United States Department of the Interior

Fish and Wildlife Service
Arizona Ecological Services Office
9828 North 31st Avenue, Suite C3
Phoenix, Arizona 85051
Telephone: (602) 242-0210 Fax: (602) 242-2513

In Reply Refer To:
02EAAZ00-2018-F-1164-R1

February 20, 2020

Mr. Joshua Fife, Biology Team Lead
Arizona Department of Transportation
Environmental Planning
1611 W. Jackson Street
Phoenix, Arizona 85007

RE: Federal Highway Administration (FHWA) File # A89-B(221)T
Arizona Department of Transportation (ADOT) File # 89A CN 375 F0047 01C
Sedona City Limits to Bear Howard Drive Pavement Rehabilitation Reinitiation

Dear Mr. Fife:

Thank you for your letter of December 23, 2019, sent by electronic mail (email), updating the scope of work on the ongoing Sedona City Limits to Bear Howard Drive Pavement Rehabilitation Project along State Route (SR) 89A in Coconino County, Arizona (Consultation #02EAAZ00-2019-F-01164). On May 17, 2019, we issued a non-jeopardy biological opinion (BO) for potential effects of the pavement preservation project on the threatened narrow-headed gartersnake (*Thamnophis rufipunctatus,* gartersnake). On that date, we also issued our concurrence on ADOT's determination that the proposed action was "not likely to adversely affect" gartersnake proposed critical habitat or the threatened Mexican spotted owl (*Strix occidentalis lucida*) or its designated critical habitat.

In your letter, you proposed additions to the existing scope of work that will include retaining wall construction and drainage improvements to stabilize streamside, erosion-prone slopes along SR 89A in the vicinity of Slide Rock State Park. Repaving of SR 89A and other actions considered in the existing BO have been underway since September 2019 and are nearing completion. Because work crews and the resources needed to begin work on the proposed erosion control measures are already on site, ADOT has requested consultation reinitiation.

Based on our analysis of the additional actions, we have revised the following sections to amend our May 17, 2019, BO: Description of the Proposed Action, Conservation Measures, Description of the Action Area, Status of the Species in the Action Area, Effects of the Action, Incidental Take Statement, and Conservation Recommendations. You determined that the expanded scope of work would adversely affect the gartersnake and its proposed critical habitat,

and we revised our analysis accordingly in Appendix A of this letter. We are not amending any part of our original concurrence on the Mexican spotted owl or its designated critical habitat.

We appreciate ADOT's continuing efforts to identify and minimize effects to listed species resulting from this project. No further section 7 consultation is required for this project at this time. Should the scope of work change again, you may need to reconsider this reinitiation. If you require further assistance or you have any questions, please contact Robert Lehman (602) 889-5950 or Greg Beatty (602) 889-5941. Please refer to the consultation number 02EAAZ00-2018-F-1164-R1 in future correspondence concerning this project.

Sincerely,

Jeffrey A. Humphrey
Field Supervisor

cc:

Fish and Wildlife Biologists, U.S. Fish and Wildlife Service, Flagstaff and Tucson, AZ (Attn: Shaula Hedwall, Jeff Servoss)
Chief, Habitat Branch, Arizona Game and Fish Department, Phoenix, AZ
Chief, Aquatic Wildlife Branch, Arizona Game and Fish Department, Phoenix, AZ
Supervisor, Region 2, Arizona Game and Fish Department, Flagstaff, AZ
District Biologist, Red Rock Ranger District, Coconino National Forest, AZ (Attn: J. Agyagos)
Wildlife Biologists, ADOT, Phoenix - Flagstaff, AZ (Attn: K. Gade, J. White, A. Navarro)
Environmental Coordinator, Bureau of Indian Affairs, Phoenix, AZ (Attn: Chip Lewis)
Yavapai Culture Director, Yavapai-Apache Nation, Camp Verde, AZ
Director, Culture Research Department, Yavapai-Prescott Indian Tribe, Prescott, AZ
Director, Cultural Resource Department, Tonto Apache Tribe, Payson, AZ
Supervisor, Traditional Cultural Program, Navajo Nation, Window Rock, AZ

