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U.S. Fish and Wildlife Service
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In Reply Refer To:
AESO/SE
22410-2012-R-0173
22410-2007-F-0132
02-21-02-F-229
02-21-98-F-266

March 31, 2014

Col. Daniel J. McFarland, Commander
U.S. Army Installation Management Command
Headquarters, U.S. Army Garrison, Fort Huachuca
2837 Boyd Avenue
Fort Huachuca, Arizona 85613-7001

Dear Colonel McFarland;

Thank you for your request for formal consultation and conference with the U.S. Fish and Wildlife Service (USFWS) pursuant to section 7 of the Endangered Species Act of 1973 (16 U.S.C. 1531-1544), as amended (Act). Your request was dated November 25, 2013, which transmitted your Programmatic Biological Assessment for Ongoing and Future Military Operations and Activities at Fort Huachuca, Arizona (PBA), with Appendices. Your letter and the PBA were received by the U.S. Fish and Wildlife Service (FWS) on November 25, 2013. At issue are impacts that may result from the proposed ongoing and future military operations and activities at Fort Huachuca, Cochise County, Arizona. The proposed action may affect the endangered Huachuca water umbel (*Lilaeopsis schaffneriana* var. *recurva*) and the species' critical habitat, the endangered jaguar (*Panthera onca*) with critical habitat, the threatened Chiricahua leopard frog (*Rana chiricahuensis*), the threatened Mexican spotted owl (*Strix occidentalis lucida*) with critical habitat, the endangered lesser long-nosed bat (*Leptonycteris curasoae yerbabuenae*), the endangered ocelot (*Felis pardalis*), and the endangered Sonora tiger salamander (*Ambystoma tigrinum stebbinsi*).

We did a conference opinion, in response to your request, pursuant to section 7(a)(4) of the Act and its implementing regulations at 50 CFR §402.10(d), on the proposed threatened northern Mexican gartersnake (*Thamnophis eques megalops*) with proposed critical habitat (78 FR 41500 and 78 FR 41550, respectively) and the proposed threatened yellow-billed cuckoo, western distinct population segment (*Coccyzus americanus*)(78 FR 61622).

Your November 25, 2013, letter also stated that you had determined your proposed action would have no effect on endangered southwestern willow flycatcher (*Empidonax traillii extimus*) and

its critical habitat, endangered Gila topminnow (*Poeciliopsis o. occidentalis*), endangered desert pupfish (*Cyprinodon macularius*), endangered Gila chub (*Gila intermedia*), endangered spikedace (*Meda fulgida*), endangered loach minnow (*Tiaroga cobitis*), and endangered Canelo Hill's ladies' tresses (*Spiranthes delitescens*). We recommend that you ensure that your rationale for these determinations are in your administrative record.

This draft biological and conference opinion is based on information provided in: (1) the November 2013 Programmatic Biological Assessment for Ongoing and Future Military Operations and Activities At Fort Huachuca, Arizona (PBA); (2) meetings, telephone conversations, and exchanges of electronic mail between our respective staffs; and (3) other published and unpublished sources of information. References cited in this biological opinion are not a complete bibliography of all references available on the species of concern or the effects of military operations on fish, wildlife, and plants, or on other subjects considered in this opinion. A complete administrative record of this consultation is on file at the Arizona Ecological Services Office (AESO).

Consultation History

- May 2011: at the conclusion of a third lawsuit, the U.S. District Court for the District of Arizona declared the 2007 BO to be arbitrary and capricious, and therefore null and void, and that the Army's reliance on that BO resulted in a breach of the Army's independent duties under Section 7. Accordingly, the Court ordered the USFWS and Army to reinitiate and complete formal consultation with regard to the impacts that may result from the proposed, ongoing and future military operations and activities at Fort Huachuca on federally-listed species and their critical habitats.
- 2012 to 2013: multiple discussions between our staffs occurred.
- June 19, 2013: We received your June 4, 2013 letter, which transmitted your May 2013 Programmatic Biological Assessment for Ongoing and Future Military Operations and Activities at Fort Huachuca, Arizona (PBA), with Appendices, requesting formal consultation.
- July 18, 2013: We transmitted to you a letter acknowledging the receipt of your PBA and outlining the additional information we required to complete formal consultation on the proposed action.
- August 8, 2013: We received your August 6, 2013 letter requesting a meeting to discuss our July 18, 2013 letter.
- August 18, 2013: Our staffs met to discuss our July 18, 2013 letter to address our concerns and what additional information was needed to initiate formal consultation. We also discussed how to address the proposed Mexican gartersnake with proposed critical habitat and the probable proposal for the western yellow-billed cuckoo.
- September 20, 2013: We received your draft PBA Addendum via electronic mail.
- October 29, 2013: Our staffs met to discuss the PBA Addendum to address our concerns and what additional information was needed to initiate formal consultation. We also discussed how to address the proposed Mexican gartersnake with proposed critical habitat and the probable proposal for the western yellow-billed cuckoo. We mutually decided to abandon the mesquite clearing project.
- November 5, 2013: our staffs held a conference call to discuss transmittal of a new revised PBA and the consultation timeframe.

- November 25, 2013: We received your November 25, 2013, response to our July 18, 2013, request for additional information. Your letter included a revised PBA and appendices, and request for formal consultation.
- January 8, 2014: our staffs held a conference call agreeing that we would send the Fort a draft biological and conference opinion by February 28, and a final biological and conference opinion by March 31, 2014. We also agreed that we would conduct formal consultation for the jaguar.
- January 13, 2014: We transmitted to you a (30-day) letter acknowledging the receipt of the November 25, 2013 PBA, and initiated formal consultation.
- February 7, 2014: We received your February 5, 2014 letter acknowledging receipt of the January 13 letter, clarifying which species you wished to consult on, and reiterating the biological opinion would be finalized by March 31, 2014.
- February 13, 2014: We met with your staff to discuss the Fort's 2013 completed activities and anticipated activities for 2014. The following day, we received materials discussed during the meeting, including revised 2013 Fort personnel and attributable population estimates as well as updated water use figures from 2013.
- November 19, 2013 to February 19, 2014: We corresponded with your staff via electronic mail and telephone to obtain more detailed information on the description of the proposed action as it relates to possible effects to Mexican spotted owl, Chiricahua leopard frog, ocelots, and jaguars. Among other topics, information was provided to us on the updated fuels management plan, conservation measures, hunting, as well as fencing and road construction and maintenance on the Fort.
- February 28, 2014: We transmitted to you our draft biological opinion.
- March 13, 2014: We received via electronic mail your comments on the draft biological opinion.
- March 31, 2014: We transmitted to you our final biological opinion of the effects of activities authorized, carried out, or funded by the Department of the Army at and near Fort Huachuca (Fort), Arizona on the Huachuca water umbel and critical habitat, Mexican spotted owl with critical habitat, lesser long-nosed bat, Chiricahua leopard frog, ocelot, and Sonora tiger salamander. Also included was our conference opinion on the proposed northern Mexican garter snake with proposed critical habitat, and the proposed western distinct population segment of the yellow-billed cuckoo. The proposed action was found to not jeopardize these species, nor adversely modify critical habitat where designated or proposed.

BIOLOGICAL AND CONFERENCE OPINION

DESCRIPTION OF THE PROPOSED ACTION

The following narrative has been adapted directly from the Revised PBA (U.S. Department of the Army 2013) to ensure an accurate description of the proposed action, including the proposed conservation measures and describes the major tenants and ongoing and future military operations and activities occurring or programmed to occur at or near Fort Huachuca between 2012 and 2022. The operations and activities include tenant-specific activities within Fort Huachuca training areas, air operations associated with Libby Army Air Field, recreational opportunities, resource management, realty actions, and programmed facilities development projects both on post and off post that are master planned to continue to meet mission objectives.

This section also includes a comprehensive list of conservation and mitigation measures proposed to avoid, minimize, or mitigate potential effects on federally-listed species and critical habitat resulting from the Proposed Action.

The PBA was initiated in 2011. New economic modeling of the Fort's expenditures in 2011 was performed to develop factors to determine the indirect and induced off-post population attributable to the Fort. A new demographic survey was done in 2012 to correct double-counting of the Fort's employee and attributable population. The factors derived from the economic modeling and from the demographic survey are applied to the annual data collected on the Fort's employee population, water use, and water recharge to determine net groundwater demands each year. For the groundwater modeling completed for this PBA, average estimates of water use and recharge using data through 2011 were used to project future groundwater recharge and withdrawal rates. Following the completion of the groundwater modeling, the 2012 data became available. The model experts assessed the data and determined that the 2012 data was consistent with the 2011 data. The use of 2011 data in the groundwater model produced results which are still current and valid for the PBA for determining the spatial and temporal effects of the Fort's activities on the San Pedro and Babocomari Rivers. The Fort's groundwater demand is calculated annually and the determinations to date (2011, 2012, and preliminary numbers from 2013) indicate the Fort's net consumption of groundwater is consistent with the values and assumptions in the PBA.

Garrison and Major Tenants

Garrison

Fort Huachuca’s Garrison includes the:

- Command Group;
- Headquarters and Headquarters Company;
- Directorate of Emergency Services;
- Directorate of Plans, Training, Mobilization and Security;
- Directorate of Human Resources;
- Directorate of Family and Morale, Welfare, and Recreation;
- Directorate of Logistics;
- Directorate of Public Works ([DPW] which includes the Environmental and Natural Resources Division);
- Directorate of Resource Management;
- Equal Employment Opportunity Office;
- Installation Safety Office;
- Public Affairs Office;
- Religious Support Office;
- Consolidated Legal Office;
- Plans, Analysis and Integration Office; and
- Internal Review and Audit Compliance Office.

These offices support all commands, agencies, and activities that reside on Fort Huachuca. Each organizational element may contain additional divisions, branches, and sections.

As part of this organizational structure the Garrison is also responsible for Range Control (part of the Directorate of Plans, Training, Mobilization, and Security) which has the responsibility to operate and maintain Fort Huachuca ranges, field training sites, access and scheduling, enforcement of range regulations, and coordination with other organizations such as the Environmental and Natural Resources Division (ENRD). The ENRD is responsible for the protection of natural resources at Fort Huachuca.

Major Tenants

In addition to the Garrison, Fort Huachuca hosts about 60 deployable and non-deployable tenant missions, primarily from the Training and Doctrine Command (TRADOC) including the U.S. Army Intelligence Center of Excellence (USAICoE), the Network Enterprise Technology Command (NETCOM), and Army Testing and Evaluation Command. Missions at Fort Huachuca are associated with Command, Control, Communications, Computer, Combat Systems, Intelligence, Surveillance, and Reconnaissance (C5ISR). C5ISR encompasses systems, procedures, and techniques used to collect and disseminate information. Key missions at Fort Huachuca are testing and evaluation of electronics, training of unmanned aircraft systems (UAS) operators and crews and Military Intelligence personnel, and development and protection of the Army computer network.

United States Army Intelligence Center of Excellence

Fort Huachuca hosts the USAICoE, which includes the 111th Military Intelligence Brigade and its 304th, 309th, and 344th Military Intelligence Battalions. The USAICoE is responsible for providing individual military skills training to soldiers, airmen, and marines.

2nd Battalion, 13th Aviation Regiment

The 2nd Battalion, 13th Aviation Regiment is responsible for the training of all Army UAS pilots and pilots from other organizations, including the Marines. The current training tempo of the Regiment nominally runs to 16 hours per day, six days a week depending on weather and air traffic control staffing and has the potential to increase up to seven days a week and 24 hours per day. The current training activities are, by their nature, heavy users of electromagnetic spectrum.

Network Enterprise Technology Command/9th Army Signal Command

The NETCOM/9th Army Signal Command (NETCOM/9th ASC) is the operational executive agent for Army-wide network operations and security. The mission of NETCOM/9th ASC entails the provision of technical control and support for network operations, the operation and management of the Army's total information structure, and the management and defense of the Army frequency spectrum.

The Electronic Proving Ground

The Electronic Proving Ground (EPG) at Fort Huachuca is the primary command, control, communications, computers, and intelligence developmental test facility of the Developmental Test Command of the Army Test and Evaluation Command. The organization is responsible for

the testing and evaluation of a diverse collection of equipment and systems within Department of Defense.

The Test Facility is part of EPG and is the primary electromagnetic environmental test facility for the developmental test command. Activities include testing to address electromagnetic environmental effects, electromagnetic compatibility, aspects of radiation hazards, spectrum supportability, electronic attack, electronic warfare, and vulnerability.

Associated with EPG is an Antenna Test Facility. The facility provides measurement support to the Army and other Department of Defense Services, with other government or commercial organizations being able to engage the facility if time and circumstances permit.

The Intelligence Electronic Warfare Test Directorate

The Intelligence Electronic Warfare Test Directorate (IEWTD) is part of the Army Developmental Test Command under the EPG. IEWTD is responsible for the testing and evaluation of systems and configurations encountered by U.S. forces in operational environments. This responsibility requires that on occasion the testers must be able to operate in commercial spectrum, without causing harmful interference.

Defense Information Systems Joint Interoperability Test Command

Joint efforts include activities, operations, organizations, in which elements of two or more of the military departments participate. The Joint Interoperability Test Command (JITC) is a Defense Information Systems Agency (DISA) organization responsible for ensuring the interoperability of Department of Defense communications systems. JITC is now required by public law to provide a “joint certification” for all C5ISR systems fielded by the services.

Air National Guard

Fort Huachuca supports the Arizona and Missouri Air National Guard, including the Arizona-based 162nd Fighter Wing and the Missouri-based 139th Airlift Wing. Beginning in 2014, Fort Huachuca will be the home for the 214th Reconnaissance Group of the 162nd Fighter Wing. The 214th, located at Davis-Monthan Air Force Base, will launch local sorties from Libby Army Air Field with UAS aircraft providing national defense in conjunction with the Department of Homeland Security. In addition, three units of the Missouri Air National Guard’s 139th Airlift Wing perform training missions at Fort Huachuca. The units conduct night-vision, mountainous terrain flight operations, airdrop, and air-land assault training operations through the unit's Advanced Airlift Tactics Training Center at Fort Huachuca.

Other Missions

Fort Huachuca began hosting the Empire Challenge exercise in 2010. Empire Challenge is an annual joint and coalition intelligence, surveillance, and reconnaissance interoperability demonstration that showcases emerging intelligence, surveillance and reconnaissance capabilities and provides vital lessons to improve joint and combined intelligence, surveillance and reconnaissance interoperability to support warfighters at the tactical edge.

Ground-based Operations

Intelligence and Electronic Warfare Equipment Training and Testing

A major mission at Fort Huachuca is the testing of intelligence and electronic warfare equipment and training of soldiers on intelligence tactics and procedures that require realistic placement of intelligence systems. Equipment is tested at various Army Security Agency (ASA) sites. However, there are additional off-post sites for expanded terrain variability, to allow electronic systems to operate under a variety of geographic and atmospheric conditions. These sites are a network of about 1,600 on-post and 800 off-post markers (Vernadero Group 2011).

Training and testing is conducted by dispatching intelligence and electronic warfare equipment to a selection of ASA sites. On-post sites are located along existing Fort roads and trails, as well as in previously-disturbed areas. Off-post sites are usually located within the right-of-way shoulders along several highways in the region. All off-post sites are located in previously-disturbed areas (Vernadero Group 2011). During training, vehicles and personnel can be deployed to any combination of ASA sites, but most remain on Fort Huachuca.

The vehicles used are typically heavy-duty four-wheel drive vehicles, civilian-type 1-ton trucks and rarely military 5-ton trucks. Vehicles are equipped with an electronic equipment shelter or are used to transport soldier-transported systems and operators. These vehicles are either driven to established parking areas at the site or other designated sites authorized for vehicle use. Vehicles must remain on established roads or trails or are permitted to park next to the road or trail in a previously-disturbed, designated area at each ASA site. Tracked vehicle movement is not authorized off post and is confined to existing roads and trails in Training Areas Bravo, Charlie, Delta, and Foxtrot on the East Range on Post (Table PA1).

Several types of transmitting antennae are used ranging from small vehicle or system-mounted whip antennae to ground mounted antennae. Ground-mounted antennae can be raised to a height of 115 feet with minor ground disturbance associated with installation of temporary guide wires. Testing activities typically last from 3 to 30 days. This training can require students to walk cross-country to other predetermined locations or ASA sites.

If the sites are in or near Agave Management Areas (Figure PA1), firing of blanks or pyrotechnics is not permitted within 0.25 miles of these areas. Training and test sites may not be used by personnel on foot unless the activity has a Range Control-approved plan for fire suppression and firefighting equipment. Night operations are prohibited from 1 July through 31 October in Agave Management Areas.

Communications Systems Training and Testing

Another major mission at Fort Huachuca involves communications systems training and testing. Physical components of the systems used during training consist of a variety of satellite, troposcatter, high-frequency, and microwave equipment to provide communications support. Portable equipment is moved on 5-ton and 2-ton military vehicles, and consists of a wide variety of generators, antennae, and trailers.

During training, vehicles and personnel are deployed to multiple pre-existing sites on Post. Typical exercises last from 7 to 14 days with 24-hour operations. Each field unit may use 40 to 80 vehicles, 50 generators, and 12 communications shelters to support soldiers at the site (Vernadero Group 2011).

The maximum area covered by a unit during training can be up to 40 ac with 13 remote site locations per exercise. Large bivouac exercises occur in predefined areas used repeatedly for such activities and utilize relay sites located across the Fort. There are 18 established bivouac areas on Post (Figure PA1). These sites are used more frequently for the larger-scale communications testing and training activities. Predefined bivouac areas often include permanent structures and concrete pads for repeated bivouac establishment. Range Control must approve sites selected on Post before use, may restrict the use of certain areas during high fire potential seasons, and enforces special regulations for areas within protected agave areas.

Larger Battalion and Brigade exercises are also conducted. Battalion level exercises are conducted 8 to 12 times per year and involve about 20 vehicles. Brigade level exercises are conducted 1 to 2 times per year with about 150 to 200 vehicles. There are no set timelines for testing activities. Tests are conducted year-round and may run 24 hours per day, seven days per week, for as long as a month. These activities occur at similar sites to those mentioned previously for communications training. Range Control may restrict the use of certain areas during high fire potential seasons and enforce special regulations for areas within Agave Management Areas.

Field Training Exercises

Training activities requiring use of range facilities are scheduled, coordinated, and controlled through Range Control. Field training exercises consist of land navigation, patrolling and tactics training, individual development training, and vehicle maneuver training.

On occasion, on-post locations are utilized by training units for setting up bivouacs containing sleeping, mess, and other facilities for field training exercises. Specific bivouac areas vary from exercise to exercise and do not always coincide with existing ASA sites. Use of any site must be requested from Range Control a minimum of 21 days in advance.

No vegetation clearing is authorized during the establishment of a bivouac. Holes can only be dug into the ground with permission from Range Control and are subject to clearance through a digging permit process. Concrete pads in some permanent bivouac areas are used for cooking to prevent wastewater from seeping into the ground in case of spills.

Land Navigation Training

Land navigation involves training personnel to accurately navigate terrain on foot and locate pre-established sites. Land navigation exercises typically involve 4 to 5 vehicles for transportation of personnel to and from the site. Vehicles are kept on existing roads, trails, or parking areas at all times. Operations generally last for one day (morning until evening) and are conducted year around, except in Agave Management Areas where night operations are prohibited from 1 July through 31 October. Live fire, firing of blanks, and use of pyrotechnics are not permitted during land navigation training.

Two land navigation courses are in Training Area Uniform (each used 48 and 80 days in 2011) and one is located in Training Area Mike (used 90 days in 2011). Although nearly all land navigation training occurs at the established courses where surveyed markers are established, additional land navigation training is conducted on-post across the West and South Ranges. This training is similar to that which occurs on land navigation courses. Activities in these areas are conducted day and night, except within Agave Management Areas where night operations are prohibited from 1 July through 31 October.

Patrolling and Tactics Training

Patrolling and tactics training occurs across the South and West Ranges. These exercises simulate patrol, search and rescue, and intelligence gathering missions, potentially occurring every month and generally lasting up to three days. Activities are conducted day and night, except within Agave Management Areas, where night operations are prohibited from 1 July through 31 October.

During these training exercises, soldiers maneuver on trails and travel cross-country on foot. Vehicles used during this training are kept on existing roads and trails. Soldiers occasionally dig shallow holes (about 5”) to bury sensors near trails and major roads. Such excavation requires authorization from Range Control and approval through a digging permit process.

Ammunition used during these operations includes pyrotechnics, smoke, and M16A2 blanks. No firing of blanks or pyrotechnics can occur within 0.25 miles of Agave Management Areas following Range and Training Regulations. Firing of blanks is also prohibited if it is determined by Range Control or the Fort Huachuca Fire Chief that a fire hazard exists.

Occasionally, a Special Forces unit will request permission to conduct patrolling training in the Huachuca Mountains on Fort Huachuca. These exercises are rare. Personnel are provided training on environmental awareness and must comply with all environmental requirements.

Individual Development Training

Several individual development training facilities are located on the South and West Ranges and within the cantonment area including:

- Rappelling tower (Training Area Tango) – A four-level tower platform used for rappelling practice;
- Rappelling cliffs (Training Area Quebec) – Cliffs located in Garden Canyon, varying in height from about 70 to 100 feet;
- Rope Bridge Training Site (Training Area Victor) – An open area with four upright telephone pole tops, about 4’ high;
- Leadership Reaction Course (Training Area Yankee) – Eight stations, each depicting a situation which requires the negotiation of obstacles by expedient means;
- Demonstration Hill (Training Area Kilo) – May be used to conduct various types of demonstrations;
- Warrior Task Complex (Cantonment Area) – Six stations, each requiring soldiers to negotiate obstacles using the Military Decision Making Process;
- Obstacle Course (Cantonment Area) – Clover-shaped with 17 obstacles. The course is a test of a Soldier’s basic motor skills and physical conditioning; and

- Confidence Course (Cantonment Area) – Clover-shaped with four groups of higher and more challenging obstacles than the obstacle course. Designed to give soldiers confidence in their mental and physical abilities.

These permanent facilities are used to train personnel from a variety of host and partner organizations (Figure PA1).

Vehicle Maneuver Training

Vehicle maneuver and driver training occurs across the Fort on existing roads and trails. The majority of vehicle maneuver training consists of wheeled-vehicles with rare tracked-vehicle training. Wheeled-vehicle training maneuvers include attaching and detaching trailers, loading and unloading equipment, and driver training.

Maneuvering activities are confined to existing roads, designated maneuver lanes, and trails. Oversized vehicles are restricted to roads whereas light vehicles can use roads and trails. No cross-country maneuvering or other use of existing off-road maneuvering lanes is authorized or planned, with the exception of use by the Missouri Air National Guard (as described below) or during emergency situations (e.g., safety and fire). Existing and planned operations will adhere to the following requirements:

- Fort Huachuca Regulation 385-8, *Safety - Range and Training Area Operations* (03 October 2006; revision in process);
- Fort Huachuca Installation Spill Contingency Plan (Baker and Vernadero Group 2011);
- Range reservation request via the Range and Facilities Management Support System (RFMSS) program, a web-based reservation system; and
- Off-Highway Vehicle Operation Policy 041 (Army 2008).

About 5,172 ac within the East Range (Training Areas Charlie [C] and Delta [D]) have been designated for off-road maneuvering lanes, but no off-road activity has occurred since 1994 (Figure PA2). With the expansion of Humor Drop Zone (DZ) and its use for dropping palletized loads from aircraft, about four short off-road recovery trips will be required for each of the classes offered by the Missouri Air National Guard. These would occur in Training Area Bravo, between the existing Humor DZ and Hubbard landing strip. No other off-road vehicle travel or training is presently authorized or planned on the Fort.

Live Fire Qualification and Training

Most live fire takes place on weapons qualifications ranges in Training Area Tango. Maximum permitted ammunition and associated noise levels used on these ranges are listed in Table PA2. The location of these firing ranges and their associated surface danger zones are shown in Figure PA2. When conditions permit, tracer rounds can be authorized by Range Control on all live firing ranges, with the exception of Ranges 2, 3, and 4.

Small arms qualification and live fire at Fort Huachuca occurs on nine live fire ranges in Training Area Tango (Table PA1) and on the convoy live fire course in Training Area Zulu on the East Range. Firing ranges are used for personnel qualification and training throughout the year. Live fire does not take place at night on Ranges 2, 3, and 4 during 1 July through 31

October because they are located in Agave Management Areas. The East Range contains several surveyed firing points usable for mortar and artillery firing into Impact Area Zulu (Figure PA3); however, mortar and artillery firing points are currently inactive.

Administrative and Support Activities

The administrative and support activities performed at Fort Huachuca are those activities associated with the day-to-day operation of the Fort and the ranges, inclusive of those activities performed by the directorates and partner organizations. Several administrative and support organizations exist at Fort Huachuca to support the Fort's ongoing role as a major Army testing and training Installation. Personnel and activities associated with these organizations almost exclusively occur within the cantonment.

Air Operations

Air operations at Fort Huachuca include fixed-wing piloted aircraft training and operations, UAS training and operations, unmanned drug and border surveillance balloon operation, and, to a much lesser extent, rotary wing aircraft. Most air operations originate from two locations on Fort Huachuca: Libby Army Air Field and the Black Tower complex in the northwest corner of the West Range (Figure PA4). Libby Army Air Field is located north of the cantonment, west of Highway 90, and is a military-civilian joint-use facility. This section includes brief descriptions of Libby Army Air Field, the Black Tower complex, and restricted airspace near Fort Huachuca, as well as an explanation of the major air operations.

Libby Army Air Field

Libby Army Air Field supports military aircraft involved in test and training programs, troop movements, and standard military, commercial, and private travel operations. Three runways, several taxiways, aprons, and parking areas for fixed and rotary-wing aircraft cover the largest portion of the airfield area. Air operations are sustained by numerous support facilities, including the Air Traffic Control Tower, a navigational aids building, an airfield operations building, an airfield fire and rescue station, utilities support structures, and storage buildings.

In 2009, 133,877 air operations occurred at Libby Army Air Field (each landing or departure counts as one evolution). Military operations include 98,074 evolutions or about 73 percent of all activity. General aviation evolutions account for the rest (Vernadero Group 2010a).

Because the airfield contains a manned operating Air Traffic Control Tower, approaches to Libby Army Air Field are Class D Airspace. The airport's airspace includes a horizontal radius of 4.7 statute miles from the airport, extending from the surface up to an altitude of 7,200 ft. Aircraft are not permitted to enter the airspace until the Air Traffic Control Tower is contacted for clearance to do so. When the Air Traffic Control Tower is not operational, the airspace reverts to Class G (uncontrolled airspace).

Fixed-Wing Piloted Aircraft Training

Fort Huachuca manages airspace and facilities used by other Department of Defense agencies for proficiency testing and training during exercises originating at other installations. The following

summary discusses aviation activities that utilize Fort Huachuca airspace or facilities during training or testing operations:

- Individual pilot proficiency training for the U.S. Air Force (Air Force) and Air Force Reserve is conducted in Fort Huachuca airspace and at Libby Army Air Field. The most common aircraft is the ground attack A-10 aircraft flown out of Tucson. In 2009, A-10 flights accounted for about 20 percent of operations. This training typically consists of touch-and-go landing (simulated aircraft landings and take-offs where aircraft are flown to Libby Army Air Field, make approaches to the airfield, simulate a landing, and depart). The Libby Army Air Field air zone used during this activity is shown in Figure PA4.

- The Air National Guard uses Fort Huachuca airspace and Libby Army Air Field continuously for individual proficiency training for pilots. Guard organizations use multiple aircraft including the C-130 and F-16. Other aircraft include the KC-135, C-17, and MQ-1 Reaper. Personnel are qualified on their aircraft (i.e., the pilots are qualified to fly their aircraft already) and they are learning to evade surface to air fire, drop pallet loads from the aircraft, and avoid detection. The Air National Guard F-16 aircraft uses Libby Army Air Field for instrument approach procedures, missed approach procedures, instrument departure procedures, and touch-and-go landings. The Air National Guard aircraft that use Libby Army Air Field make up about 35 percent of the annual military activity at the airfield (Vernadero Group 2010a).

Other fixed-wing activities at Libby Army Air Field include non-Department of Defense tenants at Fort Huachuca, such as the U.S. Forest Service Air Tanker Base and the Customs and Border Protection border surveillance activities. Occasionally, other agencies use Libby Army Air Field temporarily, including North Atlantic Treaty Organization partner aircraft, transient Air Force operational aircraft, and civilian air shows.

Warrior Alpha and Sky Warrior Unmanned Aircraft Systems

The Army flies and trains the MQ-1 Warrior-Alpha and the MQ-1C Sky Warrior from Libby Army Air Field (Vernadero Group 2010a). The MQ-5B Hunter and the RQ-7B Shadow are operated from the Black Tower runway complex.

Both the Warrior-Alpha UAS and Sky Warrior UAS operations require a 5,000-foot runway and therefore operate from Libby Army Air Field. The Warrior typically operates Monday to Friday 0700 to 1700 hours and one Saturday per month from 0800 to 1600 hours (subject to air traffic control opening for operations). The Sky Warrior has two shifts, which operate Monday to Friday 0700 to 2300 hours, and Saturdays from 0800 to 1600 hours. UAS operations have the potential to operate 24 hours per day.

The Warrior uses restricted area R-2303 A/B/C, as well as the Class-D airspace for pattern work. Other non-Department of Defense organizations also conduct limited UAS operations from Libby Army Air Field including Customs and Border Protection Predator-B flights.

Black Tower Runway Complex

The Black Tower Complex is in the northwestern corner of Fort Huachuca's West Range. The complex contains two asphalt runways and associated support and training facilities associated with the operation and training of the Shadow and Hunter UAS.

The Army was to train soldiers during the fielding of the Shadow Systems until about 2013. Beyond that, the Battalion will train Shadow operators to sustain the Army's manpower requirements for the life of the system. The lifespan of the Shadow System is not known.

The Shadow UAS typically uses R-2303A and R-2303B for training. The Hunter UAS training operates at restricted areas R-2303A and R-2303B. The Hunter UAS is restricted from using R-2303C due to the 15,000-ft floor.

The Shadow and Hunter normally fly at altitudes between 10,000 and 13,000 ft above mean sea level. They generally operate above the West Range and to the west of Fort Huachuca within R-2303 A and B airspace. The West Range ground elevation varies from 4,400 to 5,200 ft.

The UAS training is conducted at the airstrips about 6 mi west of the cantonment area on the West Range. The Army also uses equipment such as UAS ground control stations, 2.5-ton trucks, 5-ton trucks, mobile power units, and communication antennas.

Unpaved Airstrips within the Installation

Humor DZ on the East Range and the Hubbard Landing Zone are used by the Air National Guard as training flight destinations and objectives where actual airdrops or landings can be practiced (Figure PA5). The Hubbard Landing Zone dirt strip is also used for full stop landings, mostly with C-130 aircraft.

Other Air Operations

Unmanned Drug Surveillance Balloon Operation

The Tethered AerostatRadar System (TARS) was operated by the U.S. Air Force in the southern portion of the South Range from 1987 until September 2013, when the property operations were transferred to Customs and Border Protection. It is currently operated by U.S. Customs and Border Protection. The blimp-type balloon is ground-tethered and serves as an aerial platform for radar equipment used to detect aircraft illegally entering the U.S. The Aerostat operates within restricted airspace R-2312 exclusively. The balloon provides radar data for Customs and Border Protection, Department of Defense, and the Federal Aviation Administration and operates year-round, 24 hours per day within about 23 ac of the South Range. Airspace for this activity is shown in Figure PA4.

Rotary Wing

There are very few rotary wing operations originating from Libby Army Air Field and those are generally not associated with Department of Defense. The U.S. Forest Service (USFS) typically operates from May to August including a limited number of rotary wing operations, primarily

associated with wildland firefighting. Customs and Border Protection also flies missions at unscheduled times (Vernadero Group 2010a).

Recreational Activities

Recreational opportunities are made available to soldiers and their families both within and outside of the cantonment area. To a lesser degree, the general public can access some parts of the Fort for recreational activities. Public access to recreational areas may be prohibited by the Range Control Officer due to ongoing training and testing activities. As a result, some or all of Fort Huachuca may be closed to recreational activities on any given day**.** The primary recreational activities that occur outside of the cantonment area include hunting, birding, hiking, and cycling on existing roads and trails, off-highway vehicle use on existing roads and trails. Therefore, although recreational activities are available to the general public on Post, it is not advocated by Fort Huachuca.

Hunting

Recreational hunting is covered in the 2010 Fort Huachuca Integrated Natural Resources Management Plan (INRMP)(Vernadero 2010b). Hunting on Fort Huachuca is open to active and retired military personnel, full-time installation civil service employees, and their families. Both a Fort Huachuca-issued permit and Arizona Game and Fish Department hunting license is required.

Birding

The central part of southeastern Arizona is recognized for its birding opportunities and, as a consequence, the Fort receives a large number of visitations by birders year-round. An estimated 8,000 trips per year by an estimated 5,000 individual birders occur annually on Fort Huachuca (Vernadero Group 2010b). Access to Fort Huachuca by the general public can potentially reduce the quality of habitat for sensitive species resulting from increased human activity, erosion, and other general disturbance.

Hiking and Bicycling

About 20 miles of hiking trails occur on the Fort, some of which connect with USFS trails. Cycling is permitted throughout the Fort on existing roads and trails unless otherwise prohibited by Range Control. The Fort does not maintain the hiking trails.

Horseback Riding and Grazing

Horseback riding is available but limited to the on-post stables within the cantonment area. Although authorized, no significant horseback riding occurs elsewhere on the Fort; however, grazing does occur in three areas (Pastures A, B, and C) which support about 50 to 60 horses (Vernadero 2010b).

Pasture A is 946 ac and is used infrequently from May to October. Pasture B is about 175 ac and is used between March and May. Pasture C is about 312 ac and divided into two sections with rotation between the two. Horses are grazed in Area C from May to October. At other times, horses are kept in the corral and are not grazed.

Off-highway Vehicles

Off-highway vehicles are defined as two- or four-wheeled vehicles that are designed to be operated off highways. Off-highway vehicles are permitted on established roads outside the cantonment that are intended for public use. Off-highway vehicle operation outside of the cantonment area is limited to established roadways and firebreaks at a maximum speed of 25 mph unless otherwise posted, and cross-country driving is strictly prohibited except in the case of an emergency. Off-highway vehicle use on Fort Huachuca is generally low.

Other Activities

Other recreational activities are available on Post including an RV park, picnic areas, ball fields, and pools. There are seven picnic areas at Fort Huachuca: three picnic areas are at Upper, Middle, and Lower Garden Canyon; two picnic areas in Huachuca Canyon; and two picnic areas, Reservoir Hill and Lake Side, are in the cantonment area. These are day use sites with rare exception, such as authorizing Scouts to overnight.

Natural Resource Management

The primary goal of the Fort Huachuca resources management program is to protect naturally-evolved biotic communities and landscapes to support military land-based training. Fort Huachuca has developed environmental and natural resource-specific planning documents. This section summarizes the major natural resource management plans implemented by the Fort.

Integrated Natural Resources Management Plan

The Fort Huachuca INRMP was updated in 2013 (Vernadero Group 2010b). The INRMP is a plan of action for the management of natural resources and military training and operational activities occurring among those resources. The purpose of the INRMP is to guide the implementation and integration of natural resources management on Fort Huachuca including special-status species, terrestrial and aquatic wildlife, migratory birds, airport wildlife and bird-aircraft strike hazard, groundwater resources, floodplain and wetlands, vegetation, land and forest, wildland fire, invasive species, pests, and outdoor recreation. Together the INRMP and supporting planning documents listed above provide an integrated response to natural resource management and stewardship at Fort Huachuca.

Integrated Wildland Fire Management Plan (IWFMP)

Fort Huachuca manages grassland and woodland fuels to reduce wildland fire potential on Post (PBA: Appendix A). This plan is a tool to help Fort Huachuca natural resource specialists, the Fire Department, Range Control, and outside cooperators make decisions about managing fires to safeguard life and property, support training, and protect Fort Huachuca's natural resources.

The goals and objectives for fire management on Fort Huachuca are to protect life as the highest priority, protect Fort and personal property, manage fire to support military training, manage fire to benefit natural resources, manage fire to benefit historic properties, and coordinate fire operations with other Fort divisions and neighboring landowners. The IFWMP management strategy focuses on the wildland-urban interface to prevent fires which originate in the developed and grassland areas of the Fort from spreading into adjacent wildlands. The Fort is engaged in modeling, mapping, and analysis to plan future fuels management and will be updating the IFWMP in coordination with the USFWS before 2016.

Depending on funding and environmental conditions, the Fort proposes to treat (thin and burn) up to 6,190 acres in the upper elevations on the Fort over the next 10 years. See Table PA3 below for the number of acres of each biotic community proposed to be treated over the next 10 years in the upper elevations. The largest treatment unit of MEW is 1,500 acres; the largest treatment unit of PMCF is 650. The upper elevation treatment units will have more than a single treatment occurring within them over the 10 years. The initial treatment will be mechanical to reduce fuel load, once a treatment unit has undergone sufficient mechanical treatment to bring flame lengths down to an appropriate height to ensure safe burning conditions, controlled burns will be implemented within the unit.

Depending on funding and environmental conditions, the Fort proposes to treat (primarily burning, although some mechanical fuels reduction may be required, such as mesquite mastication) up to 5,120 ac annually of SDG/PGBG in lower elevations (Table PA4). The nature of the treatment regimens within the higher elevation woodlands and lower elevation grasslands differs greatly, therefore the number of acres proposed for treatment are reported differently in the tables above and below (decadal versus per annum) for the purposes of this analysis.

Agave Management Plan

Palmer's agave (*Agave palmeri*), is important for the nectar-feeding lesser long-nosed bat, as it represents the primary food source for this endangered species during part of its annual presence (July through October). The objective of the Agave Management Plan *(*completed in 2006, in PBA: Appendix B) is to maintain a sufficient number of self-sustaining natural populations of Palmer's agave on Fort Huachuca and to ensure the continued presence and protection of suitable concentrations of this important food source against natural and human threats. Agave Management Areas occur on the South and West Ranges where several areas of abundant Palmer's agave stands are found. Palmer's agave stands were outlined based on density of highly-visible reproductive adults. The Agave Management Plan describes the management actions the Fort has developed to ensure the continued viability of Palmer's agave stands within Fort Huachuca. These management activities include:

- Pre-construction surveys for Palmer's agave;
- Restrictions on seeding and planting of non-native grasses on Post;
- Special fire management within the Agave Management Areas;
- Restrictions on night time use and tracer fire within Live Fire Ranges 2, 3, and 4;
- Prohibition of off-road vehicle traffic within the Agave Management Areas and the West and South Ranges;
- Restrictions on the use of pyrotechnics and blank ammunition near Agave Management Areas; and
- Monitoring of Palmer's agave populations on the West and South Ranges.

Utility and Energy Initiatives

Fort Huachuca has been a recognized leader in energy reduction initiatives over the past 20 years and has received numerous awards recognizing the Fort's energy conservation and savings work. The Fort executes projects under the Utility Energy Services Contract that are cost effective and serve to reduce water and power use as well as increase the use of renewable energy.

Electric power is provided to Fort Huachuca by Tucson Electric Power Company. Sulfur Springs Valley Electric Cooperative manages the distribution infrastructure and system under a privatization agreement. The Fort is proposing construction of a 25 –megawatt photovoltaic solar array system within the cantonment area. Natural gas, potable water, and waste water distribution systems are owned and managed by Fort Huachuca.

The Fort has increased the use of renewable energy in the form of solar and wind, using technologies that do not consume water in the production of electricity. The Fort currently has a 10-kilowatt wind turbine installed on the West Range and a 1-megawatt wind turbine installed on the South Range. The turbines not only provide renewable energy but also afford the opportunity for the Army to conduct electronic noise and interference research associated with wind turbines.

Ongoing and future renewable energy projects were reviewed under an Energy Projects Programmatic Environmental Assessment (Vernadero Group 2010e). Proposed projects would tier off of the Programmatic Environmental Assessment, resulting in a Record of Environmental Consideration or Environmental Assessment. Potential impacts to federally-listed species will be considered during the planning stage of each project and the Fort will coordinate with the USFWS in the planning process.

Programmed Facilities Development

Future military construction projects would be within the cantonment area and within compatible land use areas. Facilities development projects include Military Construction Army project upgrades or improvements to existing buildings. These projects are in the planning stages. If any of these projects have effects or modify critical habitat the Fort will initiate consultation.

Cantonment Area

The cantonment area and other developed lands on the Fort cover about 5,720 ac, or eight percent of the Fort. The majority of the buildings and structures on the Fort are within the main cantonment area. The cantonment area is the location of a variety of operational and testing facilities, maintenance and production facilities, research, development, test and evaluation, supply facilities, hospital and medical facilities, administrative facilities, housing and community support facilities, utility and ground improvements, housing and community support services, as well as administrative and operational directorates and training facilities.

Major command headquarters are located throughout the cantonment as well as storage facilities and training. Land management activities and maintenance for all facilities fall under the direction of the DPW, and coordination is required by all Garrison and tenant activities for any infrastructure anywhere on the facility.

Fort Huachuca maintains and operates a number of facilities and conducts activities associated with operating a military Installation, including:

- Operation and maintenance of a 3.1 million gallon per day capacity wastewater treatment plant (WWTP);
- Collection of solid waste, and disposal primarily at the Huachuca City landfill with some material going to the Cochise County landfill;

- Network of roads, most of which are primary or collector streets in the cantonment area and many unpaved routes on the training ranges;
- Operation of three gates to the Fort: the Main, East, and West Gates;
- Distribution and use of electricity;
- Distribution and use of stationary fuels, such as natural gas furnished by Southwest Gas Company and propane;
- Distribution, storage, and use of vehicle and aircraft fuels;
- Operation of a Hazardous Material Management Center; and
- Operation of a Hazardous Waste 90-day Accumulation Point.

Hazardous material and hazardous waste storage complies with Occupational Safety and Health Administration hazardous communications standards and National Fire Prevention Association standard codes, the Installation Spill Contingency Plan, and the Installation Hazardous Waste Management Plan (HWMP).

The following outdoor training facilities are located within the cantonment area:

- Warrior Task Complex – Six-station course;
- Obstacle Course – Clover-shaped course with 17 obstacles designed to test a Soldier's basic motor skills and physical conditioning;
- Confidence Course – Clover-shaped course with four groups of higher and more difficult obstacles than the obstacle course;
- Libby Army Air Field – This airfield is in the northernmost corner of the cantonment area and includes a 12,000-foot Class B main runway on an east-west axis, a 5,400-foot secondary runway on a southeast-northwest axis, and a 4,300-foot tertiary runway running parallel to the main runway. Support facilities including the Air Traffic Control Tower, a navigational aids building, an airfield operations building, an airfield fire and rescue station, hangars, and storage buildings are along the south side of the main runway and within the operational land use zone. Maintenance facilities and the City of Sierra Vista air terminal are on the north side of the airfield (Vernadero Group 2010a).

Training Area Activities

Table PA2 provides a listing of the individual training areas and their primary uses, special uses, and use restrictions (Figure PA1).

Off-post Activities Authorized or Carried Out by Fort Huachuca

For military training purposes the Fort leases about 948 ac from a variety of land owners, primarily in southeastern Arizona (PBA: Appendix C). An additional 27,387 ac on the Willcox Playa, Cochise County, is withdrawn from public entry. Parcels leased vary in size from less than an acre to 640 ac. Although most leased and withdrawn land is in Cochise County, the Fort also leases land near Phoenix, Gila Bend, Oatman Mountain, Mount Graham, and Mount Lemmon, Arizona; and Lordsburg, New Mexico. Most are ASA or communications sites (antennas, microwave towers, etc.). Others are pull-off sites along roadways where equipment is temporarily operated. Uses of each site are described in PBA Appendix C. Much of the equipment is temporarily operated. Many of the equipment tests and field training exercises

conducted by a variety of training units at Fort Huachuca require placement of equipment over a large geographic area. Activities are limited to equipment maintenance and periodic checks.

Population Fluctuations and Groundwater Pumping

Fort Huachuca's 2011 employee population (including permanent party military, civilians, and contractors) was about 14,700 personnel.[1] The historical employee population has ranged between about 10,000 and 16,000 personnel since 1992 (Figure PA6). Because Fort Huachuca is primarily a mission-focused and tenant-based post, the population has and will likely continue to fluctuate in response to mission needs. This normal population fluctuation will continue as the Fort responds to Army and national defense requirements. Figure PA6 below illustrates that while the Fort's employee population has increased, the Fort's on-post groundwater pumping has declined due to aggressive water conservation programs.

On-post Groundwater Withdrawals

The on-post water uses are met by pumping from eight groundwater wells. In 2011 and 2012, the on-post groundwater withdrawals were 1,030 and 986 AF, respectively; 2013 data indicate withdrawals in 2013 were 1,013 AF[2]. Groundwater withdrawals at the Fort have decreased by over 65 percent compared to the groundwater withdrawals in 1993 during the same time that population of personnel employed at the Fort has increased (Figure PA6). However, for consultation purposes, 1,300 AF per year (AFY) of groundwater is projected for on-post groundwater withdrawals from 2012 to 2030. This value is based on the ten-year average groundwater withdrawals on-post from 2002 to 2011 that were 1,291 AFY. Groundwater use can vary from year to year based on the climate and fluctuations in employee populations on-post. By using a long-term average that is higher than the recent groundwater withdrawals by Fort Huachuca, the projected groundwater withdrawals provides for potential variation in future water use.

Fort-Attributable Groundwater Withdrawals

In addition to the direct employee population, there is an indirect and induced population attributable to the Fort. The indirect population is the family members of the direct population. The induced population is based on the jobs supported by the Fort's expenditures. The Fort has developed a groundwater accounting methodology based on a demographic survey of its employee population and economic modeling of its expenditures to estimate the total Fort-attributable population in the Sierra Vista Subwatershed (PBA: Section 3.6). This Fort-attributable population is used to estimate the total Fort-attributable groundwater demands. In 2011 and 2012, the total Fort-attributable groundwater demands (on-post and off-post) were estimated to be 5,648 and 5,446 AF per year, respectively. Fort-attributable groundwater demands are projected to remain relatively stable in the future. However, the groundwater demands can fluctuate from year to year. Before 2011, the best available data was from 2005, which had Fort-attributable groundwater demands of 5,928 AF. To be conservative, the Fort

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[1] Based on the annual census taken in September of 2012 and 2013, the employee population was about 12,448 in 2012 and 12,151 in 2013. Figure PA6 shows the 2012 population and groundwater pumping. See footnote below on the 2013 groundwater pumping.

[2] Based on the available pumping data through October 2013, the Fort's 2013 water use was trending 6 percent higher than 2012 and was initially forecasted to be approximately 1,050 AF by that year's end.

elected to use this higher number rounded to 6,000 AF per year. A more complete discussion of the groundwater accounting methodology is provided in PBA Section 3.6.

Consultation Period

The project description for ongoing and future operations and activities occurring or programmed to occur at Fort Huachuca is based on current and reasonably foreseeable future conditions at the Fort. As a result, the document assumes a 10-year consultation period because the missions of the tenant organizations and Garrison at Fort Huachuca can be reasonably forecast over that timeframe. Thus, this consultation covers 2014 to March 31, 2024.

Projections of the Fort's activities out to ten years can be made with reasonable confidence. The Fort recognizes the need to initiate consultation for any new activities not included in this PBA as required by the ESA. After ten years, there would be significant uncertainty in predicting federal government programs due to federal fiscal laws, the nature of the budget process, and uncertainty of mission requirements.

Conservation and Mitigation Measures to Avoid, Minimize, and/or Compensate for Effects to Listed Species and Critical Habitat Incorporated into the Proposed Action

The Proposed Action includes species-specific conservation measures and water-related mitigation measures that will be implemented as part of the Fort's ongoing and future activities. The Army's ability to implement conservation and mitigation measures is limited by the Federal budget and appropriations process. Funds may not be obligated until they are programmed and budgeted, and the Army has issued them formally to the Installation via a funding authorization. The descriptions of the measures below should not be interpreted as an obligation of funds in contravention of the Anti-Deficiency Act, 31 U.S.C. Section 1341, or any other applicable provision of law. The analysis and conclusions of this biological opinion are based on full implementation of the project as described in the Description of the Proposed Action section of this document, including the Conservation Measures described below.

Species-specific Conservation Measures

The species-specific conservation measures are based on the previous measures developed for the 2007 BO and the Fort's endangered species management plans. The conservation measures have been updated to account for the Fort's current (2014) ongoing operations and activities. As discussed in PBA Section 2.5, natural resource planning programs provide benefits to the species. The following species-specific conservation measures are part of the Proposed Action.

Huachuca Water Umbel Conservation Measures

Measure Number	Conservation Measure Description
HWU-1	The Fort will monitor naturally occurring Huachuca water umbel on the installation every three years. An inventory of potential habitat on the Fort will be conducted every 10 years. The Fort will conduct long-term monitoring at all transplanted Huachuca water umbel populations on the Installation (via implemented projects under Section 7(a)(1) of the ESA) as identified via the Fort's Long-Term Monitoring

	Plan (PBA: Appendix M).
HWU-2	The Fort will inventory all potential Huachuca water umbel habitat on the SPRNCA every three years in coordination with the BLM (non-concurrent with Installation survey years). The Fort will conduct long-term monitoring at all year 2010 transplanted Huachuca water umbel populations on the SPRNCA (via implemented projects under Section 7(a)(1) of the ESA) as identified via the Fort's Long-Term Monitoring Plan).
HWU-3	The Fort will maintain rock barriers around Huachuca water umbel populations on specific vulnerable populations.
HWU-4	To preclude vehicular traffic, the Fort will maintain the barrier to vehicle travel at Gate Number 7. Gate Number 7 is at the saddle between Garden Canyon on the east side of the Huachuca Mountains and Scotia Canyon on the west side of the mountains. This gate is used to allow access off post to the west side.
HWU-5	The Fort will manage existing Huachuca water umbel habitat on Post that has been degraded or lost due to mission-related activities. Management could include the propagation of Huachuca water umbel for use in site reestablishment and restoration and protection of other suitable sites in coordination with the USFWS.
HWU-6	As part of the Fort's monitoring program for Huachuca water umbel, the Fort will document any disturbance of Huachuca water umbel or its habitat on the Fort and report any disturbance to the USFWS as described in the reporting requirements (PBA Section 2.13.3).
HWU-7	The Fort will continue with water conservation efforts, effluent reuse or recharge, purchase of conservation easements and storm water recharge (PBA Section 2.13.2).
HWU-8	All maintenance activities in Garden Canyon and Huachuca Canyon will occur within the existing roadbed or existing catch basins. Silt fencing is a best management practice that can be used where there is the potential for sediment to enter Huachuca water umbel habitat in these canyons. No native vegetation will be removed outside of the existing roadbed and no invasive plant or animal species will be introduced. No water will be diverted from Garden Canyon Creek.

Southwestern Willow Flycatcher Conservation Measures

Measure Number	Description
SWFL-1	The Fort will assist BLM or other federal land managers of habitat on the Upper San Pedro River with Southwestern willow flycatcher habitat management. Assistance will be technical assistance. All plans and agreements for assistance will be coordinated with the USFWS and by the federal land manager.
SWFL-2	Fort Huachuca will continue with water conservation efforts, effluent reuse or recharge, purchase of conservation easements, and storm water recharge efforts (PBA Section 2.13.2).

Mexican Spotted Owl (MSO) Conservation Measures

Measure Number	Description
MSO-1	Fort Huachuca will conduct annual monitoring of a portion of the currently known Protected Activity Centers (PACs) and surveys of potential MSO habitat at Fort

	Huachuca in accordance with USFWS survey protocol.
MSO-2	The Fort will implement, to the maximum extent practicable, "light-on-the-land" fuel reduction projects and prescribed fire within or near PACs to reduce the threat of catastrophic wildfire, MSO habitat destruction, and restore conditions for the natural range of variability for fire frequency and effects. • Fuel reduction treatments will be developed by modeling wildfire risk in MSO habitat and developing optimized spatial treatment patterns in MSO PACs. • Fuel treatments and prescribed fire will not occur within a 100-acre area around MSO nest sites, or core use area. This area includes habitat that resembles the structural and floristic characteristics of the nest site. • Prescribed or managed natural fire will be introduced in PACs only between 1 September and 28 February, outside the MSO breeding season. • The Fort will develop a management plan in coordination with the USFWS for each prescribed fire, managed natural fire, or fuels treatment that has the potential to affect MSO.
MSO-3	Within canyons containing active MSO nests, or in canyons where occupancy or reproductive status is unknown, the Fort will minimize low-level helicopter flights within one mile of the nest, or the site of the last previously known nest. Helicopter flights closer than 0.25 mile to active nests will be prohibited from 1 March-31 August.
MSO-4	If MSOs are found nesting in Garden Canyon within 0.25 mile of the rappelling cliffs, rappelling will be halted or moved at least 0.25 mile from the active nest from 1 March-31 August, or until nestlings fledge.
MSO-5	The Fort will install and maintain all-weather signs within Huachuca and Garden Canyons, and their tributary canyons with trails, that inform visitors that the Canyon is home to sensitive species. Visitors must stay on trails and be as quiet and unobtrusive as possible, groups of visitors are limited to 12 or less, that calling or playing of taped recordings to elicit owl responses is strictly prohibited, and that smoking is prohibited.
MSO-6	All maintenance activities in Garden Canyon will occur within the existing roadbed or existing catch basins and will only occur during daylight. If MSO are detected near a road, maintenance activities are restricted to 1 September and 28 February. Silt fencing will be used where there is the potential for sediment to enter Garden Canyon Creek. No vegetation will be removed outside of the existing roadbed, except invasive species, and no invasive plant or animal species will be introduced. No water will be diverted from Garden Canyon Creek. Contractors will be instructed to follow these conservation measures.
MSO-7	The Fort will monitor take of MSOs and document any disturbance of owls or owl habitat. This and other monitoring required here will be reported to the USFWS pursuant to the "reporting requirements" described below (Section 2.13.3).
MSO-8	The Fort will close and lock access gates to Garden Canyon and Huachuca Canyon between the hours of sunset to sunrise.

Lesser Long-nosed Bat Conservation Measures

Measure Number	Description
LLNB-1	The Fort will ensure that construction, upgrading, or maintenance of roads does not

	increase or facilitate public access to Manila Mine, Pyeatt Cave, or other lesser long-nosed bat day roosts.
LLNB-2	Access routes at the closures and the mine and cave sites are posted with the following information: no vehicle access, no entry into mines or caves, explanations that the closures are needed to protect sensitive species, and warnings against entry into the mines and caves. Fort Huachuca will continue to maintain the signs. Access will not be allowed from at least 1 July through 31 October each year, and during other times when the bats are known to be present.
LLNB-3	Recreational use of the Fort's cave resources is no longer permitted. Decontamination procedures will be followed for all permitted activities within caves.
LLNB-4	Protective fencing around cave resources will be maintained.
LLNB-5	Monitoring and census of known or potential lesser long-nosed bat roosts will be conducted annually. The monitoring will use the low disturbance protocols outlined in the lesser long-nosed bat endangered species management plan.
LLNB-6	The Fort will prohibit low-level helicopter flights (below 500 feet above ground level) within 350 feet of Pyeatt Cave, Manila Mine, or other lesser long-nosed bat day roosts from 1 July through 31 October each year, and during other times when the bats are known to be present.
LLNB-7	Before construction activities, pre-construction surveys will be done for paniculate agaves that may be directly affected by construction activities. If agaves are found during pre-construction surveys, the following measures will be implemented: • Disturbance will be limited to the smallest area practicable, damage to agaves will be avoided where possible, and projects will be located in previously disturbed areas whenever possible. • Vehicle use will be limited to existing routes and areas of disturbance except as necessary to access or define boundaries for new areas of construction or operation. • All workers will strictly limit their activities and vehicles to designated areas. Construction workers will be informed of these terms and conditions.
LLNB-8	No seeding or planting of non-native grasses or other plants will occur at Fort Huachuca that may alter fire frequencies in the wildland areas. However, seeding of a mixture of native seeds, non-native hybrid sterile seeds, and weed free mulch in disturbed construction sites is authorized to establish temporary ground cover for erosion control, subject to seasonal restrictions.
LLNB-9	Prescribed fire and managed natural fire will be planned to minimize adverse effects to lesser long-nosed bat forage plants and roosts. Measures will be developed to ensure the following: • Fires in Agave Management Areas will be actively suppressed unless the area is approaching its natural fire return interval of 10 years. • Prescribed fire on the west range will be scheduled so that no more than one-half the Agave Management Areas are burned in one year with no less than a two year waiting period before burning the remaining areas. • A schedule for prescribed burns will be established and followed to reduce fuel loading in Fort Huachuca grasslands and woodlands, thereby reducing the potential for major wildfires in lesser long-nosed bat foraging and roosting habitat.
LLNB-10	Nighttime land-based training will not occur in Agave Management Areas from 1 July through 31 October and during times when the bats are known to be present.
LLNB-	No nighttime use and no tracer fire will occur on live fire ranges 2, 3, and 4 from 1

11	July through 31 October and during times when the bats are known to be present.
LLNB-12	From 1 July through 31 October each year and during times when the bats are known to be present, all nighttime UAS operations at all runways will be above 500 feet above ground level except for take-off and landings.
LLNB-13	Off-road vehicle travel will not occur in Agave Management Areas or any other part of the West Range or South Range except in cases of emergency.
LLNB-14	Pyrotechnics will not be used within 0.25 miles of Agave Management Areas.
LLNB-15	The Fort will monitor Palmer's agave populations on the West and South Ranges at appropriate intervals (following fires or other reduced vegetation cover situations) to establish trends in lesser long-nosed bat forage resources.
LLNB-16	Fort Huachuca will continue to monitor around the wind turbines in accordance with the previous consultation.
LLNB-17	The Fort will monitor lesser long-nosed bats annually, document any disturbance of roost sites, and document acres burned on the West or South ranges and whether such fire burned in Agave Management Areas. The results of this monitoring will be reported to the USFWS as described in the reporting requirements below (PBA Section 2.13.3).

Sonora Tiger Salamander Conservation Measures

Measure Number	Description
STS-1	Fort Huachuca will conduct annual monitoring of the Upper Garden Canyon pond to determine the condition of the habitat and presence of aquatic Sonora tiger salamander using the protocol developed by the Arizona Game and Fish Department and approved for use by the USFWS.
STS-2	The Fort will maintain boulders placed around the pond's perimeter at Upper Garden Canyon Pond to prevent vehicles from driving through the habitat.
STS-3	A closure to vehicle travel will be maintained at Gate Number 7. Gate Number 7 is at the saddle between Garden Canyon on the east side of the Huachuca Mountains and Scotia Canyon on the west side of the mountains. This gate is used to allow access off Post to the west side of the mountains.
STS-4	The Fort will maintain the permanent all weather sign posted at Upper Garden Canyon pond which will contain the following information: • Fishing, use of nets, and capture or release of salamanders or fish is prohibited. • Off-road vehicle use is prohibited.
STS-5	The Fort will manage Sonora tiger salamander habitat on Post where habitat has been degraded or lost due to mission related activities. Management could include restoration and protection of other suitable sites.
STS-6	An inventory of potential habitat on the Fort will be conducted once every 10 years or once during the consultation period.
STS-7	The Fort will perform a genetic analysis on a portion of Sonora tiger salamander which occurs on the Fort.
STS-8	The Fort will monitor Sonora tiger salamander and document any disturbance of Sonora tiger salamander or Sonora tiger salamander habitat. Results of this and other monitoring required will be reported to the USFWS as described in the reporting

	requirements below (PBA Section 2.13.3).
STS-9	The Fort will establish a schedule and continue to implement prescribed burns and fuels management to reduce fuel loading in Fort Huachuca woodlands.

Canelo Hills Ladies' Tresses Conservation Measures

Measure Number	Description
CHLT-1	Fort Huachuca will continue water conservation efforts, effluent reuse or recharge, purchase of conservation easements, and storm water recharge (PBA Section 2.13.2).

Chiricahua Leopard Frog Conservation Measures

Measure Number	Description
CLF-1	The Fort will manage Chiricahua leopard frog habitat on-post that has been degraded or lost, or where potential exists for creating habitat.
CLF-2	An inventory of potential habitat on the Fort will be conducted once every 10 years or once during the consultation period.
CLF-3	Erosion control measures will be implemented as required to protect habitat.

Jaguar and Ocelot Conservation Measures

Measure Number	Description
J-O-1	The Fort will continue and expand its non-invasive (e.g., motion detector cameras) monitoring program for the presence and movement of ocelot and jaguar within installation boundaries. This non-invasive monitoring program will be in place throughout the consultation period.
J-O--2	The Fort will coordinate all fuel treatment activities within jaguar and ocelot habitat (Madrean evergreen woodland) with the Service to minimize adverse effects on the jaguar or ocelot.
J-O-3	The Fort will monitor proposed control burn areas for at least three months before treatment within jaguar and ocelot habitat (Madrean evergreen woodland). Post-treatment monitoring will be implemented if a burn is approved in an area where jaguars or ocelots are detected during monitoring. The Fort will develop a monitoring plan in coordination with the Service. If a jaguar or ocelot is detected, the Fort will coordinate and consult with the Service to avoid or minimize adverse effects to the species before any controlled burns occur. Additionally, should an ocelot or jaguar be detected during any monitoring, the Fort will coordinate with the Service to minimize adverse effects to the species before mechanical treatment occurs in the area where the ocelot or jaguar were detected.
J-O-4	The Fort will ensure that hunters are aware and cognizant of the presence of ocelot and possible presence of jaguar in the area via the annual Hunting Fact Sheet with the following Advisory: "Predator hunters: Hunters, especially predator tag holders, must be familiar with identifying features of jaguars, ocelots and Mexican wolves, (see pp. 68, 69 and 105 in "2013-14 Arizona Hunting Regulations"). All 3 species are protected by state and federal law. An ocelot has been documented in the Huachuca

	Mountains several times recently and a jaguar in an adjacent mountain range. Responsible, prudent hunters will know exactly what they are shooting. Shooting a protected species on the fort could significantly restrict hunting opportunities in the future, for all hunters. Additionally, it is a State and federal offense to "take" any of these species.”

Water-Related Mitigation Measures

The Fort has completed, began implementation of, or planned the following mitigation measures to reduce the effects of water withdrawals related to Fort operations, including the indirect and induced populations attributable to Fort activities. A complete explanation of net groundwater accounting and groundwater modeling completed for this project is included in PBA Section 3, Appendix G, and Appendix K. An analysis of water-related effects resulting from Fort Huachuca operations is presented in PBA Section 5. The completed, in progress, and planned water-related mitigation measures are provided in Table PA5 and Figure PA7. The mitigation measures are discussed in greater detail in the Mitigation Measures Plan (PBA: Appendix D).

We note that we received updated, 2013 water use and conservation data from Fort Huachuca on February 13 and 14, 2014 (Fort Huachuca 2014). The data received by the USFWS differ from the data contained in PBA Appendix J (Demographic Analysis Report – Fort-Attributable Population) and PBA Appendix K (Groundwater Demand Accounting), in which the 2012 period of record includes data current as of the end of 2011.

We have reviewed the 2013 data (Fort Huachuca 2014) and have determined that the updated human population values differ inconsequentially from their 2011 analogs. Whereas the 2011 data contained in PBA Appendix J display a total direct, indirect, and induced population attributable to Fort Huachuca of 33,440 persons, the 2013 data indicate 33,373 persons (a 0.2% decrease). The 2011 data indicate a net groundwater demand of 1,180 AF; the analogous value for 2013 was 1,013 acre feet. The 14.2 percent decrease in net groundwater demand may be appreciable, but must be qualified based on the subsequent discussions of facts.

The aforementioned 2013 net groundwater demand data, as of their receipt date, did not include updated 2013 data for water recharged at the City of Sierra Vista Environmental Operations Park (EOP). This statistic, at 2,544 AF (see Treated Effluent in Table 2, PBA Appendix K), represents an appreciable component of the Fort’s net groundwater demand accounting. Absent current EOP data, the 2013 net groundwater demand cannot be definitively calculated.

We do not anticipate, however, that EOP recharge will change to any measurable degree. The input of effluent to the EOP is a function of human population within the incorporated area of the City of Sierra Vista. We again refer to the updated data received in Fort Huachuca (2014) in comparison to the data contained in PBA Appendix K. The total, Fort Huachuca incorporated area in 2011 was 22,620 persons; in 2013, it was 22,956 persons (a 3.4 percent increase). It can be reasonably anticipated that the recharge of effluent at the EOP will increase to a similar degree.

Like all water withdrawal and recharge data, EOP recharge is incorporated spatially into the groundwater model (PBA Appendix G). This small difference in human population and similarly small increase in recharge are unlikely to result in any significant difference to the model outputs. Absent a current value for the EOP, the groundwater model cannot be revised, and the current

model outputs remain the best available scientific information available. This BO's effects analyses for the Huachuca water umbel, northern Mexican gartersnake, and yellow-billed cuckoo – which employ the groundwater model outputs - are thus valid even in the absence of 2013 data.

Completed Mitigation Measures

The completed mitigation measures are included in the ongoing and future activities at Fort Huachuca, because these measures will continue to provide annual water savings through the consultation period.

Fort Huachuca Water Conservation (C1)

Fort Huachuca has reduced groundwater withdrawals from the regional aquifer by over 65 percent through water conservation measures. Groundwater withdrawals by the Fort have declined from 3,028 AFY in 1993 to 1,030 AFY in 2011 and 986 AFY in 2012 as a result of the water conservation measures (Figure PA6). This steady decline in groundwater withdrawals has occurred while population at the Fort has increased. In 2011, residential water use on-post per capita was about 52 gallons per capita per day (gpcd). Fort Huachuca has the one of lowest residential water use per capita in Arizona based on available data on water use rates for major Arizona communities (Western Resource Advocates 2010)(Figure PA8).

Fort Huachuca accomplished this water conservation by implementing a water conservation policy for all water use on the Installation (PBA: Appendix E). Families can only water their lawns two months of the year. During those months, watering is permitted only two hours a day, two days a week. Abandoned World War II buildings were demolished to cap off leaky water lines. Artificial turf was installed on most athletic fields on post. Water-saving showerheads, waterless fixtures, and front-loading washers were installed in residential housing. Waterless urinals were installed in all buildings with the exception of residences. The Mountain View golf course was converted to a desert course, and the irrigation system was upgraded to be more efficient and to use treated effluent. Water savings are measured based on the groundwater that is no longer pumped. The volume is calculated based on the difference between the 1993 pumping of 3,028 AFY and the 2011 pumping of 1,030 AFY for a net reduction of 1,998 AFY.

Fort Huachuca Stormwater Capture (C2)

Fort Huachuca has constructed five stormwater detention basins to capture urban runoff. The water recharged at these basins is dependent on the amount of precipitation each year and as a result varies from year to year. The USGS monitored the storage levels in the detention basins and calculates the subsurface basin losses (recharge) each year. The average recharge from 2007 to 2011 was 106 AFY with the range of recharge values from 13 to 232 AFY.

In addition to the stormwater detention basins, the Fort has installed rooftop capture systems in the EPG Warehouse, Barnes Field House, and Hospital for a total rooftop capture of two AFY. The total stormwater capture is estimated to be 108 AFY on average.

East Range Recharge Facility (C3)

To facilitate the recharge of treated effluent from the WWTP, the Fort constructed the East Range Recharge Facility in 2002. This $6 million project involved upgrading the treatment plant

and constructing seven effluent recharge basins and one stormwater recharge basin. The infiltration is rapid with very little evaporation loss. The average effluent recharged from 2007 to 2011 was 368 AFY, with a range from 262 to 450 AFY.

Environmental Operations Park (C4)

The Environmental Operations Park was completed in 2002 by the City of Sierra Vista with assistance from the Bureau of Reclamation. The park consists of 50 ac of constructed wetlands of which 30 ac are recharge basins. The EOP processes the wastewater without using chemicals or ultraviolet light and returns the treated water to the underground aquifer through recharge basins. Based on the groundwater demand accounting in 2011 (described in Section 3.6), 40 percent of the population of Sierra Vista is attributable to Fort Huachuca's operations and activities. Therefore, the same proportion of the wastewater effluent that is recharged at the EOP is attributable to Fort Huachuca. The EOP recharged 2,662 AF in 2011. Therefore, the EOP provided 1,072 AF of Fort-attributable recharge in 2011. For 2012, with 39 percent of the population attributable to the Fort and 2,544 AF of EOP recharge, the EOP provided 995 AF of EOP recharge. The average of 2011 and 2012, 1,034 AF, was used to estimate water savings in future projections.

Completed Babocomari Area Conservation Easements (C5)

The Fort provided funding to The Nature Conservancy to purchase conservation easements to protect the Fort against developmental encroachment on 3,628 ac in the Babocomari River area at a total cost of $9,433,027. By preventing subdivision into four acre lots based on its RU4 zoning, these easements will prevent 299 AFY of future groundwater withdrawals along the Babocomari River, based on 0.0825 AF of avoided future residential pumping per acre. This multiplication factor is calculated by dividing the number of acres by four acres per residence, multiplying by 2.5 people per residence, multiplying by 118 gallons per person per day for unincorporated areas, multiplying by 365 days per year and dividing by 325,851 gallons per acre-foot (Credits are discussed in greater detail in the Mitigation Measure Plan).

Clinton and Drijver Easements Conservation Easement (C6)

In addition to the Babocomari easements, Fort Huachuca has provided funding for the purchase of the Clinton and Drijver easement near Palominas in 2000 and 2001 for $815,000. These easements retired agricultural groundwater withdrawals next to the San Pedro River. Based on estimates of agricultural water use in the 1991 Hydrographic Survey Report of the San Pedro River (ADWR 1991), the easements result in water savings of 1,073 AFY (ADWR 1991).

River Stone Ranch Conservation Easement (C7)

The River Stone Ranch was purchased in fee simple in 2012 by The Nature Conservancy using funding provided by Fort Huachuca and will be subject to a conservation easement. The River Stone Ranch is 1,811 ac southeast of Sierra Vista next to the SPRNCA (Figure PA7). The conservation easement will limit future commercial and residential development and result in avoided future pumping. In addition, with its proximity to the San Pedro River, the property is an ideal location for future stormwater or treated effluent recharge projects.

The conservation easement prevents development on 1,811 ac. The conservation easement provides 149 AFY of water savings by avoiding future pumping based on its RU4 zoning (same calculation as Babocomari Easements [C5]). There is no significant agricultural irrigation on River Stone Ranch. The cost for acquiring River Stone Ranch was $3,001,000.

Mansker Conservation Easement (C8)

Cochise County partnered with The Nature Conservancy and allowing The Nature Conservancy to purchase the fee simple 285 ac Mansker tract on the west side of the San Pedro River near Palominas. Through the Army Compatible Use Buffer (ACUB) program, Fort Huachuca partnered with The Nature Conservancy and Cochise County to place a conservation easement on the property. The conservation easement does also provide 24 AFY of water savings from avoided future pumping.

Cochise County is developing a stormwater recharge project on the property (see in-progress measure F2). Under the terms of the conservation easement, Fort Huachuca will receive credit for avoided future pumping under the conservation easement and for recharge associated with the stormwater capture and recharge of the Palominas Pilot Stormwater Recharge project (F2).

Bella Vista Ranch (Sierra Vista Area) Conservation Easement (C9)

The Bella Vista Ranch was purchased in fee simple by The Nature Conservancy using funding provided by Fort Huachuca and will be subject to a conservation easement. The parcel is 2,893 ac (Figure PA7). The conservation easement limits future development, resulting in 238 AF of avoided future pumping in the region.

Preserve Petrified Forest (Palominas Area) Conservation Easement (C10)

The Army acquired a conservation easement on a parcel close to and west of the San Pedro River near Palominas on which about 480 ac of alfalfa were grown (Figure PA7). This parcel was purchased from Preserve Petrified Forest with funding provided by the Fort and in collaboration with Cochise County. Alfalfa requires significant amounts of irrigation utilizing groundwater. Although the parcel is not currently being irrigated, the entire irrigation infrastructure remains in place and nothing precluded the current or future landowners from irrigating the land.

The previous agricultural activity on the Preserve Petrified Forest parcel (located in Palominas) was of four circle-pivot fields planted in alfalfa. Each field was of 120 ac for a total of 480 irrigated acres. Alfalfa water duty factors are among the highest of agricultural crops in the region (ADWR 1991, Irmak et al. 2007). However, to estimate credits, the same methodology for the previous agricultural conservation easement credits (i.e., Clinton and Drijver) was applied using the regional water duty factor for agricultural crops in the Upper San Pedro Watershed of 5.4 AF/acre (PBA: Appendix D, Section 5.2.1), for a total of 2,592 AF. We concurred with this method for calculating the credits for the Preserve Petrified Forest easement (PBA: Appendix D, Attachment A). Under the easement restrictions only 12 homes could be built on the parcel. The rural water use is estimated at 118 gpcd with 2.5 persons per home, or about 4 AF. The easement results in an overall savings of 2,588 AFY of groundwater pumping (2,592 AF minus 4 AF).

In-progress Mitigation Measures

In-progress mitigation measures are those measures for which funds have been committed but that have not yet been completed. These measures will be completed and are expected to further reduce water withdrawals related to the Fort.

Huachuca City Effluent Transfer Program (F1)

Fort Huachuca and the Town of Huachuca City (Huachuca City) have entered into an Intergovernmental Agreement in which the Fort has agreed to accept influent from Huachuca City, to treat the influent, and to recharge the treated effluent to the regional aquifer. Currently, the Fort's WWTP is not being used to capacity and can easily and safely accept additional influent. In 2002, Huachuca City was required by the Arizona Department of Environmental Quality to upgrade its sewage treatment facilities to comply with the requirements for its Aquifer Protection Permit. Huachuca City's holding ponds are located within the 100-year floodplain of the Babocomari River. If the containment of the primary holding pond is compromised, there is a high probability that partially treated sewage would be released into the river.

Under its portion of the project, Huachuca City will construct a 600-ft gravity flow pipeline for untreated influent to connect to the Fort's sanitary system. New, lined wastewater ponds will be constructed that are located outside of the floodplain, and the existing Huachuca City holding ponds will be closed. The influent will be transported through about 38,500 ft of force main south to Fort Huachuca's WWTP. The transfer of the influent to Fort Huachuca will allow the Fort's WWTP to operate more efficiently and will provide additional water for recharge or reuse.

Fort Huachuca has completed construction of the 38,500-ft of force main and three lift stations. The design (plans and specifications) are complete for the Huachuca City part of the project which includes the lined wastewater holding ponds and the 600 ft gravity flow pipeline connection to the force main. The Upper San Pedro Partnership (USPP) has contributed funding provided by Fort Huachuca to Huachuca City for the town's part of the project. Influent is planned to begin flowing to the Fort Huachuca WWTP in 2014.

The project will initially deliver about 88 AFY of the Huachuca City -influent to the Fort Huachuca WWTP Number 2. This influent will be treated and will either be recharged in the East Range Recharge Facility or reused to offset existing outdoor irrigation reducing overall groundwater pumping. As Huachuca City grows, the influent volume would increase, as would groundwater withdrawal near the Babocomari River.

Palominas Pilot Stormwater Recharge Project (F2)

Through the ACUB program, Fort Huachuca partnered with The Nature Conservancy and Cochise County allowing the Nature Conservancy to purchase the fee simple on the 285-ac Mansker tract on the west side of the San Pedro River near Palominas (C8). Flooding in the Mansker tract near the Palominas Elementary School has been an issue for many years. In collaboration with The Nature Conservancy and with a grant from the Walton Family Foundation, Cochise County has initiated a pilot stormwater recharge project at the site. Under the terms of the conservation easement, Fort Huachuca will receive credit for avoided future

pumping under the conservation easement (C8) and for recharge associated with the stormwater capture and recharge of the Palominas Pilot Stormwater Recharge project (F2).

Based on the preliminary design of the recharge facility (JE Fuller 2013), a recharge site at the Mansker tract will capture 80 to 122 AFY as part of the Palominas Pilot Recharge Project. The mid-range scenario of recharge basin build-out of 98 AFY was used to estimate the water savings.

Planned Mitigation Measure

In addition to those mitigation measures discussed above, which have already been implemented or are already in progress, other possible mitigation measures were also considered. Several measures were not feasible due to legal, regulatory, conceptual, or fiscal limitations. The following mitigation measure was selected for implementation as part of the Proposed Action. The Fort will request funding for this measure in future programming cycles. A brief discussion of the Federal funding and appropriations process can be found in the Mitigation Measures Plan (PBA Appendix D).

Planned Babocomari Area Conservation Easements (P1)

As discussed above, 3,628 ac along the Babocomari River were previously protected from development (C5). This measure involves ACUB funding to purchase conservation easements on an additional 3,000 ac of land along the Babocomari River. The conservation easements do not involve retiring irrigation on agricultural land. The easements prevent future residential development on up to 3,000 ac near the Babocomari River north of Fort Huachuca. The conservation easements will result in 248 AFY of avoided future pumping along the Babocomari River and will cost about $8,000,000.

On-going Water Conservation Activities

The Fort participates in the USPP and also regularly maintains and upgrades the Fort's water system. These activities provide benefits to the regional groundwater aquifer. However, specific water savings for these on-going activities are difficult to estimate.

Upper San Pedro Partnership

The USPP was formed in 1998 to implement water resource management and conservation strategies to preserve the SPRNCA and to ensure the long-term viability of Fort Huachuca. It is a consortium of 21 agencies and organizations, public and private, that own or control land or water use in the Sierra Vista Subwatershed of the Upper San Pedro River Basin. Member groups sign a Memorandum of Understanding that commits them "to coordinate and cooperate in the identification, prioritization and implementation of comprehensive policies and projects to assist in meeting water needs in the Sierra Vista Subwatershed."

Water System Maintenance

The Department of Public Works (DPW) at Fort Huachuca is currently upgrading existing wells to reduce water lost to evaporation. Due to the age of the water system infrastructure, the

existing pumps often do not shutoff when the storage tanks are full, which results in the overflow of water from storage tanks. A portion of the overflow evaporates. Replacing the wellhead infrastructure with new pumps and sensors will prevent evaporative losses from storage tank overflow. The DPW also periodically performs leak detection surveys of the potable water lines and sanitary sewer system. Following the surveys, located leaks are repaired based on available funding. Refurbishing existing wells and reducing leaks in the potable water system results in less groundwater being pumped from the regional aquifer. Reducing leaks in the sanitary water system will result in more wastewater delivered to the treatment plant. It is difficult to quantify how much water would be saved, because there is limited data available on how much water is lost to overflow and leaks.

Reporting Requirements

For the duration of the Proposed Action, the Fort will report and meet annually with the USFWS to update the USFWS on the Fort's efforts to fulfill its obligations under the ESA. The Fort will continue to prepare and deliver an annual report to the USFWS documenting progress relative to implementation of the conservation and mitigation measures. The report will include actions taken, problems encountered, documentation of any take of listed species, effectiveness of conservation and mitigation measures, and recommendations to enhance protection of listed species. Reports will be provided on or before 31 March.

The Fort will also continue to participate in an annual meeting with the USFWS to discuss the annual work plan for the next year. The annual work plan will contain all planned projects the Fort is planning to implement in the upcoming year.

Management Responsibilities

The Army is responsible for managing all military and civilian activities on Fort Huachuca. Fort Huachuca's Installation management functions, including environmental management, fall under the IMCOM Central Regional Office, in San Antonio, Texas.

To ensure that operations will be done in compliance with environmental requirements that come from this consultation, the Range Control Officer will serve as management representative from the Range Control Operations office. This management representative has the authority to halt activities that are inconsistent with mitigation measures in the PBA and BO. The management representative will routinely coordinate with Fort Huachuca's ENRD. The ENRD will in turn coordinate with the designated USFWS representative on matters concerning this consultation.

Anyone using Fort Huachuca ranges and training areas are required to submit a range and training request to Range Scheduling, including information regarding the requested use, number, and types of troops and vehicles, and duration of training. Unit commanders will ensure that unit personnel are adequately trained in natural resource protection procedures, that the unit has adequate fire suppression capabilities, and that all restrictions or guidelines for training or testing are followed. Both the Range Control Operations Office and the ENRD will oversee unit activities and training in this regard. Failure to follow all range procedures could result in loss or limitation of range privileges at the discretion of the Range Control Officer.

The Range Control Officer is responsible for reviewing range and training area requests, maintaining a database of range usage and training man-hours, and performing scheduled or unscheduled checks of ranges and training areas to ensure compliance.

Timeline to Implement Water-related Mitigation Measures

Table PA6 shows by measure, Fort Huachuca's schedule to accomplish the water related mitigation measures detailed in the Mitigation Measures Plan (PBA: Appendix D). Mitigation measures for each year will be included in the annual work plan and discussed during the annual meeting with the USFWS. The status of measures, additions or deletions, and any revision to this table will be coordinated with the USFWS through the annual work plan, annual meetings, annual reporting, and informal or formal consultation as appropriate.

The Army will promptly coordinate with the USFWS concerning changes to these mitigation measures, to include: a failure or inability to implement the mitigation measures as planned, the mitigation measures are modified, or, the mitigation measures are not as effective as anticipated. The Army acknowledges, in accordance with 50 CFR Section 402.16, that changes to the mitigation measures may warrant new analysis of the Proposed Action and reinitiation of formal consultation with the USFWS.

Table PA1. Training area activities, Fort Huachuca, Arizona (PBA Table 2-1).				
Training Area	Total Acres	Primary Use	Bivouac Use[1]	Special Use and Use Restrictions
East				
Alpha (A)	2,471	• Intelligence and communications testing activities.	Yes	• Contains surveyed firing points.
Bravo (B)	2,471	• Intelligence and communications testing activities. • Contains part of the Hubbard Assault Airstrip. The airstrip can accommodate C-130 and C-17 aircraft. • The training area contains the Humor, Dust Devil, and part of the Tombstone DZs. DZs are used for air drops during ANG training maneuvers.	Yes	• Tracked vehicles permitted on existing roads and trails. • Contains surveyed firing points.
Charlie (C)	2,100	• Intelligence and communications testing activities. • Contains a portion of the Hubbard and Tombstone DZs, and the majority of Havoc DZ. DZs are used for airdrops during ANG training maneuvers.	Yes	• Tracked vehicles permitted on existing roads and trails. • Contains surveyed firing points.
Delta (D)	4,694	• Intelligence and communications testing activities. • Contains part of the about 5,172 acre area within the East Range where ORV travel occurred until 1994. • Contains portions of the Hubbard Assault Airstrip and the Hubbard, Havoc, and Tombstone DZs. The Hubbard Assault Airstrip can accommodate both C-130 and C-17. The Hubbard DZ, a portion of the Tombstone DZ, and a small portion of Havoc DZ are used for airdrops during ANG training maneuvers.	Yes	• Tracked vehicles permitted on existing roads and trails. • Contains surveyed firing points.
Echo (E)	4,942	• Intelligence and communications testing activities • Contains Hyena DZ, used for airdrops during ANG training maneuvers. • The area also contains a pre-existing dirt runway.	Yes	• Contains surveyed firing points.

Table PA1. Training area activities, Fort Huachuca, Arizona (PBA Table 2-1).

Training Area	Total Acres	Primary Use	Bivouac Use[1]	Special Use and Use Restrictions
Foxtrot (F)	3,583	• Intelligence and communications training and testing. • Higher level of military activity than other training areas on the East Range.	Yes	• Tracked vehicles permitted on existing roads and trails. • Contains surveyed firing points.
Zulu (Z)	6,954	• Intelligence and communications training and testing activities. • Contains various targets for artillery and mortars. High explosive ammunition may be fired, and some areas may contain unexploded ordnance (UXO). • May have non-recoverable or explosive payloads dropped from UAS or other aircraft in the future. • ASA sites are located along existing roads and trails in this area and can be used for intelligence and communications testing and training. • A Combat Live Fire Range that provides a practice area for convoy live-fire exercises is located in this training area.	No	• Off-road areas in this zone permanently “off-limits” to recreational activities.
West				
Golf (G)	1,087	• Intelligence and communications training and testing. • Portions of this area are located below landing and departure zones of secondary runways of Libby Army Air Field.	Yes	

Table PA1. Training area activities, Fort Huachuca, Arizona (PBA Table 2-1).

Training Area	Total Acres	Primary Use	Bivouac Use[1]	Special Use and Use Restrictions
Hotel (H)	4,200	• Intelligence and communications training and testing activities.	Yes	• Testing and training sites in Agave Management Areas within this training area adhere to special use regulations: • No firing of blanks or pyrotechnics within 0.25 miles (0.40 kilometers) of these areas; • Training and test sites will not be used by personnel on foot unless the activity has a Range Control approved plan for fire suppression and minimal firefighting equipment; and • Night operations are prohibited from 1 July through 31 October.
India (I)	2,223	• Intelligence and communications training and testing activities and patrolling and tactics training. • A helicopter-landing pad is located in this training area.	Yes	• Testing and training sites in Agave Management Areas within this training area adhere to special use regulations: • No firing of blanks or pyrotechnics within 0.25 miles (0.40 kilometer) of these areas; • Training and test sites will not be used by personnel on foot unless the activity has a Range Control approved plan for fire suppression and minimal firefighting equipment; and • Night operations are prohibited from 1 July through 31 October.

Table PA1. Training area activities, Fort Huachuca, Arizona (PBA Table 2-1).				
Training Area	Total Acres	Primary Use	Bivouac Use[1]	Special Use and Use Restrictions
Juliet (J)	1,111	• Intelligence and communications training and testing activities and UAS operations. • Patrolling and tactics training is also conducted in this area. • Unmanned Aerial Systems training for Shadow and Hunter systems.	Yes	• Testing and training sites in Agave Management Areas within this training area adhere to special use regulations: • No firing of blanks or pyrotechnics within 0.25 miles (0.40 kilometers) of these areas; • Training and test sites will not be used by personnel on foot unless the activity has a Range Control approved plan for fire suppression and minimal firefighting equipment; and • Night operations are prohibited from 1 July through 31 October.
Kilo (K)	1,136	• Intelligence and communications training and testing activities, and patrolling and tactics training. • Contains one Helicopter Landing Area for proficiency and emergency operations.	Yes	• Testing and training sites in Agave Management Areas within this training area adhere to special use regulations: • No firing of blanks or pyrotechnics within 0.25 miles (0.40-kilometers) of these areas; • Training and test sites will not be used by personnel on foot unless the activity has a Range Control approved plan for fire suppression and minimal firefighting equipment; and • Night operations are prohibited from 1 July through 31 October.

Table PA1. Training area activities, Fort Huachuca, Arizona (PBA Table 2-1).				
Training Area	Total Acres	Primary Use	Bivouac Use[1]	Special Use and Use Restrictions
Lima (L)	840	• Intelligence and communications training and testing activities, with patrolling and land maneuvering training occurring in this area. • One permanent bivouac site in this area.	Yes	• A large percentage of its land is in a protected agave management area
Mike (M)	1,087	• Intelligence and communications training and testing activities, with some patrolling and tactics training conducted. • A land navigation course consisting of 58 surveyed concrete points with ASA markers is found in Training Area Mike. • One large permanent bivouac site is located in this area. • This site is about 1,600 ft (488 m) from the agave management area.	Yes	• Testing and training sites in Agave Management Areas within this training area adhere to special use regulations: • No firing of blanks or pyrotechnics within 0.25 miles (0.40 kilometers) of these areas; • Training and test sites will not be used by personnel on foot unless the activity has a Range Control approved plan for fire suppression and minimal firefighting equipment; and • Night operations are prohibited from 1 July through 31 October.
November (N)	3,410	• Intelligence and communications training and testing activities, with patrolling and tactics training. • Military activities in the area are restricted to the relatively flat areas. • Contains one Helicopter Landing Area for proficiency and emergency operations.	Yes	
Romeo (R)	1,359	• Intelligence and communications training and testing activities, and patrolling and tactics training occur. • This area contains one Helicopter Landing Area for proficiency and emergency operations.	Yes	
South				

Table PA1. Training area activities, Fort Huachuca, Arizona (PBA Table 2-1).

Training Area	Total Acres	Primary Use	Bivouac Use[1]	Special Use and Use Restrictions
Oscar (O)	2,619	• Intelligence and communications training and testing activities, with patrolling and tactics training also. • Military activities in the area are restricted to the relatively flat areas.	Yes	
Papa (P)	3,459	• Military activities in the area are restricted to the relatively flat portions. • Intelligence and communications training and testing activities, with some patrolling and tactics training. • Contains a simulated Forward Operating Base and Training Village used by Fort tenants for dismounted intelligence student training. The site includes dirt access roads, temporary communication facilities, bivouac areas, and perimeter chain linked fencing. While students are typically bused to the site, onsite parking is available for trainers and others.	Yes	
Quebec (Q)	2,347	• Military activities in the area are restricted to the relatively flat areas.	No	
Sierra (S)	2,322	• Intelligence and communications training and testing activities, with some patrolling and tactics training.	Yes	

Table PA1. Training area activities, Fort Huachuca, Arizona (PBA Table 2-1).				
Training Area	Total Acres	Primary Use	Bivouac Use[1]	Special Use and Use Restrictions
Tango (T)	5,312	• Nine live firing ranges. See Table PA2 for range descriptions and the types of weapons used and Figure PA3 for locations of firing ranges. • Portions of Training Area Tango are used for personnel development training by most units on the Fort. • A small arms impact area is located within Training Area Tango. No explosive munitions are used in this impact area, and no testing or training activity is permitted in this portion of the training area.	No	• Testing and training sites in Agave Management Areas within this training area adhere to special use regulations: • No firing of blanks or pyrotechnics within 0.25 miles (0.40 hectares) of these areas; • Training and test sites will not be used by personnel on foot unless the activity has a Range Control approved plan for fire suppression and minimal firefighting equipment; and • Night operations are prohibited from 1 July through 31 October.
Uniform (U)	2,347	• Intelligence and communications training and testing activities, with patrolling and tactics training. • Two land navigation courses are in area Uniform. One land navigation course consists of 26 surveyed points. The other course consists of 44 surveyed concrete points with ASA markers. • Contains a simulated Forward Operating Base and a Training Village for dismounted intelligence student training. The site includes dirt access roads, several small wooden and stucco-finished training structures, communication facilities and bivouac areas. While students are typically bused to the site, onsite parking is available for trainers and others.	Yes	

Table PA1. Training area activities, Fort Huachuca, Arizona (PBA Table 2-1).

Training Area	Total Acres	Primary Use	Bivouac Use[1]	Special Use and Use Restrictions
Victor (V)	1,599	• Intelligence and communications training and testing activities, with patrolling and tactics training also occurring. • This area contains one Helicopter Landing Area for proficiency and emergency operations. • One site, consisting of 29 containerized buildings, was recently completed and is used for patrolling and tactics training in this area.	Yes	• Testing and training sites in Agave Management Areas within this training area adhere to special use regulations: • No firing of blanks or pyrotechnics within 0.25 miles (0.40 kilometers) of these areas; • Training and test sites will not be used by personnel on foot unless the activity has a Range Control approved plan for fire suppression and minimal firefighting equipment; and • Night operations are prohibited from 1 July through 31 October.
Whiskey (W)	1,482	• Intelligence and communications training and testing activities, with patrolling and tactics training. • One exercise area is located here. Large brigade-level exercises are conducted here. Seventeen vehicles may be used at the battalion level training, and 42 are used at the brigade level. In addition visiting entities occasionally use the site. Activities during training exercises include radio systems training, setting tactical field sites, tents, antennas, and mobile kitchens.	Yes	

Table PA1. Training area activities, Fort Huachuca, Arizona (PBA Table 2-1).

Training Area	Total Acres	Primary Use	Bivouac Use[1]	Special Use and Use Restrictions
X-Ray (X)	1,235	• Intelligence and communications training and testing activities, with patrolling and tactics training also occurring. • Large brigade level exercises are conducted in this area with the same vehicles and personnel quantities and activities as those on Training Area Whiskey.	Yes	• Testing and training sites in Agave Management Areas within this training area adhere to special use regulations: • No firing of blanks or pyrotechnics within 0.25 miles (0.40 kilometers) of these areas; • Training and test sites will not be used by personnel on foot unless the activity has a Range Control approved plan for fire suppression and minimal firefighting equipment; and • Night operations are prohibited from 1 July through 31 October.
Yankee (Y)	1,482	• Intelligence and communications training and testing activities, with patrolling and tactics training and large brigade level exercises also occurring. • The Aerostat operations facility and tethered balloon is located in this area.	Yes	

[1]Bivouacs may contain sleeping, mess, and other related facilities for the execution of field training exercises

[2]The East Range contains several surveyed firing points usable for mortar and artillery firing into Impact Area Zulu; however, mortar and artillery firing points are currently inactive.

Table PA2. Firing ranges on Fort Huachuca, Arizona. (PBA Table 2-2).

Range Number	Range Utilization	Maximum Ammunition Permitted	Maximum Noise Level at Firing Point[1]
1	Currently inactive.	NONE	N/A
2	M-16 Rifle Zero Range with 40 firing points and a target width of 100 m.	5.56 mm	156 dbP
3	Small bore multi-purpose range with 15 firing points, and 75 m maximum range.	7.62 mm	156 dbP
4	Army Standard Combat Pistol Qualification Course consisting of 15 lanes.	.45 caliber	162 dbP
5	Range 5A is a high explosive hand grenade range with 12 firing points. Range is inactive due to safety concerns. Range 5 is Hand Grenade Assault Course, using dummy bodies with or without practice fuses due to fire danger.	M67 FRAG (ONLY)	171 dbP
6	Fifty firing points and six firing lines from 100 to 1,000 yds.	.50 caliber	159 dbP
7	Currently inactive.	NONE	N/A
8	Automated record fire range with 10 firing points and target distances from 50 to 300 m.	5.56 mm	156 dbP
9	Range 9A serves as a multi-purpose machine gun range with four firing points.	.50 caliber, 40 mm	160 dbP
10	M-79 and M-203 grenade launcher range and .50 caliber dual purpose range. High Explosive cannot be fired here.	.50 caliber, 40 mm	160 dbP
11	Currently inactive.	NONE	N/A
12A	Currently inactive .50 caliber, 7.62 mm, and 40 mm live fire weapons range.	NONE	N/A
12B	Currently inactive Tank Gunnery Range.	NONE	N/A
12C	Currently inactive Tank Gunnery Range.	NONE	N/A
13	M-16 Marksmanship Record Fire Range with 16 firing positions and targets from 50 to 300 m.	5.56 mm	156 dbP
14	Currently inactive Squad Attack Course	NONE	N/A
15	Currently inactive Platoon Attack Course	NONE	N/A

1 Based on impulse noise levels and do not represent steady noise or time-weighted average.
N/A = Not Applicable; dbP = peak sound pressure level; mm = millimeter.

Table PA3. Approximate upper range (in acres) proposed to be treated within a 10-year period on Fort Huachuca, Arizona by biotic type in upper elevations.

Biotic community	Upper range to be treated within 10 years	Total acres of biotic community occurring on the Fort	Percentage of vegetation type to be treated
Madrean Evergreen Woodland (MEW)	5,500	20,342	27
Petran Montane Conifer Forest (PMCF)	690	3,875	18
10 YEAR TOTAL	**6,190**	**24,217**	

Table PA4. Approximate upper range (in acres) proposed to be treated annually on Fort Huachuca, Arizona by biotic type in lower elevations.

Biotic community	Upper range to be treated within 10 years	Total acres of biotic community occurring on the Fort
Semidesert Grassland (SDG)/Plains and Great Basin Grassland (PGBG)	5,120	46,892 of SDG; 1,867 of PGBG
ANNUAL TOTAL	**5,120**	**48,759**

Table PA5. Completed, in-progress, and planned mitigation measures, Fort Huachuca, Arizona.

Designation	Project Name	Water Savings (AFY)	Acres of Easement	Dollars	Year Implemented
Completed Mitigation Measures					
C1	Fort Huachuca Water Conservation	1,998	N/A	N/A[1]	1990 – 2011
C2	Fort Huachuca Stormwater Capture	108	N/A	N/A[1]	2003 to 2007
C3	East Range Recharge Facility	368	N/A	N/A[1]	2002
C4	Environmental Operations Park	1,034	N/A	N/A[1]	2002
C5	Babocomari Area Easements	299	3,628	$9,433,000	2000-2011
C6	Clinton and Drijver Easements	1,073	1,063	$815,000	2000-2001
C7	River Stone Ranch	149	1,811	$3,001,000	2012
C8	Mansker Easement	24	285	$ 800,000	2013
C9	Bella Vista Ranch (Sierra Vista Area) Easement	238	2,893	$4,000,000	2013
C10	Preserve Petrified Forest (Palominas Area) Conservation Easement	2,588	640	$2,600,000	2013
	Total	**7,879**	**10,320**		
In-progress Mitigation Measures					
F1	Huachuca City Effluent	88	N/A	$10,100,000	2014
F2	Palominas Pilot Recharge Project	98	N/A	See C8	2015
	Total	**186**	**0**	**$10,100,000**	
Planned Mitigation Measure					
P1	Planned Babocomari Area Easements	248	3,000	$8,000,000	2014-2022
	Total	**248**	**3,000**	**$8,000,000**	
	GRAND TOTAL	**8,344**	**13,320**	**$38,759,000**[2]	

[1] The overall costs for these projects were not available.
[2] This total does not include costs for C1, C2, C3, and C4.

Table PA6. Timeline for water related mitigation measures, Fort Huachuca, Arizona.

Water Related Mitigation Measures	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
Completed Mitigation Measures											
Fort Huachuca Water Conservation Efforts (C1)	●	●	●	●	●	●	●	●	●	●	●
Fort Huachuca Stormwater Capture (C2)	●	●	●	●	●	●	●	●	●	●	●
East Range Recharge (C3)	●	●	●	●	●	●	●	●	●	●	●
EOP Recharge (C4)	●	●	●	●	●	●	●	●	●	●	●
Babocomari Area Conservation Easements (C5)	●	●	●	●	●	●	●	●	●	●	●
Clinton and Drijver Conservation Easements (C6)	●	●	●	●	●	●	●	●	●	●	●
River Stone Ranch Conservation Easement (C7)	●	●	●	●	●	●	●	●	●	●	●
Mansker Conservation Easement (C8)		●	●	●	●	●	●	●	●	●	●
Bella Vista Ranch (Sierra Vista Area) Conservation Easement (C9)		●	●	●	●	●	●	●	●	●	●
Preserve Petrified Forest (Palominas Area) Conservation Easement (C10)		●	●	●	●	●	●	●	●	●	●
In-progress Mitigation Measures											
Huachuca City Effluent (F1)			●	●	●	●	●	●	●	●	●
Palominas Pilot Stormwater Recharge Project (F2)				●	●	●	●	●	●	●	●
Planned Mitigation Measure											
Planned Babocomari Area Conservation Easements (P1)			●	●	●	●	●	●	●	●	●

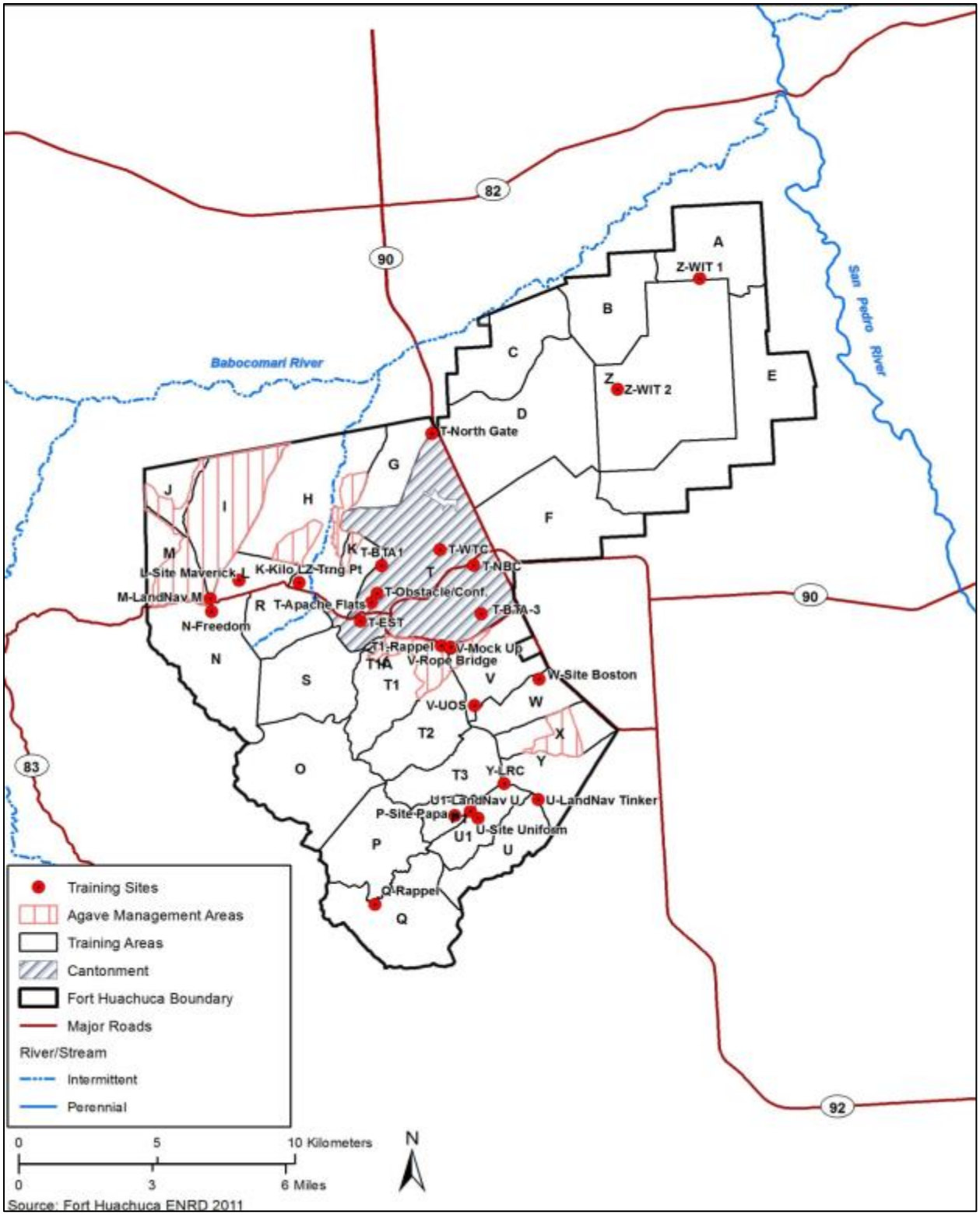


Figure PA1. Fort Huachuca, Arizona training areas and facilities (PBA Figure 2-1).

