action area would be 450 m wide. A surveyor would need to complete 5 10-m-wide transects. Once 10-m-wide belt transects have been established, survey by walking a straight path on the centerline of each transect. Surveyors should report what they see or are drawn to investigate while walking on the centerline, whether a tortoise is visible on the surface or somewhat concealed in vegetation or in a shelter. If a surveyor detects a shelter while walking on the centerline, it should be examined to determine if a desert tortoise is present, or at or near the entrance. Use mirrors or flashlights to inspect any and all shelters. If the back of a shelter cannot be seen due to shelter depth or configuration, an endoscope or borescope can be used to determine occupancy or absence of a tortoise.

Surveyors should record on datasheets all evidence that indicates desert tortoises may be present (e.g., scat, tracks, shelters, carcasses, etc., in addition to live tortoises). To the best of the surveyor's ability, condition of the sign should be categorized (e.g., fresh, < 1 year, > 1 year old). If sign is detected off-transect, it should be recorded and then noted that it was found off-transect.

For each tortoise that is encountered, at a minimum it should be recorded whether it is ≥ 180 mm. If feasible, obtain the most accurate midline carapace length (MCL) measurement possible without touching the tortoise or if the animal is partially concealed, estimate its length and note on a datasheet. If personnel have obtained a Scientific Activities License from AZGFD, or are named as agents under one, handling of tortoises is acceptable. If no Scientific Activities License has been obtained, and personnel are not named as agents under one, handling of tortoises is not permissible.

5.3 Reporting

Provide the data sheets, a map of the action area that includes the locations of the transects, desert tortoises, and sign, and a description of the habitat conditions onsite to AZGFD at the email address provided above. Ensure these materials are sent as soon after completion of the surveys as possible. Spatial information can be provided in pdf and GIS formats. In order to protect sensitive data, it is advisable to either discourage the sharing of geographic locations on social media platforms and citizen science applications or to encourage users to obscure or privatize these details.

6.0 TYPES OF PROJECT SURVEYS – SMALL PROJECT

6.1 Small Project Surveys

Operationally, AZGFD considers sites < 200 ha (500 ac) to be "small." The action areas of small projects are less likely to include the entire home ranges of desert tortoises, therefore, desert tortoises that regularly use the area may be off site during surveys. The primary purpose of these surveys is to provide information on where tortoises may be encountered in the action area of the project. We recommend that surveys be done during the summer monsoon season (July – September) when possible. Tortoise surveys conducted before April or after October may not be

accepted as a suitable survey and could necessitate return visits to the site. Contact AZGFD regarding sections of the project action area where surveys may not be necessary or appropriate.

6.2 Field Methods

Establish 10-m-wide belt transects to cover the entirety of the action area. Survey by walking a straight path on the centerline of each transect. Surveyors should report what they see or are drawn to investigate while walking on the centerline, whether a tortoise is visible on the surface or somewhat concealed in vegetation or in a shelter. If a surveyor detects a shelter while walking the centerline, it should be examined to determine if a desert tortoise is present, or at or near the entrance. Use mirrors or flashlights to inspect any and all shelters. If the back of a shelter cannot be seen due to shelter depth or configuration, an endoscope or borescope can be used to determine occupancy or absence of a tortoise.

Surveyors should record on datasheets all evidence that indicates desert tortoises may be present (e.g., scat, tracks, shelters, carcasses, etc., in addition to live tortoises). To the best of the surveyor's ability, condition of the sign should be categorized (e.g., fresh, < 1 year, > 1 year old). If sign is detected off-transect, it should be recorded and then noted that it was found off-transect.

For each tortoise that is encountered, at a minimum it should be recorded whether it is ≥ 180 mm. If feasible, obtain the most accurate MCL measurement possible without touching the tortoise or if the animal is partially concealed, estimate its length and note on a datasheet. If personnel have obtained a Scientific Activities License from AZGFD, or are named as agents under one, handling of tortoises is acceptable. If no Scientific Activities License has been obtained, and personnel are not named as agents under one, handling of tortoises is not permissible.

6.3 Reporting

Provide the data sheets, a map of the action area that includes the locations of the transects, desert tortoises, and sign, and a description of the habitat conditions onsite to AZGFD at the email address provided above. Ensure these materials are sent as soon after completion of the surveys as possible. Spatial information can be provided in pdf and GIS formats. In order to protect sensitive data, it is advisable to either discourage the sharing of geographic locations on social media platforms and citizen science applications or to encourage users to obscure or privatize these details.

7.0 TYPES OF PROJECT SURVEYS – LARGE PROJECT

7.1 Large Project Surveys

The AZGFD considers sites > 200 hectares (500 acres) to be "large." The action areas of large projects could include the entire home ranges of desert tortoises. AZGFD will always consider it acceptable to survey the entire action area with transect centerlines spaced 10 m apart. However, large projects may reach a scale where it becomes unreasonable to cover entire action areas using transects spaced at 10 m. In this case, transect spacing can be increased to 20 m or 30 m between surveyors. The primary purpose of large project surveys is to provide information on where desert tortoises are occurring within the action area. Surveys to enumerate the number of individuals should be conducted when Sonoran desert tortoises are most active (monsoon season [July – September], but also in the spring [April] and fall [October]).

7.2 Field Methods

Establish 10, 20, or 30 m-wide belt transects to cover the action area. Survey by walking a straight path on the centerline of each transect. Surveyors should report what they see or are drawn to investigate while walking on the centerline, whether the tortoise is visible on the surface or somewhat concealed in vegetation or a shelter. If a surveyor detects a shelter while walking the centerline, it should be examined to determine if a desert tortoise is present or at or near the entrance. Flashlights or a hand-held mirror should be used to illuminate and examine the shelter. If the back of a shelter cannot be seen due to shelter depth or configuration, an endoscope or borescope can be used to determine occupancy or absence of a tortoise.

Surveyors should record on datasheets all evidence that indicates desert tortoises may be present (e.g., scat, tracks, shelters, carcasses, etc., in addition to live tortoises). To the best of the surveyor's ability, condition of the sign should be categorized (e.g., fresh, < 1 year, > 1 year old). If sign is detected off-transect, it should be recorded and then noted that it was found off-transect.