W:\Bob Lehman\Jeff's Signature\SR 89A Reinitiation Feb 21920.docx

APPENDIX A: Revised Sections of the SR 89A Pavement Rehabilitation Project Biological Opinion

CHANGES TO THE DESCRIPTION OF THE PROPOSED ACTION

ADOT and the Arizona Department of Environmental Quality (ADEQ) are proposing to add drainage improvements and construction of retaining walls to the scope of work for the SR 89A Pavement Rehabilitation Project to resolve erosion issues on steep rocky slopes along the SR 89A roadway, from milepost (MP) 381.70 to MP 381.78 (Appendix B, Figure 1). Erosion on these slopes has reduced and in some cases removed the roadway shoulder and parts of the pavement and has created incised drainage channels below the road (Appendix B, Figure 2). The potential for further erosion of the roadway embankment represents a public safety issue that can be resolved as part of the ongoing repaving of SR 89A. Erosion issues in the area also represent a water quality issue. ADEQ is providing funds for the additional work in the expectation that proposed retaining walls in combination with drainage improvements will reduce downslope movement of rocks, sediments, and other debris into Oak Creek. Oak Creek is 100-180 feet west of and 50-60 vertical feet below the SR 89A roadway.

Work on drainage improvements will occur on 0.4 acre along approximately 0.08 mile (425 feet) of the existing 200-acre, 12.1-mile-long construction footprint. Construction of retaining walls will add 0.5 acre to the existing footprint by extending it laterally about 50 feet out from the west edge of the roadway. Thus, the construction footprint for the expanded scope of work will encompass 0.9 acre. The construction footprint will not include Oak Creek.

Scope of Work

- Construct a concrete embankment curb and gutter along the west edge of the SR 89A roadway to capture and redirect stormwater away from erosion-damaged slopes;
- Remove sediments from the drainage ditch on the east side of the roadway and re-grade the ditch as needed to improve flows;
- Construct up to three sections of new retaining wall approximately 20 feet downslope from the edge of SR 89A to replace existing retaining walls that are failing;
- Backfill the new retaining walls up to the edge of the roadway.

Drainage Improvements

Stormwater runoff in the construction footprint is channeled to a drainpipe at MP 381.71 via the drainage ditch on the east side of SR 89A, or flows across the roadway and downhill towards Oak Creek as overflow from the drainage ditch. These excess flows are the primary factor causing erosion of the roadway and roadway shoulders, and have caused incised channels to form below the road. One of these channels, between MP 381.72 and MP 381.73, has developed into a well-defined gully below SR 89A (Appendix B, Figures 1 and 2).

To divert stormwater from eroded areas along the west edge of the roadway, the contractor will install a concrete embankment curb and gutter along the west edge of the pavement and tie this structure to a down drain the contractor will cut in the existing drainpipe at MP 381.71 (this is the only drainpipe in the construction footprint). The new embankment curb will extend from the northern limit of the construction footprint, at MP 381.78, to the southern limit at MP 381.70. To further direct runoff and improve drainage within the construction footprint, the contractor will clear and regrade the drainage ditch as necessary.

Retaining Walls

At some point in the past, ADOT installed low retaining walls constructed of heavy wooden beams to stabilize eroding slopes within the construction footprint. These walls are 2-3 feet high and were installed 1-10 feet downhill of the guardrails. However, the walls are failing and need to be replaced (Appendix B, Figure 2).

The new retaining walls will be 10-15 feet further downhill, 3-4 times taller, and more deeply anchored than the existing walls. The contractor will determine the length of each retaining wall segment and their exact locations on the ground before construction begins. The objective is to place a wall section at each location where erosion has created an incised channel on slopes below the roadway. The total length of the retaining wall sections will be about 135 feet.