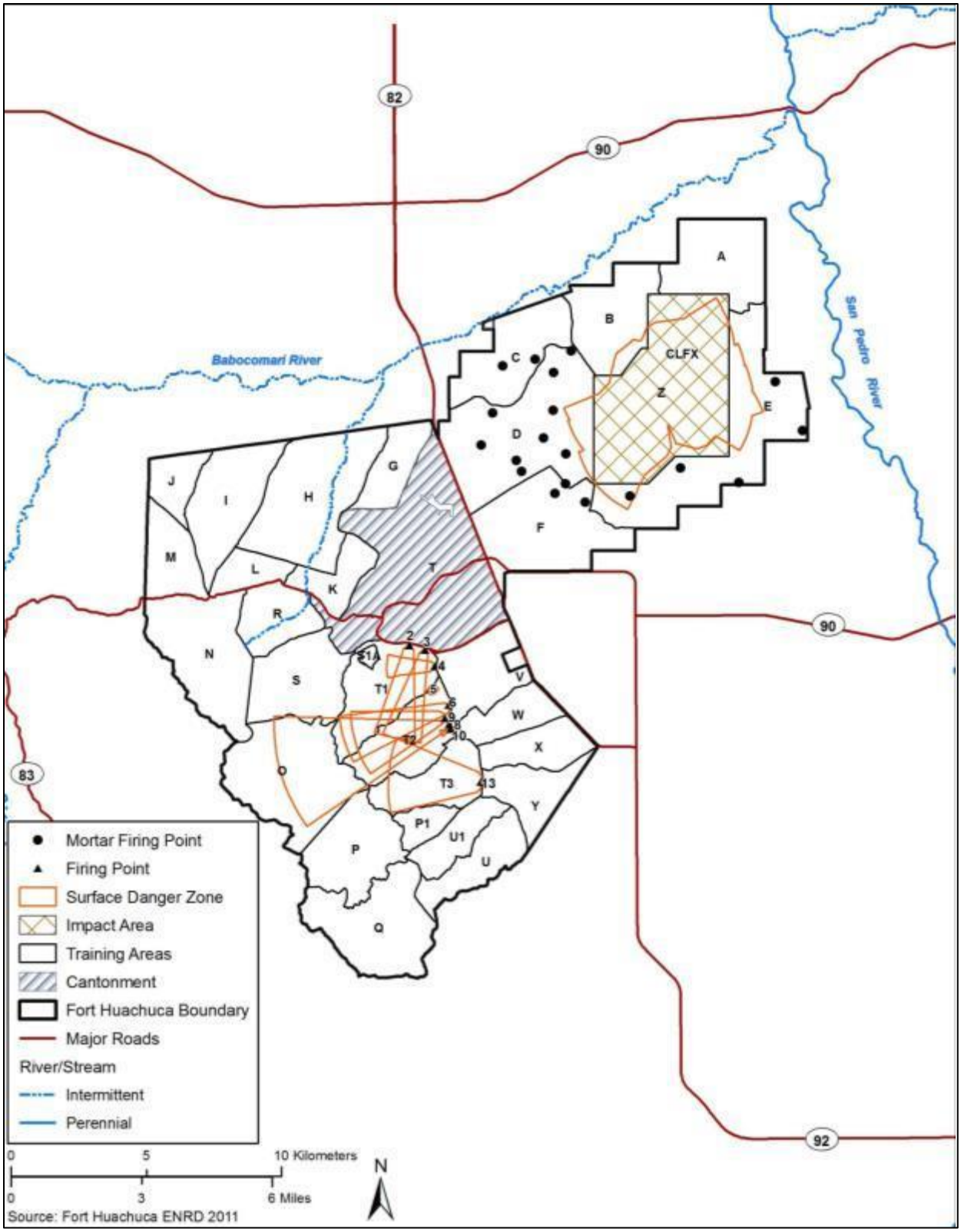


Figure PA2. Fort Huachuca, Arizona live fire ranges and associated surface danger zones (PBA Figure 2-3).

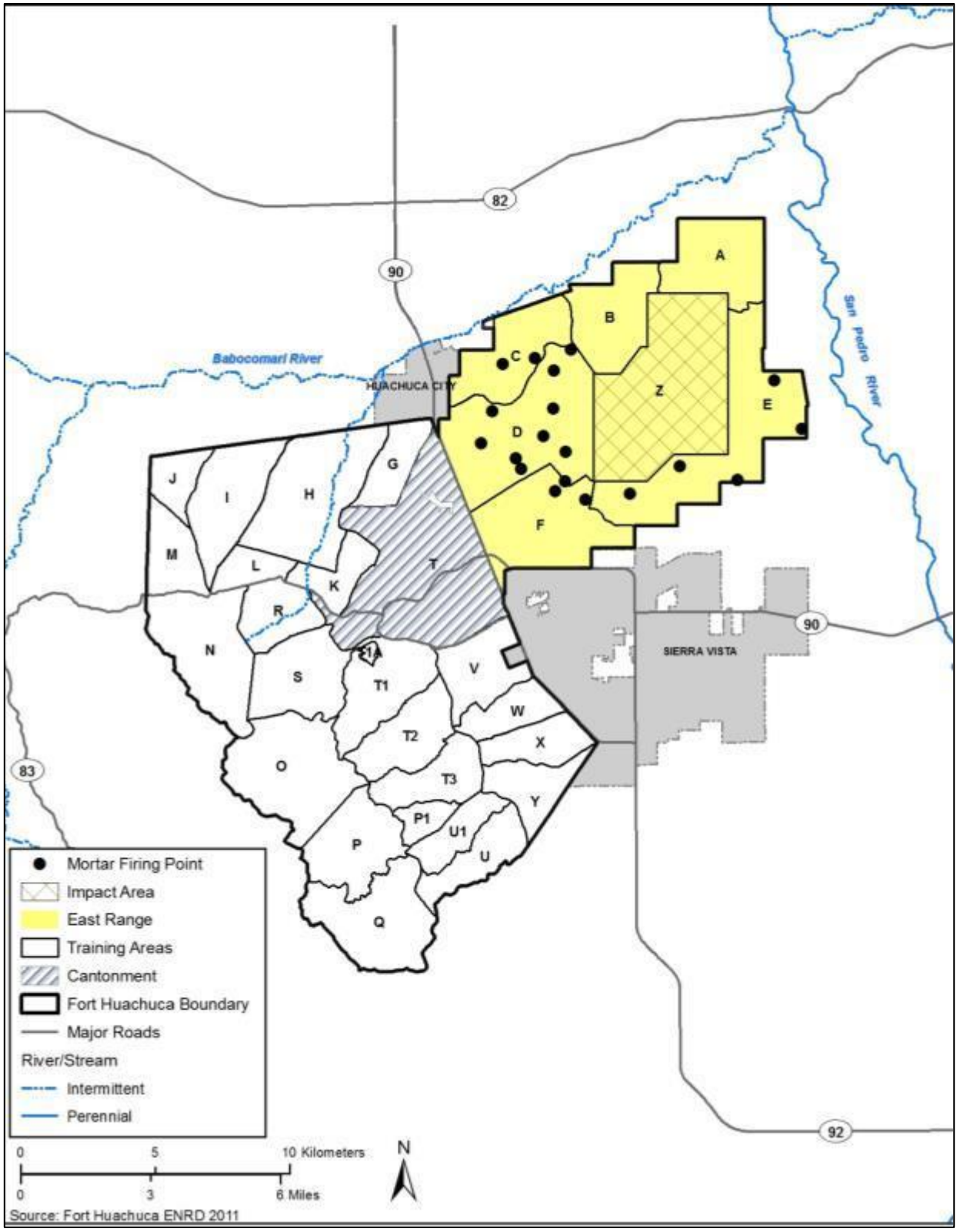


Figure PA3. Fort Huachuca, Arizona East Range off-road areas (PBA Figure 2-2).

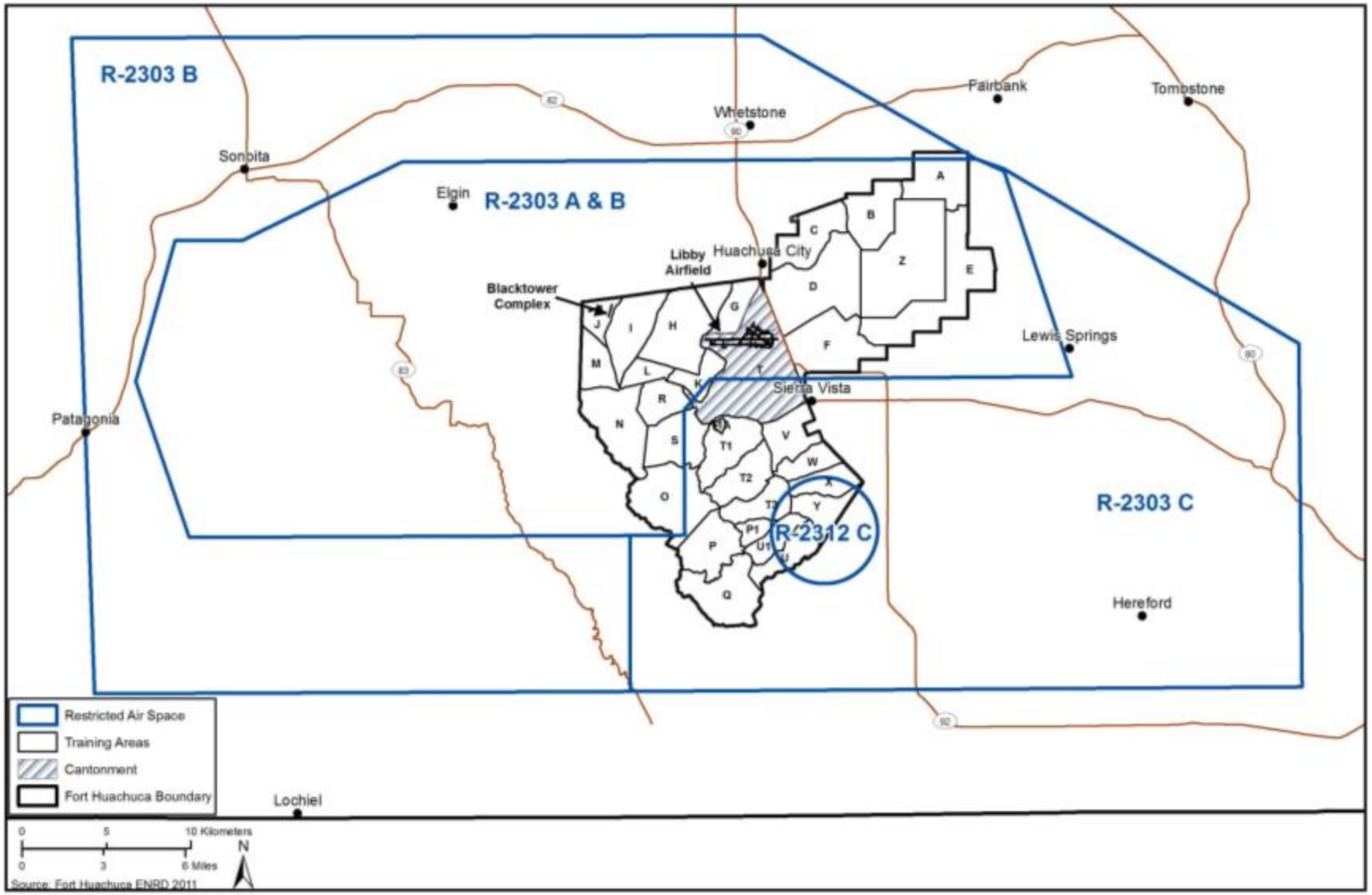


Figure PA4. Fort Huachuca, Arizona restricted airspace (PBA Figure 2-4).

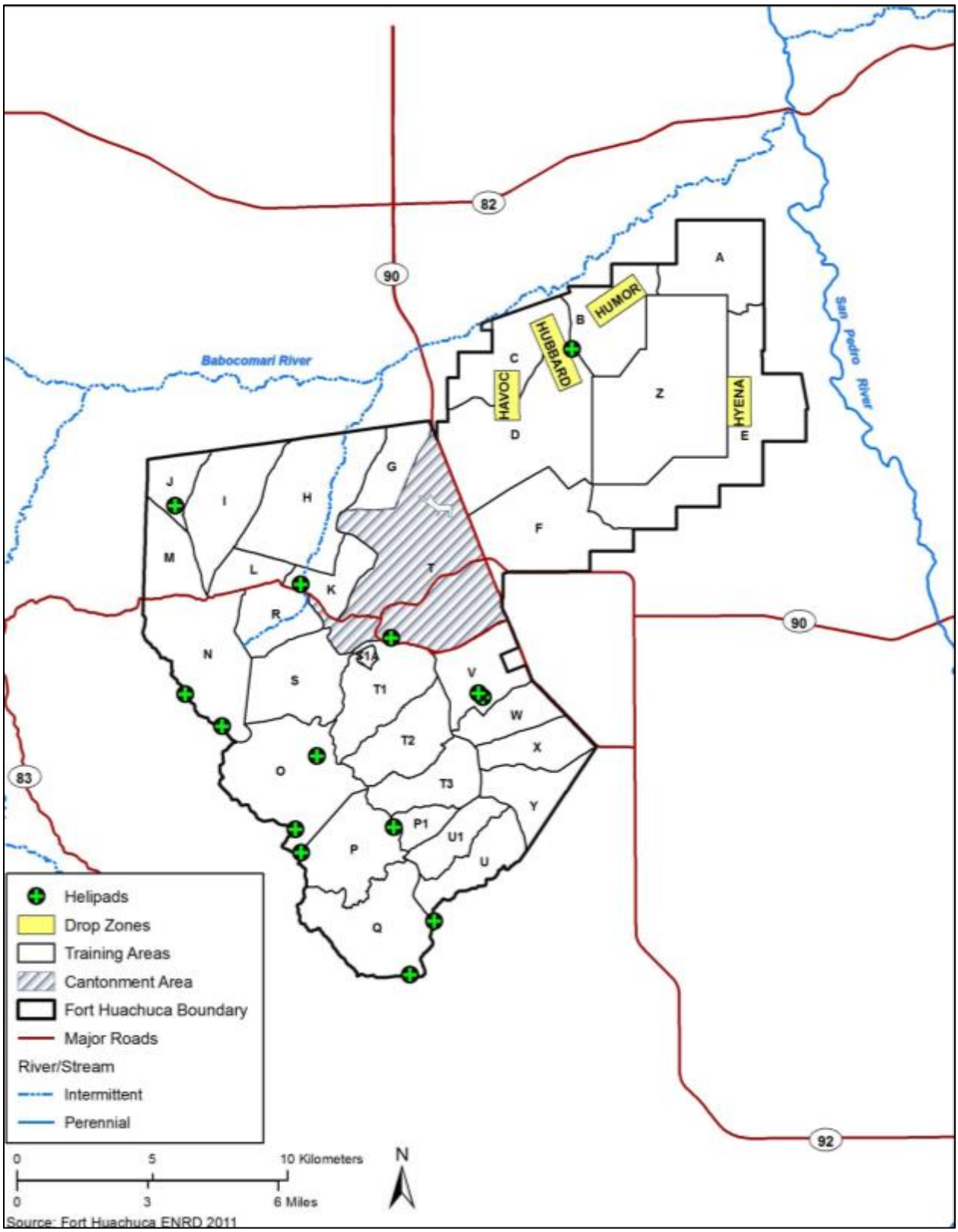


Figure PA5. Fort Huachuca, Arizona helipads and dropzones (PBA Figure 2-5).

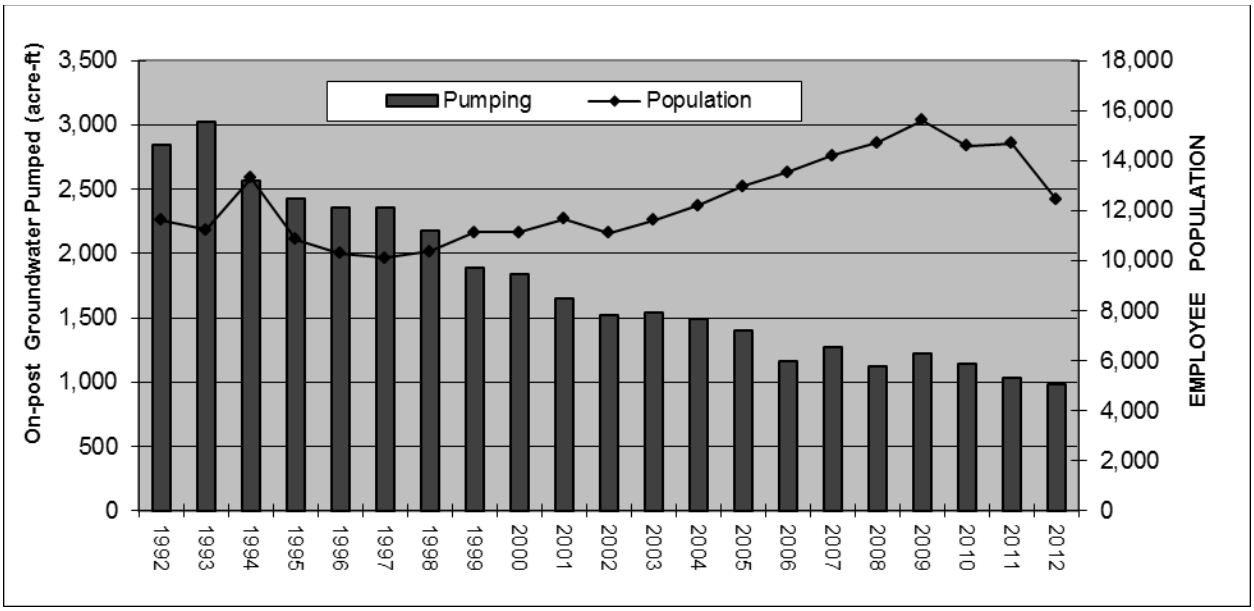


Figure PA6. Fort Huachuca, Arizona groundwater withdrawals (PBA Figure 2-6).

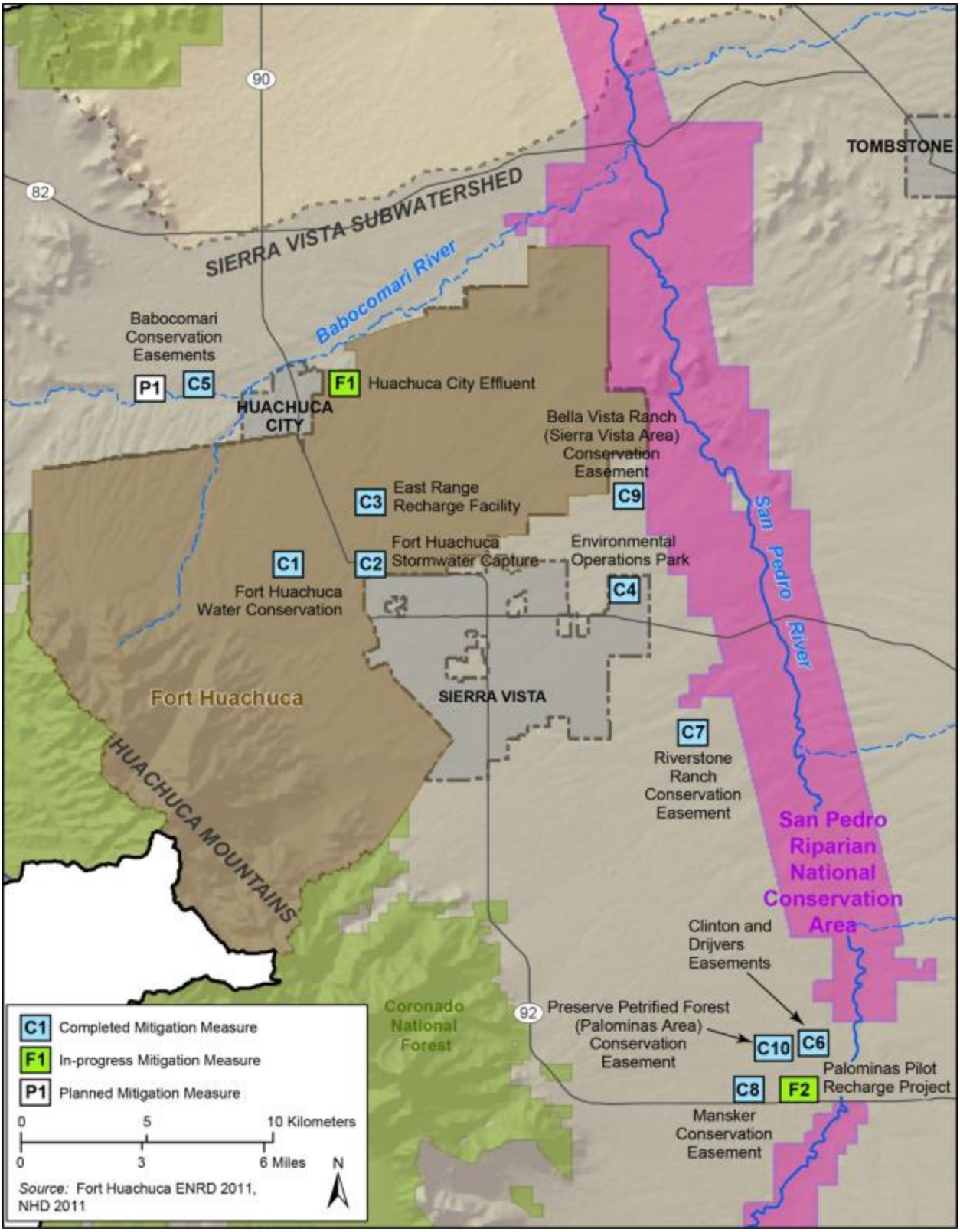
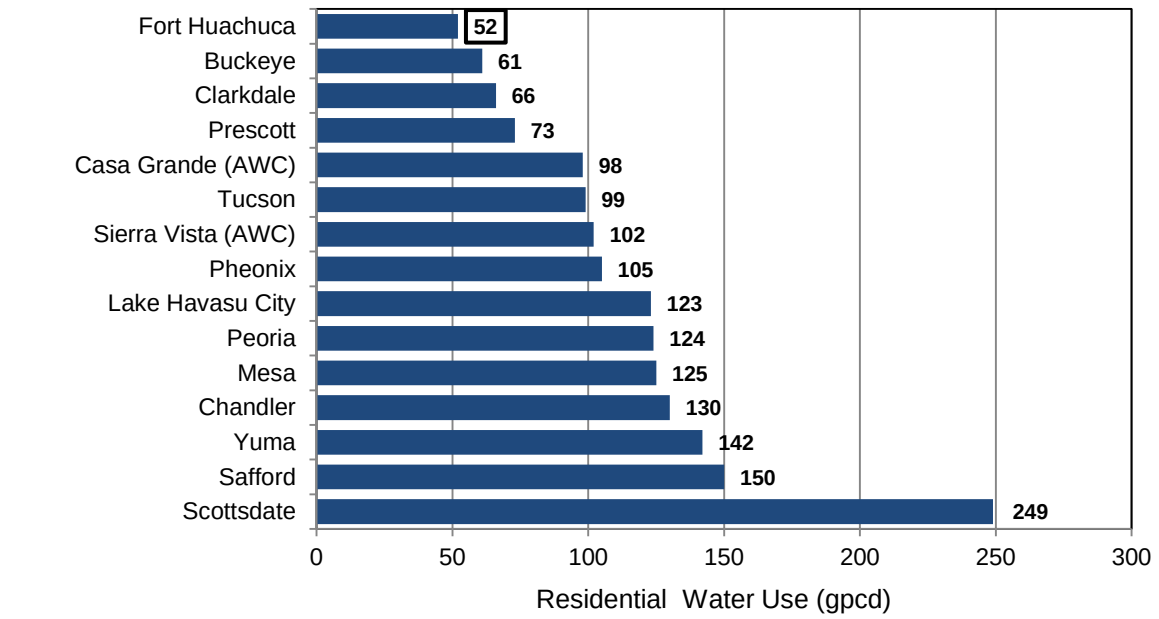


Figure PA7. Completed, in-progress, and planned mitigation measure locations, Fort Huachuca, Arizona (PBA Figure 2-7).



Source: Western Resource Advocates 2010. Fort Huachuca 2011.
AWC - Arizona Water Company

Figure PA8. Comparison of residential water use per capita rates in Arizona.

ENVIRONMENTAL BASELINE AND ACTION AREA

The environmental baseline includes past and present impacts of all Federal, State, or private actions in the action area, the anticipated impacts of all proposed Federal actions in the action area that have undergone formal or early section 7 consultation, and the impact of State and private actions which are contemporaneous with the consultation process. The environmental baseline defines the current status of the species and its habitat in the action area to provide a platform to assess the effects of the action now under consultation.

Europeans have influenced Southern Arizona for hundreds of years, and Native Americans have done so for much longer (Hastings and Turner 1965, Bahre and Hutchinson 1985, Bahre 1991, Tellman et al. 1997). Often-cited human impacts in the area include vegetation type conversion, dewatering surface waters and aquifers, erosion and channel down cutting, loss or reduction of native species, introduction and spread of nonnative species, and habitat loss. As with many of the river basins in the southwest, aquatic habitats (and fish communities) in the Gila basin have changed from historical conditions (Miller 1961, de la Torre 1970, Naiman and Soltz 1981, Miller et al. 1989, Minckley and Deacon 1991, Minckley and Marsh 2009). Aquatic habitats have been fragmented and reduced in quantity and quality due to diversion, groundwater mining, and natural and human-caused changes in the watershed and hydrologic regime (de la Torre 1970, Davis 1982, Tellman et al. 1997).

After Europeans arrived, major alterations began in the Gila River basin (Rea 1983). Beaver, which were a major influence on the structure of the Gila basin aquatic ecosystem, were locally extirpated. Beavers were reestablished in the SPRNCA in 1999. The introduction of livestock began very early and resulted in substantial alteration of the watershed and its soil and vegetation (York and Dick Peddie 1969, Humphrey 1987, Bahre 1991). Croplands increased, often along river terraces, resulting in destabilization and erosion of floodplains (Leopold 1946, Rea 1983). Roads and trails caused extensive erosion and substantial destruction of river channels (Leopold 1921, Dobyns 1981, Rutman 1997).

Diversion of water, which was already practiced by Native Americans in some areas, increased in those areas and was initiated in others (Tellman et al. 1997). As diversion and irrigation increased, the demand for water storage increased, resulting in a variety of large and small dams and impoundments (Haddock 1980). Improper grazing, mining, timber harvest, hay harvesting, fire suppression, and other activities in the nineteenth century led to widespread erosion and channel entrenchment in southeastern Arizona streams and cienegas when above-average precipitation and flooding occurred in the late 1800s and early 1900s after a drought (Bryan 1925, Martin 1975, Sheridan 1986, Webb and Betancourt 1992, Turner et al. 2003). By the mid 1900's, large stretches of river in the Gila basin no longer had perennial flow, and the remaining areas were separated by long dry stretches, dams, and impounded water (Brown et al. 1977, Rea 1983, Hendrickson and Minckley 1984, Tellman et al. 1997).

As a result of these changes, the riverine habitats of the Gila basin, including the San Pedro River (BLM 1998, Tellman et al. 1997), became fragmented, and connectivity was substantially reduced. Populations of fish or other aquatic species extirpated were not replaced by colonization (Minckley 1999, Hedrick et al. 2001). Habitat fragmentation contributes to the genetic isolation of populations (Parker et al. 1999). Population fragmentation can reduce genetic variation and viability (Minckley 1999). This, in turn, can increase the risk of extirpation

and extinction by reducing survival, reproduction, and dispersal. Isolation also precludes re-colonization should one or more populations be eliminated. When an inhospitable environment that imposes a high degree of threat on the remnant habitat surrounds isolated populations, these risks are compounded. This fragmentation has been a major factor in the decline of almost all of Arizona‘s native aquatic fauna, where native aquatic species, particularly rarer ones, tend to be isolated in small headwater areas scattered across the tributaries of the basin (Hendrickson and Minckley 1984, Minckley 1985, Minckley and Marsh 2009).

Human disturbances of the watershed, floodplain, and stream channel change many of the factors determining channel configuration. Increased sediment off the watershed is a common result of human actions, and sediment is a major determinant of channel shape (Leopold 1997). When the dynamic equilibrium has been disrupted, the channel begins a process of adjustment as it attempts to restore a dimension, pattern, and profile that are consistent with controlling hydraulic variables (Rosgen 1996). These adjustments may lead to dramatic changes in the stream channel width, depth, and geometry that encroach on human activities, such as has occurred on the Verde River and elsewhere. As human activities are affected, additional flood control and channelization may occur, which exacerbate the problems in adjacent areas, and the channel will continue to become increasingly unstable.

Action Area

The action area for the proposed action includes all areas directly and indirectly affected by the proposed action, including effects of actions that are interdependent and interrelated to the proposed action. The action area includes all areas to be affected directly or indirectly by the Federal action and not merely the immediate area involved in the action (50 CFR §402.02). Thus, the action area includes all lands within the boundary of Fort Huachuca, the San Pedro River within the Sierra Vista Subwatershed, including the San Pedro Riparian National Conservation Area (SPRNCA)(Figure EB1), the Babocomari River from below the Babocomari Cienega downstream to the confluence with the San Pedro River, and areas of the Coronado National Forest and private land next to the Fort. Areas next to the Fort are of concern, as animals and plants do not recognize boundaries. For example, because bullfrogs can disperse at least seven miles, all areas within seven miles, regardless of their ownership could be impacted by dispersing bullfrogs. Fort Huachuca also maintains off-post training sites, including a part of the Willcox Playa (Cochise County), a parcel on Oatman Mountain (Mojave County), and leased land near Phoenix and Gila Bend (Maricopa County), Mount Graham (Graham County), and Mount Lemmon (Pima County), Arizona; and in Lordsburg, New Mexico. These are primarily ASA or communications sites, or vehicle pull-off sites along roadways where equipment is temporarily operated. Uses of each site is described in Appendix C of the 2013 PBA. No additional threatened or endangered species are affected by electronic operations at these already-disturbed sites. Also note that not all species considered in the biological opinion occur throughout the greater action area; the areas where they are affected by the proposed action are described in their respective Environmental Baseline narratives.

The action area includes vegetation communities, surface water drainages, and on-site physical and topographic features (e.g., mountains, caves and mine adits/shafts, seeps and springs, stock tanks, rocky outcrops), that may be affected by the proposed action. The action area includes the indirect downgradient effects on the surface water and groundwater environments that would result from the on-site diversion and impoundment of surface water; the indirect effects on

springs and seeps in the proposed action area; and the groundwater use associated with the presence of Ft. Huachuca.

Land Ownership and Land Uses

Fort Huachuca is on the western side of the Upper San Pedro River Valley in Cochise County in southeastern Arizona, about 75 miles southeast of Tucson and about eight miles north of the U.S.-Mexico Border. Communities in the area include Sierra Vista, Benson, Tombstone, and Bisbee. Fort Huachuca is bordered by land subject to Cochise County, Santa Cruz County, and City of Sierra Vista zoning and planning requirements. Also, a large part of the land next to the Fort falls under the control of the BLM, U.S. Forest Service (USFS), and the Arizona State Land Department (Figure EB2).

Fort Huachuca is 73,142 ac situated near the City of Sierra Vista and the Town of Huachuca City. The City of Sierra Vista lies immediately east of the Fort and serves as a regional residential and commercial center. The Town of Huachuca City is north of Fort Huachuca. The Huachuca Mountains are along and within the southern and western parts of the Fort. The Fort's northern border parallels the Babocomari River, a tributary to the San Pedro River.

Fort Huachuca is divided into the East Reservation (28,544 ac) and West Reservation (44,598 ac) by State Route 90 (Figure EB3). Land uses on these reservations are generally classified as either open and operational or developed areas. The East Reservation is also called the East Range. The West Reservation is subdivided into the West Range, South Range, and the cantonment area. Libby Army Air Field is in the northern part of the cantonment.

The Fort Master Plan guides development on the Fort. Due to the specialized nature of Fort Huachuca's training and testing, efforts are underway to restrict development near the Fort. As part of the Arizona Military Regional Compatibility Project, an endeavor to address land compatibility issues at military installations statewide, Fort Huachuca partnered with Cochise County, Santa Cruz County, the City of Sierra Vista, the Arizona Department of Commerce, and other local organizations to develop a Joint Land Use Study that was issued in June 2007. In an effort to prevent incompatible development on adjacent land and minimize impacts of Army operations on local communities, the 2007 Land Use Study outlines a process for acquiring conservation easements through the Army Compatible Use Buffer (ACUB) program. These compatible use buffers protect the Fort and key terrain under restricted airspace from development that is potentially incompatible with Fort operations and in turn limits operational impacts to private landowners.

The operational areas on the West and East Reservations are used as training and testing ranges and are 67,422 ac, or about 92 percent of the Fort. Active, Reserve, and National Guard units of all services may use the training areas mainly for mountain and desert training, escape and evasion training, brigade-size field training exercises, and maneuver exercises.

The West Range covers about 16,000 ac. The West Range is used for training and testing. There are no live fire training areas in this range, and the range is used for research, development, and testing. The South Range covers about 23,000 ac, including most of the Fort's part of the Huachuca Mountains. The eastern slopes of the mountains on the southern part of the Fort serve as impact areas for small arms training. Training and some testing occur in the

northern part of the mountains. The range is divided into 12 training areas, nine firing ranges, and several impact areas. The East Range covers 28,544 ac of land. About 13,463 of these acres are public domain land that has been withdrawn from public use for military purposes. The Resource Management Plan of the Safford District of the BLM identifies these lands as being managed for military purposes and provides for resource management coordination with the Fort consistent with the requirements of the Federal Land Policy and Management Act (BLM 1991). The East Range is a platform for research and development testing and training and contains six training areas: a demolition range, a combat live-fire range, a tactical assault landing strip, a former impact area, and six drop zones.

The developed areas on the Fort include the cantonment area and Libby Army Air Field. These areas occupy 5,720 ac or about eight percent of the Fort. Both are on the eastern part of the West Reservation. The majority of buildings and structures on the Fort are located within the cantonment area. The cantonment is the location of a variety of housing and community support services, as well as administrative and operational directorates and training facilities. Major command headquarters are located in the cantonment area as well as maintenance and storage facilities, facilities for research, development and testing, medical care, and training. Infrastructure and maintenance activities are directed by the Fort Huachuca DPW. The directorate is responsible for ensuring that the Fort is in compliance with environmental laws and regulations. Libby Army Air Field includes a 12,000-ft Class B main runway on an east to west axis, a 5,365-ft secondary runway on a southeast to northwest axis, and a 4,300-ft crosswind runway running on a southeast to northwest axis (Vernadero Group 2010a).

Local and Regional Climate

The climate in the action area is semiarid, with precipitation varying by season and elevation. Precipitation occurs in both winter and summer, with about 60 percent of the total falling in the summer “monsoon” season (July to September) and 30 percent in the winter. Spring and fall are typically dry. Maximum “monsoonal” precipitation falls on the southeast (windward) side of the Huachuca Mountains (ADWR 1988). Annual precipitation across the project area varies and ranges from less than 12 inches per year near Benson to slightly more than 30 inches per year. Average annual precipitation at Fort Huachuca is 15 inches.

Temperatures regionally are moderate to extreme, with maximums and minimums also varying with elevation. The summer average high temperature is 88 degrees Fahrenheit (°F)(31 degrees Celsius [°C]) and the average winter low is 32° F (0° C). Clear skies or high thin clouds are common and permit intense surface heating during the day and radiant cooling at night. This creates large diurnal temperature fluctuations which average about 32° F (18° C). The average wind velocity is 9.8 mph. Wind gusts of 20 to 30 mph are common during the day (Vernadero Group 2010a).

To understand historical trends in streamflow in the San Pedro River (PBA Section 3.5.3.1), the historical fluctuations in winter and summer precipitation need to be considered. The Tombstone precipitation gage has the longest record in the subwatershed. Annual rainfall fluctuates with multi-year wet and dry periods. Cumulative departure from mean is used to determine whether periods are drier or wetter than the mean. Figure EB4 provides the cumulative departure from mean for the Tombstone gage from 1898 to 2012 (WRCC 2013). The cumulative departure from the mean represents the sum of the annual departures through that year since the beginning of the

period of record. Each year's departure is added to or subtracted from the previous year's cumulative total. When the slope of the cumulative departure from the mean (red line) is negative (down to the right), the sequence of years is drier than the mean, and conversely, when the slope of the cumulative departure from the mean is positive (up to the right), the sequence of years is wetter than the mean. Based on the data from the Tombstone gage:

- 1898 to 1904 was drier than the mean;
- 1905 to 1933 was wetter than the mean;
- 1934 to 1947 was drier than the mean;
- 1948 to 1959 was wetter than the mean;
- 1960 to 1982 was drier than the mean;
- 1983 to 2001 was wetter than the mean; and
- 2002 to 2012 was drier than the mean.

Drought and Climate change

The Fort's PBA contained a detailed discussion of the likely effects of climate change; the analysis is incorporated herein via reference and is expanded on in the following paragraphs. The information on how climate change might impact southeastern Arizona is less certain than current drought predictions. However, virtually all climate change scenarios predict that the American southwest will get warmer during the 21st century (IPCC 2001, 2007a; Overpeck et al. 2012, Garfin et al. 2013). Precipitation predictions show a greater range of possibilities, depending on the model and emissions scenario, though precipitation is likely to be less (USGCRP 2001, Seager et al. 2007). To maintain the present water balance with warmer temperatures and all other biotic and abiotic factors constant, precipitation will need to increase to keep pace with the increased evaporation and transpiration caused by warmer temperatures.

That southeastern Arizona and much of the American southwest have experienced serious drought recently is well known (Garfin et al. 2013, CLIMAS 2013). Almost 68 percent of Arizona was experiencing drought conditions during December 2013 (CLIMAS). What is known with far less certainty is how long droughts last. State-of-the-art climate science does not yet support multi-year or decadal drought predictions. However, instrumental and paleoclimate records from the Southwest indicate that the region has a history of multi-year and decadal drought (Hereford et al. 2002, Sheppard et al. 2002, Jacobs et al. 2005). Multi-decade drought in the Southwest is controlled primarily by persistent Pacific Ocean-atmosphere interactions, which have a strong effect on winter precipitation (Brown and Comrie 2004, Schneider and Cornuelle 2005); persistent Atlantic Ocean circulation is theorized to have a role in multi-decadal drought in the Southwest, particularly with respect to summer precipitation (Gray et al. 2003, McCabe et al. 2004, Wang et al. 2013). Given these multi-decade –regimes of ocean circulation, and the severity and persistence of the present multi-year drought, there is a fair likelihood that the current drought will persist for many more years (Stine 1994, Seager et al. 2007), albeit with periods of high year-to-year precipitation variability characteristic of Southwest climate. There is high confidence the Southwest will experience exceptional droughts that are more frequent, more intense, and longer lasting, and they will be hotter than historical droughts (Overpeck et al. 2012, Garfin et al. 2013).

Many of the predictions about the impacts of climate change are based on modeling, but many modeled predictions have already occurred (Udall 2013). In addition, many models have underestimated the increase in greenhouse gasses. The tree die-offs and fires that have occurred in the southwest early in this century show the impacts of the current drought. In addition, the basin‘s rivers, streams, and springs continue to be degraded (Overpeck et al. 2012), or lost entirely. Climate change trends are highly likely to continue (Overpeck et al. 2012), and the impacts on species will likely be complicated by interactions with other factors (e.g., interactions with nonnative species and other habitat-disturbing activities). Drought and climate change will also impact watersheds and subsequently the water bodies in those watersheds. Drought and especially long-term climate change will affect how ecosystems and watersheds function. These changes will cause a cascade of ecosystem changes, which may be hard to predict and are likely to occur non-linearly (Seager et al. 2007).

Studies have shown that since 1950, the snowmelt season in some watersheds of the western U.S. has advanced by about 10 days (Dettinger and Cayan 1995, Dettinger and Diaz 2000, Stewart et al. 2004). Such changes in the timing and amount of snowmelt are thought to be signals of climate-related change in high elevations (Smith et al. 2000, Reiners et al. 2003). The impact of climate change is the intensification of natural drought cycles and the ensuing stress placed upon high-elevation montane habitats (Cook et al. 2004, Breshears et al. 2005, Mueller et al. 2005, IPCC 2007a). The increased stress put on these habitats is likely to result in long-term changes to vegetation, invertebrate, and vertebrate populations within coniferous forests and canyon habitats that affect ecosystem function and processes (Fleishman et al. 2013).

The Assessment of Climate Change in the Southwest United States (Garfin et al. 2013) looked at 16 Global Climate Models (GCMs) and nine dynamical downscaled regional simulations (Mearns et al. 2009, as cited in Garfin et al. 2013) to assess temperature projections in the southwest. All of the GCMs and regional simulations showed progressive warming in the southwest through 2100. Average range of temperature increase from 15 GCM models by the end of the century is 2 to 6° F for the low emissions scenario (B1) and 5 to 9° F for the high emissions scenario (A2)(Nakicenovic and Swart 2000; Mearns et al. 2009, as cited in Garfin et al. 2013). The largest temperature increases are in the summer, though there is great variability among the GCMs (Garfin et al. 2013). Additionally, the freeze-free season is modeled to increase in southeastern Arizona by 17 to 24 days in the period 2041 to 2070 (Mearns et al. 2009, as cited in Garfin et al. 2013).

The discussion of precipitation change in the southwest U.S. in Garfin et al. (2013) reveals the large uncertainty regarding if and how regional precipitation may change. However, there is general agreement among the models that spring precipitation will decrease (Cayan et al. 2013). In addition, there is presently no model consensus on how the summer monsoon regime in the Southwestern U.S. will change. This is of particular importance for the Action Area, as it receives the majority of its annual precipitation from the summer monsoon, although recharge is thought to be greater in the winter (Serrat-Capdevila et al. 2007, Cayan et al. 2013).

Increased occurrence of extreme events

Extreme events such as drought, fires, heat waves, storms, and floods are predicted to occur more frequently and be more intense because of climate change (IPCC 2007a, Overpeck et al.

2012, Gershunov et al. 2013). It is anticipated that an increase in extreme events will most likely affect populations living at the edge of their physiological tolerances. The predicted increases in extreme temperature and precipitation events may lead to dramatic changes in the distribution of species or to their extirpation or extinction (Parmesan and Matthews 2006).

Decreased streamflow

Kundzewicz et al. (2007) state that of all ecosystems, freshwater ecosystems will have the highest proportion of species threatened with extinction due to climate change. Species with narrow temperature tolerances will likely experience the greatest effects from climate change and it is anticipated that populations located at the margins of species hydrologic and geographic distributions will be affected first (Meisner 1990). Current models suggest a decrease in precipitation in the Southwest (Kundzewicz et al. 2007, Seager et al. 2007) which would lead to reduced streamflows. Streamflow is predicted to decrease in the Southwest even if precipitation were to increase moderately (Nash and Gleick 1993, State of New Mexico 2005, Hoerling and Eischeid 2007). Winter and spring warming causes an increased fraction of precipitation to fall as rain, resulting in a reduced snow pack, an earlier snowmelt, and decreased summer base flow (Christensen et al. 2004, Stewart et al. 2004, Regonda et al. 2005, Stewart et al. 2005). Earlier snowmelt and warmer air temperatures can lead to a longer dry season. Warmer air temperatures lead to increased evaporation, increased evapotranspiration, and decreased soil moisture. These three factors would lead to decreased streamflow even if precipitation increased moderately (Garfin 2005, Seager et al. 2007). The effect of decreased streamflow is that streams become smaller, intermittent or dry, and thereby reduce the amount of habitat available for water-dependent species.

An example of using downscaled analysis from global climate models to regions was the analysis of annual average precipitation projections from 17 global climate models to estimate recharge in the San Pedro Basin (Serrat-Capdevila et al. 2007). While the models used in this analysis were older versions evaluated in the IPCC Third Assessment (2001), their results were similar to those generated by the next generation of models in the IPCC Fourth Assessment (2007a): 12 of 17 models predicted drier conditions for the San Pedro Basin, whereas five predicted slightly wetter conditions. The study estimated that recharge in the San Pedro Basin would decrease 4 to 6 percent by 2020, 6 to 8 percent by 2030, and 17 to 30 percent by the end of the 21st century (based upon the range of IPCC GHG emission scenarios considered).

Change in the hydrograph

In a warmer world an enhanced hydrologic cycle is expected; flood extremes could be more common (Das et al. 2011 in Gershunov et al. 2013); and droughts may be more intense, frequent, and longer-lasting (Seager et al. 2007). Stewart et al. (2005) show that timing of spring streamflow in the western U.S. during the last five decades has shifted; the major peak now arrives 1 to 4 weeks earlier, resulting in less flow in spring and summer. They conclude that almost everywhere in North America, a 10 to 50 percent decrease in spring-summer streamflow will accentuate the seasonal summer dry period with important consequences for warm-season water supplies, ecosystems, and wildfire risks (Stewart et al. 2005). Rauscher et al. (2008) suggest that with air temperature increasing from 37 to 41° F, snowmelt driven runoff in the western U.S. could occur as much as two months earlier.

Fire

Since the mid-1980s, wildfire frequency in western forests has nearly quadrupled compared to the average of the period 1970 to 1986 (Westerling et al. 2006). The total area burned is more than six and a half times the previous level (Westerling et al. 2006). In addition, the average length of the fire season during 1987 to 2003 was 78 days longer compared to 1970 to 1986 and the average time between fire discovery and control increased from about 8 to 37 days for the same time (Westerling et al. 2006). McKenzie et al. (2004) suggest, based on models, that the length of the fire season will likely increase and fires in the western U.S. will be more frequent and severe. In particular, they found that fire in New Mexico appears to be acutely sensitive to summer climate and temperature changes and may respond dramatically to climate warming (McKenzie et al. 2004). The summer temperatures in the southwest are predicted to increase more than any other season (Garfin et al. 2013).

Furthermore, drought and climate change will cause changes in fire regimes in all southeastern Arizona vegetation communities (Kitzberger et al. 2006). The timing, frequency, extent, and destructiveness of wildfires are likely to increase (Westerling et al. 2006) and may facilitate the invasion and increase of nonindigenous plants. These changed fire regimes will change vegetation communities, the hydrological cycle, and nutrient cycling in affected watersheds (Brown et al. 2004). Some regional analyses conservatively predict that acreage burned annually will double with climate change (MacKenzie et al. 2004). Such watershed impacts could cause enhanced scouring and sediment deposition, more extreme flooding (quicker and higher peak flows), and changes to water quality due to increases in ash and sediment within stream channels. Severe watershed impacts such as these, when added to reductions in extant aquatic habitats, may restrict sites available for the conservation of aquatic species and make management of extant sites more difficult.

Severe wildfires capable of decimating large areas are relatively recent phenomena and result from the cumulative effects of historical or ongoing grazing, which removes the fine fuels needed to carry fire, and fire suppression (Madany and West 1983, Savage and Swetnam 1990, Touchan et al. 1995, Swetnam and Baisan 1996, Belsky and Blumenthal 1997). Historical wildfires in the southwest were primarily cool- burning understory fires with return intervals of 3 to 7 years in ponderosa pine (Swetnam and Dieterich 1985). Cooper (1960) concluded that before the 1950s; crown fires were extremely rare or nonexistent in the region. Effects of fire may be direct and immediate or indirect and sustained over time (Gresswell 1999).

Soil

The Soil Survey of Fort Huachuca (NRCS 1997) characterizes the types of soils that occur on the Fort based on their infiltration capacity and ability to transmit water, locations of the soil types, and potential uses (Figure EB5). Fort Huachuca has a diverse assortment of soil types that exhibit wide variations in depth, texture, and chemical properties. This diversity is directly related to differences in climate, parent material, and topography at the Fort. The physical and chemical properties of the soil have an influence on the plant communities that occur on the Fort and the uses and management of soils by the Army.

Many soils in the hilly and mountainous areas, particularly on the South and West Ranges, are shallow with steep slopes. Roughly 30 percent of Fort Huachuca has soils less than two ft in depth. These soils tend to have low available water capacity and are susceptible to erosion. The high sodium and gypsum content of many soils on the East Range make these soils subject to gully erosion and piping. The soil of the cantonment area consists of alluvial fan deposits. Almost one-quarter of Fort Huachuca land has deep red clay soils that have low permeability and tend to be poorly drained.

Physiography

Fort Huachuca is in the Mexican highland section of the Basin and Range Physiographic Province (Vigil et al. 2000). Topography of the Fort is shown in Figure EB6. The broader landscape consists of isolated mountain ranges and broad, relatively flat valleys or basins. The San Pedro River Basin is typical of the Basin and Range Physiographic Province, with elongated north-south trending block-faulted mountains surrounding a central valley filled with deep alluvium (Figure EB6). The basin is divided into two distinct geographic units, referenced as the upper and lower basins. The Upper San Pedro Basin extends from the headwaters in Mexico to "the Narrows" north of Benson and the Lower San Pedro Basin extends from "the Narrows" to the Gila River (ADWR 1988). The Upper San Pedro Basin is further divided into the Benson and the Sierra Vista Subwatersheds (Figure EB7). The Sierra Vista Subwatershed contains Fort Huachuca, the City of Sierra Vista, Huachuca City, and most of the SPRNCA.

The Upper San Pedro Basin is about 2,500 mi^2 of the 4,600 mi^2 San Pedro River watershed. The basin slopes gradually from south to north, resulting in a north-flowing river. About 696 mi^2 of the basin lie within the Republic of Mexico. About 54 mi^2 drains from the west side of the Huachuca Mountains into Mexico then to the San Pedro River (ADWR 1988). Within the U.S., the west side of the San Pedro watershed is bounded by the Whetstone, Rincon, Mustang, and Huachuca Mountains along with the Canelo Hills. The Winchester, Little Dragoon, Dragoon and the Mule Mountains along with the Tombstone Hills bound the east side of the watershed. Mountain elevations vary from 6,597 ft for the Mule Mountains to 9,466 ft for the Huachuca Mountains. The elevation of the river where it enters the U.S. at the international border with the Republic of Mexico is 4,260 ft and it exits the subbasin at "the Narrows" at an elevation of 3,300 ft (Huckleberry 1996).

Water Resources

For water resources, the area affected by the Proposed Action is within the Sierra Vista Subwatershed of the Upper San Pedro Basin which ends at the gaging station near Tombstone about two miles downstream from the State Route 82 bridge across the San Pedro River. The following subsections discuss the surface water and groundwater resources in the Sierra Vista Subwatershed. Figure EB8 provides a map of the rivers, streams, and gaging stations in the Sierra Vista Subwatershed.

Relationship between Groundwater and Surface Water

Groundwater and surface water are interconnected. Groundwater is water contained in saturated layers of porous sediments below the ground surface. An aquifer is the contiguous extent of saturated sediments. Groundwater moves through an aquifer at different rates depending partly on the size and density of sediment particles at each location in the aquifer. Densely-packed,

fine particles impede the flow of groundwater; whereas loosely-packed larger particles have more open space per unit volume and allow groundwater to flow faster. Depending on the density of sediments, groundwater may move under the influence of gravity many feet per month in the case of coarser, porous sediments to only a few inches per month in finer, denser materials.

In the desert southwest, groundwater recharge mainly occurs in the coarse streambed sediments at the mountain fronts (Goodrich et al. 2004, Coes and Pool 2005, Leavick et al. 2008). The altitude of the groundwater table at the mountain front is higher than the lower-lying areas. The weight of water in locations where the water table is high exerts pressure through the aquifer, much as a hose full of water will spill water out of its low end when the other end is raised. This gravitational gradient causes groundwater to "flow" from one location to another. Because of the slow movement of groundwater through the aquifer's sediments, the water table is typically not as level as a lake where water is free to seek a level surface.

In a natural system with no human groundwater withdrawals, surface water as springs, streams, wetlands or lakes occurs where the water table intersects the ground surface. Over time, outflow from the aquifer will equal the recharge or inflow into the aquifer. Thus, in some locations surface water replenishes groundwater by conveying precipitation runoff to locations where it can percolate into the aquifer and in other locations groundwater maintains surface water flows where the aquifer intersects the streambed.

When groundwater is withdrawn from a well the water table declines near the well and the surface water outflows from the aquifer may be intercepted. The balance between inputs (natural precipitation and artificial recharge), human withdrawals (groundwater pumping), and evapotranspiration (the combined effects of direct evaporation and transpiration of water via plants) determines the presence or absence of surface water in any location as well as the level of the water table. However, because of the slow movement of groundwater from the area of active recharge to the area of the surface water outflow, the reduction of surface water outflows caused by the withdrawal of groundwater is sometimes not realized for many years. The following sections describe the regional surface water and groundwater conditions.

Regional Surface Water Resources

The two largest surface water drainages in the Sierra Vista Subwatershed are the San Pedro and Babocomari rivers. The headwaters of the San Pedro River are in Sonora, Mexico and Arizona. The San Pedro River flows northward from Mexico about 200 miles to its confluence with the Gila River. The San Pedro River is one of the few rivers in southern Arizona with substantial perennial reaches (stretches where water flows year-round).

The historical record suggests that in the mid-19th century the San Pedro River was a continuous perennial stream from near Cananea, Mexico to just beyond the Narrows north of Benson (Davis 1982, Hereford 1993). The upper San Pedro consisted of mostly treeless, un-incised cienegas (Davis 1982, Hendrickson and Minckley 1984). Between 1880 and 1926, the San Pedro River underwent a rapid sequence of entrenchment as a result of channel erosion caused by a series of large flood events. Factors that contributed to the entrenchment include improper livestock grazing, fuel harvesting, increasing aridity, and the 1887 earthquake (Hereford and Betancourt 2009 within Stromberg et al. 2009). Entrenchment set into motion a number of geomorphic, hydrologic, and biologic processes. Most of those adjustments are still continuing and may have

an influence on future resource conditions along the San Pedro River (BLM 1987, Leenhouts et al. 2006). Where floodplains are narrow, channel incision has been on the order of 10 feet. In other sections of the river, erosion has progressed laterally to create a broad channel occupied by a relatively narrow zone of river flow during periods of drought. During floods, the channel is filled by a turbid, erosive river.

The Babocomari River parallels the northern boundary of Fort Huachuca and drains the northwestern sections of the Sierra Vista Subwatershed including the Mustang Mountains, Canelo Hills, and the northern end of the Huachuca Mountains. The Babocomari River discharges into the San Pedro River just south of Fairbank near the State Route 82 bridge over the San Pedro River. The Babocomari River is ephemeral (usually dry, only flowing in response to precipitation events) throughout most of its length, with the exception of a few intermittent and perennial flow segments resulting from special geologic conditions where bedrock is very near the surface (ADWR 1988). Several drainages including O'Donnell Canyon and Lyle Canyon flow into the Babocomari and contribute runoff.

Surface Water Resources at Fort Huachuca

Fort Huachuca is within the Babocomari River and Garden Canyon watersheds. Combined, these watersheds represent a 539 mi^2 drainage area making up about 32 percent of the Sierra Vista Subwatershed. A majority of the surface water features on Fort Huachuca are ephemeral streams, consisting of dry washes, arroyos, or gullies trending in a northerly or northeasterly direction following the regional topography. Ephemeral streams on Fort Huachuca are typically narrow channels with a sand and gravel layer at the bottom of the channel. Some of these channels are deeply entrenched.

Fort Huachuca has about 4.5 mi of perennial stream, mostly in Garden Canyon (3.5 mi). Huachuca Canyon has 0.75 mi of perennial stream. Small perennial reaches also occur in McClure and Blacktail canyons.

Hydrology of the Upper San Pedro River

Surface water in the San Pedro River is comprised of "stormflow" and "baseflow." Stormflow results from precipitation. Baseflow is water that flows in the river in the absence of a rainfall event. Baseflow in the San Pedro River is composed of flow from the regional groundwater system and the recent Holocene alluvium (Kennedy and Gungle 2010). The regional and alluvial aquifer systems are discussed in detail in PBA Section 3.5.5. This section describes the river flow trends of the San Pedro and Babocomari rivers and the current state of knowledge on baseflow from the regional aquifer.

Historical River Flow Trends

The analysis of river flow trends uses data from historical streamflow measurements. The USGS maintains three streamflow measuring (gaging) stations on the San Pedro River in the Sierra Vista Subwatershed: Palominas (09470500), Charleston (09471000), and Tombstone (09471550) (Figure EB8). The station records date back to 1930, 1904, and 1967, respectively, although Charleston is the only station with a substantially complete long-term record. The USGS also

maintains streamflow gaging stations on the Babocomari River. The streamflow records for the station on the Babocomari River near Tombstone (09471400) begin in 2000.

In this section the streamflow data are presented and summarized with raster hydrographs and winter and summer low flow metrics. A "raster hydrograph" is a graphic depiction of the daily stream flow in cubic feet per second for the period of record showing high flows in dark blue, intermediate flows in shades of blue to green, low flows as yellow, and no flow as white (Koehler 2004). These graphics are useful in determining the seasonality of flows and changes in low flow patterns which are important considerations in evaluating habitat suitability for species that are dependent on the availability of flow throughout the year. The summer and winter low flow metrics provide a sense of how much regional and alluvial groundwater is discharging into the river and are used as sustainability indicators by the USPP (2010).

The San Pedro River flow fluctuates seasonally with changes in precipitation and changes in water use by riparian vegetation. Summer stormflows are the largest of the year in response to monsoon storms. When monsoons end around late September, streamflows decrease until the riparian vegetation goes dormant in the winter. Consequently, during winter and early spring, less groundwater is taken up by the dormant riparian vegetation. The result is an increase in baseflow in the winter and early spring months. Frontal winter storms also create episodic increases in stormflow in the winter and early spring. In April, riparian vegetation resumes active growth and increases water use. By the dry, pre-monsoon period of May and June, streamflows are at their lowest levels of the year. Figure EB9 illustrates streamflow patterns in the upper San Pedro River at the Charleston gage in a raster hydrograph.

San Pedro River streamflows have declined in the 20th century (Figure EB9). The annual total flow of the San Pedro River at Charleston gage has declined from 57,000 AFY during the predevelopment period (1915 to 1940) to 22,000 AFY in the 1991 to 2002 period (Thomas and Pool 2006); a 60 percent reduction. The research identified that reduced summer flows were responsible for about 70 percent of that decline, while fall and early winter declines made up 20 and seven percent, respectively. In July 2005, the flow of the San Pedro River at the Charleston gaging station was zero for the first time since records began (Figure EB 9, 10).

There are four main factors that influence baseflow trends in the Upper San Pedro River:

- Changes in precipitation;
- Changes in evapotranspiration by riparian vegetation (Stromberg et al. 2010);
- Changes in temperature (e.g., date of the last hard freeze)(Kennedy and Gungle 2010); and,
- Groundwater pumping from the regional aquifer.

By removing variability in streamflow attributable to changes in precipitation, Thomas and Pool (2006) and Leenhouts et al. (2006) found that precipitation declines were only partially responsible for the declines in streamflow in the San Pedro River at the Charleston gage. The study evaluated potential factors other than precipitation that could have resulted in streamflow declines and concluded that changes in riparian vegetation are the mostly likely causes for the observed streamflow declines because:

- There are substantial negative trends observed in growing season (summer) flows;

- winter flow have shown significant (Koehler 2005), non-significant Leenhouts et al. (2006), and increasing stability (less variation in flow)(Koehler 2014);
- The area of riparian vegetation in the Upper San Pedro basin has increased over the last century (Stromberg et al. 2010, Kepner et al. 2002); and,
- Since evapotranspiration makes up more than 90 percent of the discharge from the basin, small changes in riparian vegetation could have pronounced effects on flows in the river (Thomas and Pool 2006).

Seasonal groundwater pumping near the river was also recognized as having a substantial effect on streamflow, but groundwater pumping far from the river (i.e., Sierra Vista/Fort Huachuca area) in the regional aquifer was not seen as yet having a major influence on streamflows at the San Pedro River at the Charleston gage (Thomas and Pool 2006).

The regional aquifer has recharge zones away from the river, primarily at mountain fronts and along ephemeral channels. The alluvial aquifer consists of the "bank storage" in the near-stream alluvial deposits and is recharged mainly from stormwater runoff. Kennedy and Gungle (2010) estimated the quantity and sources of baseflow (regional or alluvial) in the San Pedro River near Tombstone. Using environmental isotope data, they concluded the composition of baseflow in the upper San Pedro River at the gage near Tombstone is 74 percent (±10) regional groundwater and 26 percent (±10) summer storm runoff stored as alluvial groundwater for 2000 to 2009. Kennedy and Gungle (2010) also examined declines in baseflow at Tombstone. Median baseflow for 1968 to 1986 was 5,830 AFY and for 1997 to 2009 was 2,880 AFY, nearly a 50 percent decline. This decline in median baseflow is also apparent in the raster hydrograph and seven-day winter low flow calculated for the Tombstone gage (Kennedy and Gungle 2010)(Figures EB11, 12) and the Charleston Gage (Koehler 2005)(Figure EB 23). Kennedy and Gungle concluded that decreases in streamflow are largely attributable to changes in the precipitation patterns and more vigorous and expansive riparian vegetation.

The USGS has installed eight pairs of piezometers along the San Pedro River and has installed pressure transducers that record the pressure associated with the elevation of groundwater in each piezometer. These wells are used to estimate the vertical gradient between the regional and alluvial aquifers. A decrease in the vertical gradient in these monitoring wells would indicate a declining contribution of baseflow from the regional aquifer. Since 2001, data from these monitoring wells indicate no changes in water levels or vertical gradients (see PBA Section 3.5.6 for more detail). In addition, from 2000 to 2009, the percentage of regional and alluvial groundwater determined by isotopic analysis has also remained relatively constant. Therefore Kennedy and Gungle (2010) concluded that together, these data show that declines in winter baseflow of the San Pedro River at the Tombstone gaging station could not be explained by (or attributable to) changes in the regional aquifer. All the paired monitoring wells are along the mainstem San Pedro River and not the Babocomari River (Figure EB8). Vertical gradient monitoring wells are not available and could not be used by Kennedy and Gungle to assess baseflow in the Babocomari River.

Streamflow data for the Babocomari River are less available than for the San Pedro River. The USGS installed a streamflow measuring station (USGS 9471400) in 2000 in the Babocomari River near Tombstone (Figure EB8) and in 2007 downstream of Lyle Canyon (USGS 09471380). A raster hydrograph and a graph of winter low flow (15 January to 15 March) for the Babocomari River at Tombstone are in Figure EB13 and Figure EB14, respectively.

Before 2000, limited streamflow data for the Babocomari River were acquired by Schwartzman (1990) during research conducted for a graduate thesis. Schwartzman (1990) divided the Babocomari River into ten sections and reported the results of streamflow measuring done in March and June of 1988. One of Schwartzman's measuring locations (number six) is nearly in the same location as the USGS gaging station on the Babocomari River near Tombstone (9471400). In March 1988 Schwartzman measured a flow of 2.7 cfs near the location of the USGS gage (Figure EB14). From 2001 to 2011, the average winter low baseflow measured by the USGS has varied from 0.6 to 3.9 cfs. The year 1988 was also a wet year similar to 2001. This limited data makes it difficult to determine trends in flow for the Babocomari River.

Recent groundwater modeling (GeoSystems Analysis 2010) suggests that effects from historical groundwater withdrawals in the regional aquifer (1940 to 2003; PBA Section 3.5.6) would result in reduced flows in the Babocomari River. Since the Babocomari River contributes flow to the San Pedro River upstream of the Tombstone gaging station, there is the potential that declines in Babocomari River baseflow could account for some part of the declines in winter baseflow observed at the San Pedro River at the Tombstone gage.

Wet and Dry Mapping

The streamflow gages only provide measurements of flow in fixed locations. Since 1999, The Nature Conservancy and BLM have mapped the spatial extent of wet reaches on the SPRNCA. Mapping is conducted during the third weekend of June to coincide with the lowest flow before the expected start of the monsoon. The mapping of wet reaches during the driest time of the year provides an additional metric on the flow conditions throughout the SPRNCA. The survey results from 1999 to 2010 indicated that 32 percent (15.9 mi) of the San Pedro River through the SPRNCA had surface flow during all surveyed years. The total wetted length varied from year to year (22.2-35.5 mi)(Turner and Richter 2011); however, the only statistically significant trend in wetted length from 1999 to 2010 (such as a segment getting wetter or drier over time) was observed in Segment 2, which generally was getting wetter over time. While wet/dry mapping cannot prove causality of changes in hydrologic conditions in a complex system, a likely explanation of the increase in Segment 2 is conservation easement purchases retiring irrigation of farm fields near or adjacent to the river in Segments 1 and 2, likely reducing water consumption there (Turner and Richter 2011).

Riparian Condition Classes

Changes in the San Pedro River streamflow could affect the form and distribution of riparian vegetation there. In 2006, the USGS and the Agriculture Research Service developed a Riparian Condition Index by using a suite of field-measured vegetation traits that are sensitive to changes in streamflow permanence and groundwater levels along the San Pedro River (Leenhouts et al. 2006). This index was designed to diagnose and monitor changes in riparian vegetation conditions due to changes in surface and groundwater conditions. Each condition class is associated with particular ranges for site hydrology, vegetation structure, and ecosystem functional capacity (Table EB1 and Figure EB15). Condition Class 1 indicates ecological conditions reflecting low water availability. Class 1 reaches are often dominated by tamarisk (salt cedar [*Tamarix* spp.]). Condition Class 2 indicates intermediate conditions and riparian trees, such as Goodding's willow (*Salix gooddingii*) and Fremont's cottonwood (*Populus*

fremontii), dominate the overstory. Cottonwoods in the Class 2 reaches suffer drying-related stress as groundwater depths increase in midsummer; salt cedar is much more prevalent in Class 2 than in the Class 3 reaches. Condition Class 3 represents the wettest conditions currently occurring along the river. Although some aquatic herbaceous plants, such as the Huachuca water umbel, do occur in Class 2 reaches within the SPRNCA (EEC 2000a), Class 3 conditions are believed to be essential for most aquatic herbaceous species (Leenhouts et al. 2006). The rich riparian species diversity observed in Class 3 reaches is markedly diminished in Class 2 reaches where water limits riparian plant growth (Leenhouts et al. 2006).

Leenhouts et al. (2006) separated the San Pedro within the SPRNCA into 14 reaches and categorized each reach into the three classes describing riparian condition. Most of the river between their Hereford gage and Charleston gage was ranked as Class 3 (Figure EB16). Just north of Charleston gage (including the Fairbank reach), the river is primarily Class 2, with intermittent (seasonal) streamflow and mean depths to groundwater up to 10 ft. Based on the results of the wet-dry mapping, streamflow analysis, and stable vertical gradients in monitoring wells along the river, the reach classification in 2003 has not changed substantially and represents the conditions in 2012.

Hydrogeology of Upper San Pedro River

There are two primary aquifers in the San Pedro Basin: the deep regional aquifer and the shallow alluvial aquifer along the San Pedro and Babocomari rivers. In most of the Sierra Vista Subwatershed these aquifers are separated by a silt and clay unit with low permeability. The regional and alluvial aquifers are underlain by bedrock (Figure EB17).

Regional Aquifer

The regional aquifer is fill that has accumulated in the structural depression between mountain ranges. The sediment deposits are coarsest and thinnest near the mountains and finer and thicker in the center of the basin. The saturated thickness of the regional aquifer is 650 to 1,300 ft in the Sierra Vista Subwatershed (Pool and Dickinson 2007).

The regional aquifer can be further divided into a lower basin and an overlying upper basin. The lower basin is an important water-bearing unit throughout most of the aquifer and consists of interbedded sand and gravel with some thick layers of siltstone and mudstone. The thickness of the lower basin fill ranges from 145 to 330 ft near the Fort (Pool and Dickinson 2007).

The upper basin fill is less than 400 ft below the ground surface in all wells where it has been recognized. The upper basin fill includes the relatively permeable fan gravel layers near the mountains that receive recharge and grades laterally to clay layers and other beds of low permeability near the basin center (Pool and Dickinson 2007).

Beneath the San Pedro River south of State Route 90, the upper basin fill is overlain by clay deposits of an old lakebed. The combination of the silt and clay layers from the upper basin fill and the old clay lakebed deposits creates a low permeability barrier which in some locations acts as a confining layer (resistant to groundwater flow) between the regional and alluvial aquifers (Pool and Coes 1999).

Alluvial Aquifer

The alluvial aquifer is a long, thin body of shallow sediments along the San Pedro and Babocomari Rivers. The oldest deposits are clay, silt, and fine sand, with interbedded coarse sand to cobble and gravel deposits accumulated before the river was entrenched in the 1880s to 1926. The pre-entrenchment deposits are as much as 20 ft thick and less than one mile wide. After stream entrenchment, sand and gravel were deposited in the narrow entrenched channel within the floodplain and pre-entrenchment alluvium. These young, post-entrenchment deposits are a few meters thick and highly permeable. Pre-entrenchment alluvium is less permeable because it consists of finer particles of fine sand, silt, and clay (Pool and Dickinson 2007).

Groundwater Flow Patterns

Generally, groundwater flows toward the San Pedro River in the permeable sand and gravel layers in regional and alluvial aquifers, although vertical flow does occur between the sand and gravel layers. Silt and clay layers are much less permeable and limit vertical flow between layers. Underlying the Fort Huachuca and Sierra Vista pumping center, the groundwater flow is primarily in the deep lower basin fill (Pool and Dickinson 2007). Groundwater from the lower basin fill must be under greater pressure than overlying groundwater to flow upward through the shallow system to reach discharge areas along the San Pedro and Babocomari rivers (Pool and Coes 1999). Groundwater in the deep flow system through the lower basin fill can be confined or semi-confined by thick layers of silt and clay in the upper basin fill (Montgomery and Associates 2011). These confining and semi-confining conditions near groundwater discharge areas result in substantial vertical-hydraulic gradients (that is, where deeper groundwater confined under less permeable layers is under greater pressure than the shallower aquifer, resulting in upward flow from the deeper to the shallower aquifer). The flow from the deep system to the shallow system occurs through permeable pockets embedded within the silt and clay unit.

Groundwater Trends

Groundwater wells remove water stored in the aquifer. Removing water from the aquifer creates a cone of depression around the well where the water table is locally lower than the surrounding aquifer. The pumping cone of depression creates a groundwater flow gradient toward the well. By altering gradients, groundwater withdrawals capture some groundwater that may discharge to springs, streams, or riparian evapotranspiration. Continued groundwater withdrawals will eventually result in a decline of surface discharges equal to amount of the withdrawals and groundwater levels will adjust to a new, lower equilibrium. Withdrawals in excess of the outflow of the groundwater system is called “mining” of groundwater in storage and leads to a continuous decline in groundwater levels.

The Upper San Pedro Partnership reports groundwater sustainability indicators in its Section 321 Reports. The indicators reported include regional aquifer water levels, storage change, water levels in the San Pedro River stream alluvium, and near-stream vertical hydraulic gradients based on monitoring data collected by others. The following discussion is a summary of the groundwater trends analysis in Appendix A, of the 2009 and 2010 Section 321 Reports (USPP 2010 and 2012).

Groundwater Trends in the Regional Aquifer

Declines in water levels beneath long-term pumping centers in the Subwatershed have been measured over decades and indicate a general trend of reduction in aquifer level (Pool and Coes 1999). Rates of water-level declines have been largest in the Sierra Vista-Fort Huachuca pumping center (Figure EB8).

Water level trends in different parts of the Sierra Vista Subwatershed vary due to differences in geology, hydrogeology, pumping, and recharge. The USPP separated the regional aquifer into four subregions: East, Environmental Operations Park (EOP), Fort Huachuca, and Southwest (Figure EB18). The trends in the subregions in their 2009 and 2010 Section 321 reports (USPP 2010 and 2012) were as follows:

- Water levels in the East subregion were relatively stable from 2000 to 2008;
- Water levels in the EOP subregion show two distinct short-term trends. Water levels in the Bella Vista and LS-6 wells have generally increased since 2002, while the monitoring wells at the east end of Fort Huachuca have stabilized (MW1 and MW-7) or steadily decreased (MW-5) over the same time. This may be a function of proximity to the EOP or to the geology of the well locations;
- The wells in the Fort Huachuca subregion have steadily declined since 1995. However, the rate of decline of 0.5 to 0.75 ft/yr since 2002 decreased considerably from 2007 to 2008 to 0.11 ft/yr but increased again in 2009; and
- Water levels in the Southwest subregion wells show the largest variation due to their location near the mountain front recharge zone. The water level fluctuations may relate to the drought that began in the late 1990's followed by the relatively heavy summer rains in 2005 to 2008 (USPP 2010).

Groundwater Trends in the Alluvial Aquifer

Exchange of water between the deep regional aquifer and shallow alluvial aquifer is driven by hydraulic (pressure) gradients, measured by comparing water levels in shallow and deep monitoring wells at the same location along the San Pedro River. Positive vertical gradients (the deeper wells showing higher surface levels than the shallow wells) indicate upward movement of water from the deeper aquifer to the shallower. Negative gradients indicate the reverse. A zero hydraulic gradient indicates hydrostatic equilibrium and no movement of groundwater between the two aquifers. A decrease in groundwater movement towards the river, caused by groundwater pumping between the mountains and the river, would be reflected in a decrease in the measured vertical hydraulic gradient (the amount by which the pressure in the deeper aquifer exceeds that in the shallower aquifer).

Kennedy and Gungle (2010) analyzed the data from eight paired shallow and deep monitoring wells along the San Pedro River. Data from seven of the eight well pairs show essentially no trends over time, either in water level or gradient (Kennedy and Gungle 2010). In one well at Lewis Spring, the water levels have risen in both the deep and shallow wells likely due to the recharge at the EOP. The lack of decline in water levels and gradients suggest that groundwater pumping in the Sierra Vista area has not yet substantially affected vertical gradients in and near the alluvial aquifer of the San Pedro River during the period and in the locations for which water level data exist (Kennedy and Gungle 2010). If groundwater pumping were affecting conditions in the alluvial aquifer, a continual decline in vertical gradients would be expected. This has not occurred.

There are no paired shallow and deep monitoring wells in the Babocomari River. In addition, streamflow at the Babocomari River has only been measured consistently since 2000, which is a limited record for analysis of streamflow trends, especially in light of the continuing drought. Information related to streamflow and recharge on the Babocomari River is insufficient for the above analysis to be performed for that watershed.

Although monitoring of groundwater level trends provides an indicator of the sustainability of the groundwater system, groundwater level data alone has limited application for the assessment of impacts from future actions. A more comprehensive tool for predicting future groundwater conditions is a regional groundwater model.

Groundwater Flow Model of the Sierra Vista Subwatershed

Groundwater models simulate groundwater flow and assess impacts of groundwater withdrawals and artificial recharge (Horak et al. 2008). In 2007, the USGS published a calibrated[3] groundwater flow model for the Upper San Pedro Basin (Pool and Dickinson 2007). The model covers the entire Upper San Pedro Basin watershed in Mexico and extends downstream to the USGS gage near Tombstone. The groundwater model is based on the USGS Modular Three-Dimensional Groundwater Flow Model (MODFLOW). MODFLOW is able to simulate a wide variety of systems and is the worldwide standard for groundwater models (Horak et al. 2008). In 2011, the Upper San Pedro Basin model was updated with the most current pumping and recharge data available and programmed to run a "forward" simulation to the year 2105 using projected pumping and recharge (Lacher 2011). This calibrated and updated groundwater model is the best science available to analyze the potential timing and location of future baseflow conditions. The Fort may only indirectly impact the regional groundwater component of baseflow. Utilizing the model to assess the Fort's impacts on regional baseflow is within the model's intended purpose of evaluating the interactions between surface water and groundwater conditions. More information on the groundwater model is provided in the PBA Groundwater Modeling Report in Appendix G.

Although modeling utilizes historical and current data to calibrate the results and represents the most robust prediction of future conditions, models are not perfect because assumptions must be made to simplify complicated relationships. Modeling of complex natural systems, such as groundwater, requires balancing many conflicting considerations. For a model to be practical, a multitude of variables (not all of which are known or understood) must be distilled into a limited number of algorithms representing the primary relationships between physical processes in the environment. Therefore, any modeling has its limitations:

- In the Upper San Pedro Basin groundwater model the simulated baseflow does not include estimates of stormflow or baseflow from bank storage in the alluvial aquifer from rainfall events. In their calibration of the model, Pool and Dickinson (2007) compared the simulated baseflow to the winter and summer low flows in the San Pedro River at Charleston. This limits the impact of stormflow on the measured flow data; and

[3] "Calibration" is the process whereby a model is validated by comparing model results with actual observations to ensure that the model reasonably represents actual outcomes resulting from observed conditions.

- The natural recharge component of the model is constant throughout the modeling period. As currently configured, the model therefore does not deal with wetter or drier precipitation patterns. Estimating stormflow and including climatic variations would require substantial revisions and recalibration of the model. Understanding model limitations and assumptions adds context to the results and, despite these limitations, the model does provide a reasonable indication of the potential magnitude, timing, and the spatial distribution of the impacts of groundwater withdrawals on baseflow.

The Upper San Pedro Basin groundwater model simulates the regional groundwater component of baseflow from the regional aquifer for various reaches of the San Pedro and Babocomari rivers. The groundwater modeling suggests that groundwater withdrawals from 1940 to 2003 have had an impact on the regional groundwater component of baseflow in the San Pedro and Babocomari rivers (Figure EB19). Based on the groundwater model, groundwater withdrawals from all wells in the Upper San Pedro Basin from 1940 to 2003 are estimated to have caused the regional groundwater part of baseflow to decline 1 to 2 cfs in the Babocomari River. Declines in the regional groundwater component of baseflow in the Babocomari would have downstream effects in the San Pedro River at the Tombstone gage (PBA Section 3.5.3). The modeled San Pedro River baseflow at the Tombstone gage is calculated to have declined by 2 to 3 cfs due to groundwater withdrawals. In contrast, Kennedy and Gungle (2010) determined that there were minimal impacts to the San Pedro River at the Tombstone gage due to groundwater withdrawals from the regional aquifer through 2009. However, their analysis did not include the Babocomari River. Current groundwater modeling suggests that declines in Babocomari River flows due to groundwater withdrawals from 1940 to 2003 are a factor in the decline in streamflow observed at the Tombstone gage on the San Pedro River (Lacher 2011).

Water Resource Summary

San Pedro River baseflow has declined in the 20th century largely due to changes in precipitation patterns and increases in riparian water consumption resulting from expansion of the riparian forest (Thomas and Pool 2006, Pool and Dickinson 2007, Leake et al. 2008, Kennedy and Gungle 2010). Groundwater withdrawals from the regional aquifer have yet to measurably impact flows in the mainstem San Pedro River upstream of the Tombstone gage (Thomas and Pool 2006, Kennedy and Gungle 2010, Lacher 2011). In the last decade (2000 to 2010), the San Pedro River low flows have been relatively stable based on USGS streamflow measurements, vertical gradients between the alluvial and regional aquifer as measured by the paired monitoring wells, environmental isotope data, and the wet/dry mapping of the San Pedro River.

However, groundwater levels continue to decline in parts of the regional aquifer due to groundwater withdrawals. Eventually without other action, these groundwater withdrawals from the regional aquifer will impact the regional groundwater component of baseflow to the San Pedro and Babocomari rivers. Previous USGS studies (Thomas and Pool 2006, Kennedy and Gungle 2010) did not include the Babocomari River in their analyses. Groundwater modeling performed by Pool and Dickinson (2007) and Lacher (2011) simulated declines in the Babocomari River regional groundwater component of baseflow due to groundwater withdrawals from all wells in the regional aquifer from 1940 to 2003 (Figure EB19).

Water Use and Accounting

As discussed in the previous sections, groundwater withdrawals can result in the loss of water in streams, wetlands, and riparian systems that are connected to the regional aquifer. The operations of Fort Huachuca will require continued groundwater withdrawals. However, the Fort's groundwater withdrawal is counterbalanced by conservation measures such as stormwater recharge, recharge of wastewater, and the purchase of conservation easements, all of which either replenish groundwater or reduce current or future withdrawals.

The following sections present the historical groundwater withdrawals by Fort Huachuca and the City of Sierra Vista, the method used to estimate the Fort-attributable population, and a description of the groundwater demand accounting system developed by the Fort to determine impacts to the San Pedro and Babocomari rivers flows. The groundwater demand accounting includes estimates of Fort-attributable groundwater demand, Fort-attributable groundwater recharge, and Fort credits for water savings through the purchase of conservation easements. These estimates are important inputs to the groundwater model to determine the spatial and temporal impacts of Fort-attributable groundwater demand and recharge.

Groundwater Withdrawals

Almost all on-post Fort Huachuca water use is met by pumping groundwater. Eight wells on Fort Huachuca are water supply wells with well depths between 710 and 1,230 ft. Two of the wells (800 gal/min pump capacity) on the East Range are used for non-potable uses as the water is not treated, and six wells (500-700 gal/min pump capacity) in the cantonment are the potable water source for the Installation. Another five wells support military testing and research across the Fort and have minimal production.

The total amount of groundwater pumped by Fort Huachuca in 2011 was 1,030 AF and in 2012 was 986 AF. Groundwater withdrawals at the Fort have decreased by over 65 percent since 1993 during the same time that employment at the Fort has increased (Figure EB20). This reduction in water use occurred as a result of water policy and water conservation programs at the Fort. Conservation efforts included installation of a new irrigation system at the golf course, conversion of the golf course to a desert course, the use of treated effluent for outdoor irrigation, demolition of World War II buildings and water infrastructure, and leak detection surveys and repairs. As a result of its decreased water use, Fort Huachuca's wastewater effluent production has declined from 1,013 AF in 2001 to 662 AF in 2011.

The primary pumping centers supporting Fort Huachuca and the area are in Sierra Vista and Huachuca City. Like virtually all of the Sierra Vista Subwatershed, Sierra Vista and Huachuca City depend entirely on groundwater. The municipal water wells servicing the incorporated areas of Sierra Vista and Huachuca City are within six miles of Fort Huachuca. The larger commercial water companies are Liberty (Bella Vista) Water Company, Arizona Water Company, and Pueblo del Sol Water Company. The groundwater withdrawals by the companies in Sierra Vista (excluding the Fort) are presented in (Figure EB21).

Fort Huachuca Attributable Population

Section 321 of the 2004 National Defense Authorization Act limited the federal responsibility under Section 7 of the Endangered Species Act for cumulative effects of water consumption

attributable to the Fort's present and future operations.[4] Consistent with Section 321, groundwater withdrawals attributable to Fort Huachuca (direct, indirect, interrelated and interdependent effects) are derived from the number of people who live in the Sierra Vista Subwatershed due to the presence of Fort Huachuca. The Fort-attributable population consists of the direct civilian, military, and contractor personnel employed by the Fort, the indirect population associated with those personnel (family members), and the induced population of persons whose employment arises from the expenditures of the direct and indirect population. The following sections describe how the estimated Fort-attributable population was derived.

Fort Huachuca Direct Population

The direct population attributable to the Fort is obtained by an annual census of the number of permanent party military, civilians, and contractors who are working on the Fort on 30 September. The full-time equivalent student number is calculated by dividing the total number of training days for all courses including weekend days during the training courses by 365. The population is increased by the number of full-time equivalent students in training throughout the fiscal year ending on 30 September.

Fort Huachuca Indirect Population

The Fort's indirect population is the family members of the direct population. The direct population number is multiplied by a factor developed from the demographic survey. Fort Huachuca conducted a demographic survey to determine the number of family members attributable to the direct population as well as the extent of the double counting of employees and family members associated with the Fort. Some family members may be both directly employed by the Fort and also be dependents of other direct personnel (PBA Appendices H and J).

Factors determined from the demographic survey were used to correct the indirect population numbers for family members and the actual population numbers for people who fall into multiple categories (PBA Appendix H). Table EB2, adjusted for double counting, provides the population for all military, government civilian and contractor personnel, military retirees, family members, and survivors associated with Fort Huachuca in 2011.

Fort Huachuca Induced Population

The Fort-attributable induced employment from the direct and indirect expenditures of the Fort is estimated to be 5,242 for 2011. These values are derived from the Impact Analysis for Planning (IMPLAN) for Fiscal Year 2011 expenditures (PBA Appendix I). Corrected for double counting and including family members associated with the induced employment the total induced population for 2011 is estimated to be 8,137 (PBA Appendix J). Based on the demographic analysis using the results from the 2012 Demographic Survey (PBA Appendix H) and the Fiscal

[4] Specifically, Section 321 states "For purposes of Section 7 of the Endangered Species Act of 1973 (16 U.S.C. 1536), concerning any present and future Federal agency action at Fort Huachuca, Arizona, water consumption by State, local, and private entities off of the installation that is not a direct or indirect effect of the agency action or an effect of other activities that are interrelated or interdependent with that agency action, shall not be considered in determining whether such agency action is likely to jeopardize the continued existence of any endangered or threatened species or result in the destruction or adverse modification of designated critical habitat."

Year 2011 IMPLAN modeling, the total Fort-attributable population in the Sierra Vista Subwatershed in 2011 is estimated to be 33,440 (Table EB2 and PBA Appendix J).

Groundwater Demand Accounting

The groundwater demand accounting establishes the amount of the groundwater demand that is attributable to the 2011 operations and activities of Fort Huachuca in the Sierra Vista Subwatershed as part of the overall assessment of Fort Huachuca's potential effects on federally-listed species and associated habitats within the SPRNCA. To make this determination, seven critical numbers are required:

- Direct population in the Sierra Vista Subwatershed attributable to the Fort;
- Indirect population in the Sierra Vista Subwatershed attributable to the Fort;
- Induced population in the Sierra Vista Subwatershed attributable to the Fort;
- Distribution of these populations between urban and unincorporated areas of the Subwatershed;
- Average per capita water use rates for the urban or unincorporated areas of the Subwatershed;
- Amount of treated effluent and stormwater recharged attributable to the Fort; and
- Volume of agricultural pumping for irrigation and future avoided pumping that has been eliminated in perpetuity through the use of conservation easements purchased by the Fort.

From these values, the net groundwater demand attributable to the Fort is determined as follows:

- Groundwater demand of the urban-area population attributable to the Fort is determined by multiplying the direct, indirect, and induced population by an urban-area per capita groundwater demand of 143 gallons per day (gpd) in 2011 (PBA Appendix K);
- Groundwater demand of the population attributable to the Fort who live in unincorporated areas of the Sierra Vista Subwatershed is determined by multiplying the direct, indirect, and induced population by an unincorporated-area per capita groundwater demand of 118 gpd (GUAC 2006);
- Groundwater demand of the industrial activities in the Sierra Vista Subwatershed attributable to the Fort by multiplying the total industrial water use by the Sierra Vista Subwatershed fraction of the total population attributable to the Fort; and
- Net groundwater demand attributable to the Fort is calculated by subtracting the volume of recharge attributable to the Fort, the volume of pumping for agricultural irrigation that has been eliminated in perpetuity with conservation easements, and the future avoided pumping eliminated in perpetuity through conservation easements from the total groundwater use attributable to the Fort.

Net Groundwater Demands Attributable to Fort Huachuca

Net groundwater demand is the sum of the Fort-attributable demand (a negative) plus recharge and "credits" that replenish groundwater or reduce withdrawals elsewhere in the aquifer. The 2011 and 2012 Fort Huachuca groundwater demand calculation is summarized in Table EB3 below. The Net Groundwater Demand Accounting in PBA Appendix K gives a detailed

description of the Fort Huachuca net groundwater demand calculation for 2011 and the results for 2012.

In 2011, Fort Huachuca's total attributable groundwater demand within the Sierra Vista Subwatershed was -5,648 AF. Deducting the artificial recharge "credit" (2,823) and the conservation easement "credit" (1,073 and 299) directly from total gross groundwater demand results in a net groundwater demand (i.e., more groundwater was pumped than recharge, adding to the Subwatershed deficit) of -1,453 AF for Fort Huachuca in 2011 (Table EB3). Applying the same methodology as in 2011 to 2012 data, results in a 2012 net groundwater demand of -1,180 AF (Table EB3). Using the groundwater model, the spatial and temporal impacts on streamflow and evapotranspiration from localized pumping and recharge can be modeled to assess the Fort Huachuca attributable spatial and temporal effects on endangered species and their critical habitat.

Demand Accounting and the Groundwater Model

For any time of interest and location of wells with respect to natural discharge areas, pumped groundwater either reduces groundwater storage or captures streamflow or evapotranspiration. In the case of the Fort Huachuca and Sierra Vista pumping center, the net groundwater demand captures water that would otherwise discharge to the Babocomari or San Pedro rivers or be consumed through evapotranspiration.

The groundwater demand accounting is a snapshot in time and does not account for spatial and temporal patterns in pumping and recharge that could locally affect aquifer storage levels and capture of natural discharge. Despite limitations, the groundwater demand accounting provides the best estimate of the Fort's continuing groundwater demands and its contribution (positive or negative) to the sustainable yield of the regional aquifer. In addition, groundwater demand and recharge estimates used in the groundwater demand accounting are important inputs to the groundwater model.

Prior groundwater demand accounting by Fort Huachuca in the 2007 PBA partitioned its net groundwater demand into pumping which reduces groundwater in storage and pumping that captures natural discharge based on a basin-wide percentage. However, the spatial and temporal impacts of pumping and recharge associated with the Fort's present and future actions are most appropriately analyzed using the updated Upper San Pedro Basin groundwater model. The locations of recharge and groundwater withdrawals can be spatially input into the groundwater model. The groundwater model can then provide estimates of declines in baseflow from the regional aquifer (capture) by year and by location. Therefore the groundwater model is the best tool available to determine the spatial and temporal impacts to the baseflow and evapotranspiration in the San Pedro River associated with the groundwater withdrawals and artificial recharge attributable to Fort Huachuca (PBA Appendix G). The projection of the net groundwater demand accounting to 2022 and the groundwater modeling of the Fort-attributable activities are discussed in PBA Section 5.8 as part of the effects analysis.

Biological Resources

This section describes the plant communities and associated wildlife that occur in the Action Area, which includes Fort Huachuca, the lower Babocomari River, and the Upper San Pedro

River. Detailed descriptions of federally-listed or proposed species and their habitat requirements and known distribution are below in the species' sections.

Fort Huachuca Vegetation and Wildlife

The vegetation of Fort Huachuca is representative of the basin and range region of southeastern Arizona. Plant species composition and vegetation productivity is largely determined by rainfall distribution (as influenced by topography). At lower elevations within the San Pedro River Valley, shrubs and grasses provide sparse vegetative cover, while on the moister slopes of the Huachuca Mountains stands of trees and shrubs predominate. Vegetation types in the lowlands of Fort Huachuca range from shrublands and open grasslands to mesquite-grass savannas. The foothills are covered with oak-grass savannas and oak woodlands and upper elevation vegetation is dominated by pinyon-juniper and pine woodlands (Vernadero Group 2010b). Thirteen vegetation types have been mapped on Fort Huachuca (Table EB4; Figure EB22).

In addition to the upland vegetation types discussed above, Fort Huachuca supports three riparian vegetation types: (1) Sonoran Riparian Deciduous Woodland (Mesquite Bosque Series); (2) Interior Riparian Deciduous Forest (Cottonwood-Willow Series and Mixed Broadleaf Series); and (3) Madrean Montane Riparian Forest. Garden, Huachuca, and McClure Canyons support most of the riparian habitat at Fort Huachuca. These important riparian vegetation types, which occur in narrow linear corridors centered on perennial or intermittent streams, are not included in Table EB4 or Figure EB22 due to lack of data, but represent important high value limited-distribution communities on Fort Huachuca (Vernadero Group 2010b).

The present distribution and composition of vegetation in the area has been affected by a series of natural and human-caused disturbances. These include intense grazing before 1890 (citation), a major earthquake in 1887, fires and heavy rainfall following the earthquake, intermittent drought, woodcutting, and subsequent continued moderate grazing, fire suppression, and troop training. Since the turn of the century, large areas of semi-desert grassland have been invaded by velvet mesquite (*Prosopis velutina*)(Kepner et al. 2002). Other “native” grassland areas have been invaded by Lehmann lovegrass, (*Eragrostis lehmanniana*). Lehmann lovegrass has also been noted as being a strong competitor with the seedlings of Palmer’s agave (*Agave palmeri*), which is a crucial forage plant of the endangered lesser long-nosed bat.

The high wildlife diversity found in the area is directly related to its location and variety of habitat types in this region. The isolation of area mountains from the other mountain ranges results in “sky islands,” isolated spots of high biodiversity separated by lower lying valleys that are typical of the Basin and Range. These areas exhibit a diversity of vegetation types and high proportion of endemic species. In addition, Fort Huachuca’s proximity to Mexico allows some wildlife species to be present that are more commonly associated with the subtropics and that are not known to occur elsewhere in the U.S. As a result, southeastern Arizona possesses one of the greatest diversities of bird species of any similarly-sized region in North America (Krueper 1993, Taylor 1995). More than 400 species occur here each year, and a total of almost 500 species has been recorded (Taylor 1995). According to the Fort Huachuca INRMP (Vernadero Group 2010b), 313 bird species have been found on the Fort.

There are 75 species of amphibians and reptiles known to occur in the Huachuca Mountains and Upper San Pedro River (Corman 1988, Vernadero Group 2010b). Three federally listed or proposed amphibians and reptiles, the Sonora tiger salamander, the Chiricahua leopard frog, and the northern Mexican gartersnake occur or have occurred on Fort Huachuca. One candidate for

federal listing, the Huachuca/Canelo population of the Arizona tree frog (*Hyla wrightorum*), is known to occur in the area (Vernadero Group 2010b).

No native fish have occurred on Fort Huachuca since 1983. The current fish species on Fort Huachuca have been stocked and include rainbow trout (*Oncorhynchus mykiss*), channel catfish (*Ictalurus punctatus*), largemouth bass (*Micropterus salmoides*), bluegill sunfish (*Lepomis macrochirus*), and redear sunfish (*L. microlophus*). Bullhead (*Ameiurus* spp.) has been found in two ponds on Fort Huachuca, as a result of unauthorized releases (Vernadero Group 2010b). Potential habitat is present on Fort Huachuca for two federally-listed fish species: Gila topminnow (*Poeciliopsis occidentalis*) and desert pupfish (*Cyprinodon macularius*), but releases of these species as well as the endangered Gila chub (*Gila intermedia*) during the 1980s had failed by June 1988 (Vernadero Group 2010b).

Upper San Pedro River Riparian Vegetation and Wildlife

This section describes the main riparian vegetation types and general wildlife of the Upper San Pedro River. Most of the information in the section is a summary of the information found in Ecology and Conservation of the San Pedro River (Stromberg et al. 2009).

Riparian Vegetation

Riverine Marshlands – Riverine marshlands are wetlands that develop along perennial streams. They are vegetated by grasses, sedges, and rushes. These marsh plants line the banks of perennial low-flow channels and form pockets in oxbows, scour pools, and beaver ponds (Stromberg et al. 2009). Huachuca water umbel frequently occurs in this type.

Cottonwood/Willow Forests – Fremont's cottonwood and Goodding's willow gallery forest forms a visually prominent element of the San Pedro River corridor. Other co-occurring woody species are narrowleaf willow (*Salix exigua*), seepwillow (*Bacharris salicifolia*), and Emory's baccharis (*Baccharis emoryi*). Cottonwoods and willows are pioneer trees that require moist bare soil for establishment. The historical river flooding and entrenchment in the late 1800s and early 1900s provided the bare moist soil conditions and triggered the establishment of pioneer cottonwood and willow forests. Using aerial photography, Stromberg et al. (2010) estimate that the coverage of the cottonwood/willow riparian forest has increased three-fold from 1955 to 2003. Most of the cottonwood/willow forest colonized land that was mapped as bare ground.

Saltcedar shrublands – Saltcedar or tamarisk (*Tamarix chinensis, T. ramosissima*, or hybrids) is a stress-tolerant pioneer species. It occurs in the riparian zone intermediate between cottonwood and mesquite (Leenhouts et al. 2006). Similar to cottonwoods it requires bare, moist soils for seedling establishment. Saltcedar generally occurs at sites with deep water levels, high soil salinity, livestock grazing, and suppressed winter/spring flooding (Leenhouts et al. 2006). Within the SPRNCA, there is a natural flood regime, salinity is low owing to frequent flooding, and livestock grazing is limited. Thus, water availability likely is a key factor currently influencing the relative dominance of cottonwood, willow, and tamarisk (Leenhouts et al. 2006).

Mesquite Forests – Mesquite is able to grow in a wide range of hydrogeomorphic settings including river floodplains, river terraces, ephemeral washes, alluvial fans, and desert uplands. Mesquite can grow up to 60 ft tall when its roots reach the groundwater table. With increasing

distances from stream channels, mesquite obtain more water from shallow soil layers, and canopy height and cover decline to 15 to 20 ft (Leenhouts et al. 2006). River entrenchment reduces habitat suitability for sacaton grasslands and favors the more deeply rooted mesquite. Mesquite also has become denser in areas once occupied by desert grasslands (Kepner et al. 2002). Livestock grazing and reduced fire frequency may have contributed to the increased abundance of mesquite in the riparian zone and elsewhere.

Sacaton grasslands – These grasslands are dominated by big sacaton (*Sporobolus wrightii*), alkali sacaton (*S. airoides*), vine mesquite (*Panicum obtusum*), and tobosa grass (*Pleuraphis mutica*). The grasslands slow the velocity of flood runoff, trap sediment, enhance infiltration of water, and contribute to the formation of shallow water tables and perennial streams (Stromberg et al. 2009) when they are in the floodplain. Many sites in the San Pedro river watershed were once vegetated by sacaton grasslands and now support mesquite forest or sacaton-mesquite savannahs (Kepner et al. 2002). The shift was largely caused by channel incision, exacerbated by livestock overgrazing. Sacaton grows in the San Pedro river floodplain but is most extensive on the terraces. The terrace grassland may be remnants that persisted after entrenchment (Stromberg et al. 2009).

In 2006, Scott et al. estimated the riparian use of groundwater along the mainstem of the San Pedro River and on the Babocomari River. Because of its extensive acreage, mesquite forest evapotranspiration is responsible for over 50 percent of the groundwater use in the riparian zone of the San Pedro River (Table EB5).

San Pedro River Wildlife

With 61 observed mammal species, the San Pedro River watershed has one the highest concentrations of mammal species in the U.S. (Duncan 1989). Of these mammals, beavers are considered a keystone species that disproportionately affect the hydrology and vegetation of riparian corridors. Beavers were extirpated from the San Pedro River in the in the mid-1980s but were reintroduced in 1999 and 2000. Creation of beaver dams in other ecosystems has been found to reduce stream channel gradient, reduce streamflow velocities, accelerate sediment deposition, and elevate water tables (Stromberg et al. 2009).

The San Pedro River corridor also supports a diverse and abundant community of breeding and migratory birds. The San Pedro River watershed hosts over 100 different breeding bird species from May to August. Bird density and richness are highest in wooded vegetation types, with values highest in the cottonwood/willow forests (Stromberg et al. 2009). In addition over 200 migratory bird species use the San Pedro riparian corridor (Krueper 1993).

The San Pedro River also supports a species rich assemblage of Arizona lowland reptiles and amphibians. There are 63 known species of reptiles and amphibians along the San Pedro River corridor. Many species, especially the native frogs, have declined in abundance. Common, active, desert snakes such as the coachwhip, western diamondback rattlesnake, and gopher snake tend to dominate the observed snake fauna (Corman 1988).

The San Pedro River historically was occupied by 13 native fish species which ranged in size from the tiny desert pupfish and Gila topminnow to the huge Colorado pikeminnow (Minckley 1973, Minckley and Marsh 2009). During the past 150 years, native fish species have declined

or disappeared from the San Pedro River, largely due to human-induced factors and introduction of non-native species. Now the only native fish in the mainstem of the upper San Pedro River are the longfin dace and the desert sucker. Non-native predatory fish include largemouth bass, green sunfish, yellow and black bullheads and constrain the survival and recovery of native fish species in the San Pedro River (Minckley 1986, 1987; Stromberg et al. 2009).