For each tortoise that is encountered, at a minimum it should be recorded whether it is ≥ 180 mm. If feasible, obtain the most accurate MCL measurement possible without touching the desert tortoise or if the animal is partially concealed, estimate its length and note on a datasheet. If personnel have obtained a Scientific Activities License from AZGFD, or are named as agents under one, handling of tortoises is acceptable. If no Scientific Activities License has been obtained, and personnel are not named as agents under one, handling of tortoises is not permissible.

7.3 Reporting

Provide the data sheets, a map of the action area that includes the locations of the transects, desert tortoises, and sign, and a description of the habitat conditions onsite to AZGFD at the email address provided above. Ensure these materials are sent as soon after completion of the surveys as possible. Spatial information can be provided in pdf and GIS formats. In order to protect sensitive data, it is advisable to either discourage the sharing of geographic locations on social media platforms and citizen science applications or to encourage users to obscure or privatize these details.

8.0 CLEARANCE SURVEY PROTOCOL FOR THE SONORAN DESERT TORTOISE

8.1 Objectives of Clearance Surveys

- Locate as many desert tortoises as possible within the project area.
- Remove all desert tortoises encountered from the project site.
- Safely excavate, collect, and rebury desert tortoise eggs if found within the project area.

8.2 Applicability of Clearance Surveys

For projects located in occupied desert tortoise habitat (as evidenced by presence of live tortoises or recent sign) we strongly recommend a clearance survey. This is especially appropriate for projects with a permanent or linear disturbance (roads, transmission lines, etc.). This survey is intended to reduce the likelihood that desert tortoises are injured or killed as a result of the proposed action. Clearance survey methods may include temporarily penning desert tortoises within the area surrounding its shelter, moving desert tortoises out of harm's way a short distance from the impact area, or translocating desert tortoises to a designated area outside its home range in accordance with an AZGFD—and other appropriate agency—approved translocation plan. It is

the project proponent's responsibility to obtain all necessary authorizations from AZGFD and applicable land management agencies.

8.3 Methods

Clearance surveys require 100% coverage of the project area, with a focus on locating all desert tortoises above and below ground within the project area. Clearance surveys should be conducted immediately prior to surface disturbance at each site within the project area or following construction of a desert tortoise-proof fence encompassing the project area. A desert tortoise-proof fence ensures tortoises cannot enter the project area after clearance surveys are completed.

Desert tortoises often pace along new fences attempting to gain access to the other side or return to areas from which they were removed. After the desert tortoise exclusion fence has been installed, the fencing should be checked several times a day when temperatures are expected to exceed 95°F (35°C) to ensure tortoises are not trapped within the fence or are fence-walking; these animals may be exposed to lethal temperatures. If a suspected hyperthermic tortoise or excessively stressed tortoise (see Figure 4) is found along a fence and temperatures are above 95°F (35°C), the tortoise should be moved to a climate-controlled area and rehydrated (following methods described above).

Figure 4. Signs associated with hyperthermia include lethargy, weakness, edema, neurological signs, and excessive, frothy oral discharge as seen in these extremely stressed tortoises (*Gopherus Polyphemus*) (Wendland et al. 2009).

Clearance surveys at the site must consist of at least 2 consecutive surveys of the site. Surveys will involve walking transects ≤ 5-m wide under typical conditions. In areas of dense vegetation or when conditions limit the ability of the surveyor to locate desert tortoises, transects should be reduced in width accordingly. To maximize effectiveness and gather useful data, surveys should be conducted around sunrise and/or sunset, particularly during the desert tortoises' peak activity periods in the monsoon season (July – September), with additional opportunities in spring (April) and fall (October). Clearance surveys should not be conducted November – March. The ultimate number of surveys required may depend on the scale of the project and the number of tortoises found on the last survey.

All methods used for handling desert tortoises during the clearance surveys must be in accordance with AZGFD handling guidelines and procedures. Anyone that handles desert tortoises during clearance activities must have the appropriate authorizations from AZGFD.

During clearance surveys, desert tortoises in shelters may be removed through tapping or careful excavation (see Extracting Desert Tortoises from Shelters, and Excavating Shelters sections, below). Multiple visits occurring at sunrise and/or sunset may be necessary if desert tortoises are inaccessible in deep shelters. Tortoises are often most active around sunrise and sunset during the height of summer. During all handling procedures, desert tortoises will be treated in a manner to ensure they do not overheat or exhibit signs of overheating (e.g., gaping, foaming at the mouth, etc.), or are placed in a situation where they cannot maintain surface and core temperatures necessary to their well-being. Desert tortoises will be kept shaded at all times until it is safe to release them. Tortoises must not be moved if the ambient air temperature exceeds 105°F (40°C) unless an alternate shelter of appropriate size and depth is available, or the tortoise is in imminent danger. Ambient air temperature will be measured in the shade, protected from the wind, at a height of 5 cm above the ground surface.

The area cleared and number of tortoises found within that area must be reported to the AZGFD or appropriate management agency. The report should be made in writing, preferably by email. Provide data sheets, maps of the clearance surveys, and include the locations of desert tortoises, sign, and shelter sites. Spatial information can be provided in pdf and GIS formats.

If a desert tortoise is encountered after clearance surveys have been completed, process the tortoise according to the methods described above.

8.4 Extracting Desert Tortoises from Shelters

Before reaching into a desert tortoise shelter, examine the entrance for other occupants. Rattlesnakes, spiders, scorpions, skunks, and Gila monsters often inhabit tortoise shelters. To determine if a tortoise resides within the shelter, firmly pound the soil at the side of the "apron" or soil mound at the entrance of the shelter 5 – 6 times with an open hand, then listen for desert tortoise movement; wait 30 seconds and repeat several times if the tortoise does not readily emerge. Avoid disturbing or pounding the center of the apron or entrance of the shelter where desert tortoises typically dig nests and lay their eggs. If the desert tortoise is visible deep in its shelter, the observer can gently tap the carapace 3 – 4 times with a stick (Medica et al. 1986). The observer should then remove the stick and move away from the shelter entrance. If tapping is successful, the desert tortoise will emerge, usually to the shelter entrance. If desert tortoise movements are not heard within a few minutes, discontinue tapping.

If the desert tortoise is within arm's reach, first ensure you are wearing a fresh pair of non-porous disposable gloves, then firmly grasp the gular, plastron, or posterior edge of the carapace and gently pull the tortoise towards the shelter entrance. If the desert tortoise resists to the point where moderate pulling effort is unsuccessful, stop pulling but maintain a grip on the tortoise; allow the tortoise to relax. When the tortoise has relaxed, again pull the tortoise towards the shelter entrance; this pattern of pulling, allowing the tortoise to relax, and then pulling again may need to be repeated many times until the animal can be extracted entirely. Try not to compromise the integrity of a

shelter if the desert tortoise will remain within the project area. If the area is to be cleared of all desert tortoises, excavate the shelter as described in the section below.