To provide support for the retaining walls, work crews will install vertical steel H-piles in the ground using a track excavator operated from the roadway. H-piles are dimensionally square-structural beams set deep into the ground to support large structures. Crews will attach a rock drill or hoe ram to the excavator arm and the arm will extend from the road down to the wall's baseline to drill auger holes, for placing H-piles in rock, or to drive H-piles directly into the ground with the hoe ram. To stabilize H-piles in rock, crews will concrete the beams into place. H-piles will likely be spaced at six-foot intervals. No heavy equipment will leave the roadway during the project because the slopes below SR 89A are too steep and unstable for safe operations.

Once work crews have placed H-piles and cut them to the desired height (15-20 feet), they will cut wood timbers and stack them between the H-piles to create the retaining walls (Appendix B, Figure 3). When walls are in place, crews will haul engineered structural backfill material via dump truck and backfill the retaining walls up to or near the roadway level, depending on contour and slope. Crews will place backfill using a gannon tractor or excavator with a bucket attachment, and compact the fill material with hand-held mechanical compactors or a compaction device fitted to the excavator.

Vegetation Removal

Crews will begin work on retaining walls by clearing and grubbing vegetation from wooded slopes along the baseline of each wall section and from areas uphill of the walls where backfilling will occur. Vegetation is sparse in these areas due to erosion (Appendix B, Figure 2); thus, vegetation clearing will be limited to scattered small trees and shrubs. Crews will complete this work on foot with hand tools and chainsaws.

Schedule for the Expanded Scope of Work

ADOT anticipates that construction of the retaining walls and drainage improvements will occur in February and March 2020 and will take three to four weeks to complete.

New Conservation Measures

The following measures are new commitments made by ADOT to minimize project effects:

- To discourage gartersnakes displaced by construction activities from sheltering inside the construction footprint, work crews will avoid the creation of rock piles that may attract gartersnakes when drilling auger holes.
- To reduce sediment transport into Oak Creek after drilling operations, work crews will spread soil and other spoils from auger holes across the hillsides above the retaining walls.
- To prevent entrapment of gartersnakes in auger holes, the contractor will either cap the holes or place H-piles immediately after drilling.

CHANGES TO THE ENVIRONMENTAL BASELINE

Description of the Action Area: Oak Creek Water Quality

Because of its exceptional recreational and ecological significance, ADEQ has designated Oak Creek and the West Fork of Oak Creek as Tier III outstanding Arizona waters (ADEQ 2010). However, *E. coli* bacteria have been a problem in Oak Creek since at least 1973 and continue to be an issue (USFWS 2019). Oak Creek is not attaining water quality standards for *E. coli* and has repeatedly exceeded the state water quality standard for full body contact (*E. coli* in stream water is an indicator of fecal contamination). In 1999, ADEQ (1999a, b) and the Environmental Protection Agency (EPA) completed and approved a total maximum daily load determination for Oak Creek. They listed sediment, wildlife, recreational uses, and rangeland grazing as probable *E. coli* pollution sources causing impairment in the Slide Rock State Park segment of Oak Creek. The City of Sedona (2017) also describes humans, dogs, and septic systems as sources of *E. coli* pollution. Because sediment in streams can exacerbate *E. coli* concentrations, it is prudent to manage nonpoint sources of sediment pollution by reducing soil erosion and sediment delivery. Additionally, the City of Sedona (2017) identified pollutants such as pesticides and oil, as well as trash and other debris carried by storm water as a concern. SR 89A parallels Oak Creek Canyon and Oak Creek for approximately 15 miles creating opportunities for roadside contaminants to be carried toward Oak Creek from storm water runoff.

Status of the Species in the Action Area

We anticipate that gartersnake densities in and adjacent to the construction footprint are low. However, low densities do not preclude encounters with gartersnakes during the proposed action. We note that gartersnake detections have occurred consistently in and near the action area at Slide Rock State Park over many years, including one in 2017 just 150 feet west of the construction footprint (Nowak 2017).

CHANGES TO EFFECTS OF THE ACTION

Construction Effects

All of the proposed activities will begin when gartersnakes at similar elevations in Arizona (~5,000 feet) typically are dormant (brumating) in underground shelters. Dormancy extends from approximately November to the end of February; thus, we expect that most or all gartersnakes in and near the construction footprint will be brumating when construction begins.