Table EB1. Observed hydrologic conditions of the three riparian condition classes along the San Pedro River, Arizona (Leenhouts et al. 2006).

Condition class	***Streamflow Regime Class***	***Streamflow Permanence (percent)***	***Average Flood-plain Groundwater Depth in Dry Season (feet)***	***Annual Groundwater Fluctuation (feet)***
3	Perennial	100	Less than 6	Less than 1.5
2	Intermittent-wet	Between 100 and 60	Between 6 and 10	Between 1.5 and 3
1	Intermittent-dry	Less than 60	Greater than 10	Greater than 3

Table EB2. Fort Huachuca, Arizona 2011 population adjusted for double counting.

Personnel Category	**Number of people after adjustment for double counting**
Active Military Living on Fort	1,602
Students on Fort	3,045
Military Family Members on Fort	2,806
Active Military Living off Fort	1,195
Military Family Members off Fort	1,742
Government Civilian Households	2,255
Government Civilian Family Members	3,946
Contractors Households	3,229
Contractor Family Members	5,650
Military Retirees	1,260
Military Retirees Family members	1,260
Subtotal	27,990
Less 9.6 percent Living Outside Subwatershed	-2,687
Induced Population	8,137
Total	**33,440**

Table EB3. 2011 and 2012 Fort Huachuca, Arizona, net groundwater demand calculation.		
Water Balance Component	**2011**	**2012**
Fort Huachuca On-Post Groundwater Demand	-1,030	-986
Fort Huachuca Off-Post Groundwater Demand	-4,618	-4,460
Total Groundwater Demand	**-5,648**	**-5,446**
Fort-Huachuca Attributable Recharge	324	355
Sierra Vista Recharge Attributable to Fort Huachuca	1,999	1,894
Septic System Recharge Attributable to Fort Huachuca	500	496
Total Artificial Recharge	**2,823**	**2,745**
Total Groundwater Demand Less Artificial Recharge	**-2,825**	**-2,701**
Credits from Conservation Easements - Retiring Agriculture	1,073	1,073
Credits from Conservation Easements - Avoiding Future Pumping	299	448
Conservation Easement Credits	**1,372**	**1,521**
Net Groundwater Demand	**-1,453**	**-1,180**

Table EB4. Vegetation types present on Fort Huachuca ranges, Arizona (acres)[1].				
Vegetation Type[2]	South Range (acres)	West Range (acres)	East Range (acres)	Total (acres)
Shrubland	0	0	10,414	10,414
Open Grassland	2,872	5,483	0	8,355
Shrub-Grassland	3	1,487	10,805	12,295
Mesquite Woodland	0	0	1,108	1,108
Mesquite-Grass Savanna	4,296	3,687	6,199	14,182
Oak-Grass Savanna	1,703	200	0	1,903
Oak Woodland	7,548	3,961	0	11,509
Mixed Woodland	2,459	510	0	2,969
Pine Woodland	1,800	27	0	1,827
Deciduous Woodland	759	230	18	1,007
Mahogany Woodland	1,117	234	0	1,351
Pinyon-Juniper	318	184	0	502
Urban and Built-Up Land	0	5,270	0	5,720
TOTAL	**22,875**	**21,723**	**28,544**	**73,142**

[1] Boundaries of the South, West, and East ranges are shown in Figure EB22, above.
[2] Riparian vegetation types are not included in this table.
Source: 2007 Programmatic Biological Assessment (ENRD 2007).

Table EB5. Riparian groundwater use in 2003 along the San Pedro River and Babocomari River and from International Border to Tombstone gaging station, Arizona (Scott et al. 2006 in Leenhouts et al. 2006).

Cover Type	**San Pedro River (acres)**	**San Pedro River Groundwater Use (AF)**	**Babocomari River (acres)**	**Babocomari Groundwater Use (AF)**	**Total Groundwater Use (AF)**
Mesquite	1,790-2,400	4,040-5,440	550-830	1,250-1,870	5,290-7,310
Cottonwood/Willow (perennial flow)	625	1,980	0	0	1,980
Cottonwood/Willow (intermittent flow)	291	390	180	240	630
Sacaton (<3 m from groundwater)	280-410	530-780	380-470	720-880	1,250-1,660
Open Water	110	400	10	50	450
Saltcedar	1-3	10-20	0	0	10-20
Total		**7,350-9,010**		**2,250-3,040**	**9,600-12,050**

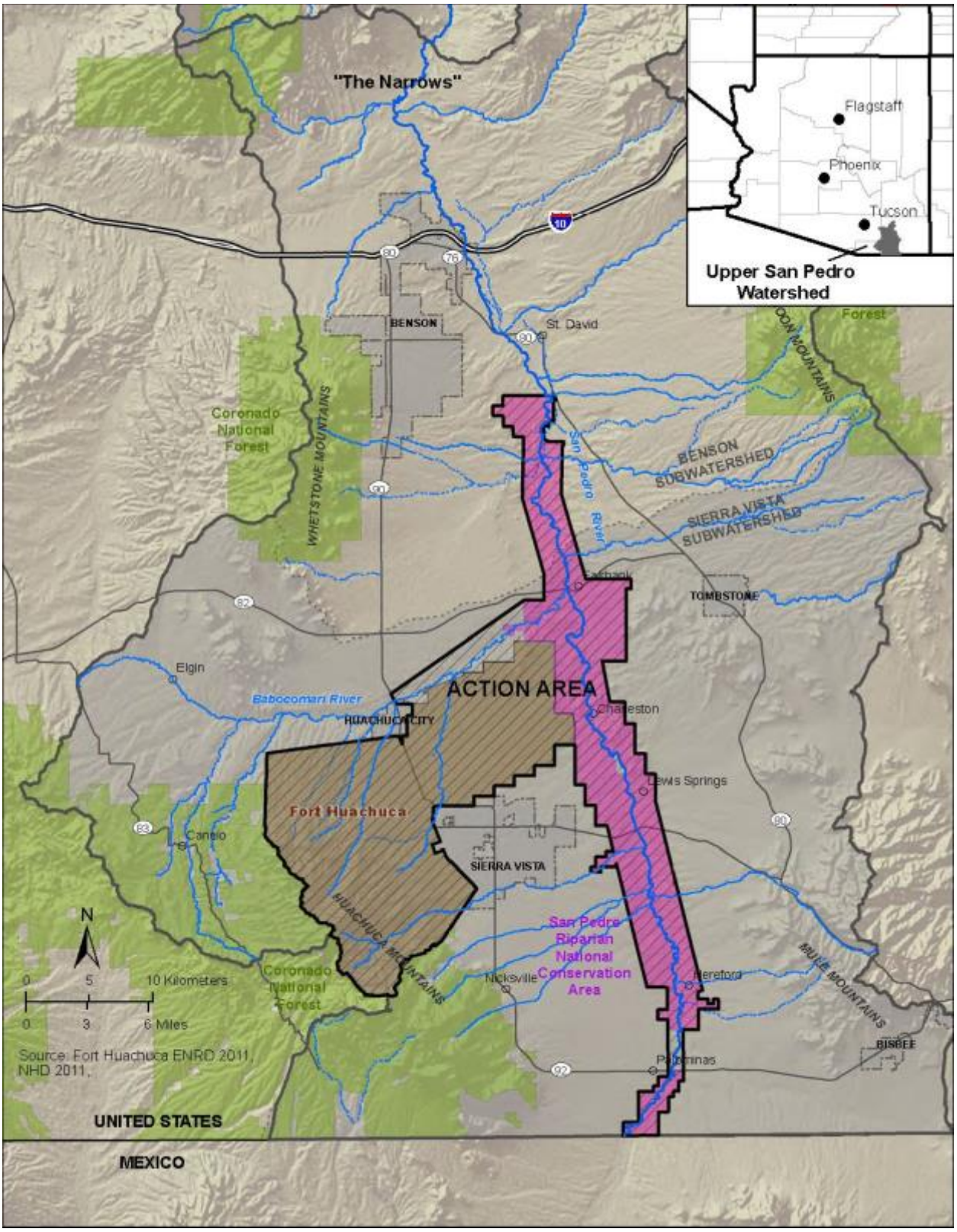


Figure EB1. Action area, Fort Huachuca, Arizona, and vicinity (PBA Figure 1-1).

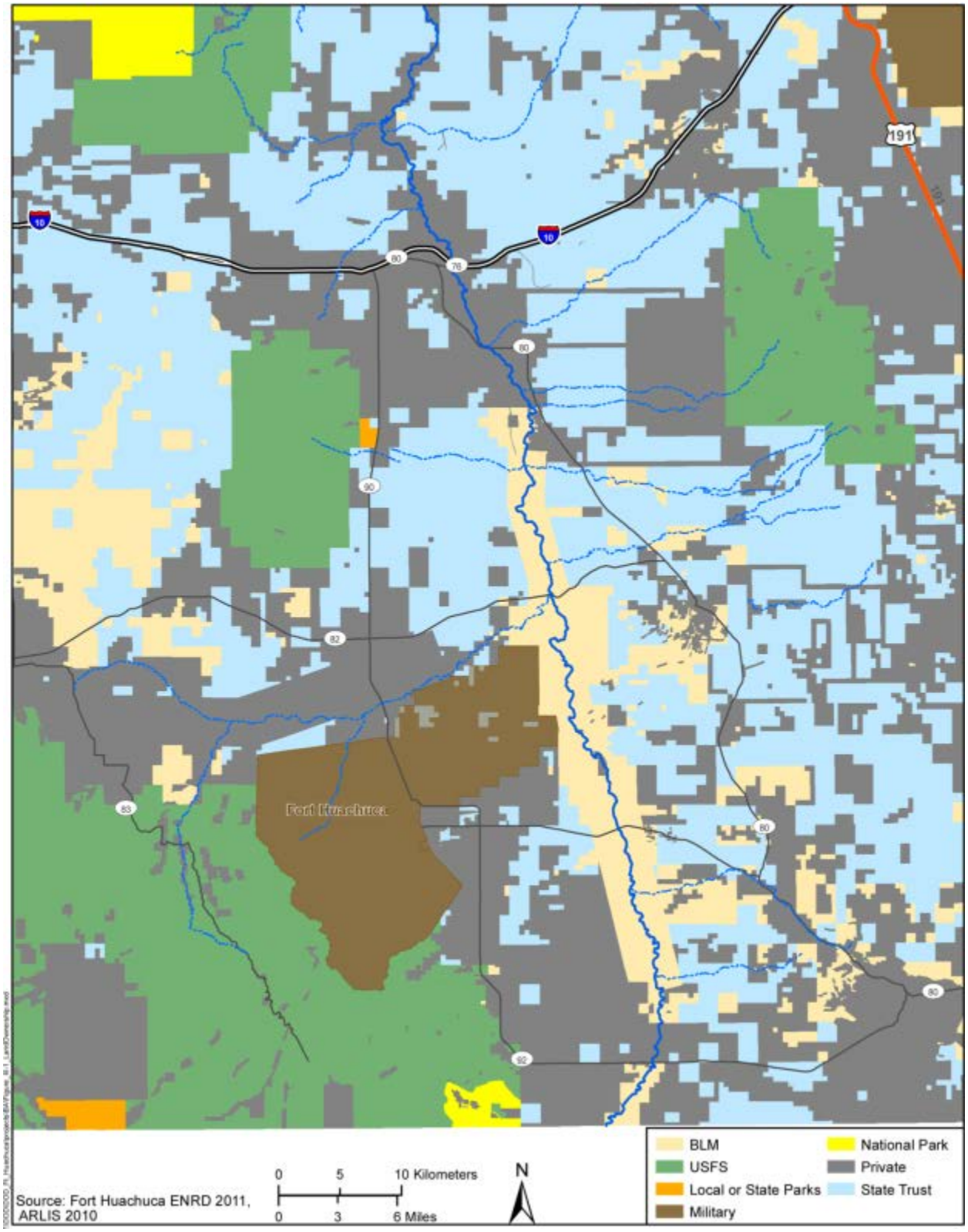


Figure EB2. Land ownership in the Fort Huachuca, Arizona area (PBA Figure 3-1).

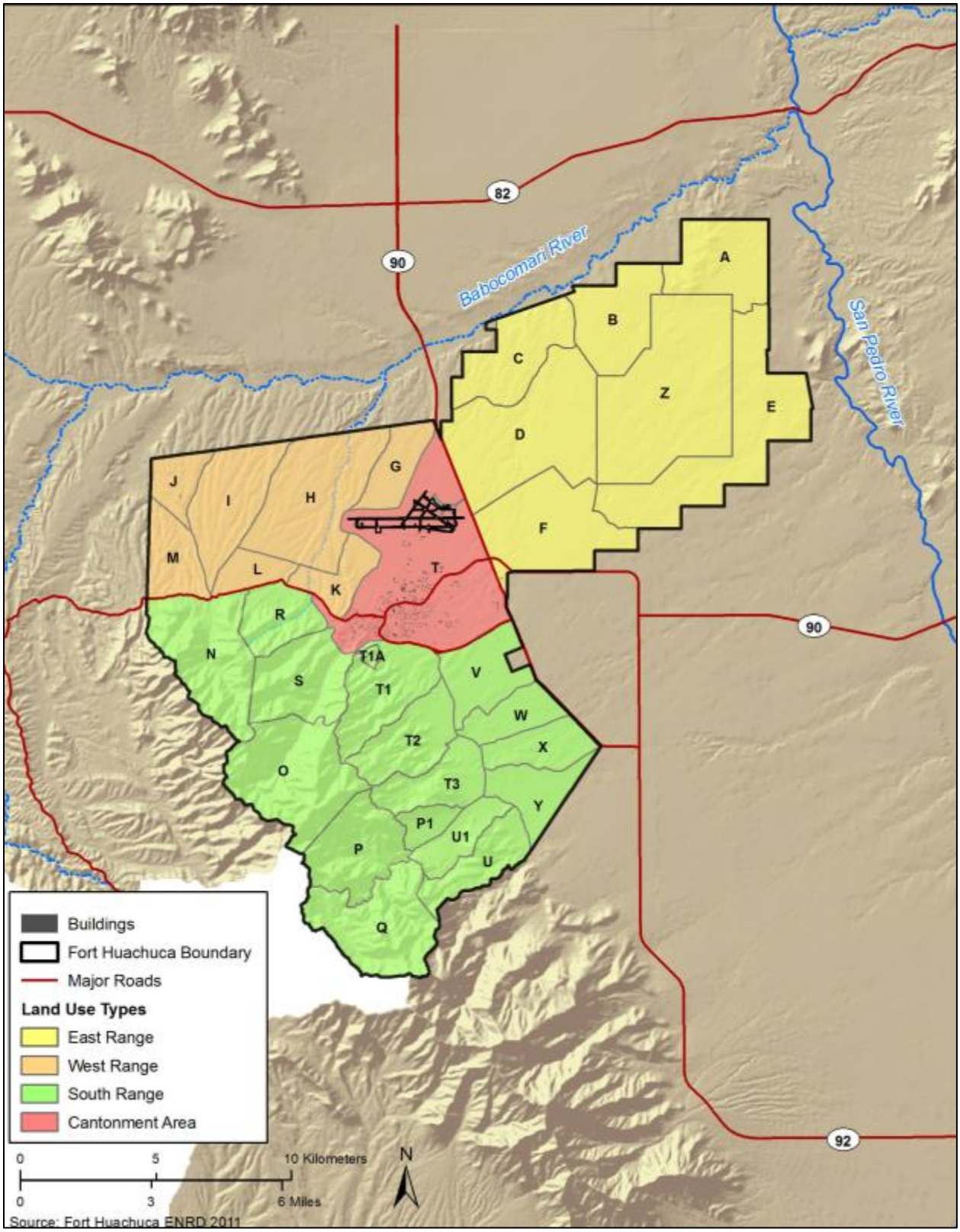


Figure EB3. Fort Huachuca, Arizona land use (PBA Figure 3-2).

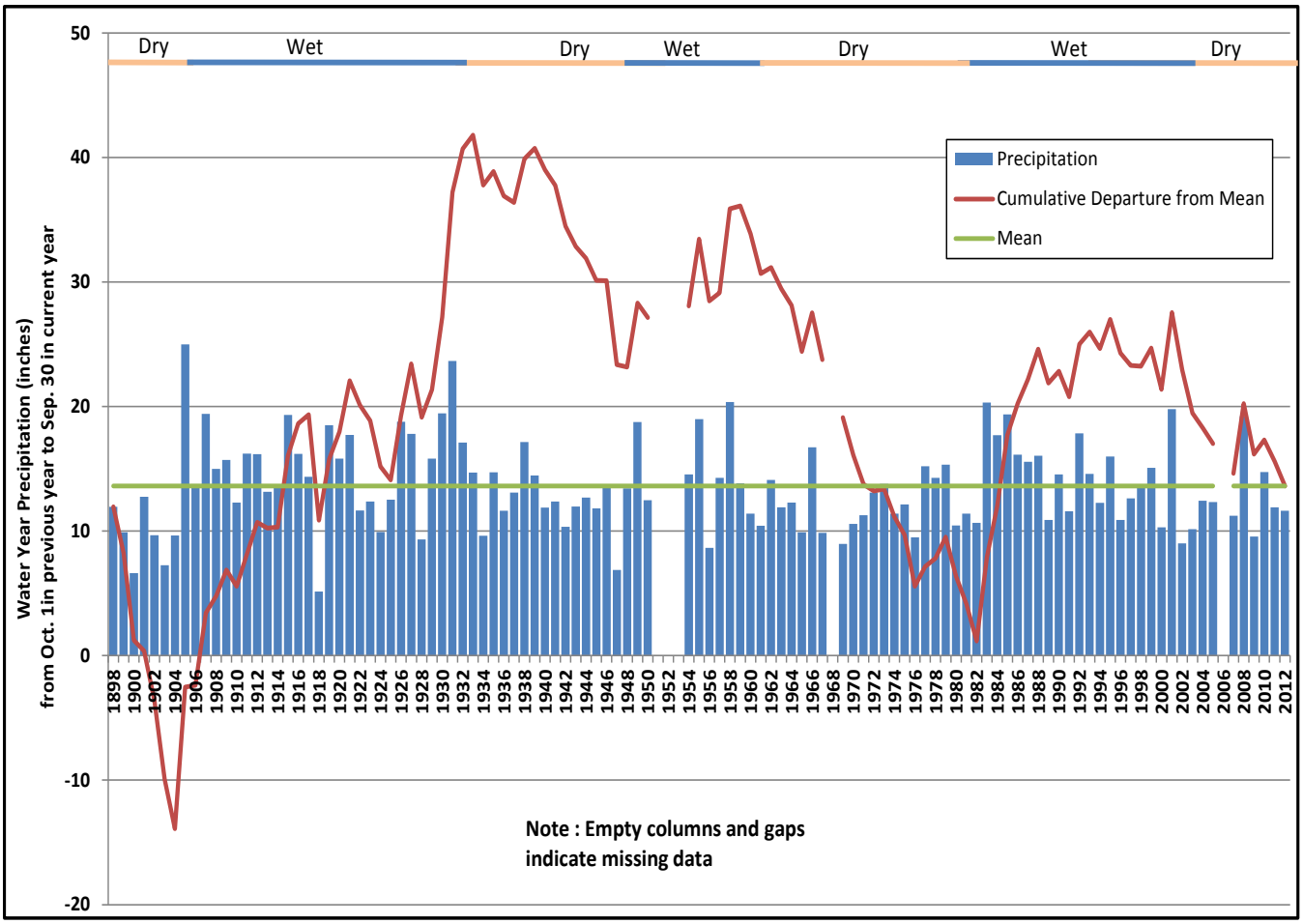


Figure EB4. Cumulative departure from the mean for the Tombstone, Arizona precipitation station from water year 1898 to 2012 (PBA Figure 3-3; WRCC 2013).

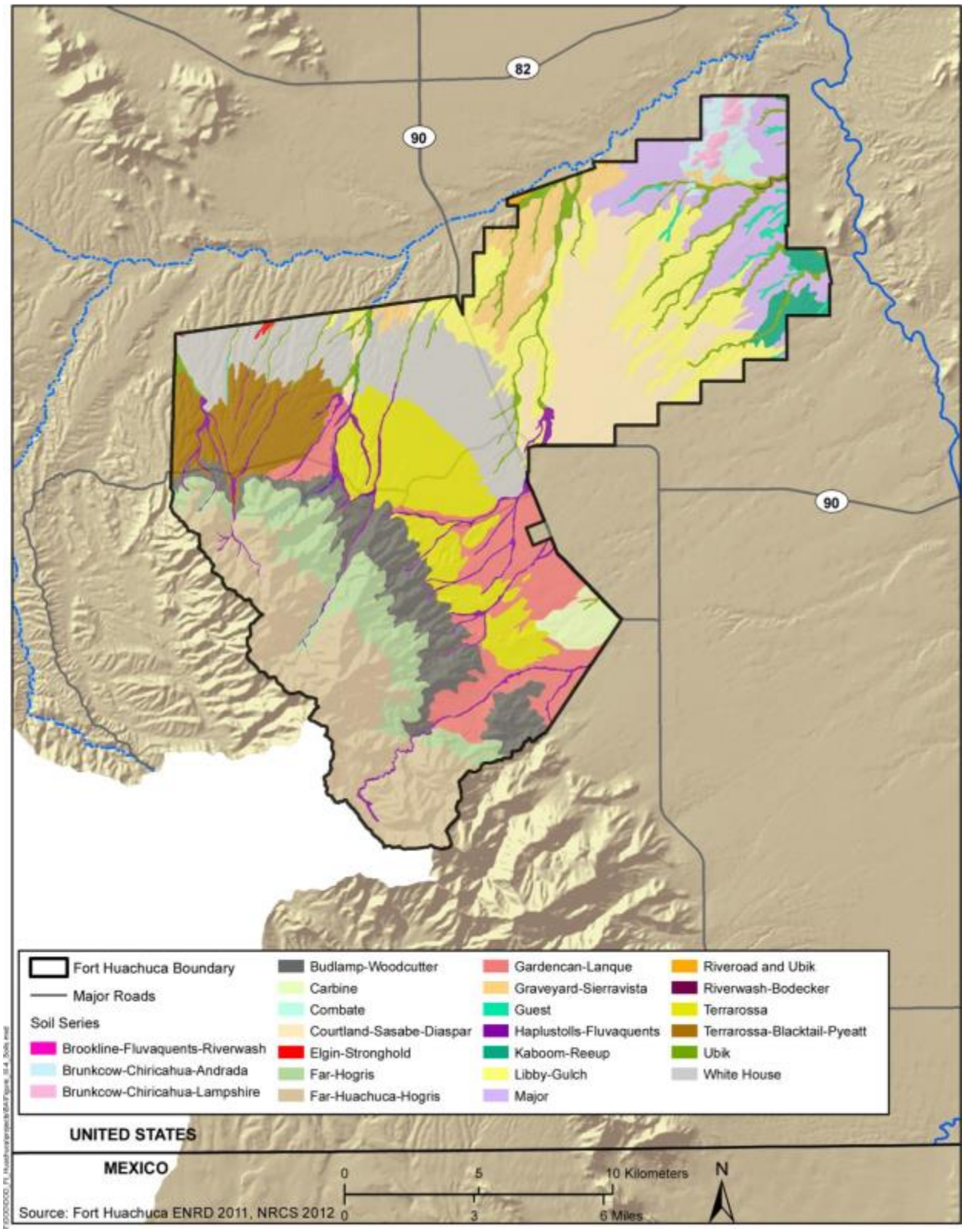


Figure EB5. Soils on Fort Huachuca, Arizona (PBA Figure 3-4).

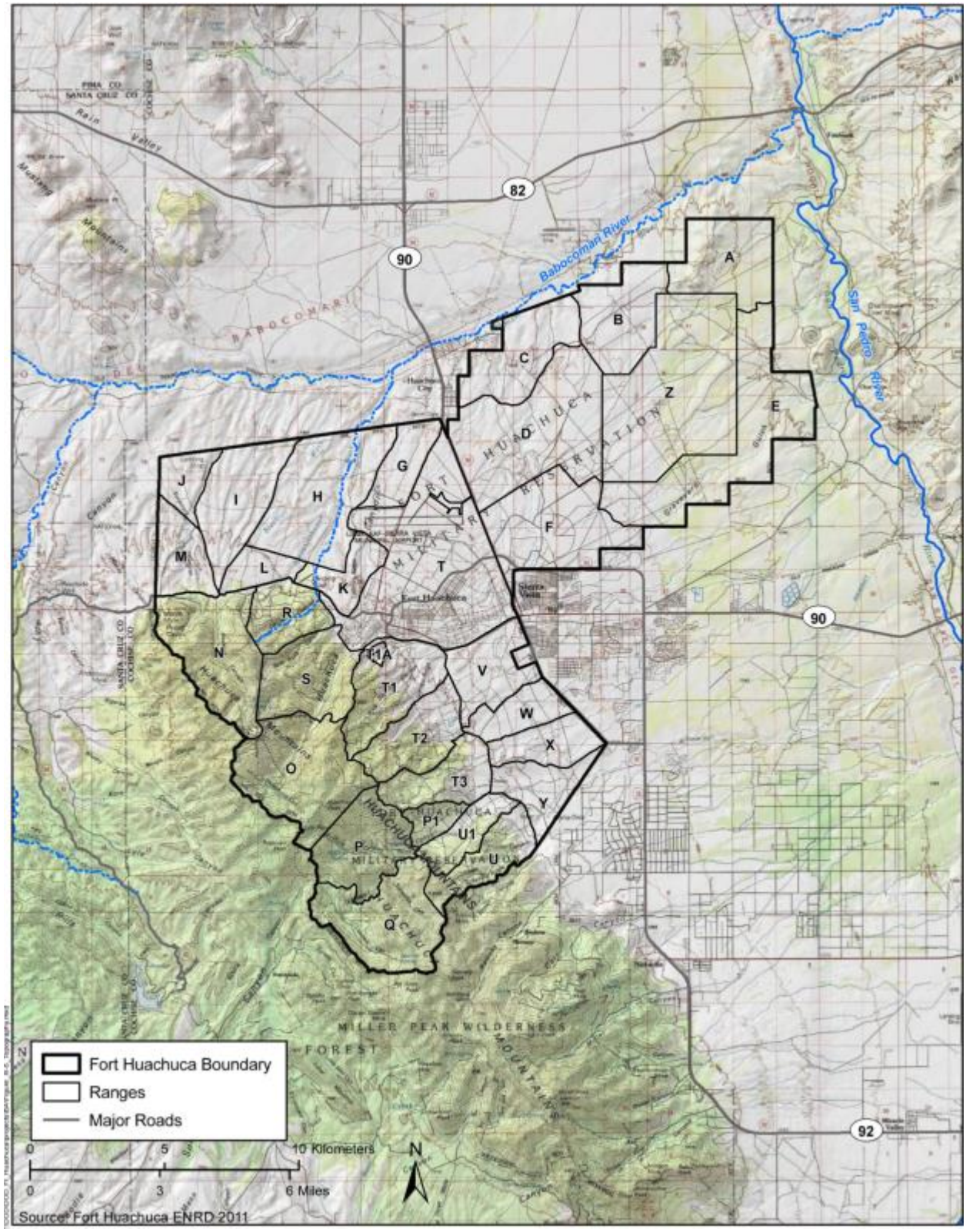


Figure EB6. Topography on Fort Huachuca, Arizona (PBA Figure 3-5).

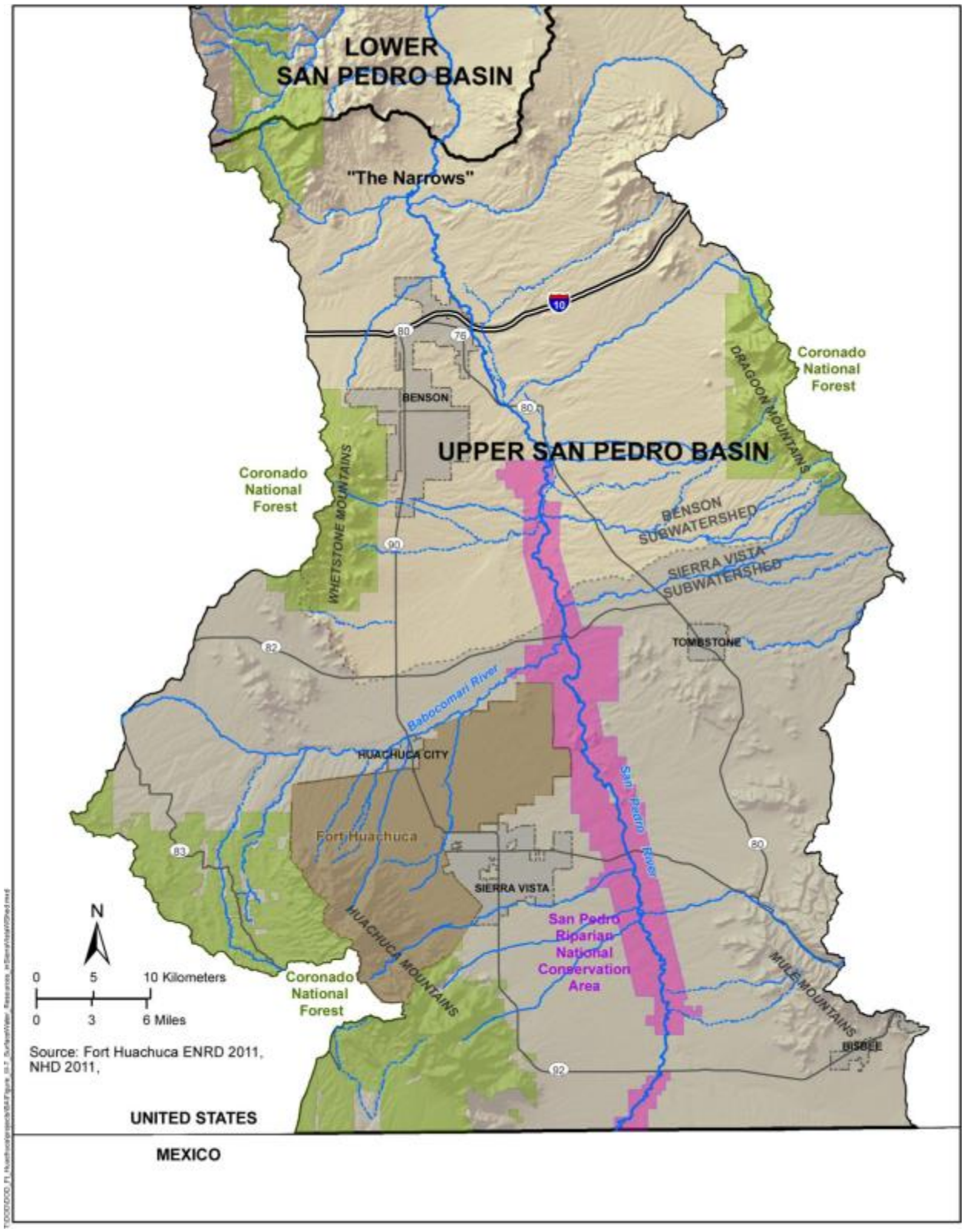


Figure EB7. Upper San Pedro Basin, Arizona (PBA Figure 3-6).

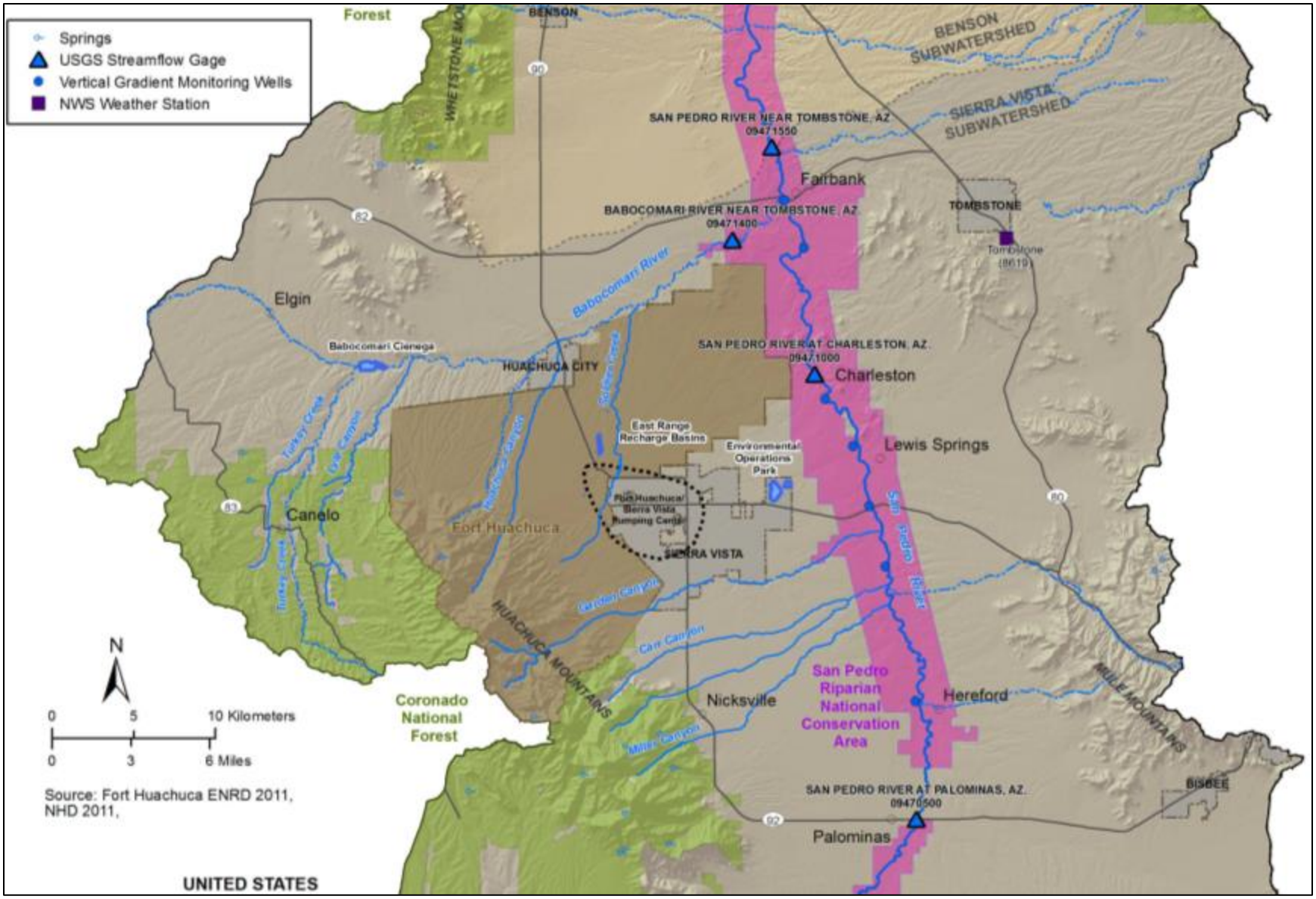


Figure EB8. Surface water wesources in the Sierra Vista Subwatershed, Arizona (PBA Figure 3-7).

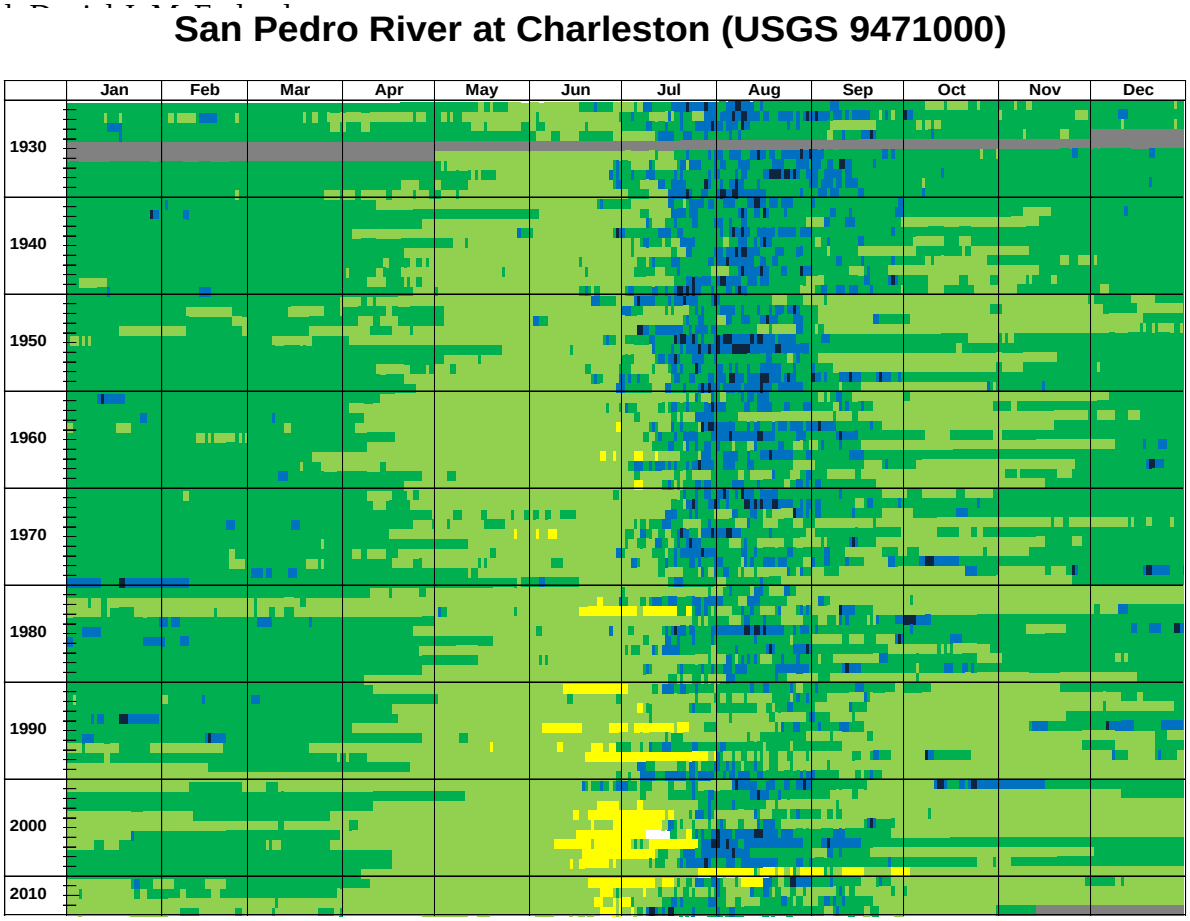


Figure 3-8. Raster Hydrograph of Average Daily Discharge (cfs)

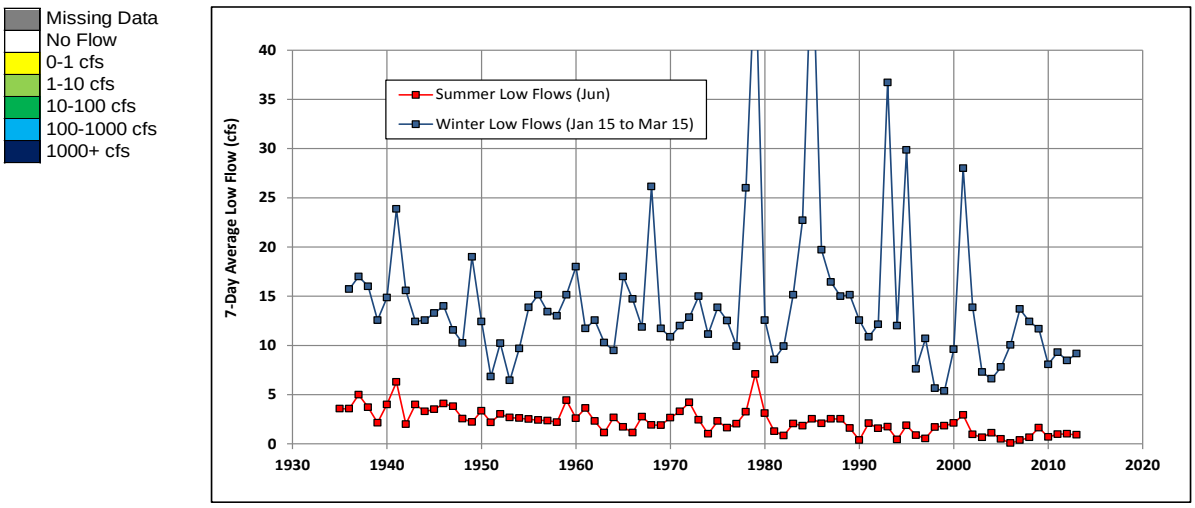


Figure EB9. Raster hydrograph of San Pedro River near Charleston, Arizona (USGS 9471000) average daily discharge (cfs)(PBA Figure 3-8).

Figure EB10. Winter low flows at the San Pedro River, near Charleston, Arizona (PBA Figure 3-9).

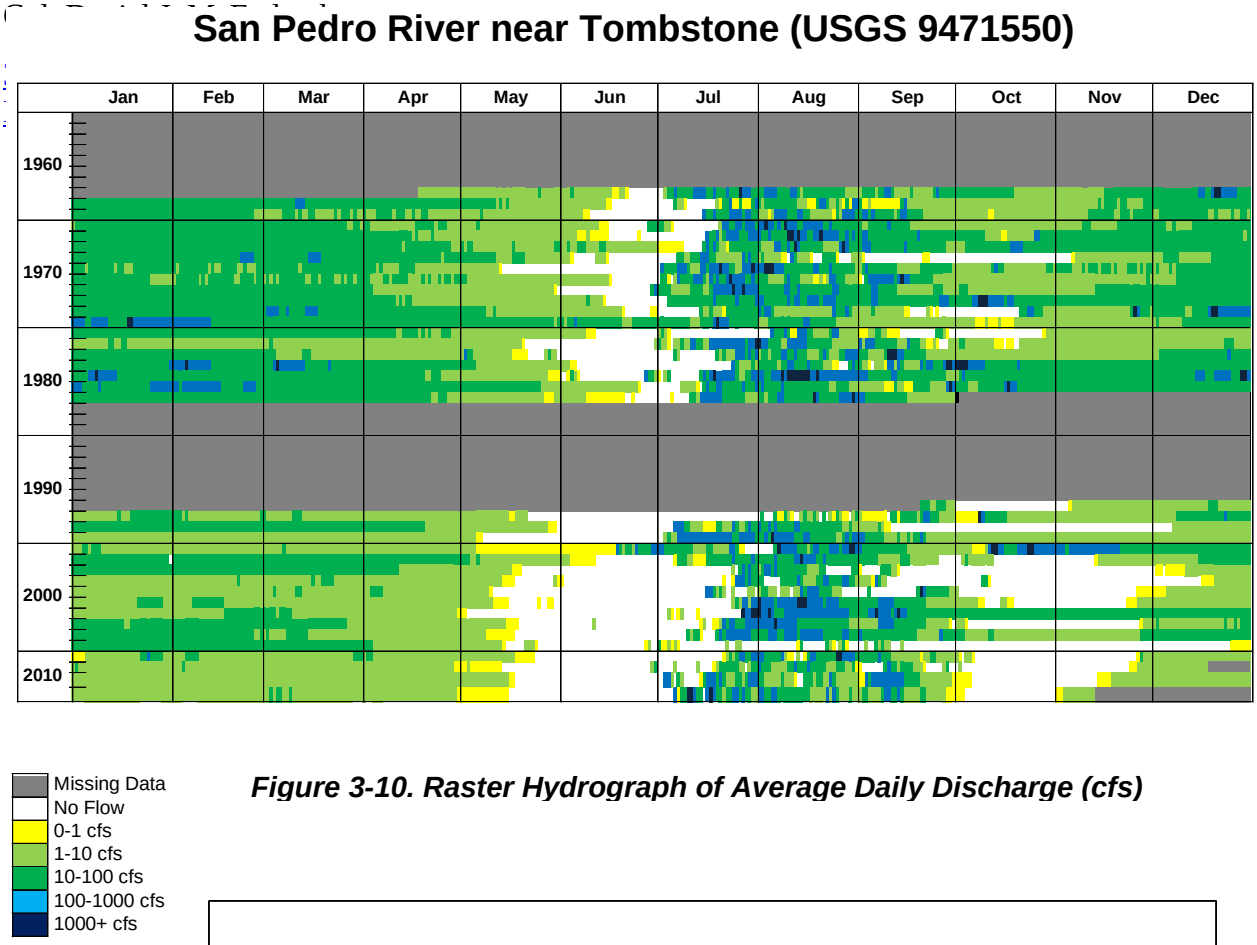


Figure 3-10. Raster Hydrograph of Average Daily Discharge (cfs)

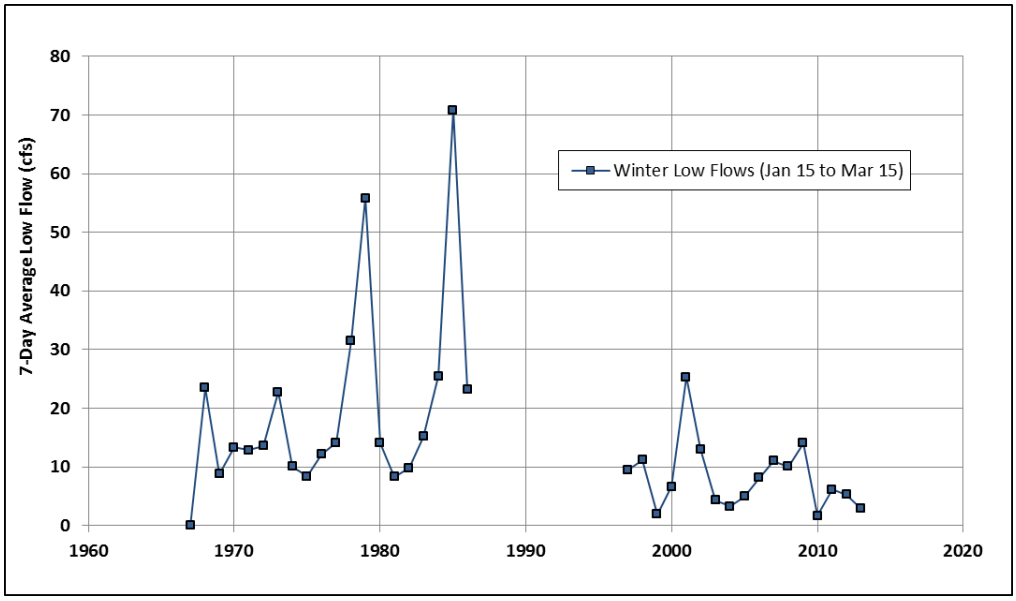


Figure EB11. Raster hydrograph of San Pedro River at Tombstone, Arizona (USGS 9471550) average daily discharge (cfs)(PBA Figure 3-10).

Figure EB12. Winter low flows at the San Pedro River near Tombstone, Arizona (USGS 9471550)(PBA Figure 3-11).

Figure EB13. Raster hydrograph of Babocomari River near Tombstone, Arizona (USGS 9471400) average daily discharge (cfs)(PBA Figure 3-12).

Figure EB14. Winter low flows at the Babocomari River, near Tombstone, Arizona (PBA Figure 3-13).

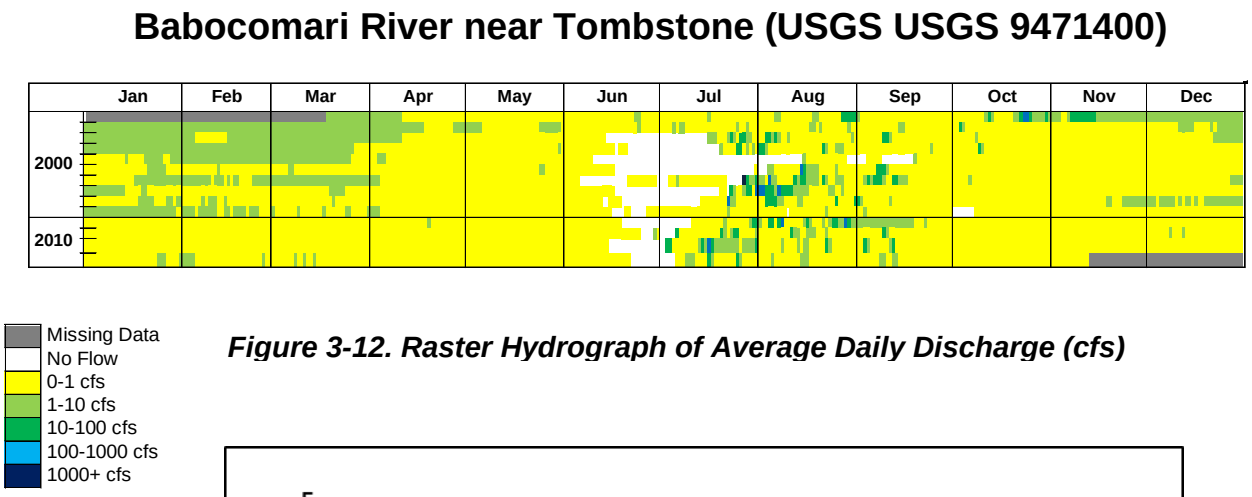
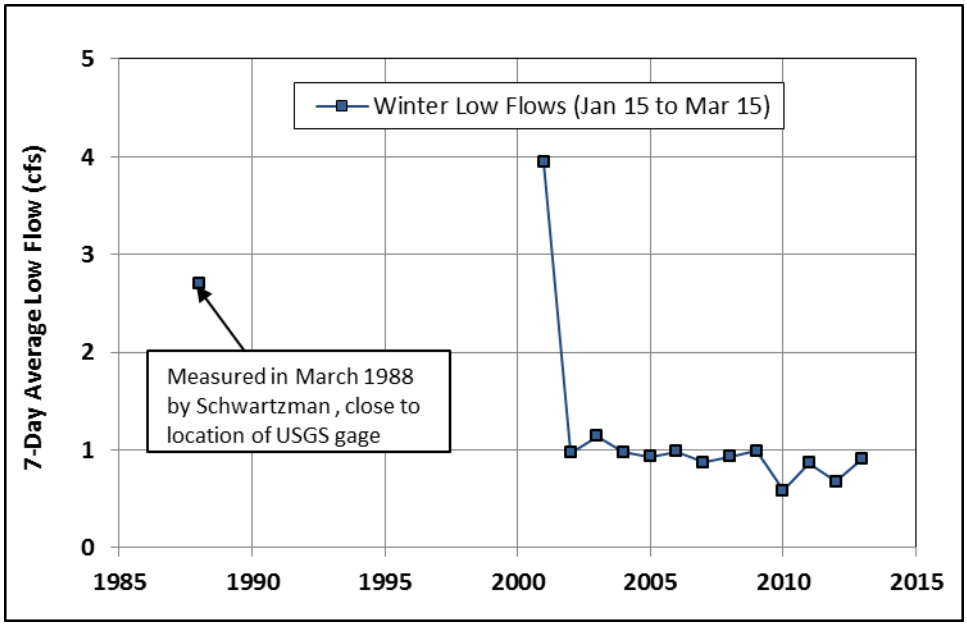


Figure 3-12. Raster Hydrograph of Average Daily Discharge (cfs)



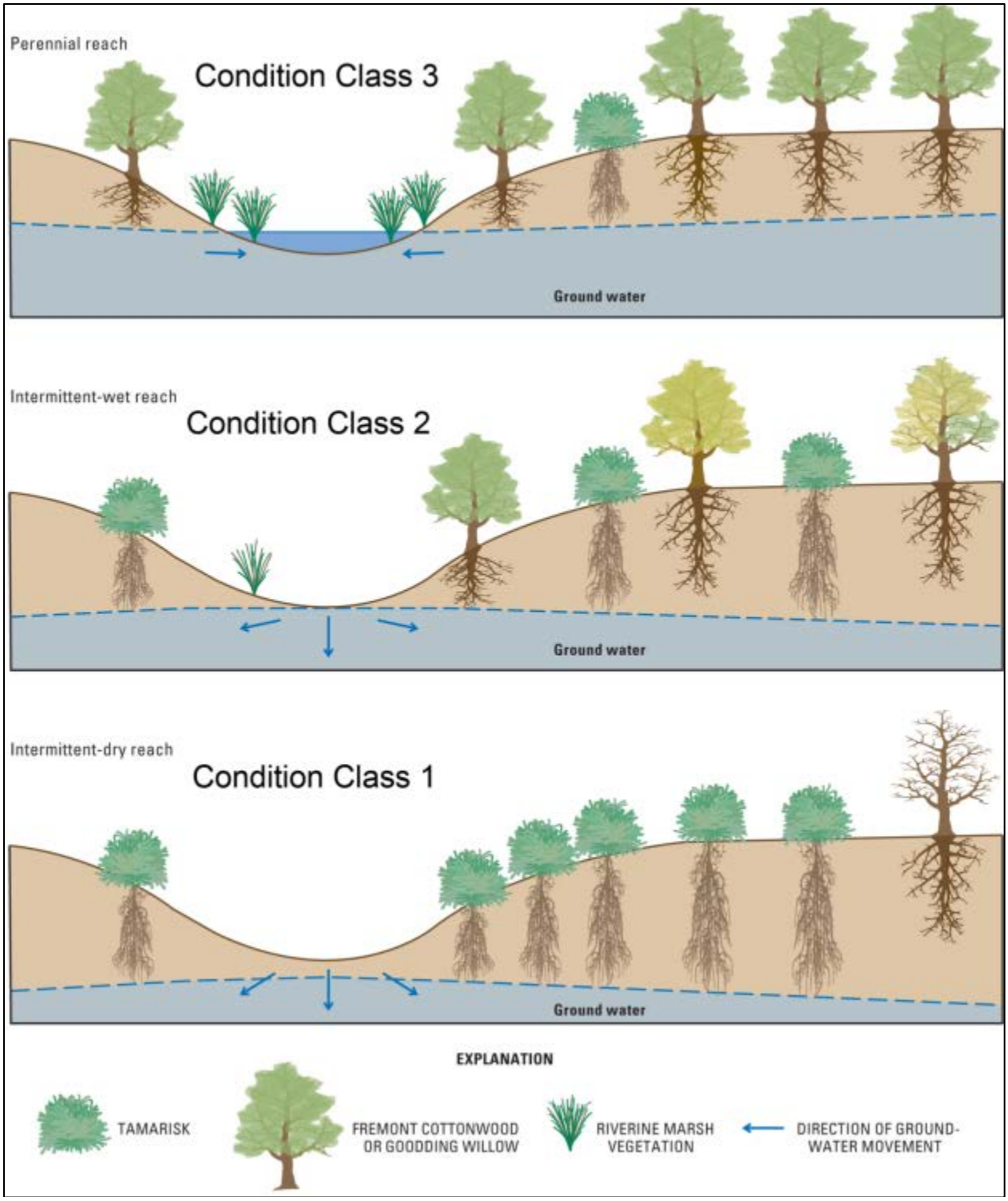


Figure EB15. Schematic diagram depicting the three major riparian condition classes and vegetation patterns along the Upper San Pedro River, Arizona (PBA Figure 3-14; Leenhouts et al. 2006).

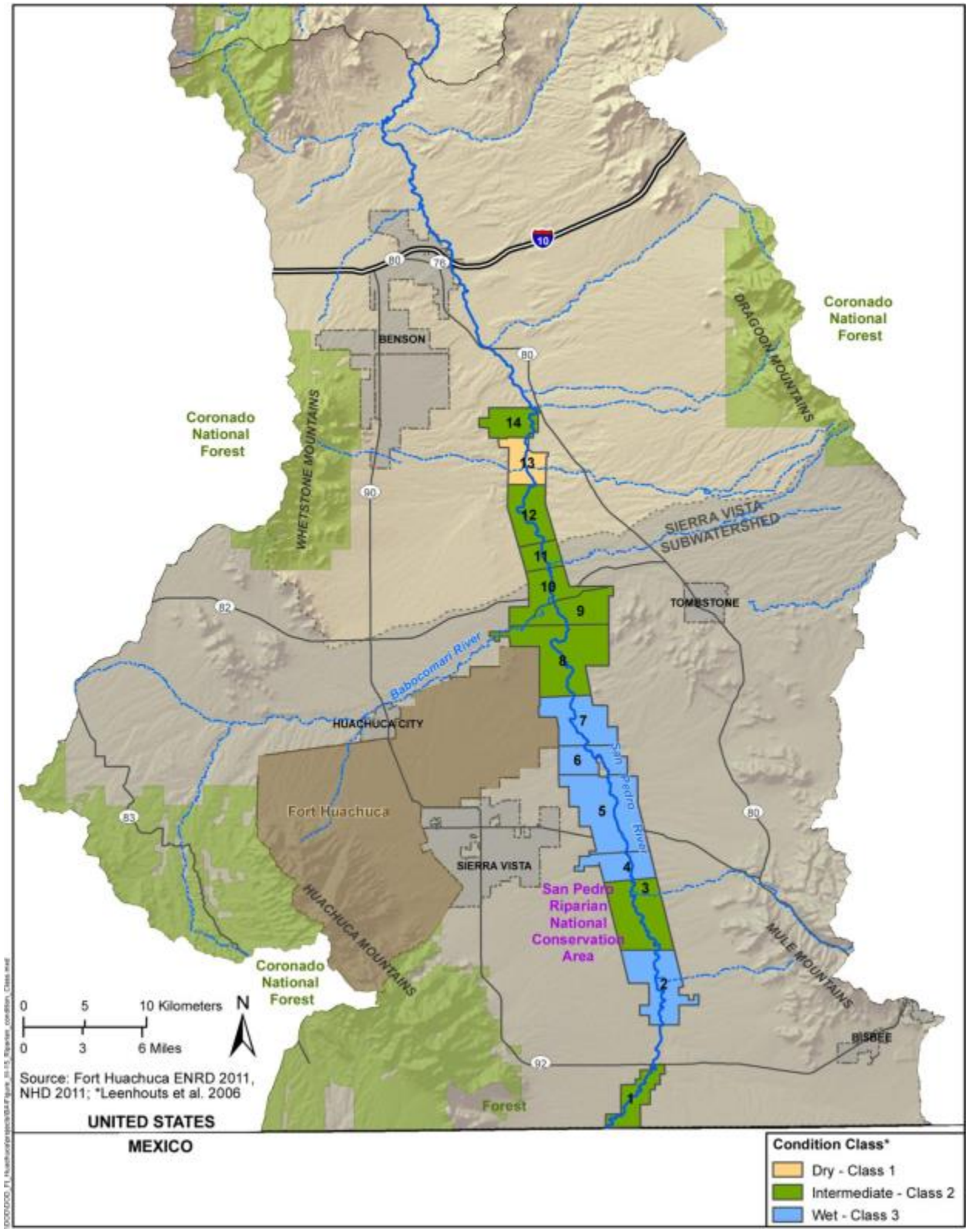


Figure EB16. Riparian condition classes along the Upper San Pedro River, Arizona (PBA Figure 3-15; Leenhouts et al. 2006)

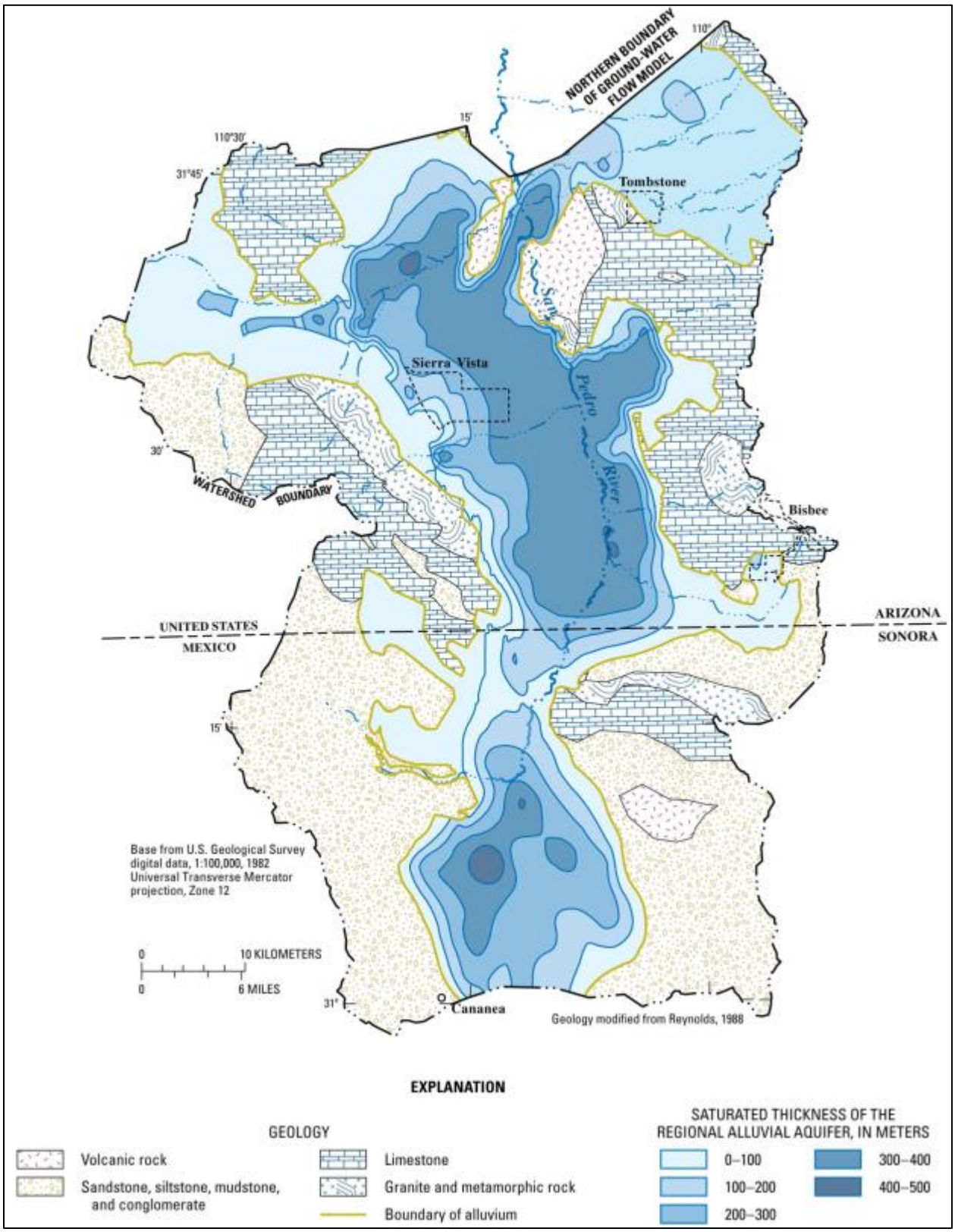


Figure EB17. Geology and saturated thickness of the regional aquifer, Upper San Pedro Basin, Arizona (PBA Figure 3-16; Pool and Dickinson 2007, Fig. 1)

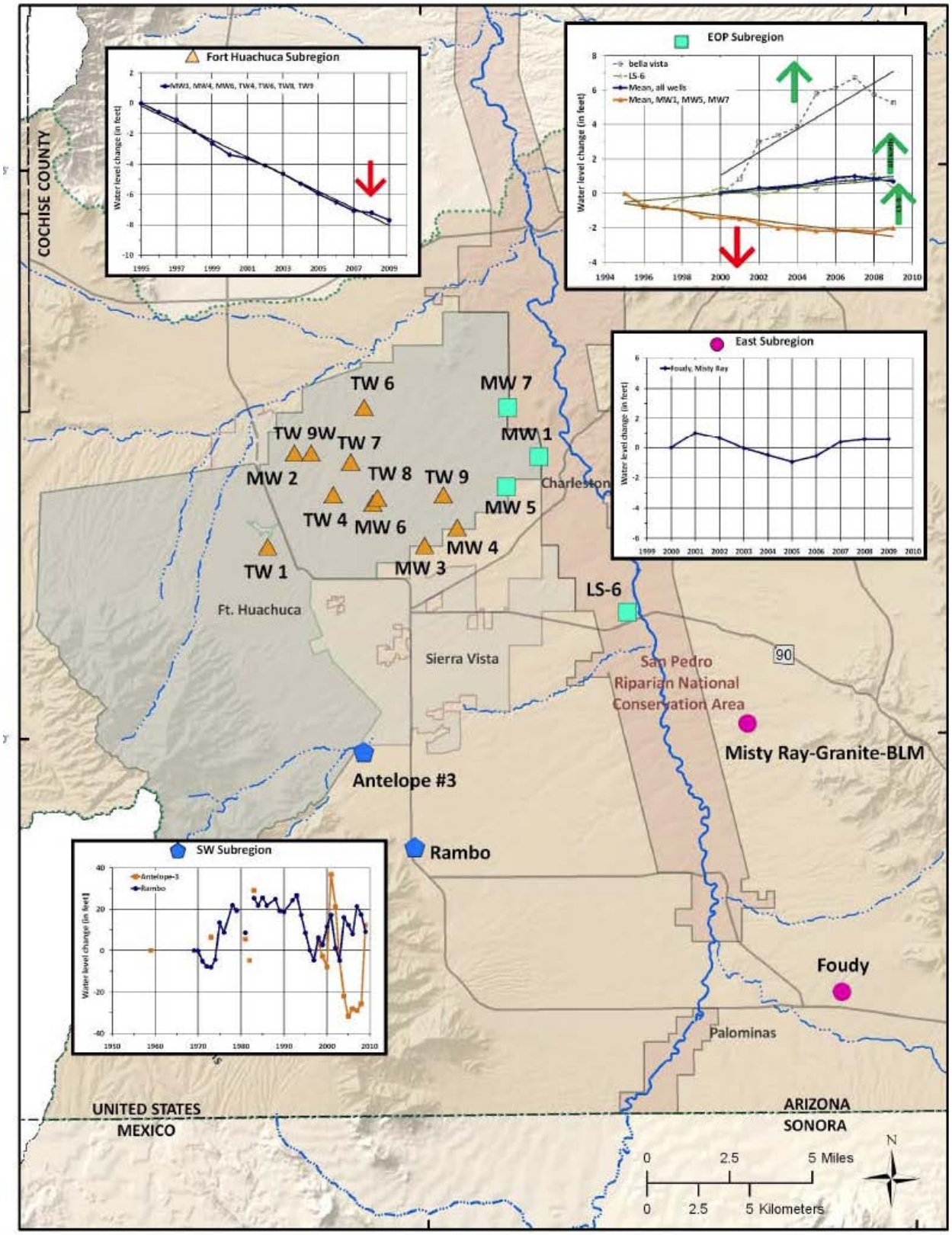


Figure EB18. Long-term of average annual water levels for the regional aquifer (PBA Figure 3-18; 2010 Section 321 Report, Appendix A).

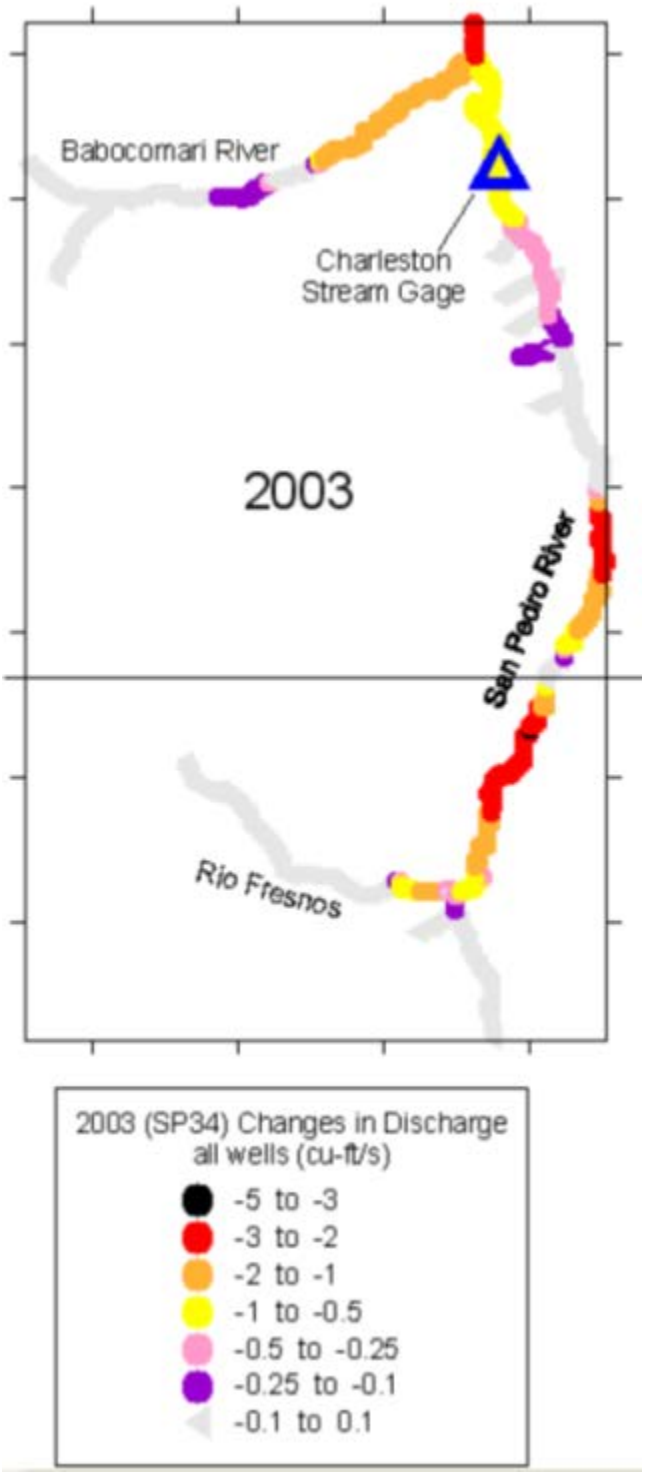


Figure EB19. Simulated changes in stream discharges due to pumping from all wells in the upper San Pedro Basin, Arizona (PBA Figure 3-19, from GeoSystems Analysis, Inc. 2010, Fig. 25).

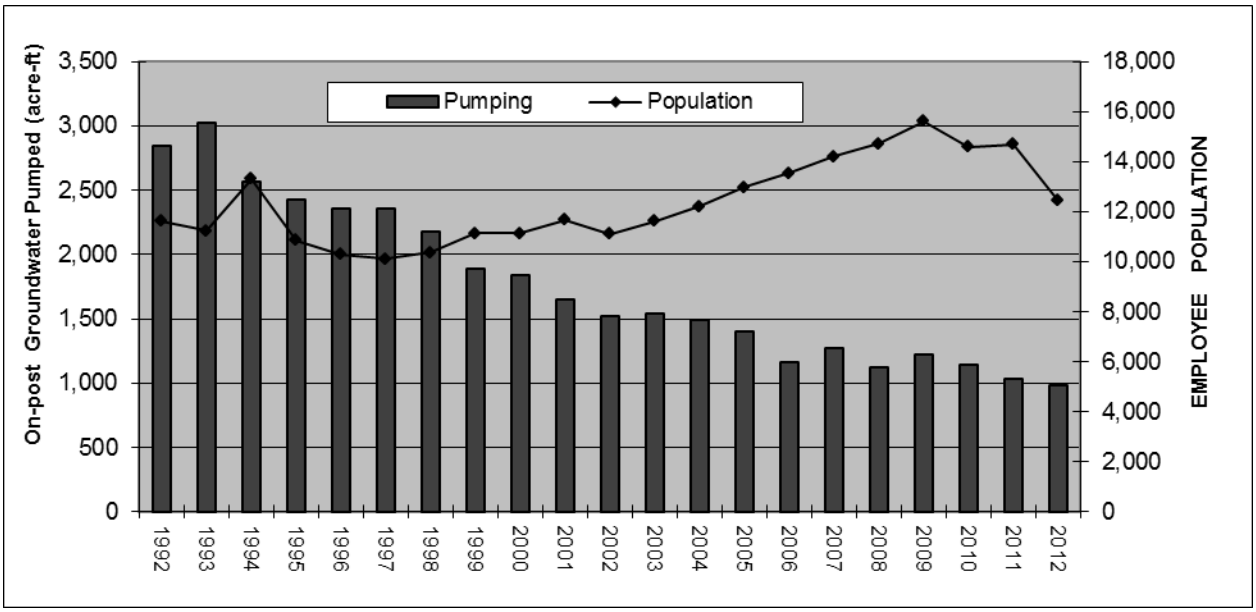


Figure EB20. Fort Huachuca, Arizona, Arizona, groundwater withdrawals (PBA Figure 3-20).

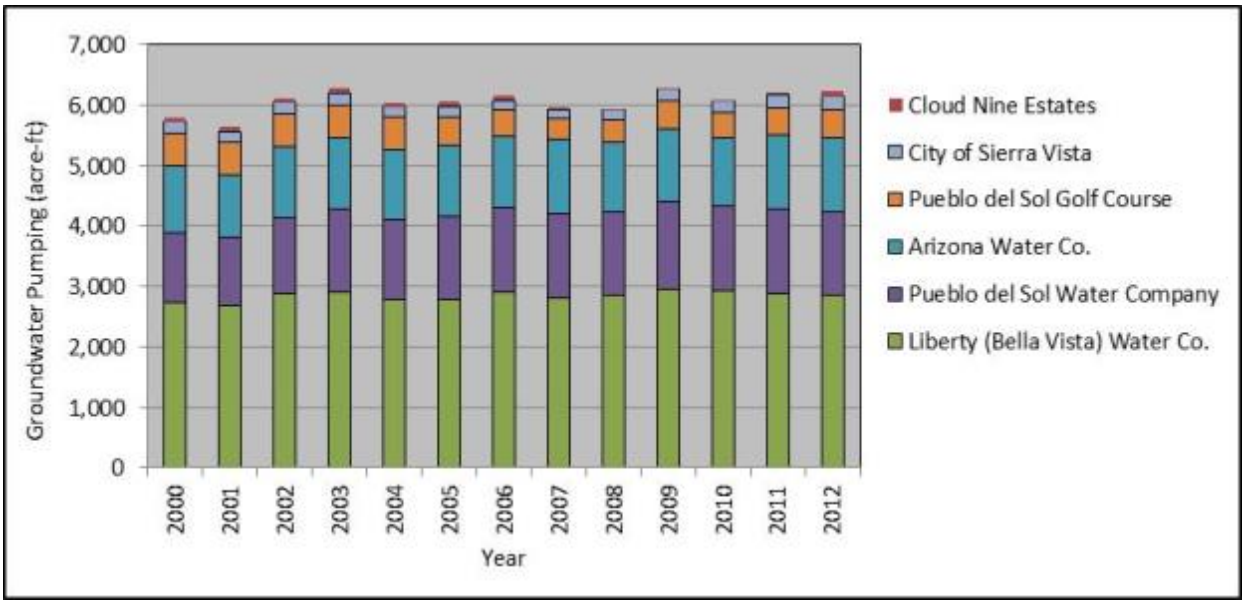


Figure EB21. Sierra Vista, Arizona groundwater withdrawals (PBA Figure 3-21).

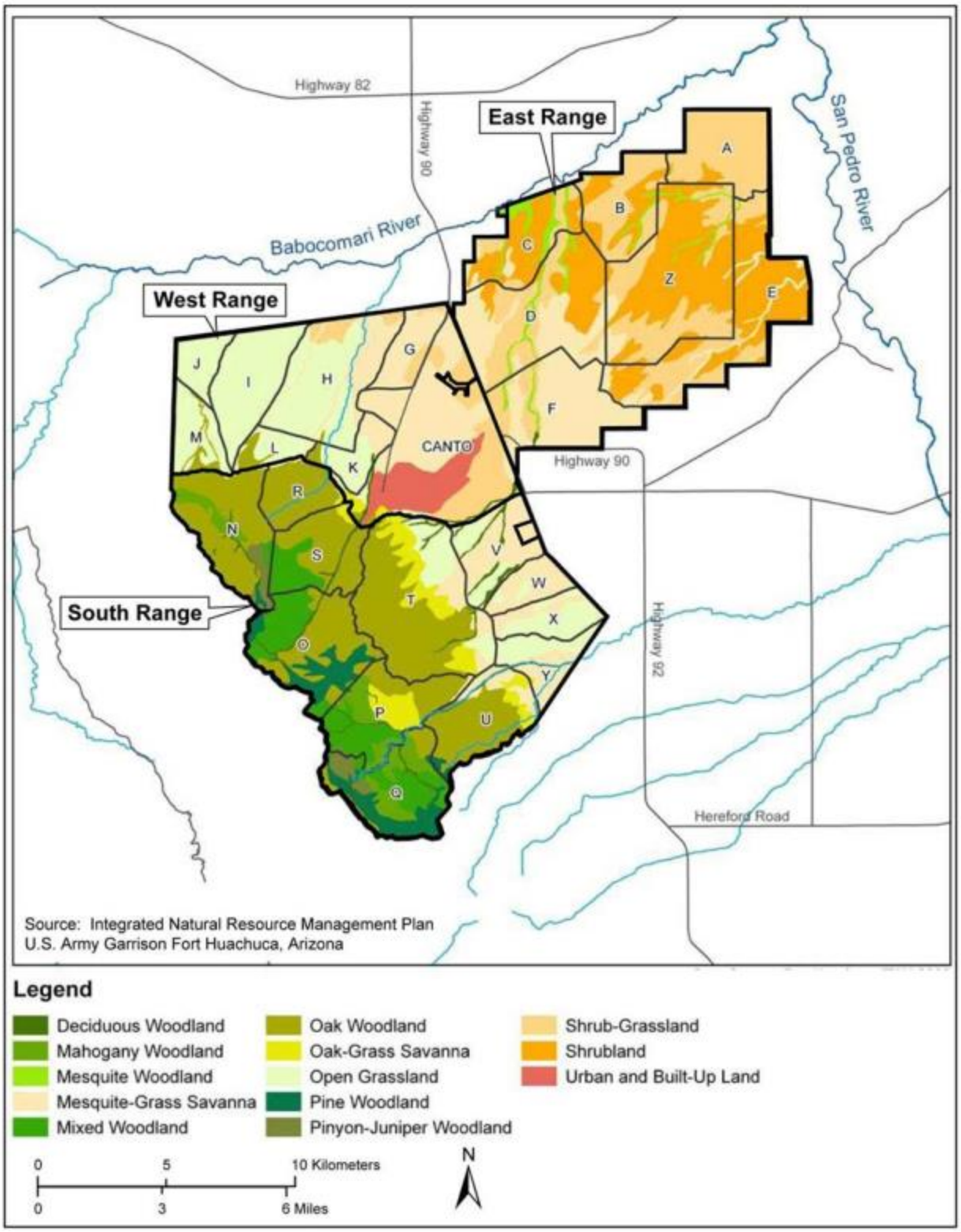


Figure EB22. Fort Huachuca, Arizona, Arizona, vegetation types (PBA Figure 3-22).

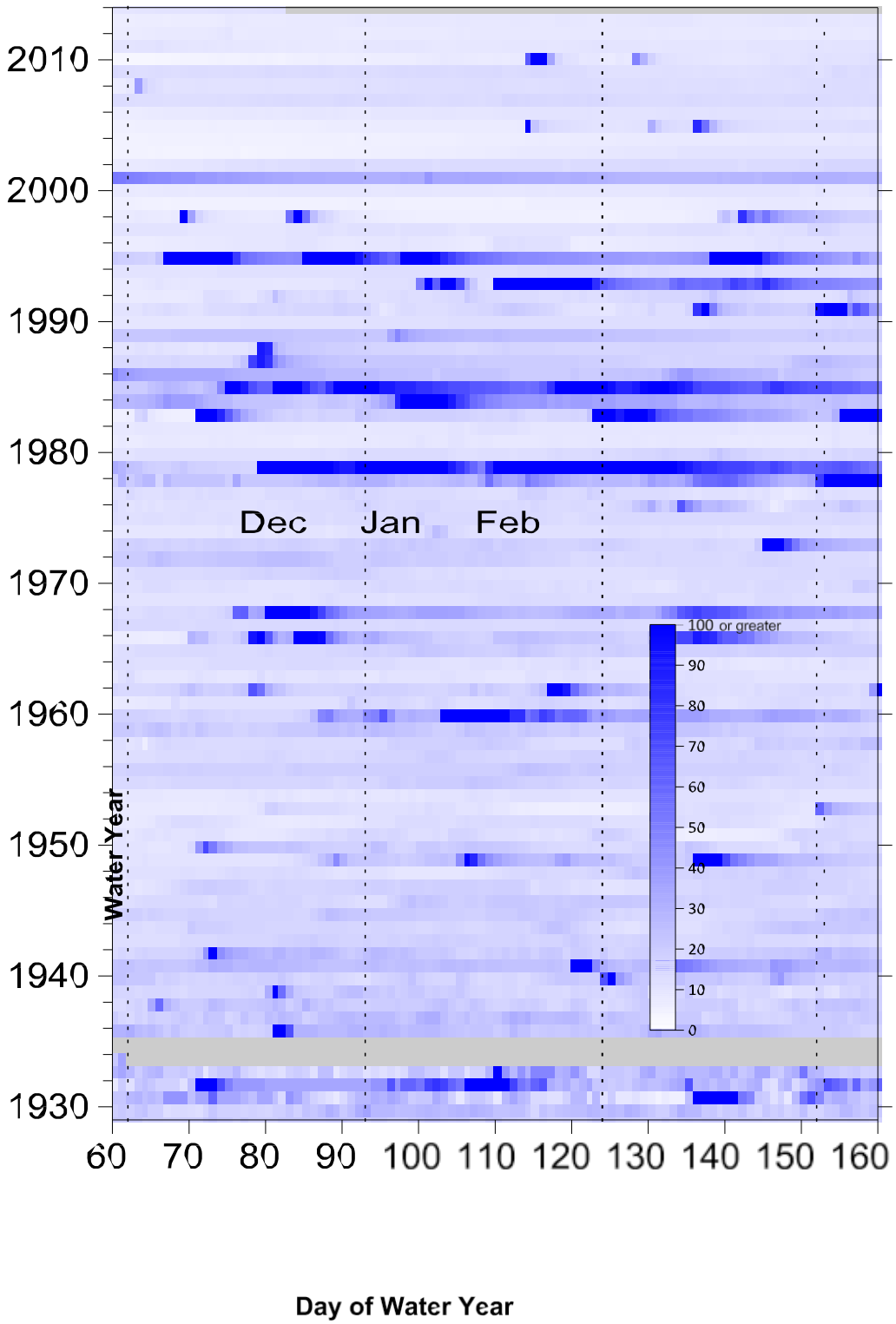


Figure EB23. Daily streamflow for the San Pedro River at Charleston, Arizona gage (Koehler 2014).

ANALYTICAL FRAMEWORK FOR THE JEOPARDY AND ADVERSE MODIFICATION DETERMINATIONS

Jeopardy Determination

In accordance with policy and regulation, the jeopardy analysis in this Biological and Conference Opinion (BCO) relies on four components: 1) the Status of the Species, which evaluates the species range-wide condition, the factors responsible for that condition, and its survival and recovery needs; 2) the Environmental Baseline, which evaluates the condition of the species in the action area, the factors responsible for that condition, and the relationship of the action area to the survival and recovery of the species; 3) the Effects of the Action, which determines the direct and indirect impacts of the proposed Federal action and the effects of any interrelated or interdependent activities on the species; and 4) Cumulative Effects, which evaluates the effects of future, non-Federal activities in the action area on the species.

Section 321 of the Defense Authorization Act of 2004 (Public Law 108-136) describes the manner in which section 7 of the Act is to be applied during interagency consultation with Fort Huachuca. Specifically, Section 321 states "For purposes of section 7 of the Endangered Species Act of 1973 (16 U.S.C. 1536), concerning any present and future Federal agency action at Fort Huachuca, Arizona, water consumption by State, local, and private entities off of the installation that is not a direct or indirect effect of the agency action or an effect of other actions that are interrelated or interdependent with that agency action, shall not be considered in determining whether such agency action is likely to jeopardize the continued existence of any endangered or threatened species or result in the destruction or adverse modification of designated critical habitat."

In accordance with policy and regulation, the jeopardy determination is made by evaluating the effects of the proposed Federal action in the context of the species current status, taking into account any cumulative effects, to determine if implementation of the proposed action is likely to cause an appreciable reduction in the likelihood of both the survival and recovery of the species in the wild.

This BCO follows a May 28, 2011 Federal court decision (Opinion) that remanded USFWS's June 14, 2007 BO (USFWS 2007a). USFWS has taken the Opinion into consideration as it has drafted this BCO. This BCO focuses on the Court's summary finding and analyzes whether or not the Fort's operations will appreciably reduce the likelihood of recovery of the species under consultation. It also examines the effects of operations on designated critical habitat and whether or not those effects will appreciably reduce the likelihood of recovery.

FWS is unable to identify a recovery "tipping point" for any of the species. Because we cannot identify tipping points, we cannot determine whether that tipping point would be reached as a result of the agency proposed action. We are unaware of any set biological definition of a tipping point for a species, although it is often discussed for ecosystems. To identify thresholds or tipping points for conservation, recovery, or any other important conservation biology issue would take far more scientific information, specifically long-term data sets on the species and ecosystem of concern, than we have available for the species under consultation. The Opinion

did not define a tipping point. However, the Opinion said that we had to clearly explain how listed species will be protected from any appreciable reduction in the likelihood of their recovery, which we have done to the best of our ability. Our explanation can be found in the conclusion section for each species.

The jeopardy analysis in this Biological and Conference Opinion places an emphasis on consideration of the range-wide survival and recovery needs of the species and the role of the action area in the survival and recovery of the species as the context for evaluating the significance of the effects of the proposed Federal action, taken together with cumulative effects, for purposes of making the jeopardy determination.

Adverse Modification Determination

This Biological and Conference Opinion does not rely on the regulatory definition of "destruction or adverse modification" of critical habitat at 50 CFR 402.02. Instead, we have relied upon the statutory provisions of the ESA to complete the following analysis with respect to critical habitat.

In accordance with policy and regulation, the adverse modification analysis in this Biological and Conference Opinion relies on four components: 1) the Status of Critical Habitat, which evaluates the range-wide condition of designated critical habitat for the species in terms of primary constituent elements (PCEs), the factors responsible for that condition, and the intended recovery function of the critical habitat overall; 2) the Environmental Baseline, which evaluates the condition of the critical habitat in the action area, the factors responsible for that condition, and the recovery role of the critical habitat in the action area; 3) the Effects of the Action, which determines the direct and indirect impacts of the proposed Federal action and the effects of any interrelated or interdependent activities on the PCEs and how that will influence the recovery role of affected critical habitat units; and 4) Cumulative Effects (as limited by Section 321), which evaluates the effects of future, non-Federal activities in the action area on the PCEs and how that will influence the recovery role of affected critical habitat units.

For purposes of the adverse modification determination, the effects of the proposed Federal action on species critical habitat are evaluated in the context of the range-wide condition of the critical habitat, taking into account cumulative effects, to determine if the critical habitat range-wide would remain functional (or would retain the current ability for the PCEs to be functionally established in areas of currently unsuitable but capable habitat) to serve its intended recovery role for the species.

The analysis in this Biological Opinion places an emphasis on using the intended range-wide recovery function of species critical habitat and the role of the action area relative to that intended function as the context for evaluating the significance of the effects of the proposed Federal action, taken together with cumulative effects, for purposes of making the adverse modification determination.

LESSER LONG-NOSED BAT

Status of the Species

Species Description

The lesser long-nosed bat is a medium-sized, leaf-nosed bat. It has a long muzzle and a long tongue, and is capable of hover flight. These features are adaptations for feeding on nectar from the flowers of columnar cacti (e.g., saguaro [*Carnegiea gigantea*]; cardon [*Pachycereus pringlei*]; and organ pipe cactus [*Stenocereus thurberi*]; and from paniculate agaves (e.g., Palmer's agave)(Hoffmeister 1986). The lesser long-nosed bat was listed (originally, as *Leptonycteris sanborni*; Sanborn's long-nosed bat) as endangered in 1988 (USFWS 1988). A recent update to the taxonomy of this species is provided by the Cole and Wilson (2006) species account for the lesser long-nosed bat, assigning the taxon full species status (*Leptonycteris yerbabuenae*). No critical habitat has been designated for this species. A recovery plan was completed in 1997 (USFWS 1997a). Loss of roost and foraging habitat, as well as direct taking of individual bats during animal control programs, particularly in Mexico, have contributed to the current endangered status of the species. Recovery actions include roost monitoring, protection of roosts and foraging resources, and reducing existing and new threats. The recovery plan states that the species will be considered for delisting when three major maternity roosts and two post-maternity roosts in the U.S., and three maternity roosts in Mexico have remained stable or increased in size for at least five years. A five-year review has been completed and recommends downlisting to threatened (USFWS 2007b).

Distribution and Life History

The lesser long-nosed bat is migratory and found throughout its historical range, from southern Arizona and extreme southwestern New Mexico, through western Mexico, and south to El Salvador. It has been recorded in southern Arizona from the Picacho Mountains (Pinal County) southwest to the Agua Dulce Mountains (Pima County) and Copper Mountains (Yuma County), southeast to the Peloncillo Mountains (Cochise County), and south to the international boundary.

Within the U.S., habitat types occupied by the lesser long-nosed bat include Sonoran Desert scrub, semi-desert and plains grasslands, and oak and pine-oak woodlands. Farther south into Mexico, the lesser long-nosed bat mostly occurs at higher elevations. Maternity roosts, suitable day roosts, and concentrations of food plants are all critical resources for the lesser long-nosed bat. All of the factors that make roost sites suitable have not yet been identified, but maternity roosts tend to be very warm and poorly ventilated (USFWS 1997a). Such roosts reduce the energetic requirements of adult females while they are raising their young (Arends et al. 1995).

Roosts in Arizona are occupied from late April to September (Cockrum and Petryszyn 1991) and on occasion, as late as November (Sidner 2000); the lesser long-nosed bat has only rarely been recorded outside of this period in Arizona (Hoffmeister 1986, Sidner and Houser 1990, USFWS 1997a). In spring, adult females, most of which are pregnant, arrive in Arizona and gather into maternity colonies in southwestern Arizona. These roosts are typically at low elevations near concentrations of flowering columnar cacti. After the young are weaned, these colonies mostly disband in July and August; some females and young move to higher elevations, primarily in the southeastern parts of Arizona near concentrations of blooming paniculate agaves. Adult males typically occupy separate roosts forming bachelor colonies. Males are known mostly from the

Chiricahua and Galiuro Mountains (Tim Snow, AGFD, 1999, pers. comm.), but also occasionally occur with adult females and young of the year at maternity sites (USFWS 1997aThroughout the night between foraging bouts, both sexes will rest in temporary night roosts (Hoffmeister 1986).

Lesser long-nosed bats appear to be opportunistic foragers and extremely efficient fliers. They are known to fly long distances from roost sites to foraging sites. Night flights from maternity colonies to foraging areas have been documented in Arizona at up to 25 mi, and in Mexico, at 25 mi and 36 mi (one way)(Dalton et al. 1994, Ober et al. 2000, Ober and Steidl 2004, Lowery et al. 2009). Lowery et al. 2009 and Steidl (University of Arizona, 2001, pers. comm.) found that typical one-way foraging distance for bats in southeastern Arizona is roughly 6 to 18 mi. A substantial portion of the lesser long-nosed bats at the Pinacate Cave in northwestern Sonora (a maternity colony) fly 25 to 31 mi each night to foraging areas in OPCNM (USFWS 1997a). Horner et al. (1990) found that lesser long-nosed bats commuted 30 to 36 mi round trip between an island maternity roost and the mainland in Sonora; the authors suggested these bats regularly flew at least 47 mi each night. Lesser long-nosed bats have been observed feeding at hummingbird feeders many miles from the closest known potential roost site (Lowery et al. 2009; Yar Petryszyn, University of Arizona, 1997, pers. comm.).

Lesser long-nosed bats, which often forage in flocks, consume nectar and pollen of paniculate agave flowers; and pollen and fruit produced by a variety of columnar cacti. Nectar of these cacti and agaves is high energy food. Concentrations of some food resources appear to be patchily distributed on the landscape, and the nectar of each plant species used is only seasonally available. Cacti flowers and fruit are available during the spring and early summer; blooming agaves are available primarily from July through October. In Arizona, columnar cacti occur in lower elevations of the Sonoran Desert region, and paniculate agaves are found primarily in higher elevation desert scrub, semi-desert grasslands and shrublands, and into the oak and pine-oak woodlands (Gentry 1982). Lesser long-nosed bats are important pollinators for agave and cacti, and are important seed dispersers for some cacti.

The conservation and recovery of lesser long-nosed bats requires the presence of secure and appropriate roosts throughout the landscape (including maternity roost sites, as well as transitional and migration roost sites) and adequate forage resources in appropriate juxtaposition to provide for life history needs including breeding, parturition, and migration (USFWS 1997a, 2007b).

Status and Threats

Recent information indicates that lesser long-nosed bat populations appear to be increasing or stable at most Arizona roost sites identified in the recovery plan (USFWS 1997a, AGFD 2005, Tibbitts 2005, Wolf and Dalton 2005, USFWS 2007b, Tibbitts 2009). Lesser long-nosed bat populations additionally appear to be increasing or stable at other roost sites in Arizona and Mexico not included for monitoring in the recovery plan (Sidner 2005, AGFD 2009). Less is known about lesser long-nosed bat numbers and roosts in New Mexico. Though lesser long-nosed bat populations appear to be doing well, many threats to their stability and recovery still exist, including excess harvesting of agaves in Mexico; collection and destruction of cacti in the U.S.; conversion of habitat for agricultural and livestock uses, including the introduction of bufflegrass (*Pennisetum ciliare*), a non-native, invasive grass species; wood-cutting; alternative

energy development (wind and solar power); illegal border activities and required law enforcement activities; drought and climate change; fires; human disturbance at roost sites; and urban development.

Approximately 35 to 40 lesser long-nosed bat roost sites, including maternity and late-summer roosts, have been documented in Arizona. Of these, 10 to 20 are monitored annually depending on available resources (USFWS 2007b). Monitoring in Arizona in 2004 documented about 78,600 lesser long-nosed bats in late-summer roosts and approximately 34,600 in maternity roosts. More recently, in 2008, the numbers were 63,000 at late-summer roosts and 49,700 at maternity roosts (AGFD 2009). Ten to 20 lesser long-nosed bat roost sites in Mexico are also monitored annually. Over 100,000 lesser long-nosed bats are found at just one natural cave at the Pinacate Biosphere Reserve, Sonora, Mexico (Cockrum and Petryszyn 1991). The numbers above indicate that although a relatively large number of lesser long-nosed bats exist, the number of known large roosts is quite small, effectively concentrating a high proportion of known lesser long-nosed bats in a relatively few roost locations which makes them potentially vulnerable at a population level if roost sites are impacted by threats.

The primary threat to lesser long-nosed bat is roost disturbance or loss. The colonial roosting behavior of this species, where high percentages of the population can congregate at a limited number of roost sites, increases the risk of significant declines or extirpation due to impacts at roost sites. Lesser long-nosed bats remain vulnerable because they are so highly aggregated (Nabhan and Fleming 1993). Some of the most significant threats known to lesser long-nosed bat roost sites are impacts resulting from use and occupancy of these roost sites by individuals crossing the border illegally. Mines and caves, which provide roosts for lesser long-nosed bats, also provide shade, protection, and sometimes water, for border crossers. The types of impacts that result from illegal border activities include disturbance from human occupancy, lighting fires, direct fatality, accumulation of trash and other harmful materials, alteration of temperature and humidity, destruction of the roost itself, and the inability to carry out conservation and research activities related to lesser long-nosed bats. These effects can lead to harm, harassment, or, ultimately, roost abandonment (USFWS 2007b). For example, the illegal activity, presumably by individuals crossing the border, at the Bluebird maternity roost site, caused bats to abandon the site in 2002, 2003, and 2005. Other reasons for disturbance or loss of bat roosts include the use of caves and mines for recreation; the deliberate destruction, defacing, or damage of caves or mines; roost deterioration (including both buildings and mines); short or long-term impacts from fire; and mine closures for safety purposes. The presence of alternate roost sites may be critical when this type of disturbance occurs.

The lesser long-nosed bat recovery plan (USFWS 1997a) identifies the need to protect foraging areas and food plants such as columnar cacti and agaves. More information regarding the average size of foraging areas around roosts would be helpful to identify the minimum area around roosts that should be protected to maintain adequate forage resources. Threats to lesser long-nosed bat forage habitat include excess harvesting of agaves in Mexico, collection and destruction of cacti in the U.S., conversion of habitat for agricultural and livestock uses, the introduction of bufflegrass and other invasive species that can carry fire in Sonoran Desert scrub, wood-cutting, urban development, fires, and drought and climate change.

Large fires in 2005, supported by invasive vegetation, affected some lesser long-nosed bat foraging habitat, though the extent is unknown. For example, the Goldwater, Aux, and Sand

Tank Fire Complexes on Barry M. Goldwater Range-East burned through and around isolated patches of saguaros. Rogers (1985) showed that saguaros are not fire-adapted and suffer a high mortality rate as a result of fire. Therefore, fire can significantly affect forage resources for lesser long-nosed bats in the Sonoran Desert. Monitoring of saguaro mortality rates should be done to assess the impacts on potential lesser long-nosed bat foraging habitat. More recently, the summer of 2011 saw huge wildfires burning across Arizona. The Wallow Fire (538,049 ac) set a new state record, burning a larger area than the 2002 Rodeo-Chediski Fire (468,638 ac). The Horseshoe 2 Fire (222,954 ac) burned about 70 percent of the Chiricahua Mountains and became the 4th largest fire in Arizona history. In addition to the Horseshoe 2 Fire, two other large wildfires (Murphy Complex and the Monument Fire) and numerous smaller fires burned 366,679 ac in the Coronado National Forest. The Horseshoe 2, Monument, and Murphy fires affected lesser long-nosed bat forage and roost resources throughout those mountain ranges. Fire suppression activities associated with wildfires could also affect foraging habitat. For example, slurry drops can leave residue on saguaro flowers, which could impact lesser long-nosed bat feeding efficiency or result in minor contamination.

Drought may affect lesser long-nosed bat foraging habitat, though the effects of drought on bats are not well understood. The drought in 2004 resulted in near complete flower failure in saguaros throughout the range of lesser long-nosed bats. During that time however, in lieu of saguaro flowers, lesser long-nosed bats foraged heavily on desert agave (*Agave deserti*) flowers, an agave species used less consistently by lesser long-nosed bats (Tibbitts 2006). Similarly, there was a failure of the agave bloom in southeastern Arizona in 2006, probably related to the ongoing drought. As a result, lesser long-nosed bats left some roosts earlier than normal and increased use of hummingbird feeders by lesser long-nosed bats was observed in the Tucson area (Scott Richardson, USFWS, January 11, 2008, pers. comm.). Climate change impacts to the lesser long-nosed bats in this portion of its range likely include loss of forage resources. Of particular concern is the prediction that saguaros, the primary lesser long-nosed bat forage resource in the Sonoran Desert, will decrease or even disappear within the current extent of the Sonoran Desert as climate change progresses (Weiss and Overpeck 2005). Monitoring bats and their forage during drought years is needed to better understand the effects of drought on this species.

We have produced numerous BOs on the lesser long-nosed bat since it was listed as endangered in 1988, some of which anticipated incidental take. Incidental take has been in the form of direct fatality and injury, harm, and harassment and has typically been only for a small number of individuals. Because incidental take of individual bats is difficult to detect, incidental take has often been quantified in terms of loss of forage resources, decreases in numbers of bats at roost sites, or increases in proposed action activities.

Examples of more recent BOs that anticipated incidental take for lesser long-nosed bats are summarized below. The 2013 BO related to the proposed Rosemont Copper Mine was issued to the Forest Service and anticipated take of up to three roost locations, up to 10 individual lesser long-nosed bats due to implementation of protective measures at roost locations, and up to 5,367 ac of lesser long-nosed bat foraging habitat (ac of habitat supporting Palmer agave). The 2010 BO related to the National Park Service's abandoned mine closure program, anticipated the direct take of up to 115 lesser long-nosed bats as a result of collisions with mine closure structures, and the abandonment of one roost site due to mine closure activities (USFWS 2010a). The 2009 and 2008 BOs for implementation of the SBI*net* Ajo 1 and Tucson West Projects,

including the installation, operation, and maintenance of communication and sensor towers and other associated infrastructure, each included incidental take in the form of 10 bats caused by collisions with towers and wind turbine blade-strike mortality for the life (presumed indefinite) of the proposed action. The 2007 BO for the installation of one 600 kilowatt wind turbine and one 50KW mass megawatts wind machine on Fort Huachuca included incidental take in the form of 10 bats caused by blade-strikes for the life (presumed indefinite) of the proposed action (USFWS 2007a). The 2005 BO for implementation of the Coronado National Forest Land and Resource Management Plan (U.S. Forest Service) included incidental take in the form of harm or harassment. The amount of take for individual bats was not quantified; instead take was to be considered exceeded if simultaneous August counts (at transitory roosts in Arizona, New Mexico, and Sonora) drop below 66,923 lesser long-nosed bats (the lowest number from 2001 – 2004 counts) for two consecutive years as a result of the action. The 2004 BO for the Bureau of Land Management Arizona Statewide Land Use Plan Amendment for Fire, Fuels, and Air Quality Management included incidental take in the form of harassment. The amount of incidental take was quantified in terms of loss of foraging resources, rather than loss of individual bats. The 2003 BO for Marine Corps Air Station–Yuma Activities on the Barry M. Goldwater Range included incidental take in the form of direct mortality or injury (five bats every 10 years). Because take could not be monitored directly, it was to be considered exceeded if nocturnal low-level helicopter flights in certain areas on the BMGR increased significantly or if the numbers of bats in the Agua Dulce or Bluebird Mine roosts decreased significantly and MCAS-Yuma activities were an important cause of the decline (USFWS 2003a). The lesser long-nosed bat recovery plan (USFWS 1997c), listing document (USFWS 1988), and the 5-year review summary and evaluation for the lesser long-nosed bat (USFWS 2007b), all discuss the status of the species, and threats, and are incorporated by reference.