8.5 Excavating Shelters

Desert tortoise shelters should be excavated only if they occur within a planned disturbance area. As an alternative to excavation in certain circumstances, the immediate area surrounding a shelter occupied by a desert tortoise may be temporarily penned (see 8.8 Temporarily Confining Desert Tortoises section, below), but this should be coordinated and approved by AZGFD and any other appropriate land management agency.

Before excavation, feel for desert tortoise eggs by gently probing (with your fingers) the soil in front of the shelter opening and along the floor of the shelter as you excavate the shelter. The purpose of probing is to locate areas of excavated soil that are less compacted and may indicate a nest. Eggs have been found up to 6 ft (1.9 m) in front of shelter openings and up to 6 ft (1.9 m) within the entrance of a shelter; they may also occur in the mound at the shelter opening. To avoid crushing eggs, do not scrape tools such as shovels, across the bottom of the shelter, but continue to probe the area with your fingers as you proceed. Removal of the top 10 in (25 cm) of soil (or until a hard layer of soil is encountered) will typically ensure that you find any desert tortoise eggs. Be particularly careful from mid-May through late August when eggs are most likely to be present. If found, follow egg handling protocols detailed in the following section.

Excavators should wear leather or cloth gloves during shelter excavation to avoid bites or stings by wildlife. Use blunt-nosed shovels or garden trowels. The preferred method involves two individuals, each with a shovel, to excavate a shelter. Place a shovel in the shelter entrance, or garden trowel for small shelters, and slice away the ceiling with the second shovel or trowel. Remove the soil with the first shovel or trowel as excavation proceeds and repeat. Excavate the shelter slowly and carefully and stop often to see if a tortoise is within reach. Do not collapse the shelter ahead of the shovel or trowel inside the shelter. You should feel the shovel contact the other shovel with each stroke to avoid striking a desert tortoise. It may take several minutes or several hours to excavate a desert tortoise shelter, depending on its length and other characteristics.

Always excavate the shelter to its absolute end(s), and then excavate an additional foot-or-so (0.3 m) of harder soil beyond the suspected end to ensure that a desert tortoise is not behind a dirt plug or mound. Search all side tunnels within the shelter for tortoises, especially in kit fox dens. If a desert tortoise is found, do not assume that it is alone. After removing the first desert tortoise encountered, return to the shelter and continue to excavate it looking for additional tortoises. After excavating the shelter, leave it collapsed so that no desert tortoise may reuse it.

A tortoise may be moved up to one kilometer but no further than necessary from its original location. Irrespective of the time of year and temperature, relocate the desert tortoise to a suitable shelter and contact AZGFD for additional guidance and coordination if needed.

8.6 Nest and Egg Handling Protocol

Sonoran desert tortoise nest and egg handling involves specialized protocols that require technical expertise and are not intended for the general public. If a tortoise nest or eggs are encountered, it

is critical not to disturb them. The AZGFD should be contacted and consulted for guidance on appropriate measures.

Desert tortoises may lay eggs during the months of May through August and usually hatch September through October. Some eggs may not hatch, or hatchlings may not emerge until the following spring. Desert tortoise eggs will need to be moved to a similarly constructed artificial nest in the wild. If unemerged hatchlings are encountered, release them into an unoccupied shelter in the wild unless otherwise directed by AZGFD.

Any nest that is found will be carefully excavated by hand at a time of day when the air temperature 15 cm above the ground is approximately equal to the soil temperature at egg level. Excavate suspected nests by hand. Disposable rubber, latex, or nitrile gloves should be worn when marking and handling eggs. Before disturbance of nest contents, each egg will be gently marked with a small dot on the top using a felt-tipped pen to establish the egg's orientation in the nest. In handling nest contents, eggs must be maintained in this orientation at all times. Because egg shells become extremely fragile in the last few weeks before hatching, special care will be taken with eggs found from August to mid-October. Because the egg is very fragile, it may break during handling; this will be lethal to the developing tortoise inside. Broken eggs will be buried nearby and left in the field, or the contents preserved and made available for research projects. Report broken eggs to AZGFD.

Measure and record the depth of the nest below the soil surface and the position of the nest relative to the shelter entrance (or other shelter cover). Place approximately 1 in (2.5 cm) of soil from the nest area in a bucket and carefully transfer the eggs to the bucket, maintaining egg orientation. Gently cover the eggs with soil that is free of cobbles and pebbles, to a depth equivalent to that of the original nest.

A nest will be prepared (or a natural one found) at the release site with the same depth and location in relation to the shelter entrance as the original nest. The eggs will be transferred to the new nest, maintaining their original orientation. The eggs will be replaced so that they touch one another. Gently cover with soil from which cobbles and pebbles have been removed so that all the air spaces around the eggs are filled.

8.7 Constructing Artificial Shelters

Constructing artificial shelters generally is not necessary when translocating Sonoran desert tortoises. Often, ample shelters can be found in surrounding habitat. However, in the infrequent case that an artificial shelter may be needed (coordinate with AZGFD), the information below provides a general description of the methods for constructing artificial shelters taken from the Tortoise Group’s adoption and care pamphlet.

Create an artificial shelter that is the same orientation and size as the shelter from which the desert tortoise was taken. The burrow for a juvenile desert tortoise should be 0.9–1.2 m (3–4 ft) long, and an adult tortoise shelter should be 1.5–1.8 m (5–6 ft) long. Shelter construction involves digging a three-sided shelf upon which plywood will be placed to serve as the roof of the shelter. A channel is dug below the level of the shelf which approximates the width of the tortoise and functions as the actual shelter.

Determine the width and length to dig the shelf, and place the plywood on the ground. Use corner stakes and twine to delineate the perimeter. Dig the shelter in a downward slant 15–20° below the horizontal line of the ground (Figure 5). Place the plywood onto the shelf. Fit the plywood snugly and then remove it. Next, dig the channel and loosen the soil along the floor of the channel to a depth of 15 cm (6 in) to allow a tortoise to dig its way out should the plywood sag and possibly trap or pin it in the shelter. Replace the plywood and shovel dirt on top. Place rocks along the eave of the shelter roof, above the opening (Figure 5). Mound the dirt so that rain water will not puddle on top of the finished shelter.