We anticipate adverse effects of the project can include harassment, injuries, and fatalities of individual gartersnakes exposed to heavy machinery operations, ground crew activities, and use of rock drills, hydraulic pile drivers, and other power tools. Ground disturbance and associated vibration levels during construction may trigger flight responses by gartersnakes sheltered inside the construction footprint. Gartersnakes that leave their shelters will be at risk of injuries or fatalities from vehicle strikes on SR 89A or wherever work crews and equipment are operating. Given low ambient temperatures at this time of year, individuals that attempt to flee may be sluggish and more vulnerable to injuries and fatalities, whether they result from construction activities, predation, or exposure. Gartersnakes that remain in their shelters during construction, in subsurface retreats in backfill areas for example, will be at risk of being trapped or crushed.

We can expect a number of factors to limit the number of individual gartersnakes adversely affected by the proposed action, including a small construction footprint, short project duration, and reduced gartersnake abundance. Ground disturbances in occupied gartersnake habitat will occur over a small area (0.5 ac) and short time frame (3-4 weeks), and new conservation measures will reduce harm to individual gartersnakes during construction. Some gartersnakes that attempt to flee the construction site may successfully move out of the area without further consequence. Lower gartersnake densities in and near the construction footprint may also reduce the project's adverse effects. The construction footprint is directly adjacent to Slide Rock State Park where a localized gartersnake decline was documented several decades ago (Nowak and Santana-Bendix 2002), and detection rates throughout Oak Creek Canyon have declined steadily since the mid-1980s (Nowak and Santana-Bendix 2002, Nowak 2006, Brennan and Rosen 2009, Nowak 2017, 2018). We note as well that no gartersnake encounters occurred during the current SR 89A repaving project (personal communication from J. Fife, ADOT biologist, February 6, 2020).

While we anticipate that construction activities will adversely affect gartersnakes, low gartersnake densities in and adjacent to the construction footprint and conservation measures are expected to reduce and limit the extent of those effects.

Retaining Wall Barrier Effects

We anticipate retaining walls can alter gartersnake behavior and habitat, but not to a degree that is reasonably certain to cause incidental take (and the walls may have some beneficial effects). The 6-12 foot-tall high retaining walls can hinder gartersnake movements and alter behavior as long as they stand, but any effects will be minimized by the short overall length of the walls

(~135 feet), and gaps between segments. We anticipate gartersnakes will be able to move around the walls while dispersing, foraging, and sheltering without additional consequences from predation or added energy expenditure. In the short term, adding backfill at the walls will remove potential gartersnake sheltering sites, but as vegetation becomes established, gartersnakes may return in the future and use the area for escape and thermal cover. It is possible the retaining walls and backfill will reduce the risk of vehicle strikes on SR 89A over the long term by diverting gartersnakes away from the roadway.

Water Quality Effects

Improving water quality is a project objective, and we anticipate that planned actions can improve sedimentation in Oak Creek, especially in the short-term. However, diverting runoff from the roadway to the drainage pipe at MP 381.71 will increase outflow at the pipe and over time may erode the hillside at the pipe's outlet. This could create a new source of sedimentation within the construction footprint.

Diverting runoff from the roadway to the drainage pipe may also increase the amount of roadway contamination that reaches Oak Creek, including gasoline, diesel fuel, oil, deicers, and other industrial chemicals (Buckler and Granato 2003). Currently, some stormwater disperses across SR 89A, and from there flows downhill towards Oak Creek along with any contaminants acquired from the roadway. As a result, much of the runoff from SR 89A infiltrates the soil before reaching the creek, and may be cleaner than when it left the road. This may not be the case after ADOT installs an embankment curb to redirect water from the road to the drainage pipe. When that occurs, all runoff from the construction footprint will pass through the drainpipe at MP 381.71, and outflow from the pipe will increase in volume and carry contaminants that it did not carry previously.