Environmental Baseline and Action Area

Please refer to the general environmental baseline and action area earlier in this biological and conference opinion.

Status of the Lesser Long-Nosed Bat in the Action Area

Three major maternity roosts and up to 10 major (> 1,000 bats) post-maternity roosts are known in Arizona. Post-maternity roosts are typically transitory roosts used by adults and young bats in summer or fall (Fleming 1995). Records of the lesser long-nosed bat at Fort Huachuca and areas within foraging distance of the Fort (~40 mi) include at least two large post-maternity roosts; observers have recorded over 15,000 lesser long-nosed bats at a mine in the Coronado National Memorial, about 10 mi from Fort Huachuca, and over 30,000 bats at Patagonia Cave, about 20 mi from the Fort (McIntire 2006). Other records (historical or recent) include: 1) Panama Mine near Pyeatt Ranch on the western boundary of Fort Huachuca; 2) Pyeatt Cave, Fort Huachuca; 3) Manila Mine, Fort Huachuca; 4) Woodcutters Canyon, Fort Huachuca; 5) Wren Bridge, Fort Huachuca; 6) Brown Canyon, Huachuca Mountains; 7) Canelo Mine eight miles west of Fort Huachuca; 8) Miller Canyon, Huachuca Mountains; 9) San Pedro RNCA at Fairbank; 10) Ramsey Canyon, Huachuca Mountains; 11) Cave of the Bells, Santa Rita Mountains; 12) State of Texas Mine, Coronado National Memorial, Huachuca Mountains; 13) Helvetia, Santa Rita Mountains; 14) Madera Canyon, Santa Rita Mountains; 15) Empire Ranch north of Sonoita; 16) several localities near Patagonia; 17) two roosts in the Dragoon Mountains, and 18) Colossal Cave, Pima County (Cockrum and Petryszyn 1991; Sidner 1993, 1994; Fleming 1995). Of the

above sites, Fleming (1995) considered the Patagonia Bat Cave, Manila Mine, State of Texas Mine, and the Cave of Bells to be major post-maternity roosts of the lesser long-nosed bat. Of the sites at Fort Huachuca, lesser long-nosed bats have been found day roosting at Pyeatt Cave and Manila Mine (some night roosting occurs at these sites as well). Wren Bridge is a night roost, and lesser long-nosed bats were mist-netted in Woodcutters Canyon (Sidner 1994, 1996, 1999). Upper Pyeatt Cave and Indecision Cave are considered potential day roosts, but the species has yet to be documented at these sites (Sidner 1996, 1999, 2000, 2005). A lesser long-nosed bat banded at Wren Bridge was found the next night at the Patagonia Bat Cave, demonstrating that individuals of this species move relatively long distances, and bats at Fort Huachuca are part of a larger regional population (Howell 1996, Sidner 1996).

Fort Huachuca is within a portion of this species' range utilized as a migratory corridor during the southward seasonal movement. Semidesert grasslands and lower oak woodlands provide summer and early fall foraging habitat of paniculate agave. There are no records of parturient or lactating lesser long-nosed bats from the installation. Rather, occurrence coincides with post-maternity dispersal of juveniles and adult females. Feeding and mass gain is critical at this time to survive migration (Sidner 1996). Before listing, little work was done on Fort Huachuca resulting in a paucity of historical occurrence data. Recent work, beginning in 1989 and continuing through 2013 resulted in the discovery and consistent monitoring of numerous day roosts, night roosts, and potential roosts (PBA Figure 4-4). Monitored sites include Manila Mine, Pyeatt Cave, Upper Pyeatt Cave, Indecision Cave, and Wren Bridge (Sidner 2012). Manila Mine and Wren Bridge are important night roosts for varying numbers of lesser long-nosed bats, and Pyeatt Cave has been used as a night roost as well.

Since 1990, Sidner, as well as the AGFD and a graduate student from the University of Arizona, have conducted surveys of six potential roost sites on Fort Huachuca and found that Manila Mine and Pyeatt Cave were used primarily as day roosts by lesser long-nosed bats, as well as other bat species; that roost sites have been inhabited by bat colonies at least six months of the year; that there is variation in bat population numbers throughout this period; and that the population numbers have increased following the use of protective measures. These roosts are located on the West Range. The long-term monitoring of lesser long-nosed bat roosts on Fort Huachuca represents one of the few long-term monitoring efforts for this species anywhere in its range and provides valuable information on the status and history of this species in southern Arizona. This long-term monitoring information places us in the unique position of having a relatively comprehensive understanding of the status of this species within the Action Area.

Annual peak numbers of lesser long-nosed bats counted at roosts on Fort Huachuca between 1990 and 2005 have varied from 24 in 1990 to approximately 23,207 in 2009 (Sidner 2010). Lesser long-nosed bats have been recorded at Fort Huachuca from late June through October and as late as November 26 (Sidner 2000), with numbers of bats typically peaking in early September (Sidner 1996). Howell (1996) suggests that there are many potential roost sites in the Huachuca Mountains where hundreds of nectar feeding bats could roost without being detected.

Sensitivity of roosting lesser long-nosed bats to human disturbance led the Fort to close Manila Mine, Pyeatt Cave, and Upper Pyeatt Cave to entry from April 15 through October 31 of each year. Entrances to these caves and mine are fenced with chain link to inhibit illegal human entry, but do not interfere with bats entering or exiting the roosts. The caves and mine are also posted. The access roads to Manila Mine and Pyeatt Cave are gated and locked.

Lesser long-nosed bats require suitable forage plants. At and near Fort Huachuca, forage plants include Palmer's agave and possibly Parry's agave (the two are known to hybridize, as well). Populations of Palmer's agave found on the South and West Ranges represent the primary food source for lesser long-nosed bats on Fort Huachuca (Howell and Robinett 1995). Several areas of agave stands on the South and West Ranges are protected and are known as agave management areas (PBA Figure 4-4). These stands have relatively high densities of agave as compared with other populations across the installation.

There are no known mines or caves on the South Range with suitable roosting habitat for lesser long-nosed bats. Nighttime netting efforts conducted on the South Range (Lower Garden, Middle Garden, Upper Garden, Huachuca, Tinker and Woodcutters Canyons) by Sidner in 1993 and 1994 were successful in trapping one lesser long-nosed bat in Woodcutters Canyon in nine nights of trapping.

There is no known roosting habitat for lesser long-nosed bats on the East Range. Only a few agaves are present in the grasslands in the northwestern corner of this range.

Effects of the Action - Lesser Long-Nosed Bat

Effects of the action refer to the direct and indirect effects of an action on the species or critical habitat, together with the effects of other activities that are interrelated and interdependent with that action, which will be added to the environmental baseline. Interrelated actions are those that are part of a larger action and depend on the larger action for their justification. Interdependent actions are those that have no independent utility apart from the action under consideration. Indirect effects are those that are caused by the proposed action and are later in time, but are still reasonably certain to occur.

Effects of the proposed action that may affect the lesser long-nosed bat include fire, noise, habitat loss, direct fatality, and human disturbance. The lesser long-nosed bat is most sensitive to activities that might adversely affect roost sites, particularly actions such as recreational caving, use for illegal border activities and associated enforcement actions, and research and monitoring. Other elements of the proposed action may affect foraging habitat or foraging bats, including fire ignited by ordnance, recreationists or other human activities; prescribed or managed natural fire; noise from aircraft or weapons firing; collisions of bats with vehicles, powerlines, wind turbines, and other project features; grazing by horses; construction activities that might result in mortality of forage plants; and individual agaves that may be damaged directly by ordnance or by bivouacs or other training activities.

Effects of Human Disturbance

Roosting lesser long-nosed bats are very sensitive to human intrusion. Recreational cavers, illegal border users, law enforcement, or researchers entering Manila Mine, Pyeatt Cave, or other sites where lesser long-nosed bats might day roost could result in temporary or permanent desertion of the roost. However, Manila Mine and Pyeatt Cave (where lesser long-nosed bats have been confirmed), as well as upper Pyeatt Cave (potential habitat) are closed while the lesser long-nosed bat is present (minimum July 1 through October 31). The Fort protects the entrances of these roosts with chain link fence (but the bats can still get through), the entrances are posted, the access roads to Manila Mine and Pyeatt Cave are gated and locked seasonally, the road to

Upper Pyeatt Cave is rough and little used, and a live video surveillance system dissuades illegal entry. Thus, the Fort has taken many precautions to ensure that the bats are not disturbed. Disturbance of known roost sites appears to be minimal. Hunting is allowed near the three known lesser long-nosed bat roosts. Potentially, a hunter could discharge a weapon near a roost site and disturb bats or cause them to temporarily abandon the roost. However, this type of disturbance is likely to be infrequent, and most hunting occurs after the bats have left in the fall. Future unauthorized human entry has some potential to transmit white nose syndrome, which could have population-level effects, if the disease reaches the Fort. The disease agent has been spreading rapidly since its discovery in the eastern U.S. in 2006 but it is not currently known to have reached the western U.S. Recreational use of the Fort's cave resources is no longer permitted. Decontamination procedures will be followed for all permitted activities within caves.

Some training activities, such as bivouacs, ordnance delivery, and other activities that may result in disturbance could also damage or destroy agaves, or result in soil compaction and reduced agave establishment. However, personnel are instructed to avoid disturbance to agaves, nearly all such training occurs at established sites or previously disturbed areas, areas directly disturbed by ordnance delivery are relatively small, and the most significant stands of Palmer's agave are designated as Agave Management Areas and protected from training activities. Very little training occurs in the habitat of Parry's agave (i.e., at higher elevations).

Effects of Fire

Fort Huachuca is participating with other federal agencies in the FireScape program (USDA FS 2009a), which provides for fuels management in the Huachuca Mountains. Fort Huachuca's Integrated Wildfire Management Plan (Gebow and Hessil 2006) provides a planning framework for reducing the risk of fire and fire suppression effects on listed species. The risk of a fire originating in lower-elevation training areas reaching forested habitat in the upper elevations is reduced to some extent by fuel management activities in lowland habitats and to a network of fire breaks that the Fort has established along ridgelines. The FireScape consultation is not current, however, so this BO will include an analysis of the effects of Fort Huachuca's fire and fuel treatment activities.

Effects of fire from the components of the proposed action, prescribed or managed fire and wildfire suppression, have the greatest potential to adversely affect agaves and forage plant availability. It appears that forage resources are not limiting to lesser long-nosed bat populations in the Huachuca Mountains, or at least it is unlikely (Steidl 2001). Liz Slauson, working at several sites in southeastern Arizona, has never observed agave flowers drained of nectar, suggesting nectar availability is not limiting. However, the bats fly south in September or October at a time when blooming agaves are becoming less and less abundant, suggesting a waning food supply may be one of the factors that triggers migration. Yar Petryszyn (1999, pers. comm.) has observed apparent antagonistic behavior of bats at agave flowers late in the season, suggesting possible competition for resources. If forage resources are limiting at times or certain places, we would expect that in some years or some areas, numbers of bats may be reduced, or bats may have to fly farther from their roosts to obtain sufficient resources, as a result of insufficient blooming agaves. Bats that fly greater distances are probably more vulnerable to predation or accidental death. Under a scenario of limiting food resources, damage or death of agaves due to prescribed fire could conceivably further reduce forage resources and bat numbers.

Although there is some uncertainty whether agaves are limiting to lesser long-nosed bats in the project area, it seems likely that landscape-scale projects, such as a prescribed fire, that are adjacent to important roosts will probably have some effects on bat foraging behavior, and some of these are likely to be adverse effects, particularly during years when agave flowering is limited such as in 2006 (S. Richardson, USFWS, pers. obs.). The USFWS considers loss of forage resources a great enough threat to include protection of foraging areas and food plants as a priority 1 task in the lesser long-nosed bat recovery plan, though information such as that provided by Steidl (2001) and others have resulted in an informal, *post hoc* reprioritization of this task.

Mortality of leaf succulents exposed to fire is extremely variable. The Baker prescribed fire was conducted in the southern Peloncillo Mountains in extreme southeastern Arizona and southwestern New Mexico. According to preliminary monitoring efforts conducted after the fire, there was seven to 11 percent mortality of Palmer's agaves exposed to fire (Peter Warren, TNC, 1997, pers. comm.). Additional mortality may accrue through loss of the smallest and least detectable sizes of agave. On the Maverick prescribed fire, also in the Peloncillo Mountains, less than five percent of agaves in burned areas were killed by the fire. Because of a mosaic of burned and unburned areas, overall mortality in the project area was perhaps less than 1 percent (T. Roller, USFWS, 1998, pers. comm., as cited in the Revised PBA). Thomas and Goodson (1992) reported an average mortality of 28 percent of five species of leaf succulents from nine burned sites in southern Arizona. Palmer's agave mortality averaged 18 percent. However, post-fire grazing may have influenced reported mortality. Concentrations of paniculate agaves are primarily on the rocky, shallow soils of hills and ridges, particularly on southerly and southeasterly facing slopes. Other Palmer's and Parry's agaves are found scattered in areas of deep, heavy soils where thick stands of shrubs and mesquite form heavy fuel loads. The relative fuel loading and potential exposure of agaves to intense fire is lower on rocky soils. Palmer agaves have evolved in a fire-prone landscape and individual agaves can survive fire (Derdeyn 1989, Slauson 2002). However, too-frequent fires can diminish agave populations (Derdeyn 1989) and invasion of non-native Lehman lovegrass, which sustains hotter fires, can reduce recruitment of agaves by killing a higher proportion of young plants.

Agave mortality due to fire may affect the abundance and distribution of blooming agaves on the landscape for many years, especially if there is high mortality within certain size classes (e.g., seedlings). In addition, natural recruitment of agaves may be very episodic, and the effects of fire on the agave seed bank are unknown. Often one of the objectives of prescribed fire is to increase abundance of grasses. Grasses are probably one of the strongest competitors with agave seedlings (Tony Burgess, 1997, pers. comm.). Increased abundance of grass could result in reduced agave abundance. Agave stalks, as they begin to bolt, are particularly palatable to domestic livestock and wild herbivores, including deer, javelina, rodents, and rabbits (Michelle Hawks, University of Arizona, 1997, pers. comm.; Wendy Hodgson, 1997, pers. comm.). Because agaves often remain partially green, succulent, and available to herbivores when food resources are low immediately following a fire, they may be preferentially selected by herbivores. This may in turn affect the availability of agave flowering stalks to bats.

Besides direct mortality of agaves, fire may alter the availability of blooming agaves. By early spring, an agave plant would have physiologically committed to bolt (send up a flowering stalk). If the plant is burned and lives, bolting continues, though the flower stalk is smaller with fewer flowers (Howell 1996; Liz Slauson, 1997, pers. comm.). If the stalk burns directly, the

reproductive effort of that plant and the availability of flowers and nectar to *Leptonycteris* have been lost. A fire may actually stimulate flowering in adult agaves one to two years following a burn (Liz Slauson, 1997, pers. comm.). However, in subsequent years following the period of increased flowering there may be a reduced number of flowering agaves. Although the availability of blooming agaves may be affected by fire, the nectar production and sugar content of surviving plants is little effected. Working in the Peloncillo Mountains, Slauson (1997, pers. comm.) found that nectar production and sugar content did not differ between unburned agaves and burned agaves that did not have greater than 80 to 90 percent of the leaf area burned. The complexity of variables influencing agave flowering may mask the effects of a burn on agave flowering within several years of a fire.

Reestablishing fire into fire-adapted communities, such as desert grassland and oak and juniper savannas, can also have many benefits and may improve overall long-term "ecosystem management" objectives. Among these is the reduction of woody fuels resulting in decreased probability of intense fires and resulting erosion, soil sterilization, and increased plant mortality. Ultimately, if fire continues to be excluded from fire-adapted systems, a major wildfire will occur with potentially devastating effects. Returning to a more natural regime of low-intensity fires would help to maintain a mosaic of grasslands, woodlands, and shrublands across the landscape and may enhance refugia in which fuel loads and the chances of damaging fires are low. The Agave Management Plan (ENRD 2006) has measures to actively suppress fires in Agave Management Areas unless the area is approaching its natural fire return interval of 10 years. Maintaining a natural fire interval is desirable from the standpoint of ecosystem management and may benefit agaves by reducing competing vegetation and precluding more severe fire where excessive fuel has built up. Prescribed burning in Agave Management Areas will be scheduled so that no more than half the number of Agave Management Areas are burned within one year with no less than a two-year waiting period before burning the remaining areas. A schedule for prescribed burns in agave habitat is included in the Integrated Wildland Fire Management Plan (Gebow and Hessil 2006), which contains specific impact avoidance and species conservation measures for lesser long-nosed bat. However, even under a prescribed fire regime there are potential adverse effects of fire to forage plants that may affect resource availability for the lesser long-nosed bat.

Activities that directly or indirectly promote invasion or increased density of nonnative grasses, particularly Lehmann lovegrass, may result in increased fire frequency or intensity, reduced densities of Palmer's agave, and thus reduced forage resources for the lesser long-nosed bat. Lehmann lovegrass is abundant in some portions of the West and South ranges at Fort Huachuca. This species increases after fire (Martin 1983, Ruyle et al. 1988, Sumrall et al. 1991, Howell 1996), and also produces an abundance of fine fuel that promotes hot fires (McPherson 1995). Thus, frequent fire is likely to increase the abundance of Lehmann lovegrass, and increased abundance of this grass will likely fuel more and hotter fires, creating a positive feedback loop (Anable et al. 1992). Frequent, hot fires brought about by prescribed fires and increasing prevalence of Lehmann lovegrass will likely reduce densities of Palmer's agave. Howell (1996) found that Lehmann lovegrass creates areas of continuous fuels at Fort Huachuca that burn at a constant temperature versus stands of native grasses that are patchy in regard to fuels and fire intensity. Agaves can persist in fire-prone native grasslands in bare areas or refugia that burn lightly or not at all. Such refugia are less common in Lehmann lovegrass stands. Howell (1996) also noted a negative relationship between the proportion of agave seedlings and ramets and the amount of Lehmann lovegrass. She suggested that Lehmann lovegrass appears to suppress agave

recruitment independent of the fire effects just described. The mechanism of suppression is unclear, but Howell (1996) suggests Lehmann lovegrass may compete effectively with agaves for nutrients and light. If agave densities are reduced due to elevated fire effects or recruitment suppression caused by Lehmann lovegrass invasion, forage resources of the lesser long-nosed bat will be reduced.

Howell (1996) found that a fire frequency of three to six per decade on the South Range is "clearly too high to allow sexual reproduction to persist in the agave community...too high to permit seedling establishment and too high to allow even the fast growing clones to achieve reproductive status." Howell (1996) suggested that fires be managed on the South Range to approximate the natural fire frequency, which is likely 10 to 15 years (8-22 years range). She also recommended suppressing fires in plots with demography biased towards young and middle age class agaves, because of their sensitivity to fire damage. Examination of Figure 5.1 of the PBA reveals that some areas of the South Range, and fewer areas on the West Range, burned four or more times from 1973 to 2006, which is, according to Howell (1996), too often for healthy agave stands. Most of the West Range and large areas of the eastern and southern parts of the South Range burned at approximately the 10 to 15 year frequency recommended by Howell (1996). As discussed, the relationship of fire frequency and intensity to agave population dynamics is complex. The USFWS recommends adaptive management in regard to fire management to ensure maintenance of viable, healthy agave populations. The Fort has several conservation measures that will reduce the effect of fire on agave (see the Fire Management, Integrated Training Area Management, and Agave Management Plan subsections in the Description of the Proposed Conservation Measures of this biological opinion). One of these is the suppression of fires in agave management areas unless the area is approaching its natural fire return interval of 10 years.

The importance of Parry's agave stands in the Huachuca Mountains as a forage resource for the lesser long-nosed bat is unknown. As discussed, Parry's agave generally occurs at higher elevation than Palmer's agave, and occurs in forest openings throughout the Huachuca Mountains. Benson and Darrow (1982) note that it typically flowers in June and early July, which is before the lesser long-nosed bat arrives at roosts at Fort Huachuca. However, J. Rorabaugh (USFWS, 1998, pers. comm.) noted many Parry's agave in flower high in the Huachuca Mountains on the crest trail during late July in 1997. It may be that agaves at high elevation bloom later than at lower sites, and could potentially be blooming and be used as a forage resource when lesser long-nosed bats arrive in July or early August.

The only significant threat to stands of agaves in the forested portions of the Huachuca Mountains is fire. Fuel loads are high in some portions of the Huachuca Mountains, and a stand-replacing, catastrophic wildfire could occur due to lightning strikes or project-related causes such as recreational use or ordnance. Because Parry's agave occurs primarily in openings and often on rocky slopes where fuel loads are relatively light, agave populations may not be severely directly affected by wildfire. Openings created by fire could conceivably increase habitat for agaves, temporarily. However, post-fire erosion of slopes could bury or scour hillsides and rocky places where agaves occur. The Fort has implemented an Integrated Wildland Fire Management Plan to reduce fuel loads and the chance of catastrophic fire in the Huachuca Mountains. With implementation of this plan, threats to agave populations posed by wildfire will be reduced.

Implementation of Fort Huachuca's revised Agave Management Plan (PBA Appendix B), as proposed by the Fort (2.5.3 of the PBA), would provide good protection for key agave stands and bat foraging areas in the lower elevations of Fort Huachuca. The plan provides for minimizing or eliminating possible adverse effects of training activities, provides a means for fire to play a more natural role without inhibiting agave population health or viability, and sets up an administrative network and environmental education programs to ensure that protective measures are carried out. However, some flexibility should be built into the plan, and the recommendation to apply prescribed fire only from November through March in the agave management areas may not be necessary to maintain healthy and viable agave populations. As demonstrated in the Baker and Maverick fires in the Peloncillo Mountains, warm season fire may not result in significant mortality. Exclusion of fire during the warm season could encourage invasion of woody species. However, cool season burns may be warranted to protect small agaves, particularly if Lehmann lovegrass is present, which could increase fire intensity. As discussed, due to uncertainties and the need to make changes as monitoring data and new research results become available, Fort Huachuca will use an adaptive management approach in which management of key agave stands would evolve with new information.

Effects of Noise

The developed parts of the Fort including small arms firing areas and airstrips used by conventional and unmanned aircraft are several miles distant from roosts in the Huachuca Mountains (PBA Figure 4-4) and the Mustang Mountains, and sounds from training activities would be attenuated and unlikely to affect bats by the time sound reaches the roost. Sounds would be further attenuated within the roost and would have insignificant effects due to distance-related attenuation. Bats would be foraging at nighttime, when recreational activities are not allowed outside the cantonment and most training activities would be reduced.

Howell (1992) examined the effects of UAS (Sky Owl and Hunter) testing on the lesser long-nosed bat at Fort Huachuca. Howell (1992) concluded that lesser long-nosed bats would not hear noise of UAS cruising at 1,000 to 3,000 ft agl. Noise generated by UAS is relatively low intensity. Also, lesser long-nosed bats are not very sensitive to sound below frequencies of 10 kHz (Howell 1974). The high frequency sounds to which the bat is sensitive attenuate very rapidly with distance (Howell 1992). Thus, noise generated by typical UAS flights over Fort Huachuca, to the Canelo Hills, the Altar Valley, or other destinations should not disturb foraging or roosting lesser long-nosed bats.

Most aircraft activity occurs during the day when bats are not foraging. Because UAS at Fort Huachuca generally operate at 5,000 ft or more above ground level, except during takeoff and landing, noise effects would be minimal at or near ground level. Some UAS fly at night. For example, the Shadow UAS flies during daytime but its hours can extend until 2300 hours, except during monsoon season (July to September), when operations may begin as early as midnight and end at 1600 hours. The Shadow is a small propeller-driven aircraft powered by a 52-horsepower motor. Sound levels from this aircraft at or near ground level would be minimal and unlikely to disturb foraging bats.

Disturbance of bats as a result of noise could also occur due to low-level fixed-wing and helicopter flights, small arms or other weapons fire associated with military training, or discharge of a firearm by a hunter. Dalton and Dalton (1993) investigated the effects of low-

level (500 ft agl) military jet flights on the lesser long-nosed bat in a mine that served as a day roost at Organ Pipe Cactus National Monument. Bats exposed to low-level flights exhibited no acute responses (panic flights, falling young bats, or startle responses). No significant differences in bat orienting responses were noted before, during, or after jet flights, but depressed levels of bat flights were noted for up to 30 minutes following the jet noise. Low-level jet noise attenuated rapidly within the roost, particularly the high frequency sounds to which bats are particularly sensitive. The authors note that extrapolation of the results to other sites with different terrain or mine tunnel geometry may not be valid. They also find that the study did not address any potential long-term effects to the bat colony. As discussed previously, wildlife typically respond more to helicopter flights than fixed-wing aircraft. A helicopter flying very low over a bat roost could produce noise as well as high winds that could disturb bats.

The findings of Dalton and Dalton (1993) combined with the apparent infrequency of low-level flights at Fort Huachuca suggest that noise from overflights probably does not significantly adversely affect lesser long-nosed bats that are roosting deep in a mine or cave, at least in the short-term. Low-level nocturnal military flights may affect bats that are foraging or night roosting differently, and as Dalton and Dalton (1993) note, the long-term effects of repeated low-level flights are unknown. Again, however, the infrequency of low-level flights at Fort Huachuca reduces the probability of this being a significant adverse effect.

Noise from military weapons fire is unlikely to disturb lesser long-nosed bats. Small arms firing would occur on the South Range; however, the firing ranges are all at least five miles from Pyeatt Cave and Manila Mine, and over three miles from Wren Bridge. Noise from weapons fire would attenuate dramatically over that distance, particularly the high frequencies. Artillery and mortar firing occurs at several areas on the East Range. Ordnance is directed eastward from these sites and is delivered into Impact Area Zulu, also on the East Range. Noise from these sources is louder than the small arms firing on the West Range. However, mortar and artillery firing on the East Range occur at a much greater distance from the known bat roosts. All mortar and artillery firing sites and the impact zone in Impact Area Zulu are more than six miles from Wren Bridge and more than seven miles from Pyeatt Cave and Manila Mine. No effects to lesser long-nosed bats are anticipated as a result of mortar and artillery firing on the East Range.

Effects of Direct Mortality

Mortality or injury of lesser long-nosed bats could also occur due to collisions with vehicles, aircraft, ordnance, power and communications lines, wind turbines, antennas, or other project features on Fort Huachuca. The frequency of such collisions is unknown, but the potential exists for bats to collide with such features. A recently completed study indicates that foraging lesser long-nosed bats would, in most cases, likely be flying too low to be affected by wind turbines but migrating individuals may fly within the sweep of the turbine rotor where they would be subject to injury or mortality from barotrauma, internal hemorrhaging caused by the rapid drop in pressure resulting from a close encounter with a wind turbine blade (Vernadero Group 2010f). The Fort has proposed no nighttime training in agave management areas from July 1 through October 31, no nighttime use and no tracer fire on live fire ranges 2, 3, and 4 from July 1 through October 31, no use of pyrotechnics within 0.25 mi of agave management areas, and no off-road vehicle use. Restrictions on low-level flights have also been implemented. Collectively, these measures greatly reduce the likelihood of collisions (see the Description of Conservation Measures of this biological opinion).

Effects of Habitat Loss

UASs crash on or off-post about once per year. There have also been two manned aircraft crashes at Fort Huachuca (at Libby Airfield) in the past 10 years. Search and rescue operations are carried out for manned aircraft that crash, and aerial or ground searches occur following crashes of UASs. Some potential exists for aircraft crashes to directly impact agaves or to start fires that affect agaves. The potential for a crash to directly affect a roost site on or off-post is remote.

Predation of agaves by gophers and ungulates on the West Range was found to be inhibiting sexual reproduction of agaves (Howell 1996). Javelina, deer, and other wildlife also predate agaves (Bowers and McLaughlin 2000, Widmer 2002, and Fehmi et al. 2004). Howell (1996) suggested that if areas of the West Range are to be managed for agaves "attention will have to be paid to the intense predation." Predator control (coyotes and other carnivores) was carried out on the South Range in the 1980's and early 1990s' in an attempt to increase populations of Chihuahuan pronghorn. While past predator control activities currently have no effect, at that time, reduced predator densities could theoretically have contributed to increased populations of gophers and ungulates that could have, in turn, resulted in increased predation of agaves. However, Howell (1996) found no correlation between predator control activities and agave demographics on the West versus the South ranges, and predation of agaves appeared to be higher on the West Range where predator control has not been implemented. Fort Huachuca continues to carry out some predator control activities.

Cattle grazing can adversely affect agave survivorship and bolting. Before the summer monsoons at Four Peaks on Tonto National Forest, cattle were observed eating the unprotected apex of several agave plants (Tricia Roller, USFWS, 1997, pers. comm.). Cattle probably trample young agaves, as well. Although cattle have been excluded from Fort Huachuca for many years, grazing by horses occurs on 1,433 ac of the West Range within 0.6 mi of protected agave stands and Wren Bridge. The horse pastures are about three mi from Manila Mine and Pyeatt Cave. Thus, the grazed area is likely foraging habitat for the lesser long-nosed bat. There are some differences in grazing behavior between horses and cattle. It is unknown whether horses browse agave bolts, but if they do, forage resource availability for the bat would be reduced by such browsing. Horses, like cattle, probably also trample young agaves and may compact soils and reduce germination and survival (Beever and Brussard 2000). Although horses tend to avoid areas of high densities of agaves (Howell and Robinett 1995), any trampling or browsing of agaves would reduce forage resources available to the lesser long-nosed bat. Direct effects due to grazing may be more intense in areas grazed during the flowering season of agave and where horses congregate near water sources.

Off-post activities are unlikely to affect lesser long-nosed bats or their habitat. These activities occur in previously-disturbed areas and, therefore, should have little effect on agaves. Activities off-post could potentially increase the chances of fire, which may adversely affect agave plants and bat forage resources. However, the Fort has several conservation measures in place to reduce the chance of this occurring (see the Description of the Proposed Conservation Measures of this biological opinion).

Climate Change

It is expected that variation in climatic factors will increase and that extreme events (e.g., drought, flood, heat wave) are likely to increase in intensity. Severe wildfires could result from weather extremes. Climate change could also result in a change in the blooming period of agaves. If lesser long-nosed bats do not adjust to this change in seasonal availability of blooming agaves, forage resources may not be available at the time lesser long-nosed bats occupy the Action Area. Therefore climate change could adversely affect lesser long-nosed bat, but such effects are independent of the Proposed Action.

Effects of Interrelated and Interdependent Actions

Some of the existing development and population in the Sierra Vista area can be attributed to Fort Huachuca, because some employees, contractors, military dependents, military retirees, and others live in the Sierra Vista area because of job opportunities or military benefits provided by the Fort. Thus, some of the residents and development off-post would not be there but for the presence of Fort Huachuca. Some of this development may result in destruction of lesser long-nosed bat foraging habitat. However, the best agave populations appear to be concentrated on the upper bajadas, while most of the development has occurred lower on the slope where agaves are uncommon. Also, as discussed previously, predicted growth in the Sierra Vista area has achieved a momentum that is separate from any influence Fort Huachuca might have.

As described in PBA section 2.13.1.4, monitoring and census of lesser long-nosed bat roosts on the Fort will occur annually. It is our assumption that such monitoring will continue under extant methodologies, with opportunity for revision during annual coordination meetings. It shall be noted that surveys for lesser long-nosed bats require permits form both the USFWS and AGFD.

Conservation Measures

LLNB-1: The Fort will ensure that construction, upgrading, or maintenance of roads does not increase or facilitate public access to Manila Mine, Pyeatt Cave, or other lesser long-nosed bat day roosts. Implementation of this conservation measure will reduce effects to lesser long-nosed bats from disturbance at known roost sites on the Fort.

LLNB-2: Access routes at the closures and the mine and cave sites are posted with the following information: no vehicle access, no entry into mines or caves, explanations that the closures are needed to protect sensitive species, and warnings against entry into the mines and caves. Fort Huachuca will continue to maintain the signs. Access will not be allowed from at least 1 July through 31 October each year, and during other times when the bats are known to be present. Implementation of this conservation measure will increase awareness of the sensitivity of lesser long-nosed bat roosts and reduce the potential for disturbance of roosting bats at the known roosts on the Fort.

LLNB-3: Recreational use of the Fort's cave resources is no longer permitted. Decontamination procedures will be followed for all permitted activities within caves. Implementation of this conservation measure will reduce the amount of disturbance at

known roosts on the Fort and also reduce the potential for the introduction and spread of the fungus responsible for White –Nose Syndrome.

LLNB-4: Protective fencing around cave resources will be maintained. The implementation of this conservation measure will reduce human access at known and potential lesser long-nosed bat roost sites and reduce the likelihood for introduction of the fungus responsible for White-Nose Syndrome.

LLNB-5: Monitoring and census of known or potential lesser long-nosed bat roosts will be conducted annually. The monitoring will use the low disturbance protocols outlined in the lesser long-nosed bat endangered species management plan. Implementation of this conservation measure will ensure that changes to the status of the species are detected, thus permitting a management response (if the change is negative).

LLNB-6: The Fort will prohibit low-level helicopter flights (below 500 ft above ground level) within 350 ft of Pyeatt Cave, Manila Mine, or other lesser long-nosed bat day roosts from 1 July through 31 October each year, and during other times when the bats are known to be present. Implementation of this conservation measure will reduce effects to lesser long-nosed bats from disturbance at known roost sites on the Fort.

LLNB-7: Before construction activities, pre-construction surveys will be done for paniculate agaves that may be directly affected by construction activities. If agaves are found during pre-construction surveys, the following measures will be implemented:

- Disturbance will be limited to the smallest area practicable, damage to agaves will be avoided where possible, and projects will be located in previously disturbed areas whenever possible;
- Vehicle use will be limited to existing routes and areas of disturbance except as necessary to access or define boundaries for new areas of construction or operation; and
- All workers will strictly limit their activities and vehicles to designated areas. Construction workers will be informed of these terms and conditions.

The implementation of this conservation measure will avoid or reduce the impacts of the proposed action on the use and availability of lesser long-nosed bat forage resources.

LLNB-8: No seeding or planting of non-native grasses or other plants will occur at Fort Huachuca that may alter fire frequencies in the wildland areas. However, seeding of a mixture of native seeds, non-native hybrid sterile seeds, and weed free mulch in disturbed construction sites is authorized to establish temporary ground cover for erosion control, subject to seasonal restrictions. The implementation of this conservation measure will avoid or reduce the impacts of the proposed action on the use and availability of lesser long-nosed bat forage resources through the reduction of unnatural fire occurrences within areas supporting agaves.

LLNB-9: Prescribed fire and managed natural fire will be planned to minimize adverse effects to lesser long-nosed bat forage plants and roosts. Measures will be developed to ensure the following:

- Fires in Agave Management Areas will be actively suppressed unless the area is approaching its natural fire return interval of 10 years;
- Prescribed fire on the west range will be scheduled so that no more than one-half the Agave Management Areas are burned in one year with no less than a two year waiting period before burning the remaining areas; and
- A schedule for prescribed burns will be established and followed to reduce fuel loading in Fort Huachuca grasslands and woodlands, thereby reducing the potential for major wildfires in lesser long-nosed bat foraging and roosting habitat. This action will minimize the loss of agaves, and also minimize negative impacts to lesser long-nosed bat roosts. Additionally, grassland habitat (i.e., Palmers agave) should be improved with implementation of this conservation measure.

LLNB-10: Nighttime land-based training will not occur in Agave Management Areas from 1 July through 31 October and during times when the bats are known to be present. The implementation of this conservation measure will avoid or reduce the impacts of the proposed action on the use and availability of lesser long-nosed bat forage resources.

LLNB-11: No nighttime use and no tracer fire will occur on live fire ranges 2, 3, and 4 from 1 July through 31 October and during times when the bats are known to be present. The implementation of this conservation measure will avoid or reduce the impacts of the proposed action on the use and availability of lesser long-nosed bat forage resources.

LLNB-12: From 1 July through 31 October each year and during times when the bats are known to be present, all nighttime UAS operations at all runways will be above 500 feet above ground level except for take-off and landings. The implementation of this conservation measure will avoid or reduce the impacts of the proposed action on the use and availability of lesser long-nosed bat forage resources.

LLNB-13: Off-road vehicle travel will not occur in Agave Management Areas or any other part of the West Range or South Range except in cases of emergency. The implementation of this conservation measure will avoid or reduce the impacts of the proposed action on the use and availability of lesser long-nosed bat forage resources.

LLNB-14: Pyrotechnics will not be used within 0.25 miles of Agave Management Areas. The implementation of this conservation measure will avoid or reduce the impacts of the proposed action on the use and availability of lesser long-nosed bat forage resources through the reduction of unnatural fire occurrences within areas supporting agaves.

LLNB-15: The Fort will monitor Palmer's agave populations on the West and South Ranges at appropriate intervals (following fires or other reduced vegetation cover situations) to

establish trends in lesser long-nosed bat forage resources. Implementation of this conservation measure will ensure that changes to the status of lesser long-nosed bat forage species are detected, thus permitting a management response (if the change is negative).

LLNB-16: Fort Huachuca will continue to monitor around the wind turbines in accordance with the previous consultation. Implementation of this conservation measure will ensure that lesser long-nosed bat mortality from these facilities is detected, thus permitting a management response.

LLNB-17: The Fort will monitor lesser long-nosed bats annually, document any disturbance of roost sites, and document ac burned on the West or South ranges and whether such fire burned in Agave Management Areas. The results of this monitoring will be reported to the USFWS as described in the reporting requirements below (PBA Section 2.13.3). Implementation of this conservation measure will ensure that changes to the status of the species are detected, thus permitting a management response (if the change is negative) to address the issues documented.

Cumulative Effects

See the Cumulative Effects section for the Huachuca water umbel, for a general description of cumulative effects and a discussion of analysis of those effects per Section 321 of the Defense Authorization Act of 2004.

Much of the land in the project area is managed by Federal agencies, particularly the BLM, Coronado National Forest, and Coronado National Memorial. The only significant known roost in the Huachuca Mountains outside of Fort Huachuca is the State of Texas Mine on the Coronado National Memorial. Activities on state and private lands may require permits or funding from Federal agencies. Thus, many of the actions that are reasonably expected to occur in the project area that may adversely affect the lesser long-nosed bat would be subject to section 7 consultation.

The effects of grazing, development, and other activities occur on large tracts of state and private lands within the project area, as well as recreation and management at Kartchner Caverns State Park (i.e. trail construction and removal of live, flowering agave bolts for visitor safety) and within the known range of the lesser long-nosed bat that are not interrelated or interdependent actions of Fort Huachuca and are not otherwise subject to section 7. Development near the base of the Huachuca Mountains or at the mouths of canyons on the east slope south of Fort Huachuca could result in destruction of bat foraging habitat and agaves. Residential and commercial development, farming, livestock grazing, actions resulting in the invasion of non-native grasses, surface mining, and other activities occur on these lands and, while difficult to predict and quantify, are expected to continue into the foreseeable future. Other non-Federal actions expected to occur include road maintenance, grazing, and recreation in the action area, current and future development, mining projects, and unregulated activities on non-federal lands, such as trespass livestock and inappropriate use of Off-Highway Vehicles, which can cumulatively adversely affect the lesser long-nosed bat. Additional cumulative effects on lesser long-nosed bats include recreation without a Federal nexus and cross-border activities that include the following: human traffic; deposition of trash; new trails from human traffic; increased fire risk

from human traffic; and water depletion and contamination. The Borderlands Restoration LLLP is trying to determine if removing individual agaves from clumps of agaves allows the remaining agaves to be more vigorous and to flower earlier.

These actions, the effects of which are considered cumulative, may result in loss or degradation of lesser long-nosed bat foraging habitat, and potential disturbance of roosts, and are reasonably certain to occur in the action area. Compliance with the Act for activities on state and private lands that may affect the lesser long-nosed bat, but are not addressed by section 7 consultation, could occur through section 10(a)(1)(B) of the Act.

Conclusion

We reviewed the current status of the lesser long-nosed bat, the environmental baseline for the action area, and the effects of the proposed action. It is our biological opinion that the proposed action is not likely to jeopardize the continued existence of the lesser long-nosed bat. No critical habitat has been designated for this species; therefore, none will be affected. In making our determination we considered the following:

- Fort Huachuca's proposed action includes many avoidance, minimization, and conservation measures intended to minimize take of lesser long-nosed bats and offset the direct and indirect impacts of the proposed action on the species and its foraging and roosting habitats (section 2.13.1.4 in the PBA)(see also the description of these conservation measures above);

- The project area in which most activities occur covers a relatively minor portion (<1%) of the total range of the lesser long-nosed bat;

- For any development projects on the Fort not considered here that may have effects to listed species or modify critical habitat, the Fort will initiate consultation;

- Monitoring will be done to verify the status of the species within the action area and to evaluate the effectiveness of the conservation measures;

- The aforementioned effects will not affect recovery of the lesser long-nosed bat based on the long-term stable to increasing status of lesser long-nosed bat, as described above; the conservation measures appear to be effective based on the long-term stable to increasing status of lesser long-nosed bat roosts and forage resources on the Fort; and the relatively minor contribution that the lesser long-nosed bat roosts and forage found within the action area represent to the species throughout its range;

- Recovery is the process that stops the decline of an endangered or threatened species by removing or reducing threats. Recovery ensures the long-term survival of the species in the wild. At that point, the species is recovered, and protection of the ESA is no longer necessary. The aforementioned effects will not appreciably reduce the likelihood of recovery of the lesser long-nosed bat based on the long-term stable to increasing status of lesser long-nosed bat, as described above; the conservation measures appear to be effective based on the long-term stable to increasing status of lesser long-nosed bat roosts and forage resources on the Fort; and the relatively minor contribution that the lesser long-nosed bat roosts and forage found within the action area represent to the species throughout its range.

- The status of the lesser long-nosed bat has improved on the Fort under conditions similar to those of the proposed action. Conservation measures implemented by the Fort related to the conservation of the lesser long-nosed bat appear to be effective, and the Fort proposes to continue those actions. Fort Huachuca has been successful in meeting Endangered Species Act requirements while responding to unprecedented changes in military training and testing missions. Previous and ongoing conservation and recovery efforts show tangible beneficial results for the listed lesser long-nosed bat; and

- Critical habitat has not been designated for the lesser long-nosed bat; thus none will be affected.

The proposed action does not appreciably reduce the likelihood of lesser long-nosed bat recovery within their historical range. The adverse effects that do occur in the action area do not reach the scale where recovery of the species would be delayed or precluded. We make this conclusion for the following reasons:

- The potential area of effect is a small part of the range of the species;

- The proposed conservation measures reduce the chance for impacts to lesser long-nosed bats at Fort Huachuca, and address the threats identified in the listing rule for this species, threats to roosts and threats to forage resources, through ongoing monitoring and management of roost sites and the maintenance and protection of forage resources through the Agave Management Areas;

- Monitoring and recovery actions continue to occur within the species' historical range; and

- The numbers of individuals at some roosts have increased since listing, and the number of known roosts is static (stable, not decreasing).

FWS is unable to identify a reliable recovery "tipping point" or threshold for the lesser long-nosed bat because it is not technically feasible, due partly to a lack or rigorous, long-term data sets on population and habitat parameters. This is such a fluid species and is migratory, therefore we really can't identify the tipping point. Because we cannot identify a tipping point, we cannot determine whether that tipping point would be reached as a result of agency operations. Since the impacts of the proposed action are minimal and the action area is small compared to the range of the species, it is highly unlikely that the proposed action would cause a tipping point away from recovery to be reached. The adverse effects that do occur in the action area do not reach the scale where recovery of the species would be delayed or precluded; there is an ongoing monitoring and management program of both roosts and forage resources which can lead to adaptive management to address declines at both known lesser long-nosed roosts, and in the Agave Management Areas. This would allow us to identify and address potential issues related to declines in bat numbers or forage resources before there were meaningful effects to recovery. A threshold for assessing effects to recovery of lesser long-nosed bat would likely involve impacts to the maternity roosts, of which none occur on, or near, Fort Huachuca.

The conclusions of this biological opinion are based on full implementation of the project as described in the Description of the Proposed Action section of this document, including any Conservation Measures that were incorporated into the project design.

INCIDENTAL TAKE STATEMENT

Please see the Incidental Take Statement for the Mexican spotted owl for a narrative and the statute and policy governing the content of this Incidental Take Statement.

The measures described below are non-discretionary, and must be undertaken by Fort Huachuca so that they become binding conditions of any grant or permit issued to an applicant, as appropriate, for the exemption in section 7(o)(2) to apply. Fort Huachuca has a continuing duty to regulate the activity covered by this incidental take statement. If Fort Huachuca: 1) fails to assume and implement the terms and conditions; or 2) fails to require the applicant to adhere to the terms and conditions of the incidental take statement through enforceable terms that are added to the permit or grant document, the protective coverage of section 7(o)(2) may lapse. In order to monitor the impact of incidental take, Fort Huachuca must report the progress of the action and its impact on the species to the USFWS as specified in the incidental take statement (50 CFR §402.14(i)(3)).

Amount or Extent of the Take

We anticipate the following incidental take of lesser long-nosed bats as a result of authorized activities that are part of the proposed action:

1. Ten (10) lesser long-nosed bats over the life of the project in the form of direct mortality or injury as a result of collisions with vehicles, aircraft, antennas, fences, and other project features;

2. The reduction in the number of bats by greater than 50% of one (1) roost site over the life of the project as a result of harassment due to noise associated with military training, hunter weapons fire, research and monitoring, recreation, and military overflights. The determination of whether the reduction is due to the proposed action will be evaluated and determined through coordination with USFWS; and

3. Loss of forage resources may be temporary (fire related) or permanent or long-term (development of facilities such as roads, buildings, etc.). Take in the form of harm is likely to result from the loss of forage plants due to prescribed fire, wildfire suppression, wildfire caused by authorized activities, and development actions described that will result in habitat loss or alteration. Detecting or quantifying take in the form of harm is difficult to quantify and document at the level of individual bats due to the small size and mobility of this species and the extended period of the effects. Take related to forage resources is likely to occur over time and is difficult to document because individual bats taken may not be affected in the same area as where the loss of forage resources has occurred. Consequently, we will use the percentage of agaves permanently affected, or which experience long-term effects during implementation of the proposed action, as a surrogate for take. Impacts to habitats that support agaves can result in take of this species due to the resultant poor body condition when lesser long-nosed bats are forced to forage in sub-optimal habitat, increased expenditure of energy and increase likelihood of predation if forced to travel farther to forage, and reduced ability to store adequate resources for migration and breeding.

Take in the form of harm due to the loss of significant forage resources is authorized for the loss of up to 20% or 10 plants, whichever is greater, of the agaves known to occur within the individual project areas of activities resulting in permanent or long-term (until the end of the consultation period) forage loss that are included in the proposed action. This take is anticipated from the long-term loss of foraging habitat within the footprint of activities such as construction, road maintenance, and other proposed ground-disturbing activities that would result in permanent or long-term agave habitat loss or alteration. If the action causes the loss of more than 20% or 10 plants, whichever is greater, of the agaves known to be present; then the number of agaves lost exceeding 20% will be replanted, or replaced by planting new agaves at a 1:1 ratio.

The reasonable and prudent measures, with their implementing terms and conditions, are designed to minimize the impact of incidental take that might otherwise result from the proposed action. This biological opinion does not authorize any form of take not incidental to the Fort's proposed action as described herein.

Effect of the Take

In this biological opinion, we find that this level of anticipated take is not likely to jeopardize the continued existence of the lesser long-nosed bat for the reasons discussed above in the Conclusion section.

Reasonable and Prudent Measures

We believe that the following reasonable and prudent measure is necessary and appropriate to minimize impacts of incidental take authorized by this biological opinion:

1. Fort Huachuca shall continue to monitor the lesser long-nosed bat and its habitat to document levels of take and determine effectiveness of conservation measures (see also the description of these conservation measures above).

Terms and Conditions

To be exempt from the prohibitions of section 9 of the Act, Fort Huachuca must comply with the following terms and conditions in regard to the proposed action. These terms and conditions implement the reasonable and prudent measure described above. Terms and conditions are nondiscretionary.

1. The following terms and conditions implement reasonable and prudent measure number one:

    1.1. Fort Huachuca shall continue to monitor lesser long-nosed bat populations and forage resources, including assessments of agave plants that occur within projects included in the proposed action;

    1.2. Fort Huachuca shall prepare an annual report which summarizes the implementation of the proposed action and any incidental take that occurred. The USFWS is especially interested in an analysis of the effectiveness of the conservation measures and terms and conditions.

If the incidental take anticipated in the paragraph entitled "Amount or Extent of Take" is reached, the Fort shall immediately notify the USFWS in writing. If, during the course of the action, the level of anticipated incidental take is exceeded, such incidental take represents new information requiring reinitiation of consultation. In the interim, the Fort must cease the activity resulting in the take if it is determined that the impact of additional taking will cause an adverse impact on the species. Fort Huachuca must immediately provide an explanation of the causes of the taking and review with the USFWS the need for possible modification of the reasonable and prudent measures.

CONSERVATION RECOMMENDATIONS

See the Conservation Recommendations section for the Huachuca water umbel for information regarding the statute and policy governing Fort Huachuca's implementation of the following recommendations:

1. The Fort should investigate the importance of Parry's agave as a forage resource for the lesser long-nosed bat;

2. The Fort should continue to investigate the fire ecology of paniculate agaves; and

3. The Fort should investigate and monitor the invasion of Lehmann lovegrass at Fort Huachuca and assist other agencies in developing methods for controlling this nonnative grass.

For the USFWS to be kept informed of actions minimizing or avoiding adverse effects or benefiting listed species or their habitat, we request notification of the implementation of any conservation recommendations. Please note that surveys for lesser long-nosed bats, or other bats, that involve capture or take, require appropriate permits from the USFWS and AGFD.

HUACHUCA WATER UMBEL

Status of the Species

The Huachuca water umbel (*Lilaeopsis schaffneriana* var. *recurva*)(umbel) is an herbaceous, semi-aquatic to occasionally fully aquatic, perennial plant with slender, erect leaves that grow from creeping rhizomes. The leaves are cylindrical, hollow with no pith, and have septa (thin partitions) at regular intervals. The yellow/green or bright green leaves are generally 0.04 to 0.12 in in diameter and often 1 to 2 in tall, but can reach up to 8 in tall under favorable conditions. Three to ten very small flowers are borne on an umbel that is always shorter than the leaves. The fruits are globose, 0.06 to 0.08 in in diameter, and usually slightly longer than wide (Affolter 1985).

On January 6, 1997, we listed the umbel as an endangered species (62 FR 665, USFWS 1997a). Critical habitat was designated on the upper San Pedro River, Garden Canyon on Fort Huachuca, Scotia Canyon and other areas of the Huachuca Mountains, the San Rafael Valley, and Sonoita

Creek on July 12, 1999 (64 FR 37441, USFWS 1999b). No recovery plan has been developed, but a draft recovery plan is anticipated to be complete in 2014.

Distribution/Abundance

Umbel has been documented in Santa Cruz, Cochise, and Pima counties, Arizona, and in adjacent Sonora, Mexico, west of the continental divide (Warren et al. 1989, Saucedo-Monarque 1990, Warren and Reichenbacher 1991, Haas and Frye 1997, Anderson 2006). The plant has been extirpated from eight sites, and has not been seen in recent years in several others. The extant sites occur primarily in five major watersheds - San Pedro River, Santa Cruz River, Río Yaqui/Bavispe, Río Sonora, and Río Magdalena. All sites are between 2,800 and 7,120 ft in elevation (Titus and Titus 2008, Vernadero 2010b).

Habitat

The umbel grows in cienegas, and along streams, rivers, and springs in southeastern Arizona and northeastern Sonora, Mexico. These wetland communities are usually associated with perennial springs and stream headwaters, have permanently or seasonally saturated highly organic soils, and have a low probability of flooding or scouring (Hendrickson and Minckley 1984). The water umbel can grow in saturated soils or as an emergent in water depths up to about 10 in. Cienegas support diverse assemblages of animals and plants, of which many species are of limited distribution, such as the umbel (Hendrickson and Minckley 1984). The surrounding non-wetland vegetation can be desert scrub, grassland, oak woodland, or conifer forest (AGFD 1997).

Umbel has an opportunistic strategy that ensures its survival in healthy riverine systems, cienegas, and springs. In upper watersheds that generally do not experience scouring floods, umbel occurs in microsites where interspecific plant competition is low. At these sites, umbel occurs on wetted soils interspersed with other plants at low density, along the periphery of the wetted channel, or in small openings in the understory. In stream and river habitats, umbel can occur in the main channel, backwaters, side channels, and nearby springs. The upper Santa Cruz River and associated springs in the San Rafael Valley, where umbel occurs, is an example of sites that meet these conditions. The types of microsites required by umbel were generally reduced from the main stems of the San Pedro and Santa Cruz rivers when channel entrenchment occurred in the late 1800s.

Habitat on the upper San Pedro River is recovering, and umbel has remained along small reaches and continues to be detected in new sites within the main channel. Cienegas, perennial streams, and rivers in the desert southwest are extremely rare. The Arizona Game and Fish Department (1993) estimated that riparian vegetation associated with perennial streams comprises about 0.4% of the total land area of Arizona, with most riparian areas being remnants of what once existed. The State of Arizona (1990) estimated that up to 90 percent of the riparian habitat along Arizona's major desert watercourses has been lost, degraded, or altered. The physical and biological habitat features essential to the conservation of umbel include a riparian plant community that is fairly stable over time and not dominated by non-native plant species, a stream channel that is relatively stable but subject to periodic, non-scouring flooding, protected sites (sites safe from catastrophic flooding), and a substrate (soil) that is permanently wet or nearly so, for growth and reproduction of the plant.

Life History

The umbel flowers from March through October with most flowering in June through August (AGFD 1997). The species reproduces sexually through flowering and asexually from rhizomes, the latter probably being the primary reproductive mode. The umbel is also suspected of self-pollination (Johnson et al. 1992). An additional dispersal opportunity occurs as a result of the dislodging of clumps of plants, which then may re-root in a different site along aquatic systems. Fruits develop from July through September, and water disperses the seeds (Arizona Game and Fish Department 1997). Seeds from plants grown in an aquarium have been seen sticking to the aquarium sides and germinating 1 to 2 weeks after falling from the parent plant (Johnson et al. 1992).

After a flood, umbel can rapidly expand its occurrence (a term referring to a hydrologically and geographically discrete grouping of plants) and occupy disturbed habitat until interspecific competition exceeds its tolerance or disturbance removes it. This response was recorded at Sonoita Creek in August 1988, when a scouring flood removed about 95% of the umbel occurrence (Gori et al. 1990). One year later, the umbel had recolonized the stream and was again co-dominant with watercress (*Nasturtium officinale*)(Warren et al. 1991). However, two patches of umbel on the San Pedro River were lost during a winter flood in 1994, and the species had still not recolonized that area as of May 1995, demonstrating the dynamic and often precarious nature of occurrences within a riparian system (Al Anderson, Grey Hawk Ranch, in litt. 1995). The expansion and contraction of umbel occurrences appears to depend on the presence of more protected sites where the species can escape the effects of scouring floods, a watershed that has an unaltered hydrograph, and a healthy riparian community that stabilizes the channel (USFWS 1999b). Density of umbel plants and size of occurrences fluctuate in response to both flood cycles and site characteristics such as the density of overstory shade, the density of both native and non-native herbaceous layers beneath the canopy, and availability of muddy or silty substrates with organic content, versus deeply entrenched channels.

While the extent of occupied habitat can be estimated, the number of individuals in each occurrence is difficult to determine because of the intermeshing nature of the creeping rhizomes and the predominantly asexual mode of reproduction. A “population” of umbel may be composed of one or many genetically distinct individuals; again, these geographically and hydrologically discrete groupings are herein referred to as occurrences. Therefore, we refer to occurrences of umbel, rather than populations.

It should also be noted that many Huachuca water umbel occurrences have not been relocated in recent years, despite surveys. Suitable habitat for the species still exists in many of these locations, and a seed bank may also persist. The species is also small and may escape detection and may be particularly difficult to locate when abundance is low or when umbel is co-occurring with other streamside vegetation. This complicates the ability to estimate the amount of occupied habitat.

Threats

Overgrazing, mining, hay harvesting, timber harvest, fire suppression, and other activities in the nineteenth century led to widespread erosion and channel entrenchment in southeastern Arizona streams and cienegas when above-average precipitation and flooding occurred in the late 1800s

and early 1900s (Bryan 1925, Martin 1975, Hastings and Turner 1980, Dobyns 1981, Hendrickson and Minckley 1984, Sheridan 1986, Bahre 1991, Webb and Betancourt 1992, Hereford 1993). A major earthquake in 1887 near Batepito, Sonora, about 40 miles south of the upper San Pedro Valley, resulted in land fissures, changes in groundwater elevation, and spring flow, and may have preconditioned the San Pedro River channel for rapid flood-induced entrenchment (Hereford 1993, Geraghty and Miller, Inc. 1995). These events contributed to long-term or permanent degradation and loss of cienega and riparian habitat on the San Pedro River and throughout southeastern Arizona and northeastern Sonora. Much habitat of the umbel and other cienega-dependent species was lost at that time.

Wetland degradation and loss continues today. Human activities such as groundwater overdrafts, surface water diversions, impoundments, channelization, improper livestock grazing, agriculture, mining, sand and gravel operations, road building, non-native species introductions, urbanization, wood cutting, wildfires, and recreation all contribute to riparian and cienega habitat loss and degradation within the historical range of the umbel. The local and regional effects of these activities are expected to increase with increasing human population.

Limited numbers of occurrences and the small size of the occurrences make the umbel vulnerable to extinction as a result of stochastic events that are often exacerbated by habitat disturbance. For instance, the restriction of this taxon to a relatively small area in southeastern Arizona and adjacent areas of Mexico increases the chance that a single environmental catastrophe, such as the flooding associated with a severe tropical storm or an extended drought, could eliminate occurrences from multiple sites or possibly entire watersheds, though such events are unlikely to cause extinction of the species. Occurrences are in most cases isolated, as well, which makes the chance of natural recolonization after extirpation less likely. Small occurrences are also subject to demographic and genetic stochasticity, which increases the probability of occurrence extirpation (Wilcox and Murphy 1985, Shafer 1990).

Critical Habitat

Seven Critical Habitat units have been designated for umbel; all are in Santa Cruz and Cochise counties, Arizona, and include stream courses and adjacent areas to the end of riparian vegetation (USFWS 1999b). The Scotia, Sunnyside, and Bear canyon units (3, 4, and 6) are within the Coronado National Forest. The remaining Units are in lands adjacent to Forest lands. The following general areas are designated as critical habitat (see legal descriptions for exact critical habitat boundaries):

Unit 1 About 1.25 mi of Sonoita Creek southwest of Sonoita;
Unit 2 About 2.7 mi of the Santa Cruz River on both sides of Forest Road 61, plus about 1.9 mi of an unnamed tributary to the east of the river;
Unit 3 About 3.4 mi of Scotia Canyon upstream from near Forest Road 48;
Unit 4 about 0.7 mi of Sunnyside Canyon near Forest Road 117 in the Huachuca Mountains;
Unit 5 About 3.8 mi of Garden Canyon near its confluence with Sawmill Canyon;
Unit 6 About 1.0 mi of Rattlesnake Canyon and 0.6 mi of an unnamed canyon, both tributaries to Lone Mountain Canyon; about 1.0 mi of Lone Mountain Canyon; about 1.0 mi of Bear Canyon; and about 0.6-mi reach of an unnamed tributary to Bear Canyon; and

Unit 7 About 33.7 mi of the San Pedro River from the perennial flow reach north of Fairbank (Arizona Department of Water Resources 1991) to 0.13 mi south of Hereford, San Pedro Riparian National Conservation Area.

The primary constituent elements of critical habitat for umbel include, but are not limited to, the habitat components that provide (USFWS 1999):

1. Sufficient perennial base flows to provide a permanently or nearly permanently wetted substrate for growth and reproduction of umbel;
2. A stream channel that is relatively stable, but subject to periodic flooding that provides for rejuvenation of the riparian plant community and produces open microsites for umbel expansion;
3. A riparian plant community that is relatively stable over time and in which non-native species do not exist or are at a density that has little or no adverse effect on resources available for umbel growth and reproduction; and
4. In streams and rivers, refugial sites in each watershed and in each reach, including but not limited to springs or backwaters of mainstem rivers that allow each occurrence to survive catastrophic floods and recolonize larger areas.

Activities that may destroy or adversely modify critical habitat include those that alter the primary constituent elements to the extent that the value of critical habitat for both the survival and recovery of umbel is appreciably diminished. Such activities are also likely to jeopardize the continued existence of the species.

Recovery Planning

There is currently no recovery plan for the Huachuca water umbel; we expect to initiate recovery planning in 2014. We cannot anticipate the recovery criteria that may be used, but we are aware of the types of measures that are needed to ensure conservation (which equates with recovery), as we have engaged in numerous section 7 consultations for actions affecting the species since it was listed in 1997.

We feel that the ability for the species to be recovered and critical habitat's ability to contribute to the recovery of the species both depend on maintaining self-sustaining, watershed-scale distributions or occurrences of plants within the full suite of watersheds within the species' range. Survival and recovery of the species would potentially be placed at risk if any one higher-order watershed (such as San Pedro River, Santa Cruz River, or Rio Yaqui) were so geomorphically or hydrologically altered that the species could no longer survive or be recovered there, regardless of the persistence of a seed bank. In terms of the critical habitat, survival and recovery of the species would potentially be placed at risk if a group of smaller units within one of the higher-order watersheds (such as are present in the Huachuca Mountains) or an entire, large unit (the upper San Pedro River) were so geomorphically or hydrologically altered that the unit could no longer support the species and contribute to recovery.

Climate Change

Climate change is a confounding factor in terms of the status, baseline, and recovery of Huachuca water umbel. The effects of climate change on aquatic environments are analyzed in

the Drought and Climate Change subsection of the Action Area and Environmental Baseline Section, above; these prior analyses are incorporated herein via reference.

In summary, the best available information indicates that the aquatic ecosystems in which Huachuca water umbel occur will experience: increased occurrence of extreme events such as drought, fires, heat waves, storms, and floods (which can also interact synergistically, i.e. droughts can increase wildfire potential, and elevated flood flows can result from wildfires); decreased streamflows and floods are predicted to occur more frequently because of climate change (IPCC 2007a, Overpeck et al. 2012). It is anticipated that an increase in extreme events will most likely affect occurrences living at the edge of their physiological tolerances. The predicted increases in extreme temperature and precipitation events may lead to dramatic changes in the distribution of species or to their extinction (Parmesan and Matthews 2006).

Decreased streamflow

Current models suggest a decrease in precipitation in the Southwest (Kundzewicz et al. 2007, Seager et al. 2007) which would lead to reduced streamflows and a reduced amount of habitat for Huachuca water umbel. Streamflow is predicted to decrease in the Southwest even if precipitation were to increase moderately (Nash and Gleick 1993, State of New Mexico 2005, Hoerling and Eischeid 2007). Winter and spring warming causes an increased fraction of precipitation to fall as rain, resulting either from decreased precipitation (Kundzewicz et al. 2007, Seager et al. 2007); changes in the duration and volume of runoff resulting from decreases in the proportion of snow relative to total precipitation (Christensen et al. 2004, Stewart et al. 2004, Regonda et al. 2005, Stewart et al. 2005); and increased evapotranspiration and decreased soil moisture from higher temperatures (Garfin 2005, Seager et al. 2007). The effect of these anticipated reductions in decreased streamflow is that sites occupied by Huachuca water umbel will become smaller, intermittent or dry, and thereby reduce the amount of habitat available for the species. Given that these projections are for the southwestern United States in general, they apply both to the rangewide status of the species and the species' status within the action area, which is discussed in the Environmental Baseline section, below.

Change in the hydrograph

In a warmer world, an enhanced hydrologic cycle is expected; flood extremes could be more common resulting in larger floods; droughts may be more intense, frequent, and longer-lasting (Seager et al. 2007). Stewart et al. (2005) show that timing of spring streamflow in the western U.S. during the last five decades has shifted so that the major peak now arrives 1 to 4 weeks earlier, resulting in less flow in the spring and summer. They conclude that almost everywhere in North America, a 10 to 50 percent decrease in spring-summer streamflow fractions will accentuate the seasonal summer dry period with important consequences for warm-season water supplies, ecosystems, and wildfire risks (Stewart et al. 2005). Rauscher et al. (2008) suggest that with air temperature increasing from 37 to 41° F (3 to 5° C), snowmelt driven runoff in the western U.S. could occur as much as two months earlier than present. Changes in the hydrograph could potentially alter riparian recruitment patterns.

Drought

The Southwestern U.S. is currently experiencing drought conditions (CLIMAS 2013). Almost 97 percent of Arizona was abnormally dry or drier (March 2013, CLIMAS 2013). Although Huachuca water umbel evolved in the Southwest and have survived drought in the past, it is anticipated that a prolonged, intense drought would affect many umbel occurrences, in particular those occupying small headwater streams which are likely to dry or become intermittent. In addition, there is a clear association between severe droughts and large fires in the Southwest (Swetnam and Baisan 1996) that can harm aquatic plants, their habitat, and the watersheds that contain them.

Fire

Since the mid-1980s, wildfire frequency in western forests has nearly quadrupled compared to the average of the period 1970 to 1986 (Westerling et al. 2006). The total area burned is more than six and a half times the previous level (Westerling et al. 2006). In addition, the average length of the fire season during 1987 to 2003 was 78 days longer compared to 1970 to 1986 and the average time between fire discovery and control increased from about 8 to 37 days for the same time (Westerling et al. 2006). McKenzie et al. (2004) suggest, based on models, that the length of the fire season will likely increase and fires in the western U.S. will be more frequent and severe. In particular, they found that fire in New Mexico appears to be acutely sensitive to summer climate and temperature changes and may respond dramatically to climate warming (McKenzie et al. 2004). The summer temperatures in the southwest are predicted to increase more than any other season (Garfin et al. 2013).

Furthermore, drought and climate change will cause changes in fire regimes in all southeastern Arizona vegetation communities (Kitzberger et al. 2006). The timing, frequency, extent, and destructiveness of wildfires are likely to increase (Westerling et al. 2006) and may facilitate the invasion and increase of nonindigenous plants. These changed fire regimes will change vegetation communities, the hydrological cycle, and nutrient cycling in affected watersheds (Brown et al. 2004). Some regional analyses conservatively predict that acreage burned annually will double with climate change (MacKenzie et al. 2004). Such watershed impacts could cause enhanced scouring and sediment deposition, more extreme flooding (quicker and higher peak flows), and changes to water quality due to increases in ash and sediment within stream channels. Severe watershed impacts such as these, when added to reductions in extant aquatic habitats, will severely restrict sites available for the conservation of aquatic and semi-aquatic plants.

Severe wildfires capable of extirpating or decimating Huachuca water umbel occurrences are relatively recent phenomena and result from the cumulative effects of historical or ongoing grazing, which removes the fine fuels needed to carry fire through the understory in regular, small fires to decrease the potential for catastrophic fires, and fire suppression (Madany and West 1983, Swetnam 1990, Swetnam and Baisan 1996, Gresswell 1999). Historical wildfires in the southwest were primarily cool-burning understory fires with return intervals of 3 to 7 years in ponderosa pine (Swetnam and Dieterich 1985). Cooper (1960) concluded that before the 1950s; crown fires were extremely rare or nonexistent in the region. Effects of fire may be direct and immediate or indirect and sustained over time (Gresswell 1999).

Environmental Baseline – Huachuca Water Umbel

The environmental baseline includes past and present impacts of all Federal, State, or private actions in the action area, the anticipated impacts of all proposed Federal actions in the action area that have undergone formal or early section 7 consultation, and the impact of State and private actions that are contemporaneous with the consultation process. The environmental baseline defines the current status of the species and its habitat in the action area to provide a platform to assess the effects of the action now under consultation. Also refer to the General Environmental Baseline and Action Area earlier in this biological and conference opinion.

The action area for the proposed action – in which Huachuca water umbel will be directly or indirectly affected – includes occupied portions of Garden Canyon and its tributaries Sawmill and McClure canyons on Fort Huachuca (ENRD 2012b); the San Pedro River within the San Pedro Riparian National Conservation Area; and the Babocomari River downstream of the Babocomari Cienega. If these umbel occurrences persist over the long term, they will contribute to the recovery of the species by serving as refugial sites.

Huachuca water umbel has been documented in Garden Canyon since 1958, in Sawmill Canyon since 1979, and in McClure Canyon since 1997 (EEC 2002). In the SPRNCA, the species has been documented since 1958 (EEC 2002), and Huachuca water umbel has more recently been documented on the Babocomari River (Titus and Titus 2008c) about three miles downstream of the Babocomari Ranch headquarters (PBA Figure 4-1). A summary of inventory and monitoring efforts is provided in the discussions of the species' status both on Fort Huachuca and the SPRNCA, below.

Status of Huachuca Water Umbel on Fort Huachuca

Inventory, monitoring, and management of Huachuca water umbel has been done on the Fort since 1999. Fort Huachuca conducts a survey of all potential Huachuca water umbel habitat on the installation every four years. The survey encompasses 16 marshland sites (survey segments), originally identified during the 1999 installation-wide inventory of potential umbel habitat, which are surveyed to determine presence, distribution, and percentage of critical habitat occupied by Huachuca water umbel using Service-approved methodology (Vernadero Group 2010b). Surveys were conducted in 1999 and subsequently in 2002, 2005, and 2009 (Vernadero Group 2010b). Survey transects (50 m in length) were established down the center of the habitat, downstream of the first plant encountered. A population was defined as any individual plant, patch, or patches of Huachuca water umbel on either side of the line within the transect. Sixteen naturally-occurring Huachuca water umbel populations were documented on Fort Huachuca during surveys conducted in September and October 2009 (Vernadero Group 2010b). Also note that the term population, rather than occurrence, is used herein to conform to the terminology used in the monitoring reports.

Huachuca water umbel populations documented by the aforementioned surveys are monitored with frequency transects every other year in between the survey years (Service 2007). Monitoring surveys have been conducted in 2000, 2001, 2003, 2004, 2006, 2008, and 2011 (ENRD 2012b). Monitoring methods follow the Service-approved protocol that uses the line-intercept method for generating frequency of occurrence (ENRD 2012b). The Huachuca water umbel monitoring protocol is implemented by extending a 100-meter measuring tape down the

center of 10 predefined Land Condition Trend Analysis[5] transects. According to the established monitoring protocol, the length of a transect may increase, due to the detection of new populations at the ends of a transect, but should not decrease (ENRD 2012b). Three of ten transects have retained their original transect length, six transects have varied nearly every year; and one transect continued to add length as new populations are encountered at transects' extremities (ENRD 2012b). Consequently, due to the variance in length of individual transects, comparison of frequency of occurrence results between transects and between years generally cannot be made, with the exception of transects HWU-2, HWU-5, and HWU-10 and between years 2008 and 2011 since consistent transect lengths were retained (ENRD 2012b). Overall, the frequency of Huachuca water umbel on the Fort has varied between about 3 and 9 percent from 2000 to 2011 (ENRD 2012b; see Appendix L).

In 2008, surveyors suggested that a more accurate picture of Huachuca water umbel status could be drawn if all data being collected were used, rather than just presence/absence, and suggested assessing the extent of occupied habitat by using data for all documented patches rather than line intercepts (Vernadero Group 2009, ENRD 2012b). Percent of transect occupied generally increased between 2008 and 2011 (the dates for which data are available) and ranged from less than one percent to nearly 15 percent (PBA Appendix L Table 2).

In 2009, Fort Huachuca developed and implemented a project to collect, propagate, and transplant Huachuca water umbel in coordination with the Service and the Desert Botanical Garden (EEC 2008a, Vernadero Group 2010c, 2011). The intent of this project was to guard against the possibility of extirpation of water umbel from a catastrophic event and recover umbel by creating occurrences in suitable unoccupied habitat. In October of 2007, water umbel was collected from two sites on Fort Huachuca and from two sites along the SPRNCA (Vernadero Group 2010c, 2011). Propagation of the collected material was successful, providing enough material to create four new populations on the Fort in 2009 (Huachuca Canyon, a previously unoccupied McClure Canyon pool site, a previously unoccupied McClure Canyon marsh site, and a previously unoccupied Garden Canyon site (Vernadero Group 2010c). Subsequent monitoring at the sites shows population expansion and contraction and flowering has been observed within the first year of transplant at a number of sites (ENRD 2012a). The initial transplants are still being monitored to determine long term survival.

Status of Huachuca Water Umbel on the SPRNCA

The SPRNCA supports naturally occurring Huachuca water umbel and a 33.7-mi reach of the river is designated critical habitat (Service 1997). Huachuca water umbel was first documented on the upper San Pedro River in 1958 near State Route 80 west of St. David. However, it is no longer extant there (Warren et al. 1991, Haas and Frye 1997, USFWS 1999b). In 1995, and 1997 additional occurrences of Huachuca water umbel were documented by BLM and The Nature Conservancy and by researchers from the University of Arizona (Vernadero Group 2011). In 2001, 43 Huachuca water umbel patches were found on the SPRNCA (EEC 2002). Huachuca water umbel occurrences currently occur throughout the SPRNCA, which in the past was divided into four named reaches for discussion. These sections included: 1) the northernmost section from Fairbank to the northern boundary of the SPRNCA (Tombstone gage section); 2) from

[5] The Land Condition Trend Analysis (LCTA) program is the US Army's standard for land inventory and monitoring, employing standardized methods of natural resources data collection, analyses, and reporting designed to meet multiple goals and objectives (Anderson 2002).

Charleston northward to Fairbank (Brunckow Hill section); 3) from State Route 90 north to Charleston (Lewis Spring section); and 4) from Hereford north to State Route 90 (near Hereford Bridge section). This reach name-base convention is no longer employed in monitoring reports; current reporting uses the percent of occupied critical habitat, as described below.

Surveyors have typically identified groupings of Huachuca water umbel plants which began and ended along an undefined length of streambank as "patches." Groupings of plants on opposite banks were counted as separate or independent patches (Mark Fredlake, BLM, 2011, pers. comm.). Monitoring methods for these surveys consisted of searching both banks for patches of Huachuca water umbel plants. In these early surveys, a standard definition for a Huachuca water umbel patch had not been developed because it was believed any definition would have been arbitrary (Fredlake, BLM, 2011, pers. comm,). Due to the uncertainty over what constitutes a "biological population" in this largely clonal species, the term "patch" or "occurrence" would probably be more appropriate for use in place of terms such as "population" or "metapopulation" as used in the monitoring and inventory reports referenced and described below; however, the original terminology from those reports has been retained.

As agreed upon in discussions with USFWS (January 2000), beginning in 2000, and subsequently in 2001, 2004, 2007, 2008, 2009, and 2010, the Fort inventoried potential habitat of Huachuca water umbel within the SPRNCA, using a protocol co-developed with USFWS (EEC 2002, USFWS 2007a). The USFWS protocol selected the fall season (September to October) as the most effective season to monitor Huachuca water umbel, because it was determined that the greatest extent of Huachuca water umbel population could be documented then (EEC 2002). However September to October can also be a period of high water within the SPRNCA, potentially reducing the ability to detect Huachuca water umbel because of the high water conditions and inaccessibility of survey areas.

The protocol defined a Huachuca water umbel population as any individual plant or patch on either side of the bank, located along a 50 m stream segment beginning at the first plant observed (Vernadero Group 2011). Plants outside the linear segment were identified as a new patch. See Vernadero Group (2011) and PBA Appendix L for additional details on the survey protocol.

In October 2000, while preparing for the first monitoring season on the SPRNCA, a major flood occurred that brought the river to a flood stage well above normal (EEC 2001). Normal October flows at the Charleston gaging station average 10 cfs, while flows reached 2,800 cfs on 12 October 2000 and continued precipitation brought the Charleston gage to 8,550 cfs on 23 October (USGS 2012). For comparison, the highest previously recorded flood flow was 18,400 cfs in October 1977; the highest subsequent flood flow was 3,160 cfs in July 2006 (USGS 2012).

Flood conditions restricted access to the river and as a result, the first SPRNCA protocol-level monitoring survey was delayed until 2001 (EEC 2002). The 2001 survey, therefore, defined a post-flood baseline condition for Huachuca water umbel occupation along the SPRNCA as 43 populations (EEC 2002). The number of documented populations was 30 in 2004, 28 in 2007 and 29 in 2008 (Vernadero Group 2010b). In 2009, however, 65 populations of Huachuca water umbel were documented in the SPRNCA (Vernadero Group 2011). The increase in Huachuca water umbel populations detected in 2009 was not a result of a flood, but rather drought, because the lack of water within the streambed in 2009 resulted in improved detection of Huachuca water umbel populations (Vernadero Group 2011). The following and most recent monitoring season

(2010), was substantially wetter than 2009 and 44 Huachuca water umbel populations were documented (Vernadero Group 2011). In 2010, at least two of the consistently documented historical populations were lost due to bank sloughing.

This sloughing, or erosion, of bank soils occurred because the dried, deeply fractured bank soils were quickly eroded and the umbel populations washed away when flows returned in 2010 (Vernadero Group 2011). Although the number of populations documented has varied annually from 2001 to 2010, the general distribution of Huachuca water umbel has remained consistent on the SPRNCA (Vernadero Group 2011)(PBA Appendix L). Throughout all survey years, the greatest number of populations has consistently been recorded south of State Route 90, followed by the area north of State Route 90 to Fairbank, with the fewest recorded north of Fairbank.

Before the 2009 field season, it was clear that it was problematic to assess the fate of Huachuca water umbel on the SPRNCA by merely comparing the number of documented populations. Population numbers have shown great variability. Annual monitoring results have documented the fluid nature of many Huachuca water umbel populations along the SPRNCA, as well as some populations that are relatively stable. The methodology does not allow for a comparison of the size of individual populations from year to year since individual populations/patches are not marked. These populations are in annual flux, and fluctuations appear to be responsible for at least a portion of apparent decreases in population counts. GIS analysis of between-year population occurrences in 2007, for example, revealed that three populations (populations 12, 23, and 27) contained multiple historical populations (EEC 2007). Therefore, what had been counted as distinct populations in previous years, were documented as single populations in 2007. This ultimately resulted in an apparent reduction of the population count when in fact populations merely expanded, merging with one another (EEC 2007).

As a result of the difficulties in accurately assessing Huachuca water umbel status across years due to the fact that populations grow and merge, the Fort began reporting the percentage of critical habitat occupied by Huachuca water umbel, in addition to the population counts, in annual monitoring reports beginning in 2008 (Vernadero Group 2008, 2009, 2010b). The percent of critical habitat occupied was determined by summation of the linear extent of each Huachuca water umbel population divided by the linear extent of critical habitat. The entire length of critical habitat (54,235 meters) was used, rather than the number of miles surveyed each year, in an effort to maintain consistency across years.

Results from this analysis showed variability in Huachuca water umbel occupancy; however the general trend is not one of decline, but rather of increasing occupancy on the SPRNCA (PBA Appendix L, Table 3 in Vernadero Group 2011). The length of occupied critical habitat was:

- 274.8 m (0.5% of total critical habitat occupied) in 2001;
- 199.7 m (0.4%) in 2004;
- 409.1 m (0.8%) in 2007;
- 362.4 m (0.7%)in 2008;
- 1,041.1 m (1.9%) in 2009; and
- 965.7 m (1.8%) in 2010.

Huachuca water umbel has been established in Curry Draw on the SPRNCA as a cooperative effort between Fort Huachuca and the Bureau of Land Management. This site as well as

locations within Huachuca Canyon Creek, McClure Canyon, Frog and Horsethief Draw springs and Cave Spring are monitored for success, but are not part of the monitoring of naturally-occurring occurrences. If successfully established over the long term, this occurrence will contribute to the recovery of the species by serving as a near-mainstem protected site.

The environmental baseline for the Huachuca water umbel within the SPRNCA, regardless of apparent changes in the species' abundance, exists in an impaired condition. The most-current version of the U.S. Geological Survey's Water Management of the Region Aquifer in the Sierra Vista Subwatershed, Arizona—2011 Report to Congress (321 Report)(USPP 2013) states that the estimated aquifer storage change in the Sierra Vista Subwatershed was -4,600 AF (AF). There was thus 4,600 more AF of ground water being withdrawn and discharged than there was infiltrating and being recharged. Since 2002 (the beginning of the monitoring required by section 321), about 65,200 AF have been removed from storage in addition to the hundreds of thousands of AF that previously were removed from storage since groundwater pumping began in the first half of the 20th century (D. R. Pool, USGS, unpub. data, 2011, as cited in USPP 2013).

Regional Aquifer Groundwater Trends

Trends in the regional groundwater system are discussed in detail in the Groundwater Trends in the Regional Aquifer subsection of the Hydrogeology of Upper San Pedro River section, above. As shown in PBA Figure 3-18, Fort Huachuca maintains several monitoring and test wells within the Installation boundary. However, the silt and clay layer underlying the San Pedro River near Charleston restricts flow and creates confining and semi-confining conditions (PBA Figure 3-17). Due to the differences in the hydrogeology of the monitoring wells compared to the San Pedro River, horizontal gradients are unlikely to accurately represent the changes in groundwater flow from the Fort Huachuca pumping center to the San Pedro River near Charleston (PBA Section 3.5.5). The vertical gradient between the deep aquifer and shallow aquifer measured in paired monitoring wells along the San Pedro River is a better indicator of whether groundwater withdrawals from the Fort Huachuca and Sierra Vista pumping centers are impacting flows on the San Pedro River. The data from the paired monitoring wells along the San Pedro River are discussed in the following paragraphs.

Exchange of water between the deep regional aquifer and shallow alluvial aquifer is driven by hydraulic (pressure) gradients, measured by comparing water levels in shallow and deep monitoring wells at the same location along the San Pedro River. Positive vertical gradients (the deeper wells showing higher surface levels than the shallow wells) indicate upward movement of water from the deeper aquifer to the shallower. Negative gradients indicate the reverse. A zero hydraulic gradient indicates hydrostatic equilibrium and no movement of groundwater between the two aquifers. A decrease in groundwater movement towards the river, caused by groundwater pumping between the mountains and the river, would be reflected in a decrease in the measured vertical hydraulic gradient (the amount by which the pressure in the deeper aquifer exceeds that in the shallower aquifer).

Groundwater Trends in the Alluvial Aquifer

Decreasing trends in baseflow have already been noted in the upper reaches of the San Pedro River within the United States. Thomas and Pool (2006) found that "…summer flows at

Palominas significantly or nearly significantly decreased from 1931 and 1951 to 2002." Thomas and Pool (2006, page 28), further stated that the statistically nonsignificant, but still measurable, decreasing trends in summer flows at Palominas from 1961 and 1971 to 2002 "…may be related to the large gap in the flow record from 1982 to 1995." It is hypothesized that these declining trends may be due in part to water-intensive mining operations in Cananea, Sonora, but it is likely that the pumping of ground water in unincorporated areas within Cochise County is contributing to the negative trends that did exhibit statistical significance.

Kennedy and Gungle (2010) analyzed the data from eight paired shallow and deep monitoring wells along the San Pedro River. Data from seven of the eight monitoring well pairs show essentially no trends over time, either in water level or gradient (Kennedy and Gungle 2010). In one well at Lewis Spring, the water levels have risen in both the deep and shallow wells likely due to the recharge at the EOP. The lack of decline in water levels and gradients during this period suggest that groundwater pumping in the Sierra Vista area has not yet substantially affected vertical gradients in and near the alluvial aquifer of the San Pedro River during the period and in the locations for which water level data exist (Kennedy and Gungle 2010). If groundwater pumping were affecting conditions in the alluvial aquifer, a continual decline in vertical gradients would be expected. This has not occurred.

There are no paired shallow and deep monitoring wells in the Babocomari River alluvial aquifer. In addition, streamflow at the Babocomari River has only been measured consistently since 2000, which is a limited record for analysis of streamflow trends. Information related to streamflow and recharge on the Babocomari River is insufficient for the above analysis to be performed for that watershed.

Although monitoring of groundwater level trends provides an indicator of the sustainability of the groundwater system, groundwater level data alone has limited application for the assessment of impacts from future actions. A more comprehensive tool for predicting future groundwater conditions is a regional groundwater model.

Trends in the Surface Water System

The San Pedro River through the SPRNCA consists of perennial and intermittent reaches, with flows being generally more perennial in the upper reaches and becoming more intermittent as the river flows north. The USGS maintains three streamflow measuring stations on the San Pedro River. They include the Palominas gage, Charleston gage and the Tombstone gage, with the Charleston gage being the only station with a substantially complete long-term record.

Many researchers have documented a long-term decline in flows at the Charleston gaging station (Corell 1996, Corell et al. 1996, Pool and Coes 1999, Koehler 2004, Thomas and Pool 2006, and others), but it has been more difficult to ascribe a cause to the observed declines in discharge.

San Pedro River streamflows have declined in the 20th century. The annual total flow of the San Pedro River at Charleston gage has declined from 57,000 AFY during the predevelopment period (1915 to 1940) to 22,000 AFY from 1991 to 2002 period (Thomas and Pool 2006). The research identified that reduced summer flows were responsible for about 70 percent of that decline, while fall and early winter declines made up 20 and seven percent, respectively. In July 2005, the flow

of the San Pedro River at the Charleston gaging station was zero for the first time since records began (Figure 3-8 and Figure 3-9).

There are four main factors that influence baseflow trends in the Upper San Pedro River:

- Changes in precipitation;
- Changes in evapotranspiration by riparian vegetation (Stromberg et al. 2010);
- Changes in temperature (e.g., date of the last hard freeze)(Kennedy and Gungle 2010); and,
- Groundwater pumping from the regional aquifer.

By removing variability in streamflow attributable to changes in precipitation, Thomas and Pool (2006) found that precipitation declines were only partially responsible for the recent declines in streamflow in the San Pedro River at the Charleston gage. The study evaluated potential factors other than precipitation that could have resulted in streamflow declines and concluded that changes in upland and riparian vegetation are the mostly likely causes for the observed streamflow declines because:

- There are substantial negative trends observed in growing season (summer) flows but not in winter flow;
- The area of riparian vegetation in the Upper San Pedro basin has increased over
- the last century (Stromberg et al. 2010); and,
- Since evapotranspiration makes up more than 90 percent of the discharge from the basin, small changes in upland and riparian vegetation could have pronounced effects on flows in the river (Thomas and Pool 2006).

Seasonal groundwater pumping near the river was also recognized as having a substantial effect on streamflow, but groundwater pumping far from the river (i.e., Sierra Vista/Fort Huachuca area) in the regional aquifer was not seen as having a major influence on streamflows at the San Pedro River at the Charleston gage (Thomas and Pool 2006).

Baseflow in the Upper San Pedro River is the result of groundwater discharge to the river from the regional and alluvial aquifers. The regional aquifer has recharge zones away from the river, primarily at mountain fronts and along ephemeral channels. The alluvial aquifer consists of the "bank storage" in the near-stream alluvial deposits and is recharged mainly from stormwater. Kennedy and Gungle (2010) estimated the quantity and sources of baseflow (regional or alluvial) in the San Pedro River near Tombstone. Using environmental isotope data, they concluded the composition of baseflow in the upper San Pedro River at the Tombstone gage is 74 (±10) percent regional groundwater and 26 (±10) percent summer storm runoff stored as alluvial groundwater for the 2000 to 2009 period. Kennedy and Gungle (2010) also examined declines in baseflow at Tombstone. Median baseflow for the earlier period of record, 1968 to 1986, was 5,830 AFY and for the later period, 1997 to 2009, was 2,880 AFY, which is nearly a 50 percent decline. This decline in median baseflow is also apparent in the raster hydrograph and seven-day winter low flow calculated for the gaging station on the San Pedro River at Tombstone (PBA Figure 3-10 and Figure 3-11). Kennedy and Gungle (2010) concluded that decreases in streamflow in a large part are attributable to changes in the precipitation patterns and more vigorous and expansive vegetation.

The USGS has installed eight pairs of piezometers along the San Pedro River and has installed pressure transducers that record the pressure associated with the elevation of groundwater in each piezometer. These wells are used to estimate the vertical gradient between the deeper regional and shallow alluvial aquifer. A decrease in the vertical gradient in these monitoring wells would indicate a declining contribution of baseflow from the regional aquifer. Since 2001, data from these monitoring wells indicate no changes in water levels or vertical gradients (PBA Section 3.5.6). In addition, from 2000 to 2009, the percentage of regional and alluvial groundwater determined by isotopic analysis has also remained relatively constant. Therefore, Kennedy and Gungle (2010) concluded that together, these data show that declines in winter baseflow of the San Pedro River at the Tombstone gaging station could not be explained by (or attributable to) changes in the regional aquifer.

All the paired monitoring wells to measure vertical gradients are along the mainstem of the San Pedro River and not the Babocomari River (PBA Figure 3-7). Streamflow data for the Babocomari River are less available than the San Pedro River. The USGS installed a stream gage (USGS 9471400) in 2000 in the Babocomari River near Tombstone (PBA Figure 3-7). A raster hydrograph and a graph of winter low flow (15 January to 15 March) for the Babocomari River at this gage are in Figure 3-12 and Figure 3-13, respectively. There were no USGS gaging stations along the Babocomari River before 2000. Before 2000, limited historical streamflow data for the Babocomari River were acquired by Schwartzman (1990) during research conducted for a graduate thesis. Schwartzman (1990) divided the Babocomari River into ten sections and reported the results of streamflow measuring conducted in March and June of 1988. One of Schwartzman's measuring locations (number six) is nearly in the same location as USGS gage on the Babocomari River near Tombstone. In March 1988 Schwartzman measured a flow of 2.7 cubic feet per second (cfs) near the USGS gage (PBA Figure 3-13). From 2001 to 2011, the average winter low baseflow measured by the USGS has varied from 0.6 to 3.9 cfs. The flow naturally fluctuates with wet and dry years. The year in 1988 was a wet year similar to 2001. With the limited data it is difficult to determine trends in flow for the Babocomari River.

Recent groundwater modeling (GeoSystems Analysis 2010) suggests that effects of historical groundwater withdrawals from the regional aquifer (1940 to 2003; PBA Section 3.5.6) would result in reduced flows in the Babocomari River. Since the Babocomari River contributes flow to the San Pedro River upstream of the Tombstone gaging station, there is the potential that declines in Babocomari River baseflow could account for some portion of the declines in winter baseflow observed at the San Pedro River at the Tombstone gage.

The streamflow gaging stations only provide measurements of flow in fixed locations. Since 1999, The Nature Conservancy and BLM have coordinated the efforts of volunteers to map the spatial extent of wet reaches on the SPRNCA. Mapping was done during the third weekend of June to coincide with the lowest flow before the expected start of the monsoon. The mapping of wet reaches during the driest time of year provides an additional metric on flow conditions throughout the San Pedro River. The survey results from 1999 to 2010 indicated that 32 percent (15.9 miles) of the San Pedro River through the SPRNCA had surface flow during all surveyed years. The total wetted length varied from year to year (22.2 to 35.5 miles)(Turner and Richter 2011); however, the only statistically significant trend in wetted length from 1999 to 2010 (such as a segment getting wetter or drier over time) was observed in Segment 2, which generally was getting wetter.

Prior Consultations in the Action Area

Since the June, 14, 2007, publication of the final Biological Opinion on the proposed ongoing and future military operations and activities at Fort Huachuca (File number 22410-2007-F-0132), we have completed five formal and informal consultations regarding actions with effects to Huachuca water umbel and its critical habitat with the Action Area.

- In our May 21, 2012, Biological Opinion (BO) with the Bureau of Land Management on their Gila District Livestock Grazing Program (File number 22410-2006-F-0414), we found that the proposed action would not jeopardize the continued existence of Huachuca water umbel or adversely modify or destroy its critical habitat.

- In our October 3, 2011, BO with the Federal Highway Administration on their replacement of the State Route 90 bridge over the San Pedro River (File number 22410-2011-F-0019), we found that the proposed action would not jeopardize the continued existence of Huachuca water umbel or adversely modify or destroy its critical habitat. It is likely that we will transmit an additional review of proposed changes to the action – with a substantively similar conclusion - in late 2013 or early 2014.

- In our April 2, 2009, BO with the Coronado National Forest, Coronado National Memorial, and Fort Huachuca, on the Huachuca FireScape Project (22410-2008-F-0451), we concurred that the proposed action was not likely to adversely affect the Huachuca water umbel and its critical habitat.

- In our January 22, 2009, review of the improvement project at the State Route 82 Bridge over the San Pedro River, and in its June 13, 2011, reinitiation (File number 22410-2009-I-0131), we concurred that the action was not likely to adversely affect the Huachuca water umbel and its critical habitat.

- In our December 31, 2008, Biological Opinion on Aquatic Species Conservation at the San Pedro Riparian and Las Cienegas National Conservation Areas (File number 22410-2008-F-0103), we concluded that the proposed action would contribute to the recovery of Huachuca water umbel and would not jeopardize the continued existence of Huachuca water umbel or adversely modify or destroy its critical habitat.

The combined effect of the actions analyzed in these consultations to the environmental baseline for the Huachuca water umbel has been a modest improvement in the status of the species, as it has been established in Curry Draw, near Murray Springs, within the SPRNCA as a result of implementation of the December 31, 2008, BO.

Effects of the Action – Huachuca Water Umbel

Effects of the action refer to the direct and indirect effects of an action on the species or critical habitat, together with the effects of other activities that are interrelated and interdependent with that action, which will be added to the environmental baseline. Interrelated actions are those that are part of a larger action and depend on the larger action for their justification. Interdependent actions are those that have no independent utility apart from the action under consideration.

Indirect effects are those that are caused by the proposed action and are later in time, but are still reasonably certain to occur.

The Environmental Baseline section, above, discussed the Huachuca water umbel's status both on Fort Huachuca and within the SPRNCA. Similarly, the effects to Huachuca water umbel and the species' critical habitat are separated into two categories for analysis: direct and indirect effects to plants occurring on and critical habitat designated within the boundaries of the installation; and indirect effects (including the effects of interdependent and interrelated actions) to plants and critical habitat on the San Pedro River within the SPRNCA.

Huachuca water umbel occurrence sites and critical habitat within the boundary of Fort Huachuca are affected directly and indirectly through actions that disturb land and vegetation. Huachuca water umbel occurrence sites and critical habitat along the San Pedro River within the SPRNCA are affected indirectly by Fort Huachuca's pumping of ground water from within the Sierra Vista Subwatershed. The following narrative contains separate analyses of on-post and off-post effects.

Effects to Huachuca Water Umbel on Fort Huachuca

The Description of the Proposed Action section, above, described the full range of activities conducted by Fort Huachuca. The proposed action also includes a series of species-specific conservation measures intended to avoid and minimize the adverse effects of the proposed action. These measures, and their effects to both the species and, as applicable, its critical habitat, are as follows:

- HWU-1: The Fort will monitor naturally occurring Huachuca water umbel on the installation every three years. A survey of potential habitat on the Fort will be conducted once every 10 years. The Fort will conduct long-term monitoring at all transplanted Huachuca water umbel populations on the Installation (via implemented projects under Section 7(a)(1) of the ESA) as identified via the Fort's Long-Term Monitoring Plan (PBA Appendix M). Implementation of this conservation measure will ensure that changes to the status of the species, including within critical habitat, are detected, thus permitting a management response (if the change is negative);

- HWU-2: The Fort will inventory all potential Huachuca water umbel habitat on the SPRNCA every three years in coordination with the Bureau of Land Management (non-concurrent with Installation survey years). The Fort will conduct Long-Term Monitoring at all year 2010 transplanted Huachuca water umbel populations on the SPRNCA (via implemented projects under Section 7(a)(1) of the ESA) as identified via the Fort's Long-Term Monitoring Plan). Implementation of this conservation measure will ensure that changes to the status of the species, including within critical habitat, are detected, thus permitting a management response in collaboration with the BLM(if the change is negative);

- HWU-3: The Fort will maintain rock barriers around Huachuca water umbel populations on specific vulnerable populations. This conservation measure will minimize vehicular intrusions into Huachuca water umbel habitat, including critical habitat;

- HWU-4: To preclude vehicular traffic, the Fort will maintain the vehicle barrier at Gate Number 7. Gate Number 7 is at the saddle between Garden Canyon on the east side of the Huachuca Mountains and Scotia Canyon on the west side of the mountains. This gate is used to allow access off post to the west side of the mountains. Maintenance of this gate will minimize the passage of vehicles onto Fort Huachuca sites containing Huachuca water umbel (and its critical habitat) within Garden Canyon;

- HWU-5: The Fort will manage existing Huachuca water umbel habitat on Post that has been degraded or lost due to mission-related activities. Management could include the propagation of Huachuca water umbel for use in site introduction and restoration and protection of other suitable sites. This conservation measure will allow continued implementation and potential expansion of Huachuca water umbel restoration work;

- HWU-6: As part of the Fort's monitoring program for the Huachuca water umbel, the Fort will document any disturbance of Huachuca water umbel or its habitat on the Fort and report any disturbance to the Service as described in the reporting requirements (PBA Section 2.13.3). Implementation of HWU-6 will allow tracking of unanticipated adverse effects to the species and/or its critical habitat and, by extension, promote a management response when needed;

- HWU-7: The Fort will continue with water conservation efforts, effluent reuse or recharge, purchase of conservation easements, and storm water recharge (PBA Section 2.13.2). Continued implementation of Conservation Measure HWU-7 will ensure that water mitigation - a crucial aspect of Fort Huachuca's proposed action – proceeds such that both the species and its critical habitat are conserved; and

- HWU-8: All maintenance in Garden Canyon and Huachuca Canyon will be within the existing roadbed or catch basins. Silt fencing is a best management practice that can be used where there is the potential for sediment to enter Huachuca water umbel habitat in these canyons. No native vegetation will be removed outside of the existing roadbed and no invasive plant or animal species will be introduced. No water will be diverted from Garden Canyon Creek. This conservation measure will minimize the adverse effects of human activities and related erosion within Huachuca water umbel habitat, including critical habitat.

The elements of the proposed action (see Description of the Proposed Action, above) that could adversely affect Huachuca water umbel or, as applicable, its critical habitat within the Fort Huachuca portion of the action area (i.e. Garden Canyon and its tributaries Sawmill and McClure canyons, and Huachuca Canyon) include fire, human disturbance, erosion, and water use.

<u>Fire</u>

Fire would generally not burn the wetland habitat of the Huachuca water umbel. However, fire has the potential to burn adjacent upland habitats causing indirect effects on Huachuca water umbel habitat that could include increased runoff of floodwaters, deposition of debris and sediment originating in the burned area, and potential for scouring of the Huachuca water umbel habitat. Although the Huachuca water umbel is adapted to reestablish after flooding and sediment deposition, a large event above Huachuca water umbel habitat could adversely affect

the local occurrence of the species. Recolonization and re-establishment of Huachuca water umbel could be significantly slowed following large-scale habitat alteration.

Fort Huachuca is participating with other federal agencies in the FireScape program (USDA FS 2009a), which provides for fuels management in the Huachuca Mountains. Fort Huachuca's Integrated Wildfire Management Plan (Gebow and Hessil 2006) provides a planning framework for reducing the risk of fire and fire suppression effects on listed species. The risk of a fire originating in lower-elevation training areas reaching forested habitat in the upper elevations is reduced to some extent by fuel management activities in lowland habitats and to a network of fire breaks that the Fort has established along ridgelines. The FireScape consultation is not current, however, so this BO will include an analysis of the effects of Fort Huachuca's fire and fuel treatment activities.

Fuels management, prescribed fire, managed natural fire, and wildland firefighting have the potential to affect Huachuca water umbel and the aquatic ecosystems in which it occurs. According to the PBA, fuels management on the Fort is ongoing and employs a variety of hand methods, combined with prescribed burning. Fuels modification activities in wooded habitats situated in the uplands adjacent to streams occupied by Huachuca water umbel, are designed to reduce the density of vegetation in oak, pine-oak, oak-pine, and mixed conifer vegetation in an attempt to return these communities to more natural conditions following decades of fire suppression.

Fuels management activities, including thinning, slash removal, and prescribed fire may temporarily degrade Huachuca water umbel habitat. Fort Huachuca's Integrated Wildland Fire Management Plan (IWFMP) is due to be updated in coordination with our office before 2016. Depending on funding and environmental conditions, Fort Huachuca proposes to treat (mechanically thin and subsequently burn) up to 6,190 ac in the upper elevations on the Fort over the next 10 years. See Table HWU-1 below for the number of acres of each biotic community proposed to be treated over the next 10 years in the upper elevations. The upper elevation treatment units will have more than a single treatment occurring within them over the 10 years. The initial treatment will be mechanical to reduce the fuel load; once a treatment unit has undergone sufficient mechanical treatment to bring flame lengths down to an appropriate height to ensure safe burning conditions, controlled burns will be implemented within the unit.