Alternatively, the tortoise and its shelter may be temporarily penned (see section below).

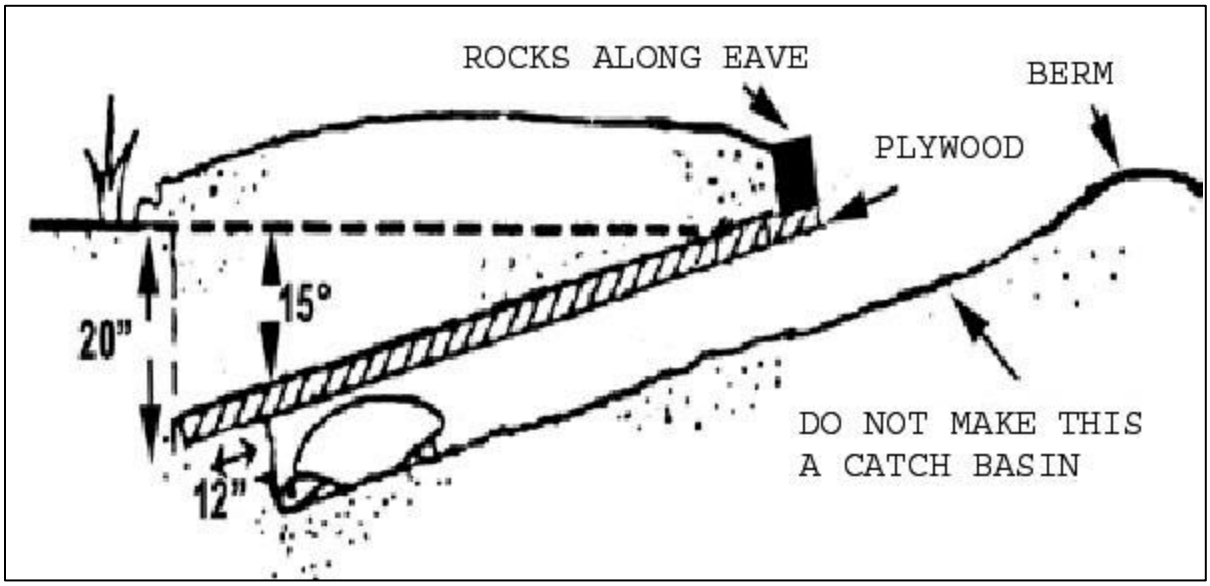

Figure 5. Diagram of an artificial tortoise shelter (Tortoise Group 2019).

8.8 Temporarily Confining Desert Tortoises

Occasionally, desert tortoises may be found on the periphery of the project area that may need to be temporarily penned to prevent them from moving onto the project site and then needing to be physically moved. These situations should be coordinated with AZGFD and construction activity will need to be carefully monitored in the area around the penned tortoise. The methodology for penning desert tortoises (U.S. Department of Defense 2005) is adapted from a methodology developed by Gilbert Goodlett (EnviroPlus Consulting, Ridgecrest, California). Generally, desert tortoises should not be penned in areas of moderate or heavy public use. Penning will be accomplished by installing a circular fence, approximately 6 m (20 ft) in diameter to enclose the tortoise/shelter (Figure 6). The pen should be constructed with durable materials (*i.e.*, 16 gauge or heavier) suitable to resist desert environments. Fence material should consist of 1-in horizontal by 2-in (2.5 by 5.0 cm) vertical, galvanized welded wire. Pen material should be 50 cm (24 in) in width. Steel T-posts or rebar (0.6–0.9 m [2–3 ft]) should be placed every 1.5–1.8 m (5–6 ft) to support the pen material. The pen material should extend 46 cm (18 in) aboveground. The bottom of the enclosure will be buried 15–30 cm (6–12 in) or bent inward (towards the burrow), soil

mounded along the base, and implement other measures to ensure zero ground clearance. Care will be taken to minimize visibility of the pen by the public. A designated "Desert Tortoise Monitor" will check the pen at least daily and ensure that the desert tortoise is in the shelter or pen, the desert tortoise is alive and well, and the pen is intact. All instances of penning or issues associated with penning will be reported to AZGFD within 3 days.

Figure 6. Example of fencing designed for the temporary penning of a desert tortoise. Note: this fencing is currently under installation; the open trench at the base of the fence must be backfilled to eliminate gaps that could entrap tortoises.

9.0 Avoidance, Minimization, and Mitigation Measures For The Sonoran Desert Tortoise

Mitigation should be tailored to the nature of the proposed action, its anticipated effects, and the density and expected response of desert tortoises to the action. The following mitigation actions are grouped to assist in selection of appropriate actions for specific projects. Nevertheless, each project is different and development of an appropriate mitigation plan will require the input of a desert tortoise biologist and authorizing agencies. Mitigation measures suggested herein are recommendations to be used in developing mitigation plans for specific projects. Required mitigation will be developed by permitting agencies and project proponents in accordance with land management plans, the National Environmental Policy Act (NEPA), and other applicable guidance and regulations.

The first set of mitigation measures are presented as a generic mitigation outline. Within the outline, measures are listed in the general order and priority in which they should be applied to project proposals. This step-down process is in accordance with NEPA regulations and Fish and Wildlife Service mitigation policy. A second set of measures follow the outline and consist of project-specific mitigation recommendations. These and/or other measures developed during project planning should be added to the generic mitigation outline as appropriate.

Some of the following recommended measures are defined fairly specifically; others provide more general guidance to be considered in the process of developing a project mitigation plan. When integrating these measures into a mitigation plan, replace “should” with “shall” to reflect their obligatory status.

9.1 Generic Mitigation Plan for Projects in Desert Tortoise Habitat

9.2 Priority 1: Avoid the Impacts

To the extent possible, project features should be located in previously disturbed areas or outside of desert tortoise habitat.

If impacts to desert tortoises or their habitat cannot be avoided, then:

9.3 Priority 2: Minimize the Impacts

A. **Scheduling Activities to Reduce Potential Adverse Effects:**

To the extent possible, project activities should be scheduled when tortoises are inactive (typically November 1 to March 1).

B. Information and Education of Project Personnel:

A desert tortoise protection education program should be presented to all employees, inspectors, supervisors, contractors, and subcontractors who carry out proposed activities at the project site. The education program should include discussions of the following:

1. The legal and sensitive status of the tortoise;
2. a brief discussion of tortoise life history and ecology;
3. mitigation measures designed to reduce adverse effects to tortoises;
4. and protocols to follow if a tortoise is encountered, including appropriate contact points.