We expect the construction of retaining walls and water drainage improvements will have an overall insignificant effect to gartersnakes and its prey. There will be short-term sedimentation improvements associated with retaining wall construction. The long-term effects are less certain based upon redirecting and concentrating water into a drainage pipe and its influence to hillside sedimentation and contaminant inflow toward Oak Creek. Because of the localized retaining wall sedimentation improvements, the overall short-distance influenced by the project, and the existing water quality contaminant baseline, we anticipate that retaining walls and drainage improvements will not noticeably change water quality to a degree that will adversely affect gartersnakes or its prey.

Effects to Proposed Critical Habitat

The 0.9-ac retaining wall/drainage improvement footprint is entirely within the proposed gartersnake 7,369-ac Oak Creek Critical Habitat Subunit (78 FR 41550). The primary constituent elements (PCEs) of gartersnake proposed critical habitat include: 1) stream habitat; 2) adequate terrestrial space; 3) a viable prey base; and 4) absence or low occurrence of nonnative aquatic species.

PCE 1. Stream Habitat

Adverse effects of the project to PCE 1 (stream habitat) during construction are likely to be insignificant. Proposed actions will involve no instream work, and no physical alteration of the creek's active channel, banks, or floodplain will occur. Construction of the retaining walls will occur well above and away from Oak Creek and require work crews to operate rock drills, pile drivers, and other power tools on steep slopes that are prone to erosion. However, no heavy equipment use will occur on these slopes and Best Management Practices (BMP) and conservation measures will minimize sediment transport into Oak Creek.

After construction, drainage structures on SR 89A will prevent stormwater runoff from reaching erosion-damaged slopes below the roadway, which over the near term will likely reduce sedimentation and turbidity in Oak Creek and improve watershed condition (PCE 1). Reducing sedimentation can help minimize adverse effects to gartersnake prey respiration, foraging success, and spawning and foraging habitat (Wheeler et al. 2005). Streambed siltation affects spawning by decreasing dissolved oxygen content where fish lay their eggs, resulting in reduced recruitment of fish and fewer prey for the gartersnake (Nowak and Santana-Bendix 2002). Turbidity can also reduce gartersnake foraging success by reducing water clarity and visibility (de Queiroz 2003; Hibbitts and Fitzgerald 2005).

The long-term effects from sedimentation and water quality to PCE 1 (stream habitat) are less certain but we anticipate the effects will be insignificant. Planned actions will divert stormwater runoff from erosion-damaged slopes along a short section of SR 89A (~425 feet), but will add it to (i.e., increase) current outflows at the only available drainpipe. Concentrating stormwater runoff at one location has the potential to increase erosion at that site. Concentrating runoff at the drainpipe may also provide a more direct pathway for roadway contamination to reach Oak Creek. Although it is uncertain exactly to what degree this will reduce or exacerbate contaminant/erosion runoff, we expect the change from this short distance of roadway will not significantly alter the existing water quality/stream habitat baseline. We note that the action will alleviate the immediate effects of erosion and provide time for the action agency and cooperating agencies to monitor the effectiveness of actions taken during this project and to consider if additional measures are needed.

PCE 2. Adequate Terrestrial Space

The retaining walls will permanently alter the contours of gartersnake critical habitat causing an adverse effect to gartersnake critical habitat PCE 2 (terrestrial space). The 6-12 foot-tall retaining walls along approximately 135 feet of Oak Creek (in three separate sections) will create obstacles to gartersnake movements, and backfill will eliminate sheltering sites on rocky slopes directly below the roadway. However, once vegetation recovers on backfill areas, new thermal and escape cover may replace sheltering sites buried by backfill during construction.

We also anticipate that the erosion control efforts on the slopes below SR 89A will help protect terrestrial and aquatic habitats below the retaining walls. Approximately 0.5 ac of the 0.9-ac construction footprint consists of the sparsely wooded slopes directly below SR 89A where

erosion issues are most pronounced and where ADOT's planned actions are expected to minimize further vegetation loss and hillside incision.

PCE 3. Viable Prey Base

Given that ADOT's proposed erosion control/drainage improvement measures will involve no instream work, occur well above and away from Oak Creek, and BMPs will minimize sedimentation effects, we anticipate the effects to PCE 3 (gartersnake prey species) during construction will be insignificant.