Prescribed fire is, by design, low intensity and is not intended to remove all vegetative cover; patchy coverage will remain. Prescribed fire is also not intended to reduce riparian vegetation. We therefore conclude that there will be no direct effects to Huachuca water umbel from burning of aquatic or riparian ecosystems. Regarding indirect effects of post-fire changes in the upland vegetative communities, we anticipate there will be no appreciable, long-term changes in the magnitude, frequency, or duration of flood flows. In the event that runoff is elevated or contains ash, we believe that the effects will be temporary and Huachuca water umbel would be able to persist in discreet sites, particularly within reaches containing deergrass (*Muhlenbergia rigens*), boulders, and other elements of hydraulic complexity that would tend to shelter individual umbel plants.

Although active fire suppression, as opposed to planned, prescriptive fires, is critical to reduce damage from some wildfires, suppression activities can also adversely affect the water umbel. However, the Fort is committed to making protection of water umbel habitat an objective of fire

suppression. Suppression-related off-road vehicle activity, including tracked vehicles, will be minimized. A resource advisor will be on-site during all fires to advise the incident commander of species issues. Areas disturbed will be kept to a minimum and located outside of areas important for the water umbel, whenever possible. Prescribed fire is planned in advance and is thus subject to section 7 consultation under the regulations at 50 CFR § 402. We note, however, that the effects of wildfire suppression would be consulted upon as an emergency consultation, as provided for at 50 CFR § 402.05.

Human Disturbance

Military training and testing are limited in the canyons of the Huachuca Mountains where this species occurs, and vehicle use is restricted to existing roads and trails, minimizing potential for direct impact. Road repair or maintenance in Huachuca water umbel habitat is done using best management practices and conservation measures developed in consultation with the Service for road repairs. These measures act to confine effects of maintenance to the immediate area of the road and to minimize off-site effects.

A hiking trail passes by a Huachuca water umbel site at Sawmill Spring. Limited trampling by recreationists likely occurs at this locality, but is not considered a serious threat. The site at the upper Garden Canyon picnic ground is in the picnic area and is likely subject to foot traffic, but the Fort has placed large boulders around the area to exclude vehicles (Conservation Measure HWU 3, above). Other occurrences in Garden and McClure canyons receive less use by recreationists, and trampling and damage by vehicles are also less likely in these areas. Additionally, the Fort has closed Gate 7 which previously allowed vehicular access to the upper Garden Canyon watershed from the west (HWU-4). Pipelines originally constructed to tap springs in Garden Canyon and convey water downstream for water supply are no longer in use. Water will not be diverted from Garden Canyon for any purpose.

Erosion

Erosion and sedimentation can occur in Huachuca water umbel habitat as a result of wildland fire in upland habitat adjacent to water umbel habitat, as discussed above under fire. However, the Fort has restoration and erosion best management practices that will be put in place following fires. Erosion may also result from degraded or improperly maintained roads. We anticipate that implementation of Conservation Measures HWU-4, HWU-5, and HWU-8 will minimize these effects.

Water Use

There will be no effects on the Huachuca water umbel or its critical habitat on Fort Huachuca as a result of the installation's groundwater use. The occurrences of umbel and it's critical habitat are located in the upper portions of the Garden Canyon watershed (including its tributaries, Sawmill and McClure canyons) and Huachuca Canyon, are located well up-gradient from the regional aquifer and are therefore unaffected by groundwater development and use that affect base flows. Because umbel are not affected by groundwater use development, use and baseflow, there is no appreciable reduction in their likelihood of recovery caused by reduced base flows.

Activities on the Fort do, however, have the potential to affect surface waters. A pipeline currently exists in Garden Canyon that has the potential to divert a portion of the flow in Garden Canyon for downstream use. The potential amount of such a diversion is unknown, but the source is eight springs, with the uppermost spring located near the pictograph sites. From this point, water could be collected and diverted in a pipeline from the various springs along Garden Canyon Creek (Tom Cochran, 1998, pers. comm. as cited in the 2007 Revised PBA). Fort Huachuca has removed all water uses from this pipeline. However, the pipeline infrastructure will remain intact and may be used in the future for mobilizing, emergencies, and firefighting. These uses are expected to be infrequent and of short duration, and thus should have no measurable effect on water umbel occurrences in Garden Canyon, including the critical habitat that exists there.

Effects to Huachuca Water Umbel in the San Pedro Riparian National Conservation Area

Surface flows in the San Pedro and Babocomari rivers derive from four primary sources: 1) stormwater runoff; 2), flows from bank storage; 3) baseflow discharged from the alluvial aquifer; and 4) baseflow discharged from the regional groundwater aquifer. The regional groundwater component of baseflow is an important source of water for many reaches of the San Pedro and Babocomari rivers, sustaining flows when direct runoff of precipitation and discharges from the banks or alluvium are not occurring.

Huachuca water umbel occurrences and critical habitat on the mainstem San Pedro River are affected indirectly by the pumping of groundwater from the regional aquifer. Ground water is pumped: 1) by Fort Huachuca to serve its on-base military and civilian population; 2) by municipal and investor-owned utilities to serve local industries and residents; and 3) by private land owners operating private wells and well shares. To the extent that groundwater withdrawals by Fort Huachuca reduce the contribution of regional groundwater to baseflow, surface flows would also be affected. Groundwater withdrawals from the alluvial aquifer and from the regional aquifer closer to the river have more appreciable temporal and spatial impacts than groundwater withdrawals from the regional aquifer which is significantly more distant from the rivers. Further, the effect of groundwater withdrawals on the rivers is relatively greater during low-flow periods when surface flows are likely to be maintained solely by discharges from the alluvial and regional aquifers.

Fort Huachuca's pumping (direct and interrelated) results in both removal of ground water from *storage* in the regional aquifer and the *capture* of water from discharge. Ground water in storage is that which resides in an aquifer. Such stored water may be discharging to a spring or waterway. Water used by plants through evapotranspiration is also categorized as discharge. Under unaffected conditions (i.e., no pumping), infiltration of rainfall and runoff maintains storage in equilibrium with discharge. Water withdrawn from the ground by wells initially derives exclusively from storage. As pumping continues, increasing proportions of water are derived from the capture of discharge, and decreasing proportions are derived from storage. In other words, ground water wells are withdrawing not only water residing in the aquifer, but also water that was otherwise destined to become the surface flow of a stream or be available to sustain riparian vegetation. If water withdrawal continues unmitigated, it will eventually deplete storage, reverse the flow direction of groundwater, and capture (dewater) the stream itself. Deprivation of the base flow of the San Pedro River could eventually cause perennial reaches to become intermittent or ephemeral. Such a change in the hydrologic regime of the San Pedro

River, depending upon the reach in which it occurred, could result in losses of numerous Huachuca water umbel occurrences. The following narrative describes the magnitude of this potential effect, the effect of Fort Huachuca's proposed measures to avoid and minimize it, and the methodology by which these analyses are conducted.

The first step for Fort Huachuca to determine the effects of its proposed action on the Huachuca water umbel is to determine the magnitude of groundwater withdrawal, recharge (natural and enhanced), and water conservation (including water-saving activities as well as mitigating projects). Determination of the amount of groundwater withdrawal first and foremost requires an understanding of the anthropogenic water use (water demand) associated with Fort Huachuca. This requires an understanding of how many humans reside in the Sierra Vista Subwatershed due to the presence of Fort Huachuca and how much water is used by those individuals. The human population includes both military and civilian personnel assigned to Fort Huachuca or one of its tenant units or organizations as well people who reside in the area due to the presence of the installation, including, but not limited to, dependents, contractors, retirees, and indirectly-affiliated individuals who are present due to the Fort's substantial economic contributions to the area.

To determine the human population, Fort Huachuca: 1) conducted a demographic survey (PBA Appendix H); 2) ran an economic impact model (PBA Appendix I); and 3) produced a demographic survey report (PBA Appendix J), based on the results of the demographic survey. The contents of these analyses are incorporated herein via reference. The purposes of the demographic survey (PBA Appendix H) are to: accurately determine the number of people directly attributable to Fort Huachuca; and determine the proportion of Fort Huachuca-related households compared to all households within the Sierra Vista Subwatershed.

The purpose of the economic impact model (PBA Appendix I), which uses Impact Analysis for Planning (IMPLAN) software and fiscal year 2011 (October 1, 2010 to September 30, 2011) expenditure, contract, and payroll data, is to determine the total of the direct and indirect impacts of Fort Huachuca. Direct economic impacts are those that occur as a direct result of the military personnel, civilians and contractors employed at the Fort and their associated wages. Indirect economic impacts and induced impacts occur as a result of the multiplier effects, defined as spending that ripples through the economy generating additional income based upon structural trade linkages within the economy. The IMPLAN model's results present economic impacts as the total number of jobs with no distinction between full-time and part-time jobs. All employment figures are converted to full time equivalent employment (FTE) for reporting purposes.

We note that the IMPLAN economic impact model differs from the Economic Income Forecasting System (EIFS) model that was used in the 2007 PBA and our 2007 BO. The EIFS model has a firm basis in regional economic theory and has been widely applied by the Department of the Army within the context of National Environmental Policy Act (NEPA) analyses to determine the economic impacts of changes in personnel levels; IMPLAN is a similarly rigorous and defensible model. Further, Fort Huachuca utilized up-to-date data in the IMPLAN model development; the prior EIFS model has not been updated and thus does not constitute the best available information. The lack of current data also applies to the calculation of the human population attributable to Fort Huachuca that was performed by Robert Carreira from the Center for Economic Research (Appendix I in the 2007 PBA) and to the 2007 study

entitled Fort Huachuca and the San Pedro River: Improving Water Deficit Liability Calculations Through Economic Modeling, authored by Janie Chermak, Ph.D., John Talberth, Ph.D., and Jason Hansen of the University of New Mexico and the Center for Sustainable Economy. The latter model was provided to USFWS subsequent to our completion of the 2007 BO, but we are not aware of the publication of any updates.

The demographic survey report (PBA Appendix J) combines the results of the demographic survey (PBA Appendix H), which indicates the population directly attributable to Fort Huachuca and the IMPLAN model (PBA Appendix I), which estimates the induced employment that results from the expenditures by the Fort. The final result of the demographic survey report is that Fort Huachuca's total direct, indirect, and induced population in the Sierra Vista Subwatershed is an estimated 33,440 persons. The 33,440-person estimated human population was then employed in an accounting of Fort Huachuca's groundwater demand, the results of which appear in PBA Appendix K, which is incorporated herein via reference.

Groundwater Demand

There are several types of groundwater demand that were evaluated in determining Fort Huachuca's 2011 Net Groundwater Demand: surface water, agricultural, municipal, rural, and industrial. Fort Huachuca does not use surface water or agricultural water; therefore, these two groundwater demands were eliminated from the Fort's Net Groundwater Demand Calculation. The groundwater use attributable to Fort Huachuca's 33,440-person estimated human population for 2011 is determined by an analysis of the following factors:

- The average municipal per capita water use for those individuals living in urban areas (municipal);
- The average unincorporated area per capita water use for those living outside of urban areas (rural); and
- A fraction of total industrial groundwater demand within the Sierra Vista Subwatershed (industrial).

Average per capita water demand for the Sierra Vista/Fort Huachuca area was calculated based on dividing the combined Fort Huachuca and City of Sierra Vista groundwater pumping by the combined 2011 resident population. Groundwater pumping in 2011 at Fort Huachuca and in Sierra Vista was 1,030 AF and 6,218 AF, respectively, for a total of 7,248 AF. The combined 2011 resident population was 45,098, with 7,454 on the Fort, and 37,644 off of the Fort in Sierra Vista. The resulting per capita water use rate for urban residents was 143 gpcd. This value is lower than the 2000 municipal per capita water use value of 180 gpcd for Fort Huachuca and the City of Sierra Vista, reflecting conservation measures to reduce pumping since that time.

For residents of unincorporated areas of the Subwatershed, an average water use rate of 118 gpcd was used. This value was estimated by the Groundwater Users Advisory Council of the Prescott Active Management Area (2006) for domestic well demand. We note that the 118 gpcd value was derived for the Prescott area in Yavapai County, Arizona, which is relatively similar in elevation and climate to the Sierra Vista area. Both the Fort's direct off-Post population and the induced population were distributed between urban and unincorporated areas of the Subwatershed according to the distribution representative of the whole Subwatershed. Based on 2010 Census data within the Sierra Vista Subwatershed, 42 percent of the population lives

outside of Sierra Vista in unincorporated areas (U.S. Census Bureau 2012). From the Fort's total direct and indirect personnel in 2011 of 25,303, 17,871 persons resided in incorporated areas, and 7,432 were assumed to live in unincorporated areas of the Subwatershed. Similarly, among the Fort's 2011 induced population of 8,137, 42 percent (3,338) are assumed to live outside urban areas, bringing the total unincorporated area population attributable to Fort Huachuca to 10,820 (7,432 plus 3,388). The total incorporated population attributable to the Fort in 2011 is estimated at 22,620 (17,871 plus 4,749). Adding the 10,820 residents of the unincorporated areas to the 22,620 residents of incorporated areas renders the 33,440-person total induced human population cited above.

Fort Huachuca's total gross groundwater demand within the Sierra Vista Subwatershed is derived by applying the urban-area total groundwater demand of 143 gpcd to the incorporated population attributable to the Fort, applying the unincorporated-area domestic demand of 118 gpcd to the unincorporated-area population attributable to the Fort, and adding a fraction of the total Subwatershed's industrial groundwater demand.

Including the induced population, the Fort was responsible for approximately 43 percent of the total 2011 population of the Sierra Vista Subwatershed. Therefore, the Fort's share of industrial groundwater demand in 2011 is estimated as 43 percent of the total industrial demand in the Subwatershed. USPP (USPP 2010) estimated that 1,350 acre feet were required for sand and gravel operations and industrial golf course irrigation in the Sierra Vista Subwatershed in 2010, which puts Fort Huachuca's industrial groundwater demand responsibility at 584 AF.

Groundwater Recharge

Combining industrial demand (584 AF) with Incorporated demand (3,635 AF) and unincorporated-area demand (1,428 AF) yields a total groundwater demand of 5,648 AF in the Sierra Vista Subwatershed attributable to Fort Huachuca in 2011.

Human-induced recharge occurs from effluent recharge basins and stormwater detention basins, incidental stormwater recharge in urban areas, and incidental recharge from turf grass irrigation, septic systems, and effluent discharged other than in basins. According to the Arizona Department of Water Resources (ADWR; 2005), only 5 percent of Sierra Vista is without sewer; hence septic system recharge in the city is very small. Total human-induced recharge except for septic systems in 2011 is estimated at 324 and 4,962 AF for Fort Huachuca and Sierra Vista. The portion of Sierra Vista's human-induced recharge attributable to Fort Huachuca is based on the ratio of the Fort's off-Post urban-area population to the total Sierra Vista population. This fraction, 40 percent, of Sierra Vista recharge equals 1,999 AF, giving a total recharge "credit" of 2,323 (324 plus 1,999 AF to Fort Huachuca in 2011 not including septic system recharge).

Septic systems are generally credited for contributing to groundwater recharge. The Arizona Department of Water Resources (2005) assumes that all indoor water use (estimated at 69 gpcd) is recharged. This assumption fails to account for any evapotranspiration of leach field water. The Upper San Pedro Partnership (2010) has adopted a septic recharge rate of 70 percent. The Arizona Department of Water Resources (2005) assumes an average of 3 people per home and an average per-capita indoor water use of 69 gpcd. Applying this recharge rate to the 5 percent of Sierra Vista homes that are without sewer and all of the unincorporated population in the Sierra Vista Subwatershed and then reducing those values to account only for the population

attributable to Fort Huachuca yields a septic recharge "credit" of about 500 AF in 2011 for Fort Huachuca. About 430 of those AF are recharged in unincorporated areas of the Subwatershed. Total recharge credits to Fort Huachuca in 2011 is estimated to be 2,823 (2,323 plus 500) AF (Table 3-3 in the PBA for summary data). Conservation easements purchased by the Fort in 2000 and 2001 eliminated 195 ac of irrigated agriculture which required 1,073 AF of water consumption near the San Pedro River (ADWR 1991, USFWS 2002d, cited as Harlow 2002 in the PBA; USFWS 2013a). Groundwater pumped near the river derives mostly from capture rather than groundwater storage. Elimination of this pumping therefore has a much greater potential for a near-term impact on streamflows and riparian evapotranspiration than mitigation that occurs miles away from the river.

The Fort has also purchased conservation easements in the Babocomari River area north of the Fort (3,628 ac). These conservation easements result in 299 AFY of future avoided pumping based on 0.0825 AF of avoided future residential pumping per acre. This multiplication factor is calculated by dividing the number of acres by four acres per residence, multiplying by 2.5 people per residence, multiplying by 118 gpcd, multiplying by 365 days per year and dividing by 325,851 gallons per acre-foot (credits are discussed in greater detail in the Mitigation Measure Plan, PBA Appendix D). The recharge "credit" and the conservation easement "credit" are deducted directly from total gross groundwater demand attributable to the Fort to determine the Fort's net groundwater demand of 1,453 AF in 2011 (Table 1 in PBA Appendix K).

Table 2 provides the calculation of the Fort Huachuca net groundwater demand for 2012 using the same methodology as for 2011. The Fort's attributable population and water use decreased compared to 2011. Also, in 2012, the Army provided funding through ACUB for conservation easements on 1,811 acres on River Stone Ranch. Overall, the net groundwater demand in 2012 was 1,180 AF (Table 2 in PBA Appendix K).

Beyond 2012, Fort Huachuca must project groundwater demand and the yield associated with the conservation measures described in PBA Appendix D, the Mitigation Measures Plan, the contents of which are incorporated herein via reference. Table 5.1 from the PBA summarizes the elements used in determining the 2011 and 2012 groundwater demand and also includes projections of net groundwater demand. Table 5.1 has been reproduced in this BO as Table HWU-2, below. In Table HWU-2, the total groundwater demand and incidental recharge can be projected forward with reasonable certainty because of the Fort's thorough understanding of its staffing levels and water conservation infrastructure. The water yields of conservation measures that have been implemented as of the present time can also be forecast into the future with reasonable certainty; the projected yields of Mitigation Measures C2 though C10 are already known, and the respective projects have been implemented or are otherwise reasonably certain to occur. Mitigation Measures F1 and F2 are in progress, but not yet complete. We feel, based on the narrative in PBA Appendix D (the Mitigation Measures Plan), that the aforementioned measures are reasonably certain to occur, as they have been completed or are being implemented, or funding has been committed, agreements have been executed, planning and compliance efforts are underway, and the Fort has a history of implementing its proposed conservation measures. In regard to Mitigation Measure F1 – the Huachuca City Effluent Project – we have consulted informally with Fort Huachuca on the facility's construction and operation (letter of February 2, 2012; File number 02EAAZ-00-2012-I-0043)(FWS 2012).

The planned acquisition of Babocomari Easements (Mitigation Measure P1) appears less certain to occur. While Fort Huachuca has already acquired conservation easements in the Babocomari area, additional acquisitions are not underway at this time. The projected water yield of this potential, year 2022 action is 248 AFA, but we note that projected net groundwater demands become positive numbers (i.e. a surplus) beginning in 2014 (1,419) and remain at 1,517 AFA through 2021. Therefore, even if the 2022 acquisition of additional Babocomari conservation easements is discounted due to uncertainty, we still anticipate a net groundwater surplus due to the Fort's activities by then.

The groundwater demand accounting appearing in Table 5-1 and Appendix K of the PBA and in Table HWU-2, above, contains estimates of Fort Huachuca's attributable groundwater withdrawals and the benefits (or credits) of Mitigation Measures to determine its overall contribution (positive or negative) to the sustainability of the regional aquifer.

The groundwater demand accounting, however, only utilizes annual estimates of total groundwater withdrawals and recharge and is unable to account for spatial and temporal patterns in pumping and recharge that could locally affect groundwater levels and the regional groundwater component of baseflow to reaches of the San Pedro and Babocomari Rivers. Groundwater withdrawals are generally concentrated in the Sierra Vista and Fort Huachuca area, while mitigation measures occur throughout the Sierra Vista Subwatershed. Mitigation measures closer to the river and further upstream have temporal and spatial benefits that are more significant in the shorter term than the relatively longer term potential impacts of Fort Huachuca's pumping of groundwater.

The effects of groundwater withdrawal and recharge on surface waters of interest may be evaluated with a model calibrated to local conditions. In this case, Fort Huachuca's analysis of the spatial and temporal impacts of pumping and recharge (the new water demand accounting appearing in Table HWU-2) associated with the Fort's present and future actions are analyzed with the numerical groundwater model developed by the U.S. Geological Survey (USGS)(Pool and Dickinson 2007), and subsequently modified in 2010 and 2011 by Laurel Lacher (GSA 2010a, GSA 2010b, Lacher 2011). Groundwater demand accounting by Fort Huachuca in the 2007 PBA partitioned the installation's net groundwater demand into pumping which reduces groundwater in storage and pumping that captures natural discharge based on a basin-wide percentage; the Pool and Dickinson (2007) model was not yet published or made available for use. The spatial and temporal impacts of pumping and recharge associated with the Fort's present and future actions are now most appropriately analyzed using the model.

The updated model is based on the USGS Modular Three-Dimensional Groundwater Flow Model (MODFLOW). MODFLOW has undergone extensive USGS peer review, is able to simulate a wide variety of systems, and is the worldwide standard for groundwater models (Horak et al. 2008). MODFLOW simulates groundwater flow on a horizontal scale of 250m and at multiple vertical levels. The updated Upper San Pedro Basin model modified by Lacher (2011) was peer-reviewed by the USGS in 2012 (Leake and Gungle 2012). Leake and Gungle had concerns with artificial recharge near streams due to the 250-meter resolution of the model and the representation of the model properties at the site-scale; the limited ability of the model to simulate detailed geometries of artificial recharge areas and evapotranspiration areas; and stream locations that are smaller than the 250-meter grid spacing. However, Leake and Gungle (2012) found the work that Lacher had completed with the model was reasonable and valid.

The initial (Pool and Dickinson 2007) USGS groundwater model's abstract states that the model's purpose is to "…simulate seasonal and long-term variations in ground-water flow in the Sierra Vista Subwatershed in Arizona and Sonora." The model includes the simulation of details of the groundwater flow system that were not simulated by previous models, such as groundwater flow in the sedimentary rocks that surround and underlie the alluvial basin deposits, withdrawals for dewatering purposes at the Tombstone mine, discharge to springs in the Huachuca Mountains, thick low-permeability intervals of silt and clay that separate the groundwater flow system into deep-confined and shallow-unconfined systems, ephemeral-channel recharge, and seasonal variations in ground-water discharge by wells and evapotranspiration. Steady-state and transient conditions during 1902 to 2003 were simulated by using a five-layer numerical groundwater flow model representing multiple hydrogeologic units. Hydraulic properties of model layers, streamflow, and evapotranspiration rates were estimated as part of the calibration process by using observed water levels, vertical hydraulic gradients, streamflow, and estimated evapotranspiration rates as constraints. Simulations approximate observed water-level trends throughout most of the model area and streamflow trends at the Charleston gage on the San Pedro River. Differences in observed and simulated water levels, streamflow, and evapotranspiration could be reduced through simulation of climate-related variations in recharge rates and recharge from flood-flow infiltration.

Pool and Dickinson (2007) compared their modeling to that employed by three other numerical models pertaining to the upper San Pedro River: Freethy (1982); Goode and Maddock (2000); and Corell et al. (1996). Vionett (1992) provided an additional approach, but it was not specifically evaluated by Pool and Dickinson (2007). We concur with Fort Huachuca's selection of the Pool and Dickinson (2007) groundwater model because it is the most comprehensive and current of the available models and is likely to more accurately account for predevelopment groundwater conditions – those that existed before the onset of large-scale water withdrawals (see also Pool and Coes 1999) – an understanding of which is crucial for determining when steady-state conditions (i.e. recharge equals discharge) may be assumed to have existed.

The PBA (and this BCO) includes a cautionary narrative regarding the use of groundwater models, and of the modified USGS model (Pool and Dickinson 2007, GSA 2010a, GSA 2010b, Lacher 2011) in particular. Models are representations of complex systems and the modeling results are a simulation of what may happen in the future, but do not necessarily accurately predict real conditions. The groundwater model results should always be interpreted with awareness of the limitations of the model. The following list identifies key limitations associated with the model as it applies to this analysis.

- The groundwater model can only model the discharge of the regional groundwater component of baseflow to the San Pedro River and does not include surface flows attributable to flow from bank storage or precipitation. The Fort may only indirectly impact the regional groundwater component of baseflow. Utilizing the model to assess the Fort's impacts on the regional component of baseflow is within the model's intended purpose.

- The groundwater model does not include urban-enhanced recharge and may underestimate the recharge near developed areas like the Fort and the City of Sierra Vista. Urban enhanced recharge (also called Incidental Recharge) refers to recharge attributable to human development associated with paving over areas where rainwater would otherwise be released

to the atmosphere as evapotranspiration before it could percolate to groundwater. The rainwater runs rapidly off the paved surfaces and is concentrated in washes and drainages where more water is able to percolate to groundwater than would otherwise on undisturbed native soils; such ephemeral channel recharge is appreciable (Coes and Pool 2005). Urban enhanced recharge is estimated to be 2,300 AFY, of which 40 percent (900 AF) is attributable to the Fort.

- The benefits from conservation easements were not included in the modeling due to uncertainty in estimating where and when future development would have occurred on areas with conservation easements (mitigation measures C5, C7, C8, C9, P1) or uncertainty in when agricultural pumping would recommence without the conservation easements (mitigation measures C6 and C10).

- The groundwater model does not include urban-enhanced recharge (i.e. infiltration of the increased rainfall runoff from impervious surfaces in urban areas) and may underestimate the recharge in developed areas like the Fort and the City of Sierra Vista.

With these limitations, the groundwater modeling does not include about 2,400 AF of credits in 2012 and over 5,500 AF of mitigation credits by 2022. Therefore, the model underestimates the positive benefits of the Fort's mitigation measures and actual groundwater benefits of the Fort-attributable activities would likely be greater than simulated.

To estimate the Fort-attributable impacts on baseflow, two simulations (scenarios) were developed and are described in detail in Groundwater Modeling Report (PBA Appendix G). These are the "With Fort-attributable" (WFA) and the "No Fort-attributable" (NFA) simulations. The WFA simulation includes all Fort-attributable groundwater withdrawals and all completed and in-progress mitigation measures that could feasibly be modeled. The NFA simulation removes all Fort-attributable pumping and recharge both on- and off-Fort while maintaining all other groundwater pumping and recharge within the Basin. Results from the WFA and the NFA simulations were subtracted to determine the Fort's impact. The future Fort impacts to the San Pedro River regional groundwater component of baseflow are the difference between the WFA and NFA simulations. The difference between the two scenarios results in a quantification of the future impacts of Fort Huachuca's attributable pumping (and conservation measures) on the regional groundwater component of baseflow in the San Pedro and Babocomari rivers.

Figure 5-3 in the PBA, and below as Figure HWU-1, provides the simulated regional groundwater component of baseflow for the winter and summer for various locations on the San Pedro and Babocomari rivers. PBA Figure 5-4 (Figure HWU-2 below) presents the changes in baseflow between the WFA simulation and the NFA simulation. PBA Figure 5-5 (Figure HWU-3 below) provides the graph of the simulated regional groundwater baseflow at the Tombstone Gage, which marks the downstream end of the Action Area.

The groundwater modeling simulated negative impacts associated with Fort-attributable changes in the regional groundwater component of baseflow in the lower Babocomari River. The regional groundwater component of baseflow in the lower Babocomari River is projected to decline by -0.1 cfs due to the Fort. However, the regional groundwater component of baseflow at the Babocomari Cienega in the upper Babocomari River, where Huachuca water umbel may

occur, will not be impacted due to being up-gradient from the Fort Huachuca/Sierra Vista pumping center.

Overall, the groundwater model predicts positive impacts of Fort-attributable activities on the net regional groundwater component of baseflow leaving the Sierra Vista Subwatershed from 2012 to 2030 (Figures HWU-1, HWU-2, and HWU-3). This does not include the additional benefits from the conservation easements. For the San Pedro River in the SPRNCA, the Fort-attributable activities, including completed and in-progress conservation measures that could be feasibly modeled, are simulated to increase the regional groundwater component of baseflow by 0.3 cfs at the Charleston gage (PBA Figure 5-3) and 0.4 cfs at the Tombstone gage by 2030 (PBA Figure 5-5). At no point during the period from 2012 to 2030, does the Fort-attributable groundwater withdrawal reduce the baseflow in the mainstem of the San Pedro River. The Fort anticipates in 2014 (PBA Table 5-1), there will be a net surplus in the groundwater demand accounting for the Fort, and beyond 2014, the Fort attributable impacts to the regional groundwater component of baseflow would be positive as a result of the Proposed Action.

Please note that the analyses above are based on data through 2011, reported in 2012, though we currently possess some data through 2013 (Fort Huachuca 2014). We have discussed the relevance of the 2013 data and our rationale for what they are not being employed in this analysis, in the introductory paragraphs of the Water-Related Mitigation Measures subsection of the Description of the Proposed Action section, above. This prior determination is incorporated herein via reference. In brief, the 2012 and 2013 data sets do not significantly differ, a key 2013 statistic is not available, and no updated groundwater model results exist. The data employed herein thus continue to represent the best available scientific information.

Caution was exercised in applying the aforementioned model results to the predictions of absolute changes in the wet or dry conditions of the San Pedro and Babocomari rivers, the key component in the analysis of effects to Huachuca water umbel and its critical habitat. In general, the model was used to simulate the relative change from the current conditions to future years or between scenarios with the Fort's attributable pumping and without the Fort's attributable pumping. In this regard, the model provides very useful estimates of the relative temporal and spatial trends for the regional groundwater component of baseflow on the San Pedro River between different scenarios or periods (GSA 2010a). Previous modeling efforts considered differences in the -0.1 to 0.1 cubic foot per second (cfs) range to be in the numerical "noise" of the model results (Lacher 2011). In the Groundwater Model Report's (PBA Appendix G) results section, which compares different model simulations, only differences greater than ±0.1 cfs are considered as outside of the numerical "noise;" this concept is apparent in the color-coded legend in Figure HWU2.

The PBA evaluated the impacts to the San Pedro River from the future and on-going activities at Fort Huachuca. Projections of the Fort's activities out to ten years can be made with reasonable confidence. The Fort recognizes the need to initiate consultation for any new activities not included in the PBA, if appropriate. After ten years, the uncertainty in predicting federal government programs due to federal fiscal laws and the nature of the budget process becomes considerably more difficult and uncertain. The PBA, however, also includes groundwater modeling results to 2030. Given that indirect effects, as defined at 50 CFR §402.02, are those that are caused by or will result from the proposed action and are later in time, but are still reasonably certain to occur, we must conduct our analysis to at least 2030.

Huachuca water umbel is a semi-aquatic plant that requires persistent and readily-available moisture. Baseflows in the mainstem upper San Pedro River are the result of discharges from the regional and alluvial aquifers; therefore, and for the purposes of this analysis, our primary concern regarding Huachuca water umbel and its critical habitat on the SPRNCA is the potential effects of groundwater use on the groundwater and surface water hydrology of the species' habitat.

As can be seen in Table HWU2, negative net groundwater demands attributable to the Fort are projected to exist in 2012 and 2013, before implementation of all the mitigation measures. These impacts can be reasonably assumed to reduce discharges to the San Pedro River, and this would represent an adverse effect to both the species and its critical habitat. As has been stated previously, however, the water demand accounting in Table HWU-2 is not spatially or temporally explicit. We therefore cannot use the demand accounting data to definitively determine where or when the supposed impacts will take place. The groundwater model employed by Fort Huachuca, however, does generate spatially and temporally explicit results, and these appear above in Figures HWU1, HWU2, and HWU3.

The groundwater modeling, which represents the best available scientific information, indicates that it is unlikely that there will be a Fort-attributable decrease in the regional groundwater component of baseflow in the mainstem of the San Pedro River beginning in 2014 and continuing through the end of the modeling period in 2030. On this basis alone, it would appear to be unlikely there will be measurable adverse effects to Huachuca water umbel in the SPRNCA from 2014 onward.

This document will be transmitted to Fort Huachuca in 2014, the year in which it has been mathematically anticipated that a projected net groundwater surplus for the Fort will exist. We recognize, however, that the regional and alluvial aquifers and the associated baseflows in the San Pedro River are unlikely to respond to the proposed action in the exact timeframes predicted by the groundwater model. We cannot determine the magnitude of such a time lag, nor the volume of the net groundwater demand that might persist over time until a surplus net water demand prevails. Our effects analysis will therefore focus qualitatively, rather than quantitatively, on the residual adverse effects to Huachuca water umbel that may exist during the early portion of implementation of the proposed action.

If it is presumed that there will continue to be some Fort-attributable reductions in baseflows beyond 2013, we would anticipate that Huachuca water umbel will suffer some degree of mortality from desiccation and that there might be some associated reduction in occurrence counts and length of occupied critical habitat. We reiterate that this analysis does not rely on the regulatory definition of "destruction or adverse modification" of critical habitat at 50 CFR 402.02. Instead, we have relied upon the statute and the August 6, 2004, Ninth Circuit Court of Appeals decision in Gifford Pinchot Task Force v. U.S. Fish and Wildlife Service (No. 03-35279) to complete our analysis with respect to critical habitat. Critical habitat is defined in section 3 of the ESA "as the specific areas within the geographical area occupied by the species, at the time it is listed in accordance with the Act, on which are found those physical and biological features essential to the conservation of the species and that may require special management considerations or protection; and specific areas outside the geographical area occupied by a species at the time it is listed, upon a determination that such areas are essential

for the conservation of the species." We have also relied upon the Consultation Handbook which provides guidance on determining adverse modification of critical habitat and jeopardy pursuant to the following: "Adverse effects on individuals of a species or constituent elements or segments of critical habitat generally do not result in jeopardy or adverse modification determinations unless that loss, when added to the environmental baseline, is likely to result in significant adverse effects throughout the species' range, or appreciably diminish the capability of the critical habitat to satisfy essential requirements of the species" (Service and NMFS 1998).

Effects to the Species

Huachuca water umbel occurs in disturbance-prone habitats; like many desert streams, the San Pedro River exhibits a tremendous dichotomy between baseflows, which may be measured in tenths of a cubic foot per second, and peak flows, which have exceeded 24,000 cfs (USGS 2013). The river has also endured periods of profound historic drought and floods. The persistence of the species in such a variable system indicates that it is resilient (EEC 2001). We do anticipate that the residual, and temporary, reduction in baseflows that may occur before the onset of a surplus net water demand will be within the range of conditions experienced by the species and thus, the proposed action is unlikely to result in a contraction of the species' occurrence in the San Pedro River, much less extirpate the species.

As discussed above, the environmental baseline for the Huachuca water umbel within the SPRNCA exists in an impaired condition, with a 2011 annual deficit of 4,600 AF and the 65,200 AF withdrawn since the first half of the 20th century (D. R. Pool, unpub. data, 2011, as cited in USPP 2013). We anticipate that baseflow declines would have the greatest effect on Huachuca water umbel occurring in the river reach between Fairbank and the northern boundary of the SPRNCA (Tombstone gage section), though the three other occupied reaches [from Charleston northward to Fairbank (Brunckow Hill) section, from State Route 90 north to Charleston (Lewis Spring section), and from Hereford north to State Route 90 (Hereford Bridge section)] could also experience impacts of cumulative pumping.

The groundwater withdrawals that are the likely proximal cause of declining trends are due to both Fort Huachuca and its attributable population and other water uses not directly or indirectly associated with Fort Huachuca. Section 321 of the Defense Authorization Act of 2004 (Public Law 108-136) prohibit the USFWS from considering water consumption by State, local, and private entities off of the installation that is not a direct or indirect effect of the agency action or an effect of other actions that are interrelated or interdependent with that agency action, in determining whether such agency action at Fort Huachuca will jeopardize the continued existence of Huachuca water umbel or result in the destruction or adverse modification of its critical habitat. The impaired groundwater hydrology that has resulted from past groundwater withdrawals must be considered part of the environmental baseline. By contrast, consideration of the future, increasing water uses by non-Federal entities, which would ordinarily be analyzed as cumulative effects, is prohibited by section 321.

So, while the proposed action is anticipated to result in a net increase in groundwater available for discharge to the San Pedro River and a small, but measurable decrease in discharges to the Babocomari River, we anticipate that past removals of groundwater from storage (due to both Federal and non-Federal actions), and the capture of discharge that resulted from them, have or will continue to adversely affect Huachuca water umbel. While unquantifiable, we anticipate

that Fort Huachuca's actions will eventually increase groundwater elevations and increase in Fort-associated contributions to stream flows within the San Pedro River, will not worsen the still-deteriorating baseline conditions(i.e. baseflows will continue to decline due to other groundwater uses not attributable to Fort Huachuca), and are thus unlikely to result in significantly increased adverse effects throughout Huachuca water umbel's range such that recovery cannot be achieved.

Effects to the Critical Habitat

In our analysis of the effects of the action on critical habitat, we consider whether or not a proposed action will result in the destruction or adverse modification of critical habitat. In doing so, we must determine if the proposed action will result in effects that appreciably diminish the value of critical habitat for the recovery of a listed species. To determine this, we analyze whether the proposed action will adversely modify any of the PCEs that were the basis for determining the habitat to be critical. To determine if an action results in adverse modification of critical habitat, we must also evaluate the current condition of all designated CHUs, and the PCEs of those units, to determine the overall ability of all designated critical habitat to support recovery. Further, the functional role of each of the CHUs in recovery must also be considered because, collectively, they represent the best available scientific information as to the recovery needs of the species.

Our analysis of the proposed action's effects to Huachuca water umbel critical habitat is framed by the Act, and the August 6, 2004, Ninth Circuit Court of Appeals decision in Gifford Pinchot Task Force v. U.S. Fish and Wildlife Service, and the Consultation Handbook (USFWS and NMFS 1994), the latter of which states, in part, that adverse effects on the constituent elements or segments of critical habitat generally do not result in jeopardy or adverse modification determinations unless that loss, when added to the environmental baseline, is likely to appreciably diminish the capability of the critical habitat to satisfy essential requirements of the species.

Primary Constituent Element 1 (sufficient perennial baseflows to provide a permanently or nearly permanently wetted substrate for growth and reproduction of umbel), will be affected to some presently unquantifiable degree. The magnitude of the residual adverse effect of Fort Huachuca's pumping to the groundwater-derived portion of baseflow before the modeled onset of positive contributions to the groundwater contribution to baseflows is unquantifiable. It is likely, however, that the relatively large magnitude of net groundwater surplus anticipated to begin to affect the river in 2014 (or later) will ensure the adverse effects will be of short duration, and more than completely ameliorated.

Primary Constituent Element 2 (a stream channel that is relatively stable, but subject to periodic flooding that provides for rejuvenation of the riparian plant community and produces open microsites for umbel expansion) will not be affected by the proposed action. The residual effects to baseflows, regardless of magnitude, cannot alter flood-flow hydrology, which results from precipitation and snowmelt runoff, and which serves as an important source of alluvial aquifer recharge as well as a mechanism by which the in-channel vegetation is kept in an early successional state that favors umbel. It must also be noted that flood flows affect Primary Constituent Element 1 in that overbank flood events result in appreciable alluvial aquifer recharge whereby water is stored in the river's banks and released after flood flows recede.

Primary Constituent Element 3 describes a riparian plant community that is relatively stable over time and in which non-native species do not exist or are at a density that has little or no adverse effect on resources available for umbel growth and reproduction. Riparian vegetation communities are dynamic by nature, but the residual, Fort-attributable reductions in baseflows that persist beyond 2013 can be anticipated to cause some unquantifiable decrease in hydric plants (such as Huachuca water umbel) and a corresponding increase in more-xeric species that may compete with the endangered plant. Given that the San Pedro River exhibits a highly variable flow regime under baseline conditions, we anticipate that a temporary decrease in base flow, its magnitude decreasing as the anticipated groundwater surplus begins to occur, is unlikely to appreciably or permanently diminish the riparian community (or cause a transition to a more-xeric community) over the longer term.

Primary Constituent Element 4 refers to locations where Huachuca water umbel occurs in streams and rivers, and requires the presence of refugial (protected) sites in each watershed and in each reach, including but not limited to springs or backwaters of mainstem rivers that allow each occurrence to survive catastrophic floods and recolonize larger areas. Refugial sites along the mainstem San Pedro include nearby backwaters and springs, but would not include occurrences in remote sites such as those in the Huachuca Mountains, as the latter are separated from the mainstem San Pedro by ephemeral reaches. The formation of backwaters is a function of flood-flow hydrology and, as discussed in the analysis of PCE 2, is not anticipated to be affected.

Also, regarding the persistence of refugial sites, Huachuca water umbel has been established in a discharge area of Murray Springs, which is in Curry Draw, a San Pedro River tributary. These discharges are likely to be appreciably influenced by groundwater discharging down-gradient from the Sierra Vista Environmental Operations Park (EOP; a municipal wastewater treatment and recharge facility)(see Mitigation Measure C4 in Table HWU2). Inasmuch as Fort Huachuca and its associated, off-post human population is responsible for a portion of the inflows to the EOP, the proposed action has the indirect effect of helping ensure sufficient water is supplied to Huachuca water umbel in Curry Draw. We anticipate that colonization of the San Pedro River will continue to occur from upstream sites in Sonora as well as from within the northeastern canyons of the Huachuca Mountains. Mainstem San Pedro River recolonizations are anticipated to result from resettlement of clumps of dislodged plant material, while more-distant recolonizations are more likely to result from the transport of buoyant seeds.

We have discussed the impaired environmental baseline in the Effects to the Species section; our critical habitat analysis is similarly constrained by Section 321 of the Defense Authorization Act of 2004. So, while the proposed action is anticipated to result in a net increase in groundwater available for discharge to the Huachuca water umbel critical habitat along the San Pedro River, we anticipate that past non-Federal removals of groundwater from storage, and the capture of discharge that resulted from them, have or will continue to adversely affect the critical habitat. While unquantifiable, we anticipate that Fort Huachuca's actions will eventually increase groundwater elevations and stream flows within the San Pedro River. These actions, even considering the affected baseline, are unlikely to appreciably diminish the capability of the critical habitat to satisfy essential requirements of the species or result in significant adverse effects throughout Huachuca water umbel's range (in the San Pedro River, on Fort Huachuca, and elsewhere in the designation) such that recovery cannot be achieved.

As discussed in the narrative above and displayed Table HWU-2 and Figures HWU-1, HWU-2, and HWU-3, for the San Pedro River in the SPRNCA, the Fort-attributable activities that could be feasibly modeled with the groundwater model are not predicted to result in a decrease in the regional groundwater component of baseflow in Huachuca water umbel critical habitat. By 2030, the groundwater modeling predicts Fort-attributable increases in the regional groundwater component of baseflow up to 0.3 cfs at the Charleston gage and 0.4 cfs at the Tombstone gage (Figure 5-3). These results do not include the benefits of conservation easements. Therefore, the Fort-attributable activities should, over the long term help to maintain flows in the mainstem of the San Pedro River, where there are numerous occurrences of the Huachuca water umbel and where portions of designated critical habitat are. In the Babocomari River, there would be decreases in the regional groundwater component of baseflow in the lower part of the river near the SPRNCA. There are no known occurrences of Huachuca water umbel in the lower Babocomari River where groundwater modeling projects declines in the regional groundwater component of baseflow.

In summary, Fort Huachuca's mitigation measures provide a conservation benefit to two of the critical habitat primary constituent elements: perennial baseflows in the San Pedro River (PCE-1) and refugial sites for recolonization (PCE-4). The Fort's activities will not impact the other primary constituent elements of a stable, native species-dominated riparian community (PCE-3) and a stream channel subject to periodic, rejuvenating flooding (PCE-2).

Cumulative Effects

Cumulative effects include the effects of future State, tribal, local, or private actions that are reasonably certain to occur in the action area considered in this biological opinion. Future Federal actions that are unrelated to the proposed action are not considered in this section because they require separate consultation pursuant to section 7 of the Act.

Section 321 of the Defense Authorization Act of 2004 (Public Law 108-136) describes the manner in which section 7 of the Act is to be applied during interagency consultation with Fort Huachuca. Specifically, Section 321 states "For purposes of section 7 of the Endangered Species Act of 1973 (16 U.S.C. 1536), concerning any present and future Federal agency action at Fort Huachuca, Arizona, water consumption by State, local, and private entities off of the installation that is not a direct or indirect effect of the agency action or an effect of other actions that are interrelated or interdependent with that agency action, shall not be considered in determining whether such agency action is likely to jeopardize the continued existence of any endangered or threatened species or result in the destruction or adverse modification of designated critical habitat."

For the Huachuca water umbel, the most appreciable cumulative effect is the pumping of ground water from the Sierra Vista Subwatershed by and for individuals whose presence is not related to Fort Huachuca or another Federal entity. The subwatershed has a modeled 2011 annual deficit of 4,600 AF, an appreciable proportion of which is the result of local, non-Federal actions cumulative to the operation of Fort Huachuca and which we anticipate will continue into the foreseeable future. Nevertheless, these water consumption-related effects cannot be considered when determining if the proposed action will jeopardize the continued existence of the Huachuca water umbel.

Section 321 does not preclude our analysis of other-than-water-consumption-related effects of cumulative actions. There are, however, relatively few other activities that may affect the Huachuca water umbel in the action area; most are the result of Federal actions conducted by Fort Huachuca or the BLM, and thus are not considered cumulative effects. The effects of undocumented immigrants (UDIs) have not been analyzed in depth, but there is the potential that foot traffic within the SPRNCA and through Garden and McClure canyons could result in trampling of Huachuca water umbel and increased exposure to wildfire risk.

HUACHUCA WATER UMBEL

Status of the Species

The Huachuca water umbel (Lilaeopsis schaffneriana var. recurva)(umbel) is an herbaceous, semi-aquatic to occasionally fully aquatic, perennial plant with slender, erect leaves that grow from creeping rhizomes. The leaves are cylindrical, hollow with no pith, and have septa (thin partitions) at regular intervals. The yellow/green or bright green leaves are generally 0.04 to 0.12 in in diameter and often 1 to 2 in tall, but can reach up to 8 in tall under favorable conditions. Three to ten very small flowers are borne on an umbel that is always shorter than the leaves. The fruits are globose, 0.06 to 0.08 in in diameter, and usually slightly longer than wide (Affolter 1985).

On January 6, 1997, we listed the umbel as an endangered species (62 FR 665, USFWS 1997b). Critical habitat was designated on the upper San Pedro River, Garden Canyon on Fort Huachuca, Scotia Canyon and other areas of the Huachuca Mountains, the San Rafael Valley, and Sonoita Creek on July 12, 1999 (64 FR 37441, USFWS 1999a). No recovery plan has been developed, but a draft recovery plan is anticipated to be complete in 2014.

Distribution/Abundance

Umbel has been documented in Santa Cruz, Cochise, and Pima counties, Arizona, and in adjacent Sonora, Mexico, west of the continental divide (Warren et al. 1989, Saucedo-Monarque 1990, Warren and Reichenbacher 1991, Haas and Frye 1997, Anderson 2006). The plant has been extirpated from eight sites, and has not been seen in recent years in several others. The extant sites occur primarily in five major watersheds - San Pedro River, Santa Cruz River, Río Yaqui/Bavispe, Río Sonora, and Río Magdalena. All sites are between 2,800 and 7,120 ft in elevation (Titus and Titus 2008a, b; Vernadero 2010).

Habitat

The umbel grows in cienegas, and along streams, rivers, and springs in southeastern Arizona and northeastern Sonora, Mexico. These wetland communities are usually associated with perennial springs and stream headwaters, have permanently or seasonally saturated highly organic soils, and have a low probability of flooding or scouring (Hendrickson and Minckley 1984). The water umbel can grow in saturated soils or as an emergent in water depths up to about 10 in. Cienegas support diverse assemblages of animals and plants, of which many species are of limited distribution, such as the umbel (Hendrickson and Minckley 1984). The surrounding non-wetland vegetation can be desert scrub, grassland, oak woodland, or conifer forest (AGFD 1997).

Umbel has an opportunistic strategy that ensures its survival in healthy riverine systems, cienegas, and springs. In upper watersheds that generally do not experience scouring floods, umbel occurs in microsites where interspecific plant competition is low. At these sites, umbel occurs on wetted soils interspersed with other plants at low density, along the periphery of the wetted channel, or in small openings in the understory. In stream and river habitats, umbel can occur in the main channel, backwaters, side channels, and nearby springs. The upper Santa Cruz River and associated springs in the San Rafael Valley, where umbel occurs, is an example of sites that meet these conditions. The types of microsites required by umbel were generally reduced from the main stems of the San Pedro and Santa Cruz rivers when channel entrenchment occurred in the late 1800s.

Habitat on the upper San Pedro River is recovering, and umbel has remained along small reaches and continues to be detected in new sites within the main channel. Cienegas, perennial streams, and rivers in the desert southwest are extremely rare. The Arizona Game and Fish Department (1993) estimated that riparian vegetation associated with perennial streams comprises about 0.4% of the total land area of Arizona, with most riparian areas being remnants of what once existed. The State of Arizona (1990) estimated that up to 90 percent of the riparian habitat along Arizona's major desert watercourses has been lost, degraded, or altered. The physical and biological habitat features essential to the conservation of umbel include a riparian plant community that is fairly stable over time and not dominated by non-native plant species, a stream channel that is relatively stable but subject to periodic, non-scouring flooding, protected sites (sites safe from catastrophic flooding), and a substrate (soil) that is permanently wet or nearly so, for growth and reproduction of the plant.

Life History

The umbel flowers from March through October with most flowering in June through August (AGFD 1997). The species reproduces sexually through flowering and asexually from rhizomes, the latter probably being the primary reproductive mode. The umbel is also suspected of self-pollination (Johnson et al. 1992). An additional dispersal opportunity occurs as a result of the dislodging of clumps of plants, which then may re-root in a different site along aquatic systems. Fruits develop from July through September, and water disperses the seeds (Arizona Game and Fish Department 1997). Seeds from plants grown in an aquarium have been seen sticking to the aquarium sides and germinating 1 to 2 weeks after falling from the parent plant (Johnson et al. 1992).

After a flood, umbel can rapidly expand its occurrence (a term referring to a hydrologically and geographically discrete grouping of plants) and occupy disturbed habitat until interspecific competition exceeds its tolerance or disturbance removes it. This response was recorded at Sonoita Creek in August 1988, when a scouring flood removed about 95% of the umbel occurrence (Gori et al. 1990). One year later, the umbel had recolonized the stream and was again co-dominant with watercress (Nasturtium officinale)(Warren et al. 1991). However, two patches of umbel on the San Pedro River were lost during a winter flood in 1994, and the species had still not recolonized that area as of May 1995, demonstrating the dynamic and often precarious nature of occurrences within a riparian system (Al Anderson, Grey Hawk Ranch, in litt. 1995). The expansion and contraction of umbel occurrences appears to depend on the presence of more protected sites where the species can escape the effects of scouring floods, a

watershed that has an unaltered hydrograph, and a healthy riparian community that stabilizes the channel (USFWS 1999a). Density of umbel plants and size of occurrences fluctuate in response to both flood cycles and site characteristics such as the density of overstory shade, the density of both native and non-native herbaceous layers beneath the canopy, and availability of muddy or silty substrates with organic content, versus deeply entrenched channels.

While the extent of occupied habitat can be estimated, the number of individuals in each occurrence is difficult to determine because of the intermeshing nature of the creeping rhizomes and the predominantly asexual mode of reproduction. A "population" of umbel may be composed of one or many genetically distinct individuals; again, these geographically and hydrologically discrete groupings are herein referred to as occurrences. Therefore, we refer to occurrences of umbel, rather than populations.

It should also be noted that many Huachuca water umbel occurrences have not been relocated in recent years, despite surveys. Suitable habitat for the species still exists in many of these locations, and a seed bank may also persist. The species is also small and may escape detection and may be particularly difficult to locate when abundance is low or when umbel is co-occurring with other streamside vegetation. This complicates the ability to estimate the amount of occupied habitat.

Threats

Overgrazing, mining, hay harvesting, timber harvest, fire suppression, and other activities in the nineteenth century led to widespread erosion and channel entrenchment in southeastern Arizona streams and cienegas when above-average precipitation and flooding occurred in the late 1800s and early 1900s (Bryan 1925, Martin 1975, Hastings and Turner 1980, Dobyns 1981, Hendrickson and Minckley 1984, Sheridan 1986, Bahre 1991, Webb and Betancourt 1992, Hereford 1993). A major earthquake in 1887 near Batepito, Sonora, about 40 miles south of the upper San Pedro Valley, resulted in land fissures, changes in groundwater elevation, and spring flow, and may have preconditioned the San Pedro River channel for rapid flood-induced entrenchment (Hereford 1993, Geraghty and Miller, Inc. 1995). These events contributed to long-term or permanent degradation and loss of cienega and riparian habitat on the San Pedro River and throughout southeastern Arizona and northeastern Sonora. Much habitat of the umbel and other cienega-dependent species was lost at that time.

Wetland degradation and loss continues today. Human activities such as groundwater overdrafts, surface water diversions, impoundments, channelization, improper livestock grazing, agriculture, mining, sand and gravel operations, road building, non-native species introductions, urbanization, wood cutting, wildfires, and recreation all contribute to riparian and cienega habitat loss and degradation within the historical range of the umbel. The local and regional effects of these activities are expected to increase with increasing human population.

Limited numbers of occurrences and the small size of the occurrences make the umbel vulnerable to extinction as a result of stochastic events that are often exacerbated by habitat disturbance. For instance, the restriction of this taxon to a relatively small area in southeastern Arizona and adjacent areas of Mexico increases the chance that a single environmental catastrophe, such as the flooding associated with a severe tropical storm or an extended drought, could eliminate occurrences from multiple sites or possibly entire watersheds, though such

events are unlikely to cause extinction of the species. Occurrences are in most cases isolated, as well, which makes the chance of natural recolonization after extirpation less likely. Small occurrences are also subject to demographic and genetic stochasticity, which increases the probability of occurrence extirpation (Wilcox and Murphy 1985, Shafer 1990).

Critical Habitat

Seven Critical Habitat units have been designated for umbel; all are in Santa Cruz and Cochise counties, Arizona, and include stream courses and adjacent areas to the end of riparian vegetation (USFWS 1999a). The Scotia, Sunnyside, and Bear canyon units (3, 4, and 6) are within the Coronado National Forest. The remaining Units are in lands adjacent to Forest lands. The following general areas are designated as critical habitat (see legal descriptions for exact critical habitat boundaries):

Unit 1 About 1.25 mi of Sonoita Creek southwest of Sonoita;
Unit 2 About 2.7 mi of the Santa Cruz River on both sides of Forest Road 61, plus about 1.9 mi of an unnamed tributary to the east of the river;
Unit 3 About 3.4 mi of Scotia Canyon upstream from near Forest Road 48;
Unit 4 about 0.7 mi of Sunnyside Canyon near Forest Road 117 in the Huachuca Mountains;
Unit 5 About 3.8 mi of Garden Canyon near its confluence with Sawmill Canyon;
Unit 6 About 1.0 mi of Rattlesnake Canyon and 0.6 mi of an unnamed canyon, both tributaries to Lone Mountain Canyon; about 1.0 mi of Lone Mountain Canyon; about 1.0 mi of Bear Canyon; and about 0.6-mi reach of an unnamed tributary to Bear Canyon; and
Unit 7 About 33.7 mi of the San Pedro River from the perennial flow reach north of Fairbank (Arizona Department of Water Resources 1991) to 0.13 mi south of Hereford, San Pedro Riparian National Conservation Area.

The primary constituent elements of critical habitat for umbel include, but are not limited to, the habitat components that provide (USFWS 1999a):

Sufficient perennial base flows to provide a permanently or nearly permanently wetted substrate for growth and reproduction of umbel;
A stream channel that is relatively stable, but subject to periodic flooding that provides for rejuvenation of the riparian plant community and produces open microsites for umbel expansion;
A riparian plant community that is relatively stable over time and in which non-native species do not exist or are at a density that has little or no adverse effect on resources available for umbel growth and reproduction; and
In streams and rivers, refugial sites in each watershed and in each reach, including but not limited to springs or backwaters of mainstem rivers that allow each occurrence to survive catastrophic floods and recolonize larger areas.

Activities that may destroy or adversely modify critical habitat include those that alter the primary constituent elements to the extent that the value of critical habitat for both the survival and recovery of umbel is appreciably diminished. Such activities are also likely to jeopardize the continued existence of the species.

Recovery Planning

There is currently no recovery plan for the Huachuca water umbel; we expect to initiate recovery planning in 2014. We cannot anticipate the recovery criteria that may be used, but we are aware of the types of measures that are needed to ensure conservation (which equates with recovery), as we have engaged in numerous section 7 consultations for actions affecting the species since it was listed in 1997.

We feel that the ability for the species to be recovered and critical habitat's ability to contribute to the recovery of the species both depend on maintaining self-sustaining, watershed-scale distributions or occurrences of plants within the full suite of watersheds within the species' range. Survival and recovery of the species would potentially be placed at risk if any one higher-order watershed (such as San Pedro River, Santa Cruz River, or Rio Yaqui) were so geomorphically or hydrologically altered that the species could no longer survive or be recovered there, regardless of the persistence of a seed bank. In terms of the critical habitat, survival and recovery of the species would potentially be placed at risk if a group of smaller units within one of the higher-order watersheds (such as are present in the Huachuca Mountains) or an entire, large unit (the upper San Pedro River) were so geomorphically or hydrologically altered that the unit could no longer support the species and contribute to recovery.

Climate Change

Climate change is a confounding factor in terms of the status, baseline, and recovery of Huachuca water umbel. The effects of climate change on aquatic environments are analyzed in the Drought and Climate Change subsection of the Action Area and Environmental Baseline Section, above; these prior analyses are incorporated herein via reference.

In summary, the best available information indicates that the aquatic ecosystems in which Huachuca water umbel occur will experience: increased occurrence of extreme events such as drought, fires, heat waves, storms, and floods (which can also interact synergistically, i.e. droughts can increase wildfire potential, and elevated flood flows can result from wildfires); decreased streamflows and floods are predicted to occur more frequently because of climate change (IPCC 2007a, Overpeck et al. 2012). It is anticipated that an increase in extreme events will most likely affect occurrences living at the edge of their physiological tolerances. The predicted increases in extreme temperature and precipitation events may lead to dramatic changes in the distribution of species or to their extinction (Parmesan and Matthews 2006).

Decreased streamflow

Current models suggest a decrease in precipitation in the Southwest (Kundzewicz et al. 2007, Seager et al. 2007) which would lead to reduced streamflows and a reduced amount of habitat for Huachuca water umbel. Streamflow is predicted to decrease in the Southwest even if precipitation were to increase moderately (Nash and Gleick 1993, State of New Mexico 2005, Hoerling and Eischeid 2007). Winter and spring warming causes an increased fraction of precipitation to fall as rain, resulting either from decreased precipitation (Kundzewicz et al. 2007, Seager et al. 2007); changes in the duration and volume of runoff resulting from decreases in the proportion of snow relative to total precipitation (Christensen et al. 2004, Stewart et al. 2004, Regonda et al. 2005, Stewart et al. 2005); and increased evapotranspiration and decreased soil moisture from higher temperatures (Garfin 2005, Seager et al. 2007). The effect of these anticipated reductions in decreased streamflow is that sites occupied by Huachuca water umbel

will become smaller, intermittent or dry, and thereby reduce the amount of habitat available for the species. Given that these projections are for the southwestern United States in general, they apply both to the rangewide status of the species and the species' status within the action area, which is discussed in the Environmental Baseline section, below.

Change in the hydrograph

In a warmer world, an enhanced hydrologic cycle is expected; flood extremes could be more common resulting in larger floods; droughts may be more intense, frequent, and longer-lasting (Seager et al. 2007). Stewart et al. (2005) show that timing of spring streamflow in the western U.S. during the last five decades has shifted so that the major peak now arrives 1 to 4 weeks earlier, resulting in less flow in the spring and summer. They conclude that almost everywhere in North America, a 10 to 50 percent decrease in spring-summer streamflow fractions will accentuate the seasonal summer dry period with important consequences for warm-season water supplies, ecosystems, and wildfire risks (Stewart et al. 2005). Rauscher et al. (2008) suggest that with air temperature increasing from 37 to 41° F (3 to 5° C), snowmelt driven runoff in the western U.S. could occur as much as two months earlier than present. Changes in the hydrograph could potentially alter riparian recruitment patterns.

Drought

The Southwestern U.S. is currently experiencing drought conditions (CLIMAS 2013). Almost 97 percent of Arizona was abnormally dry or drier (March 2013, CLIMAS 2013). Although Huachuca water umbel evolved in the Southwest and have survived drought in the past, it is anticipated that a prolonged, intense drought would affect many umbel occurrences, in particular those occupying small headwater streams which are likely to dry or become intermittent. In addition, there is a clear association between severe droughts and large fires in the Southwest (Swetnam and Baisan 1996) that can harm aquatic plants, their habitat, and the watersheds that contain them.

Fire

Since the mid-1980s, wildfire frequency in western forests has nearly quadrupled compared to the average of the period 1970 to 1986 (Westerling et al. 2006). The total area burned is more than six and a half times the previous level (Westerling et al. 2006). In addition, the average length of the fire season during 1987 to 2003 was 78 days longer compared to 1970 to 1986 and the average time between fire discovery and control increased from about 8 to 37 days for the same time (Westerling et al. 2006). McKenzie et al. (2004) suggest, based on models, that the length of the fire season will likely increase and fires in the western U.S. will be more frequent and severe. In particular, they found that fire in New Mexico appears to be acutely sensitive to summer climate and temperature changes and may respond dramatically to climate warming (McKenzie et al. 2004). The summer temperatures in the southwest are predicted to increase more than any other season (Garfin et al. 2013).

Furthermore, drought and climate change will cause changes in fire regimes in all southeastern Arizona vegetation communities (Kitzberger et al. 2006). The timing, frequency, extent, and destructiveness of wildfires are likely to increase (Westerling et al. 2006) and may facilitate the invasion and increase of nonindigenous plants. These changed fire regimes will change

vegetation communities, the hydrological cycle, and nutrient cycling in affected watersheds (Brown et al. 2004). Some regional analyses conservatively predict that acreage burned annually will double with climate change (MacKenzie et al. 2004). Such watershed impacts could cause enhanced scouring and sediment deposition, more extreme flooding (quicker and higher peak flows), and changes to water quality due to increases in ash and sediment within stream channels. Severe watershed impacts such as these, when added to reductions in extant aquatic habitats, will severely restrict sites available for the conservation of aquatic and semi-aquatic plants.

Severe wildfires capable of extirpating or decimating Huachuca water umbel occurrences are relatively recent phenomena and result from the cumulative effects of historical or ongoing grazing, which removes the fine fuels needed to carry fire through the understory in regular, small fires to decrease the potential for catastrophic fires, and fire suppression (Madany and West 1983, Swetnam 1990, Swetnam and Baisan 1996, Gresswell 1999). Historical wildfires in the southwest were primarily cool-burning understory fires with return intervals of 3 to 7 years in ponderosa pine (Swetnam and Dieterich 1985). Cooper (1960) concluded that before the 1950s; crown fires were extremely rare or nonexistent in the region. Effects of fire may be direct and immediate or indirect and sustained over time (Gresswell 1999).

Environmental Baseline – Huachuca Water Umbel

The environmental baseline includes past and present impacts of all Federal, State, or private actions in the action area, the anticipated impacts of all proposed Federal actions in the action area that have undergone formal or early section 7 consultation, and the impact of State and private actions that are contemporaneous with the consultation process. The environmental baseline defines the current status of the species and its habitat in the action area to provide a platform to assess the effects of the action now under consultation. Also refer to the General Environmental Baseline and Action Area earlier in this biological and conference opinion.

The action area for the proposed action – in which Huachuca water umbel will be directly or indirectly affected – includes occupied portions of Garden Canyon and its tributaries Sawmill and McClure canyons on Fort Huachuca (ENRD 2012b); the San Pedro River within the San Pedro Riparian National Conservation Area; and the Babocomari River downstream of the Babocomari Cienega. If these umbel occurrences persist over the long term, they will contribute to the recovery of the species by serving as refugial sites.

Huachuca water umbel has been documented in Garden Canyon since 1958, in Sawmill Canyon since 1979, and in McClure Canyon since 1997 (EEC 2002). In the SPRNCA, the species has been documented since 1958 (EEC 2002), and Huachuca water umbel has more recently been documented on the Babocomari River (Titus and Titus 2008c) about three miles downstream of the Babocomari Ranch headquarters (PBA Figure 4-1). A summary of inventory and monitoring efforts is provided in the discussions of the species' status both on Fort Huachuca and the SPRNCA, below.

Status of Huachuca Water Umbel on Fort Huachuca

Inventory, monitoring, and management of Huachuca water umbel has been done on the Fort since 1999. Fort Huachuca conducts a survey of all potential Huachuca water umbel habitat on

the installation every four years. The survey encompasses 16 marshland sites (survey segments), originally identified during the 1999 installation-wide inventory of potential umbel habitat, which are surveyed to determine presence, distribution, and percentage of critical habitat occupied by Huachuca water umbel using Service-approved methodology (Vernadero Group 2010d). Surveys were conducted in 1999 and subsequently in 2002, 2005, and 2009 (Vernadero Group 2010d). Survey transects (50 m in length) were established down the center of the habitat, downstream of the first plant encountered. A population was defined as any individual plant, patch, or patches of Huachuca water umbel on either side of the line within the transect. Sixteen naturally-occurring Huachuca water umbel populations were documented on Fort Huachuca during surveys conducted in September and October 2009 (Vernadero Group 2010d). Also note that the term population, rather than occurrence, is used herein to conform to the terminology used in the monitoring reports.

Huachuca water umbel populations documented by the aforementioned surveys are monitored with frequency transects every other year in between the survey years (Service 2007). Monitoring surveys have been conducted in 2000, 2001, 2003, 2004, 2006, 2008, and 2011 (ENRD 2012b). Monitoring methods follow the Service-approved protocol that uses the line-intercept method for generating frequency of occurrence (ENRD 2012b). The Huachuca water umbel monitoring protocol is implemented by extending a 100-meter measuring tape down the center of 10 predefined Land Condition Trend Analysis[6] transects. According to the established monitoring protocol, the length of a transect may increase, due to the detection of new populations at the ends of a transect, but should not decrease (ENRD 2012b). Three of ten transects have retained their original transect length, six transects have varied nearly every year; and one transect continued to add length as new populations are encountered at transects' extremities (ENRD 2012b). Consequently, due to the variance in length of individual transects, comparison of frequency of occurrence results between transects and between years generally cannot be made, with the exception of transects HWU-2, HWU-5, and HWU-10 and between years 2008 and 2011 since consistent transect lengths were retained (ENRD 2012b). Overall, the frequency of Huachuca water umbel on the Fort has varied between about 3 and 9 percent from 2000 to 2011 (ENRD 2012b; see Appendix L).

In 2008, surveyors suggested that a more accurate picture of Huachuca water umbel status could be drawn if all data being collected were used, rather than just presence/absence, and suggested assessing the extent of occupied habitat by using data for all documented patches rather than line intercepts (Vernadero Group 2009a, ENRD 2012b). Percent of transect occupied generally increased between 2008 and 2011 (the dates for which data are available) and ranged from less than one percent to nearly 15 percent (PBA Appendix L Table 2).

In 2009, Fort Huachuca developed and implemented a project to collect, propagate, and transplant Huachuca water umbel in coordination with the Service and the Desert Botanical Garden (EEC 2008a, Vernadero Group 2010c, 2011b). The intent of this project was to guard against the possibility of extirpation of water umbel from a catastrophic event and recover umbel by creating occurrences in suitable unoccupied habitat. In October of 2007, water umbel was collected from two sites on Fort Huachuca and from two sites along the SPRNCA (Vernadero

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6 The Land Condition Trend Analysis (LCTA) program is the US Army's standard for land inventory and monitoring, employing standardized methods of natural resources data collection, analyses, and reporting designed to meet multiple goals and objectives (Anderson 2002).

Group 2010c, 2011b). Propagation of the collected material was successful, providing enough material to create four new populations on the Fort in 2009 (Huachuca Canyon, a previously unoccupied McClure Canyon pool site, a previously unoccupied McClure Canyon marsh site, and a previously unoccupied Garden Canyon site (Vernadero Group 2010c). Subsequent monitoring at the sites shows population expansion and contraction and flowering has been observed within the first year of transplant at a number of sites (ENRD 2012a). The initial transplants are still being monitored to determine long term survival.

Status of Huachuca Water Umbel on the SPRNCA

The SPRNCA supports naturally occurring Huachuca water umbel and a 33.7-mi reach of the river is designated critical habitat (Service 1997). Huachuca water umbel was first documented on the upper San Pedro River in 1958 near State Route 80 west of St. David. However, it is no longer extant there (Warren et al. 1991, Haas and Frye 1997, USFWS 1999a). In 1995, and 1997 additional occurrences of Huachuca water umbel were documented by BLM and The Nature Conservancy and by researchers from the University of Arizona (Vernadero Group 2011c). In 2001, 43 Huachuca water umbel patches were found on the SPRNCA (EEC 2002). Huachuca water umbel occurrences currently occur throughout the SPRNCA, which in the past was divided into four named reaches for discussion. These sections included: 1) the northernmost section from Fairbank to the northern boundary of the SPRNCA (Tombstone gage section); 2) from Charleston northward to Fairbank (Brunckow Hill section); 3) from State Route 90 north to Charleston (Lewis Spring section); and 4) from Hereford north to State Route 90 (near Hereford Bridge section). This reach name-base convention is no longer employed in monitoring reports; current reporting uses the percent of occupied critical habitat, as described below.

Surveyors have typically identified groupings of Huachuca water umbel plants which began and ended along an undefined length of streambank as “patches.” Groupings of plants on opposite banks were counted as separate or independent patches (Mark Fredlake, BLM, 2011, pers. comm.). Monitoring methods for these surveys consisted of searching both banks for patches of Huachuca water umbel plants. In these early surveys, a standard definition for a Huachuca water umbel patch had not been developed because it was believed any definition would have been arbitrary (Fredlake, BLM, 2011, pers. comm,). Due to the uncertainty over what constitutes a “biological population” in this largely clonal species, the term “patch” or “occurrence” would probably be more appropriate for use in place of terms such as “population” or “metapopulation” as used in the monitoring and inventory reports referenced and described below; however, the original terminology from those reports has been retained.

As agreed upon in discussions with USFWS (January 2000), beginning in 2000, and subsequently in 2001, 2004, 2007, 2008, 2009, and 2010, the Fort inventoried potential habitat of Huachuca water umbel within the SPRNCA, using a protocol co-developed with USFWS (EEC 2002, USFWS 2007a). The USFWS protocol selected the fall season (September to October) as the most effective season to monitor Huachuca water umbel, because it was determined that the greatest extent of Huachuca water umbel population could be documented then (EEC 2002). However September to October can also be a period of high water within the SPRNCA, potentially reducing the ability to detect Huachuca water umbel because of the high water conditions and inaccessibility of survey areas.

The protocol defined a Huachuca water umbel population as any individual plant or patch on either side of the bank, located along a 50 m stream segment beginning at the first plant observed (Vernadero Group 2011c). Plants outside the linear segment were identified as a new patch. See Vernadero Group (2011c) and PBA Appendix L for additional details on the survey protocol.

In October 2000, while preparing for the first monitoring season on the SPRNCA, a major flood occurred that brought the river to a flood stage well above normal (EEC 2001). Normal October flows at the Charleston gaging station average 10 cfs, while flows reached 2,800 cfs on 12 October 2000 and continued precipitation brought the Charleston gage to 8,550 cfs on 23 October (USGS 2012). For comparison, the highest previously recorded flood flow was 18,400 cfs in October 1977; the highest subsequent flood flow was 3,160 cfs in July 2006 (USGS 2012).

Flood conditions restricted access to the river and as a result, the first SPRNCA protocol-level monitoring survey was delayed until 2001 (EEC 2002). The 2001 survey, therefore, defined a post-flood baseline condition for Huachuca water umbel occupation along the SPRNCA as 43 populations (EEC 2002). The number of documented populations was 30 in 2004, 28 in 2007 and 29 in 2008 (Vernadero Group 2010d). In 2009, however, 65 populations of Huachuca water umbel were documented in the SPRNCA (Vernadero Group 2011c). The increase in Huachuca water umbel populations detected in 2009 was not a result of a flood, but rather drought, because the lack of water within the streambed in 2009 resulted in improved detection of Huachuca water umbel populations (Vernadero Group 2011c). The following and most recent monitoring season (2010), was substantially wetter than 2009 and 44 Huachuca water umbel populations were documented (Vernadero Group 2011c). In 2010, at least two of the consistently documented historical populations were lost due to bank sloughing.

This sloughing, or erosion, of bank soils occurred because the dried, deeply fractured bank soils were quickly eroded and the umbel populations washed away when flows returned in 2010 (Vernadero Group 2011c). Although the number of populations documented has varied annually from 2001 to 2010, the general distribution of Huachuca water umbel has remained consistent on the SPRNCA (Vernadero Group 2011c)(PBA Appendix L). Throughout all survey years, the greatest number of populations has consistently been recorded south of State Route 90, followed by the area north of State Route 90 to Fairbank, with the fewest recorded north of Fairbank.

Before the 2009 field season, it was clear that it was problematic to assess the fate of Huachuca water umbel on the SPRNCA by merely comparing the number of documented populations. Population numbers have shown great variability. Annual monitoring results have documented the fluid nature of many Huachuca water umbel populations along the SPRNCA, as well as some populations that are relatively stable. The methodology does not allow for a comparison of the size of individual populations from year to year since individual populations/patches are not marked. These populations are in annual flux, and fluctuations appear to be responsible for at least a portion of apparent decreases in population counts. GIS analysis of between-year population occurrences in 2007, for example, revealed that three populations (populations 12, 23, and 27) contained multiple historical populations (EEC 2007). Therefore, what had been counted as distinct populations in previous years, were documented as single populations in 2007. This ultimately resulted in an apparent reduction of the population count when in fact populations merely expanded, merging with one another (EEC 2007).

As a result of the difficulties in accurately assessing Huachuca water umbel status across years due to the fact that populations grow and merge, the Fort began reporting the percentage of critical habitat occupied by Huachuca water umbel, in addition to the population counts, in annual monitoring reports beginning in 2008 (Vernadero Group 2008, 2009, 2010). The percent of critical habitat occupied was determined by summation of the linear extent of each Huachuca water umbel population divided by the linear extent of critical habitat. The entire length of critical habitat (54,235 meters) was used, rather than the number of miles surveyed each year, in an effort to maintain consistency across years.

Results from this analysis showed variability in Huachuca water umbel occupancy; however the general trend is not one of decline, but rather of increasing occupancy on the SPRNCA (PBA Appendix L, Table 3 in Vernadero Group 2011c). The length of occupied critical habitat was:

274.8 m (0.5% of total critical habitat occupied) in 2001;
199.7 m (0.4%) in 2004;
409.1 m (0.8%) in 2007;
362.4 m (0.7%)in 2008;
1,041.1 m (1.9%) in 2009; and
965.7 m (1.8%) in 2010.

Huachuca water umbel has been established in Curry Draw on the SPRNCA as a cooperative effort between Fort Huachuca and the Bureau of Land Management. This site as well as locations within Huachuca Canyon Creek, McClure Canyon, Frog and Horsethief Draw springs and Cave Spring are monitored for success, but are not part of the monitoring of naturally-occurring occurrences. If successfully established over the long term, this occurrence will contribute to the recovery of the species by serving as a near-mainstem protected site.

The environmental baseline for the Huachuca water umbel within the SPRNCA, regardless of apparent changes in the species' abundance, exists in an impaired condition. The most-current version of the U.S. Geological Survey's Water Management of the Region Aquifer in the Sierra Vista Subwatershed, Arizona—2011 Report to Congress (321 Report)(USPP 2013) states that the estimated aquifer storage change in the Sierra Vista Subwatershed was -4,600 AF (AF). There was thus 4,600 more AF of ground water being withdrawn and discharged than there was infiltrating and being recharged. Since 2002 (the beginning of the monitoring required by section 321), about 65,200 AF have been removed from storage in addition to the hundreds of thousands of AF that previously were removed from storage since groundwater pumping began in the first half of the 20th century (D. R. Pool, USGS, unpub. data, 2011, as cited in USPP 2013).

Regional Aquifer Groundwater Trends

Trends in the regional groundwater system are discussed in detail in the Groundwater Trends in the Regional Aquifer subsection of the Hydrogeology of Upper San Pedro River section, above. As shown in PBA Figure 3-18, Fort Huachuca maintains several monitoring and test wells within the Installation boundary. However, the silt and clay layer underlying the San Pedro River near Charleston restricts flow and creates confining and semi-confining conditions (PBA Figure 3-17). Due to the differences in the hydrogeology of the monitoring wells compared to the San Pedro River, horizontal gradients are unlikely to accurately represent the changes in groundwater

flow from the Fort Huachuca pumping center to the San Pedro River near Charleston (PBA Section 3.5.5). The vertical gradient between the deep aquifer and shallow aquifer measured in paired monitoring wells along the San Pedro River is a better indicator of whether groundwater withdrawals from the Fort Huachuca and Sierra Vista pumping centers are impacting flows on the San Pedro River. The data from the paired monitoring wells along the San Pedro River are discussed in the following paragraphs.

Exchange of water between the deep regional aquifer and shallow alluvial aquifer is driven by hydraulic (pressure) gradients, measured by comparing water levels in shallow and deep monitoring wells at the same location along the San Pedro River. Positive vertical gradients (the deeper wells showing higher surface levels than the shallow wells) indicate upward movement of water from the deeper aquifer to the shallower. Negative gradients indicate the reverse. A zero hydraulic gradient indicates hydrostatic equilibrium and no movement of groundwater between the two aquifers. A decrease in groundwater movement towards the river, caused by groundwater pumping between the mountains and the river, would be reflected in a decrease in the measured vertical hydraulic gradient (the amount by which the pressure in the deeper aquifer exceeds that in the shallower aquifer).

Groundwater Trends in the Alluvial Aquifer

Decreasing trends in baseflow have already been noted in the upper reaches of the San Pedro River within the United States. Thomas and Pool (2006) found that "…summer flows at Palominas significantly or nearly significantly decreased from 1931 and 1951 to 2002." Thomas and Pool (2006, page 28), further stated that the statistically nonsignificant, but still measurable, decreasing trends in summer flows at Palominas from 1961 and 1971 to 2002 "…may be related to the large gap in the flow record from 1982 to 1995." It is hypothesized that these declining trends may be due in part to water-intensive mining operations in Cananea, Sonora, but it is likely that the pumping of ground water in unincorporated areas within Cochise County is contributing to the negative trends that did exhibit statistical significance.

Kennedy and Gungle (2010) analyzed the data from eight paired shallow and deep monitoring wells along the San Pedro River. Data from seven of the eight monitoring well pairs show essentially no trends over time, either in water level or gradient (Kennedy and Gungle 2010). In one well at Lewis Spring, the water levels have risen in both the deep and shallow wells likely due to the recharge at the EOP. The lack of decline in water levels and gradients during this period suggest that groundwater pumping in the Sierra Vista area has not yet substantially affected vertical gradients in and near the alluvial aquifer of the San Pedro River during the period and in the locations for which water level data exist (Kennedy and Gungle 2010). If groundwater pumping were affecting conditions in the alluvial aquifer, a continual decline in vertical gradients would be expected. This has not occurred.

There are no paired shallow and deep monitoring wells in the Babocomari River alluvial aquifer. In addition, streamflow at the Babocomari River has only been measured consistently since 2000, which is a limited record for analysis of streamflow trends. Information related to streamflow and recharge on the Babocomari River is insufficient for the above analysis to be performed for that watershed.

Although monitoring of groundwater level trends provides an indicator of the sustainability of the groundwater system, groundwater level data alone has limited application for the assessment of impacts from future actions. A more comprehensive tool for predicting future groundwater conditions is a regional groundwater model.

Trends in the Surface Water System

The San Pedro River through the SPRNCA consists of perennial and intermittent reaches, with flows being generally more perennial in the upper reaches and becoming more intermittent as the river flows north. The USGS maintains three streamflow measuring stations on the San Pedro River. They include the Palominas gage, Charleston gage and the Tombstone gage, with the Charleston gage being the only station with a substantially complete long-term record.

Many researchers have documented a long-term decline in flows at the Charleston gaging station (Corell 1996, Corell et al. 1996, Pool and Coes 1999, Koehler 2004, Thomas and Pool 2006, and others), but it has been more difficult to ascribe a cause to the observed declines in discharge.

San Pedro River streamflows have declined in the 20th century. The annual total flow of the San Pedro River at Charleston gage has declined from 57,000 AFY during the predevelopment period (1915 to 1940) to 22,000 AFY from 1991 to 2002 period (Thomas and Pool 2006). The research identified that reduced summer flows were responsible for about 70 percent of that decline, while fall and early winter declines made up 20 and seven percent, respectively. In July 2005, the flow of the San Pedro River at the Charleston gaging station was zero for the first time since records began (Figure 3-8 and Figure 3-9).

There are four main factors that influence baseflow trends in the Upper San Pedro River:

Changes in precipitation;
Changes in evapotranspiration by riparian vegetation (Stromberg et al. 2010);
Changes in temperature (e.g., date of the last hard freeze)(Kennedy and Gungle 2010); and,
Groundwater pumping from the regional aquifer.

By removing variability in streamflow attributable to changes in precipitation, Thomas and Pool (2006) found that precipitation declines were only partially responsible for the recent declines in streamflow in the San Pedro River at the Charleston gage. The study evaluated potential factors other than precipitation that could have resulted in streamflow declines and concluded that changes in upland and riparian vegetation are the mostly likely causes for the observed streamflow declines because:

There are substantial negative trends observed in growing season (summer) flows but not in winter flow;
The area of riparian vegetation in the Upper San Pedro basin has increased overthe last century (Stromberg et al. 2010); and,
Since evapotranspiration makes up more than 90 percent of the discharge from the basin, small changes in upland and riparian vegetation could have pronounced effects on flows in the river (Thomas and Pool 2006).

Seasonal groundwater pumping near the river was also recognized as having a substantial effect on streamflow, but groundwater pumping far from the river (i.e., Sierra Vista/Fort Huachuca area) in the regional aquifer was not seen as having a major influence on streamflows at the San Pedro River at the Charleston gage (Thomas and Pool 2006).

Baseflow in the Upper San Pedro River is the result of groundwater discharge to the river from the regional and alluvial aquifers. The regional aquifer has recharge zones away from the river, primarily at mountain fronts and along ephemeral channels. The alluvial aquifer consists of the "bank storage" in the near-stream alluvial deposits and is recharged mainly from stormwater. Kennedy and Gungle (2010) estimated the quantity and sources of baseflow (regional or alluvial) in the San Pedro River near Tombstone. Using environmental isotope data, they concluded the composition of baseflow in the upper San Pedro River at the Tombstone gage is 74 (±10) percent regional groundwater and 26 (±10) percent summer storm runoff stored as alluvial groundwater for the 2000 to 2009 period. Kennedy and Gungle (2010) also examined declines in baseflow at Tombstone. Median baseflow for the earlier period of record, 1968 to 1986, was 5,830 AFY and for the later period, 1997 to 2009, was 2,880 AFY, which is nearly a 50 percent decline. This decline in median baseflow is also apparent in the raster hydrograph and seven-day winter low flow calculated for the gaging station on the San Pedro River at Tombstone (PBA Figure 3-10 and Figure 3-11). Kennedy and Gungle (2010) concluded that decreases in streamflow in a large part are attributable to changes in the precipitation patterns and more vigorous and expansive vegetation.

The USGS has installed eight pairs of piezometers along the San Pedro River and has installed pressure transducers that record the pressure associated with the elevation of groundwater in each piezometer. These wells are used to estimate the vertical gradient between the deeper regional and shallow alluvial aquifer. A decrease in the vertical gradient in these monitoring wells would indicate a declining contribution of baseflow from the regional aquifer. Since 2001, data from these monitoring wells indicate no changes in water levels or vertical gradients (PBA Section 3.5.6). In addition, from 2000 to 2009, the percentage of regional and alluvial groundwater determined by isotopic analysis has also remained relatively constant. Therefore, Kennedy and Gungle (2010) concluded that together, these data show that declines in winter baseflow of the San Pedro River at the Tombstone gaging station could not be explained by (or attributable to) changes in the regional aquifer.

All the paired monitoring wells to measure vertical gradients are along the mainstem of the San Pedro River and not the Babocomari River (PBA Figure 3-7). Streamflow data for the Babocomari River are less available than the San Pedro River. The USGS installed a stream gage (USGS 9471400) in 2000 in the Babocomari River near Tombstone (PBA Figure 3-7). A raster hydrograph and a graph of winter low flow (15 January to 15 March) for the Babocomari River at this gage are in Figure 3-12 and Figure 3-13, respectively. There were no USGS gaging stations along the Babocomari River before 2000. Before 2000, limited historical streamflow data for the Babocomari River were acquired by Schwartzman (1990) during research conducted for a graduate thesis. Schwartzman (1990) divided the Babocomari River into ten sections and reported the results of streamflow measuring conducted in March and June of 1988. One of Schwartzman's measuring locations (number six) is nearly in the same location as USGS gage on the Babocomari River near Tombstone. In March 1988 Schwartzman measured a flow of 2.7 cubic feet per second (cfs) near the USGS gage (PBA Figure 3-13). From 2001 to 2011, the average winter low baseflow measured by the USGS has varied from 0.6 to 3.9 cfs. The flow

naturally fluctuates with wet and dry years. The year in 1988 was a wet year similar to 2001. With the limited data it is difficult to determine trends in flow for the Babocomari River.

Recent groundwater modeling (GeoSystems Analysis 2010) suggests that effects of historical groundwater withdrawals from the regional aquifer (1940 to 2003; PBA Section 3.5.6) would result in reduced flows in the Babocomari River. Since the Babocomari River contributes flow to the San Pedro River upstream of the Tombstone gaging station, there is the potential that declines in Babocomari River baseflow could account for some portion of the declines in winter baseflow observed at the San Pedro River at the Tombstone gage.

The streamflow gaging stations only provide measurements of flow in fixed locations. Since 1999, The Nature Conservancy and BLM have coordinated the efforts of volunteers to map the spatial extent of wet reaches on the SPRNCA. Mapping was done during the third weekend of June to coincide with the lowest flow before the expected start of the monsoon. The mapping of wet reaches during the driest time of year provides an additional metric on flow conditions throughout the San Pedro River. The survey results from 1999 to 2010 indicated that 32 percent (15.9 miles) of the San Pedro River through the SPRNCA had surface flow during all surveyed years. The total wetted length varied from year to year (22.2 to 35.5 miles)(Turner and Richter 2011); however, the only statistically significant trend in wetted length from 1999 to 2010 (such as a segment getting wetter or drier over time) was observed in Segment 2, which generally was getting wetter.

Prior Consultations in the Action Area

Since the June, 14, 2007, publication of the final Biological Opinion on the proposed ongoing and future military operations and activities at Fort Huachuca (File number 22410-2007-F-0132), we have completed five formal and informal consultations regarding actions with effects to Huachuca water umbel and its critical habitat with the Action Area.

In our May 21, 2012, Biological Opinion (BO) with the Bureau of Land Management on their Gila District Livestock Grazing Program (File number 22410-2006-F-0414), we found that the proposed action would not jeopardize the continued existence of Huachuca water umbel or adversely modify or destroy its critical habitat.

In our October 3, 2011, BO with the Federal Highway Administration on their replacement of the State Route 90 bridge over the San Pedro River (File number 22410-2011-F-0019), we found that the proposed action would not jeopardize the continued existence of Huachuca water umbel or adversely modify or destroy its critical habitat. It is likely that we will transmit an additional review of proposed changes to the action – with a substantively similar conclusion - in late 2013 or early 2014.

In our April 2, 2009, BO with the Coronado National Forest, Coronado National Memorial, and Fort Huachuca, on the Huachuca FireScape Project (22410-2008-F-0451), we concurred that the proposed action was not likely to adversely affect the Huachuca water umbel and its critical habitat.

In our January 22, 2009, review of the improvement project at the State Route 82 Bridge over the San Pedro River, and in its June 13, 2011, reinitiation (File number 22410-2009-I-0131), we

concurred that the action was not likely to adversely affect the Huachuca water umbel and its critical habitat.

In our December 31, 2008, Biological Opinion on Aquatic Species Conservation at the San Pedro Riparian and Las Cienegas National Conservation Areas (File number 22410-2008-F-0103), we concluded that the proposed action would contribute to the recovery of Huachuca water umbel and would not jeopardize the continued existence of Huachuca water umbel or adversely modify or destroy its critical habitat.

The combined effect of the actions analyzed in these consultations to the environmental baseline for the Huachuca water umbel has been a modest improvement in the status of the species, as it has been established in Curry Draw, near Murray Springs, within the SPRNCA as a result of implementation of the December 31, 2008, BO.

Effects of the Action – Huachuca Water Umbel

Effects of the action refer to the direct and indirect effects of an action on the species or critical habitat, together with the effects of other activities that are interrelated and interdependent with that action, which will be added to the environmental baseline. Interrelated actions are those that are part of a larger action and depend on the larger action for their justification. Interdependent actions are those that have no independent utility apart from the action under consideration. Indirect effects are those that are caused by the proposed action and are later in time, but are still reasonably certain to occur.

The Environmental Baseline section, above, discussed the Huachuca water umbel's status both on Fort Huachuca and within the SPRNCA. Similarly, the effects to Huachuca water umbel and the species' critical habitat are separated into two categories for analysis: direct and indirect effects to plants occurring on and critical habitat designated within the boundaries of the installation; and indirect effects (including the effects of interdependent and interrelated actions) to plants and critical habitat on the San Pedro River within the SPRNCA.

Huachuca water umbel occurrence sites and critical habitat within the boundary of Fort Huachuca are affected directly and indirectly through actions that disturb land and vegetation. Huachuca water umbel occurrence sites and critical habitat along the San Pedro River within the SPRNCA are affected indirectly by Fort Huachuca's pumping of ground water from within the Sierra Vista Subwatershed. The following narrative contains separate analyses of on-post and off-post effects.

Effects to Huachuca Water Umbel on Fort Huachuca

The Description of the Proposed Action section, above, described the full range of activities conducted by Fort Huachuca. The proposed action also includes a series of species-specific conservation measures intended to avoid and minimize the adverse effects of the proposed action. These measures, and their effects to both the species and, as applicable, its critical habitat, are as follows:

HWU-1: The Fort will monitor naturally occurring Huachuca water umbel on the installation every three years. A survey of potential habitat on the Fort will be conducted once every 10

years. The Fort will conduct long-term monitoring at all transplanted Huachuca water umbel populations on the Installation (via implemented projects under Section 7(a)(1) of the ESA) as identified via the Fort's Long-Term Monitoring Plan (PBA Appendix M). Implementation of this conservation measure will ensure that changes to the status of the species, including within critical habitat, are detected, thus permitting a management response (if the change is negative);

HWU-2: The Fort will inventory all potential Huachuca water umbel habitat on the SPRNCA every three years in coordination with the Bureau of Land Management (non-concurrent with Installation survey years). The Fort will conduct Long-Term Monitoring at all year 2010 transplanted Huachuca water umbel populations on the SPRNCA (via implemented projects under Section 7(a)(1) of the ESA) as identified via the Fort's Long-Term Monitoring Plan). Implementation of this conservation measure will ensure that changes to the status of the species, including within critical habitat, are detected, thus permitting a management response in collaboration with the BLM(if the change is negative);

HWU-3: The Fort will maintain rock barriers around Huachuca water umbel populations on specific vulnerable populations. This conservation measure will minimize vehicular intrusions into Huachuca water umbel habitat, including critical habitat;

HWU-4: To preclude vehicular traffic, the Fort will maintain the vehicle barrier at Gate Number 7. Gate Number 7 is at the saddle between Garden Canyon on the east side of the Huachuca Mountains and Scotia Canyon on the west side of the mountains. This gate is used to allow access off post to the west side of the mountains. Maintenance of this gate will minimize the passage of vehicles onto Fort Huachuca sites containing Huachuca water umbel (and its critical habitat) within Garden Canyon;

HWU-5: The Fort will manage existing Huachuca water umbel habitat on Post that has been degraded or lost due to mission-related activities. Management could include the propagation of Huachuca water umbel for use in site introduction and restoration and protection of other suitable sites. This conservation measure will allow continued implementation and potential expansion of Huachuca water umbel restoration work;

HWU-6: As part of the Fort's monitoring program for the Huachuca water umbel, the Fort will document any disturbance of Huachuca water umbel or its habitat on the Fort and report any disturbance to the Service as described in the reporting requirements (PBA Section 2.13.3). Implementation of HWU-6 will allow tracking of unanticipated adverse effects to the species and/or its critical habitat and, by extension, promote a management response when needed;

HWU-7: The Fort will continue with water conservation efforts, effluent reuse or recharge, purchase of conservation easements, and storm water recharge (PBA Section 2.13.2). Continued implementation of Conservation Measure HWU-7 will ensure that water mitigation - a crucial aspect of Fort Huachuca's proposed action – proceeds such that both the species and its critical habitat are conserved; and

HWU-8: All maintenance in Garden Canyon and Huachuca Canyon will be within the existing roadbed or catch basins. Silt fencing is a best management practice that can be used where there is the potential for sediment to enter Huachuca water umbel habitat in these canyons. No native vegetation will be removed outside of the existing roadbed and no invasive plant or animal

species will be introduced. No water will be diverted from Garden Canyon Creek. This conservation measure will minimize the adverse effects of human activities and related erosion within Huachuca water umbel habitat, including critical habitat.

The elements of the proposed action (see Description of the Proposed Action, above) that could adversely affect Huachuca water umbel or, as applicable, its critical habitat within the Fort Huachuca portion of the action area (i.e. Garden Canyon and its tributaries Sawmill and McClure canyons, and Huachuca Canyon) include fire, human disturbance, erosion, and water use.

Fire

Fire would generally not burn the wetland habitat of the Huachuca water umbel. However, fire has the potential to burn adjacent upland habitats causing indirect effects on Huachuca water umbel habitat that could include increased runoff of floodwaters, deposition of debris and sediment originating in the burned area, and potential for scouring of the Huachuca water umbel habitat. Although the Huachuca water umbel is adapted to reestablish after flooding and sediment deposition, a large event above Huachuca water umbel habitat could adversely affect the local occurrence of the species. Recolonization and re-establishment of Huachuca water umbel could be significantly slowed following large-scale habitat alteration.

Fort Huachuca is participating with other federal agencies in the FireScape program (Coronado National Forest 2009), which provides for fuels management in the Huachuca Mountains. Fort Huachuca's Integrated Wildfire Management Plan (Gebow and Hessil 2006) provides a planning framework for reducing the risk of fire and fire suppression effects on listed species. The risk of a fire originating in lower-elevation training areas reaching forested habitat in the upper elevations is reduced to some extent by fuel management activities in lowland habitats and to a network of fire breaks that the Fort has established along ridgelines. The FireScape consultation is not current, however, so this BO will include an analysis of the effects of Fort Huachuca's fire and fuel treatment activities.

Fuels management, prescribed fire, managed natural fire, and wildland firefighting have the potential to affect Huachuca water umbel and the aquatic ecosystems in which it occurs. According to the PBA, fuels management on the Fort is ongoing and employs a variety of hand methods, combined with prescribed burning. Fuels modification activities in wooded habitats situated in the uplands adjacent to streams occupied by Huachuca water umbel, are designed to reduce the density of vegetation in oak, pine-oak, oak-pine, and mixed conifer vegetation in an attempt to return these communities to more natural conditions following decades of fire suppression.

Fuels management activities, including thinning, slash removal, and prescribed fire may temporarily degrade Huachuca water umbel habitat. Fort Huachuca's Integrated Wildland Fire Management Plan (IWFMP) is due to be updated in coordination with our office before 2016. Depending on funding and environmental conditions, Fort Huachuca proposes to treat (mechanically thin and subsequently burn) up to 6,190 ac in the upper elevations on the Fort over the next 10 years. See Table HWU1 below for the number of acres of each biotic community proposed to be treated over the next 10 years in the upper elevations. The upper elevation treatment units will have more than a single treatment occurring within them over the 10 years. The initial treatment will be mechanical to reduce the fuel load; once a treatment unit has

undergone sufficient mechanical treatment to bring flame lengths down to an appropriate height to ensure safe burning conditions, controlled burns will be implemented within the unit.

Prescribed fire is, by design, low intensity and is not intended to remove all vegetative cover; patchy coverage will remain. Prescribed fire is also not intended to reduce riparian vegetation. We therefore conclude that there will be no direct effects to Huachuca water umbel from burning of aquatic or riparian ecosystems. Regarding indirect effects of post-fire changes in the upland vegetative communities, we anticipate there will be no appreciable, long-term changes in the magnitude, frequency, or duration of flood flows. In the event that runoff is elevated or contains ash, we believe that the effects will be temporary and Huachuca water umbel would be able to persist in discreet sites, particularly within reaches containing deergrass (Muhlenbergia rigens), boulders, and other elements of hydraulic complexity that would tend to shelter individual umbel plants.

Although active fire suppression, as opposed to planned, prescriptive fires, is critical to reduce damage from some wildfires, suppression activities can also adversely affect the water umbel. However, the Fort is committed to making protection of water umbel habitat an objective of fire suppression. Suppression-related off-road vehicle activity, including tracked vehicles, will be minimized. A resource advisor will be on-site during all fires to advise the incident commander of species issues. Areas disturbed will be kept to a minimum and located outside of areas important for the water umbel, whenever possible. Prescribed fire is planned in advance and is thus subject to section 7 consultation under the regulations at 50 CFR § 402. We note, however, that the effects of wildfire suppression would be consulted upon as an emergency consultation, as provided for at 50 CFR § 402.05.

Human Disturbance

Military training and testing are limited in the canyons of the Huachuca Mountains where this species occurs, and vehicle use is restricted to existing roads and trails, minimizing potential for direct impact. Road repair or maintenance in Huachuca water umbel habitat is done using best management practices and conservation measures developed in consultation with the Service for road repairs. These measures act to confine effects of maintenance to the immediate area of the road and to minimize off-site effects.

A hiking trail passes by a Huachuca water umbel site at Sawmill Spring. Limited trampling by recreationists likely occurs at this locality, but is not considered a serious threat. The site at the upper Garden Canyon picnic ground is in the picnic area and is likely subject to foot traffic, but the Fort has placed large boulders around the area to exclude vehicles (Conservation Measure HWU 3, above). Other occurrences in Garden and McClure canyons receive less use by recreationists, and trampling and damage by vehicles are also less likely in these areas. Additionally, the Fort has closed Gate 7 which previously allowed vehicular access to the upper Garden Canyon watershed from the west (HWU-4). Pipelines originally constructed to tap springs in Garden Canyon and convey water downstream for water supply are no longer in use. Water will not be diverted from Garden Canyon for any purpose.

Erosion

Erosion and sedimentation can occur in Huachuca water umbel habitat as a result of wildland fire in upland habitat adjacent to water umbel habitat, as discussed above under fire. However, the Fort has restoration and erosion best management practices that will be put in place following fires. Erosion may also result from degraded or improperly maintained roads. We anticipate that implementation of Conservation Measures HWU-4, HWU-5, and HWU-8 will minimize these effects.

Water Use

There will be no effects on the Huachuca water umbel or its critical habitat on Fort Huachuca as a result of the installation's groundwater use. The occurrences of umbel and it's critical habitat are located in the upper portions of the Garden Canyon watershed (including its tributaries, Sawmill and McClure canyons) and Huachuca Canyon, are located well up-gradient from the regional aquifer and are therefore unaffected by groundwater development and use that affect base flows. Because umbel are not affected by groundwater use development, use and baseflow, there is no appreciable reduction in their likelihood of recovery caused by reduced base flows.

Activities on the Fort do, however, have the potential to affect surface waters. A pipeline currently exists in Garden Canyon that has the potential to divert a portion of the flow in Garden Canyon for downstream use. The potential amount of such a diversion is unknown, but the source is eight springs, with the uppermost spring located near the pictograph sites. From this point, water could be collected and diverted in a pipeline from the various springs along Garden Canyon Creek (Tom Cochran, 1998, pers. comm. as cited in the 2007 Revised PBA). Fort Huachuca has removed all water uses from this pipeline. However, the pipeline infrastructure will remain intact and may be used in the future for mobilizing, emergencies, and firefighting. These uses are expected to be infrequent and of short duration, and thus should have no measurable effect on water umbel occurrences in Garden Canyon, including the critical habitat that exists there.

Effects to Huachuca Water Umbel in the San Pedro Riparian National Conservation Area

Surface flows in the San Pedro and Babocomari rivers derive from four primary sources: 1) stormwater runoff; 2), flows from bank storage; 3) baseflow discharged from the alluvial aquifer; and 4) baseflow discharged from the regional groundwater aquifer. The regional groundwater component of baseflow is an important source of water for many reaches of the San Pedro and Babocomari rivers, sustaining flows when direct runoff of precipitation and discharges from the banks or alluvium are not occurring.