C. Designation of a Desert Tortoise Coordinator:

The project proponent should designate a desert tortoise coordinator who should be responsible for overseeing compliance with the mitigation program, coordination with permitting agencies, land managers, and Arizona Game and Fish Department; and as a contact point for personnel that encounter desert tortoises. The desert tortoise coordinator should be on site during project activities and should be familiar with and have a copy of the desert tortoise mitigation plan.

D. Removal of Harm to Desert Tortoises on Project Sites:

If a tortoise is found in a project area, activities should be modified to avoid injuring or harming it. If activities cannot be modified, tortoises in harm's way should be moved in accordance with guidelines established above (see section 3.0 General Handling Guidelines).

E. Minimization of Project Footprint:

1. Vehicle use should be limited to existing or designated routes to the extent possible
2. Areas of new construction or disturbance should be flagged or marked on the ground prior to construction. All construction workers should strictly limit their activities and vehicles to areas that have been marked. Construction personnel should be trained to recognize markers and understand the equipment movement restrictions involved.

F. Limitation of Habitat Disturbance within the Project Footprint:

1. Blading of new access or work areas should be minimized to the extent possible. Disturbance to shrubs should be avoided if possible. If shrubs cannot be avoided during equipment operation or vehicle use, wherever possible they should be crushed rather excavated or bladed and removed.

2. Project features that might trap or entangle desert tortoises, such as open trenches, pits, open pipes, etc. should be covered or modified to prevent entrapment. This may only be necessary during the tortoise active season and may be unnecessary if an on-site biologist is monitoring activities - see "Suggested Mitigation Measures for Projects Conducted During the Tortoise Activity Period" below.

G. Preventing Attraction of Predators or Enhancement of Predator Populations:

Construction sites should be maintained in a sanitary condition at all times to prevent attracting predators. The project proponent is responsible for controlling and limiting litter, trash, and garbage by placing refuse in predator-proof, sealable receptacles immediately. This practice not

only keeps the site clean but also reduces the likelihood of attracting avian predators such as ravens, along with other potential predators that can harm Sonoran desert tortoises. Additionally, care should be taken to avoid creating artificial perches or other structures that could facilitate predator access. Trash and debris should be removed when construction is complete to ensure that the habitat remains as natural and undisturbed as possible.

9.4 Priority 3: Rectify the Impacts

A. Removal of Hazards:

After completion of the project, trenches, pits, and other features in which tortoises could be entrapped or entangled, should be filled in, covered, or otherwise modified so they are no longer a hazard to desert tortoises.

B. Habitat Restoration:

After project completion, measures should be taken to facilitate restoration. Restoration techniques should be tailored to the characteristics of the site and the nature of project impacts identified in the mitigation plan as developed by project biologists, AZGFD, and other relevant agencies. Techniques may include removal of equipment and debris, recontouring, replacing boulders that were moved during construction; and seeding/planting native vegetation, and transplanting of cacti and yuccas, etc. Only native plant species, preferably from a source on or near the project area, should be used in restoration.

9.5 Priority 4: Reduce or Eliminate the Impacts over Time, and Provide Guidance and Information for Improving Future Mitigation Plans

Monitoring and Reporting Requirements:

The project proponent should submit a monitoring report to AZGFD and any permitting State or Federal agency within 90 days of project completion. For long-term or ongoing projects that may result in continuing impacts to tortoises and habitat, annual monitoring reports should be prepared. Monitoring reports should briefly document the effectiveness of the desert tortoise mitigation measures, actual acreage of desert tortoise habitat disturbed, the number of desert tortoises excavated from burrows, the number of desert tortoises moved from construction sites, and other applicable information on individual desert tortoise encounters. The report should make recommendations for modifying or refining the mitigation program to enhance desert tortoise protection and reduce needless hardship on the project proponents.

The following mitigation measures are designed for specific project types or conditions. Most act to minimize project impacts (priority 2 measures).

For Projects Involving Hazardous Materials:

Oil, fuel, pesticides, and other hazardous material spills should be cleaned up and properly disposed of as soon as they occur in accordance with applicable State and Federal regulations. All hazardous material spills must be reported promptly to the appropriate surface management agencies and hazardous materials management authorities.

For Projects Conducted During the Tortoise Activity Period (typically March 1 to November 1)

1. Construction and operation activities should be monitored by a qualified desert tortoise biologist. The biologist should be present during all activities in which encounters with tortoises may occur. The biologist should watch for tortoises wandering into construction areas, check under vehicles, check at least three times per day any excavations that might trap tortoises, and conduct other activities necessary to ensure the death and injury of tortoises is minimized. This measure may only be warranted in areas of moderate to high tortoise density. Additionally, desert tortoises are drawn to water and damp soil, which can result from using a water truck for dust control. The scent of wet or damp soil mimics the conditions of a natural rainstorm, attracting tortoises and potentially increasing their presence on or near project roads. Therefore, heightened vigilance is essential to prevent harm to tortoises in these situations.

2. Unleashed dogs should be prohibited in project areas.

3. If temporary fencing is necessary to exclude desert tortoises during construction, the fence should include: 1) portable, stand-alone chain-link fence modules or plastic snow fencing, supported by standard metal fence posts; and 2) desert tortoise fencing that complies with section 8.8 Temporarily Confining Desert Tortoises. Note that snow fencing or orange safety fencing, typically made from plastic or PVC, does not withstand desert conditions well and should not be used for periods exceeding 60 days.

For Long-term or Permanent Projects in Which Continued Encounters with Desert Tortoises Are Expected:

Construction of permanent or long-term projects in moderate to high density desert tortoise habitat should be enclosed with desert tortoise barrier fencing to prevent tortoises from wandering onto the project site where they may be subject to collection, death, or injury. Barrier fencing should consist of wire mesh with a maximum mesh size of 1inch (horizontal) by 2-inch (vertical) fastened securely to posts. The wire mesh should extend at least 18 inches above the ground and preferably 12 inches below the surface of the ground. Where burial is not possible, the lower 12 inches should be folded outward, away from the enclosed site, and fastened to the ground so as to prevent tortoise entry. Any gates or gaps in the fence should be constructed and operated to prevent desert tortoise entry (such as installing "tortoise guards" similar to cattle guards, and/or keeping gates closed). Specific measures for tortoise-proofing gates and gaps should be addressed project by project. Fencing is a relatively expensive mitigation measure and may only be appropriate in areas of moderate to high tortoise density

10.0 Specifications For Desert Tortoise Exclusion Fencing

10.1 Fence Construction

The specifications for fencing materials and construction procedures were standardized by the USFWS to effectively confine tortoises or exclude them from potentially harmful situations, particularly in areas near roads and highways. For further details, please consult the "USFWS Desert Tortoise Fencing Specifications 2005," which can be accessed via the following URL:

https://eplanning.blm.gov/public_projects/nepa/41489/93713/113028/AppendixD_Desert-Tortoise-Fence-Specs.pdf.