We anticipate the long-term effects to gartersnake prey from erosion control measures and drainage improvements will be insignificant. Because of the small project area (a construction footprint of 0.9 acre), retaining wall sedimentation improvements, and existing water quality baseline, we expect the proposed changes will not noticeably alter prey base habitat in Oak Creek.

PCE 4. Absence of Nonnative Aquatic Species

We anticipate no adverse effects of the project on PCE 4 (nonnative aquatic species) because planned actions will not occur within Oak Creek and the erosion control and drainage improvements along a short distance of roadway are not expected to influence the occurrence of nonnative fish species, bullfrogs, or crayfish in Oak Creek.

CONCLUSIONS

It is our biological opinion that construction activities along SR 89A as proposed are not likely to jeopardize the continued existence of the narrow-headed gartersnake or destroy or adversely modify its proposed critical habitat. We base our determinations on the following reasons:

- We expect the project construction will adversely affect a small number of individual gartersnakes, but ADOTs conservation measures will minimize those effects. We do not anticipate the small number of gartersnakes incidentally taken will affect the gartersnake at the population level, due to its distribution across Arizona and occurrence along Oak Creek.
- We expect planned actions along this short segment of SR 89A will reduce roadside erosion over the short-term (PCE 1 and 2) and in the long-term not noticeably alter the existing Oak Creek water quality/sediment or prey species baseline (PCE 1 and 3) or increase nonnative aquatic species (PCE 4).
- Retaining wall construction will permanently alter about 135 feet of proposed gartersnake PCE 2 (terrestrial space) along the perimeter of the SR 89A roadway, representing a minor alteration and proportion of the 7,369-ac Oak Creek Critical Habitat Subunit. This small alteration to terrestrial space (PCE 2) will not appreciably alter proposed critical habitat, allowing it to remain functional for gartersnake conservation and recovery into the foreseeable future.

CHANGES TO THE INCIDENTAL TAKE STATEMENT

The FWS anticipates two narrow-headed gartersnakes will be taken as a result of the proposed action. The incidental take is expected to be in the form harassment and harm (injuries or fatalities). Construction activities are anticipated to disturb, displace, and subsequently harass surface active or dormant gartersnakes, resulting in gartersnake injuries or fatalities due to vehicle strikes, crushing by heavy equipment, predation, or exposure.

Because narrow-headed gartersnakes are small-bodied, secretive, well-camouflaged, use subsurface retreats and protective cover, and because heavy machinery operations extend underground and backfilling the retaining walls may bury gartersnakes, gartersnakes may be incidentally taken but not observed during the project.

Given that gartersnakes are secretive and easily overlooked, detecting live gartersnakes during the project may signal a higher likelihood that garternsakes may be incidentally take. Therefore, if ADOT observes one live narrow-headed gartersnake during construction activities, ADOT will contact this office as soon as possible to discuss whether consultation reinitiation and/or additional conservation measures are necessary.

Based upon the detection of one dead narrow-headed gartersnake in the action area caused by project activities, we will consider the amount or extent of incidental take of two narrow-headed gartersnakes has been reached (because finding all incidentally taken gartersnakes is difficult). As provided in 50 CFR Section 402.16, consultation reinitiation would be required for any additional incidental take authorization.

CONSERVATION RECOMMENDATIONS

To the three conservation recommendations in the existing BO, we add the following recommendation:

1. We recommend that ADOT work with ADEQ and Coconino Nation Forest to increase erosion protection in the large gulley at MP 381.72-MP 381.73 by constructing a rock or rip rap armored spillway below the drainpipe outlet at MP 381.71. The pipe currently receives runoff only from the ditch drain on the east side of the roadway; however, undirected flows that are the source of erosion problems along SR 89A will be channeled into the drainpipe via new embankment curb and gutters. These improvements will increase flows into the pipe and the risk of erosion at the pipe outlet. A spillway would reduce scour effects and could be used to direct outflow from the pipe away from retaining walls.