Huachuca water umbel occurrences and critical habitat on the mainstem San Pedro River are affected indirectly by the pumping of groundwater from the regional aquifer. Ground water is pumped: 1) by Fort Huachuca to serve its on-base military and civilian population; 2) by municipal and investor-owned utilities to serve local industries and residents; and 3) by private land owners operating private wells and well shares. To the extent that groundwater withdrawals by Fort Huachuca reduce the contribution of regional groundwater to baseflow, surface flows would also be affected. Groundwater withdrawals from the alluvial aquifer and from the regional aquifer closer to the river have more appreciable temporal and spatial impacts than groundwater withdrawals from the regional aquifer which is significantly more distant from the rivers. Further, the effect of groundwater withdrawals on the rivers is relatively greater during

low-flow periods when surface flows are likely to be maintained solely by discharges from the alluvial and regional aquifers.

Fort Huachuca's pumping (direct and interrelated) results in both removal of ground water from storage in the regional aquifer and the capture of water from discharge. Ground water in storage is that which resides in an aquifer. Such stored water may be discharging to a spring or waterway. Water used by plants through evapotranspiration is also categorized as discharge. Under unaffected conditions (i.e., no pumping), infiltration of rainfall and runoff maintains storage in equilibrium with discharge. Water withdrawn from the ground by wells initially derives exclusively from storage. As pumping continues, increasing proportions of water are derived from the capture of discharge, and decreasing proportions are derived from storage. In other words, ground water wells are withdrawing not only water residing in the aquifer, but also water that was otherwise destined to become the surface flow of a stream or be available to sustain riparian vegetation. If water withdrawal continues unmitigated, it will eventually deplete storage, reverse the flow direction of groundwater, and capture (dewater) the stream itself. Deprivation of the base flow of the San Pedro River could eventually cause perennial reaches to become intermittent or ephemeral. Such a change in the hydrologic regime of the San Pedro River, depending upon the reach in which it occurred, could result in losses of numerous Huachuca water umbel occurrences. The following narrative describes the magnitude of this potential effect, the effect of Fort Huachuca's proposed measures to avoid and minimize it, and the methodology by which these analyses are conducted.

The first step for Fort Huachuca to determine the effects of its proposed action on the Huachuca water umbel is to determine the magnitude of groundwater withdrawal, recharge (natural and enhanced), and water conservation (including water-saving activities as well as mitigating projects). Determination of the amount of groundwater withdrawal first and foremost requires an understanding of the anthropogenic water use (water demand) associated with Fort Huachuca. This requires an understanding of how many humans reside in the Sierra Vista Subwatershed due to the presence of Fort Huachuca and how much water is used by those individuals. The human population includes both military and civilian personnel assigned to Fort Huachuca or one of its tenant units or organizations as well people who reside in the area due to the presence of the installation, including, but not limited to, dependents, contractors, retirees, and indirectly-affiliated individuals who are present due to the Fort's substantial economic contributions to the area.

To determine the human population, Fort Huachuca: 1) conducted a demographic survey (PBA Appendix H); 2) ran an economic impact model (PBA Appendix I); and 3) produced a demographic survey report (PBA Appendix J), based on the results of the demographic survey. The contents of these analyses are incorporated herein via reference. The purposes of the demographic survey (PBA Appendix H) are to: accurately determine the number of people directly attributable to Fort Huachuca; and determine the proportion of Fort Huachuca-related households compared to all households within the Sierra Vista Subwatershed.

The purpose of the economic impact model (PBA Appendix I), which uses Impact Analysis for Planning (IMPLAN) software and fiscal year 2011 (October 1, 2010 to September 30, 2011) expenditure, contract, and payroll data, is to determine the total of the direct and indirect impacts of Fort Huachuca. Direct economic impacts are those that occur as a direct result of the military personnel, civilians and contractors employed at the Fort and their associated wages. Indirect

economic impacts and induced impacts occur as a result of the multiplier effects, defined as spending that ripples through the economy generating additional income based upon structural trade linkages within the economy. The IMPLAN model's results present economic impacts as the total number of jobs with no distinction between full-time and part-time jobs. All employment figures are converted to full time equivalent employment (FTE) for reporting purposes.

We note that the IMPLAN economic impact model differs from the Economic Income Forecasting System (EIFS) model that was used in the 2007 PBA and our 2007 BO. The EIFS model has a firm basis in regional economic theory and has been widely applied by the Department of the Army within the context of National Environmental Policy Act (NEPA) analyses to determine the economic impacts of changes in personnel levels; IMPLAN is a similarly rigorous and defensible model. Further, Fort Huachuca utilized up-to-date data in the IMPLAN model development; the prior EIFS model has not been updated and thus does not constitute the best available information. The lack of current data also applies to the calculation of the human population attributable to Fort Huachuca that was performed by Robert Carreira from the Center for Economic Research (Appendix I in the 2007 PBA) and to the 2007 study entitled Fort Huachuca and the San Pedro River: Improving Water Deficit Liability Calculations Through Economic Modeling, authored by Janie Chermak, Ph.D., John Talberth, Ph.D., and Jason Hansen of the University of New Mexico and the Center for Sustainable Economy. The latter model was provided to USFWS subsequent to our completion of the 2007 BO, but we are not aware of the publication of any updates.

The demographic survey report (PBA Appendix J) combines the results of the demographic survey (PBA Appendix H), which indicates the population directly attributable to Fort Huachuca and the IMPLAN model (PBA Appendix I), which estimates the induced employment that results from the expenditures by the Fort. The final result of the demographic survey report is that Fort Huachuca's total direct, indirect, and induced population in the Sierra Vista Subwatershed is an estimated 33,440 persons. The 33,440-person estimated human population was then employed in an accounting of Fort Huachuca's groundwater demand, the results of which appear in PBA Appendix K, which is incorporated herein via reference.

Groundwater Demand

There are several types of groundwater demand that were evaluated in determining Fort Huachuca's 2011 Net Groundwater Demand: surface water, agricultural, municipal, rural, and industrial. Fort Huachuca does not use surface water or agricultural water; therefore, these two groundwater demands were eliminated from the Fort's Net Groundwater Demand Calculation. The groundwater use attributable to Fort Huachuca's 33,440-person estimated human population for 2011 is determined by an analysis of the following factors:

The average municipal per capita water use for those individuals living in urban areas (municipal);
The average unincorporated area per capita water use for those living outside of urban areas (rural); and
A fraction of total industrial groundwater demand within the Sierra Vista Subwatershed (industrial).

Average per capita water demand for the Sierra Vista/Fort Huachuca area was calculated based on dividing the combined Fort Huachuca and City of Sierra Vista groundwater pumping by the combined 2011 resident population. Groundwater pumping in 2011 at Fort Huachuca and in Sierra Vista was 1,030 AF and 6,218 AF, respectively, for a total of 7,248 AF. The combined 2011 resident population was 45,098, with 7,454 on the Fort, and 37,644 off of the Fort in Sierra Vista. The resulting per capita water use rate for urban residents was 143 gpcd. This value is lower than the 2000 municipal per capita water use value of 180 gpcd for Fort Huachuca and the City of Sierra Vista, reflecting conservation measures to reduce pumping since that time.

For residents of unincorporated areas of the Subwatershed, an average water use rate of 118 gpcd was used. This value was estimated by the Groundwater Users Advisory Council of the Prescott Active Management Area (2006) for domestic well demand. We note that the 118 gpcd value was derived for the Prescott area in Yavapai County, Arizona, which is relatively similar in elevation and climate to the Sierra Vista area. Both the Fort's direct off-Post population and the induced population were distributed between urban and unincorporated areas of the Subwatershed according to the distribution representative of the whole Subwatershed. Based on 2010 Census data within the Sierra Vista Subwatershed, 42 percent of the population lives outside of Sierra Vista in unincorporated areas (U.S. Census Bureau 2012). From the Fort's total direct and indirect personnel in 2011 of 25,303, 17,871 persons resided in incorporated areas, and 7,432 were assumed to live in unincorporated areas of the Subwatershed. Similarly, among the Fort's 2011 induced population of 8,137, 42 percent (3,338) are assumed to live outside urban areas, bringing the total unincorporated area population attributable to Fort Huachuca to 10,820 (7,432 plus 3,388). The total incorporated population attributable to the Fort in 2011 is estimated at 22,620 (17,871 plus 4,749). Adding the 10,820 residents of the unincorporated areas to the 22,620 residents of incorporated areas renders the 33,440-person total induced human population cited above.

Fort Huachuca's total gross groundwater demand within the Sierra Vista Subwatershed is derived by applying the urban-area total groundwater demand of 143 gpcd to the incorporated population attributable to the Fort, applying the unincorporated-area domestic demand of 118 gpcd to the unincorporated-area population attributable to the Fort, and adding a fraction of the total Subwatershed's industrial groundwater demand.

Including the induced population, the Fort was responsible for approximately 43 percent of the total 2011 population of the Sierra Vista Subwatershed. Therefore, the Fort's share of industrial groundwater demand in 2011 is estimated as 43 percent of the total industrial demand in the Subwatershed. USPP (USPP 2010) estimated that 1,350 acre feet were required for sand and gravel operations and industrial golf course irrigation in the Sierra Vista Subwatershed in 2010, which puts Fort Huachuca's industrial groundwater demand responsibility at 584 AF.

Groundwater Recharge

Combining industrial demand (584 AF) with Incorporated demand (3,635 AF) and unincorporated-area demand (1,428 AF) yields a total groundwater demand of 5,648 AF in the Sierra Vista Subwatershed attributable to Fort Huachuca in 2011.

Human-induced recharge occurs from effluent recharge basins and stormwater detention basins, incidental stormwater recharge in urban areas, and incidental recharge from turf grass irrigation,

septic systems, and effluent discharged other than in basins. According to the Arizona Department of Water Resources (ADWR; 2005), only 5 percent of Sierra Vista is without sewer; hence septic system recharge in the city is very small. Total human-induced recharge except for septic systems in 2011 is estimated at 324 and 4,962 AF for Fort Huachuca and Sierra Vista. The portion of Sierra Vista's human-induced recharge attributable to Fort Huachuca is based on the ratio of the Fort's off-Post urban-area population to the total Sierra Vista population. This fraction, 40 percent, of Sierra Vista recharge equals 1,999 AF, giving a total recharge "credit" of 2,323 (324 plus 1,999 AF to Fort Huachuca in 2011 not including septic system recharge).

Septic systems are generally credited for contributing to groundwater recharge. The Arizona Department of Water Resources (2005) assumes that all indoor water use (estimated at 69 gpcd) is recharged. This assumption fails to account for any evapotranspiration of leach field water. The Upper San Pedro Partnership (2010) has adopted a septic recharge rate of 70 percent. The Arizona Department of Water Resources (2005) assumes an average of 3 people per home and an average per-capita indoor water use of 69 gpcd. Applying this recharge rate to the 5 percent of Sierra Vista homes that are without sewer and all of the unincorporated population in the Sierra Vista Subwatershed and then reducing those values to account only for the population attributable to Fort Huachuca yields a septic recharge "credit" of about 500 AF in 2011 for Fort Huachuca. About 430 of those AF are recharged in unincorporated areas of the Subwatershed. Total recharge credits to Fort Huachuca in 2011 is estimated to be 2,823 (2,323 plus 500) AF (Table 3-3 in the PBA for summary data). Conservation easements purchased by the Fort in 2000 and 2001 eliminated 195 ac of irrigated agriculture which required 1,073 AF of water consumption near the San Pedro River (ADWR 1991, USFWS 2002d, cited as Harlow 2002 in the PBA; USFWS 2013a). Groundwater pumped near the river derives mostly from capture rather than groundwater storage. Elimination of this pumping therefore has a much greater potential for a near-term impact on streamflows and riparian evapotranspiration than mitigation that occurs miles away from the river.

The Fort has also purchased conservation easements in the Babocomari River area north of the Fort (3,628 ac). These conservation easements result in 299 AFY of future avoided pumping based on 0.0825 AF of avoided future residential pumping per acre. This multiplication factor is calculated by dividing the number of acres by four acres per residence, multiplying by 2.5 people per residence, multiplying by 118 gpcd, multiplying by 365 days per year and dividing by 325,851 gallons per acre-foot (credits are discussed in greater detail in the Mitigation Measure Plan, PBA Appendix D). The recharge "credit" and the conservation easement "credit" are deducted directly from total gross groundwater demand attributable to the Fort to determine the Fort's net groundwater demand of 1,453 AF in 2011 (Table 1 in PBA Appendix K).

Table 2 provides the calculation of the Fort Huachuca net groundwater demand for 2012 using the same methodology as for 2011. The Fort's attributable population and water use decreased compared to 2011. Also, in 2012, the Army provided funding through ACUB for conservation easements on 1,811 acres on River Stone Ranch. Overall, the net groundwater demand in 2012 was 1,180 AF (Table 2 in PBA Appendix K).

Beyond 2012, Fort Huachuca must project groundwater demand and the yield associated with the conservation measures described in PBA Appendix D, the Mitigation Measures Plan, the contents of which are incorporated herein via reference. Table 5.1 from the PBA summarizes the elements used in determining the 2011 and 2012 groundwater demand and also includes

projections of net groundwater demand. Table 5.1 has been reproduced in this BO as Table HWU2, below. In Table HWU2, the total groundwater demand and incidental recharge can be projected forward with reasonable certainty because of the Fort's thorough understanding of its staffing levels and water conservation infrastructure. The water yields of conservation measures that have been implemented as of the present time can also be forecast into the future with reasonable certainty; the projected yields of Mitigation Measures C2 though C10 are already known, and the respective projects have been implemented or are otherwise reasonably certain to occur. Mitigation Measures F1 and F2 are in progress, but not yet complete. We feel, based on the narrative in PBA Appendix D (the Mitigation Measures Plan), that the aforementioned measures are reasonably certain to occur, as they have been completed or are being implemented, or funding has been committed, agreements have been executed, planning and compliance efforts are underway, and the Fort has a history of implementing its proposed conservation measures. In regard to Mitigation Measure F1 – the Huachuca City Effluent Project – we have consulted informally with Fort Huachuca on the facility's construction and operation (letter of February 2, 2012; File number 02EAAZ-00-2012-I-0043)(FWS 2012).

The planned acquisition of Babocomari Easements (Mitigation Measure P1) appears less certain to occur. While Fort Huachuca has already acquired conservation easements in the Babocomari area, additional acquisitions are not underway at this time. The projected water yield of this potential, year 2022 action is 248 AFA, but we note that projected net groundwater demands become positive numbers (i.e. a surplus) beginning in 2014 (1,419) and remain at 1,517 AFA through 2021. Therefore, even if the 2022 acquisition of additional Babocomari conservation easements is discounted due to uncertainty, we still anticipate a net groundwater surplus due to the Fort's activities by then.

The groundwater demand accounting appearing in Table 5-1 and Appendix K of the PBA and in Table HWU2, above, contains estimates of Fort Huachuca's attributable groundwater withdrawals and the benefits (or credits) of Mitigation Measures to determine its overall contribution (positive or negative) to the sustainability of the regional aquifer.

The groundwater demand accounting, however, only utilizes annual estimates of total groundwater withdrawals and recharge and is unable to account for spatial and temporal patterns in pumping and recharge that could locally affect groundwater levels and the regional groundwater component of baseflow to reaches of the San Pedro and Babocomari Rivers. Groundwater withdrawals are generally concentrated in the Sierra Vista and Fort Huachuca area, while mitigation measures occur throughout the Sierra Vista Subwatershed. Mitigation measures closer to the river and further upstream have temporal and spatial benefits that are more significant in the shorter term than the relatively longer term potential impacts of Fort Huachuca's pumping of groundwater.

The effects of groundwater withdrawal and recharge on surface waters of interest may be evaluated with a model calibrated to local conditions. In this case, Fort Huachuca's analysis of the spatial and temporal impacts of pumping and recharge (the new water demand accounting appearing in Table HWU2) associated with the Fort's present and future actions are analyzed with the numerical groundwater model developed by the U.S. Geological Survey (USGS)(Pool and Dickinson 2007), and subsequently modified in 2010 and 2011 by Laurel Lacher (GSA 2010, Lacher 2011). Groundwater demand accounting by Fort Huachuca in the 2007 PBA partitioned the installation's net groundwater demand into pumping which reduces groundwater

in storage and pumping that captures natural discharge based on a basin-wide percentage; the Pool and Dickinson (2007) model was not yet published or made available for use. The spatial and temporal impacts of pumping and recharge associated with the Fort's present and future actions are now most appropriately analyzed using the model.

The updated model is based on the USGS Modular Three-Dimensional Groundwater Flow Model (MODFLOW). MODFLOW has undergone extensive USGS peer review, is able to simulate a wide variety of systems, and is the worldwide standard for groundwater models (Horak et al. 2008). MODFLOW simulates groundwater flow on a horizontal scale of 250m and at multiple vertical levels. The updated Upper San Pedro Basin model modified by Lacher (2011) was peer-reviewed by the USGS in 2012 (Leake and Gungle 2012). Leake and Gungle had concerns with artificial recharge near streams due to the 250-meter resolution of the model and the representation of the model properties at the site-scale; the limited ability of the model to simulate detailed geometries of artificial recharge areas and evapotranspiration areas; and stream locations that are smaller than the 250-meter grid spacing. However, Leake and Gungle (2012) found the work that Lacher had completed with the model was reasonable and valid.

The initial (Pool and Dickinson 2007) USGS groundwater model's abstract states that the model's purpose is to "…simulate seasonal and long-term variations in ground-water flow in the Sierra Vista Subwatershed in Arizona and Sonora." The model includes the simulation of details of the groundwater flow system that were not simulated by previous models, such as groundwater flow in the sedimentary rocks that surround and underlie the alluvial basin deposits, withdrawals for dewatering purposes at the Tombstone mine, discharge to springs in the Huachuca Mountains, thick low-permeability intervals of silt and clay that separate the groundwater flow system into deep-confined and shallow-unconfined systems, ephemeral-channel recharge, and seasonal variations in ground-water discharge by wells and evapotranspiration. Steady-state and transient conditions during 1902 to 2003 were simulated by using a five-layer numerical groundwater flow model representing multiple hydrogeologic units. Hydraulic properties of model layers, streamflow, and evapotranspiration rates were estimated as part of the calibration process by using observed water levels, vertical hydraulic gradients, streamflow, and estimated evapotranspiration rates as constraints. Simulations approximate observed water-level trends throughout most of the model area and streamflow trends at the Charleston gage on the San Pedro River. Differences in observed and simulated water levels, streamflow, and evapotranspiration could be reduced through simulation of climate-related variations in recharge rates and recharge from flood-flow infiltration.

Pool and Dickinson (2007) compared their modeling to that employed by three other numerical models pertaining to the upper San Pedro River: Freethy (1982); Goode and Maddock (2000); and Corell et al. (1996). Vionett (1992) provided an additional approach, but it was not specifically evaluated by Pool and Dickinson (2007). We concur with Fort Huachuca's selection of the Pool and Dickinson (2007) groundwater model because it is the most comprehensive and current of the available models and is likely to more accurately account for predevelopment groundwater conditions – those that existed before the onset of large-scale water withdrawals (see also Pool and Coes 1999) – an understanding of which is crucial for determining when steady-state conditions (i.e. recharge equals discharge) may be assumed to have existed.

The PBA (and this BCO) includes a cautionary narrative regarding the use of groundwater models, and of the modified USGS model (Pool and Dickinson 2007, GSA 2010a, GSA 2010b,

Lacher 2011) in particular. Models are representations of complex systems and the modeling results are a simulation of what may happen in the future, but do not necessarily accurately predict real conditions. The groundwater model results should always be interpreted with awareness of the limitations of the model. The following list identifies key limitations associated with the model as it applies to this analysis.

The groundwater model can only model the discharge of the regional groundwater component of baseflow to the San Pedro River and does not include surface flows attributable to flow from bank storage or precipitation. The Fort may only indirectly impact the regional groundwater component of baseflow. Utilizing the model to assess the Fort's impacts on the regional component of baseflow is within the model's intended purpose.

The groundwater model does not include urban-enhanced recharge and may underestimate the recharge near developed areas like the Fort and the City of Sierra Vista. Urban enhanced recharge (also called Incidental Recharge) refers to recharge attributable to human development associated with paving over areas where rainwater would otherwise be released to the atmosphere as evapotranspiration before it could percolate to groundwater. The rainwater runs rapidly off the paved surfaces and is concentrated in washes and drainages where more water is able to percolate to groundwater than would otherwise on undisturbed native soils; such ephemeral channel recharge is appreciable (Coes and Pool 2005). Urban enhanced recharge is estimated to be 2,300 AFY, of which 40 percent (900 AF) is attributable to the Fort.

The benefits from conservation easements were not included in the modeling due to uncertainty in estimating where and when future development would have occurred on areas with conservation easements (mitigation measures C5, C7, C8, C9, P1) or uncertainty in when agricultural pumping would recommence without the conservation easements (mitigation measures C6 and C10).

The groundwater model does not include urban-enhanced recharge (i.e. infiltration of the increased rainfall runoff from impervious surfaces in urban areas) and may underestimate the recharge in developed areas like the Fort and the City of Sierra Vista.

With these limitations, the groundwater modeling does not include about 2,400 AF of credits in 2012 and over 5,500 AF of mitigation credits by 2022. Therefore, the model underestimates the positive benefits of the Fort's mitigation measures and actual groundwater benefits of the Fort-attributable activities would likely be greater than simulated.

To estimate the Fort-attributable impacts on baseflow, two simulations (scenarios) were developed and are described in detail in Groundwater Modeling Report (PBA Appendix G). These are the "With Fort-attributable" (WFA) and the "No Fort-attributable" (NFA) simulations. The WFA simulation includes all Fort-attributable groundwater withdrawals and all completed and in-progress mitigation measures that could feasibly be modeled. The NFA simulation removes all Fort-attributable pumping and recharge both on- and off-Fort while maintaining all other groundwater pumping and recharge within the Basin. Results from the WFA and the NFA simulations were subtracted to determine the Fort's impact. The future Fort impacts to the San Pedro River regional groundwater component of baseflow are the difference between the WFA and NFA simulations. The difference between the two scenarios results in a quantification of the

future impacts of Fort Huachuca's attributable pumping (and conservation measures) on the regional groundwater component of baseflow in the San Pedro and Babocomari rivers.

Figure 5-3 in the PBA, and below as Figure HWU1, provides the simulated regional groundwater component of baseflow for the winter and summer for various locations on the San Pedro and Babocomari rivers. PBA Figure 5-4 (Figure HWU2 below) presents the changes in baseflow between the WFA simulation and the NFA simulation. PBA Figure 5-5 (Figure HWU-3 below) provides the graph of the simulated regional groundwater baseflow at the Tombstone Gage, which marks the downstream end of the Action Area.

The groundwater modeling simulated negative impacts associated with Fort-attributable changes in the regional groundwater component of baseflow in the lower Babocomari River. The regional groundwater component of baseflow in the lower Babocomari River is projected to decline by -0.1 cfs due to the Fort. However, the regional groundwater component of baseflow at the Babocomari Cienega in the upper Babocomari River, where Huachuca water umbel may occur, will not be impacted due to being up-gradient from the Fort Huachuca/Sierra Vista pumping center.

Overall, the groundwater model predicts positive impacts of Fort-attributable activities on the net regional groundwater component of baseflow leaving the Sierra Vista Subwatershed from 2012 to 2030 (Figures HWU1, HWU2, and HWU3). This does not include the additional benefits from the conservation easements. For the San Pedro River in the SPRNCA, the Fort-attributable activities, including completed and in-progress conservation measures that could be feasibly modeled, are simulated to increase the regional groundwater component of baseflow by 0.3 cfs at the Charleston gage (PBA Figure 5-3) and 0.4 cfs at the Tombstone gage by 2030 (PBA Figure 5-5). At no point during the period from 2012 to 2030, does the Fort-attributable groundwater withdrawal reduce the baseflow in the mainstem of the San Pedro River. The Fort anticipates in 2014 (PBA Table 5-1), there will be a net surplus in the groundwater demand accounting for the Fort, and beyond 2014, the Fort attributable impacts to the regional groundwater component of baseflow would be positive as a result of the Proposed Action.

Please note that the analyses above are based on data through 2011, reported in 2012, though we currently possess some data through 2013 (Fort Huachuca 2014). We have discussed the relevance of the 2013 data and our rationale for what they are not being employed in this analysis, in the introductory paragraphs of the Water-Related Mitigation Measures subsection of the Description of the Proposed Action section, above. This prior determination is incorporated herein via reference. In brief, the 2012 and 2013 data sets do not significantly differ, a key 2013 statistic is not available, and no updated groundwater model results exist. The data employed herein thus continue to represent the best available scientific information.

Caution was exercised in applying the aforementioned model results to the predictions of absolute changes in the wet or dry conditions of the San Pedro and Babocomari rivers, the key component in the analysis of effects to Huachuca water umbel and its critical habitat. In general, the model was used to simulate the relative change from the current conditions to future years or between scenarios with the Fort's attributable pumping and without the Fort's attributable pumping. In this regard, the model provides very useful estimates of the relative temporal and spatial trends for the regional groundwater component of baseflow on the San Pedro River between different scenarios or periods (GSA 2010a). Previous modeling efforts considered

differences in the -0.1 to 0.1 cubic foot per second (cfs) range to be in the numerical "noise" of the model results (Lacher 2011). In the Groundwater Model Report's (PBA Appendix G) results section, which compares different model simulations, only differences greater than ±0.1 cfs are considered as outside of the numerical "noise;" this concept is apparent in the color-coded legend in Figure HWU2.

The PBA evaluated the impacts to the San Pedro River from the future and on-going activities at Fort Huachuca. Projections of the Fort's activities out to ten years can be made with reasonable confidence. The Fort recognizes the need to initiate consultation for any new activities not included in the PBA, if appropriate. After ten years, the uncertainty in predicting federal government programs due to federal fiscal laws and the nature of the budget process becomes considerably more difficult and uncertain. The PBA, however, also includes groundwater modeling results to 2030. Given that indirect effects, as defined at 50 CFR §402.02, are those that are caused by or will result from the proposed action and are later in time, but are still reasonably certain to occur, we must conduct our analysis to at least 2030.

Huachuca water umbel is a semi-aquatic plant that requires persistent and readily-available moisture. Baseflows in the mainstem upper San Pedro River are the result of discharges from the regional and alluvial aquifers; therefore, and for the purposes of this analysis, our primary concern regarding Huachuca water umbel and its critical habitat on the SPRNCA is the potential effects of groundwater use on the groundwater and surface water hydrology of the species' habitat.

As can be seen in Table HWU2, negative net groundwater demands attributable to the Fort are projected to exist in 2012 and 2013, before implementation of all the mitigation measures. These impacts can be reasonably assumed to reduce discharges to the San Pedro River, and this would represent an adverse effect to both the species and its critical habitat. As has been stated previously, however, the water demand accounting in Table HWUTable HWU2 is not spatially or temporally explicit. We therefore cannot use the demand accounting data to definitively determine where or when the supposed impacts will take place. The groundwater model employed by Fort Huachuca, however, does generate spatially and temporally explicit results, and these appear above in Figures HWU1, HWU2, and HWU3.

The groundwater modeling, which represents the best available scientific information, indicates that it is unlikely that there will be a Fort-attributable decrease in the regional groundwater component of baseflow in the mainstem of the San Pedro River beginning in 2014 and continuing through the end of the modeling period in 2030. On this basis alone, it would appear to be unlikely there will be measurable adverse effects to Huachuca water umbel in the SPRNCA from 2014 onward.

This document will be transmitted to Fort Huachuca in 2014, the year in which it has been mathematically anticipated that a projected net groundwater surplus for the Fort will exist. We recognize, however, that the regional and alluvial aquifers and the associated baseflows in the San Pedro River are unlikely to respond to the proposed action in the exact timeframes predicted by the groundwater model. We cannot determine the magnitude of such a time lag, nor the volume of the net groundwater demand that might persist over time until a surplus of conservation measure-driven water savings overtakes the negative influence of Fort Huachuca's water demands' on baseflows. Our effects analysis will therefore focus qualitatively, rather than

quantitatively, on the residual adverse effects to Huachuca water umbel that may exist during the early portion of implementation of the proposed action.

If it is presumed that there will continue to be some Fort-attributable reductions in baseflows beyond 2013, we would anticipate that Huachuca water umbel will suffer some degree of mortality from desiccation and that there might be some associated reduction in occurrence counts and length of occupied critical habitat. We reiterate that this analysis does not rely on the regulatory definition of "destruction or adverse modification" of critical habitat at 50 CFR 402.02. Instead, we have relied upon the statute and the August 6, 2004, Ninth Circuit Court of Appeals decision in Gifford Pinchot Task Force v. U.S. Fish and Wildlife Service (No. 03-35279) to complete our analysis with respect to critical habitat. Critical habitat is defined in section 3 of the ESA "as the specific areas within the geographical area occupied by the species, at the time it is listed in accordance with the Act, on which are found those physical and biological features essential to the conservation of the species and that may require special management considerations or protection; and specific areas outside the geographical area occupied by a species at the time it is listed, upon a determination that such areas are essential for the conservation of the species." We have also relied upon the Consultation Handbook which provides guidance on determining adverse modification of critical habitat and jeopardy pursuant to the following: "Adverse effects on individuals of a species or constituent elements or segments of critical habitat generally do not result in jeopardy or adverse modification determinations unless that loss, when added to the environmental baseline, is likely to result in significant adverse effects throughout the species' range, or appreciably diminish the capability of the critical habitat to satisfy essential requirements of the species" (Service and NMFS 1998).

Effects to the Species

Huachuca water umbel occurs in disturbance-prone habitats; like many desert streams, the San Pedro River exhibits a tremendous dichotomy between baseflows, which may be measured in tenths of a cubic foot per second, and peak flows, which have exceeded 24,000 cfs (USGS 2013). The river has also endured periods of profound historic drought and floods. The persistence of the species in such a variable system indicates that it is resilient (EEC 2001). We anticipate that the residual, and temporary, reduction in baseflows that may occur before the onset of the conservation measure-driven water savings overtakes the negative influence of Fort Huachuca's water demands on those baseflows will be within the range of conditions experienced by the species. The proposed action is thus unlikely to result in a long-term or permanent contraction of the species' occurrence in the San Pedro River, much less extirpate the species.

As discussed above, the environmental baseline for the Huachuca water umbel within the SPRNCA exists in an impaired condition, with a 2011 annual deficit of 4,600 AF and the 65,200 AF withdrawn since the first half of the 20th century (D. R. Pool, unpub. data, 2011, as cited in USPP 2013). We anticipate that baseflow declines would have the greatest effect on Huachuca water umbel occurring in the river reach between Fairbank and the northern boundary of the SPRNCA (Tombstone gage section), though the three other occupied reaches [from Charleston northward to Fairbank (Brunchow Hill) section, from State Route 90 north to Charleston (Lewis Spring section), and from Hereford north to State Route 90 (Hereford Bridge section)] could also experience impacts of cumulative pumping.

The groundwater withdrawals that are the likely proximal cause of declining trends are due to both Fort Huachuca and its attributable population and other water uses not directly or indirectly associated with Fort Huachuca. Section 321 of the Defense Authorization Act of 2004 (Public Law 108-136) prohibit the USFWS from considering water consumption by State, local, and private entities off of the installation that is not a direct or indirect effect of the agency action or an effect of other actions that are interrelated or interdependent with that agency action, in determining whether such agency action at Fort Huachuca will jeopardize the continued existence of Huachuca water umbel or result in the destruction or adverse modification of its critical habitat. The impaired groundwater hydrology that has resulted from past groundwater withdrawals must be considered part of the environmental baseline. By contrast, consideration of the future, increasing water uses by non-Federal entities, which would ordinarily be analyzed as cumulative effects, is prohibited by section 321.

So, while the proposed action is anticipated to result in a net increase in groundwater available for discharge to the San Pedro River and a small, but measurable decrease in discharges to the Babocomari River, we anticipate that past removals of groundwater from storage (due to both Federal and non-Federal actions), and the capture of discharge that resulted from them, have or will continue to adversely affect Huachuca water umbel. While unquantifiable, we anticipate that Fort Huachuca's actions will eventually increase groundwater elevations and increase in Fort-associated contributions to stream flows within the San Pedro River, will not worsen the still-deteriorating baseline conditions(i.e. baseflows will continue to decline due to other groundwater uses not attributable to Fort Huachuca), and are thus unlikely to result in significantly increased adverse effects throughout Huachuca water umbel's range such that recovery cannot be achieved.

Effects to the Critical Habitat

In our analysis of the effects of the action on critical habitat, we consider whether or not a proposed action will result in the destruction or adverse modification of critical habitat. In doing so, we must determine if the proposed action will result in effects that appreciably diminish the value of critical habitat for the recovery of a listed species. To determine this, we analyze whether the proposed action will adversely modify any of the PCEs that were the basis for determining the habitat to be critical. To determine if an action results in adverse modification of critical habitat, we must also evaluate the current condition of all designated CHUs, and the PCEs of those units, to determine the overall ability of all designated critical habitat to support recovery. Further, the functional role of each of the CHUs in recovery must also be considered because, collectively, they represent the best available scientific information as to the recovery needs of the species.

Our analysis of the proposed action's effects to Huachuca water umbel critical habitat is framed by the Act, and the August 6, 2004, Ninth Circuit Court of Appeals decision in Gifford Pinchot Task Force v. U.S. Fish and Wildlife Service, and the Consultation Handbook (USFWS and NMFS 1994), the latter of which states, in part, that adverse effects on the constituent elements or segments of critical habitat generally do not result in jeopardy or adverse modification determinations unless that loss, when added to the environmental baseline, is likely to appreciably diminish the capability of the critical habitat to satisfy essential requirements of the species.

Primary Constituent Element 1 (sufficient perennial baseflows to provide a permanently or nearly permanently wetted substrate for growth and reproduction of umbel), will be affected to some presently unquantifiable degree. The magnitude of the residual adverse effect of Fort Huachuca's pumping to the groundwater-derived portion of baseflow before the modeled onset of positive contributions to the groundwater contribution to baseflows is unquantifiable. It is likely, however, that the relatively large magnitude of net groundwater surplus anticipated to begin to affect the river in 2014 (or later) will ensure the adverse effects will be of short duration, and more than completely ameliorated.

Primary Constituent Element 2 (a stream channel that is relatively stable, but subject to periodic flooding that provides for rejuvenation of the riparian plant community and produces open microsites for umbel expansion) will not be affected by the proposed action. The residual effects to baseflows, regardless of magnitude, cannot alter flood-flow hydrology, which results from precipitation and snowmelt runoff, and which serves as an important source of alluvial aquifer recharge as well as a mechanism by which the in-channel vegetation is kept in an early successional state that favors umbel. It must also be noted that flood flows affect Primary Constituent Element 1 in that overbank flood events result in appreciable alluvial aquifer recharge whereby water is stored in the river's banks and released after flood flows recede.

Primary Constituent Element 3 describes a riparian plant community that is relatively stable over time and in which non-native species do not exist or are at a density that has little or no adverse effect on resources available for umbel growth and reproduction. Riparian vegetation communities are dynamic by nature, but the residual, Fort-attributable reductions in baseflows that persist from 2013 until 2014 or 2015 are small (modeled to be as small as 0.01 CFS; see Figure 5-4 in the Revised PBA and HWU2, below7) can be anticipated to cause some minor, unquantifiable decrease in hydric plants (such as Huachuca water umbel) and a corresponding increase in more-xeric species that may compete with the endangered plant. Given that the San Pedro River exhibits a highly variable flow regime under baseline conditions, we anticipate that a temporary decrease in base flow, its magnitude decreasing as the anticipated, modeled groundwater surplus begins to occur in 2015, is unlikely to appreciably or permanently diminish the riparian community (or cause a transition to a more-xeric community) over the longer term.

Primary Constituent Element 4 refers to locations where Huachuca water umbel occurs in streams and rivers, and requires the presence of refugial (protected) sites in each watershed and in each reach, including but not limited to springs or backwaters of mainstem rivers that allow each occurrence to survive catastrophic floods and recolonize larger areas. Refugial sites along the mainstem San Pedro include nearby backwaters and springs, but would not include occurrences in remote sites such as those in the Huachuca Mountains, as the latter are separated from the mainstem San Pedro by ephemeral reaches. The formation of backwaters is a function of flood-flow hydrology and, as discussed in the analysis of PCE 2, is not anticipated to be affected.

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7 The revision to state that Fort Huachuca's positive influence on baseflow could begin in 2014 is due to the fact that the acquisition of the Petrified Forest conservation measure (C10) was completed in 2013. In Table HWU2 (and Revised PBA Table 5-1), this measure was to occur in 2014.

Also, regarding the persistence of refugial sites, Huachuca water umbel has been established in a discharge area of Murray Springs, which is in Curry Draw, a San Pedro River tributary. These discharges are likely to be appreciably influenced by groundwater discharging down-gradient from the Sierra Vista Environmental Operations Park (EOP; a municipal wastewater treatment and recharge facility)(see Mitigation Measure C4 in Table HWU2). Inasmuch as Fort Huachuca and its associated, off-post human population is responsible for a portion of the inflows to the EOP, the proposed action has the indirect effect of helping ensure sufficient water is supplied to Huachuca water umbel in Curry Draw. We anticipate that colonization of the San Pedro River will continue to occur from upstream sites in Sonora as well as from within the northeastern canyons of the Huachuca Mountains. Mainstem San Pedro River recolonizations are anticipated to result from resettlement of clumps of dislodged plant material, while more-distant recolonizations are more likely to result from the transport of buoyant seeds.

We have discussed the impaired environmental baseline in the Effects to the Species section; our critical habitat analysis is similarly constrained by Section 321 of the Defense Authorization Act of 2004. So, while the proposed action is anticipated to result in a net increase in groundwater available for discharge to the Huachuca water umbel critical habitat along the San Pedro River, we anticipate that past non-Federal removals of groundwater from storage, and the capture of discharge that resulted from them, have or will continue to adversely affect the critical habitat. While unquantifiable, we anticipate that Fort Huachuca's actions will eventually increase groundwater elevations and stream flows within the San Pedro River. These actions, even considering the affected baseline, are unlikely to appreciably diminish the capability of the critical habitat to satisfy essential requirements of the species or result in significant adverse effects throughout Huachuca water umbel's range (in the San Pedro River, on Fort Huachuca, and elsewhere in the designation) such that recovery cannot be achieved.

As discussed in the narrative above and displayed Table HWU2 and Figures HWU1, HWU2, and HWU-3, for the San Pedro River in the SPRNCA, the Fort-attributable activities that could be feasibly modeled with the groundwater model are not predicted to result in a decrease in the regional groundwater component of baseflow in Huachuca water umbel critical habitat. By 2030, the groundwater modeling predicts Fort-attributable increases in the regional groundwater component of baseflow up to 0.3 cfs at the Charleston gage and 0.4 cfs at the Tombstone gage (Figure 5-3). These results do not include the benefits of conservation easements. Therefore, the Fort-attributable activities should, over the long term help to maintain flows in the mainstem of the San Pedro River, where there are numerous occurrences of the Huachuca water umbel and where portions of designated critical habitat are. In the Babocomari River, there would be decreases in the regional groundwater component of baseflow in the lower part of the river near the SPRNCA. There are no known occurrences of Huachuca water umbel in the lower Babocomari River where groundwater modeling projects declines in the regional groundwater component of baseflow.

In summary, Fort Huachuca's mitigation measures provide a conservation benefit to two of the critical habitat primary constituent elements: perennial baseflows in the San Pedro River (PCE-1) and refugial sites for recolonization (PCE-4). The Fort's activities will not impact the other primary constituent elements of a stable, native species-dominated riparian community (PCE-3) and a stream channel subject to periodic, rejuvenating flooding (PCE-2).

Cumulative Effects

Cumulative effects include the effects of future State, tribal, local, or private actions that are reasonably certain to occur in the action area considered in this biological opinion. Future Federal actions that are unrelated to the proposed action are not considered in this section because they require separate consultation pursuant to section 7 of the Act.

Section 321 of the Defense Authorization Act of 2004 (Public Law 108-136) describes the manner in which section 7 of the Act is to be applied during interagency consultation with Fort Huachuca. Specifically, Section 321 states "For purposes of section 7 of the Endangered Species Act of 1973 (16 U.S.C. 1536), concerning any present and future Federal agency action at Fort Huachuca, Arizona, water consumption by State, local, and private entities off of the installation that is not a direct or indirect effect of the agency action or an effect of other actions that are interrelated or interdependent with that agency action, shall not be considered in determining whether such agency action is likely to jeopardize the continued existence of any endangered or threatened species or result in the destruction or adverse modification of designated critical habitat."

For the Huachuca water umbel, the most appreciable cumulative effect is the pumping of ground water from the Sierra Vista Subwatershed by and for individuals whose presence is not related to Fort Huachuca or another Federal entity. The subwatershed has a modeled 2011 annual deficit of 4,600 AF, an appreciable proportion of which is the result of local, non-Federal actions cumulative to the operation of Fort Huachuca and which we anticipate will continue into the foreseeable future. Nevertheless, these water consumption-related effects cannot be considered when determining if the proposed action will jeopardize the continued existence of the Huachuca water umbel.

Section 321 does not preclude our analysis of other-than-water-consumption-related effects of cumulative actions. There are, however, relatively few other activities that may affect the Huachuca water umbel in the action area; most are the result of Federal actions conducted by Fort Huachuca or the BLM, and thus are not considered cumulative effects. The effects of undocumented immigrants (UDIs) have not been analyzed in depth, but there is the potential that foot traffic within the SPRNCA and through Garden and McClure canyons could result in trampling of Huachuca water umbel and increased exposure to wildfire risk.

Conclusion

After reviewing the current status of Huachuca water umbel, the environmental baseline for the action area, the effects of the proposed action, and the cumulative effects not related to water consumption by State, local, and private entities off Fort Huachuca (as stated in Section 321), it is our biological opinion that the proposed action at Fort Huachuca is not likely to jeopardize the continued existence of the Huachuca umbel, nor to destroy or adversely modify umbel critical habitat. Our rationale for this conclusion is below.

Fort Huachuca

The percent of survey transect occupied by Huachuca water umbel on the installation generally increased between 2008 and 2011 (Vernadero Group 2009a, ENRD 2012b).

The effects of the proposed action to Huachuca water umbel occurring in the Huachuca Mountains on Fort Huachuca are unlikely to result in large-scale mortality of the species or extirpate it from its occupied range in Garden, Sawmill, and McClure canyons.

The establishment of additional occurrences of Huachuca water umbel in new sites within Garden, McClure, and Huachuca canyons has increased both the number and locations occupied by individuals and thus, the overall resilience of the species has increased.

Conservation Measures (HWU-1, 3, 4, 5, 6, and 8) will effectively avoid, minimize, or offset the adverse effects occurring on Fort Huachuca, including those within critical habitat.

The adverse effects that do occur on Fort Huachuca (occasional trampling by recreational users and occasional erosion beyond the capability of best management practices to ameliorate it) do not reach the scale where recovery of the species is likely to be appreciably reduced. The effects to critical habitat are anticipated to be of a similar small scale, and are unlikely to destroy or adversely modify the critical habitat on Fort Huachuca to the extent that recovery is likely to be appreciably reduced.

San Pedro Riparian National Conservation Area

The length of occupied Huachuca water umbel habitat is increasing over time, ranging from 274.8 m (0.5% of total critical habitat occupied) in 2001 to 199.7 m (0.4%) in 2004, 409.1 m (0.8%) in 2007, 362.4 m (0.7%) in 2008, 1,041.1 m in 2009 (1.9%t), and 965.7 m (1.8%) in 2010 (Vernadero Group 2011c; PBA Appendix L, Table 3).

The residual, and temporary, reduction in baseflows (modeled to be 0.01 CFS at the most) that may occur before the onset of a “positive” Fort Huachuca groundwater budget balance in 2014 or 20158 (wherein a surplus of conservation measure-driven water savings overtakes the influence of Fort Huachuca’s water demands on baseflows) will be within the range of conditions experienced by the species and thus, the proposed action is unlikely to result in a contraction of the species occurrence in the San Pedro River, much less extirpate the species.

Beginning as early as 2014, there Fort Huachuca will have a “positive” groundwater budget balance. All reaches of occupied Huachuca water umbel habitat (and critical habitat) within the SPRNCA will eventually be subject to increasing baseflows.

Conservation Measures (HWU-2 and 7), as well as implementation of the Mitigation Measures Plan, will effectively avoid, minimize, and offset the adverse effects occurring on SPRNCA, including within critical habitat.

The residual reductions in baseflow are likely small in magnitude, brief, and are immediately followed by a surplus of conservation measure-driven increases in baseflow in 2014 or 2015 that will endure through at least 2030. The Fort’s effects to the Huachuca water umbel itself are

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8 Again, we note that the Preserve Petrified Forest conservation measure (C10) in Table HWU2 (and Revised PBA Table 5-1) was implemented in 2013, rather than 2014 as anticipated. The effects of the measure will thus occur earlier than initially anticipated (beginning in 2014 rather than 2015).

therefore anticipated to be completely minimized in the near-term, with longer-term effects contributing to recovery by promoting increased baseflows in the San Pedro River. The proposed action is thus unlikely to appreciably reduce the likelihood of recovery.

The eventual increase in groundwater elevations and the associated increase in baseflows within the San Pedro River will not worsen the deteriorating baseline conditions and are thus unlikely to result in significantly increased adverse effects throughout the Huachuca water umbel's range such that the likelihood of recovery will be appreciably reduced or cannot be achieved. Recovery is the process that stops the decline of an endangered or threatened species by removing or reducing threats. Recovery ensures the long-term survival of the species in the wild. At that point, the species is recovered, and protection of the ESA is no longer necessary.

The effects to critical habitat are anticipated to parallel the aforementioned trend of near-term reduction in baseflows, which are minimized over time by the accumulating, mitigative effects of the conservation measures, until a net positive effect with longer-term contributions to recovery is achieved. The proposed action is therefore unlikely to destroy or adversely modify Huachuca water umbel critical habitat on SPRNCA to the extent that recovery would be delayed or precluded.

The proposed action does not appreciably reduce the likelihood of Huachuca water umbel recovery within its historical range. The adverse effects that do occur in the action area are small and do not reach the scale where recovery of the species would be delayed or precluded. We make this conclusion for the following reasons:

The potential area of effect is a small part of the range of the species;

The Fort is no longer contributing to the groundwater deficit, so it is making a "positive" contribution to the groundwater budget balance (wherein a surplus of conservation measure-driven water savings overtakes the influence of Fort Huachuca's water demands on baseflows) beginning in 2014 or 2015 (see second item under the San Pedro Riparian National Conservation Area conclusions as well Footnote 3, above);

The proposed conservation measures reduce the chance for impacts to Huachuca water umbel both at Fort Huachuca and on the San Pedro Riparian National Conservation Area;

Monitoring and recovery actions continue to occur within the species' historical range, both on and off the Fort; and

The number of known sites where Huachuca water umbel occurs has increased since the species was listed.

FWS is unable to identify a reliable recovery "tipping point" or threshold for the Huachuca water umbel. However, in the Recovery Planning subsection of the Status of the Species section, above, we hypothesized that the survival and recovery of the species would potentially be placed at risk if any one higher-order watershed were so physically altered that the species could no longer survive or be recovered there, regardless of the persistence of a seed bank. In terms of the critical habitat, we hypothesize that survival and recovery of the species could be placed at risk if

a group of smaller units within one of the higher-order watersheds were so physically altered that the unit could no longer support the species and contribute to recovery.

Since the impacts of the proposed action are minimal and the action area is small compared to the range of the Huachuca water umbel, it is highly unlikely that the proposed action would cause large-scale physical alteration to the species' habitat, thus making it unlikely that a tipping point away from recovery would be reached. While the action area does include an appreciable portion of the species' critical habitat, the effects are also small and it is similarly unlikely that a tipping point away from recovery would be reached.

The adverse effects that do occur in the action area do not reach the scale where recovery of the species would be delayed or precluded. Adverse effects are anticipated to be of a similar small scale, and are unlikely to destroy or adversely modify the critical habitat in the action area to the extent that recovery would be delayed or precluded for many of the reasons found in the conclusion and discussion above.

The conclusions of this biological opinion are based on full implementation of the project as described in the Description of the Proposed Action section of this document, including any Conservation Measures that were incorporated into the project design.

INCIDENTAL TAKE STATEMENT – HUACHUCA WATER UMBEL

Sections 7(b)(4) and 7(o)(2) of the Act generally do not apply to listed plant species. However, limited protection of listed plants from take is provided to the extent that the Act prohibits the removal and reduction to possession of Federally listed endangered plants from areas under Federal jurisdiction, or for any act that would remove, cut, dig up, or damage or destroy any such species on any other area in knowing violation of any regulation of any State or in the course of any violation of a State criminal trespass law.

CONSERVATION RECOMMENDATIONS - HUACHUCA WATER UMBEL

Sections 2(c) and 7(a)(1) of the Act direct Federal agencies to use their authorities to further the purposes of the Act by carrying out conservation programs for the benefit of listed species. Conservation recommendations are discretionary agency activities to minimize or avoid effects of a proposed action on listed species or critical habitat, to help implement recovery plans, or to develop information.

We recommend that Fort Huachuca participate in recovery planning efforts for the Huachuca water umbel. We will be preparing a recovery plan in the near future and would like to incorporate the Fort's expertise.

We recommend that Fort Huachuca continue with its ongoing efforts to arrest erosion and restore ecosystems on and adjacent to streams on the installation within which Huachuca water umbel occurs.

We recommend Fort Huachuca continue to establish Huachuca water umbel in new sites and to document the findings so as to improve similar, future efforts.

We recommend that Fort Huachuca continue to conduct genetic studies to determine population and metapopulation dynamics of Huachuca water umbel throughout its range.

To be kept informed of actions minimizing or avoiding adverse effects or benefiting listed species or their habitats, we request notification of the implementation of any conservation recommendations.

Table HWU1. Approximate upper range (in acres) proposed to be treated within a 10-year period on Fort Huachuca, Arizona by biotic type in upper elevations within which Huachuca water umbel occurs.

Biotic community	Approximate upper range (in acres) proposed to be treated within a 10- year period in the upper elevations on Fort Huachuca	Total acres of biotic community occurring on the Fort
Madrean Evergreen Woodland (MEW)	5,500	20,342
Petran Montane Conifer Forest (PMCF)	690	3,875
10 YEAR TOTAL	6,190	24,217

Table HWU2 (Revised PBA Table 5-1). Summary of groundwater demand and water yield of conservation measures.												
	Actuals		Forecasts (based on average values)									
	2011	2012	2013*	2014	2015	2016	2017	2018	2019	2020	2021	2022
Total Fort Huachuca Groundwater Demand	-5,648	-5,446	-6,000	-6,000	-6,000	-6,000	-6,000	-6,000	-6,000	-6,000	-6,000	-6,000
Incidental Recharge (septic, urban enhanced, golf course return flows	1,482	1,450	1,450	1,450	1,450	1,450	1,450	1,450	1,450	1,450	1,450	1,450
Completed Mitigation Measures (see Table 1 from PBA Appendix D, the Mitigation Measures Plan)												
Fort Huachuca Water Conservation Efforts (C1)	Water savings reflected in reduced Fort Attributable Demand, above											
Fort Huachuca Stormwater Capture (C2)	13	32	108	108	108	108	108	108	108	108	108	108
East Range Recharge (C3)	256	269	368	368	368	368	368	368	368	368	368	368
EOP Recharge (C4)	1,072	995	1,034	1,034	1,034	1,034	1,034	1,034	1,034	1,034	1,034	1,034
Babocomari	299	299	299	299	299	299	299	299	299	299	299	299

Conservation Easements (C5)												
Clinton and Drijvers Conservation Easements (C6)	1,073	1,073	1,073	1,073	1,073	1,073	1,073	1,073	1,073	1,073	1,073	1,073
River Stone Ranch Conservation Easement (C7)	0	149	149	149	149	149	149	149	149	149	149	149
Mansker Conservation Easement (C8)	0	0	24	24	24	24	24	24	24	24	24	24
Bella Vista Ranch Conservation Easement (Sierra Vista area) (C9)	0	0	0	238	238	238	238	238	238	238	238	238
Preserve Petrified Forest (Palominas area) (C10)	0	0	0	2,558	2,558	2,558	2,558	2,558	2,558	2,558	2,558	2,558
In-progress Mitigation Measures (see Table 1 from PBA Appendix D, the Mitigation Measures Plan)												
Huachuca City Effluent (F1)	0	0	0	88	88	88	88	88	88	88	88	88
Palominas Pilot Stormwater Recharge Project (F2)	0	0	0	0	98	98	98	98	98	98	98	98
Planned Mitigation Measures (see Table 1 from PBA Appendix D, the Mitigation Measures Plan, noting that mesquite management is no longer a component of the proposed action)												
Planned Babocomari Conservation Easements (P1)	0	0	0	0	0	0	0	0	0	0	0	248
Projected Net Groundwater	-1,453	-1,180	-1,495	1,419	1,517	1,517	1,517	1,517	1,517	1,517	1,517	1,765

Demand/Surplus												
* Please see the discussion regarding 2013 groundwater demand data in the introductory paragraphs of the Water-Related Mitigation Measures subsection of the Description of the Proposed Action section, above.												

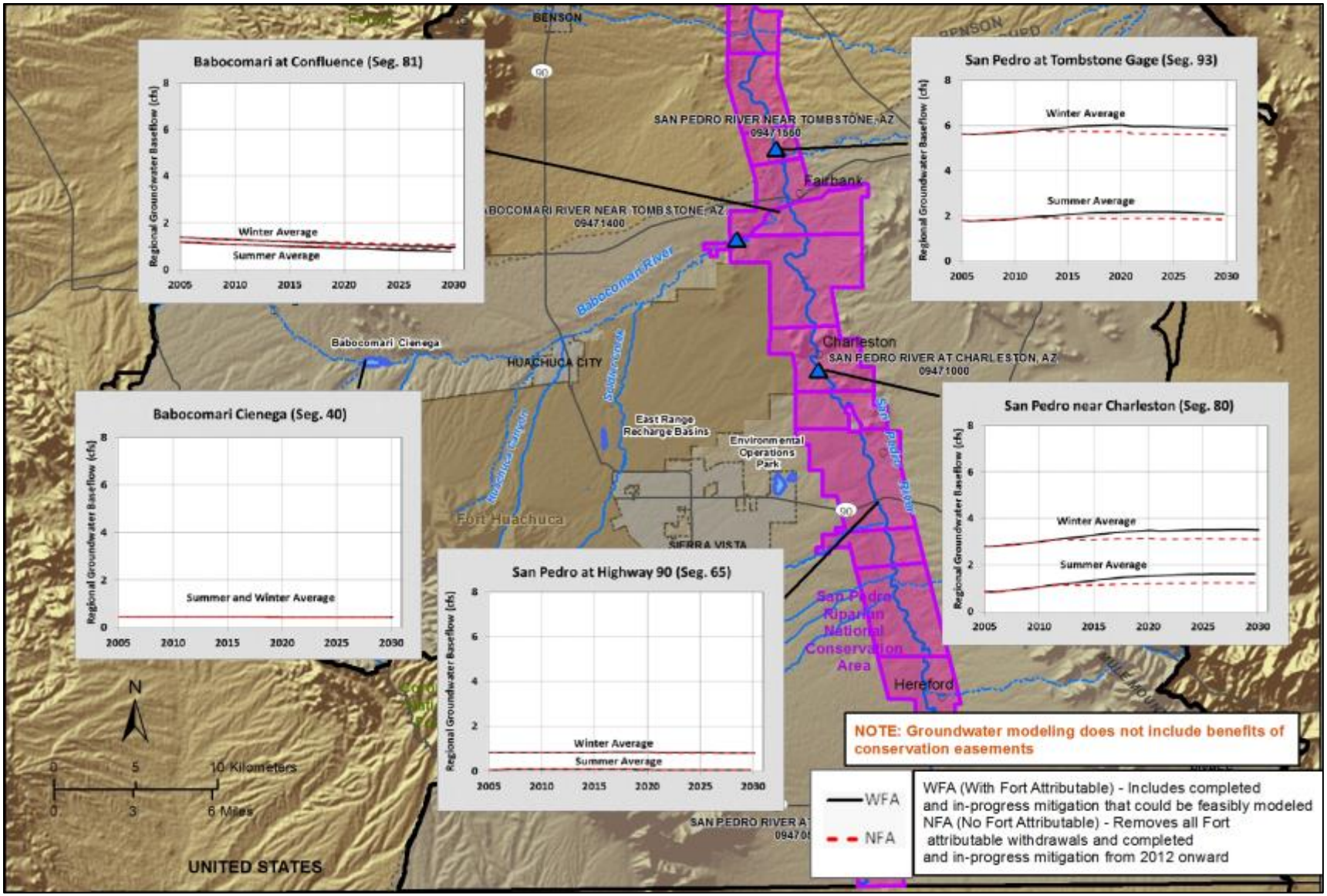

Figure HWU1 (Revised PBA Figure 5-3). Simulated regional groundwater baseflows for locations in the Sierra Vista Subwatershed, Arizona.

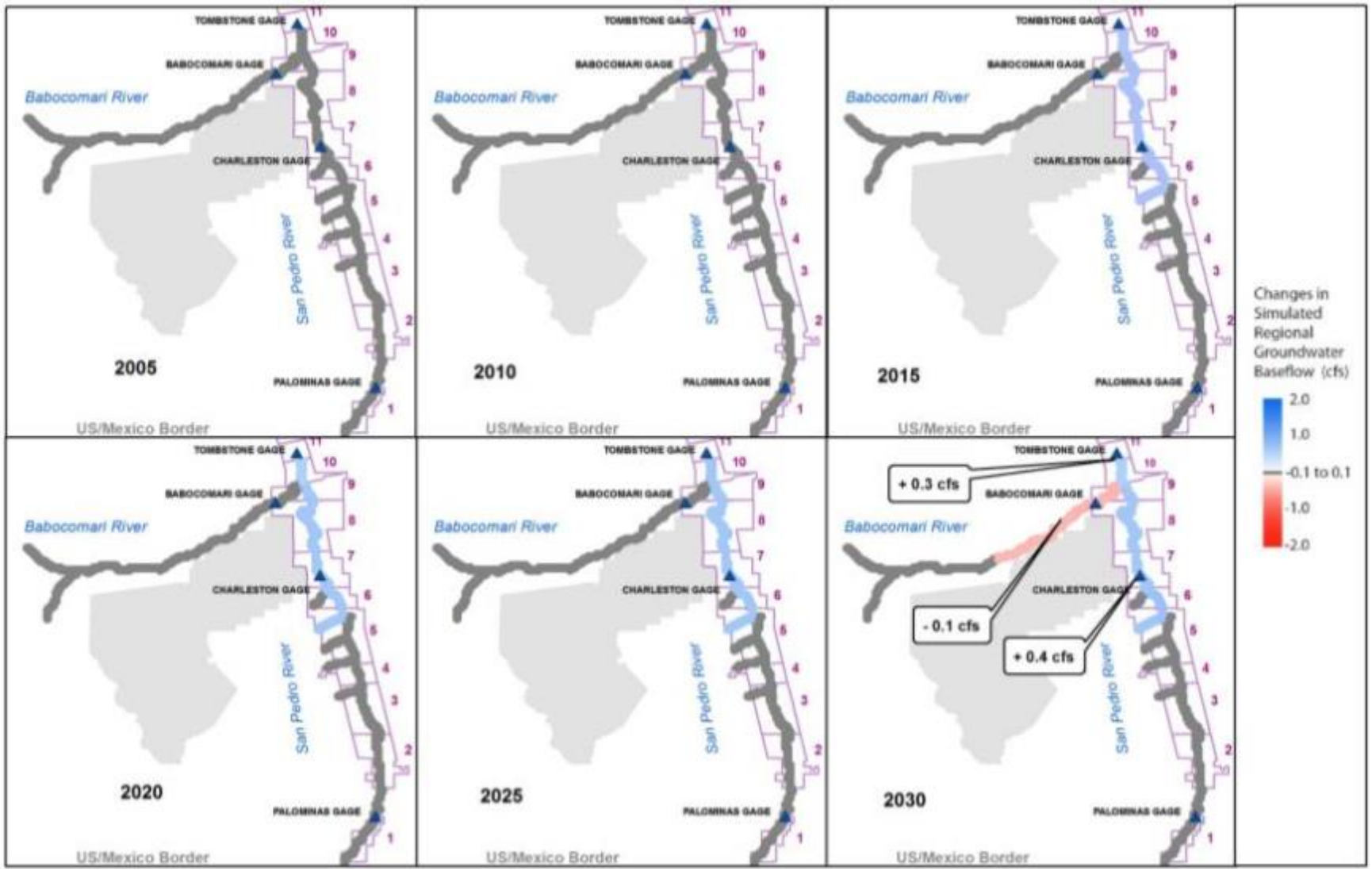

Figure HWU2 (Revised PBA Figure 5-4). Fort Huachuca's effects through 2030 with mitigation (conservation measures).

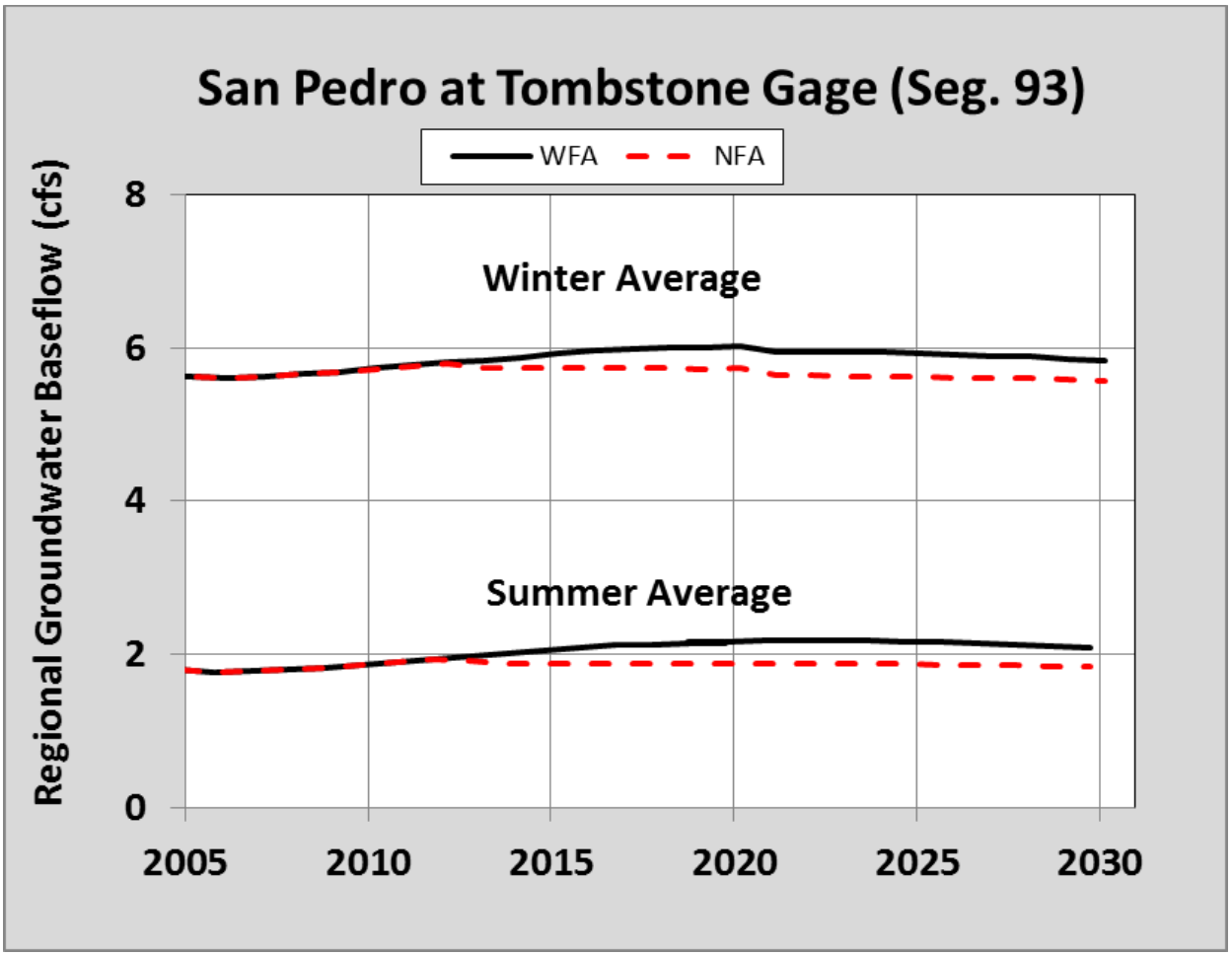

Figure HWU3 (Revised PBA Figure 5-5). Simulated regional groundwater baseflow in the San Pedro River at the Tombstone Gage which marks the downstream end of the action area.

OCELOT

Status of the Species

Description, Legal Status, and Recovery Planning

The ocelot (*Leopardus pardalis*), a medium-sized spotted cat, belongs to the genus *Leopardus* which also includes the margay (*Leopardus wiedii*) and the oncilla (*Leopardus tigrinus*). The ocelot is divided into as many as 11 subspecies that range from the southwestern U.S. to northern Argentina (USFWS 2010bb). Two subspecies occur in the United States: the Texas/Tamaulipas ocelot (*L. pardalis albescens*) and the Arizona/Sonora ocelot (*L. p. sonoriensis*)(Hall 1981).

The ocelot was listed as endangered in 1972 under the authority of the Endangered Species Conservation Act of 1969 (USFWS 1972). The 1969 Act maintained separate lists for foreign and native wildlife. The ocelot appeared on the foreign list, but due to an oversight, was not included on the native list. Following passage of the ESA in 1973, the ocelot was included on the January 4, 1974, list of “Endangered Foreign Wildlife” that “grandfathered” species from the lists under the 1969 Act into a new list under the ESA (USFWS 1974). The entry for the ocelot

included "Central and South America" under the "Where found" column in the new ESA list. Endangered status was extended to the U.S. portion of the ocelot's range with a final rule published July 21, 1982 (USFWS 1982). The "Historic range" column for the ocelot's entry in the rule reads, "U.S.A. (TX, AZ) south through Central America to South America." The entry on the current list (USFWS 2003b) is essentially the same, and reads, "U.S.A. (TX, AZ) to Central and South America." The ocelot was upgraded to CITES Appendix I in 1986 (Nowell and Jackson 1996) and is considered endangered in Mexico (SEMARNAT 2010).

The species has a recovery priority number of 5C, meaning that it has a low potential for recovery with a relatively high degree of conflict. Recovery for the ocelot was originally addressed in Listed Cats of Texas and Arizona Recovery Plan (with Emphasis on the Ocelot) (USFWS 1990). A draft revised recovery plan was made available for public comment in 2010 (USFWS 2010b), with the goal of improving the status of the species to the point that it no longer needs the protection of the ESA. The draft revised recovery plan has not been finalized as of the date of this biological opinion. The draft recovery strategy calls for:

- the assessment, protection, and restoration of sufficient habitat to support viable populations of the ocelot in the borderlands of the U.S. and Mexico;
- the reduction of effects of human population growth and development to ocelot survival and mortality;
- the maintenance or improvement of genetic fitness, demographic conditions, and health of the ocelot;
- the assurance of long-term viability of ocelot conservation through partnerships, the development and application of incentives for landowners, application of existing regulations, and public education and outreach;
- the use of adaptive management, in which recovery is monitored and recovery tasks are revised by the USFWS in coordination with the Recovery Team as new information becomes available; and
- the support of international efforts to ascertain the status and conservation of the ocelot in Sonora and south of Tamaulipas.

The major focus of the draft revised recovery plan is on two cross-border management units, the Texas/Tamaulipas Management Unit and the Arizona/Sonora Management Unit (ASMU). The boundaries of the ASMU are defined as the original range of the subspecies (*L. p. sonoriensis*) as described by Hall (1981) which generally extends from central Arizona south to central Sinaloa. Draft delisting criteria for the ASMU are: 1) the ASMU population is estimated through reliable scientific monitoring to be above 2,000 animals for 10 years; 2) significant threats to this population have been identified and addressed; and 3) habitat linkages to facilitate an ASMU metapopulation have been identified and are conserved for the foreseeable future.

Life History and Habitat

The ocelot is a medium-sized spotted cat weighing from 7 to 16 kg (15-35 lbs), with males weighing more than females (USFWS 2010b). The coloration of the upper parts of the body is pale gray to cinnamon. There are spots on the head, two black stripes on the cheeks, and four to five longitudinal black stripes on the neck. The body shows elongated black-edged spots

arranged in chain-like bands. The rounded ears are black dorsally, with a conspicuous white spot. The underparts are whitish, spotted with black. The tail is marked with dark bars or incomplete rings (Hall 1981).

The life history of the ocelot has been summarized by Laack (1991), Laack et al. (2005), Tewes and Schmidly (1987), and others. Ocelots can live greater than 10 years in the wild and can live longer (18 years plus) in captivity (Murray and Gardner 1997). Gestation lasts about 70 to 80 days, and breeding reaches a peak during autumn in Texas (Tewes and Schmidly 1987); however breeding peaks may vary throughout the ocelot range. Wild ocelots probably first produce young at about 18 to 30 months-of-age (Eaton 1977, Tewes and Schmidly 1987), although Laack (1991) observed first reproduction in wild female ocelots between 30 and 45 months-of-age. Average litter size is about 1 to 1.5 kittens per litter (Murray and Gardner 1997, Mora et al. 2000, Laack et al. 2005). Males are believed to contribute little to direct parental care (Tewes 1986, Laack 1991) and young may become independent at one year of age (Murray and Gardner 1997). There is little information on the interval between successive litters in the wild, but it is likely two years (Murray and Gardner 1997, USFWS 2010b).

Although ocelots usually disperse from the natal range, sometimes females may remain in their natal range (Laack 1991). The age at which subadult ocelots disperse from the natal range varies, but is about two years of age (Ludlow and Sunquest 1987, Laack 1991). Laack (1991) found that there was no obvious sex difference in age at dispersal and that duration of successful dispersal (time elapsed between leaving natal range and establishing an independent home range) was 7 to 9.5 months. Studies have shown that dispersal distance varies considerably, for example, in Texas, dispersal distances have been documented between 2.5 and 42.5 km (1.5-26.4 mi)(Navarro-Lopez 1985, Tewes 1986, Laack 1991, USFWS 2010b). The longest documented dispersal distance (50 km/31 miles) that we are aware of was of a male ocelot in Tamaulipas, Mexico (Booth-Binczik 2007).

No studies have documented dispersal distance of ocelots in Sonora and Arizona; however, a subadult male ocelot was documented in Arizona in 2010 just west of Globe (it was killed by a car)(Holbrook et al. 2011). Ocelots have also been recently detected in the Whetstone (detected in 2009)(Avila-Villegas and Lamberton-Moreno 2013) and Huachuca Mountains (detections from 2011 to 2013)(Tim Snow, AGFD, March 13, 2013, electronic mail). The nearest recently (in 2011) documented female with young (one kitten) was located about 48 km (30 mi) south of the international border in the Sierra Azul of Sonora, Mexico (Avila-Villegas and Lamberton-Moreno 2013). If ocelots documented in Globe and the Huachuca and Whetstone mountains dispersed from the nearest breeding population, assuming the nearest breeding population is the one previously mentioned, it means the ocelots moved about 220 km (135 mi) to Globe; 55 km (35 mi) to the Huachuca Mountains (Tim Snow, AGFD, March 18, 2013, electronic mail), and 110 km (70 mi) to the Whetstone Mountains (Avila-Villegas and Lamberton-Moreno 2012). Avila-Villegas and Lamberton-Moreno (2012), however, believe that travel from northern Sonora to Globe seems unlikely.

Ocelots are solitary animals that maintain home ranges (Ludlow and Sunquist 1987, Emmons 1988, Laack 1991, Crawshaw 1995). Home range for the ocelot varies throughout its range. Adult female home range sizes vary from about 2 km^2 to 17 km^2 (494-4,201 ac) while adult male

home range sizes vary from a 5 km^2 to 38 km^2 (1,235-9,390 ac), both depending on the habitat type in which they are found (Ludlow and Sunquist, 1987, Crawshaw and Quigley 1989, Konecny 1989, Crawshaw 1995, Fernandez 2002). In the Tamaulipan thornscrub of south Texas and northeastern Mexico, mean ocelot home range sizes reported include: Laack (1991): 6.2 km^2 (1,544 ac) for males, 2.87 km^2 (709 ac) for females; Navarro-Lopez (1985): 2.5 km^2 (623 ac) for males, 2.1 km^2 (512 ac) for females; Tewes (1986): 12.3 km^2 (3,039 ac) for males and 7.0 km^2 (1,730 ac) for females; and Caso (1994): 8.1 km^2 (2,006 ac) for males, 9.6 km^2 (2,372 ac) for females. No home range studies have been done for ocelots in Arizona or northwestern Mexico. However, in western Mexico, specifically, in the tropical deciduous forest of Jalisco, average home range size using the Kernel estimator for male ocelots was 11.7 km^2 (2,891 ac) and for females was 5.8 km^2 (1,433 ac); average home range size using the 95% Minimum Convex Polygon estimator was 16.26 km^2 (4,018 ac) for males and 7.34 km^2 (1,814 ac) for females (Fernandez 2002).

Ocelots inhabit a wide variety of densely vegetated habitat types, including, but not limited to, thorn scrub, semi-arid woodland, tropical deciduous and semi-deciduous forest, subtropical forest, lowland rainforest, palm savanna, and seasonally flooded savanna woodland (Ludlow and Sunquist 1987, Crawshaw and Quigley 1989, Crawshaw 1995). In south Texas, ocelots occur predominantly in dense thornscrub communities (Navarro-Lopez 1985, Tewes 1986, Laack 1991). Laack (1991) also documented minimal use of Johnsongrass (*Sorghum halepense*) by ocelots. Caso (1994) found ocelots used primarily forest or woody communities in Tamaulipas, Mexico, and used open pastures much less often.

In Sonora, López González et al. (2003) reported 27 of 36 (75%) verified ocelot records in Sonora were associated with tropical or subtropical habitats, namely subtropical thornscrub, tropical deciduous forest and tropical thornscrub; a few ocelots were recorded in oak woodlands, but were all males. The mean elevation of the 33 records located with precision was 700 (+/-450) m (2,297 +/-1,476 ft), at which elevation subtropical thornscrub is the main habitat (López González et al. 2003). They report that ocelots were associated largely with the mountainous Sierra region of eastern Sonora and that records closer to the Sonoran desert biome were mainly associated with riparian areas, where the shrub cover is thicker than the surrounding areas. Avila-Villegas and Lamberton-Moreno (2012) collected 68 camera photographs of ocelots in the Sierra Azul in northern Sonora, all of which were taken at elevations between 1,275 and 1,625 m (4,183-5,331 ft) in Madrean evergreen woodland.

Of the four ocelot recently recorded in Arizona, the one in the Whetstone Mountains was documented (via remote camera) in Madrean evergreen woodland (Avila-Villegas and Lamberton-Moreno 2012). The two ocelots in the Huachuca Mountains have been detected via remote camera in Madrean evergreen woodland and plains and great basin grassland (University of Arizona 2013). The detection (via remote camera) of an ocelot on Fort Huachuca in the Huachuca Mountains was in Madrean evergreen woodland (encinal [oak woodland] with a slight component of juniper and manzanita)(PBA 2013). Other detections of ocelots in the Huachucas (i.e., ocelots treed by dogs) were most likely in Madrean lower montane pine-oak forest and woodland (Tim Snow, AGFD, March 13, 2013, electronic mail).

Madrean evergreen woodland and plains and great basin grassland are biotic communities depicted by The Nature Conservancy (2006). The Madrean evergreen woodland biotic community is described in detail in Brown (1994). Madrean lower montane pine-oak forest and woodland is an ecosystem described by NatureServe (2013) and Firescape (http://www.azfirescape.org/chiricahua/ecosystem-description/madrean-lower-montane-pine-oak-forest-and-woodland). We report ocelot detections using different classification systems because that is how they were reported to us and we do not have the ability to cross-walk the systems at this time.

Despite the variation in habitat use, the species does not appear to be a habitat generalist. Ocelot spatial patterns are strongly linked to dense cover or vegetation, suggesting it uses a fairly narrow range of microhabitats (Emmons 1988, Horne 1998). Horne (1998), in southern Texas, was the first to statistically analyze ocelot habitat selection patterns. He found ocelots used closed (>95% canopy closure) cover types more than cover types with less-than-moderate canopy cover and avoided mixed cover type (50-75% canopy closure). Also in southern Texas, Jackson et al. (2005) suggested that ocelots prefer closed canopy over other land cover types, but that areas used by this species tended to consist of more patches with greater edge. No habitat use studies have been conducted in Arizona or Sonora.

Ocelots are generally active for more than half of each 24-hour period and are typically most active at night and during crepuscular periods with more limited diurnal activity (Ludlow and Sunquist 1987, Crawshaw and Quigley 1989, Fernandez 2002, Avila-Villegas and Lamberton-Moreno 2013). Ocelots are likely generally nocturnal because they follow the nocturnal habits of their primary prey, small mammals (Ludlow and Sunquist 1987, Emmons 1988, and Crawshaw and Quigley 1989).

Ocelots are solitary hunters and eat a wide variety of prey, but small mammals, especially rodents, comprise most of their diet (Emmons 1987, Ludlow and Sunquist 1987, Crawshaw 1995, De Villa Meza et al. 2002, Fernandez 2002). Ocelot diets, however, also include medium to large mammals, reptiles, amphibians, birds, fishes, and insects (Emmons 1987, De Villa Meza et al. 2002, Fernandez 2002). Based on these results some authors have suggested that ocelots are opportunistic feeders (Bisbal 1986, Emmons 1987).

Distribution and Abundance

Ocelots historically ranged from Louisiana, Arkansas, Texas, and Arizona in the U.S. southward through Mexico, Central and South America to Peru and northern Argentina (Murray and Gardner 1997). Currently, the ocelot ranges from extreme southern Texas and southern Arizona through Mexico and Central America to Ecuador and northern Argentina (Murray and Gardner 1997, USFWS 2010b). There are reports of the species up to 3,000 m (9,842 ft)(Caso et al. 2008). In Mexico, it has disappeared from much of its historical range on the west coast (Caso et al. 2008). The Arizona/Sonora ocelot subspecies occurs in southern Arizona and northwestern Mexico (Sonora and northern Sinaloa)(USFWS 2010b). Breeding populations of this subspecies occur in the States of Sonora and northern Sinaloa (USFWS 2010b).

Estimating population size of secretive nocturnal carnivores, especially species that inhabit dense vegetative cover, such as the ocelot, is difficult. No rangewide ocelot population estimates exist that we are aware of. In Sonora, López González et al. (2003) obtained 36 verified ocelot records, 21 of which were obtained after 1990, including 19 individual male records, 6 females, and 11 of undetermined sex. A population of 2,025 ($\pm$ 675) ocelots in Sonora was estimated by López González et al. (2003) based on the distribution of these records and the availability of potential habitat. Out of the 26 records, the northern-most record of a female was at 30°30' latitude and only one record was of a kitten (located in the southern part of Sonora)(López González et al. 2003). Since this study, a number of ocelots, including a female with kitten, have recently been documented just south of the U.S.-Mexico border in northern Sonora. Specifically, with the use of trail cameras, six ocelots were documented between February 2007 and April 2011 in the Sierra Azul, about 30 miles southeast of Nogales, including two males, one female, one kitten, and two of undetermined sex; three dead ocelots were documented in the same area during the same timeframe (Avila-Villegas and Lamberton-Moreno 2013). Additionally, with the use of trail cameras, two ocelots have been documented (one in 2009 and one in 2013) in the Sierra de Los Ajos, about 30 miles south of the U.S.-Mexico border near Naco, Mexico (USFWS 2010b; Rosa Elena Jimenez Maldonado, CONANP, May 31, 2013, electronic mail).

In Arizona, no population estimates exist, but four individuals have recently been documented, including the following: 1) one in the Whetstone Mountains documented in 2009 (Avila-Villegas and Lamberton-Moreno 2013); 2) one subadult male (road-killed) near Globe found in 2010; 3 and 4) two males in the Huachuca Mountains documented initially in 2011 and 2012, respectively (Tim Snow, AGFD, March 13, 2013, electronic mail). Both ocelots in the Huachuca Mountains have been detected on multiple occasions, with one detected as recently as November 2013. However, detections of ocelots in southern Arizona remain an uncommon occurrence. One ocelot was recently (October 2013) documented (via trail camera) on Fort Huachuca (site of the proposed action) in the Huachuca Mountains (PBA 2013). Due to the nature of the photograph, the identity of the ocelot cannot be confirmed; however, based on comparison of the tail stripes, it is thought that it is likely one of the ocelots previously detected in the Huachuca Mountains.

Currently the U.S. population of the Texas ocelot subspecies has fewer than 100 individuals, found in two separate populations in southern Texas (USFWS 2010b). A third and larger population of the Texas/Tamaulipas ocelot subspecies occurs more than 124 mi south of the Texas/Mexico border in the Sierra of Tamaulipas, Mexico (Caso 1994).

Although methods used to calculate densities vary among studies, some ocelot population density estimates for particular habitats include: 5.7/100 km^2 (38.6 $miles^2$) in subtropical thornscrub to tropical deciduous forest in Sonora, Mexico (Carrillo and López González 2002); 25 to 225/100 km^2 in the tropical deciduous forest of Jalisco (Casariego Madorell 1998, Fernandez 2002); 30 adult ocelots/100 km^2 in Bolivian dry-forests (Maffei et al. (2005); and 40 adult ocelots/100 km^2 in the llanos (interspersed dry tropical forest in savanna) of central Venezuela (Ludlow and Sunquist 1987).

Threats

Although the ocelot is protected over most of its range (Fuller et al. 1987), it is still threatened by habitat loss and fragmentation due to increased human development, agriculture, and cattle grazing; illegal killing (e.g., retaliatory killing due to depredation of poultry); and illegal trade (pet and pelt)(Fernandez 2002, Caso et al. 2008, USFWS 2010b). Widespread commercial harvests for the fur trade ceased decades ago (Caso et al. 2008); however, human population growth and development continue throughout the ocelot's range. Connectivity among ocelot populations or colonization of new habitats is discouraged by the proliferation of highways and increased road mortality among dispersing ocelots. Increased illegal and law enforcement actions along the U.S.-Mexico border could limit ocelot movement across the border, but it is uncertain if and how much this is affecting that movement.

In Texas, collisions with motor vehicles appear to be the leading cause of known ocelot mortality (Tewes 1986; Tuovila 1999, as cited in USFWS 2010b) and accounted for 45 percent of deaths of 80 radio-tagged ocelots (Haines et al. 2005 as cited in USFWS 2010b) between 1983 and 2002 (USFWS 2010b). Twenty-six of 61 ocelot deaths between 1983 and 2004 were caused by vehicle collisions in Texas (Laack and Tewes unpublished data, as cited in USFWS 2010b). Since 2007, in Arizona and Northern Sonora, there have been four documented cases of ocelots being killed by vehicles or illegally killed, including: one ocelot struck close to Globe; one ocelot struck on Mexico Highway 15, between Imuris and Cananea, Sonora; and two ocelots illegally killed in the Sierra Azul (Avila-Villegas and Lamberton-Moreno 2013; Sergio Avila, Sky Island Alliance, March 15, 2013, electronic mail).

Planning and Conservation Efforts

The ocelot is included on CITES Appendix I and is protected across most of its range (Caso et al. 2008). Part of the species range includes protected areas, including some capable of maintaining long-term viable populations (Caso et al. 2008). While loss and fragmentation of habitat adversely affect ocelot populations, there have been notable efforts to acquire, protect, and restore habitat, and decrease mortality of the species in Texas and northeastern Mexico (see USFWS 2010b for a detailed account of planning and conservation efforts made for the ocelot in Texas and northeastern Mexico).

Some planning efforts have also been made for the Sonora subspecies. For example, the recovery plan for ocelots is currently being updated and includes conservation planning efforts for ocelots in Arizona and Sonora. Among others, a specific delisting criterion includes the identification and protection of habitat linkages to facilitate a metapopulation in Sonora and Arizona. Additionally, Grigione et al. (2009) conducted a study to identify priority conservation areas for jaguars, ocelots, and jaguarundis in the U.S. – Mexico border region. For ocelots, it was determined that little was known in the western bioregion (Arizona-Sonora). One Cat Conservation Unit (CCU) of high priority was identified in the Sierra Madre Occidental (in Sonora) and two corridors (from the Sonora CCU to the U.S.) and one CCU (in the U.S.) were identified as needing further study.

Few conservation implementation efforts have been made specifically for the Sonora subspecies; however, conservation efforts made for jaguars undoubtedly also contribute to ocelot conservation. For example, the Northern Jaguar Project purchased a total of 18,211 ha (45,000

ac) to create the Northern Jaguar Reserve for the protection of jaguars in Sonora. Ocelots also occur there and will benefit from this protection. Rancho El Aribabi, a privately owned ranch in northern Sonora where ocelots occur, was recently recognized by the Mexican government as a reserve. Additionally, the Northern Jaguar Project implements a felid photograph project in Sonora where private landowners are paid for photos of live felids. Although primarily designed to support the conservation of jaguars, the project also benefits ocelots. The Reserva Forestal Nacional y Refugio de Fauna Silvestre Ajos-Bavispe (Ajos-Bavispe National Forest Reserve and Wildlife Refuge) in northeastern Sonora also protects habitat in which ocelots and jaguars have been detected; survey (attempt to detect an animal) efforts with trail cameras have resulted in detections of about five individual ocelots within the reserve's boundaries. Sky Island Alliance (2013) is also conducting felid surveys and landowner outreach in northern Sonora. During this effort, they documented recent ocelot occurrences in extreme northern Sonora, including a female with a kitten. Lastly, it is possible that the proposed critical habitat for jaguar will afford some protection to ocelots occurring in the U.S., as there is some overlap in habitat use between the two species.

Environmental Baseline – Ocelot

The environmental baseline includes past and present impacts of all Federal, State, or private actions in the action area, the anticipated impacts of all proposed Federal actions in the action area that have undergone formal or early section 7 consultation, and the impact of State and private actions that are contemporaneous with the consultation process. The environmental baseline defines the current status of the species and its habitat in the action area to provide a platform to assess the effects of the action now under consultation. Also refer to the General Environmental Baseline and Action Area earlier in this biological and conference opinion.

Action Area

The action area is defined as the area within which effects to the listed species and its critical habitat (if any is designated) are likely to occur and is not limited to the actual footprint of the proposed action. The proposed action falls within the range of the Sonora subspecies as well as within the ASMU as defined in the draft revised Ocelot Recovery Plan (USFWS 2010b). For the purposes of the ocelot analysis, we use the Fort Huachuca Action Area definition (see page 1-1 and Figure 1-1 of the PBA; BO at page 53).

Terrain, Vegetation Communities, and Climate in the Action Area

Please refer to the general environmental baseline and action area regarding these subjects.

Status of the Ocelot in the Action Area

<u>Life History and Habitat</u>

Life history of the ocelot is described above in the Status of the Species. Generally, life history elements are similar throughout their range, although some, such as diet and vegetation community use vary by region (see Status of the Species). As discussed in greater detail in the Status of the Species, no home range or habitat use studies have been conducted for the Arizona/Sonora subspecies of ocelot in northwestern Mexico or Arizona, however ocelots in Sonora appear to be primarily associated with tropical or subtropical habitats, namely subtropical thornscrub, tropical deciduous forest and tropical thornscrub (López González et al. 2003); however, they are also associated with other vegetation types such as temperate oak woodland and pine-oak forest (López González et al. 2003) and Madrean evergreen woodland (Avila-Villegas and Lamberton-Moreno 2012). Based on limited records in Arizona, ocelots appear to be associated with Madrean evergreen woodland (Avila-Villegas and Lamberton-Moreno 2012, PBA 2013) and Madrean lower montane pine-oak forest and woodland (Tim Snow, AGFD, March 13, 2013, electronic mail). The ocelot detected (via trail camera) on Fort Huachuca in the Huachuca Mountains was in Madrean evergreen woodland (encinal [oak woodland] with a slight component of juniper and manzanita)(PBA 2013).

Potential ocelot habitat in Arizona is yet to be quantified, but could become increasingly important to the survival of the ocelot as threats (i.e., illegal killing, land conversion) continue in Sonora. Ocelots in Arizona and Sonora represent a distributional extreme and the important genetic and adaptive resources that can characterize peripheral populations (Lomolino and Channell 1995). Similar to the jaguar, conservation of ocelots in their northern-most portion of their range may be important to the long-term survival of ocelots.

Distribution, Abundance, and Population Trends

See information above in the “Distribution and Abundance” section of the “Status of the Species” for information regarding ocelot population estimates in Sonora and recent sighting information of ocelots in northern Sonora and Arizona.

Threats

Threats to the Sonora subspecies of ocelot are similar to threats to the species throughout its range as described under “Status of the Species.” Recently documented cases of ocelots being killed by vehicles (Arizona and Sonora) and illegally killed (Sonora only) in the northwestern most portion of the ocelot range corroborate the hypothesis that roads and vehicles and illegal killing of ocelots are still among the primary threats to ocelot in this region. Other threats include habitat loss and fragmentation due to, among other things, urban expansion and roads. Connectivity among ocelot populations and colonization of unoccupied habitat are discouraged by the proliferation of highways and other barriers.

Other threats to ocelots in this region are international border issues (USFWS 2010b, Avila-Villegas and Lamberton-Moreno 2013) such as infrastructure along and near the U.S.-Mexico border, including pedestrian and vehicle barriers and towers and their associated roads and lighting; and illegal and U.S. Border Patrol traffic (pedestrian and vehicle). Fences designed to prevent the passage of humans (i.e., pedestrian barriers) also prevent passage of ocelots. Other

infrastructure (e.g., vehicle barriers, towers, roads, and lighting) and human activity may limit ocelot movement across the border, but it is uncertain if and how much this is affecting that movement. Connectivity to Mexico is likely essential for maintaining ocelots in Arizona (the northern portion of the ASMU). As included in the recovery criteria for this species, delisting the species will require that habitat linkages to facilitate an ASMU metapopulation are identified and conserved for the foreseeable future.

Planning and Conservation Efforts

Significant planning and conservation efforts have been made for the ocelot in certain parts of its range, such as Texas. As described above in "Status of the Species," some planning and conservation efforts have also been made for the Arizona/Sonora subspecies.

Past and Ongoing Federal Actions in the Action Area

Although a number of Federal actions have occurred in the action area, none of these actions has undergone formal consultation for effects to ocelot; therefore, no incidental take has been anticipated for ocelots in the action area.

Effects of the Action - Ocelot

Effects of the action refer to the direct and indirect effects of an action on the species or critical habitat, together with the effects of other activities that are interrelated and interdependent with that action, which will be added to the environmental baseline. Interrelated actions are those that are part of a larger action and depend on the larger action for their justification. Interdependent actions are those that have no independent utility apart from the action under consideration. Indirect effects are those that are caused by the proposed action and are later in time, but are still reasonably certain to occur.

The proposed action, Ongoing and Future Military Operations and Activities at Fort Huachuca, Arizona, may result in disturbance to ocelots and their habitat, as well as possible injury or death of an ocelot. That said, because the proposed action may benefit ocelots by reducing the risk of severe fire and managing for open space and wildlife, we anticipate the net effect of the proposed action on ocelots will be beneficial.

Disturbance to ocelots may occur from both auditory and visual stimulus arising from multiple components of the action. Human presence (both pedestrians and vehicles), lights, and noise are associated with ground and air-based military operations, recreational activities, natural resource and fuels management activities, roads, and facilities operations and maintenance.

Ocelots are secretive animals that generally avoid areas of high human use and associated noise, infrastructure, and lights. Artificial illumination at night can result in a wide variety of effects, including, but not limited to, changes in dispersal and movement patterns, behavior, and habitat use (Beir 1995, Longcore and Rich 2004). No data exist on the effects of artificial lighting on ocelots; however, in Peru, Emmons (1989) found that while ocelots were equally active during moonlit and dark nights they avoided open areas on moonlit nights (they likewise avoided open

areas by day). They concluded that ocelots therefore generally seemed to shift their foraging to denser cover in bright light conditions. They also found that spiny rats, a major prey of ocelots, are equally active during moonlit and dark conditions; however they also changed their behavior so as to be hidden from view of trails on bright nights. They suggest that ocelots seem more likely to have their hunting impeded than enhanced by bright light conditions, which may hinder their ability to approach its prey unseen. In Southern California, radio-collared mountain lions usually avoid habitat corridors that contain artificial lights (Beier 1995). During overnight monitoring, mountain lions made consistent movements in the direction of the darkest horizon. Dispersers especially avoided night-lights in conjunction with open terrain (Beier 1995). Installation of light in cattle corrals is a well-known technique to reduce jaguar predation of cattle (because jaguars avoid lighted areas). Other studies have shown that moonlight greatly influences the activity levels of nocturnal rodents (i.e., ocelot prey) such that rodent activity may decrease or shift from open areas to cover as level of moonlight increases (Grigione and Mrykalo 2004). Based on the effects of artificial lighting on other felids and the effects of moonlight on ocelots, it is likely that artificial illumination can disturb ocelots. The degree of the disturbance would likely be related to the level of brightness and spatial extent, frequency, and duration of the lighting.

Noise impacts can affect wildlife in a number of ways, possibly causing, among other things, changes in breeding behaviors, home ranges size and location, and habitat use, activity, and foraging patterns; increased stress response; and possibly damaged hearing if the noise is loud enough (Pater et al. 2009, NoiseQuest 2013). Although no studies have been conducted that we are aware of that specifically examine the effects of noise on ocelots, because ocelots are known to be secretive animals, elevated noise levels may result in disturbance to ocelots. As with artificial lighting, the degree of the disturbance would likely be related to the noise level, spatial extent, frequency, and duration.

Impacts to ocelot habitat may also occur from multiple project components, including ground-based military operations, recreational activities, natural resource and fuels management activities, roads, and facilities operations and maintenance. Although habitat use patterns of ocelots in Arizona are not well known, based on recent ocelot detections, we anticipate that ocelots are most likely to use Madrean evergreen woodland and Madrean lower montane pine-oak forest and woodland vegetation communities (both higher elevation communities in comparison to grassland communities) that occur on the Fort. For the purposes of this biological opinion, we will refer to these biotic and vegetation communities collectively as Madrean evergreen woodland (MEW). While it is possible that ocelots may use grasslands occurring on the Fort, we expect they use this vegetation type less frequently (because of less dense cover) than MEW. Based on this, we anticipate that fuels management activities (including mechanical treatment and prescribed fire) that occur in MEW of the Huachuca Mountains will have the greatest potential (in comparison to other project components) to adversely affect ocelots and their habitat. Fuels management activities may temporarily degrade ocelot habitat and disturb ocelots and, although unlikely, the prescribed fire element of fuels management could injure or kill an ocelot. That said, fuels management may also benefit ocelots and their habitat by preventing larger and more severe fires from occurring. Because the majority of military operations and facilities are located outside of MEW, we anticipate that they will generally have fewer effects on ocelots and their habitat. Recreational and resource management activities may

have some adverse effects on ocelots; however, overall management of open space at Fort Huachuca benefits ocelots and their habitat and prey. Additionally, conservation measures included in the project description will help avoid and minimize adverse effects to ocelots. If additional ocelot habitat use data reveals that ocelots in Arizona consistently use areas outside of MEW, particularly if they are found to use regularly semidesert grassland, the potential impacts of the proposed action will likely need to be reexamined.

Effects of Military Operations

Ground-based and air operations associated with the Fort may have various effects on ocelots and their prey. Of all the military operations, we anticipate that ground-based operations in the MEW of the Huachuca Mountains have the greatest likelihood of disturbing ocelots. However, because these activities rarely occur in this area (i.e., they generally occur at lower elevations in more open vegetation communities), potential disturbance to ocelots in the MEW is likely to occur infrequently. Ground-based and air operations outside of the MEW of the Huachuca Mountains occur frequently; however because ocelots are less likely to use these areas, potential disturbance to ocelots is also likely to occur infrequently. Impacts to ocelot habitat from military operations will generally be minimal; however, there is a risk of fire in ocelot habitat originating from military operations. Regulations, plans, and policies in place to reduce the impact of military operations on the environment, including the risk of fire, will also reduce potential impacts to ocelot habitat.

Ground-based Operations

There are nine major components of ground-based operations at the Fort including: 1) Intelligence and Electronic Warfare Equipment Training and Testing, 2) Communications Systems Training and Testing, 3) Field Training Exercises, 4) Land Navigation Training, 5) Patrolling and Tactics Training, 6) Individual Development Training, 7) Vehicle Maneuver Training, 8) Live Fire Qualification and Training, and 9) Administrative and Support Activities. Most of these activities occur on the post; however, some occur off-post as well. Ground operations can occur year round and many exercises include 24-hour operations. Many of these ground based operations involve both vehicles and personnel deployment to multiple sites. There are 18 established bivouac (training) areas on the Fort, two of which are located in the foothills of the Huachuca Mountains (lower encinal zone of the MEW).

Because ground-based military activities in the MEW of the Huachuca Mountains, where ocelots are most likely to occur, are relatively infrequent and confined to small groups primarily using existing roads and trails, potential disturbance to ocelots in the MEW of the Fort will also occur infrequently. Noise and lights associated with ground-based military activities in lower elevation areas (outside of the MEW), some of which occasionally occurs at night, attenuates with distance and therefore would likely not be a significant source of disturbance to ocelots using the MEW (higher elevations). Lighting associated with ground-based military operations in or near the MEW is minimal and mostly intermittent (e.g., headlights on vehicles). There are lights at training facilities (e.g., Papa and Uniform) on the edge of MEW; however, these are only turned on during the intermittent training activities .

Ocelots using or crossing through areas where the majority of ground-based military operations occur (i.e., in lower elevations in more open vegetation such as semidesert grassland) may be disturbed by these operations; this disturbance could affect ocelot movement between MEW areas. However, because many of these operations are intermittent, they are not likely to completely impede ocelot movement across the Fort. For example, weapons ranges, a source of anthropogenic noise on the Fort (peak sound levels at the firing point range from 156 dbP to 162 dbP, depending on the weapon, Table PA2), are primarily used during the day (on occasion, some night training is conducted on the ranges). Therefore, during the night, when ocelots are generally more active, nearly no noise originates from the weapons ranges. Consequently, the ranges are generally not a potential source of noise disturbance for about half of every diel cycle (24-hour period).

High military use areas (e.g., cantonment area, airfield), which are discussed further in sections below, may be avoided altogether by ocelots due to high human presence, lights, and noise associated with these areas. However, because these high military use areas are located in lower elevations, outside of the MEW, disturbance to ocelots in these areas will likely be a relatively rare occurrence (i.e., ocelots are not expected to regularly use the lower elevation areas due to lack of suitable cover).

Because most ground-based military operations occur only on existing trails, roads, and already disturbed areas, impacts to ocelot habitat will likely be minimal. Cross-country travel on-foot, some of which occurs in lower encinal areas, may cause damage to vegetation that may be used by ocelots; however because this type of travel is conducted in small groups on a limited basis, overall impacts to ocelot habitat should be minimal. Cross-country travel by vehicles is prohibited with the exception of use by the Missouri Air National Guard (MANG) or during emergency situations (e.g., safety and fire). During classes offered by the MANG, short off-road recovery trips will occur in Training Area Bravo. Because this area is located in the shrub-grassland, no MEW will be impacted by this training. Cross-country travel for safety and fire situations could occur in MEW; however, this type of travel should be a rare event and therefore have little impact on ocelots and their habitat. Regulations, policies, training, and plans in place on the Fort, such as the Off-Highway Vehicle Operation Policy and environmental awareness training, reduce the potential for impacts to the Fort environment, including ocelot habitat, from travel by foot or vehicle.

Fire could occur from military operations and impact ocelots and their habitat; however, measures, such as limiting use of areas or firing of blanks when fire hazard is high and fuels treatments, minimize this risk. According to the Fort, spot fires occur on occasion due to military activities on the firing ranges (in grassland vegetation); however, these are extinguished immediately. As such, these small range fires likely pose very little risk to ocelots and their habitat.

Direct injury or mortality of ocelots could occur as a result of ground-based military operations, particularly from collisions with vehicles and firing of weapons. With some training exercises, up to 200 vehicles may be used, although exercises with this many vehicles are only conducted one to two times per year. Exercises with fewer vehicles are conducted more frequently. We anticipate the risk of vehicular collisions with ocelots associated with military activities is very

low because: 1) ocelots are rare, 2) the majority of these activities occurs outside of the MEW, 3) the posted maximum speed limit is 25 mph in most areas of the cantonment, though major roads have speed limits of 35 to 45 mph, and 4) the speed limit in the Huachuca Mountains is 15 to 25 mph.

Similarly, the risk of injury or mortality of ocelots from weapons use on the qualifying ranges is very low. The ranges are generally located in graded or sparsely vegetated areas lacking suitable cover for ocelot. Additionally, managed burns are conducted regularly in the areas around the ranges to reduce fuel loading and fire hazard. Therefore, it is unlikely that ocelots will occur in these areas. Areas with suitable vegetative cover for ocelot are separated by distance from the ranges and may additionally be afforded protection from stray munitions by intervening topography. Potential risk to ocelots from range use will further be minimized by range safety briefings provided to all soldiers using the range. The briefing provides information on potential special status species that may be present, including the ocelot.