10.2 Materials

Fences should be constructed with durable materials (i.e., 16 gauge or heavier) suitable to resist desert environments, alkaline and acidic soils, wind, and erosion. Fence material should consist of 1-inch horizontal by 2-inch vertical, galvanized welded wire, 36 inches in width. Other materials include: Hog rings, steel T-posts, and smooth or barbed livestock wire. Hog rings should be used to attach the fence material to existing strand fence. Steel T-posts (5 to 6-foot) are used for new fence construction. Standard smooth livestock wire fencing should be used for new fence construction, on which tortoise-proof fencing would be attached.

10.3 Retrofitting Existing Livestock Fence

Option 1 (see drawing diagram of Appenix A below). Fence material should be buried a minimum of 12 inches below the ground surface, leaving 22-24 inches above ground. A trench should be dug or a cut made with a blade on heavy equipment to allow 12 inches of fence to be buried below the natural level of the ground. The top end of the tortoise fence should be secured to the livestock wire with hog rings at 12 to 18-inch intervals. Distances between T-posts should not exceed 10 feet, unless the tortoise fence is being attached to an existing right-of-way fence that has larger interspaces between posts. The fence must be perpendicular to the ground surface, or slightly angled away from the road, towards the side encountered by tortoises. After the fence has been installed and secured to the top wire and T-posts, excavated soil will be replaced and compacted to minimize soil erosion.

Option 2 (see drawing diagram of Appenix A below). In situations where burying the fence is not practical because of rocky or undigable substrate, the fence material should be bent at a 90° angle to produce a lower section approximately 14 inches wide which will be placed parallel to, and in direct contact with, the ground surface; the remaining 22-inch wide upper section should be placed vertically against the existing fence, perpendicular to the ground and attached to the existing fence with hog rings at 12 to18-inch intervals. The lower section in contact with the ground should be placed within the enclosure in the direction of potential tortoise encounters and level with the ground surface. Soil and cobble (approximately 2 to 4 inches in diameter; can use larger rocks where soil is shallow) should be placed on top of the lower section of fence material on the ground covering it with up to 4 inches of material, leaving a minimum of 18 inches of open space between the cobble surface and the top of the tortoise-proof fence. Care should be taken to ensure that the fence material parallel to the ground surface is adequately covered and is flush with the ground surface.

10.4 New Fence Construction

Options 1 or 2 should be followed except in areas that require special construction and engineering such as wash-out sections (see below). T-posts should be driven approximately 24 inches below the ground surface spaced approximately 10 feet apart. Livestock wire should be stretched between the T-posts, 18 to 24 inches above the ground to match the top edge of the fence material; desert tortoise-proof fencing should be attached to this wire with hog rings placed at 12 to 18-inch intervals. Smooth (barb-less) livestock wire should be used except where grazing occurs.

If fence is constructed within the range of bighorn sheep, two smooth-strand wires are required at the top of the T-post, approximately 4 inches apart, to make the wire(s) more visible to sheep. A 20 to 24-inch gap must exist between the top of the fence material and the lowest smoothstrand wire at the top of the T-post. The lower of the top two smooth-strand wires must be at least 43 inches above the ground surface.

(72-inch T-posts: 24 inches below ground + 18 inches of tortoise fence above ground + 20 to 24-inch gap to lower top wire + 4 inches to upper top wire = 66 to 70 inches).

10.5 Inspection of Desert Tortoise Barriers

The risk level for a desert tortoise encountering a breach in the fence is greatest in the spring, summer, 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 cattleguards 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; cattleguards 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 cattleguard 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 cattleguards 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.

10.6 Repair and Maintenance of Desert Tortoise Barriers

Repairs of fence wash-outs: (1) realign the fence out of the wash if possible to avoid the problem area, or (2) re-construct tortoise-proof fencing using techniques that will ensure that an effective desert tortoise barrier is established that will not require frequent repairs and maintenance.
Gaps and breaks will require either: (a) repairs to the existing fence in place, with similar diameter and composition of original material, (b) replacement of the damaged section to the nearest T-post, with new fence material that original fence standards, (c) burying fence, and/or (d) restoring zero ground clearance by filling in gaps or holes under the fence and replacing cobble over fence constructed under Option 2. Tortoise-proof fencing should be constructed and maintained at cattleguards to ensure that a desert tortoise barrier exists at all times.

All fence damage should be repaired in a timely manner to ensure that tortoises do not travel through damaged sections. Similarly, cattleguards will be cleaned out of deposited material underneath them in a timely manner. In addition to periodic inspections, debris should be removed that accumulates along the fence. All cattleguards 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.

11.0 Culverts and Passageways for Desert Tortoises

Effective road and highway infrastructure planning is critical to mitigating the impacts of habitat fragmentation on desert tortoises. Implementing culverts and passageways can enhance connectivity between tortoise populations separated by roads, thus improving their genetic diversity and overall population viability. This section outlines recommendations for designing and maintaining culverts and passageways to facilitate tortoise movement and reduce road mortality and closely follows the recommendations outlined in the USFWS's document on passages for connectivity of Mojave desert tortoises by the Desert Tortoise Recovery Office.

11.1 Design Recommendations

Exclusion Fencing and Passageway Spacing

Exclusion Fencing: Desert tortoise exclusion fencing should be considered for roads with an average daily traffic volume over 200 vehicles. These fences help prevent tortoises from accessing roadways, thereby reducing mortality.

Passageway Spacing: To restore connectivity, passages should be spaced approximately 2200 feet (670 m) apart. This spacing is based on multi-year home range estimates and aims to provide at least one road passage for tortoises living near the road.

Placement Considerations

Habitat Potential: Passages should be installed in areas with high habitat potential on both sides of the road. Avoid placing passages in areas where one side is no longer suitable for tortoises.