Literature Cited

Arizona Department of Environmental Quality (ADEQ). 1999a. Total maximum daily loads for Oak Creek – Slide Rock State Park. Parameters: Escherichia coliform. Phoenix.

Arizona Department of Environmental Quality (ADEQ). 1999b. Pathogen total maximum daily loads for Oak Creek – Slide Rock State Park, Oak Creek Canyon, AZ. Phoenix.

Arizona Department of Environmental Quality (ADEQ). 2010. Oak Creek and Spring Creek Verde River Watershed Total Maximum Daily Loads for *Escherichia coliform*. Phoenix, Arizona.

Brennan, T.C. and P.C. Rosen. 2009. Report on narrow-headed gartersnake (*Thamnophis rufipunctatus*) surveys at Oak Creek and the Black River, Arizona. Report submitted to the Arizona Game and Fish Department.

Buckler, D.R., and G.E. Granato. 2003. Assessing biological effects from highway-run-off constituents. Chapter 8 *in* G.E. Granato, C. Zenone, and P.A. Cazenas (eds). The National Highway Runoff Data and Methodology Synthesis – Technical Issues for Monitoring Highway Runoff and Urban Stormwater. Federal Highway Administration Publication No. FHWA-EP-03-054-2003.

City of Sedona. 2017. Sedona Community Plan. Plan Amended October 26, 2016; October 25, 2017, Plan effective: March 25, 2014. Ratified by voters: March 11, 2014, Adopted by Sedona City Council: November 7, 2013. The City of Sedona, AZ.

de Queiroz, A. 2003. Testing an adaptive hypothesis through context-dependence: effects of water depth on foraging behavior in three species of garter snakes. Ethology 109:369- 384.

Hibbitts, T.J., and L.A. Fitzgerald. 2005. Morphological and ecological convergence in two natracine snakes. Biological Journal of the Linnean Society 85:363-371.

Nowak, E.M., and M.A. Santana-Bendix. 2002. Status, distribution, and management recommendations for the narrow-headed gartersnake (*Thamnophis rufipunctatus*) in Oak Creek, Arizona. Final report to Arizona Game and Fish Department in fulfillment of Heritage Grant I99007. USGS Forest and Rangeland Ecosystem Science Center, Colorado Plateau Field Station, Flagstaff, Arizona.

Nowak, E. 2006. Monitoring surveys and radio-telemetry of narrow-headed gartersnakes (*Thamnophis rufipunctatus*) in Oak Creek, Arizona. Final Report to the Arizona Game and Fish Department.

Nowak, E. 2017. Surveys and captive facility for narrow-headed and northern Mexican gartersnakes in Oak Creek, Arizona, 2016-2017 report. Northern Arizona University, Flagstaff.\

Nowak, E. 2018. USFWS recovery permit report- 2018 summary, *Thamnophis rufipunctatus* and *Thamnophis eques* Permit # TE43322B-1. Northern Arizona University, Flagstaff.

U.S. Fish and Wildlife Service (USFWS). 2019. Biological opinion for the proposed Oak Creek Watershed Recreation Project. Consultation # 02EAAZ00-2018-F-1161. Arizona Ecological Services Office, Phoenix.

Wheeler, A.P., P.L. Angermeier, and A.E. Rosenberger. 2005. Impacts of new highways and subsequent urbanization on stream habitat and biota. Reviews in Fisheries Science:141-164.

APPENDIX B: Figures

Figure 1. Linear representation of the construction footprint (shown in red). The footprint begins at MP 381.70 and extends north approximately 400 feet (0.08 mi) to MP 381.78. Note that the natural drainage descending towards Oak Creek from the east has degraded into an erosion gully below SR 89A.

Figure 2. Photos from the west edge of SR 89A showing erosion of steep slopes below the roadway. Both photos show sections of old, failing retaining walls. The single corrugated steel pipe in the construction footprint is in the background of the top photo, viewed from the north looking south. The view in the bottom photo is from the roadway looking down the large

erosion gully between MP 381.72-MPO 381.73. This is the same gully that can be seen in Figure 1.

Figure 3. An example of a retaining wall like the sectionalized wall planned for SR 89A.