Disturbed ground associated with ground-based operations may be more susceptible to colonization by invasive nonnative plants. Nonnative species may out-compete native species and introduced grasses carry fire better and burn hotter than native species, which would degrade ocelot habitat. The invasive species monitoring and control measures, per the INRMP, should minimize this potential risk.

Air Operations

Air operations at Fort Huachuca include fixed-wing piloted aircraft training and operations, UAS training and operations, unmanned drug and border surveillance balloon operation, and, to a much lesser extent, rotary wing aircraft. Users include the Army and other DOD agencies, as well as non-DOD tenants such as the U.S. Forest Service Air Tanker Base and the Customs and Border Protection border surveillance activities. Most air operations originate from two locations on Fort Huachuca: Libby Army Air Field, located north of the cantonment, and the Black Tower complex in the northwest corner of the West Range. In 2009, 133,877 air operations occurred at Libby Army Air Field (each landing or departure counts as one evolution). This level of air operations is expected to continue.

The flight elevations for different aircraft are variable; however, aircraft overflights at altitudes below 500 ft above ground level (AGL) are generally not permitted over the Huachuca Mountains, where ocelots are most likely to occur. According to the PBA, because aircraft sounds and visual appearance diminish rapidly with increasing altitude, overflights of fixed-wing or rotary wing military aircraft at altitudes above 500 ft above ground level are unlikely to elicit a biologically significant response from ocelots and their prey species. Flights below 500 ft AGL in the Huachuca Mountains may occur under emergency and exigent circumstances; however, these flights are generally conducted by the U.S. Forest Service and U.S. Customs and Border Protection. Arizona Department of Public Safety, Air Methods (Life Net), and PHI (Air Evac) also conduct flights below 500 ft AGL in emergency and exigent circumstances by request only. These flights are not part of this consultation. Military aircraft that may fly below 500 ft AGL include the 160th SOAR, K-9 and team training, as well as the 306th Rescue Wing from Davis Monthan Air Force Base Para-rescue by request only.

Except for gradual ascents and descents associated with airfield operations, UASs operated at Fort Huachuca generally fly about 5,000 ft AGL or higher. At these altitudes, noise from UAS attenuates to audible but negligible levels on the ground; therefore UAS activity at these elevations is not likely to significantly disturb ocelots. Descents and ascents of UASs and other aircraft may disturb ocelots, however, because the airport and airstrips are located away from the MEW, potential disturbance should be minimal. In other words, noise from descents and ascents is greatly attenuated in MEW and therefore is not likely to affect ocelot behavior.

Effects of Recreational Activities

Recreational opportunities are made available to soldiers and their families both within and outside of the cantonment area. The general public can also access the Fort for recreational activities. Public access to recreational areas may be prohibited by the Range Control Officer due to ongoing training and testing activities. As a result, some or all of Fort Huachuca may be closed to recreational activities on any given day. The primary recreational activities that occur outside of the cantonment include hunting, birding, hiking, and cycling on existing roads and trails, as well as off-highway vehicle use on existing roads and trails. Overall, there is minimal potential for adverse effects to ocelots on the Fort from recreational activities due to the low amount of human activity in general and the prohibition on recreational activity outside the cantonment at night, when ocelots are generally most active.

Recreational hunting is included in the 2010 Fort Huachuca Integrated Natural Resources Management Plan (INRMP)(Vernadero 2010b). Hunting on Fort Huachuca is open to active and retired military personnel, full-time installation civil service employees, and their families. Mountain lion hunting and hunting with the use of dogs is allowed on the Fort. Both a Fort Huachuca-issued permit and AGFD hunting license is required. Hunting activities, including walking through ocelot habitat with dogs, inadvertently baying or treeing an ocelot with dogs, and shooting in ocelot habitat may disturb ocelots. Of these, baying or treeing ocelots with dogs would like have the greatest potential impact on ocelots. Ocelots have been treed by dogs several times recently in the Huachuca Mountains, however, it has not occurred on the Fort. Should ocelots be treed or bayed on the Fort, they would likely experience a stress response and would be prevented from feeding, breeding, and sheltering during the duration in which they were treed. This, however, should last only a short time as the hunters are required to follow AGFD hunting regulations which require hunters to: 1) stop pursuing an ocelot once they aware that they are in pursuit of one, 2) call dogs off immediately, and 3) allow the ocelot to leave the area and take all steps to not intentionally harass the animal. We do not anticipate that temporarily preventing male ocelots from feeding, breeding (should female ocelots occur in the area, which has not been documented), or sheltering would have severe consequences (i.e., lead to death), as they do not care for young. If females were to occur in the area and be treed, temporarily preventing them from feeding, breeding, and sheltering could be much more detrimental as they care for young (young left alone would be vulnerable to predation and starvation). Again, females and their young have not been recently documented in Arizona; however, they have been documented recently about 30 mi south of the Huachuca Mountains. Therefore, it is possible that they could occur in the Huachuca Mountains. After being treed or bayed, ocelots may temporarily continue to experience increased stress levels and alter their

behavior, including avoiding the area in which they were treed or bayed. Overall, possible disturbance to ocelots from hunters should be infrequent (as ocelots are rare) and temporary.

Occasional discharge of firearms by hunters represents a source of noise within MEW. However, noise from sporadic gunshots during hunting season is infrequent and of momentary occurrence and therefore, not likely to be a significant source of disturbance to ocelots. Ocelots could be unintentionally shot by hunters, however, the risk of this occurring will be significantly decreased by conservation measure J-O-4 which will ensure that hunters are aware and cognizant of the presence of ocelot in the area (see the conservation measure section below for details).

Recreational activities such as birding, hiking, bicycling, and picnicking, occur on the Fort, including in MEW, and may result in disturbance to ocelots and their habitat. We anticipate potential disturbance to ocelots from these activities will be fairly minimal as these activities are only allowed during daylight hours (when ocelots are generally less active) on designated roads, trails, and picnic areas. Horseback riding is available but limited to the on-post stables within the cantonment area. Although authorized, no significant horseback riding occurs elsewhere on the Fort; however, grazing, does occur in three areas (Pastures A, B, and C which are collectively about 1,433 ac) that support 50 to 60 horses (Vernadero 2010b) during a portion of the year. Due to the location of the stables and pastures (in grasslands and disturbed areas), we anticipate few effects to ocelots from horse-related activities.

Off-highway vehicle use on Fort Huachuca is low; however, OHVs are permitted on established roads and firebreaks outside the cantonment area that are intended for public use. OHVs may disturb ocelots and degrade their habitat, particularly OHV use in MEW; however, potential disturbance to ocelots and their habitat will be minimized as cross-country driving is strictly prohibited except in the case of an emergency. OHVs could potentially strike and injure or kill an ocelot crossing a road; however, we anticipate the risk of this occurring is very low because: 1) ocelots are rare, 2) OHV use on the Fort is low, 3) the posted maximum speed limit is 25 mph (in most areas), and 4) OHV use is only allowed during daylight hours.

As described above in the ground-based operations discussion, disturbed ground associated with recreational activities may be more susceptible to colonization by invasive nonnative plants. Nonnative species may out-compete native species and introduced grasses also carry fire better and burn hotter than native species, which would degrade ocelot habitat.

Effects of Natural Resource Management Program

The primary goal of the natural resources management program for Fort Huachuca is to protect naturally-evolved biotic communities and landscapes to support military land-based training. As part of this program, Fort Huachuca has developed environmental and natural resource specific planning documents, including the Integrated Natural Resources Management Plan and Integrated Wildland Fire Management Plan, the effects of which are discussed below. The Fort's natural resource management programs benefit ocelots and their prey by maintaining open space and managing for wildlife conservation; specific aspects of these programs, however, may adversely affect ocelots and their habitat.

Integrated Natural Resources Management Plan (INRMP)

The Fort Huachuca INRMP, updated in March 2010 (Vernadero Group 2010b), is a plan of action for the management of natural resources and military training and operational activities. The purpose of the INRMP is to guide the implementation and integration of natural resources management on Fort Huachuca including special-status species, terrestrial and aquatic wildlife, migratory birds, airport wildlife and bird-aircraft strike hazard, groundwater resources, land and forest, floodplain and wetlands, vegetation, wildland fire, invasive species, pests, and outdoor recreation. Although specific aspects of the Fort's INRMP (e.g., recreational activities, which are discussed above) may adversely affect ocelots and their habitat, overall the plan benefits ocelots by maintaining open space and managing for ecosystem and wildlife conservation.

Fuels Management/Integrated Wildland Fire Management Plan (IWFMP)

Fort Huachuca is participating with other federal agencies in the FireScape program (USDA FS 2009a), which provides for fuels management in the Huachuca Mountains. Fort Huachuca's Integrated Wildfire Management Plan (Gebow and Hessil 2006) provides a planning framework for reducing the risk of fire and fire suppression effects on listed species. The risk of a fire originating in lower-elevation training areas reaching forested habitat in the upper elevations is reduced to some extent by fuel management activities in lowland habitats and to a network of fire breaks that the Fort has established along ridgelines. The FireScape consultation is not current, however, so this BO will include an analysis of the effects of Fort Huachuca's fire and fuel treatment activities.

Fuels management, prescribed fire, managed natural fire, and wildland firefighting have the potential to affect ocelots and their habitat. According to the PBA, fuels management on the Fort is ongoing and employs a variety of hand methods, combined with prescribed burning. Fuels modification activities in wooded habitats, including MEW, expected to be used by ocelot are designed to reduce the density of vegetation in oak, pine-oak, oak-pine, and mixed conifer vegetation in an attempt to return these communities to more natural conditions following decades of fire suppression. Based on this, we anticipate that fuels management activities in MEW would have the greatest potential (in comparison to other proposed activities) for adversely affecting ocelots and their habitat. Fuels management activities, including thinning, slash removal, and prescribed fire may temporarily degrade ocelot habitat and disturb ocelots. Although unlikely, the prescribed fire element of fuels management could injure or kill an ocelot. The Fort's IWFMP is due to be updated in coordination with our office before 2016.

Depending on funding and environmental conditions, the Fort proposes to treat (thin and burn) up to 6,190 ac in the upper elevations on the Fort over the next 10 years. See Table O1 below for the number of acres of each biotic community proposed to be treated over the next 10 years in the upper elevations. The largest treatment unit of MEW is 1,500 acres; the largest treatment unit of PMCF is 650. The upper elevation treatment units will have more than a single treatment occurring within them over the 10 years. The initial treatment will be mechanical to reduce fuel load, once a treatment unit has undergone sufficient mechanical treatment to bring flame lengths down to an appropriate height to ensure safe burning conditions, controlled burns will be implemented within the unit.

Depending on funding and environmental conditions, the Fort proposes to treat (primarily burning, although some mechanical fuels reduction may be required, such as mesquite mastication) up to 5,120 ac annually of SDG/PGBG in lower elevations. The nature of the treatment regimens within the higher elevation woodlands and lower elevation grasslands differs greatly, therefore the number of acres proposed for treatment are reported differently in the tables above and below (decadal versus per annum) for the purposes of this analysis.

As explained previously in this document, based on limited information on ocelot habitat associations in Arizona, we anticipate MEW is more likely to be used by ocelots than SDG/PGBG and PMCF; however, ocelots have been documented in many other habitat types, including grasslands on occasion. Therefore, it is possible that ocelots on the Fort may use SDG/PGBG or PMCF, particularly when moving between patches of more suitable habitat. Although we do not know the home range size of ocelots in Arizona, considering ocelot home ranges in other parts of their distribution range from 2 to 38 km^2 (494-9,390 ac), using only the approximate upper range of MEW that will be treated over a 10-year timeframe (5,500 ac), an equivalent of about 0.60 to 11 potential ocelot home ranges may be directly impacted over the 10 years of the project; this figure assumes no overlap in home ranges (the calculation of potential ocelot home ranges was made by the dividing the approximate upper range of MEW to be treated over 10 years (5,500 ac) by the largest and the smallest ocelot home range estimates (494 to 9,390 ac), respectively.

Because ocelot home ranges generally overlap (Murray and Gardner 1997, Fernandez 2002, Dillon and Kelly 2008), the proposed fuels management activities could impact additional ocelot home ranges. Although we know that two ocelots co-occur in the Huachuca Mountains, we have not documented their home range size, configuration, or potential overlap; therefore, we do not know whether fuels treatment on the Fort will impact additional home ranges. The definition of home range varies, but it is generally considered the area over which an animal normally travels, searches for food, and cares for young. Given the recent, continuous use of the Huachuca Mountains by two male ocelots, we believe that they have established home ranges in the U.S. that encompass these mountains. One of these ocelots has been documented on Fort Huachuca; therefore it is likely that a portion of this ocelot's home range occurs on the Fort. Because fuels management activities will result in a temporary reduction of dense vegetation (generally preferred by ocelots), if these activities occur on or near the ocelot's home range, the male ocelot detected on the Fort could adjust his home range or alter his habitat use patterns so that he discontinues use of the treated area or uses it less frequently, at least for a few years as the understory cover regenerates. Adjusting home range location, size, or configuration could have number of potential negative consequences, including but not limited to: 1) increased intra- and inter-specific competition, 2) increased predation, 3) reduced access to prey, and 4) increased encounters with humans and human development such as roads and vehicles.

Although we anticipate that treatment of MEW will have the greatest potential impact on ocelots, treatment of other biotic communities, particularly SDG/PGBG, may also impact ocelots, particularly their movement between patches of more suitable habitat. As in MEW, fuels management activities in SDG will likely reduce vegetative cover which may render the habitat less suitable for ocelots. Although fuels treatment will locally reduce vegetative cover in treated

areas, the majority of the potential ocelot habitat on the Fort will remain undisturbed at any time. The potential effects to ocelots and ocelot habitat from fuels treatment will be temporary; however, they will be ongoing annually for the life of the project.

In addition to affecting ocelot habitat, the project will also result in temporary impacts to ocelot prey habitat. Fuels management may cause a temporary reduction in the ocelot prey base; however, according to the PBA, fresh vegetative growth stimulated by fuels management and reduction of litter and woody debris favors herbivores (i.e., prey for ocelots). Therefore, fuels management should increase the ocelot prey base which would be beneficial for ocelots.

In addition to potential impacts to ocelot habitat, crews conducting the fuels management work (e.g., running chainsaws and weedeaters, walking and driving, etc.) may disturb ocelots using the treatment units and cause them to temporarily flee or avoid the areas. Temporary avoidance of the treatment areas could cause ocelots to travel longer distances, possibly into or through less suitable habitat. Extra travel would require ocelots to expend additional energy and increase the potential for encounters with humans, vehicles, potential predators (i.e., mountain lions, jaguars), and other stresses.

The prescribed fire element of fuels management could injure or kill an ocelot; however we anticipate that the risk of this occurring is very low as ocelots are rare and only a small percentage of potential ocelot habitat will be treated each year. Furthermore, this risk will be reduced by the Fort's camera monitoring program (see conservation measures J-O-1 and J-O-3 below for more information on this program). According to the U.S. Forest Service, who operates controlled burns on the Fort, prescribed fire typically moves much slower than wildfire and it is very unlikely that an ocelot would not be able to get out of the area simply because the fire behavior of a controlled burn is not that extreme (Shane Hall via Debbie Brewer, January 6, 2014, pers. comm.).

According to the PBA, the history of fire suppression in the area has allowed for increased fuel density, which combined with extreme weather conditions, has led to hotter, larger, and more destructive wildland fires in recent years. Therefore, although fuels management may temporarily adversely affect ocelots, it will also likely benefit ocelots and their habitat by preventing larger and more severe fires from occurring. More severe fires, like stand replacing fires, could potentially degrade much larger amounts of ocelot habitat than the proposed fuels management. Furthermore, areas affected by severe fires generally take much longer to recover than areas treated for fuels reduction.

A number of conservation measures will reduce the risks to ocelots and their habitat from fuel management. For example, fuel management planning on the Fort is being updated in coordination with our office to ensure all necessary precautions are taken to protect ocelots and their habitat. Additionally, the Fort will continue its remote camera monitoring (conservation measure J-O-1), coordinate all fuel treatment activities within the MEW with the USFWS (conservation measure J-O-2), and conduct pre-treatment, and post-treatment monitoring coordinated with the USFWS (conservation measure J-O-3) as described below and in Section 2.13.1.8 (Conservation Measures) of the Description of the Proposed Action (pages 2-36 of the PBA).

Effects of Facilities, Roads, and Fencing Development and Maintenance

Facilities construction, operations, and maintenance, including the cantonment area

Most future military construction projects will occur within the cantonment or other compatible land use areas in already disturbed habitat. Because the cantonment is within grassland at lower elevations, and no construction activities are proposed within MEW, where ocelots are most likely to occur, we anticipate that construction activities will have little effect on ocelots. Likewise, because the majority of existing facilities are located in the cantonment, we anticipate that operations and maintenance of the facilities have minimal effects on ocelots. Noise and lights associated with the cantonment attenuates with distance and therefore would likely not be a significant source of disturbance to ocelots using the MEW. Ocelots may avoid the cantonment area due to high human presence, traffic, lights, and noise; however, because it is located in grasslands, it is unlikely that ocelots would regularly use the area regardless of human presence. Ocelots may be deterred from moving through the cantonment area in search of higher quality habitat; however, because the cantonment area is not fenced, the area should not act as a complete barrier to ocelot movement. The Fort is committed to consulting with the USFWS if future development projects, upgrades, or improvements may affect this species.

Roads construction, use, and maintenance

No new roadways or roadway widening, power lines, pipelines, mining or development activities, are proposed or projected by the Fort within MEW, where ocelots are most likely to occur. Outside of MEW, two road construction projects are proposed in already disturbed areas of the Fort. One new two-lane road is planned around the airfield; it will be a realignment of the monitor site road for the north taxiway extension (Debbie Brewer, Fort Huachuca, December 19, 2013, electronic mail). It is unlikely that ocelots occur near the realignment as it is already disturbed with high amounts of human activity; therefore, we do not anticipate that the construction or use of this road will affect ocelots or degrade their habitat. Road widening from two lanes to four lanes is planned for Lawton Road so that a loop of four lanes connects the main and east gates (Debbie Brewer, Fort Huachuca, December 19, 2013, electronic mail). Because the proposed road widening will occur in already disturbed areas of the cantonment, no ocelot habitat should be impacted. Activities associated with road widening and the vehicles using the widened road, could disturb ocelots moving through the area; however, these impacts would be temporary. Furthermore, because high levels of human activity already occur in the cantonment, activities from road widening are not likely to represent a significant increase in activity. Four-lanes roads accommodate more traffic than two-lane roads, therefore, widening may increase the risk of vehicular collisions with ocelots. However, we anticipate that this risk is low because: 1) ocelots are rare, 2) the road is located outside of MEW, 3) the posted maximum speed limit is 25 mph in the built up portion of the cantonment area and 35 to 45 mph on major roads.

The use of roads associated with some activities (i.e., ground-based military operations, recreational activities) is analyzed in sections above; however, use of roads not analyzed above (e.g., ingress and egress, administrative use, etc.) is addressed here. Vehicular collisions with ocelots are known to be a significant threat and source of ocelot mortality. That said, we

anticipate risk of vehicular collisions with ocelots associated with general operations on the Fort is low because: 1) ocelots are rare, 2) the majority of these operations occurs outside of the MEW, and 3) the posted maximum speed limit is 25 mph in most areas. Vehicles will likely collide with potential ocelot prey; however, we do not anticipate it will have a significant impact on the ocelot prey base.

The following roads maintenance information is not included in the PBA but was provided by Debbie Brewer with Fort Huachuca (electronic mail December 19, 2013). Road maintenance is conducted on an as needed or emergency basis. Unimproved roads throughout the Fort are maintained, although some more than others. In MEW areas, where ocelots are most likely to occur, unimproved roads include fire breaks (one-lane dirt roads) are only minimally maintained. Outside of MEW and montane environments in general, unpaved roads are graded twice a year (at the most) and paved roads are repaved once every 20 to 25 years. Generalized maintenance such as filling potholes or repairing monsoon damage is done as needed. All road maintenance is conducted within the existing roadways and roadbeds. Road maintenance activities, particularly those that occur in MEW, may disturb ocelots near the activities. However, because road maintenance activities (particularly in MEW) occur very infrequently and only during the daytime, potential disturbance from these activities to ocelots is unlikely. Similarly, maintenance activities are unlikely to degrade ocelot habitat as all maintenance takes place in the roadway itself.

Fencing

The Fort boundary is fenced with four-strand barbed wire fencing. Although this could inhibit some wildlife movement, we do not anticipate that it will prevent ocelots or their prey from crossing the boundary of the Fort. No impermeable fences are proposed on the Fort. If they are proposed later, the Fort will consult with us regarding potential impacts to ocelots and other listed species and critical habitat.

Effects of Off-post Activities Authorized or Carried Out by Fort Huachuca

Off-post activities authorized or carried out by Fort Huachuca are limited to equipment maintenance or periodic checks (mostly a single vehicle sitting on the side of the road testing communication equipment) and are not expected to affect ocelots or their habitat.

Effects of Conservation Measures

Conservation measures included in the proposed action will help avoid and minimize potential adverse effects to ocelots. Specifically, the following conservation measures for ocelots and jaguars have been included in the Description of the Proposed Action (page 2-36 of the PBA):

J-O-1: The Fort will continue and expand its non-invasive (e.g., motion detector cameras) monitoring program for the presence and movement of ocelot and jaguar within installation boundaries. This monitoring program will be in place throughout the consultation period.

J-O-2: The Fort will coordinate all fuel treatment activities within jaguar and ocelot habitat (Madrean evergreen woodland) with the USFWS to avoid adverse effects on the jaguar or ocelot.

J-O-3: The Fort will conduct monitoring of proposed control burn areas for at least three months before controlled burn treatment within jaguar and ocelot habitat (Madrean evergreen woodland). Post treatment monitoring will be implemented if a burn is approved in an area where jaguars or ocelots are detected during monitoring. The Fort will develop a monitoring plan in coordination with the USFWS. If a jaguar or ocelot is detected, the Fort will coordinate and consult with the USFWS to avoid or minimize adverse effects to the species before any controlled burns occur. Additionally, should an ocelot or jaguar be detected during any monitoring, the Fort will coordinate with the USFWS to minimize adverse effects to the species before mechanical treatment occurs in the area where the ocelot or jaguar were detected.

J-O-4: The Fort will ensure that hunters are aware and cognizant of the presence of ocelot and possible presence of jaguar in the area via the annual Hunting Fact Sheet with the following Advisory: “Predator hunters: Hunters, especially predator tag holders, must be familiar with identifying features of jaguars, ocelots and Mexican wolves, (see pp. 68, 69 and 105 in "2013-14 Arizona Hunting Regulations"). All 3 species are protected by state and federal law. An ocelot has been documented in the Huachuca Mountains several times recently and a jaguar in an adjacent mountain range. Responsible, prudent hunters will know exactly what they are shooting. Shooting a protected species on the fort could significantly restrict hunting opportunities in the future, for all hunters. Additionally, it is a State and federal offense to "take" any of these species.”

The conservation measures will reduce the risk of ocelots being killed or injured by fuels management activities or by hunters. The general ocelot monitoring program will help provide wildlife and land managers with valuable information on ocelot distribution and habitat associations on the Fort.

Effects to Recovery of the Ocelot in the ASMU with the Project

As stated in the “Status of the Species” section above delisting criteria for the ASMU are: 1) the ASMU population is estimated through reliable scientific monitoring to be above 2,000 animals for 10 years; 2) significant threats to this population have been identified and addressed; and 3) habitat linkages to facilitate an ASMU meta-population have been identified and are conserved for the foreseeable future. Although the proposed action may adversely affect ocelots and their habitat, including possibly temporarily impacting sufficient habitat to support an equivalent of about 0.60 to 11 potential ocelot home ranges over a 10-year timeframe, the overall action will benefit ocelots by reducing the risk of severe fires, and maintaining open space and habitat for ocelots. Therefore, in totality, the proposed action should contribute to recovery of the ASMU. Because habitat linkages to facilitate an ASMU meta-population have not been identified, the extent to which this project may impact those habitat linkages is not known.

Cumulative Effects - Ocelot

Cumulative effects include the effects of future State, local, or private actions that are reasonably certain to occur in the action area considered in this biological opinion. Future Federal actions that are unrelated to the proposed action are not considered in this section because they require separate consultation under section 7 of the Act.

Many lands within the action area are managed by Federal agencies; thus, many activities that could potentially affect ocelots are Federal activities that are subject to section 7 consultation. The effects of these Federal activities are not considered cumulative effects. However, a portion of the action area also occurs on private lands. Residential and commercial development, road construction, farming, livestock grazing, mining, off-highway vehicle use, and other activities occur on these lands and are expected to continue into the foreseeable future. These actions, the effects of which are considered cumulative, may result in fragmentation, loss, or degradation of ocelot habitat and disturbance to ocelots. Additionally, population growth on State and local lands in the Sierra Vista Subwatershed is likely to result in an increase in recreational activities in the Fort Huachuca/Sierra Vista region, including the SPRNCA and the Coronado National Forest. Increased recreation may increase the potential for human disturbance to ocelots, as well as degradation or loss of habitat for both the ocelot and its prey (e.g., from wildfires, off-road vehicle use, etc.). Although not documented recently in the U.S., illegal hunting of ocelots adversely affects ocelots. Illegal activities associated with cross-border smuggling and illegal immigration (e.g., human traffic, deposition of trash, creation of trails and routes, and increased fire risk from human traffic) also occur in the action area. These activities can also degrade ocelot habitat and disturb ocelots.

Conclusion - Ocelot

After reviewing the current status of the ocelot, the environmental baseline for the action area, and the effects of the proposed action, it is our biological opinion that the project, as proposed, is not likely to jeopardize the continued existence of the ocelot. Critical habitat has not been designated for this species; thus no critical habitat will be affected by the proposed action. We base our conclusion on the items listed below.

- Although we anticipate the proposed action will result in impacts to ocelot habitat, the impacts are relatively small in the context of the range of the ASMU of ocelots (i.e., recovery unit level). Additionally, nearly all the impacts will be temporary.
- Although we anticipate the proposed action will result in disturbance to ocelots, the number of ocelots that may potentially be disturbed is small in comparison to the estimated number of ocelots in the ASMU. The number of ocelots in the ASMU is not known; however, a population of 2,025 ($\pm$ 675) ocelots in Sonora was estimated by López González et al. (2003) based on the distribution of these records and the availability of potential habitat. Therefore, the estimated number of ocelots in the ASMU would be somewhat larger than the Sonora estimate.

- Although abundance and population trends for the ocelot rangewide are not well known and populations throughout the species' range continue to be at risk, the proposed project will not have an appreciable impact on the population at the rangewide or ASMU-specific scales. Thus, the proposed action is not expected, directly or indirectly, to reduce appreciably the

likelihood of both survival and recovery of the ocelot in the wild by reducing the reproduction, numbers, or distribution of the species.

- Recovery is the process that stops the decline of an endangered or threatened species by removing or reducing threats. Recovery ensures the long-term survival of the species in the wild. At that point, the species is recovered, and protection of the ESA is no longer necessary. The aforementioned effects will not appreciably reduce the likelihood of recovery of the ocelot.

- Conservation measures (J-O-1, J-O-2, J-O-3, J-O-4) in the proposed action are anticipated to avoid and minimize adverse effects of the proposed action to ocelots.

- The proposed action is anticipated to benefit ocelots by reducing the risk of severe fires that could significantly impact ocelot habitat, and maintaining open space and habitat for ocelots.

The proposed action does not appreciably reduce the likelihood of ocelot recovery within their historical range. The adverse effects that do occur in the action area do not reach the scale where recovery of the species would be delayed or precluded. We make this conclusion for the following reasons:

- The potential area of effect is a small (about 5,500 ac), peripheral part of the range of the species (the range of the ocelot has not been quantified, but it occurs in appropriate habitat from Arizona and Texas south to Argentina; 5,500 acres represents a miniscule part of this range);

The proposed conservation measures reduce the chance for impacts (i.e., reduce the risk of ocelots being killed or injured by fuels activities or by hunters) to ocelots at Fort Huachuca; and

- The fire and fuels management actions will benefit ocelots by reducing the risk of catastrophic fire.

FWS is unable to identify a reliable recovery “tipping point” or threshold for the ocelot because it is not technically feasible, due partly to a lack or rigorous, long-term data sets on population and habitat parameters. Because we cannot identify a tipping point, we cannot determine whether that tipping point would be reached as a result of agency operations. Since the impacts of the proposed action are minimal and the action area is small compared to the range of the species, it is highly unlikely that the proposed action would cause a tipping point away from recovery to be reached. The adverse effects that do occur in the action area do not reach the scale where recovery of the species would be delayed or precluded. The conclusions of this biological opinion are based on full implementation of the project as described in the Description of the Proposed Action section of this document, including any Conservation Measures that were incorporated into the project design.

INCIDENTAL TAKE STATEMENT - OCELOT

Section 9 of the Act and Federal regulation pursuant to section 4(d) of the Act, prohibit take of endangered or threatened species, respectively, without special exemption. "Take" is defined as to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or to attempt to engage in any such conduct. "Harm" is further defined to include significant habitat modification or degradation that results in death or injury to listed species by significantly impairing behavioral patterns, including breeding, feeding, or sheltering. "Harass" is defined in the regulations as ``an intentional or negligent act or omission which creates the likelihood of injury to wildlife by annoying it to such an extent as to significantly disrupt normal behavioral patterns which include, but are not limited to, breeding, feeding, or sheltering (50 CFR §17.3). Incidental take is defined as take that is incidental to, and not the purpose of, the carrying out an otherwise lawful activity. Under the terms of section 7(b)(4) and section 7(o)(2), taking that is incidental to and not intended as part of the proposed action is not considered to be prohibited taking under the Act provided such taking is in compliance with this Incidental Take Statement.

The measures described below are non-discretionary, and must be undertaken by Fort Huachuca so that they become binding conditions of any grant or permit issued to any applicant, contractor, or permittee, as appropriate, for the exemption in section 7(o)(2) to apply. Fort Huachuca has a continuing duty to regulate the activity that is covered by this incidental take statement. If Fort Huachuca (1) fails to assume and implement the terms and conditions, or (2) fails to require any applicant, contractor, or permittee to adhere to the terms and conditions of this incidental take statement through enforceable terms that are added to the permit or grant document, the protective coverage of section 7(o)(2) may lapse. In order to monitor the impact of incidental take, Fort Huachuca must report the progress of the action and its impact on the species as specified in the Incidental Take Statement (see 50 CFR 402.14(I)(3)).

Amount or Extent of Take Anticipated

Trail cameras have detected a male ocelot within the area subject to direct and/or indirect effects of the proposed action (the action area). More specifically, these effects include temporary modification of 5,500 ac of ocelot habitat over 10 years from fuels management activities; this represents an equivalent of about 0.60 to 11 potential ocelot home ranges that may be directly impacted over the 10 years of the project. Furthermore, fuels management is planned specifically in the area where the ocelot was detected on the Fort. Consequently, incidental take of an ocelot is reasonably certain to occur as a result of implementation of the proposed action. Incidental take of <u>one</u> ocelot over the life of the project in the form of harm and harassment (see first paragraph under "INCIDENTAL TAKE STATEMENT – OCELOT for the definition of harm and harass) is anticipated for the following activity:

1. Disturbance of ocelots and their habitat due to fuels management activities and hunting which disrupt normal behavior patterns which include, but are not limited to, breeding, feeding or sheltering. Fuels management activities are anticipated to cause ocelots to shift home range location and travel longer distances, possibly through less suitable habitat. Extra travel would require ocelots to expend additional energy and increase the potential for encounters with humans, vehicles, potential competitors and predators, and other stresses.

We anticipate the above anticipated incidental take will be difficult to detect because: 1) dead or impaired individual ocelots are very difficult to find unless they are radio-collared (there are no plans to radio-collar ocelots in Arizona); 2) the status of the species is changing over time through immigration, emigration, and natural loss; and, 3) the species ranges over a relatively large area, and thus the same individual can be difficult to re-detect. However, monitoring and reporting requirements (Terms and Conditions 1 and 2) will allow us to assess the effects of proposed project activities on ocelots. In addition, Fort Huachuca will report to us any mortality or injury of ocelots due to collisions with vehicles, hunting, or any other activities carried out or authorized by the Fort.

The amount of anticipated incidental take will have been exceeded, triggering a requirement for reinitiation (50 CFR §402.16) if:

1. Based on the annual and emergency (see Term and Condition 2) reporting on the status of the proposed project:
    a. Ocelots are treed or bayed by hunters on the Fort more than once every two years; OR
    b. Additional ocelots are documented in the action area and are reasonably certain to be taken by the proposed action. This will be determined through discussion between the Fort and USFWS.

In summary, and stated differently, the maximum allowable incidental take of ocelots is the harassment and harm (as measured by treeing or baying up to once every two years) of <u>one</u> individual over the life of the project.

Effect of the Take

We conclude that this level of anticipated take is not likely to result in jeopardy to the ocelot, for the effects are not expected to appreciably reduce the survival and recovery of the species. Ocelots range from southern United States all the way to Argentina and thus, take of one ocelot in the form of harassment in the United States will not jeopardize the species.

Reasonable and Prudent Measures

The USFWS believes the following Reasonable and Prudent Measures are necessary and appropriate to minimize impacts of incidental take of ocelot:

1. Monitor ocelots on the Fort and coordinate all fuel treatment activities within jaguar and ocelot habitat; and

2. Monitor incidental take resulting from the proposed action and report to the USFWS the findings of that monitoring.

Terms and Conditions

To be exempt from the prohibitions of section 9 of the Act, the Fort shall comply with the following Terms and Conditions, which implement the Reasonable and Prudent Measures described above and outline required reporting and monitoring requirements. These terms and conditions are non-discretionary.

1. The following Terms and Condition implement Reasonable and Prudent Measure Number 1:

   1.1 Fort Huachuca shall conduct (or provide funding to conduct) ocelot monitoring and coordinate all fuel treatment activities within jaguar and ocelot habitat with the USFWS for the life of the proposed action as outlined in Section 2.13.1.8 (Conservation Measures) of the Description of the Proposed Action (pages 2-36 of the PBA). These include the following two measures:

   1.2 J-O-1: The Fort will continue and expand its non-invasive (e.g., motion detector cameras) monitoring program for the presence and movement of ocelot and jaguar within installation boundaries. This monitoring program will be in place throughout the consultation period.

   1.3 J-O-2: The Fort will coordinate all fuel treatment activities within jaguar and ocelot habitat (Madrean evergreen woodland) with the USFWS to avoid adverse effects on the jaguar or ocelot.

   1.4 J-O-3: The Fort will conduct monitoring of proposed control burn areas for at least three months before controlled burn treatment within jaguar and ocelot habitat (Madrean evergreen woodland). Post treatment monitoring will be implemented if a burn is approved in an area where jaguars or ocelots are detected during monitoring. The Fort will develop a monitoring plan in coordination with the USFWS. If a jaguar or ocelot is detected, the Fort will coordinate and consult with the USFWS to avoid or minimize adverse effects to the species before any controlled burns occur. Additionally, should an ocelot or jaguar be detected during any monitoring, the Fort will coordinate with the USFWS to minimize adverse effects to the species before mechanical treatment occurs in the area where the ocelot or jaguar were detected.

   An ocelot monitoring plan shall be coordinated with our office. The plan shall include two types of monitoring: general ocelot monitoring and ocelot monitoring associated with fuels management treatment. General objectives of the monitoring program include, but are not limited to the following: 1) determine if the male ocelot previously detected on the Fort continues to use the area; 2) determine if additional ocelots are present on the Fort; 3) gather basic information on ocelot movement and habitat use patterns on the Fort, including, if possible, determining travel routes; and 4) enable Fort operations (including fuels management treatments and hunting) to take into account the presence of ocelots in the area. The exact design, scope, and location of the monitoring program will be determined in the plan and updated as needed to gather the best possible information on ocelots. The monitoring plan will include, among other information: 1) the monitoring objectives (monitoring for two purposes: general ocelot monitoring, and ocelot monitoring associated with fuels management treatment); 2) a detailed description

of monitoring methods and analysis techniques to be employed, and frequency with which photos will be downloaded and viewed (at least monthly) or other methods as appropriate; 3) a communications plan that explains, among other things, how ocelot detections will be relayed to the USFWS and AGFD; and 4) reporting format and schedule. All aspects of the monitoring plan and implementation of the plan must be coordinated with USFWS. Additionally, monitoring efforts must be informally coordinated (e.g., via conference call, electronic mail), as appropriate, the FS, NPS, and other parties. Among other things, coordination will occur on monitoring plan results, with emphasis on ocelot and jaguar detections.

1.5 Ocelot monitoring will be conducted through non-invasive means, including, but not limited to the use of trail cameras. All necessary permits will be obtained.

1.6 All ocelot detections shall be reported to USFWS (AESO) and AGFD within 72 hours.

2. The following Term and Condition implements Reasonable and Prudent Measure Number 2:

2.1 To monitor incidental take resulting from the proposed action, Fort Huachuca shall monitor the impacts of the action as they relate to ocelot (including, but not limited to, how many acres of MEW and SDG are treated for fuels management annually on the Fort, and how many ocelots are treed or bayed by dogs on the Fort) and report these to the USFWS for the life of the project. A report will be due to the USFWS annually on March 31. The report will include a description of the action implemented, including conservation measures and reasonable and prudent measures. Emergencies and any unanticipated events that may cause take to be exceeded will be reported immediately (at a maximum within 24 hours) to the Arizona Ecological Services Office Field Supervisor via electronic mail and telephone.

Review requirement: The USFWS believes that no more than <u>one</u> ocelot will be incidentally taken (in the form of harassment) as a result of the proposed action. The reasonable and prudent measures, with their implementing terms and conditions, are designed to minimize incidental take that might otherwise result from the proposed action. If, during the course of the action, the level of incidental take is exceeded, such incidental take would represent new information requiring review of the reasonable and prudent measures provided. Fort Huachuca must immediately provide an explanation of the causes of the taking and review with the USFWS-AESO the need for possible modification of the reasonable and prudent measures.

CONSERVATION RECOMMENDATIONS - OCELOT

Section 7(a)(1) of the Act directs Federal agencies to utilize their authorities to further the purposes of the Act by carrying out conservation programs for the benefit of endangered and threatened species. Conservation recommendations are discretionary agency activities to minimize or avoid adverse effects of a proposed action on listed species or critical habitat, to help implement recovery plans, or to develop information.

To conserve the ocelot, we recommend that Fort Huachuca implement the following:

1. Participate in the implementation of the Ocelot Recovery Plan.

2. Pursue funding for ocelot monitoring, research, and conservation needs identified by the Ocelot Recovery Team.

In order for the Service to be kept informed of actions minimizing or avoiding adverse effects or benefitting listed species or their habitats, the Service requests notification of the implementation of any conservation recommendations.

Table O1. Approximate upper range (in acres) proposed to be treated within a 10-year period on Fort Huachuca, Arizona by biotic type in upper elevations.

Biotic community	Upper range to be treated within 10 years	Total acres of biotic community occurring on the Fort	Percentage of vegetation type to be treated
Madrean Evergreen Woodland (MEW)	5,500	20,342	27
Petran Montane Conifer Forest (PMCF)	690	3,875	18
10 YEAR TOTAL	**6,190**	**24,217**	

Table O-2. Approximate upper range (in acres) proposed to be treated annually on Fort Huachuca, Arizona by biotic type in lower elevations.

Biotic community	Upper range to be treated within 10 years	Total acres of biotic community occurring on the Fort
Semidesert Grassland (SDG)/Plains and Great Basin Grassland (PGBG)	5,120	46,892 of SDG; 1,867 of PGBG
ANNUAL TOTAL	**5,120**	**48,759**

JAGUAR

Status of the Species

Legal Status

In 1972, the jaguar (*Panthera onca*) was listed as endangered (37 FR 6476, FWS 1972) under the Endangered Species Conservation Act of 1969 (ESCA), a precursor to the Endangered Species Act of 1973, as amended (Act; 16 U.S.C. 1531 *et seq.*). Under the ESCA, the USFWS maintained separate listings for foreign species and species native to the United States. At that time, the jaguar was believed to be extirpated in the United States; thus, the jaguar was included only on the foreign species list. On July 25, 1979, the USFWS published a notice (44 FR 43705) stating that, through an oversight in the listing of the jaguar and six other endangered species, the United States populations of these species were not protected by the Act. The notice asserted that it was always the intent of the USFWS that all populations of these species, including the

jaguar, deserved to be listed as endangered, whether they occurred in the United States or in foreign countries. Therefore, the notice stated that the USFWS intended to take action as quickly as possible to propose the U.S. populations of these species (including the jaguar) for listing. On July 25, 1980, the USFWS published a proposed rule (45 FR 49844) to list the jaguar in the United States. The proposal for listing the jaguar was withdrawn on September 17, 1982 (47 FR 41145) stating that the Act mandated withdrawal of proposed rules to list species which have not been finalized within two years of the proposal. On July 22, 1997, the USFWS published a final rule clarifying that endangered status for the jaguar extended into the United States (62 FR 39147, FWS 1997b).

Life History

The jaguar, a large member of the cat family (Felidae), is an endangered species that currently occurs from southern Arizona and New Mexico to southern South America. Jaguars are muscular cats with relatively short, massive limbs and a deep-chested body. They are cinnamon-buff in color with many black spots; melanistic (dark coloration) forms are also known, primarily from the southern part of the range.

The life history of the jaguar has been summarized by Seymour (1989) and Brown and López González (2001), among others. Jaguars breed year-round rangewide, but at the southern and northern ends of the range there is evidence for a spring breeding season. Gestation is about 100 days; litters range from one to four cubs (usually two). Cubs remain with their mother for nearly two years. Females begin sexual activity at three years of age, males at four. Studies have documented few wild jaguars more than 11 years old, although a wild male jaguar in Arizona was documented to be at least 15 years of age (Johnson et al. 2011), and in Jalisco, Mexico, two wild females were documented to be at least 12 and 13 (Núñez, Subcomité Técnico Consultativo para la Conservación y Manejo sustentable del Jaguar y otros felinos de México, 2011, pers. comm.). The consensus of jaguar experts is that the average lifespan of the jaguar is 10 years.

Prey

The list of prey taken by jaguars throughout their range includes more than 85 species (Seymour 1989). Known prey include, but are not limited to, collared peccaries (javelina [*Pecari tajacu*]), white-lipped peccaries (*Tayassu pecari*), capybaras (*Hydrochoerus* spp.), pacas (*Agouti paca*), agoutis (*Dasyprocta* spp.), armadillos (*Dasypus* spp.), caimans (*Caiman* spp.), turtles (*Podocnemis* spp.), white-tailed deer (*Odocoileus virginianus*), livestock, and various other reptiles, birds, and fish (sources as cited in Seymour 1989, Núñez et al. 2000, Rosas-Rosas 2006, Rosas-Rosas et al. 2008). Jaguars are considered opportunistic feeders, especially in rainforests, and their diet varies according to prey density and ease of prey capture (sources as cited in Seymour 1989). Jaguars equally use medium- and large-size prey, with a trend toward use of larger prey as distance increases from the equator (López González and Miller 2002). Javelina and white-tailed deer are thought to be the mainstays in the diet of jaguars in the United States and Mexico borderlands (Brown and López González 2001).

Home Range and Movement

Like most large carnivores, jaguars have large home ranges. According to Brown and López-González (2001), their home ranges are highly variable and depend on sex, topography, available prey, and population dynamics. However, little information is available on this subject outside tropical America, where several studies of jaguar ecology have been conducted. Data compiled from studies in Brazil, Venezuela, and Belize found mean home range areas for males vary from 12.8 to 140 km^2 (5-52mi^2) during the wet season and 28 to 165.8 km^2 (11-64 mi^2) during the dry season. For females, the ranges were smaller, with less variation between seasons (Rabinowitz and Nottingham 1986, Crawshaw and Quigley 1991, Brown and López-González 2001, Cavalcanti and Gese 2009). In the tropical deciduous forest of Jalisco, Mexico, mean home range size for two males was 100.3 (+/- 15.0 km^2 [38.7 +/- 5.8 mi^2]) and four females was 42.5 (+/- 16 km^2 [16.4 +/- 6.2 mi^2])(Núñez-Pérez 2006).

Only one limited home range study using standard radio-telemetry techniques has been conducted for jaguars in northwestern Mexico. Telemetry data from one adult female tracked for four months during the dry season in the municipality of Sahuaripa, Sonora, indicated a home range size of 100 km^2 (39 mi^2)(López-González, University of Queretaro, 2011, pers. comm.). Additionally, camera trap data indicated that the average male home range in Sahuaripa, Sonora, was 84 km^2 (32 mi^2 (López-González, University of Queretaro, 2011, pers. comm.). Also using camera traps, in Nacori Chico, Sonora, Rosas-Rosas and Bender (2012) estimated the home range for one adult male jaguar encompasses about 200 km^2 (77 mi^2).

No home range studies have been conducted for jaguars in southwestern U.S. using standard radio-telemetry techniques. The home ranges of borderland jaguars are presumably as large or larger than the home ranges of tropical jaguars (Brown and López González 2001), as jaguars in this area are at the northern limit of their range and the arid environment contains resources and environmental conditions that are more variable than those in the tropics (Hass 2002, as cited in McCain and Childs 2008). Therefore, jaguars require more space in arid areas to obtain essential resources such as food, water, and cover.

Male jaguars have been documented to disperse up to 64 km in Brazil (Rabinowitz and Zeller 2010) and 70 km in Jalisco (Núñez et al. 2002). The mean one-day movement of radio-collared jaguars in the Pantanal region of southwestern Brazil was 2.4 (+/- 2.3 km [1.5 +/- 1.4 mi]), with that of one male being significantly larger (3.3 +/- 1.8 km [2.0 +/- 1.1 mi]) than that displayed by females (1.8 +/- 2.5 km)(Crawshaw and Quigley 1991). Additionally, the mean distance travelled by all animals during one-day intervals in the dry season (2.7 +/- 2.5 km [1.7 +/- 1.5 mi]) was significantly greater than the mean one-day movement for all other months combined (1.6 +/- 2.1 km ([.0 +/- 1.3 mi])(Crawshaw and Quigley 1991). In coastal Jalisco, jaguars moved up to 20 km (12.4 mi) in one night (Núñez et al. 2002).

Habitat

Jaguars are known from a variety of vegetation communities (Seymour 1989). Toward and at middle latitudes, they show a high affinity for lowland wet communities, including swampy savannas or tropical rain forests. Swank and Teer (1989) stated that jaguars prefer a warm, tropical climate, usually associated with water, and are rarely found in extensive arid areas. However, jaguars have been documented in arid areas, including thornscrub, lowland desert,

desertscrub, mesquite grassland, Madrean oak woodland, and pine-oak woodland communities of northwestern Mexico and southwestern U.S. (López-González and Brown 2002, Boydston and López-González 2005, McCain and Childs 2008). The more open, dry habitat of southwestern U.S. has been characterized as marginal in terms of water, cover, and prey densities (Rabinowitz 1999). Jaguars rarely occur above 2,591 m (8,500 ft)(Brown and López-González 2001).

Jaguar habitat use patterns are affected by many variables, including human infrastructure and activities. Conde et al. (2010) found significant differences in habitat use between male and female jaguars in the Mayan Forest of the Yucatan Peninsula by modeling occupancy as a function of land cover type, distance to roads, and sex. Although both male and female jaguars preferred tall forest, short forest was used by females but avoided by males. Whereas females significantly avoided roads, males did not and ventured into low-intensity cattle ranching and agriculture. Other studies have also shown that jaguars selectively use large areas of relatively intact habitat away from certain forms of human influence. Zarza et al. (2007) report that towns and roads had an impact on the spatial distribution of jaguars (jaguars used greater than expected areas located more than 6.5 km [4 mi] from human settlements and 4.5 km [2.8 mi] from roads) in the Yucatan peninsula. In the state of Mexico, Monroy-Vichis et al. (2007) report that one male jaguar occurred with greater frequency in areas relatively distant from roads and human populations. In some areas of western Mexico, however, jaguars (both sexes) have frequently been recorded near human settlements and roads (Núñez-Pérez, Subcomité Técnico Consultativo para la Conservación y Manejo sustentable del Jaguar y otros felinos de México, August 2, 2011, electronic mail). In Marismas Nacionales, Nayarit, a jaguar den was recently located very close to an agricultural field, apparently 1 km (0.6 mi) from a small town (Núñez-Pérez, Subcomité Técnico Consultativo para la Conservación y Manejo sustentable del Jaguar y otros felinos de México, August 2, 2011, electronic mail).

No formal habitat use studies have been conducted (with the exception of Núñez et al.'s [2002] examination of arroyo use) in the northwestern most portion of the jaguar's range. However, results of a study in the municipality of Nácori Chico, Sonora, showed that jaguar kill sites of wild prey (i.e., white-tailed deer and peccary)(Rosas-Rosas, Colegio de Postgraduados Campus San Luis Potosí, August 6, 2011, electronic mail) and cattle were positively associated with oak forest and semi-tropical thornscrub vegetation types, whereas they were negatively associated with upland mesquite (Rosas-Rosas et al. 2010). Sites of cattle kills were also positively associated with proximity to permanent water sources and roads (Rosas-Rosas et al. 2010). General jaguar habitat associations have been described in this region by various authors. In western Mexico, including Nayarit and Jalisco, jaguars primarily occur in tropical deciduous forest, although other formerly important habitats are the mangrove forests and swamps of the Agua Bravo and Marismas Nacionales straddling the borders of Nayarit and Sinaloa (Brown and López-González 2001). In Jalisco, oak and pine forest are used by jaguars, some of them located between 2,700 and 2,800 m (8,858-9,186 ft)(Núñez-Pérez, Subcomité Técnico Consultativo para la Conservación y Manejo sustentable del Jaguar y otros felinos de México, August 2, 2011, electronic mail). Although jaguars are not primarily associated with these vegetation communities, it is important to consider oak woodlands and pine forests as potential jaguar corridors (Núñez-Pérez, Subcomité Técnico Consultativo para la Conservación y Manejo sustentable del Jaguar y otros felinos de México, August 2, 2011, electronic mail to FWS).

Several studies have helped refine a general understanding of habitats that have been or might be used by jaguars in Arizona and New Mexico, including studies by the Sierra Institute Field Studies Program (2000), Hatten et al. (2002), Menke and Hayes (2003), Robinson et al. (2006), Sanderson and Fisher (2013). As Johnson et al. (2011) explain, however, any conclusions about the conservation importance of the habitat types in which jaguars have occurred or might occur in Arizona and New Mexico are preliminary and can vary widely, depending on what assumptions are factored into the analyses, such as the number and reliability of jaguar occurrence records and the significance of single "point in time" occurrence observations as predictors of habitat use by jaguars.

Hatten et al. (2005) used Geographic Information System (GIS) to characterize potential jaguar habitat in Arizona by overlaying 25 historical jaguar sightings on landscape and habitat features believed important (e.g., vegetation biomes and series, elevation, terrain ruggedness, proximity to perennial or intermittent water sources, human density). The amount of Arizona land area identified as potential jaguar habitat ranged from 21 to 30 percent, depending on the input variables. All jaguar records were observed in four biomes. Of these, 56 percent were observed in scrub grasslands of southeastern Arizona, 20 percent in Madrean evergreen forest (woodland), 12 percent in Rocky Mountain montane conifer forest, and 12 percent in Great Basin conifer woodland. Related to water, when springs, rivers, and creeks were combined, all of the jaguar records were within 10 km (6.2 mi) of a water source. Sixty percent of jaguars were observed between 1,220 and 1,829 m (4,003-6,001 ft) in elevation, largely in the scrub grassland biome of southeastern Arizona. The remaining jaguar sightings were between 1,036 and 2,743 m (3,399-8,999 ft). With respect to topography, 92 percent of jaguar sightings occurred in intermediately rugged to extremely rugged terrain, with the remainder (8%) in nearly level terrain.

More recently, Sanderson and Fisher (2013) modeled jaguar habitat in the Northwestern Jaguar Recovery Unit (NRU)(see description below) following a variant of the Hatten et al. (2005) method. Habitat factors used to characterize potential jaguar habitat were: 1) percentage of tree cover; 2) ruggedness index; 3) human influence; 4) ecoregion; 5) elevation (some model versions only); and 6) distance from water. Altogether, 13 habitat model versions were produced with input from the Technical Subgroup of the Jaguar Recovery Team. The habitat models were also translated into carrying capacity. The final habitat model (version 13) suggests a potential carrying capacity of more than 3,400 jaguars over an area of over 226,000 km^2 (see TableJ1 below). This capacity was further broken down into smaller geographic areas or "subunits" of the NRU which, from south to north, may have the potential to contain: about 1,318 jaguars in the Jalisco Core Area, about 929 jaguars in the Sinaloa Secondary Area, about 1,124 jaguars in the Sonora Core Area, and about 42 jaguars in the Borderlands Secondary Area (which includes portions of northern Sonora, southern Arizona, and southeastern New Mexico). The current populations are substantially below these carrying capacities, but are not zero according to recent observations in all four subunits (Sanderson and Fisher 2013).

Distribution, Abundance, Population Trends

Historically, the jaguar inhabited 21 countries throughout the Americas, from the United States south into Argentina, but currently the jaguar is found in 19 of those countries (no longer in El Salvador and Uruguay)(Caso et al. 2008). The population trend of jaguars is declining (Caso et

al. 2008), although the rate of decline is unknown and likely highly variable throughout the jaguar range. To better understand abundance and population trends, research, inventories, and monitoring programs are being implemented in some parts of the jaguar range (Wildlife Conservation Society 2007, Chávez et al. 2007, Caso et al. 2008, Panthera 2011). During a symposium in 2009 titled "The Jaguar in the XXI Century: The Continental Perspective", experts estimated that there are still probably more than 30,000 jaguars (Medellin 2009) and that Mexico has an estimated 4,100 jaguars (Zarza et al. 2010). Sanderson et al. (2002) found that the jaguar is known to be extant in about 8.75 million km^2 (3.4 million mi^2), which represents 46 percent of its historical global range. Jaguars are known to be extirpated in 37 percent of their historical range, and their status in another 18 percent is unknown (Sanderson et al. 2002). The probability of long-term survival of the jaguar is considered high in 70 percent of the currently occupied range (over 6 million km^2 or 2.3 million mi^2)(Sanderson et al. 2002). Zeller (2007) updated Sanderson et al.'s (2002) work and found that the jaguar is known to be extant in about 11.7 million km^2, which represents 61 percent of its historical range, likely reflecting simply a greater representation of knowledge rather than actual range expansion. Within the currently occupied range, 90 Jaguar Conservation Units (JCUs) were identified representing a total area of 1.9 million km^2 (0.7 million mi2)(Zeller 2007). JCUs were defined either as: areas with a stable prey community, currently known or believed to contain a population of jaguars large enough (at least 50 breeding individuals) to be potentially self-sustaining over the next 100 years; or areas containing fewer jaguars but with adequate habitat and a stable, diverse prey base, such that jaguar populations in the area could increase if threats were alleviated (Sanderson et al. 2002, Zeller 2007).

In northwestern and western Mexico, jaguars occur from the border of Colima and Jalisco north through Nayarit, Sinaloa, southwestern Chihuahua, and Sonora to the border with the U.S. Breeding populations currently occur in Jalisco, Nayarit, Sinaloa, and Sonora. The most northern recently documented breeding population of jaguars occurs in Sonora near the towns of Huasabas and Sahuaripa, about 210 km (130 mi) south of the U.S./Mexico international border (Brown and López-González 2001, Valdez et al. 2002). Since 2009, two jaguars have been documented at Rancho El Aribabi, Sonora, about 48 km (30 mi) southeast of Nogales, and one jaguar has been documented in the Sierra Los Ajos within the Reserva Forestal Nacional y Refugio de Fauna Silvestre Ajos-Bavispe, about 48 km (30 miles) south of the U.S. border near Naco, Mexico. Estimates in the Sonora and Jalisco JCUs were 50 to 100 and greater than 500, respectively (Zeller 2007). Results of the Mexican National Jaguar Census (Manriquez, CONANP, July 15, 2011, electronic mail) indicate there are an estimated 271 jaguars in Sonora, 211 in Sinaloa, 92 in Nayarit, and 176 in Jalisco.

In the United States, jaguars historically occurred in California, Arizona, New Mexico, Texas, and possibly Louisiana (62 FR 39147). The last jaguar sightings in California, Texas, and Louisiana were documented in the late 1800s into the early 1900s, with the last confirmed jaguar killed in Texas in 1948 (Nowak 1975). While jaguars have been documented as far north as the Grand Canyon, Arizona, occurrences in the U.S. since 1963 have been limited to south-central Arizona and extreme southwestern New Mexico. Three records of females with cubs have been documented in the U.S. (all in Arizona), the last in 1910 (Lange 1960, Nowak 1975, Brown 1989), and no females have been confirmed in the U.S. since 1963 (Brown and López-González

2001, Johnson et al. 2011). As a result, jaguars in the U.S. are thought to be part of a population, or populations, that occur largely in Mexico.

From 1996 through 2013, several individual adult jaguars have been documented within Arizona and New Mexico. One adult male was observed and photographed on March 7, 1996, in the Peloncillo Mountains in New Mexico near the Arizona border (Glenn 1996, Brown and López-González 2001). The Peloncillo Mountains run north-south to the Mexican border, where they join the foothills of the Sierra San Luis and other mountain ranges connecting to the Sierra Madre Occidental. Another jaguar was photographed in 2004; however, it could not be determined if the animal was a unique individual. Another adult male was observed and photographed on August 31, 1996, in the Baboquivari Mountains of southern Arizona (Childs 1998, Brown and López-González 2001). In February 2006, another adult male jaguar was observed and photographed in the Animas Mountains in Hidalgo County, New Mexico (McCain and Childs 2008). From 2001 to 2009, two jaguars, both adult males, were photographed (one repeatedly) using infra-red camera traps in south-central Arizona, near the Mexico border, one of which, was the male observed and photographed in 1996 in the Baboquivari Mountains. More specifically, these two jaguars were documented in three different mountain range complexes in southeastern Arizona, over an area extending from the U.S./Mexico international border north 66 km (47 mi) and 63 km (39 mi) east to west (McCain and Childs 2008). Furthermore, they were found using areas from rugged mountains at 1,577 m (5,174 ft) to flat lowland desert floor at 877 m (2,877 ft)(McCain and Childs 2008). A male jaguar was seen and photographed by a hunter in the Whetstone Mountains in 2011. This same male jaguar has been documented in the Santa Rita Mountains many times from 2012 to 2014. Considering he has been regularly detected in the Santa Rita Mountains for about one and half years, we hypothesize he has established a home range in these mountains.

Boydston and López-González (2005) estimated the potential geographic distribution of jaguars in the southwestern U.S. and northwestern Mexico by modeling the jaguar ecological niche from occurrence records (100 male records from Arizona [47], New Mexico [6], Chihuahua [8], and Sonora [39] and 42 female records from Arizona [6] and Sonora [36]). They report that eastern Sonora appeared capable of supporting male and female jaguars with potential range expansion into southeastern Arizona, while New Mexico and Chihuahua contained environmental characteristics primarily limited to the male niche and thus may be areas into which males occasionally disperse. They found significant differences between land cover within the female distribution and the available landscape. The predicted distribution of female jaguars was mainly across areas of shrubland, deciduous broadleaf forest, and grassland, but deciduous broadleaf forest and mixed forest composed more of the female distribution than expected by chance when compared to the available land cover for the study area. Shrubland was a smaller proportion of the female distribution than expected, and grassland and needleleaf forest were present in proportion to their availability. Boydston and López-González's (2005) results indicated that the availability of areas meeting females' environmental requirements may be an important factor limiting the distribution of northern jaguars.

Grigione et al. (2009) conducted a mapping study to construct a blueprint of priority conservation areas for jaguars, as well as ocelots and jaguarundis, in the U.S. – Mexico border region. For the jaguar in the western bioregion of the study area (including Arizona, New

Mexico, Sonora, Chihuahua, and Sinaloa), four units were identified (two very high priority, one high priority, and one low priority), including two in the U.S. and two in Mexico (totaling 102,530 km^2 [39,587mi^2]). Within these four units, currently 19.8 percent of the area has any form of protection (Grigione et al. 2009). A very high priority corridor was identified between the two Mexican units; otherwise the connections between the units are poorly understood and consequently two corridors needing further study were identified. Two underpasses were identified as being needed in northern Sonora, where jaguars are believed to be crossing roads as they disperse north. The authors conclude that the region to the south of Arizona and New Mexico is especially critical for the recovery of the jaguar in the southwestern U.S. because the source population is likely in central Sonora. Citing Brown and López-González (2001) and List (2007), Grigione et al. (2009) explain that to reach the U.S., jaguars need to travel through Sonora and Chihuahua, where there are many challenges to jaguar survival and movement, including the U.S.–Mexico border fence. The Sky Islands Unit was ranked as "very high priority" for a conservation area for jaguars (Grigione et al. 2009).

Populations at the edge of a species' range play a role in maintaining the total genetic diversity of a species (FWS 2012a); in some cases, these peripheral populations persist the longest as fragmentation and habitat loss impact the total range (Channell and Lomolino 2000). The U.S. and northwestern Mexico represent the northernmost extent of the jaguar's range, with populations persisting in distinct ecological conditions (xeric, or extremely dry, habitat) that occur nowhere else in the species' range (Sanderson et al. 2002). Peripheral populations such as these are an important genetic resource in that they may be beneficial to the protection of evolutionary processes and the environmental systems that are likely to generate future evolutionary diversity (Lesica and Allendorf 1995). This may be particularly important considering the potential threats of global climate change. Citing Young and Clarke (2000), Grigione et al. (2009) suggest that conservation of peripheral populations, such as the jaguar in the northernmost portion of its range, plays a role in maintaining the total genetic heterozygosity of a species.

Threats

In addition to the numerous anthropogenic threats affecting jaguars, the species has a number of intrinsic biological factors that limit its recovery, including being a K-selected species (i.e., species with large body size, long life expectancy, and fewer offspring which require extensive parental care until they mature) and having large spatial requirements. Small and isolated jaguar populations do not appear to be highly persistent (Haag et al. 2010, Rabinowitz and Zeller 2010). However, persistence of relatively small populations appears to increase with connectivity to other populations and reduction of threats within a corridor (Rabinowitz and Zeller 2010). The prospects for the jaguar being self-sustaining in the wild are favorable; however conservation of key jaguar habitats and populations is critical to this sustainability (USFWS 2012b).

Illegal killing of jaguars is one of the two most significant threats to the jaguar (Nowell and Jackson 1996, Medellín et al. 2002, Núñez et al. 2002, Chávez and Ceballos 2006, Medellin 2009) and, to recover jaguars, likely requires the most immediate response (USFWS 2012a). Experts from throughout the jaguar range agree that one of the most severe causes of mortality is the direct hunting of jaguars, either because jaguars have caused some conflict by killing

livestock or to sell the jaguar as a trophy or its skin or teeth (Medellin 2009). This illegal and indiscriminate killing eliminates hundreds or even thousands of jaguars each year in Latin America and must be controlled to reduce the risk of extinction (Medellin 2009).

Range wide, habitat destruction and modification form the other of the two most significant threats to the jaguar (Nowell and Jackson 1996, Medellín et al. 2002, Núñez et al. 2002, Chávez and Ceballos 2006, Medellin 2009). To recover jaguars, addressing this threat of habitat loss requires immediate response. The jaguar is classified as "Near Threatened" on the Red List of the International Union for the Conservation (IUCN) due to a number of factors, including habitat loss and fragmentation of populations across portions of the range (Caso et al. 2008). Various factors, particularly habitat loss, have caused a considerable reduction in the historical range of the jaguar (Sanderson et al. 2002, Zeller 2007, Rabinowitz and Zeller 2010). Most loss of occupied range has occurred in the southern U.S., northeastern Mexico, northern Brazil, and southern Argentina (Sanderson et al. 2002). Deforestation rates are high in Latin America and fragmentation of forest habitat isolates jaguar populations so that jaguars are more vulnerable to human persecution (Nowell and Jackson 1996). Medellin et al. (2002) report that loss, fragmentation, and modification of jaguar habitat have contributed to population declines throughout much of the species' range, including northern Mexico.

Human population growth has both direct and indirect impacts on jaguar survival and mortality. For example, human growth and development tend to fragment habitat and isolate populations of jaguars and other wildlife. For carnivores in general, negative impacts of high road density have been well documented and thoroughly reviewed (e.g., Noss et al. 1996, Carroll et al. 2001, as cited by Menke and Hayes 2003). Roads may have direct impacts to carnivores and carnivore habitats, including mortality caused by vehicles, disturbance, habitat fragmentation, changes in prey numbers or distribution, and provision of increased access for legal or illegal harvest (Menke and Hayes 2003, Colchero et al. 2010). Although roads, particularly high-use roads, pose a threat to the species, jaguars are known to cross them. For example, to move between the Whetstone and Santa Rita mountains, the male jaguar would have had to cross over or through a passage beneath State Route 82 or 83 or Interstate 10 to move between the mountain ranges. That said, the Jaguar Recovery Team is working to develop road crossing design recommendations to facilitate jaguar movement across roads. Additionally, they are working to identify roads in the NRU where jaguar road crossings should be installed to ensure connectivity of important jaguar areas.

Habitat fragmentation may disrupt original patterns of gene flow and lead to drift-induced differentiation among local population units and top predators, such as the jaguar, may be particularly susceptible to this effect, given their low population densities, leading to small effective sizes in local population fragments (Haag et al. 2010). Large-scale habitat removal and fragmentation of once-contiguous habitat can cause the reduction of genetic diversity in jaguar populations (Haag et al. 2010). To avoid the negative demographic and genetic consequences of small population size caused by habitat fragmentation, connectivity should be restored to ensure gene flow is maintained (Haag et al. 2010). Citing a number of sources, Rabinowitz and Zeller (2010) explain that reduction or loss of genetic exchange leads to smaller effective population sizes, increased levels of genetic drift and inbreeding, and potential deleterious effects on sperm production, mating ability, female fecundity, and juvenile survival. Furthermore, they state that

such effects eventually compromise adaptive potential, reduce fitness, and contribute to extirpation risk for a population and, ultimately, for the species. To ensure genetic health and long-term viability of jaguars range-wide, it is critical to maintain gene flow among populations through maintaining and restoring connectivity. Corridors can provide one of the most basic requirements for species persistence and genetic exchange (Rabinowitz and Zeller 2010). Boydston and López-González (2005) suggest that range expansion to the north of eastern Sonora could help prevent genetic isolation and extirpation of the northern jaguars and also increase chances for long-term survival of this species in the face of global anthropogenic changes.

Overall, the threat of human encroachment cannot be eliminated, but through conservation planning and implementation efforts, it can be reduced. Conservation of key habitat areas is critical to the recovery of jaguars. There are many opportunities and methods (i.e., creation of new reserves, incentive programs, etc.) to continue to conserve jaguar habitat; however, they will require significant international, national, and local cooperation, as well as financial support.

The jaguar is classified as "Near Threatened" on the IUCN Red List in part due to poaching of prey (Caso et al. 2008). According to experts across the jaguar range, hunting of the most important prey, such as peccaries and deer, is one of the primary factors negatively affecting the jaguar (Medellin 2009). An estimated 27 percent of jaguar range has a depleted wild prey base (WCS 2008 as cited by Caso et al. 2008). Illegal hunting of potential jaguar prey species is one of the main threats to long-term conservation of jaguars in northwestern Mexico (Rosas-Rosas 2006). Human population growth can put pressure on game populations that are used for human consumption. These same game populations are often prey for jaguars. Furthermore, overhunting of natural prey may cause an increase in jaguar predation on livestock and consequently increase human-jaguar conflicts, including continued negative attitudes toward jaguars and illegal killing of jaguars.

Jaguar Recovery Planning

The species has a recovery priority number of 5C, meaning that it has a low potential for recovery with a relatively high degree of conflict. Recovery for the jaguar was originally addressed in Listed Cats of Texas and Arizona Recovery Plan (with Emphasis on the Jaguar) (USFWS 1990), but only general information and recommendations to assess jaguar status in the U.S. and Mexico, and protect and manage occupied and potential habitat in the U.S. were presented. No specific recovery recommendations or objectives for the jaguar were presented. In 2007, the USFWS made a 4(f)(1) determination that development of a formal recovery plan would not promote conservation of the jaguar. The rationale for this determination was that for the purposes of formal recovery planning, the jaguar qualifies as an exclusively foreign species. The USFWS was subsequently sued for making this determination and the judge remanded the decision regarding recovery planning back to the USFWS. Subsequently, in 2010, the USFWS made a new determination that development of a recovery plan would contribute to jaguar conservation and that therefore the USFWS should prepare a recovery plan.

In 2012, a Recovery Outline for the jaguar (USFWS 2012a) was finalized by the USFWS. The outline, prepared by the Technical Subgroup of the Jaguar Recovery Team in conjunction with the Implementation Subgroup of the Jaguar Recovery Team and the USFWS, serves as interim

guidance for the USFWS to direct recovery efforts, including recovery planning, for the jaguar until a full recovery plan is developed and approved. The Recovery Team is currently developing a draft recovery plan and thus, the Recovery Outline for the Jaguar represents the best available scientific information for this consultation.

The goal for the Recovery Outline is to conserve and protect the jaguar and its habitat so that its long-term survival is secured and it can be considered for removal from the list of threatened and endangered species (delisted). Although the recovery outline does not include Recovery Criteria, the Preliminary Recovery Strategy does include eight Preliminary Recovery Objectives, which collectively describe the specific conditions under which the goals for recovery of the jaguar (i.e., delisting) will be met. These objectives are:

1. Assess, protect, and restore sufficient habitat to support viable populations of jaguars in the two recovery units;
2. Mediate or mitigate the effects of human population growth and development on jaguar survival and mortality where possible;
3. Reduce direct human-caused (i.e., illegal and legal killing) mortality of jaguars;
4. Reduce illegal hunting of jaguar prey and improve regulation of legal hunting where appropriate (i.e., in cases where hunting is leading to significant reductions of jaguar prey);
5. Maintain or improve genetic fitness, demographic conditions, and health of the jaguar;
6. Assure the long-term viability of jaguar conservation through partnerships, the development and application of incentives for landowners, application of existing regulations, and public education and outreach;
7. Practice adaptive management in which recovery is monitored and recovery tasks are revised by the USFWS in coordination with the Jaguar Recovery Team as new information becomes available; and
8. Support international efforts to ascertain the status and conservation needs of the jaguar in the two recovery units.

The 2012 Recovery Outline for the Jaguar described two recovery units for the jaguar across its range, the Northwestern Recovery Unit (NRU, 222,197 km^2 [85,791 mi^2])(see Figure J1 below) and the Pan American Recovery Unit (PARU, 14.9 million km^2 [5.75 million mi^2])(USFWS 2012a). The analyses in this BO focuses on the NRU. Please note that the boundaries and areal extent of the NRU were revised by Sanderson and Fisher (2013), per Jaguar Recovery Team guidance; these revisions are described in the subsequent section. Recovery units are subunits of the listed species' habitat that are geographically or otherwise identifiable and essential to the recovery of the species (USFWS 2012a). Recovery units for the jaguar are further divided into core, secondary, and peripheral areas (USFWS 2012a). Core areas have both persistent verified records of jaguar occurrence over time and recent evidence of reproduction. Secondary areas are those that contain jaguar habitat with either or both historical or recent records of jaguar presence with no recent record or very few records of reproduction. In peripheral areas, most historical jaguar records are sporadic, and there is no or minimal evidence of long-term presence or reproduction that might indicate colonization or sustained use of these areas by jaguars.

Northwestern Recovery Unit and Northwestern Management Unit

The NRU is about 226,826km^2 (85,578 mi^2); with 29,021 km^2 (11,205 mi^2) in the U.S. and 197,805 km^2 (71,304 mi^2) in Mexico (Sanderson and Fisher 2013). Table J1, below, describes the subdivisions within the NRU. The Northern Management Unit (NMU), as called in the Jaguar Recovery Outline (USFWS 2012a) and now called the Borderlands Secondary Area (BSA)(Sanderson and Fisher 2013), lies within the NRU and is about 62,976 km^2 (24,315 mi^2); with 29,021 km^2 (11,205 mi^2) in the U.S. and 33,955 km^2 (13,110 mi^2) in Mexico (Figure J1 and Table J1).

Within the U.S., jaguar habitat in the NRU primarily occurs on tribal (Tohono O'odham Nation) lands and federally and state owned lands, including those managed by the U.S. Forest Service (Coronado National Forest), Bureau of Land Management, National Park Service, USFWS, and Arizona State Land Department. The remaining lands within the U.S. portion of the NRU are privately owned. Within Mexico, jaguar habitat within the NRU primarily occurs on privately owned, ejido (communal), and indigenous community (i.e., Yaqui) lands. Although there are natural protected areas (ANP) designated by the Comisión Nacional de Áreas Naturales Protegidas (CONANP [National Commission for Natural Protected Areas]) within the NRU, they overlap privately-owned and communal lands. The protected status of these ANPs does not change the land ownership status but instead imposes use restrictions on the lands. At this time, at least eight federally recognized protected areas have been established within the NRU in Mexico that provide for jaguar protection (USFWS 2012a).

Jaguar Critical Habitat

Jaguar critical habitat was proposed in 2012, with a revision in July 2013 (USFWS 2012b and 2013b) , and was finalized on March 5, 2014. It includes six units, including unit 4, the Whetstone Unit, which was divided into subunits: (4a) Whetstone Subunit, (4b) Whetstone-Santa Rita Subunit, and (4c) Whetstone-Huachuca Subunit. Subunit 4c includes portions of the Huachuca Mountains adjacent to Fort Huachuca. Final jaguar critical habitat (USFWS 2014) includes the primary constituent elements (PCEs) listed below.

Expansive open spaces in the southwestern United States of at least 100 square km (38.6 square mi) in size which:

1) Provide connectivity to Mexico;
2) Contain adequate levels of native prey species, including deer and javelina, as well as medium-sized prey such as coatis, skunks, raccoons, or jackrabbits;
3) Include surface water sources available within 20 km (12.4 mi) of each other;
4) Contain from greater than 1 to 50 percent canopy cover within Madrean evergreen woodland, generally recognized by a mixture of oak, juniper, and pine trees on the landscape, or semi-desert grassland vegetation communities, usually characterized by *Pleuraphis mutica* (tobosagrass) or *Bouteloua eriopoda* (black grama) along with other grasses;
5) Are characterized by intermediately, moderately, or highly rugged terrain;
6) Are below 2,000 m (6,562 ft) elevation; and
7) Are characterized by minimal to no human population density, no major roads, or no stable nighttime lighting over any 1-square-km (0.4-square-mi) area.

Only a short summary of jaguar critical habitat is included here, because although jaguar critical habitat was proposed on Fort Huachuca, it was exempted in the final jaguar critical habitat rule (USFWS 2014) and therefore not addressed in this biological opinion.

Environmental Baseline - Jaguar

The environmental baseline includes past and present impacts of all Federal, State, or private actions in the action area, the anticipated impacts of all proposed Federal actions in the action area that have undergone formal or early section 7 consultation, and the impact of State and private actions that are contemporaneous with the consultation process. The environmental baseline defines the current status of the species and its habitat in the action area to provide a platform to assess the effects of the action now under consultation. Also refer to the General Environmental Baseline and Action Area earlier in this biological and conference opinion.

Action Area

The action area is defined as the area within which effects to the listed species and its critical habitat (if any is designated) are likely to occur and is not limited to the actual footprint of the proposed action. The proposed project falls within the northern-most secondary area of the NRU, or the BSA as described in Sanderson and Fisher (2013)(formerly called the NMU in the Jaguar Recovery Outline [USFWS 2012a]). For the purposes of the jaguar analysis, we use the Fort Huachuca Action Area definition (BO page 53, Figure EB1; see page 1-1 and Figure 1-1 of the PBA).

Terrain, Vegetation Communities, and Climate in the Action Area

The Action Area subsection of the general Environmental Baseline section, above, includes descriptions of the terrain, vegetation communities, and climate in the action area.

Status of the Species within the Action Area

Life History and Habitat

Life history of the jaguar is described above in the Status of the Species. Generally, life history elements are similar throughout their range, although some, such as diet and vegetation community use, vary by region.

Distribution and Abundance

No jaguars have been detected within the action area; however, there have been recent confirmed sightings in Cochise County and elsewhere in southern Arizona. The jaguar currently in the

Santa Rita Mountains, previously detected in the Whetstone Mountains, may have traveled through the Huachuca Mountains to arrive at the Whetstones. Although we cannot know with any certainty that the jaguar traveled through the Huachuca Mountains, it remains a logical hypothesis because these mountains provide the most direct suitable travel corridor from Mexico to the Whetstones. We assume the jaguar traveled north from Mexico, as the northern-most recently documented breeding population of jaguars occurs about 210 km (130 mi) south of the U.S./Mexico international border (Brown and López-González 2001,Valdez et al. 2002). Also, two jaguars have been recently documented in Sonora about 48 km (30 mi) southeast of Nogales (i.e., nearly directly south of the Huachuca Mountains). Suitable habitat exists for jaguars on the Fort and adjacent areas; therefore, the species could occur in the future on Fort Huachuca.

Threats

Threats to the jaguar in the action area are similar to threats to the species throughout its range as described under "Status of the Species;" however, in the United States, the threat of illegal killing is not currently a problem (USFWS 2012a). Other threats to jaguars in this region are international border issues such as: infrastructure along and near the U.S.-Mexico border, including pedestrian and vehicle barriers and towers and their associated roads and lighting, and illegal and U.S. Border Patrol traffic (pedestrian and vehicle). Pedestrian barriers designed to prevent the passage of humans also prevent passage of jaguars. Other infrastructure (e.g., roads, vehicle barriers, towers, and lighting) and human activity may limit jaguar movement across the border, but it is uncertain if and how much this is affecting that movement. McCain and Childs (2008) identified open-pit mines as a threat to jaguars in the species core habitats in the southwestern U.S., specifically mentioning the Patagonia and Santa Rita mountains. Connectivity to Mexico is essential for maintaining jaguars in the BSA in Arizona and New Mexico.

Critical Habitat within the Action Area as Defined by Fort Huachuca

Portions of the Huachuca Mountains on and adjacent to Fort Huachuca were proposed as jaguar critical habitat (USFWS 2013b), however, as stated above, Fort Huachuca was exempted in the final jaguar critical habitat rule because of management measures and protections within the Fort's INRMP, which provide for jaguar conservation and recovery (USFWS 2014). Although no critical habitat occurs on the Fort, it is helpful to review what was proposed on the Fort because, as discussed in greater detail in the effects analysis, proposed jaguar critical habitat on the Fort is considered synonomous with high quality jaguar habitat. The portions of the proposed critical habitat on Fort Huachuca were about 15,850 ac (Figure J2) and occurred within the Whetstone-Huachuca Subunit (Subunit 4c) of the proposed critical habitat (USFWS 2013b). This subunit provides connectivity, essential to the conservation of the jaguar, from occupied habitat in the Whetstone Mountains (in Cochise County, north of Fort Huachuca) to occupied habitat in Mexico.

Past and Ongoing Federal Actions in the Action Area

Three projects have undergone formal section 7 consultation for effects to jaguar in the action area. Incidental take of one jaguar has been authorized and no jeopardy opinions have been

issued. A summary of these consultations is below. Although not in the action area, a biological opinion (consultation number 22410-2009-F-0389) was recently issued for the construction and operation of the proposed Rosemont mine in the Santa Rita Mountains, Arizona. Adverse effects to jaguars and proposed jaguar critical habitat were expected to occur from the proposed action; however, we determined that the proposed action was not likely to jeopardize the continued existence of jaguars or destroy or adversely modify proposed critical habitat. Incidental take of one jaguar was anticipated in the form of harassment.

1. *Biological Opinion on Nationwide U.S. Department of Agriculture, Animal and Plant Health Inspection Service-Wildlife Services (USDA, APHIS-WS) Activities on the endangered Jaguar* (Consultation Number 000194RO issued on June 22, 1999)

This consultation analyzed the effects of USDA, APHIS-WS' national animal damage control activities on jaguars. Adverse effects to jaguars could occur from certain animal damage control methods, including the use of leg-hold and box traps, snares, and M-44s. We determined that the proposed action was not likely to jeopardize the continued existence of jaguars and anticipated that, due to animal damage control activities, there would be an undeterminable level of take as a result of harassment and injury, and the take of one jaguar as the result of direct injury or mortality. The anticipated level of take was considered to be exceeded if animal damage control activities are directed at jaguars, or if one jaguar is unintentionally trapped, injured, or killed. To minimize incidental take, a number of reasonable and prudent measures were included in the biological opinion. To date, no incidental take has been documented resulting from WS' program.

2. *Biological Opinion on the Pedestrian Fence Proposed along the U.S. and Mexico Border near Sasabe, Naco, and Douglas* (Consultation number 22410-2007-F-0416 issued August 29, 2007)

This consultation addressed the effects of DHS's construction of a pedestrian fence (and other activities such as road construction and maintenance) along the U.S./Mexico international border near Sasabe, Pima County; Nogales, Santa Cruz County; and near Naco and Douglas, Cochise County. Some pedestrian fence segments that were constructed in these three areas were included in this consultation, while others did not undergo section 7 consultation (because all environmental laws were waived, as permitted by the Real ID Act of 2005, by Secretary of the Department of Homeland Security for construction of part of the border fence). Specifically, pedestrian fence segments were constructed in Sasabe (all 7 mi included in this consultation), Nogales (about 6 mi, roughly 2 of which were included), Naco (about 25 mi, 15 of which were in this consultation), and Douglas (about 17 mi, 7 of which were included). Adverse effects to jaguars were expected to occur from the proposed action by impeding jaguar movement between Mexico and the U.S., disturbing jaguars, and degrading their habitat. We determined that the proposed action was not likely to jeopardize the continued existence of jaguars and no incidental take was anticipated. Conservation measures, including funding for the implementation of jaguar recovery actions, were included to help offset the effects of the action on jaguars.

3. *Biological Opinion on Secure Border Initiative (SBInet) Tucson West Tower Project, Ajo, Tucson, Casa Grande, Nogales, and Sonoita Stations Area of Operation, U.S. Border*

Patrol, Tucson Sector, Arizona (Consultation number 22410-2008-F-0373 issued September 4, 2008)

This consultation addressed the effects of the construction, operation, and maintenance of communication and sensor towers, roads, and mobile surveillance systems, as well as the deployment of unattended ground sensors. Adverse effects to jaguars were expected to occur from the proposed action by disturbing jaguars and degrading their habitat. We determined that the proposed action was not likely to jeopardize the continued existence of jaguars and no incidental take was anticipated. Conservation measures, including funding for jaguar monitoring, were included to help offset the effects of the action on jaguars.

In addition to the aforementioned activities, DHS/CBP has constructed a number of vehicle barriers and pedestrian fences in the action area that have not undergone formal consultation because all ESA compliance was waived, as permitted by the Real ID Act of 2005, by Secretary of the Department of Homeland Security for construction of part of the border fence. Furthermore, CBP – Tucson Sector regularly conducts patrol activities within the action area that may affect jaguars and, with the exception of patrol activities associated with the Tucson West Towers Project, have not undergone formal consultation.

Effects of the Action - Jaguar

Effects of the action refer to the direct and indirect effects of an action on the species or critical habitat, together with the effects of other activities that are interrelated and interdependent with that action, which will be added to the environmental baseline. Interrelated actions are those that are part of a larger action and depend on the larger action for their justification. Interdependent actions are those that have no independent utility apart from the action under consideration. Indirect effects are those that are caused by the proposed action and are later in time, but are still reasonably certain to occur.

The proposed action, Ongoing and Future Military Operations and Activities at Fort Huachuca, Arizona, may result in disturbance to jaguars and their habitat, as well as possible, but highly unlikely, injury or death of a jaguar. That said, because the proposed action may benefit jaguars by reducing the risk of severe fire and managing for open space and wildlife, we anticipate the net effect of the proposed action on jaguars will be beneficial.

Disturbance to jaguars may occur from both auditory and visual stimulus arising from multiple components of the action. Human presence (both pedestrians and vehicles), lights, and noise are associated with ground and air-based military operations, recreational activities, natural resource and fuels management activities, roads, and facilities operations and maintenance.

Jaguars are secretive animals that generally avoid areas of high human use and associated infrastructure, noise, and lights. Nighttime lighting can have a variety of effects on species that are active at night, including jaguar. Such effects can range from altering foraging patterns, predation risk, biological clocks, mortality on roads, and disruption of dispersal movements through artificially lighted landscapes (Longcore and Rich 2004, Beier 2006). Although the specific effects of artificial lighting on jaguars are not known, the effects of human disturbance

and artificial night lighting on large felids have been documented by several studies. Beier (1995) for example found dispersing pumas (*Puma concolor*) avoided night-lights in conjunction with open terrain, suggesting that pumas were moving away from city lights and urban glow and navigating toward the darkest horizon. Ngopresert et al.'s (2007) regression model showed that leopard (*Panthera pardus*) habitat use increased with distance from human settlements. In addition, a manual on the problem of depredation caused by jaguars and puma on cattle ranches states that the installation of lights in livestock corrals is a useful measure to deter jaguars from killing livestock (Hoogesteijn and Hoogesteijn 2010). Based on these findings, it is likely that artificial illumination can disturb jaguars. The degree of the disturbance would likely be related to the brightness and spatial extent, frequency, and duration of the lighting.

Noise, including chronic noise (e.g., heavily travelled roads) to episodic noise (e.g., sonic booms), can affect wildlife in a number of ways, possibly causing, among other things, changes in breeding behaviors, home ranges size and location, and habitat use, activity, and foraging patterns; increased stress response; and possibly damaged hearing if the noise is loud enough (Pater et al. 2009, NoiseQuest 2013). Although no studies have been conducted, that we are aware of, that specifically examine the effects of noise on jaguars, because jaguars are known to be secretive animals, elevated noise levels may result in disturbance to jaguars. As with artificial lighting, the degree of the disturbance would likely be related to the noise level, spatial extent, frequency, and duration.

Impacts to jaguar habitat may also occur from multiple project components, including ground-based military operations, recreational activities, natural resource and fuels management activities, roads and facilities operations and maintenance. Although habitat use patterns of jaguars in Arizona are not well known, based on recent jaguar studies and detections, as well as modeling efforts and proposed critical habitat, we anticipate that jaguars are most likely to use Madrean evergreen woodlands (MEW) and semidesert grasslands (SDG) with intermediately, moderately, or highly rugged terrain. Although we are not analyzing the effects to proposed jaguar critical habitat in the biological opinion, the proposed jaguar critical habitat on Fort Huachuca map (Figure J2) is helpful to understand where high quality jaguar habitat occurs on the Fort. As depicted by the map, jaguar habitat occurs in the hilly or mountainous terrain in the western part of the Fort and adjacent areas in the Huachuca Mountains and Canelo Hills. Critical habitat was not proposed to the east of these areas because of lack of suitable terrain (i.e., lack of intermediately, moderately, or highly rugged terrain), as well as, in some areas, too much human influence. The majority of the proposed critical habitat on the Fort lies within MEW, although small portions lie within SDG and plains and great basin grassland (PGBG). The SDG occurs in the southeastern portion of proposed critical habitat on the Fort, while the PGBG occurs in the northeastern portion (Figure J3). The elevations above 2,000 m are not considered jaguar habitat as jaguars usually occur below this elevation. Although jaguars may occur outside of proposed jaguar critical habitat, we anticipate that impacts from the proposed action in proposed jaguar critical habitat would have the most significant effects to jaguars. That said, impacts outside of proposed jaguar critical habitat may affect jaguars, particularly their movement between areas of higher quality habitat, like proposed critical habitat. For the purposes of this analysis, we herein refer to proposed jaguar critical habitat as high quality jaguar habitat.

We anticipate that fuels management (including mechanical treatment methods and prescribed fire) that occur in high quality jaguar habitat will have the greatest potential to adversely affect jaguars and their habitat (in comparison to other project components). Fuels management activities may temporarily degrade jaguar habitat and disturb jaguars and, although unlikely, the prescribed fire element of fuels management could injure or kill and jaguar. That said, fuels management may also benefit jaguars and their habitat by preventing larger and more severe fires from occurring. Because the majority of military operations and facilities are located outside of high quality jaguar habitat on the Fort, we anticipate that they will generally have fewer effects on jaguars and their habitat. Recreational and resource management activities may have some adverse effects on jaguars; however, overall management of open space at Fort Huachuca benefits jaguars and their habitat and prey. Additionally, conservation measures included in the project description will help avoid and minimize adverse effects to jaguars.

Effects of Military Operations

Ground-based and air operations associated with the Fort may have various effects on jaguars and their prey. Of all the military operations, we anticipate that ground-based operations in high quality jaguar habitat on the Fort (i.e., western portion of the Fort) have the greatest likelihood of disturbing jaguars. However, because these activities rarely occur in this area (i.e., they occur in less rugged terrain outside of the mountains), potential disturbance to jaguars, should they occur on the Fort, is likely to be infrequent. Ground-based and air operations outside of high quality jaguar habitat of the Huachuca Mountains occur frequently; however because jaguars are less likely to use these areas, potential disturbance to jaguars is also likely to be infrequent. Impacts to jaguar habitat from military operations will be minimal; however, there is a risk of fire in jaguar habitat originating from military operations. Regulations, plans, and policies in place to reduce the impact of military operations on the environment, including the risk of fire, will also reduce potential impacts to jaguar habitat.

<u>Ground-based Operations</u>

There are nine major components of ground-based operations at the Fort including: 1) Intelligence and Electronic Warfare Equipment Training and Testing, 2) Communications Systems Training and Testing, 3) Field Training Exercises, 4) Land Navigation Training, 5) Patrolling and Tactics Training, 6) Individual Development Training, 7) Vehicle Maneuver Training, 8) Live Fire Qualification and Training, and 9) Administrative and Support Activities. Most of these activities occur on the post; however, some occur off-post as well. Ground operations can occur year round and many exercises include 24-hour operations. Many of these ground based operations involve both vehicles and personnel deployment to multiple sites. There are 18 established bivouac (training) areas on the Fort, two of which are located in the foothills of the Huachuca Mountains (lower encinal zone of the MEW).

Because most ground-based military activities occur outside of high quality jaguar habitat, effects to jaguars and their habitat from these activities should be limited. That said, periodic live fire takes place on existing weapons qualification ranges in Training Areas Tango 1, 2, and 3, parts of which are in high quality jaguar habitat (or proposed jaguar critical habitat); see Figure 5-7 of the PBA). Active ranges include weapons ranging from pistols to machine guns

and 40 mm grenade launchers. Safety arcs from some of these ranges extend into high quality jaguar habitat (see Figure 2-3 of the PBA), and some of the ranges themselves (e.g., Ranges 6, 8, 9, 10, and 13) appear to be within high quality jaguar habitat. The area of overlap represents a small part of high quality jaguar habitat. These are periodic ongoing activities that take place mainly during daylight, when jaguars are least active. Nighttime firing occurs infrequently (less than 10 times a year) on Ranges 6, 8, 9, 10, and 13. Peak sound levels at the firing points range from 156 to 162 dbP, depending on the weapon (Table 2-1 of the PBA). Sound attenuates as a function of distance from the source and as a result of shielding by terrain; however, portions of high quality habitat closest to the various weapons qualifications ranges would be exposed to elevated noise from gunfire during use of nearby qualifications ranges.

Lighting associated with ground-based military operations in or near high quality jaguar habitat is minimal and mostly intermittent (e.g., headlights on vehicles). There are lights at training facilities (e.g., Papa and Uniform) within high quality jaguar habitat; however, these are only turned on during the intermittent training activities.

Jaguars using or crossing through areas where the majority of ground-based military operations occur (i.e., in lower elevations in less rugged terrain) may be disturbed by these operations; this disturbance could affect jaguar movement between high quality jaguar habitat. However, because many of these operations are intermittent (e.g., weapons training), they are not likely to completely impede jaguar movement across the Fort.

High military use areas (e.g., cantonment, airfield), which are discussed further in sections below, may be avoided altogether by jaguars due to high human presence, lights, and noise associated with these areas. However, because these high military use areas are outside of high quality jaguar habitat, disturbance to jaguars in these areas will likely be a relatively rare occurrence (i.e., jaguars would rarely use the less rugged, lower elevation areas).

Because most ground-based military operations occur only on existing trails, roads, and already disturbed areas, impacts to jaguar habitat will likely be minimal. Cross-country travel on-foot, some of which occurs in lower encinal areas, may cause damage to vegetation that may be used by jaguars; however because this type of travel is conducted in small groups on a limited basis, overall impacts to jaguar habitat should be minimal. Cross-country travel by vehicles is prohibited with the exception of use by the Missouri Air National Guard (MANG) or during emergency situations (e.g., safety and fire). During classes offered by the MANG, short off-road recovery trips will occur in Training Area Bravo. Because this area is outside of high quality jaguar habitat, the latter will not be impacted by this training. Cross-country travel for safety and fire situations could occur in high quality jaguar habitat; however, this type of travel should be a rare event and therefore have little impact on jaguars and their habitat. Regulations, policies, training, and plans in place on the Fort, such as the Off-Highway Vehicle Operation Policy and environmental awareness training, reduce the potential for impacts to the Fort environment, including jaguar habitat, from travel by foot or vehicle.

Fire could occur from military operations and impact jaguars and their habitat; however, measures, such as limiting use of areas or firing of blanks when fire hazard exists and fuels treatments, minimize this risk. According to the Fort, spot fires occur on occasion due to

military activities on the firing ranges (in grassland vegetation); however, these are extinguished immediately. As such, these small range fires likely pose very little risk to jaguars and their habitat.

Direct injury or mortality of jaguars could occur as a result of ground-based military operations, particularly from collisions with vehicles and firing of weapons. With some training exercises, up to 200 vehicles may be used, although exercises with this many vehicles are only conducted one to two times per year. Exercises with fewer vehicles are conducted more frequently. We anticipate the risk of vehicular collisions with jaguars associated with military activities is very low because: 1) jaguars are rare and have never been documented on the Fort, 2) the majority of these activities occurs outside of the high quality jaguar habitat, 3) the posted maximum speed limit is 25 mph in most areas of the cantonment, though major roads have speed limits of 35 to 45 mph, and 4) the speed limit in the Huachuca Mountains is 15 to 25 mph.

Similarly, the risk of injury or mortality of jaguars from weapons use on the qualifying ranges is very low. Although the weapons safety fans on the South Range extend westward into moderately to highly rugged terrain with high quality jaguar habitat, the ranges are generally located in graded or sparsely vegetated areas outside of high quality jaguar habitat. Additionally, managed burns are conducted regularly in the areas around the ranges to reduce fuel loading and fire hazard. Therefore, it is unlikely that jaguars will occur in these areas. High quality jaguar habitat is separated by distance from the ranges and may additionally be afforded protection from stray munitions by intervening topography. Potential risk to jaguars from range use will further be minimized by range safety briefings provided to all soldiers using the range. The briefing provides information on potential special status species that may be present, including the jaguar.

Disturbed ground associated with ground-based operations may be more susceptible to colonization by invasive nonnative plants. Nonnative species may outcompete native species and introduced grasses carry fire better and burn hotter than native species, which would degrade jaguar habitat. The invasive species monitoring and control measures, per the INRMP, should minimize this potential risk.

Air Operations

Air operations at Fort Huachuca include fixed-wing piloted aircraft training and operations, UAS training and operations, unmanned drug and border surveillance balloon operation, and, to a much lesser extent, rotary wing aircraft. Users include the Army and other DOD agencies, as well as non-DOD tenants such as the U.S. Forest Service Air Tanker Base and the Customs and Border Protection border surveillance activities. Most air operations originate from two locations on Fort Huachuca: Libby Army Air Field, located north of the cantonment, and the Black Tower complex in the northwest corner of the West Range. In 2009, 133,877 air operations occurred at Libby Army Air Field (each landing or departure counts as one operation). This level of air operations is expected to continue.

The flight elevations for different aircraft are variable; however, aircraft overflights at altitudes below 500 ft above ground level (AGL) are generally not permitted over the Huachuca Mountains, where jaguars are most likely to occur. According to the PBA, because aircraft

sounds and visual appearance diminish rapidly with increasing altitude, overflights of fixed-wing or rotary wing military aircraft at altitudes above 500 ft above ground level are unlikely to elicit a biologically significant response from jaguars and their prey species. Flights below 500 ft AGL in the Huachuca Mountains may occur under emergency and exigent circumstances; however, these flights are conducted by the U.S. Forest Service and U.S. Customs and Border Protection and are not part of this consultation.

Except for gradual ascents and descents associated with airfield operations, UASs operated at Fort Huachuca generally fly about 5,000 ft AGL or higher. At these altitudes, noise from UAS attenuates to audible but negligible levels on the ground; therefore UAS activity at these elevations is not likely to significantly disturb jaguars. Descents and ascents of UASs and other aircraft may disturb jaguars, however, because the airport and airstrips are located away from high quality jaguar habitat, potential disturbance should be minimal. In other words, noise from descents and ascents is greatly attenuated in high quality jaguar habitat and therefore is not likely to affect jaguar behavior.

Effects of Recreational Activities

Recreational opportunities are made available to soldiers and their families both within and outside of the cantonment. To a lesser degree, the general public can access some parts of the Fort for recreational activities. Public access to recreational areas may be prohibited by the Range Control Officer due to training and testing activities. As a result, some or all of Fort Huachuca may be closed to recreational activities on any given day. The primary recreational activities that occur outside of the cantonment include hunting, birding, hiking, and cycling on existing roads and trails, as well as off-highway vehicle use on existing roads and trails. Overall, there is minimal potential for adverse effects to jaguars on the Fort from recreational activities due to the low amount of human activity in general and the prohibition on recreational activity outside the cantonment at night, when jaguars are generally most active.

Recreational hunting is included in the 2010 Fort Huachuca Integrated Natural Resources Management Plan (INRMP)(Vernadero 2010b). Hunting on Fort Huachuca is open to active and retired military personnel, full-time installation civil service employees, and their families. Mountain lion hunting and hunting with the use of dogs is allowed on the Fort. Both a Fort Huachuca-issued permit and AGFD hunting license is required. Hunting activities, including walking through jaguar habitat with dogs, inadvertently baying or treeing a jaguar with dogs, and shooting in jaguar habitat may disturb jaguars. Of these, baying or treeing jaguars with dogs would have the greatest potential impact on jaguars. Jaguars have been treed by dogs several times recently in Arizona, however, it has not occurred on the Fort. Should jaguars be treed or bayed on the Fort, they would likely experience a stress response and would be prevented from feeding, breeding, and sheltering during the time they were treed. This, however, should last only a short time as the hunters are required to follow AGFD hunting regulations which require hunters to: 1) stop pursuing a jaguar once they aware that they are in pursuit of one, 2) call dogs off immediately, and 3) allow the jaguar to leave the area and take all steps to not intentionally harass the animal. We do not anticipate that temporarily preventing male jaguars from feeding, breeding (should female jaguars occur in the area, which has not been documented), or sheltering would have severe consequences (i.e., lead to death), as they do not care for young. If females

were to occur in the area and be treed, temporarily preventing them from feeding, breeding, and sheltering could be much more detrimental as they care for young (young left alone would be vulnerable to predation and starvation). Again, however, females and their young have not been recently documented in Arizona. After being treed or bayed, jaguars may temporarily continue to experience increased stress levels and alter their behavior, including avoiding the area in which they were treed or bayed. Overall, possible disturbance to jaguars from hunters should be infrequent (as jaguars are rare) and temporary.

Occasional discharge of firearms by hunters represents a source of noise within MEW. However, noise from sporadic gunshots during hunting season is infrequent and of momentary occurrence and therefore, not likely to be a significant source of disturbance to jaguars. Jaguars, should they occur in the action area, could be unintentionally shot by hunters, however, the risk of this occurring will be significantly decreased by conservation measure J-O-4 which will ensure that hunters are aware and cognizant of the presence of jaguar in the area (see the conservation measure section below for details).

Recreational activities such as birding, hiking, bicycling, and picnicking, occur on the Fort, including in MEW and SDG, and may result in disturbance to jaguars and their habitat. We anticipate potential disturbance to jaguars from these activities will be fairly minimal as these activities are only allowed during daylight (when jaguars are generally less active) on designated roads, trails, and picnic areas. Horseback riding is available but limited to the on-post stables within the cantonment. Although authorized, no significant horseback riding occurs elsewhere on the Fort; however, grazing, does occur in three areas (Pastures A, B, and C which are collectively about 1.433 ac) that support 50 to 60 horses (Vernadero 2010b) during a portion of the year. Due to the location of the stables and pastures (in lower elevation grasslands and disturbed areas), we anticipate few effects to jaguars from horse-related activities.

Off-highway vehicle use on Fort Huachuca is low; however, OHVs are permitted on established roads and firebreaks outside the cantonment area that are intended for public use. OHVs may disturb jaguars and degrade their habitat, particularly OHV use in high quality jaguar habitat; however, potential disturbance to jaguars and their habitat will be minimized as cross-country driving is strictly prohibited except for emergencies. OHVs could potentially strike and injure or kill a jaguar crossing a road; however, we anticipate the risk of this occurring is very low because: 1) jaguars are rare and have never been documented on the Fort, 2) OHV use on the Fort is low, 3) the posted maximum speed limit is 25 mph (in most areas), and 4) OHV use is only allowed during daylight hours.