Wash Associations: Where possible, align passageways with natural washes, as tortoises preferentially use these areas for foraging and movement.

Structural Design

Culvert Specifications: Under-road passages, such as culverts, should have an openness ratio (structure's cross-section/length) of 0.4. Square passages should be at least 5.9 feet (1.8 m) on each side, and circular passages should have a diameter of at least 6.6 feet (2.0 m).

Substrate and Lighting: Culverts should have a natural substrate (e.g., sand, silt, gravel) to encourage use by tortoises. The ability of tortoises to see light at the end of the passageway is crucial; therefore, shorter culverts with a large diameter are preferred.

Noise and Visual Barriers

Sound Attenuation: High traffic volumes can deter tortoises from using passageways. Installing sound-attenuating walls above the entrance can reduce noise and light disturbance from passing vehicles.

Flooding and Debris Management: Design passageways to minimize debris accumulation and maintain a clear, dry path wide enough to encourage use by tortoises.

11.2 Maintenance and Monitoring

Regular Maintenance: Regular inspections and maintenance are required to ensure fencing and passageways remain effective, especially after storm events. Damaged fencing and blocked passages should be promptly repaired.

Effectiveness Monitoring: Monitoring should accompany the installation of passageways to assess their effectiveness in maintaining connectivity. Data on tortoise use, road mortality rates, and habitat conditions should be collected to refine design and placement guidelines.

11.3 Research and Adaptation

Ongoing Research: Additional research is necessary to understand the long-term effects of roads and passageways on desert tortoise genetics, demography, and connectivity. Studies should focus on optimal design criteria and spacing to maximize passageway use.

Adaptive Management: Recommendations should be implemented through adaptive management, adjusting strategies based on monitoring results and new research findings.

12.0 EARTHEN V-DITCHES

12.1 Design Specifications

To ensure the safety of the Sonoran desert tortoise during construction and operation activities, it is crucial to consider specific design specifications for earthen v-ditches. The sides of these ditches should have a maximum slope of 35 degrees to prevent tortoises from becoming trapped. The depth and width of the v-ditch should be appropriate for the expected water flow and soil type, avoiding exceptionally deep trenches that tortoises cannot escape and ensuring the width is sufficient to handle water flow without posing unnecessary hazards to wildlife. Regular escape ramps, installed at intervals of at least every 50 meters, should feature a gentle slope not steeper than 15 degrees, allowing tortoises and other small animals to exit easily. Additionally, vegetation should be maintained along the edges of the v-ditch to provide cover. Regular inspections and maintenance are necessary to keep the v-ditch free of debris and ensure the functionality of escape ramps, with maintenance and checks planned during critical periods for tortoises. Adhering to these design specifications will minimize the impact on Sonoran desert tortoises, enhancing their protection and promoting their conservation in areas affected by construction activities.

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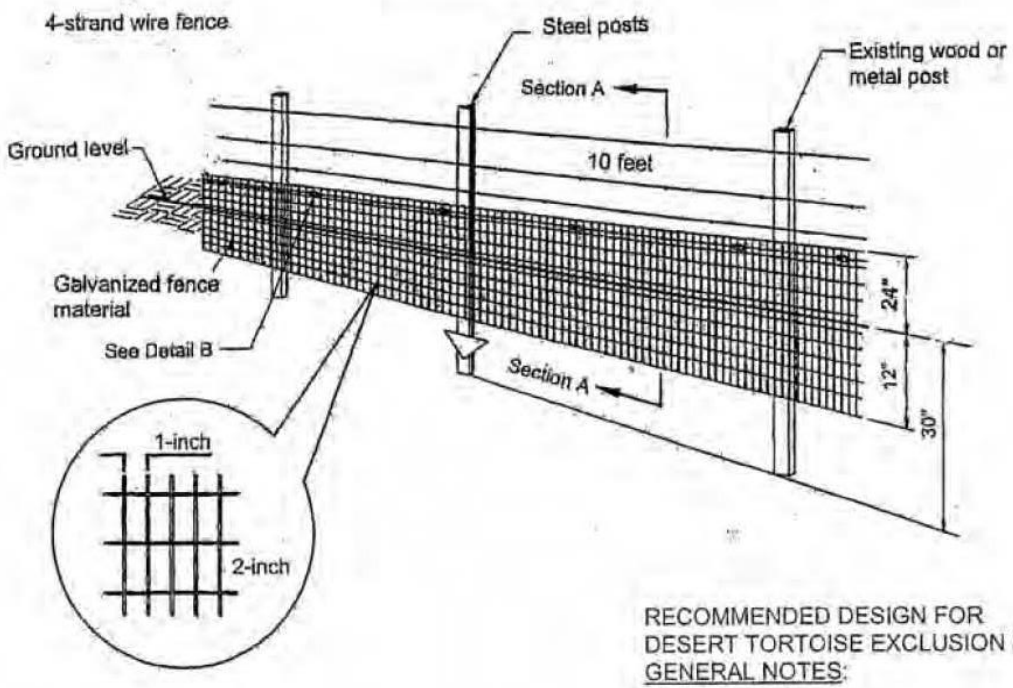
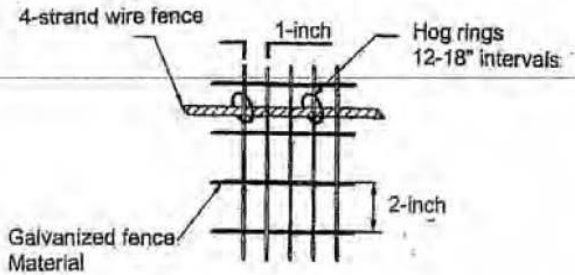
APPENDIX A

Desert Tortoise Exclusion Fencing

DESERT TORTOISE EXCLUSION FENCE (2005)



DETAIL A



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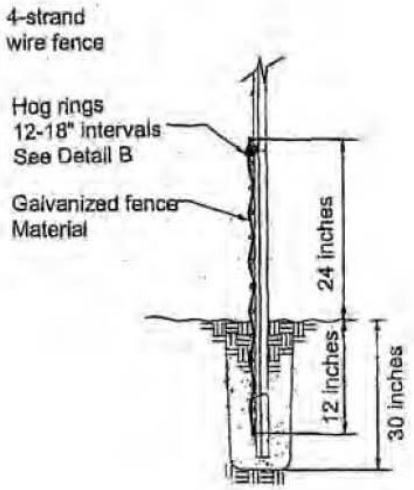


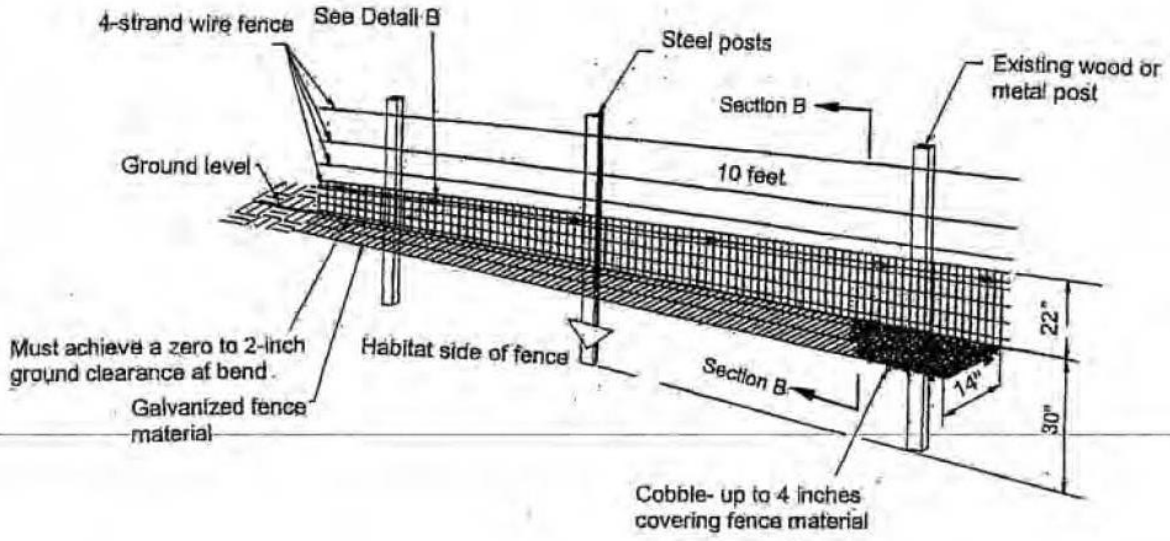
SECTION A

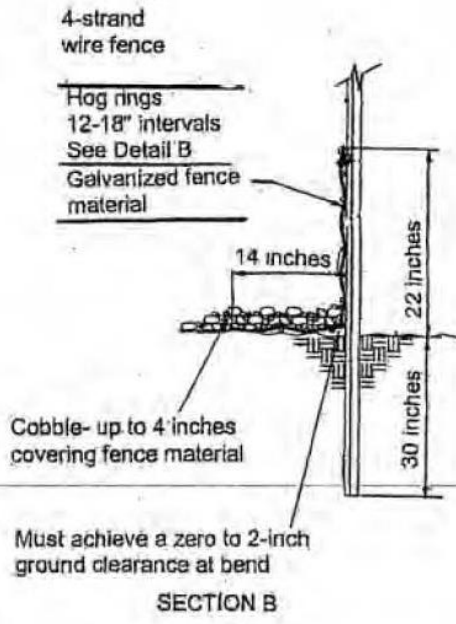
RECOMMENDED DESIGN FOR
DESERT TORTOISE EXCLUSION FENCE
GENERAL NOTES:

1. Ensure that fence posts and materials conform to the standards approved by the U.S. Fish and Wildlife Service.
2. Ensure that the height above ground level is no less than 18 inches and no higher than 24 inches.
3. Ensure that the depth of fence material below ground level is about 12 inches but no less than 6 inches. (See SECTION A above)
4. Install additional steel posts when span between existing fence posts exceed 10 feet.
5. Attach fence material to existing fence or wire using hog rings at 12-inch intervals.
6. Fasten fence material to posts with 3 tie wires with a wire near the top, bottom, and center of the fence material.
7. Backfill trenches with excavated material and compact the material.
8. Attach fence material to all gates. Ensure that clearance at base of gate achieves zero ground clearance.
9. Substitute smooth wire for barbed wire if additional support wires are necessary.
10. The number and placement of support wires may be modified to allow sheep and deer to pass safely.
11. Erosion at the edge of the fence material where the fence crosses washes may occur and requires appropriate and timely monitoring and repair.
12. Tie the fence into existing culverts and cattleguards when determined necessary to allow desert tortoise passage underneath roadways.

FOR BEDROCK OR CALICHE SUBSTRATE

1. Use this fence design (see below) only for that portion of the fence where fence material cannot be placed 6 inches below existing ground level due to presence of bedrock, large rocks or caliche substrate.
2. Ensure that the fence height above ground level is no less than 22 inches.
3. Ensure that there is a zero to 2-inch ground clearance at the bend.
4. Ensure that the bent portion of the fence is lying on the ground and pointed in the direction of desert tortoise habitat.
5. Cover the portion of the fence that is flush with the ground with cobble (rocks placed on top of the fence material to a vertical thickness up to 4 inches).
6. When substrate no longer is composed of bedrock or caliche, install fence using design shown above.





SECTION B

APPENDIX B

Desert Tortoise Field Survey Datasheet

Sonoran Desert Tortoise: Field Survey Datasheet

Date of survey: _____ (day, month, year) Survey biologist(s): _____ (name, email, and phone number)

Site description: _____ (project name and size; general location)

County: _____ Location: _____ (UTM coordinates, lat-long, and/or TRS; map datum)

Area size to be surveyed: _____ Transect #: ____ Transect length: _____

GPS Start-point: _____ (easting, northing, elevation in meters) Start time: _____am/pm

GPS End-point: _____ (easting, northing, elevation in meters) End time: _____am/pm

Start Temp: _____ºC End Temp: _____ºC

Live Tortoises

Detection number	GPS location Easting	GPS location Northing	Time	Tortoise location (*in burrow*: all of tortoise beneath plane of burrow opening, or *not in burrow*)	Approx MCL ≥180 mm? (*Yes, No or Unknown*)	Existing tag # if present
1						
2						
3						
4						
5						
6						
7						
8						
9						
10						

Tortoise Sign (burrows, scats, carcasses, etc)

Detection number	GPS location Easting	GPS location Northing	Type of sign (*burrows, scats, carcass, etc*)	Description and comments
1				
2				
3				
4				
5				
6				
7				
8				
9				
10				