As described above in the ground-based operations discussion, disturbed ground associated with recreational activities may be more susceptible to colonization by invasive nonnative plants. Nonnative species may outcompete native species and introduced grasses also carry fire better and burn hotter than native species, which would degrade jaguar habitat.

Effects of Natural Resource Management Program

The primary goal of the natural resources management program for Fort Huachuca is to protect naturally-evolved biotic communities and landscapes to support military land-based training. As

part of this program, Fort Huachuca has developed environmental and natural resource specific planning documents, including the Integrated Natural Resources Management Plan and Integrated Wildland Fire Management Plan, the effects of which are discussed below. The Fort's natural resource management programs benefit jaguars and their prey by maintaining open space and managing for wildlife conservation; specific aspects of these programs, however, may adversely affect jaguars and their habitat.

Integrated Natural Resources Management Plan (INRMP)

The Fort Huachuca INRMP, updated in March 2010 (Vernadero Group 2010b), is a plan of action for the management of natural resources and military training and operational activities. The purpose of the INRMP is to guide the implementation and integration of natural resources management on Fort Huachuca including special-status species, terrestrial and aquatic wildlife, migratory birds, airport wildlife and bird-aircraft strike hazard, groundwater resources, land and forest, floodplain and wetlands, vegetation, wildland fire, invasive species, pests, and outdoor recreation. Although specific aspects of the Fort's INRMP (e.g., recreational activities, which are discussed above) may adversely affect jaguars and their habitat, overall the plan benefits jaguars by maintaining open space and managing for ecosystem and wildlife conservation.

Fuels Management/Integrated Wildland Fire Management Plan (IWFMP)

Fort Huachuca is participating with other federal agencies in the FireScape program (USDA FS 2009a), which provides for fuels management in the Huachuca Mountains. Fort Huachuca's Integrated Wildfire Management Plan (Gebow and Hessil 2006) provides a planning framework for reducing the risk of fire and fire suppression effects on listed species. The risk of a fire originating in lower-elevation training areas reaching forested habitat in the upper elevations is reduced to some extent by fuel management activities in lowland habitats and to a network of fire breaks that the Fort has established along ridgelines. The FireScape consultation is not current, however, so this BO will include an analysis of the effects of Fort Huachuca's fire and fuel treatment activities.

Fuels management, prescribed fire, managed natural fire, and wildland firefighting have the potential to affect jaguars and their habitat. According to the PBA, fuels management on the Fort is ongoing and employs a variety of hand methods, combined with prescribed burning. Fuels modification activities in wooded habitats, including MEW (within high quality jaguar habitat), expected to be used by jaguar are designed to reduce the density of vegetation in oak, pine-oak, oak-pine, and mixed conifer vegetation in an attempt to return these communities to a more natural condition following decades of fire suppression. Based on this, we anticipate that fuels management activities in MEW would have the greatest potential (in comparison to other proposed activities) for adversely affecting jaguars and their habitat. Fuels management activities, including thinning, slash removal, and prescribed fire may temporarily degrade jaguar habitat and disturb jaguars. As described above, a small amount of SDG and PGBG occurs within proposed jaguar critical habitat (Figure J3) or high quality jaguar habitat, so fuels management in these areas may also affect jaguars and their habitat. Although unlikely, the prescribed fire element of fuels management could injure or kill a jaguar. The Fort's IWFMP is due to be updated in coordination with our office before 2016.

Depending on funding and environmental conditions, the Fort proposes to treat (thin and burn) up to 6,310 ac in the upper elevations on the Fort over the next 10 years. See Table J2 below for the number of acres of each biotic community proposed to be treated over the next 10 years in the upper elevations. The largest treatment unit of MEW is 1,500 ac; the largest treatment unit of PMCF is 650. The upper elevation treatment units will have more than a single treatment occurring within them over the 10 years. The initial treatment will be mechanical to reduce the fuel load, once a treatment unit has undergone sufficient mechanical treatment to reduce flame lengths to an appropriate height to ensure safe burning conditions, controlled burns will be implemented within the unit.

Depending on funding and environmental conditions, the Fort proposes to treat (primarily burning, although some mechanical fuels reduction may be required, such as mesquite mastication) up to 5,120 ac annually of SDG/PGBG in lower elevations. The nature of the treatment regimen within the higher elevation woodlands and lower elevation grasslands differs greatly; therefore, the number of acres proposed for treatment are reported differently in the tables above and below (decadal versus per annum) for the purposes of this analysis.

Over 10 years, about 23 percent or 3,685 ac of high quality jaguar habitat (of 15,850 ac on the Fort), all within MEW, will be treated for fuels management. Although we do not know the home range size of jaguars in Arizona, considering that home ranges in Sonora range from 84 to 200 km^2 (20,757-49,421 ac), using the estimation of high quality jaguar habitat that will be treated over 10 years (3,685 ac), an equivalent of about 7 to 18 percent of a jaguar home range, will be directly impacted over 10 years by the project. This figure assumes no overlap in jaguar home ranges. The calculation of potential jaguar home ranges was made by the dividing the estimated acres of proposed jaguar critical habitat (high quality jaguar habitat) to be treated over 10 years (3,685 acres) by the largest and the smallest jaguar home range estimates (20,757-49,421 ac), respectively. Because jaguar home ranges generally overlap, the proposed fuels management activities could impact additional jaguar home ranges (or parts of additional jaguar home ranges). That said, jaguars have not been detected on the Fort; therefore, we cannot accurately predict at this time whether one or possibly more home ranges will be affected on the Fort by fuels treatment. If jaguars are detected on the Fort in the future, it would be prudent to reassess the potential impacts of the action on jaguars. It is important to note that the impacts to high quality jaguar habitat from fuels management will be temporary and although vegetation, including canopy cover, may be temporarily altered, other variables known to be important to jaguars, such as terrain ruggedness, will not change due to fuels management.

In addition to affecting jaguar habitat, the project will also result in temporary impacts to jaguar prey habitat. Fuels management may cause a temporary reduction in the jaguar prey base; however, according to the PBA, fresh vegetative growth stimulated by fuels management activities and reduction of litter and woody debris favors herbivores (i.e., prey for jaguars). Therefore, fuels management should increase the prey base, which would be beneficial for jaguars.

In addition to impacts to jaguar habitat, crews conducting fuels management work (e.g., running chainsaws and weedeaters, walking and driving) may disturb jaguars, should they occur in the

area, using the treatment units and cause them to temporarily flee or avoid the areas. Temporary avoidance of the treatment areas could cause jaguars to travel longer distances, possibly into or through less suitable habitat. Extra travel would require jaguars to expend additional energy and increase the potential for encounters with humans, vehicles, potential predators (i.e., cougars, jaguars), and other stresses. These potential effects to jaguars will be temporary; however, they could be ongoing for the life of the project.

The prescribed fire element of fuels management could injure or kill a jaguar; however, we anticipate that the risk of this occurring is very low as jaguars are rare and have never been documented on the Fort, and only a small percentage of potential jaguar habitat will be treated each year. Furthermore, this risk will be reduced by the Fort's camera monitoring program (see see J-O-1 and J-O-3). According to the U.S. Forest Service, the agency that operates controlled burns on the Fort, prescribed fire typically moves much slower than wildfire and it is very unlikely that a jaguar would not be able to leave the area, simply because the fire behavior of a controlled burn is not that extreme (Shane Hall, U.S. Forest Service, via Debbie Brewer, January 6, 2014 electronic mail)(note, the communication was regarding ocelots, but because jaguars are larger and faster than ocelots, this statement should also apply to jaguars).

According to the PBA, the history of fire suppression in the area has allowed for increased fuel density, which combined with extreme weather conditions, has led to hotter, larger, and more destructive wildland fires in recent years. Therefore, although fuels management may temporarily adversely affect jaguars, it will also likely benefit jaguars and their habitat by preventing larger and more severe fires from occurring. More severe fires, like stand replacing fires, could potentially degrade much larger amounts of jaguar habitat than the proposed fuels management. Furthermore, areas affected by severe fires generally take much longer to recover than areas treated for fuels reduction.

A number of conservation measures will reduce the risks to jaguars and their habitat from fuel management. For example, fuel management planning on the Fort is being updated in coordination with our office and the USFS Missoula Fire Sciences Laboratory to ensure all necessary precautions are taken to protect jaguars and their habitat. Additionally, the Fort will continue its remote camera monitoring (conservation measure J-O-1), coordinate all fuel treatment activities within the jaguar habitat with the USFWS (conservation measure J-O-2), and conduct pre-treatment, during-treatment, and post-treatment monitoring coordinated with the USFWS (conservation measure J-O-3) as described below and in Section 2.13.1.8 (Conservation Measures) of the Description of the Proposed Action (pages 2-36 of the PBA).

<u>Effects of Facilities, Roads, and Fencing Development and Maintenance</u>

Facilities construction, operations, and maintenance, including the cantonment area

Most future military construction projects will be within the cantonment or other compatible land in already disturbed habitat. Because the cantonment is outside of high quality jaguar habitat, we anticipate that construction activities will have little effect on jaguars. Likewise, because the majority of existing facilities are in the cantonment, we anticipate that operations and maintenance of the facilities have minimal effects on jaguars. Noise and lights associated with

the cantonment attenuate with distance and therefore would likely not be a significant source of disturbance to jaguars in high quality jaguar habitat. Jaguars may avoid the cantonment due to high human presence, traffic, lights, and noise; however, because it is located outside of high quality jaguar habitat, it is unlikely that jaguars would regularly use the area regardless of human presence. Jaguars may be deterred from moving through the cantonment in search of higher quality habitat; however, because the cantonment area is not fenced, the area should not act as a complete barrier to jaguar movement. The Fort is committed to consulting with the USFWS if future development projects, upgrades, or improvements may affect this species.

Roads construction, use, and maintenance

No new roadways or roadway widening, power lines, pipelines, mining or development activities, are proposed or projected by the Fort within high quality jaguar habitat. Outside of high quality jaguar habitat, two road construction projects are proposed in already disturbed areas of the Fort. One new two-lane road is planned around the airfield; it will realign the monitor site road for the north taxiway extension (Debbie Brewer with Fort Huachuca, December 19, 2013, electronic mail). It is unlikely that jaguars occur near the realignment as it is already disturbed with high amounts of human activity; therefore, we do not anticipate that the construction or use of this road will affect jaguars or degrade their habitat. Road widening from two lanes to four lanes is planned for Lawton Road that will result in a loop of four lanes (Debbie Brewer with Fort Huachuca, December 19, 2013, electronic mail). Because the proposed road widening will occur in already disturbed areas of the cantonment, no jaguar habitat should be impacted. Activities associated with road widening and the vehicles using the widened road could disturb jaguars moving through the area; however, these impacts would be temporary. Furthermore, because high levels of human activity already occur in the cantonment, activities from road widening are not likely to represent a significant increase in activity. Four-lane roads accommodate more traffic than two-lane roads, therefore, widening may increase the risk of vehicular collisions with jaguars. However, we anticipate that this risk is low because: 1) jaguars are rare and have never been documented on the Fort, 2) the road is located outside of high quality jaguar habitat, 3) the posted maximum speed limit is 25 mph in most areas of the cantonment, though major roads have speed limits of 35 to 45 mph, and 4) the speed limit in the Huachuca Mountains is 15 to 25 mph.

The use of roads associated with some activities (i.e., ground-based military operations, recreational activities) is analyzed in sections above; however, use of roads not analyzed above (e.g., ingress and egress, administrative use) is addressed here. Vehicular collisions with large felids, such as jaguars, are known to be a threat and source of mortality. That said, we anticipate risk of vehicular collisions with jaguars associated with general operations on the Fort is low because: 1) jaguars are rare and have never been documented on the Fort, 2) the majority of these operations occurs outside of the MEW, and 3) the posted maximum speed limit is 25 mph in most areas. Vehicles will likely collide with potential jaguar prey; however, we do not anticipate it will have a significant impact on the jaguar prey base or to jaguars.

The following roads maintenance information is not included in the PBA but was provided by Fort Huachuca (Debbie Brewer, electronic mail December 19, 2013). Road maintenance is conducted on an as needed or emergency basis. Unimproved roads throughout the Fort are

maintained, although some more than others. In MEW areas, where most of the high quality jaguar habitat occurs, unimproved roads including fire breaks (one-lane dirt roads) are only minimally maintained. Outside of MEW and montane environments in general, unpaved roads are graded twice a year (at the most) and paved roads are repaved once every 20 to 25 years. Generalized maintenance such as filling potholes or repairing monsoon damage is done as needed. All road maintenance is conducted within the existing roadways and roadbeds. Road maintenance activities, particularly those that occur in high quality jaguar habitat, may disturb jaguar near the activities. However, because road maintenance activities occur infrequently, potential disturbance from these activities to jaguar is unlikely. Similarly, maintenance activities are unlikely to degrade jaguar habitat as all maintenance takes place in the roadway itself.

Fencing

The Fort boundary is fenced with four-strand barbed wire fencing. Although this could inhibit some wildlife movement, we do not anticipate that it will prevent jaguars or their prey from crossing the boundary of the Fort. No impermeable fences are proposed on the Fort.

Effects of Off-post Activities Authorized or Carried Out by Fort Huachuca

Off-post activities authorized or carried out by Fort Huachuca are limited to equipment maintenance or periodic checks (mostly a single vehicle sitting on the side of the road testing communication equipment) and are not expected to significantly affect jaguars or their habitat.

Effects of Conservation Measures

Conservation measures included in the proposed action will help avoid and minimize potential adverse effects to jaguars. Specifically, the following conservation measures for jaguars and ocelots have been included in the Description of the Proposed Action (page 2-36 of the PBA):

J-O-1: The Fort will continue and expand its non-invasive (e.g., motion detector cameras) monitoring program for the presence and movement of ocelot and jaguar within installation boundaries. This monitoring program will be in place throughout the consultation period.

J-O-2: The Fort will coordinate all fuel treatment activities within jaguar and ocelot habitat (Madrean evergreen woodland) with the Service to avoid adverse effects to jaguar or ocelot.

J-O-3: The Fort will conduct monitoring of proposed control burn areas for at least three months before controlled burn treatment within jaguar and ocelot habitat (Madrean evergreen woodland). Post treatment monitoring will be implemented if a burn is approved in an area where jaguars or ocelots are detected during monitoring. The Fort will develop a monitoring plan in coordination with the Service. If a jaguar or ocelot is detected, the Fort will coordinate and consult with the Service to avoid or minimize adverse effects to the species before any controlled burns occur. Additionally, should an ocelot or jaguar be detected during any monitoring, the Fort will coordinate with the Service to minimize

adverse effects to the species before mechanical treatment occurs in the area where the ocelot or jaguar were detected.

J-O-4: The Fort will ensure that hunters are aware and cognizant of the presence of ocelot and possible presence of jaguar in the area via the annual Hunting Fact Sheet with the following Advisory: “Predator hunters: Hunters, especially predator tag holders, must be familiar with identifying features of jaguars, ocelots and Mexican wolves, (see pp. 68, 69 and 105 in "2013-14 Arizona Hunting Regulations"). All 3 species are protected by state and federal law. An ocelot has been documented in the Huachuca Mountains several times recently and a jaguar in an adjacent mountain range. Responsible, prudent hunters will know exactly what they are shooting. Shooting a protected species on the fort could significantly restrict hunting opportunities in the future, for all hunters. Additionally, it is a State and federal offense to "take" any of these species.”

The conservation measures will reduce the risk of jaguars being killed or injured by fuels management activities or by hunters. The general jaguar monitoring program will help provide wildlife and land managers with valuable information on jaguar presence on the Fort.

Effects to Recovery of the Jaguar in the ASMU with the Project

Because no recovery criteria have been established for the species, we cannot determine how the proposed project will specifically affect the downlisting and delisting of jaguars. As stated in the “Status of the Species”, eight recovery objectives were outlined in the Jaguar Recovery Outline.

Although the proposed action may adversely affect jaguars (should they occur in the area) and their habitat, including possibly temporarily impacting sufficient habitat to support an equivalent of about 7 to 18 percent of a jaguar home range over 10 years, the overall action will benefit jaguars by reducing the risk of severe fires, and maintaining open space and habitat for jaguars. Therefore, in totality, the proposed action should contribute to recovery of jaguars in the NRU.

Cumulative Effects - Jaguar

Cumulative effects include the effects of future State, local, or private actions that are reasonably certain to occur in the action area considered in this biological opinion. Future Federal actions that are unrelated to the proposed action are not considered in this section because they require separate consultation under section 7 of the Act.

Many lands within the action area are managed by Federal agencies; thus, many activities that could potentially affect jaguars are Federal activities subject to section 7 consultation. The effects of these Federal activities are not considered cumulative effects. However, a portion of the action area also occurs on private lands. Residential and commercial development, road construction, farming, livestock grazing, mining, off-highway vehicle use, and other activities occur on these lands and are expected to continue into the foreseeable future. These actions, the

effects of which are considered cumulative, may result in fragmentation, loss, or degradation of jaguar habitat and disturbance to jaguars. Additionally, population growth on State and local lands in the Sierra Vista Subwatershed is likely to result in an increase in recreational activities in the Fort Huachuca/Sierra Vista region, including the SPRNCA and the Coronado National Forest. Increased recreation may increase the potential for human disturbance to jaguars, as well as degradation or loss of habitat for both the jaguar and its prey (e.g., from wildfires, off-road vehicle use). Although not documented recently in the U.S., illegal hunting of jaguars adversely affects jaguars. Illegal activities associated with cross-border smuggling and illegal immigration (e.g., human traffic, deposition of trash, creation of trails and routes, and increased fire risk from human traffic) also occur in the action area. These activities can also degrade jaguar habitat and disturb jaguars.

Conclusion - Jaguar

After reviewing the current status of the jaguar, the environmental baseline for the action area, and the effects of the proposed action, it is our biological opinion that the project, as proposed, is not likely to jeopardize the continued existence of the jaguar. Critical habitat has been designated for this species in the action area outside of the Fort's boundaries; thus critical habitat will be minimally affected by the proposed action. We base our conclusion on the following:

- Although we anticipate the proposed action will result in impacts to jaguar habitat, the impacts are relatively small in the context of the range within the NRU of jaguars (i.e., at the recovery unit scale). More specifically, about 3,685 ac of high quality jaguar habitat will be treated for fuels management over 10 years, which is sufficient habitat to support an equivalent of about 7 to 18 percent of a jaguar home range. Impacts to jaguar habitat from other project components will be minimal. The NRU is about 226,826 km^2 or 56,049,925 ac. Not all of the NRU contains high quality habitat; therefore, we cannot determine the exact percentage of high quality habitat to be impacted by the proposed action in the context of the total acres of high quality habitat in the NRU. However, the percentage of the total NRU that will be impacted by the proposed action is less than 0.01 percent. Additionally, most of the impacts will be temporary;

- Although we anticipate the proposed action will result in disturbance to jaguars, should they occur in the action area, the number of jaguars that may potentially be disturbed is small in comparison to the estimated number of jaguars in the NRU. More specifically, given the amount of high quality jaguar habitat that will be affected by the project, we anticipate that only one jaguar, if jaguars are present in the action area, may be disturbed by the proposed action. Because jaguar home ranges can overlap, it is possible that more jaguars could be affected; however, this is unlikely as no jaguars have been detected in the Huachuca Mountains. The number of jaguars in the NRU is not known; however, the Mexican National Jaguar Census (Manriquez, CONANP, July 15, 2011, electronic mail) indicate there are an estimated 750 jaguars in Sonora, Sinaloa, Nayarit, and Jalisco; these states represent the majority of the area of the NRU in Mexico. Using this estimate, the proposed action may disturb about 0.1 percent of jaguars in the NRU;

- Although abundance and population trends for the jaguar rangewide are not well known and populations throughout the species' range continue to be at risk, the proposed project will not have an appreciable impact on the population at the rangewide (there are an estimated 30,000 jaguars throughout the species' range) or NRU-specific scales (as explained above, there are an estimated 750 jaguars in the states that comprise the majority of the Mexico portion of the NRU). Disturbing one jaguar, should jaguars occur in the action area, out of 30,000 rangewide or about 750 jaguars in the NRU represents a very small percentage of total jaguars in the NRU (about 0.1%) or rangewide (about 0.003%). Thus, the proposed action is not expected, directly or indirectly, to reduce appreciably the likelihood of both survival and recovery of the jaguar in the wild by reducing the reproduction, numbers, or distribution of the species;

- Conservation measures (J-O-1, J-O-2, J-O-3, J-O-4) in the proposed action are anticipated to avoid and minimize adverse effects of the proposed action to jaguars;

- Recovery is the process that stops the decline of an endangered or threatened species by removing or reducing threats. Recovery ensures the long-term survival of the species in the wild. At that point, the species is recovered, and protection of the ESA is no longer necessary. The aforementioned effects will not appreciably reduce the likelihood of recovery of the jaguar because of the beneficial aspects of the conservation measures and based on the relatively minor part of the range of the jaguar that the U.S.represents; and

- The proposed action is anticipated to benefit jaguars by reducing the risk of severe fires that could significantly impact jaguar habitat, and maintaining open space and habitat for jaguars.

The proposed action does not appreciably reduce the likelihood of jaguar recovery within its historical range. The adverse effects that do occur in the action area are small and do not reach the scale where recovery of the species would be delayed or precluded. We make this conclusion for the following reasons:

- The potential area of effect (about 3,685 ac) is a miniscule part (about 9.9×10^{-7} percent) of the range of the species (the jaguar ranges from the southern U.S. to northern Argentina which totals about 5.8 million mi^2 or 3,712,000,000 acres);

- The proposed conservation measures reduce the chance for impacts (i.e., reduce the risk of jaugars being killed or injured by fuels activities or by hunters) to the jaguar; and

- Jaguars have yet to be detected at Fort Huachuca or in the Huachuca Mountains. Therefore, it is unlikely that their recovery will be negatively impacted by the effects of the proposed action.

FWS is unable to identify a reliable recovery "tipping point" or threshold for the jaguar because it is not technically feasible, due partly to a lack or rigorous, long-term data sets on population and habitat parameters. Because we cannot identify a tipping point, we cannot determine whether that tipping point would be reached as a result of agency operations. Since the impacts of the proposed action are minimal and the action area is miniscule compared to the range of the

species, it is highly unlikely that the proposed action, or any action in the U.S., would cause a tipping point away from recovery to be reached. The tipping point for jaguar would likely occur outside of the U.S., since most of the jaguar's range is to the south. The adverse effects that do occur in the action area do not reach the scale where recovery of the species would be delayed or precluded. Adverse effects and associated incidental take from the proposed action are anticipated to be almost non-existent, and are unlikely to destroy or adversely modify the critical habitat in the action area to the extent that recovery would be delayed or precluded for many of the reasons found in the conclusion and discussion above.

The conclusions of this biological opinion are based on full implementation of the project as described in the Description of the Proposed Action section of this document, including any Conservation Measures that were incorporated into the project design.

INCIDENTAL TAKE STATEMENT - JAGUAR

Section 9 of the Act and Federal regulation pursuant to section 4(d) of the Act, prohibit take of endangered or threatened species, respectively, without special exemption. "Take" is defined as to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or to attempt to engage in any such conduct. "Harm" is further defined to include significant habitat modification or degradation that results in death or injury to listed species by significantly impairing behavioral patterns, including breeding, feeding, or sheltering. "Harass" is defined in the regulations as ``an intentional or negligent act or omission which creates the likelihood of injury to wildlife by annoying it to such an extent as to significantly disrupt normal behavioral patterns which include, but are not limited to, breeding, feeding, or sheltering (50 CFR §17.3). Incidental take is defined as take that is incidental to, and not the purpose of, the carrying out an otherwise lawful activity. Under the terms of section 7(b)(4) and section 7(o)(2), taking that is incidental to and not intended as part of the proposed action is not considered to be prohibited taking under the Act provided such taking is in compliance with this Incidental Take Statement.

Amount or Extent of Take Anticipated – Jaguar

Occupancy is difficult to document for rare and secretive animals. While there are no documented occurrences of jaguars on the Fort or in the Huachuca Mountains, we conclude that, based on the consistent occurrence of jaguars in nearby areas and the presence of appropriate habitat and habitat connectivity, jaguars are likely to occur in the action area. However, we do not anticipate the proposed action will result in incidental take of jaguars because, although we consider the action area likely to be occupied by jaguars, we do not believe it meets the standards relating to reasonably likely to occur as defined under the Arizona Cattle Growers' Association v. U.S. Fish and Wildlife Service decision in 2001 by the 9th Circuit Appellate Court (273 F.3d 1229). In other words, we are not reasonably certain that take of a jaguar will occur. If, however, jaguars are definitively documented in the action area in the future, reinitiation of consultation would be prudent to reexamine incidental take.

CONSERVATION RECOMMENDATIONS - JAGUAR

Section 7(a)(1) of the Act directs Federal agencies to utilize their authorities to further the purposes of the Act by carrying out conservation programs for the benefit of endangered and threatened species. Conservation recommendations are discretionary agency activities to minimize or avoid adverse effects of a proposed action on listed species or critical habitat, to help implement recovery plans, or to develop information.

To conserve the jaguar, we recommend that Fort Huachuca implement the following:

1. Participate in the implementation of the Jaguar Recovery Plan, once it is developed; and

2. Pursue funding for jaguar monitoring, research, and conservation needs identified by the Jaguar Recovery Team.

In order for the Service to be kept informed of actions minimizing or avoiding adverse effects or benefitting listed species or their habitats, the Service requests notification of the implementation of any conservation recommendations.

Table J1. Modeled habitat and potential jaguar numbers of jaguars in the Northwestern Management Unit (NMU) and Northwestern Recovery Unit (NRU) using model version 13 (Sanderson and Fisher 2013).			
Subunit	Area of subunit km^2	Estimate of Habitat Area km^2	Estimated number of potential jaguars
Jalisco Core Area	54,949		1,4101,318
Sinaloa Secondary Area	31,191		1,198929
Sonora Core Area	77,710		1,6701,124
Borderlands Secondary Area/NMU – Mexico	33,955		13537
Borderlands Secondary Area/NMU – U.S.	29,021		276
BSA/NMU - Total	62,976		16243
NRU – Mexico	184,676197,805		4,4133,408
NRU – United States	62,976		6
NRU – Total	227,782		4,4403,414

Table J2. Approximate upper range (in acres) proposed to be treated within a 10-year period on Fort Huachuca, Arizona by biotic type in upper elevations.			
Biotic community	Upper range to be treated within 10 years	Total acres of biotic community occurring on the Fort	Percentage of vegetation type to be treated
Madrean Evergreen Woodland (MEW)	5,500	20,342	27
Petran Montane Conifer Forest (PMCF)	690	3,875	18
10 YEAR TOTAL	**6,190**	**24,217**	

Table J3. Approximate upper range (in acres) proposed to be treated annually on Fort Huachuca, Arizona by biotic type in lower elevations.		
Biotic community	Upper range to be treated within 10 years	Total acres of biotic community occurring on the Fort
Semidesert Grassland (SDG)/Plains and Great Basin Grassland (PGBG)	5,120	46,892 of SDG; 1,867 of PGBG
ANNUAL TOTAL	**5,120**	**48,759**

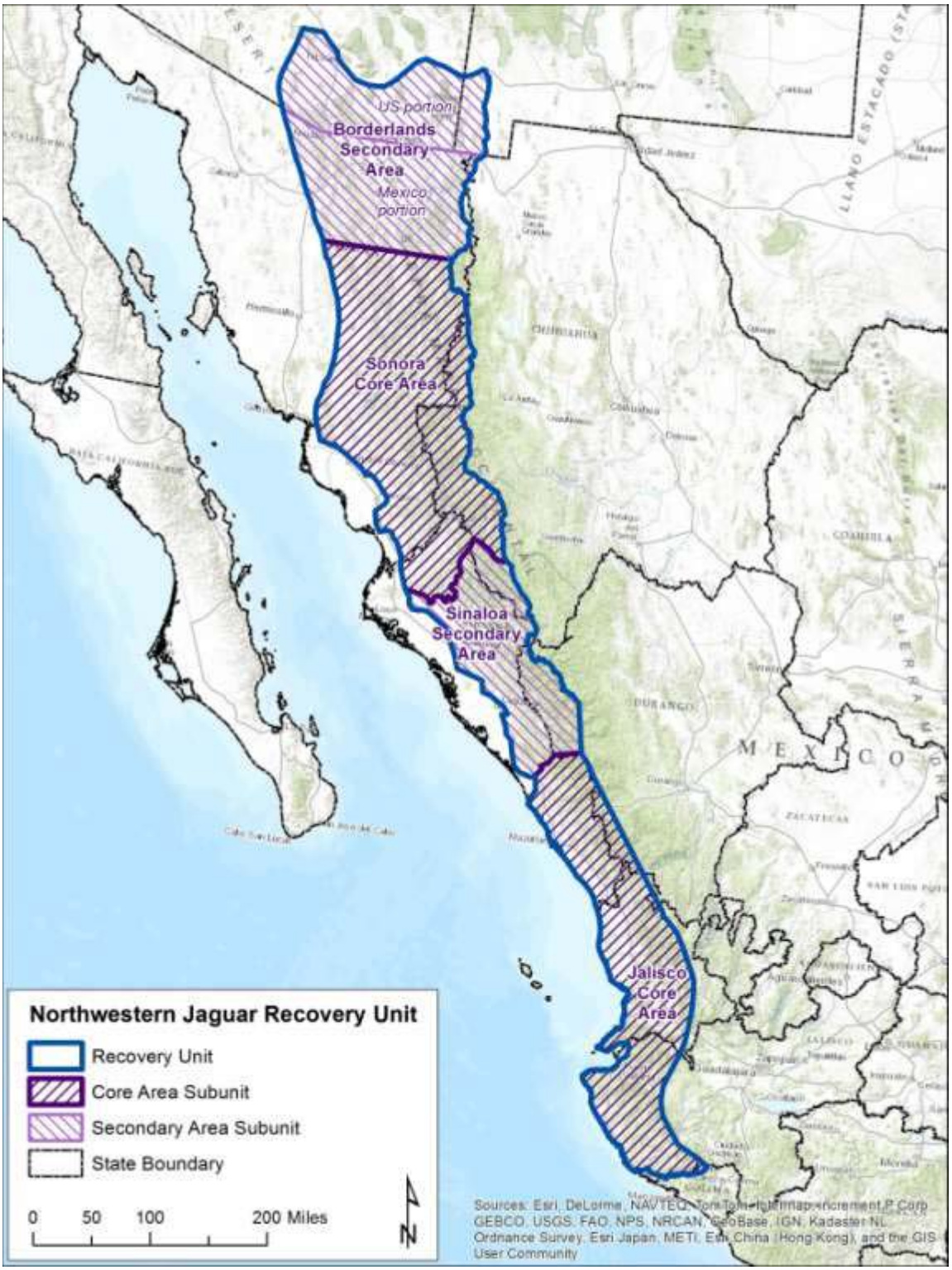

Figure J1. Northwestern jaguar recovery unit, U.S. and Mexico.

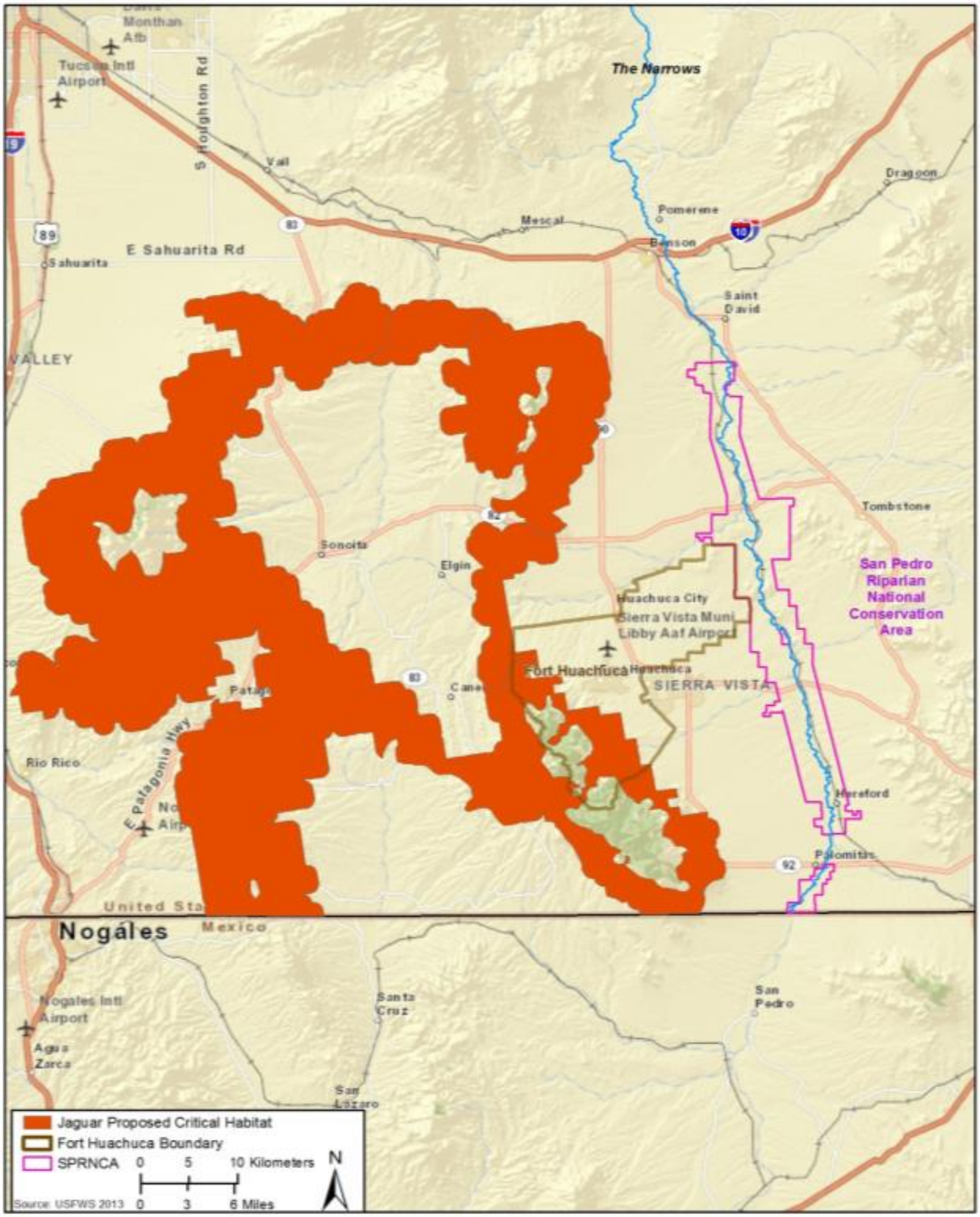

Figure J2. Proposed critical habitat (2013) for the jaguar on Fort Huachuca, Arizona (Figure Figure 5-7 of the PBA). Critical habitat has been designated (USFWS 2014), but not on Fort Huachuca. The purpose of this is to show what is the most likely jaguar habitat on Fort Huachuca.

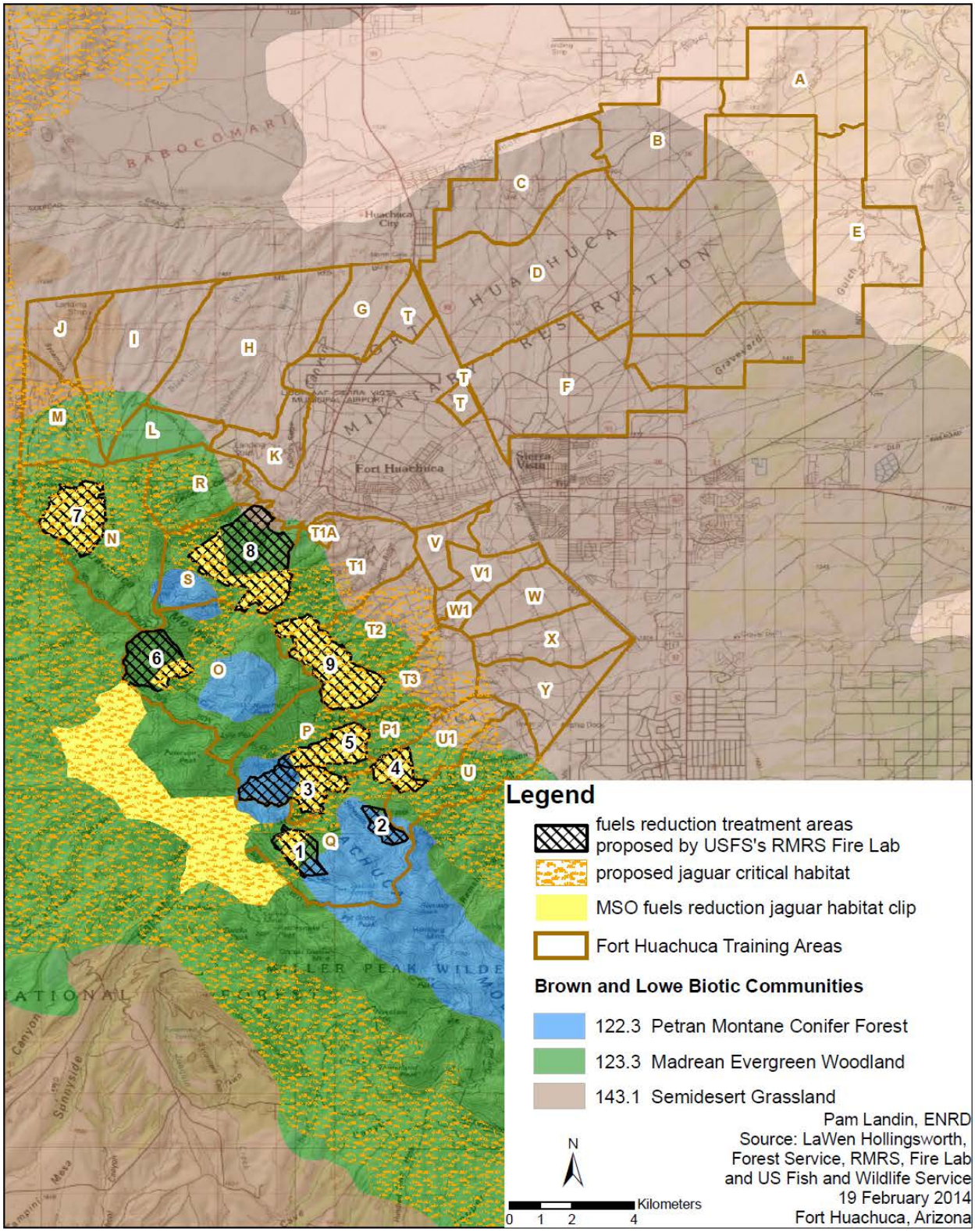

Figure J3. Biotic communities, proposed jaguar critical habitat, and fuel treatment areas on Fort Huachuca, Arizona.

Col. Daniel J. McFarland

SONORAN TIGER SALAMANDER

Status of the Species

Description, Legal Status, and Recovery Planning

The Sonoran tiger salamander (*Ambstyoma mavortium stebbinsi*) is a large salamander with a dark venter and light-colored blotches, bars, or reticulation on a dark background. Metamorphosed terrestrial Sonoran tiger salamanders have a color pattern ranging from a reticulate pattern with an irregular network of light coloration, often coupled with light spots, on a dark background color to a pattern of large, well-defined light or yellow spots or transverse bars, some of which encroach on the dark venter (Jones et al. 1988). Branchiate adults are gray to olive on the dorsum, head, and tail, and off-white to yellow on the ventral surface. They have three external gills on each side of their head. Larvae are aquatic with external plume-like gills and well-developed tail fins (Behler and King 1980).

The Sonoran tiger salamander was listed as an endangered species in 1997 as the Sonora tiger salamander (*Ambystoma tigrinum stebbinsi*)(62 FR 665). The listing covered the entire historical range in the United States and Mexico. Critical habitat was not designated for the salamander. A recovery plan for the species was completed in 2002 (USFWS 2002b). Loss of natural standing water habitat; predation by non-native fish, bullfrogs, and crayfish; disease; and potential genetic swamping by the introduced, non-native barred tiger salamander (*A. m. mavortium*) have contributed to the current endangered status of the species. A recent update to the taxonomy of this subspecies is provided by Crother (2008); therefore, common and scientific names used herein follow Crother (2008).

Distribution/Abundance

All sites where Sonoran tiger salamanders have been found are located in Arizona in the Santa Cruz and San Pedro river drainages, including sites in the San Rafael Valley and adjacent parts of the Patagonia and Huachuca mountains in Santa Cruz and Cochise counties. All confirmed historical and extant aquatic populations are found in cattle tanks or impounded cienegas within 19 miles of Lochiel, Arizona. Salamanders collected from a ciénega at Rancho Los Fresnos in the San Rafael Valley, Sonora, may be *A. m. stebbinsi* (Varela-Romero et al.1992). Surveys during 2006-2008 failed to locate additional salamanders and most waters on the ranch are now occupied by nonnative bullfrogs, crayfish, green sunfish, and black bullhead (USFWS 2006a, b and files). A single metamorph tiger salamander was found just west of the ranch in a drying tank during a survey in 2009, but was not verified as *A.m. stebbinsi* (USFWS files).

The Sonoran tiger salamander is known from at least 81 aquatic localities, although not all are currently occupied (USFWS 2007c and files, Collins and Jones 1987, Collins 1996, Abbate 1998). During intensive surveys in 1997, from one to 150 Sonoran tiger salamanders were found at 25 stock tanks (Abbate 1998). Populations and habitats are dynamic, thus the number and location of extant aquatic populations change over time, as exhibited by the differences between survey results in 1985 and 1993 to 1996 (Collins and Jones 1987; Collins 1996; J. Collins, 1996, pers. comm.). In 1999, the lab of Dr. James Collins, Arizona State University, found Sonoran

tiger salamanders at 17 localities (Collins 1999). During surveys by AGFD from 2001 to 2006, Sonoran tiger salamanders were found at 37 of 139 stock tanks, which were sampled from 1 to 7 times each. At 23 of 29 tanks where salamanders were found, and which were sampled more than once, salamanders were not found on at least one visit. The 5-year review acknowledges that there is no current information that clearly defines the abundance or population trends for this species (USFWS 2007c) but does state that the current survey data are consistent with population levels discussed in the recovery plan (USFWS 2002b).

Habitat

Historically, the Sonoran tiger salamander probably inhabited springs, ciénegas, and possibly backwater pools of the Santa Cruz River and streams in the San Rafael Valley where permanent or nearly permanent water allowed survival of mature branchiates. The grassland community of the San Rafael Valley and adjacent montane slopes, where all extant populations of Sonoran tiger salamander occur, may represent relictual grassland and a refugium for grassland species. Tiger salamanders in this area might have become isolated and, over time, genetically distinct from ancestral A. m. mavortium and A. m. nebulosum (Jones et al. 1995, Storfer et al. 2004). The Sonoran tiger salamander apparently has opportunistically taken advantage of available stock tank habitats as natural habitats disappeared (Hendrickson and Minckley 1984) or were invaded by nonnative predators with which the salamander cannot coexist (USFWS 2007c).

Although most records for Sonoran tiger salamanders occur at stock tanks where breeding occurs, terrestrial metamorphs potentially may wander considerable distances from these aquatic habitats, and are occasionally encountered in upland habitats. A Sonoran tiger salamander was captured in a pit fall trap at Oak Spring in Copper Canyon, Huachuca Mountains, by AGFD personnel. The nearest known breeding site is about 0.6 mi to the south, suggesting the salamander may have moved at least that far. Capture in a pit fall trap also confirms that the individual was surface active. On Fort Huachuca, S. Stone (pers. comm., 1998) reported finding terrestrial tiger salamanders (probably *A. m. mavortium*) 1.9 to 2.5 mi from the nearest known breeding pond. Referring to conservation of the California tiger salamander, *A. californiense*, Petranka (1998) finds that based on studies of movements of other Ambystoma species, conservation of a 650 to 1,650 ft radius of natural vegetation around a breeding pond would protect the habitat of most of the adult terrestrial population. Adults of A. mavortium subspecies typically live in or about mammal burrows (Petranka 1998), although metamorphs may construct their own burrows as well (Gruberg and Stirling 1972, Semlitsch 1983). Some species of salamanders exhibit migrations of up to several miles each way from breeding sites to upland habitats (Stebbins and Cohen 1995). If such migrations occur in the Sonoran tiger salamander, we have no information about migration corridors or non-breeding habitat. Because of the arid nature of the environments where the subspecies occurs, if salamanders move very far from breeding ponds, they likely do so during more mesic times of year, such as during the monsoon.

Life History

Past surveys indicate that Sonora tiger salamander breeding takes place from late winter through spring with the potential for opportunistic breeding occurring after summer monsoon rains (Allison et al. 1994, Maret and Collins 1998). Courtship and breeding in tiger salamanders

typically occurs at night and underwater, proving difficult to observe (USFWS 2002b). When fully developed, females may oviposit anywhere from 200 to 2000 gelatinous eggs either individually or in clumps of up to 50, attaching them to aquatic vegetation, sticks, fencing, and other substrata (Behler and King 1980). Hatching time is variable and dependent upon water temperature, but typically takes 2 to 4 weeks (USFWS 2002b). Once hatched, larval salamanders have well developed tails, small legs, and plume like gills. Their diet consists of zooplankton, algae, and a variety of aquatic macroinvertebrates (Behler and King 1980, Collins and Holomuzki 1984). From this point, their course of development is dependent upon the persistence of water. If the breeding site dries, some larvae metamorphose into terrestrial adults in as little as two months and a minimum snout vent length of 45mm (Collins et al. 1988, Maret and Collins 1998, Brodman and Jaskula 2002). If water persists, roughly 17 to 40 percent of Sonora tiger salamanders may metamorphose into terrestrial adults (Collins et al. 1988), the remainder grow and mature into branchiate adults. Branchiate adults retain all the characteristics of the larvae, but are much larger and reproductively mature. Branchiate adults also feed on macroinvertebrates, but their diet may include salamander and other amphibian eggs and larvae (Holomuzki 1986). Although rare, under certain conditions the branchiate adult may further metamorphose into a cannibal morph, denoted by a larger head, bigger mouth, and more developed teeth (Pfennig and Collins 1993).

Little is known about the behavior and ecology of terrestrial Sonoran tiger salamanders outside their breeding sites. Using knowledge of other species as surrogates, we can assume that they feed mostly on terrestrial insects and spend the majority of their life in burrows, emerging on rainy nights or during periods of high humidity. While breeding site fidelity has been documented, terrestrial metamorphs are also the only life history stage that enables salamanders to disperse and colonize new habitat (Stenhouse 1985, USFWS 2002b, Jenkins et al. 2006). There are few data to evaluate the extent to which metamorphosed Sonoran tiger salamanders move away from breeding ponds. However, marked Sonoran tiger salamanders have been found 0.9 and 1.2 mi from tanks where they had been found the previous spring, and others have been found 1.9 to 2.5 mi from the nearest potential source population (Maret et al. 2006). Dispersal distance from a breeding site is likely dependent upon local topography, vegetation, precipitation, and availability of burrows.

Sonoran tiger salamanders are one of three subspecies of tiger salamanders found in Arizona; the other two subspecies are the aforementioned Arizona tiger salamander and non-native barred tiger salamander. The eggs, larvae, and branchiate adults of the three subspecies appear similar. Metamorphosed Arizona tiger salamanders have 11 to 50 irregularly shaped, yellow to olive spots and blotches, often with indistinct edges, on a dark dorsal ground, with a similar pattern on the head and tail (Stebbins 2003). Metamorphosed barred tiger salamanders have large, distinct, yellowish bars, spots, or transverse bars on a darkly grounded dorsum. Some of the spots or bars encroach on the dark venter. The reticulate pattern that can be seen in Sonoran tiger salamanders is not seen in Arizona or barred tiger salamanders; however, many metamorphosed Sonoran tiger salamanders do not have the reticulate pattern and are visually indistinguishable from barred tiger salamanders.

Threats

Before the 20th century, the San Rafael Valley contained many more cienegas and vernal pools than it does today. Erosion and arroyo cutting in the late 19th and early 20th centuries caused the San Rafael Valley water table to drop and many natural standing water habitats to disappear (Hendrickson and Minckley 1984, Hadley and Sheridan 1995). However, at the same time natural standing water habitats were disappearing, cattle ponds were built. Many of the remaining springs and cienegas were converted into impoundments at this time, so most of the small standing water habitats remaining in the San Rafael Valley are cattle ponds. Currently, Sonoran tiger salamanders breed almost exclusively in these cattle ponds. The fact that Sonoran tiger salamanders breed in human-constructed cattle ponds instead of natural habitats does not necessarily threaten persistence of the taxon. Sonoran tiger salamanders have successfully bred in cattle ponds for decades, but salamanders are now dependent on humans to maintain the habitat. In particular, cattle ponds require occasional re-excavation because they fill in with silt, and pond dams also require occasional maintenance. Cattle pond habitats are also vulnerable to extreme weather conditions. Long-term drought could dry many of the ponds, and if ponds remained dry for several years, lack of breeding could lead to local extirpation of the salamander population.

There are reports of introduced non-native fish occurring in the San Rafael Valley as early as the 1950s, and various introduced fish species now occur in San Rafael Valley ponds, including mosquitofish, green sunfish, bluegill sunfish, black bullheads, and largemouth bass. Bullfrogs have also been in the valley since at least the early 1970s. Laboratory and field experiments have shown that metamorphosed bullfrogs and all of the fish species listed above quickly eat salamander larvae, and even adult Sonoran tiger salamanders have been found in the stomachs of adult bullfrogs (Snyder et al. 1998). In addition, whenever non-native fish are introduced to a pond, the salamanders almost always disappear within the next few years, and do not reappear unless all fish are removed (Snyder et al. 1998). Given the observation that bullfrogs eat salamanders and the effect of bullfrogs on other native western herpetofauna populations (Rosen et al. 1996a, Kupferberg 1997, Kiesecker and Blaustein 1997), bullfrogs should be considered a threat to Sonoran tiger salamanders. Occasional drying of cattle ponds due to drought or siltation has limited the number of ponds occupied by non-native fish and bullfrogs, because both taxa are vulnerable to drying. Crayfish are potential predators on salamanders as well, but have only been found in a few San Rafael Valley ponds, and those did not contain salamanders (USFWS 2002b). Crayfish are in many San Rafael Valley streams; however, and if they are introduced to ponds with salamanders, it is likely they will harm Sonoran tiger salamanders, much as they have harmed other western herpetofauna populations (Gamradt and Kats 1996, Fernandez and Rosen 1996).

Tiger salamander populations in the western United States and Canada, including populations of the Sonoran tiger salamander, exhibit frequent epizootics (Collins et al. 2001). Sonoran tiger salamander populations experience frequent disease-related die-offs (about 8% of populations are affected each year) in which almost all salamanders and larvae in the pond die. *Ambystoma tigrinum* virus (ATV) is the pathogen believed to be primarily responsible for these die-offs (Jancovich et al. 1997). ATV may be spread by bullfrogs, birds, cattle, or other animals that move among tanks (Jancovich et al. 1997); however, the viral life cycle appears to be restricted

to tiger salamanders - no other syntopic hosts have been identified (Jancovich et al. 2001). In the laboratory, Sonoran tiger salamanders exhibited lower survival and growth rates when exposed to the disease as compared to Arizona tiger salamanders from the White Mountains of Arizona (Collins et al. 2003). Animals that survive ATV exposure may harbor transmissible infection for more than six months. Dispersing metamorphosed salamanders have been found carrying ATV, and when they return to a pond to breed, they may reinfect the aquatic population (Collins et al. 2003). ATV is an emerging pathogen (Storfer 2003), and genetic analysis suggests a single introduction and recent spread over a large geographic area from Arizona to Saskatchewan (Jancovich et al. 2005). ATV may have switched from sport fishes to salamanders or was introduced with water dogs (*A. m. mavortium*) imported for use as fish bait in Arizona and elsewhere (Jancovich et al. 2005). Collins et al. (2003) identified ATV in waterdogs obtained from a Phoenix bait shop. Sonoran tiger salamanders also contract chytridiomycosis, a fungal disease associated with global declines of frogs and toads (Berger et al. 1998, Longcore et al. 1999, Speare and Berger 2000, Davidson et al. 2003). However, compared to anurans, infected salamanders exhibit only minimal symptoms (Davidson et al. 2000). In the laboratory, infected Sonoran tiger salamanders did not die from the disease and are capable of ridding themselves or much reducing chytrid infections by frequent sloughing of the skin (Davidson et al. 2003).

Illegal collection of salamanders for bait has been reported from the San Rafael Valley although there are no data on the number of Sonoran tiger salamanders that are collected for bait (Collins and Jones 1987, USFWS 2002b). If large numbers of salamanders are collected for bait, it could threaten the persistence of Sonoran tiger salamander populations. Given the popularity of other salamanders as bait, it is reasonable to assume that illegal collection of salamanders will continue to occur. Collecting *Ambystoma* in the San Rafael Valley is prohibited under Arizona Game and Fish Commission Orders 40 and 41, except under special permit. Furthermore, transport and stocking of live bullfrogs and fishing with live bait fish or *Ambystoma* within the range of the Sonoran tiger salamander in Arizona are prohibited (R1-316). Sale of live waterdogs at Parker Canyon Lake is prohibited under the same regulation. In the San Rafael Valley, live crayfish can be used as bait, but only at the place of capture. Transported crayfish must be dead. Arizona Game and Fish Department includes Sonoran tiger salamander in Arizona's Species of Greatest Conservation Need (AGFD 2012b); however, this designation affords the species and its habitat no legal protection. State of Arizona Executive Order Number 8-16 (Streams and Riparian Resources), signed on June 10, 1989, directs state agencies to evaluate their actions and implement changes, as appropriate, to allow for restoration of riparian resources.

Sonoran tiger salamanders also face the threat of genetic swamping by introduced barred tiger salamanders which are often sold as large larvae or branchiate adults for fishing bait or to anglers trying to establish a population that could be harvested at a later date. However, the data are inconclusive. Genetic analysis was conducted between the gene loci of Sonoran tiger salamanders and the gene loci of rosy salamanders (*A. rosaceum*), barred tiger salamander, and Arizona tiger salamanders (Jones et al. 1988). Based on distinctive reticulate color patterns, low heterozygosity, and apparent geographic isolation, subspecific designation of Sonoran tiger salamander was considered warranted by Collins and Jones (1987) and Jones et al. (1988). Further analysis of mitochondrial DNA reaffirmed subspecific designation (Collins et al. 1988). In more recent genetic analysis, Storfer et al. (2004) concluded that barred salamanders (*A. m. mavortium*) or hybrids between barred salamanders and Sonoran tiger salamanders may be

present at seven stock tanks along Highway 83 and near Parker Canyon Lake in the San Rafael Valley (Storfer et al. 2004). Storfer et al. (2004) reported 6 microsatellite loci that had alleles that were diagnostic for the hybrids of *A. m. stebbinsi* and *A. m. mavortium*. A salamander population in Upper Garden Canyon Pond on Fort Huachuca, near the crest of the Huachuca Mountains, may also be putative hybrids of *A. m. mavortium* and *A. m. stebbinsi* (Storfer et al. 1999). In 2009, Andy Baldwin of the Arizona Sonora Desert Museum sampled tissues of five salamanders collected from Peterson Ranch Pond in Scotia Canyon (USFWS files). He concluded that two individuals appear to be A. m. stebbinsi and three appear to be *A. m. nebulosum* based on one microsatellite locus (USFWS files). One of these samples still needs to be redone (T. Jones, 2014, pers. comm.). The data are certainly suggestive of hybridization, but only one microsatellite locus is not particularly conclusive and further analysis is needed (T. Jones, pers. comm., 2014). An additional difficulty is that we don't know which microsatellites were which in recent analyses; as both Storfer et al. (1999) and Andy Balwin didn't report them.

With the exception of Bog Hole in the San Rafael Valley, Upper Garden Canyon Pond on Fort Huachuca, and Rancho Los Fresnos in Sonora, Mexico, cattle grazing occurs throughout the range of the Sonoran tiger salamander. Cattle can degrade habitat at stock tank breeding sites and overgrazing can cause loss of cover and erosion that can threaten the integrity of stock tanks used by the salamander. However, the salamander has coexisted for about 250 years with grazing and because of its current use of livestock tanks for breeding, is now dependent upon maintenance of cattle waters by ranchers (USFWS 2002b). For further information on the ecology, taxonomy, range, and threats to this subspecies, refer to Lowe (1954), Gehlbach (1967), Collins and Jones (1987), Snyder et al. (1998), and Crother (2008).

Recovery Planning

The conservation and recovery of Sonoran tiger salamanders requires the presence of secure breeding populations throughout the landscape and protection of adequate available habitat that supports viable populations in the long term. About 75 percent of the of the lands that fall within the range of the Sonoran tiger salamander is managed by Federal agencies, so that many activities that might affect the salamander or its habitat are also subject to Section 7 consultation. A total of 21 Section 7 consultations on Sonoran tiger salamanders included programmatic efforts for Forest Land Management Plans that address watershed management and multiple uses (livestock grazing, and wildfire and prescribed burns), fire suppression activities, military base operations, Department of Homeland Security infrastructure, sportfish stocking, and conservation actions for the species. Biological opinions on actions potentially affecting Sonoran tiger salamanders may be found at our website www.fws.gov/southwest/es/arizona in the Section 7 Biological Opinion page of the Document Library. Consultations with the Coronado National Forest in the late 1990's resulted in the development of a "Stock Pond Management and Maintenance Plan" addressing cattle pond maintenance guidelines to minimize incidental take of salamanders associated with cleaning out ponds (USFWS 1999a, b). The "Stock Pond Management and Maintenance Plan" was later included as an appendix to the species recovery plan. Consultations with the Coronado National Forest also provided measures to reduce the possibility that salamanders might be unintentionally killed or moved among cattle ponds by fire suppression activities (USFWS 1999a, b; 2002c). A recent consultation regarding the effects of sportfish stocking provided conservation measures to reduce the risks from

introduction of nonnative tiger salamanders and non-native predatory organisms into Sonoran tiger salamander habitat (USFWS 2011a). At least 17 of the 81 sites where salamanders have been detected are on private lands to the west of Fort Huachuca (USFWS files). These private lands are used primarily for grazing, but potentially could be subdivided and developed as ranchettes, or used for other purposes. Compliance with the Act for activities on private lands that may affect the Sonoran tiger salamander, but are not addressed by section 7 consultation, could occur through section 10(a)(1)(B) of the Act.

Since completion of the Sonoran Tiger Salamander Recovery Plan in 2002, conservation actions ongoing for the salamander throughout its range include surveys and monitoring of populations, improvements to stock tanks that provide habitat, and when documented, enforcement of prohibition of illegal stocking of barred tiger salamanders in the habitat of the salamander. From 2003 through 2013, AGFD conducted monitoring of the salamander with a goal of estimating the proportion of area occupied (PAO), or fraction of actual habitat occupied by the species out of all available habitat that could be occupied. This methodology has allowed researchers to make inferences about the overall population and potential changes in abundance of a species across the greater landscape (MacKenzie and Kendall 2002, MacKenzie and Nichols 2004). Sampling is achieved by randomly conducting presence-absence surveys on a subset of all available habitats selected by a probability based sampling technique (Bailey et al. 2004). We are currently seeking funding in 2014 to analyze the PAO monitoring data, and use results to determine further needs for recovering the species. The USFWS also conducted a 5-year review of the species in 2007 per requirements of the Act. This 5-year review emphasizes the threat of introgression to the species with barred tiger salamanders and recommends adaptive management for mixed populations of Sonora and barred tiger salamanders, including eliminating such populations to reduce potential introgression. The overall recommendation of this 5-year review was to leave the species status as endangered (USFWS 2007c).

Environmental Baseline

The environmental baseline includes past and present impacts of all Federal, State, or private actions in the action area, the anticipated impacts of all proposed Federal actions in the action area that have undergone formal or early section 7 consultation, and the impact of State and private actions that are contemporaneous with the consultation process. The environmental baseline defines the current status of the species and its habitat in the action area to provide a platform to assess the effects of the action now under consultation. Also refer to the General Environmental Baseline and Action Area earlier in this biological and conference opinion.

Description of the Action Area

The action area for the proposed action, in which Sonoran tiger salamander will be directly or indirectly affected, includes lands within Fort Huachuca that may provide habitat for the species including, but not limited to, Garden, Sawmill, and McClure canyons in Training Area Q of the South Range. The action area also includes salamander habitat off-post in Scotia Canyon that could be affected by the proposed action.

Status of the Species within the Action Area

Status of the Sonoran tiger salamander on Fort Huachuca is unclear. In the past, tiger salamanders have been documented at the following locations on Fort Huachuca: wastewater treatment ponds and water features on the golf course within the cantonment area, and Upper Garden Canyon Pond at the crest of the Huachuca Mountains and the junction of Sawmill and Garden canyons in training area Q of the South Range (Collins and Snyder 1998). They have also recently been found at a military training facility, warehouse, and housing area on Fort Huachuca (K. Strickler, pers comm., 2010). However, we have no further information on these locations or specimens. None of the tiger salamanders records on Fort Huachuca have been verified to be Sonoran tiger salamanders.

The South Range of Fort Huachuca sits at the northeastern boundary of the range of the Sonoran tiger salamander. As stated in the status of the species, distinction of the three subspecies of tiger salamanders in Arizona is problematic. Because Fort Huachuca is at the edge of the range of the Sonoran tiger salamander subspecies, and there was a high likelihood that barred tiger salamander was introduced at certain locations within the cantonment, Fort Huachuca contracted Andrew Storfer to survey potential tiger salamander habitats and use genetic markers to determine their subspecific status (Storfer et al. 1999). Mitochondrial DNA sequencing and allozyme analysis of salamanders collected from the wastewater treatment ponds in 1998 indicate that these salamanders were A. m. mavortium (Storfer et al. 1999). These salamanders were subsequently eradicated when wastewater treatment ponds were drained and reconfigured as infiltration ponds that have surface water only for brief times. Interviews with Fort Huachuca employees suggested that the salamanders found in the golf course ponds in the late 1990s were barred tiger salamanders released into the ponds (Collins and Snyder 1998). The golf course ponds no longer exist. Subspecific status of salamanders collected from Upper Garden Pond has been less conclusive: molecular genetic analysis revealed that these salamanders had allozymes like barred tiger salamander and mtDNA most similar to the endangered Sonoran tiger salamander, and, therefore, were not clearly identified as either subspecies of tiger salamander based on current analytical techniques (Storfer et al. 1999). Several years later, Storfer et al. (2004) conducted further mitochondrial DNA sequencing and analysis of microsatellite loci that suggested that salamanders in six cattle tanks in the San Rafael Valley west of Upper Garden Canyon Pond were putative hybrids of the Sonoran tiger salamander and the barred tiger salamander (Storfer et al. 2004). In addition, the analysis revealed these salamanders had alleles shared only with the barred tiger salamander (Storfer et al. 2004). However, the Upper Garden Canyon Pond salamanders were not included in this subsequent analysis for unknown reasons. In addition, it is unknown if salamanders found at a military training facility, warehouse, and housing area on the Fort in 2010 were Sonoran tiger salamanders, barred tiger salamanders, or hybrids. Finally, Fort personnel salvaged five tiger salamanders from Upper Garden Canyon Pond in 2013 that are yet to be identified to subspecies. Photographs of four of these salamanders taken after metamorphosis reveal that two of the salamanders appear to have markings within the range of that seen in *A.t. stebbinsi* and two are likely *A.t. mavortium*; color pattern variation among the four individuals is consistent with hybridization between the two taxa. (T. Jones, pers comm., 2014). However, genetic analysis of these individuals has yet to be conducted but the Fort committed to funding this analysis (S. Stone, pers. comm., 2013).

Upper Garden Canyon Pond nearly dried in the spring of 1996, and subsequently dried in June 1997, June 1999, spring 2003, spring 2005, and spring 2006 (USFWS 2007c). Periodic drying results in the elimination or metamorphosis of aquatic larval and branchiate salamanders. Reduced water levels stimulate metamorphosis, and many salamanders simply walk away from drying ponds and return to breed when the pond refills. Drought conditions in early 1996 severely diminished the volume of the tank, and surveys of this population in April 1996 detected only one branchiate salamander. Visible larval salamander numbers ranged from many hundreds in the early 2000s to none, depending on water and submergent vegetation conditions and time of day or year. No salamander metamorphs or larvae were seen in March 2003 at low water before the pond dried that spring. However, in December 2003, several larvae approximately 4 in long were visible in the shallow, ice skimmed water, indicating that salamander breeding had occurred after summer rains provided runoff to the pond. After 2006, Fort Huachuca personnel did not detect salamanders in Upper Garden Pond for several years during visual surveys of the pond, which frequently has high turbidity and a large amount of emergent vegetation. If the pond remained dry for several seasons or for years, or water was not present long enough to allow breeding and metamorphosis, the number of surviving terrestrial salamanders might not have been sufficient to re-colonize the pond. Re-colonization would then have to occur as a result of immigration from another pond. While visiting the pond on April 8, 2013, Fort personnel discovered that salamanders were once again present in the very shallow drying pond (S. Stone, pers. comm., 2013).

The upper reaches of Scotia Canyon support perennial surface water and the canyon may be a movement corridor for salamanders to access higher elevation sites in the Huachuca Mountains from localities in and near the lower reaches of Scotia and Sunnyside canyons. The Peterson Ranch ponds in Scotia Canyon are about one mile from the Garde Canyon ponds, with other mesic areas between them. Tiger salamanders (*A. m. stebbinsi* or *A. m. mavortium*) occurred at the lower Scotia Canyon impoundment until about 1995. No salamanders were recorded again until 2007 when there was an unconfirmed report from Peterson Ranch Pond (P. Rosen, pers. comm., 2008). During draining and bullfrog control at the Peterson Ranch Pond in 2008, 43 large branchiate salamanders were netted (J. Rorabaugh, pers. comm., 2008). These salamanders were held for several days in kiddie pools near the pond and then repatriated after most netting and seining was completed. The nearest source population is the upper Garden Canyon Pond at Fort Huachuca (about a mile away). As stated in the status of the species, four of these salamanders were collected and submitted for genetic testing, along with another salamander collected from the site in 2008. Two of these individuals appear to be A. t. stebbinsi and 3 appear to be *A. t. nebulosum* based on one microsatellite locus (USFWS files). In addition, salamanders from Peterson Ranch Pond tested positive for chytridiomycosis in 2009. Arizona Game and Fish Department biologists and Coronado National Forest staff visited the site on April 5, 2011, and verified the continued presence of salamanders (2 mature brachiates were observed)(USFWS files).

Effects of the Action – Sonoran tiger salamander

Effects of the action refer to the direct and indirect effects of an action on the species or critical habitat, together with the effects of other activities that are interrelated and interdependent with that action, which will be added to the environmental baseline. Interrelated actions are those that

are part of a larger action and depend on the larger action for their justification. Interdependent actions are those that have no independent utility apart from the action under consideration. Indirect effects are those that are caused by the proposed action and are later in time, but are still reasonably certain to occur.

The Description of the Proposed Action section, above, described the full range of activities conducted by Fort Huachuca. The elements of the proposed action that may affect the Sonoran tiger salamander include ground based operations, recreational activities, and natural resource management. The Description of the Proposed Action also includes a series of species-specific conservation measures intended to avoid and minimize the adverse effects of the proposed action. Additional conservation measures that minimize effects to the salamander are included in Appendix A and Appendix N of the PBA and will be included in the discussion that follows.

STS-1: Fort Huachuca will conduct annual monitoring of the Upper Garden Canyon pond each year to determine the condition of the habitat and presence of Sonoran tiger salamander according to a protocol developed in conjunction with USFWS. Implementation of this conservation measure will ensure that changes to the status of the species are detected, thus permitting a management response (if the change is negative);

STS-2: The Fort will maintain boulders placed around the pond's perimeter at Upper Garden Canyon Pond to prevent vehicles from driving through the habitat. This conservation measure will minimize human intrusions into Sonoran tiger salamander habitat;

STS-3: A closure to vehicle travel will be maintained at Gate Number 7. Gate Number 7 is at the saddle between Garden Canyon on the east side of the Huachuca Mountains and Scotia Canyon on the west side of the mountains. This gate is used to allow access off Post to the west side of the mountains. Maintenance of this gate will minimize the passage on nonessential vehicles from Fort Huachuca to sites containing Sonoran tiger salamander and its habitat within Scotia Canyon;

STS-4: The Fort will maintain the permanent all weather sign posted at Upper Garden Canyon pond which will contain the following information: Fishing, use of nets, and capture or release of salamanders or fish is prohibited; Off-road vehicle use is prohibited. This conservation measure will minimize collection of Sonoran tiger salamanders as well as minimize harm to the species and its habitat caused by potential off-road vehicle use in area of Upper Garden Canyon pond;

STS-5: The Fort will manage Sonoran tiger salamanders and habitat on Post where habitat has been degraded or lost due to mission related activities. Management could include salamander introduction in conjunction with USFWS site restoration and subsequent salamander introduction in conjunction with USFWS, and protection of other suitable sites. The Fort has no plans to create habitat or release salamanders. This conservation measure could allow continued implementation and potential expansion of Sonoran tiger salamander recovery work;

STS-6: An inventory of potential habitat on the Fort will be conducted once every 10 years or once during the consultation period. Implementation of this conservation measure will ensure that changes to the status of the species are detected, thus permitting a management response (if the change is negative);

STS-7: Fort will fund a genetic analysis on tiger salamander populations on the Fort. Implementation of this conservation measure will ensure that changes to the genetic status of the species are detected, thus permitting a management response if past or future introductions of barred tiger salamanders by recreationists in the action have contributed to introgression of the Sonoran tiger salamander population;

STS-8: The Fort will monitor Sonoran tiger salamander and document any disturbance of Sonora tiger salamander or Sonoran tiger salamander habitat. Results of this and other monitoring required will be reported to the USFWS as described in the reporting requirements below (PBA Section 2.13.3). Implementation of this conservation measure will allow tracking of unanticipated adverse effects to the species or its habitat and, by extension, promote a management response when needed; and

STS-9: The Fort will establish a schedule and continue to implement prescribed burns and/or fuels management to reduce fuel loading in Fort Huachuca woodlands. This conservation measure will minimize the adverse effects of high intensity wildfires within Sonoran tiger salamander habitat.

Effects of Military Ground Based Operations

There are few ground based operations proposed by Fort Huachuca that could adversely affect the Sonoran tiger salamander. Except for rappelling training on the cliffs in Garden Canyon, military training activities are restricted to the relatively flat areas in training area Q where the only likely population of Sonoran tiger salamanders is located. It is possible, but highly unlikely, that metamorph salamanders could be hit by vehicles near Upper Garden Canyon Pond. Vehicle use is restricted to existing roads in this area, minimizing any potential for direct impact to terrestrial salamanders. The Fort has also placed large boulders around Upper Garden Canyon Pond to exclude vehicles from salamander habitat in and surrounding the pond. No bivouacs will take place in this training area. Therefore, adverse impacts to salamanders from ground based operations are unlikely to occur.

Effects of Recreational Activities

Some recreational activities made available to soldiers, their families, and to the public may adversely affect the Sonoran tiger salamander. There are three picnic areas at upper, middle, and lower Garden Canyon that are primarily used by Fort Huachuca personnel. Hiking may also occur in Garden Canyon, although areas outside the picnic areas receive less use by recreationists. Gate 7 also provides hiking access to Scotia Canyon outside Fort Huachuca. There is potential for recreationists in Garden Canyon or other aquatic sites on post to introduce barred tiger salamanders or nonnative predators such as centrarchid fishes, bullfrogs, and crayfish into the waters of Garden Canyon and Upper Garden Canyon Pond. There is also

potential for recreationists to collect Sonoran tiger salamanders in the Upper Garden Canyon Pond to use as bait elsewhere. Introduction of barred tiger salamanders may cause introgression of the Sonoran tiger salamander population (if they are *A. m. stebbensi*). Introduced barred tiger salamanders in Upper Garden Canyon Pond could also move to Peterson Ranch Pond in Scotia Canyon which has recently had a population of tiger salamanders, and may be the source population of salamanders for Upper Garden Canyon Pond. Release of nonnative fish into Upper Garden Canyon Pond would likely decimate the population of salamanders within a few years if not removed (Snyder et al. 1998). Release of bullfrogs or crayfish could harm the species through predation, as well as serve as a vector for Bd. Bullfrogs could also then move to any other aquatic site within seven miles of the pond, including Peterson Ranch Pond. As described above, release of barred tiger salamanders into ponds on Fort Huachuca has likely occurred in the past (Storfer et al. 1999). To minimize the chance of this happening, the Fort will maintain the permanent all weather sign posted at Upper Garden Canyon pond which states that fishing, use of nets, and capture or release of salamanders is prohibited. In addition to off-road vehicle restrictions, information signage, and boulder placement around Upper Garden Canyon Pond described above, the Fort has closed Gate 7 which previously allowed vehicular access to the upper Garden Canyon watershed from the west through Scotia Canyon. Discarding of cigarettes by recreational users could lead to a wildfire. Effects to the salamander from fire are described in the following section.

Effects of Natural Resource Management Program

The primary goal of the natural resources management program for Fort Huachuca is to protect naturally-evolved biotic communities and landscapes to support military land-based training. As part of this program, Fort Huachuca has developed environmental and natural resource specific planning documents, including the Integrated Natural Resources Management Plan and Integrated Wildland Fire Management Plan, the effects of which are discussed below. The Fort's natural resource management programs benefit the Sonoran tiger salamander by maintaining healthy ecosystems and managing for wildlife conservation; specific aspects of these programs, however, may adversely affect salamanders and their habitat.

Integrated Natural Resources Management Plan (INRMP)

The Fort Huachuca INRMP, updated in March 2010 (Vernadero Group 2010b), is a plan of action for the management of natural resources and military training and operational activities occurring among those resources. The purpose of the INRMP is to guide the implementation and integration of natural resources management on Fort Huachuca including special-status species, terrestrial and aquatic wildlife, migratory birds, airport wildlife and bird-aircraft strike hazard, groundwater resources, floodplain and wetlands, vegetation, land and forest, wildland fire, invasive species, pests, and outdoor recreation. Although specific aspects of the Fort's INRMP (e.g., recreational activities, which are discussed above) may adversely affect Sonoran tiger salamanders and their habitat, overall the plan benefits the salamander by actively managing for the conservation of the species and its habitat.

Fuels Management/Integrated Wildland Fire Management Plan (IWFMP)

Fort Huachuca is participating with other federal agencies in the FireScape program (USDA FS 2009a), which provides for fuels management in the Huachuca Mountains. Fort Huachuca's Integrated Wildfire Management Plan (Gebow and Hessil 2006) provides a planning framework for reducing the risk of fire and fire suppression effects on listed species. The risk of a fire originating in lower-elevation training areas reaching forested habitat in the upper elevations is reduced to some extent by fuel management activities in lowland habitats and to a network of fire breaks that the Fort has established along ridgelines. The FireScape consultation is not current, however, so this BO will include an analysis of the effects of Fort Huachuca's fire and fuel treatment activities.

Fuels management, prescribed fire, managed natural fire, and wildland firefighting activities have the potential to affect the Sonoran tiger salamander and its habitat. According to the PBA, fuels management on the Fort is ongoing and employs a variety of hand methods, combined with prescribed burning. The Fort Huachuca IFWMP states that prescribed fire can be used to reduce fuel levels in Garden Canyon, particularly from around the Scout Cabin to Gate 7. In addition, conservation measure WFP-19 in Appendix N of the PBA states that a resource advisor would be present or available during all prescribed fire in salamander habitat areas. Resource advisors would be qualified to address Sonora tiger salamander concerns, serve as an advisor to the fire boss, and coordinate with USFWS. Fires ignited by ordnance, recreational users, or vehicles also have the potential to affect the Sonoran tiger salamander and its habitat and will be managed by Fort Huachuca as wildland fire use or with fire suppression. According to the IWFMP, Fort Huachuca will manage wildland fire use and suppression to minimize unnecessary impacts to resources and convey the importance of this strategy to all fire management forces. However, fire suppression and wildland fire use are not included in the proposed action.

Data are lacking on the effects of fire on salamanders. Prescribed fire in the area of Garden Canyon could potentially result in direct death or injury of salamanders, and reduced habitat quality or quantity. It is likely that fire has little direct effect on salamanders as adults are rarely active above ground; when they are active, it is usually under cool, moist weather conditions that occur outside the fire season (USFWS 1999a). During the dry season, salamanders are generally either in burrows, where they are relatively safe from fire, or under moist rotten logs or moist vegetation mats that are not likely to burn except under extreme fire weather conditions; when prescribed fires would not be implemented. Prescribed fire that increases downed woody debris while retaining some shade, probably improves habitat structure of salamanders in the long term. However, in the short-term fire can be detrimental to plethodontid salamanders by eliminating ground cover and associated invertebrates that are key food sources.

Degradation of watershed condition immediately after fires can result in increased runoff, erosion, sedimentation, and debris and ash flow that can scour aquatic habitats or bury them in debris (DeBano et al. 1998). In degraded watersheds, less precipitation is captured and stored, thus perennial aquatic systems downstream may become ephemeral during dry seasons or drought (Rinne and Neary 1996). Although effects on salamanders are unknown, in salmonid fish, ash and slurry flow into streams can be toxic and populations of macroinvertebrates (salamander prey species) can be drastically reduced after a fire (Rinne and Neary 1996), at least

temporarily. Smoke diffusion into water and ash flow can result in high levels of phosphorus and nitrogen (Spencer and Hauer 1991) with unknown effects to salamanders. Siltation of a pond due to erosion and runoff following a fire could eliminate habitat. However, the effects of siltation may also be more subtle. Lefcort et al. (1997) examined the effects of silt on growth and metamorphosis of larval mole salamanders, *A. opaceum* and *A. t. tigrinum*. Salamanders in silty water grew more slowly, metamorphosed sooner, and were more susceptible to infection by a water mold, *Saprolegnia parasitica*, than salamanders in non-silty water. The IFWMP identifies "no-slurry use areas" where fire retardants will not be used including Garden Canyon and other sensitive wildlife habitat. Amphibians such as salamanders are perhaps the most at-risk from lethal exposure to fire retardants because they often reside in shallow, low water volume habitat that is not readily visible from the air and therefore more susceptible to direct hits. Restricting fire retardant use by only using water drops in Garden Canyon will minimize the adverse effects of fire retardant to the salamander and its habitat.

During fire control activities, water is sometimes extracted from ponds or lakes. Such water transfer could result in spread of disease or non-native species or aquatic salamanders could be scooped out of a tank and dropped on the fire. Appendix N of the PBA includes a conservation measure (RAW-10) that mandates no water will be drafted for fire (prescribed fire) control activities from bodies of water known to be occupied by the Sonoran tiger salamander and that no waters would be transferred between sources.

As stated in the PBA, recent studies have shown that fuel treatments, especially those that combine reduction of both surface and crown fuels by treatments such as thinning followed by prescribed burning or other means of removing slash, can alter fire behavior and lower the risk of severe fires (Finney 2001, Graham 2003). These type of fuel treatments would provide a long term net conservation benefit to the species.

Establishment of fire crew camps, equipment staging areas, and landing strips; use of off-road vehicles, particularly tracked vehicles; and creation of fire lines during prescribed fire could all result in direct mortality of terrestrial Sonoran tiger salamanders. Salamanders could be killed if active on the surface or may be crushed in shallow burrows, or they could be harmed if habitat was degraded. If Petranka's (1998) estimate of a 650 to 1,650 ft radius around breeding sites is accurate as the area where most terrestrial tiger salamanders occur, then Conservation Measure WFP-19 included in Appendix N of the PBA, which limits project-related activities within 1,650 feet of occupied stock tanks, would limit take of Sonoran tiger salamanders. Conservation measure RAW-7 (crossings for motorized vehicles across a perennial stream would not be permitted, unless an established road already exists or where dry, intermittent sections occur) and RAW-9 (placement of prescribed fire support sites [e.g., camps, staging areas and, refueling sites] would be outside riparian areas or river/stream corridors) would also limit incidental mortality of salamanders. If the aquatic populations of salamanders in Upper Garden Canyon Pond or Peterson Ranch Pond are eliminated due to disease, ash flow, increased turbidity, or collection, but the habitat remains suitable (i.e., the tank is not silted in or erodes away, and fish are not introduced), the tank is likely to be recolonized by terrestrial salamanders. As a result, effects of the action that result in destruction of breeding sites or introduction of nonnative predators are much more serious to the viability of the species than death or injury of individuals.

Cumulative Effects

Cumulative effects include the effects of future State, tribal, local or private actions that are reasonably certain to occur in the action area considered in this biological opinion. Future Federal actions that are unrelated to the proposed action are not considered in this section because they require separate consultation pursuant to section 7 of the Act.

Many lands within the action area are managed by Federal agencies; thus, many activities that could potentially affect Sonoran tiger salamanders are Federal activities that are subject to section 7 consultation. The effects of these Federal activities are not considered cumulative effects. However, population growth on State and local lands in the Sierra Vista subbasin is likely to result in an increase in recreational activities in the Fort Huachuca/Sierra Vista region, including the Coronado National Forest. Increased recreation may increase the potential for degradation or loss of habitat for the salamander (e.g., from wildfires, off-road vehicle use, etc.). Illegal activities associated with cross-border smuggling and illegal immigration (e.g., human traffic, deposition of trash, creation of trails and routes, and increased fire risk from human traffic) also occur in the action area. These activities can also degrade salamander habitat.

Conclusion

After reviewing the current status of the species, the environmental baseline for the action area, and the effects of the proposed action, it is our biological opinion that the proposed action is not likely to jeopardize the continued existence of the Sonoran tiger salamander. Critical habitat has not been designated for the species; thus no critical habitat will be affected by the proposed action. We base our conclusion on the following:

- Although we anticipate the proposed action will result in impacts to Sonoran tiger salamander habitat, the impacts are short-term and relatively small in the context of the range of the species;

- Although we anticipate the proposed action will result in harm to Sonoran tiger salamanders, the number of salamander that may potentially be harmed is small in comparison to the number of salamanders throughout the range of the species;

- Conservation measures included in the proposed action are anticipated to avoid, minimize, and offset some adverse effects (see above) of the proposed action to Sonoran tiger salamanders; and

- The proposed action is anticipated to benefit Sonoran tiger salamanders by minimizing potential introgression of the Sonoran tiger salamander by actively managing potential for hybridization of salamanders in the action area.

The proposed action does not appreciably reduce the likelihood of Sonora tiger salamander recovery within their historical range. We make this conclusion for the following reasons:

- The Fort is on the edge of historical range, and has never had pure Sonoran tiger salamanders confirmed there;

- The proposed conservation measures reduce the chance for impacts to any Sonoran tiger salamanders which may occur on Fort Huachuca; and

- Monitoring and recovery actions continue to occur within the species' historical range.

FWS is unable to identify a recovery "tipping point" or threshold for the Sonoran tiger salamander because it is not technically feasible, due partly to a lack or rigorous, long-term data sets on population and habitat parameters. Because we cannot identify a tipping point, we cannot determine whether that tipping point would be reached as a result of agency operations. Since the impacts of the proposed action are minimal and the Fort is at the edge of historical range, it is highly unlikely that the proposed action would cause a tipping point away from recovery to be reached.

INCIDENTAL TAKE STATEMENT

Section 9 of the ESA and Federal regulation pursuant to section 4(d) of the ESA prohibit the take of endangered and threatened species, respectively, without special exemption. "Take" is defined as to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture or collect, or to attempt to engage in any such conduct. "Harm" is defined to include significant habitat modification or degradation that results in death or injury to listed species by significantly impairing essential behavioral patterns, including breeding, feeding, or sheltering (50 CFR 17.3). "Harass" is defined as intentional or negligent actions that create the likelihood of injury to listed species to such an extent as to significantly disrupt normal behavior patterns which include, but are not limited to, breeding, feeding or sheltering (50 CFR 17.3). "Incidental take" is defined as take that is incidental to, and not the purpose of, the carrying out of an otherwise lawful activity. Under the terms of sections 7(b)(4) and 7(o)(2), taking that is incidental to and not intended as part of the agency action is not considered to be prohibited taking under the Act provided that such taking is in compliance with the terms and conditions of this incidental take statement.

The measures described below are non-discretionary, and must be undertaken by Fort Huachuca so that they become binding conditions of any grant or permit issued to the applicant, as appropriate, for the exemption in section 7(o)(2) to apply. Fort Huachuca has a continuing duty to regulate the activity covered by this incidental take statement. If Fort Huachuca: (1) fails to assume and implement the terms and conditions; or (2) fails to require the applicant to adhere to the terms and conditions of the incidental take statement through enforceable terms that are added to the permit or grant document, the protective coverage of section 7(o)(2) may lapse. In order to monitor the impact of incidental take, Fort Huachuca must report the progress of the action and its impact on the species to the USFWS as specified in the incidental take statement (50 CFR §402.14(i)(3)).

Amount or Extent of Take

We anticipate that take of Sonoran tiger salamanders could occur in the form of harm, harassment, injury, or death resulting from prescribed fire, contamination of aquatic sites with ash, loss of aquatic sites due to sedimentation, crushing of occupied burrows, vehicle strikes of terrestrial individuals, loss of downed wood and other terrestrial refugia, introduction and spread of diseases, facilitation of increased access for collection and introduction and movement of nonnative salamanders and other harmful aquatic species, both on and off the Fort. Implementation of the proposed conservation measures will minimize the potential for these events to occur, but the possibility cannot be eliminated.

We anticipate that incidental take of Sonoran tiger salamander will be difficult to detect for the following reasons: the species is small and cryptic, remaining hidden within aquatic sites, subterranean burrows, and in moist refugia (e.g. downed logs) for much of its life; finding a dead or impaired specimen is unlikely; losses may be masked by seasonal fluctuations in numbers or other causes (e.g., oxygen depletions for aquatic species). We have determined that the numbers of Sonoran tiger salamander sites are an appropriate surrogate measure to quantify incidental take. As such, take will be exceeded if implementation of the proposed action results in the harm, harassment, or death of an indeterminate number of Sonoran tiger salamanders at Upper Garden Canyon Pond or Peterson Ranch Pond, for a total of two such incidents (described below) between 2014 and 2024. Upper Garden Canyon is surveyed at least annually by Fort Huachuca, and Peterson Ranch Pond is surveyed at least annually by AGFD and the Coronado National Forest.

The actions analyzed herein could take individual salamanders of various life stages including metamorphs, branchiates, and eggs (though we are unable to count the exact number) at Upper Garden Canyon Pond through direct fatality or harm from trampling (human or machine); and harm or harassment through habitat modification resulting from effects of prescribed fire, (e.g., contamination of aquatic sites with ash, loss of aquatic sites due to sedimentation, loss of downed wood, and other terrestrial refugia), and the introduction of nonnative salamanders, nonnative fish, bullfrogs, and other harmful aquatic species and diseases.

The actions analyzed herein could also take individual salamanders including metamorphs, branchiates, and eggs (though we are unable to count the exact number) at Peterson Ranch Pond of various life stages through harm or harassment through introduction of nonnative fish, bullfrogs, and other harmful aquatic species and diseases. We do not anticipate the complete loss of Peterson Ranch Pond as a result of any activity authorized under the proposed action. If the loss of the salamander population at Peterson Ranch Pond occurs, in coordination with Fort Huachuca, we will determine whether it was the result of the proposed action or if environmental conditions such as drought or Bd or other disease that is prevalent within the action area (see Environmental Baseline).

This amount of incidental take will not prevent the population at Peterson Ranch Pond from recovering to pre-take levels because it is within dispersal distance of other occupied Sonoran tiger salamander sites in the San Rafael Valley. Therefore, if Sonoran tiger salamanders are

extirpated from Peterson Ranch Pond, the salamanders will be able to recolonize the site on their own, or we can assist them as we have done in the past.

The reasonable and prudent measures, with their implementing terms and conditions, are designed to minimize the impact of incidental take that might otherwise result from the proposed action. The biological opinion does not authorize any form of take not incidental to implementation of the proposed action as described in this biological opinion and in the PBA.

Effect of the Take

In this biological opinion, we find that this level of anticipated take is not likely to result in jeopardy to the Sonoran tiger salamander, for the effects are not expected to appreciably reduce the survival and recovery of the species for the reasons discussed above in the Conclusion section.

Reasonable and Prudent Measures

1. For aquatic sites on Fort Huachuca that are within 2.5 miles of historical range (i.e., west of the crest of the Huachuca Mountains, Gate Seven) of the Sonoran tiger salamander; manage against native species by removing nonnative aquatic salamanders.

Terms and Conditions

1. The following term and condition implements reasonable and prudent measure number one:

    1.1. Nonnative salamanders that might become established on Fort Huachuca in Upper Garden Canyon due to the proposed action could disperse to the historical range of the Sonoran tiger salamander (i.e., west of the crest of the Huachuca Mountains, Gate Seven) or impact Sonoran tiger salamanders that may occur at Upper Garden Canyon Pond. Monitor any aquatic site on Fort Huachuca within 2.5 miles of the historical range of the Sonoran tiger salamander at least annually for nonnative tiger salamanders. If nonnative salamanders are discovered within 2.5 miles of the historical range, then Fort Huachuca will insure their removal as soon as possible to prevent breeding and dispersal from occurring. This quick action will minimize the effort required to remove these nonnative salamanders that are causing hybridization in the Sonoran tiger salamander.

CONSERVATION RECOMMENDATIONS

Sections 2(c) and 7(a)(1) of the Act direct Federal agencies to use their authorities to further the purposes of the Act by carrying out conservation programs for the benefit of listed species. Conservation recommendations are discretionary agency activities to minimize or avoid effects of a proposed action on listed species or critical habitat, to help implement recovery plans, or to develop information.

- We recommend that Fort Huachuca continue to participate in implementing recovery actions for the Sonoran tiger salamander.

- We recommend that the Fort attempt to prevent the introduction or movement and remove nonnative aquatic species on the Fort.

- We recommend that Fort Huachuca study the movements and habitat use of terrestrial salamanders in and near Upper Garden Canyon Pond to determine if Upper Garden Canyon Pond is a source population for tiger salamanders in Peterson Ranch Pond in Scotia Canyon. We recommend that Fort Huachuca not maintain Upper Garden Canyon Pond as habitat that would support tiger salamanders if genetic analysis determines that any salamanders found in Upper Garden Canyon Pond are hybrids of *A. t. stebbinsi*, or are *A. t. mavoritium* or *A. t. nebulosum*.

For the USFWS to be kept informed of actions minimizing or avoiding adverse effects or benefiting listed species or their habitat, we request notification of the implementation of any conservation recommendations.

Please note that surveys for Sonoran tiger salamanders, or other salamanders, that involve capture or take, require appropriate permits from the USFWS and AGFD.

CONFERENCE OPINION - NORTHERN MEXICAN GARTERSNAKE

Status of the Species

Legal Status

The northern Mexican gartersnake was proposed as threatened under the Act in July 2013 (78 FR 41500; FWS 2013x), with critical habitat (78 FR 41550; FWS 2013y). A final determination is expected in July, 2014. Refer to these two rules for more in-depth information on the ecology and threats to the species, including references. The proposed rules are incorporated here by reference.

The New Mexico Department of Game and Fish lists the northern Mexican gartersnake as State-endangered (NMDGF 2006). The Arizona Game and Fish Department lists the northern Mexican gartersnake as a Tier 1A Species of Greatest Conservation Need (AGFD 2012b).

Throughout Mexico, the Mexican gartersnake is listed at the species level of its taxonomy as “Amenazadas,” or Threatened, by the Secretaria de Medio Ambiente y Recursos Naturales (SEDESOL 2010). Threatened species are “those species, or populations of the same, likely to be in danger of disappearing in a short or medium timeframe, if the factors that negatively impact their viability, cause the deterioration or modification of their habitat or directly diminish the size of their populations continue to operate” (SEDESOL 2010 [NOM–059–ECOL–2001]).

Description

The northern Mexican gartersnake ranges in color from olive to olive-brown or olive-gray with three lighter-colored stripes that run the length of the body, the middle of which darkens towards the tail. It may occur with other native gartersnake species and can be difficult for people without specific expertise to identify. The snake may reach a maximum length of 44 in (112 cm). The pale yellow to light-tan lateral stripes distinguish the northern Mexican gartersnake from sympatric gartersnake species because a portion of the lateral stripe is found on the fourth scale row, while it is confined to lower scale rows for other species. Paired black spots extend along the olive dorsolateral fields (region adjacent to the top of the snake's back) and the olive-gray ventrolateral fields. The scales are keeled.

Habitat and Natural History

Throughout its rangewide distribution, the northern Mexican gartersnake occurs at elevations from 130 to 8,497' (40 to 2,590m)(Rossman et al. 1996) and is considered a "terrestrial-aquatic generalist" by Drummond and Marcías-García (1983). The northern Mexican gartersnake is a riparian obligate (restricted to riparian areas when not dispersing) and occurs chiefly in the following habitat types: 1) Source-area wetlands (e.g., cienegas [mid-elevation wetlands with highly organic, reducing {basic or alkaline} soils], or stock tanks); 2) large-river riparian woodlands and forests; and 3) streamside gallery forests (as defined by well-developed broadleaf deciduous riparian forests with limited, if any, herbaceous ground cover or dense grass) (Hendrickson and Minckley 1984, Rosen and Schwalbe 1988). Emmons and Nowak (2013) found this subspecies most commonly in protected backwaters, braided side channels and beaver ponds, isolated pools near the river mainstem, and edges of dense emergent vegetation that offered cover and foraging opportunities when surveying in the upper Verde River region.

The northern Mexican gartersnake is surface active at ambient air temperatures ranging from 71˚ F to 91˚ F (22-33˚ C) and forages along the banks of water bodies (Rosen 1991). Rosen (1991) found that northern Mexican gartersnakes spent approximately 60 percent of their time moving, 13 percent of their time basking on vegetation, 18 percent of their time basking on the ground, and 9 percent of their time under surface cover; body temperatures ranged from 75 to 9˚ F (24-33˚ C) and averaged 82˚ F (28˚ C), which is lower than similar species with comparable habitat and prey preferences. Rosen (1991) suggested that lower preferred body temperatures exhibited by northern Mexican gartersnakes may be due to: their tendency to occupy cienega-like habitat, where warm air temperatures are relatively unavailable; and their tendency to remain in dense cover. In the northern-most part of its range, the northern Mexican gartersnake appears to be most active during July and August, followed by June and September.

The northern Mexican gartersnake is an active predator and is believed to heavily depend upon a native prey base (Rosen and Schwalbe 1988). Northern Mexican gartersnakes forage along vegetated banklines, searching for prey in water and on land, using different strategies (Alfaro 2002). Generally, its diet consists of amphibians and fishes, such as adult and larval (tadpoles) native leopard frogs (e.g., lowland leopard frog [*Lithobates yavapaiensis*] and Chiricahua leopard frog), as well as juvenile and adult native fish species (e.g., Gila topminnow, desert pupfish, , and roundtail chub [*G. robusta*])(Rosen and Schwalbe 1988). Drummond and Marcías-García (1983) found that as a subspecies, Mexican gartersnakes fed primarily on frogs. Auxiliary prey items may also include young Woodhouse's toads (*Anaxyrus woodhousei*),

treefrogs (Family Hylidae), earthworms, deermice (*Peromyscus* spp.), lizards of the genera Aspidoscelis and Sceloporus, larval tiger salamanders (*Ambystoma tigrinum*), and leeches (Gregory et al. 1980, Holm and Lowe 1995, Degenhardt et al. 1996, Rossman et al. 1996, Manjarrez 1998). In situations where native prey species are rare or absent, this snake's diet may include nonnative species, including larval and juvenile bullfrogs (*Lithobates catesbeianus*), western mosquitofish (*Gambusia affinis*)(Holycross et al. 2006, Emmons and Nowak 2013), or other soft-rayed fishes. Venegas-Barrera and Manjarrez (2001) reported the first observation of a snake in the natural diet of any species of Thamnophis after documenting the consumption by a Mexican gartersnake (subspecies not provided) of a Mexican alpine blotched gartersnake (*T. scalaris*).

Native predators of the northern Mexican gartersnake include birds of prey, other snakes (kingsnakes (*Lampropeltis* spp.), whipsnakes (*Coluber* spp.), regal ring-necked snakes (*Diadophis punctatus regalis*), wading birds, mergansers (*Mergus merganser*), belted kingfishers (*Megaceryle alcyon*), raccoons (*Procyon lotor*), skunks (*Mephitis* spp.), and coyotes (*Canis latrans*)(Rosen and Schwalbe 1988, Brennan et al. 2009). Historically, large, highly predatory native fish species such as Colorado pikeminnow (*Ptychochielus lucius*) may have preyed upon northern Mexican gartersnake where they co-occurred. Native chubs (*Gila* spp.) may also prey on neonatal gartersnakes.

Sexual maturity in northern Mexican gartersnakes occurs at two years of age in males and at 2 to 3 years of age in females (Rosen and Schwalbe 1988). Northern Mexican gartersnakes are viviparous (bringing forth living young rather than eggs). Mating has been documented in April and May followed by the live birth of between 7 and 38 newborns (average is 13.6) in July and August (Rosen and Schwalbe 1988, Nowak and Boyarski 2012). However, field observations in Arizona provide preliminary evidence that mating may also occur during the fall, but further research is required to confirm this hypothesis (V. Boyarski, AGFD, pers. comm., 2012). Unlike other gartersnake species, which typically breed annually, one study suggests that only half of the sexually mature females within a population of northern Mexican gartersnake might reproduce in any one season (Rosen and Schwalbe 1988).

Historical Distribution

Within the United States, the northern Mexican gartersnake historically occurred predominantly in Arizona at elevations ranging from 130 to 6,150 ft (40-1,875 m). It was generally found where water was relatively permanent and supported suitable habitat. The northern Mexican gartersnake historically occurred in every county and nearly every subbasin within Arizona, from several perennial or intermittent creeks, streams, and rivers as well as lentic (still, non-flowing water) wetlands such as cienegas, ponds, or stock tanks. Northern Mexican gartersnake records exist within the following subbasins in Arizona: Colorado River, Bill Williams River, Agua Fria River, Salt River, Tonto Creek, Verde River, Santa Cruz River, Cienega Creek, San Pedro River, Babocomari River, and the Rio San Bernardino (Black Draw)(Woodin 1950, Nickerson and Mays 1970, Bradley 1986, Brennan and Holycross 2006, Cotton et al. 2013).

Historically, the northern Mexican gartersnake had a limited distribution in New Mexico that consisted of scattered locations throughout the Upper Gila River watershed in Grant and western

Hidalgo Counties, including the Upper Gila River, Mule Creek in the San Francisco River subbasin, and the Mimbres River (Price 1980, Fitzgerald 1986, Degenhardt et al. 1996, Holycross et al. 2006).

Within Mexico, northern Mexican gartersnakes historically occurred within the Sierra Madre Occidental and the Mexican Plateau in the Mexican states of Sonora, Chihuahua, Durango, Coahuila, Zacatecas, Guanajuato, Nayarit, Hidalgo, Jalisco, San Luis Potosí, Aguascalientes, Tlaxacala, Puebla, México, Veracruz, and Querétaro, comprising approximately 85 percent of the total rangewide distribution of the subspecies (Conant 1963, Van Devender and Lowe 1977, McCranie and Wilson 1987, Rossman et al. 1996, Lemos-Espinal et al. 2004). We are not aware of any systematic, rangewide survey effort for the northern Mexican gartersnake in Mexico and have not found survey data for the subspecies in Mexico to be published in the scientific literature or otherwise readily available, outside of the information presented.

Current Distribution and Population Status

The only viable northern Mexican gartersnake populations in the United States where the subspecies remains reliably detected are all in Arizona: 1) The Page Springs and Bubbling Ponds State Fish Hatcheries along Oak Creek, 2) lower Tonto Creek, 3) the upper Santa Cruz River in the San Rafael Valley, 4) the Bill Williams River, and 5) the upper Verde River. In New Mexico, the northern Mexican gartersnake may occur in extremely low population densities within its historical distribution; limited survey effort is inconclusive to determine extirpation. The status of the northern Mexican gartersnake on tribal lands, such as those owned by the White Mountain or San Carlos Apache Tribes, is poorly known due to historically limited survey access and access to any survey data. As stated previously, less is known specifically about the current distribution of the northern Mexican gartersnake in Mexico due to limited surveys and limited access to information on survey efforts and field data from Mexico. In Table NMGS1 below, we summarize the population status of northern Mexican gartersnakes at all known localities throughout their United States distribution, as supported by museum records or reliable observations.

We have concluded that in as many as 24 of 29 known localities in the United States (83 percent), the northern Mexican gartersnake population is likely not viable and may exist at low population densities that could be threatened with extirpation or may already be extirpated. In most localities where the species may occur at low population densities, existing survey data are insufficient to prove extirpation. Only five populations of northern Mexican gartersnakes in the United States are considered likely viable where the species remains reliably detected. When considering the total number of stream miles in the United States that historically supported the northern Mexican gartersnake that are now permanently dewatered (except in the case of temporary flows in response to heavy precipitation), we concluded that as much as 90 percent of historical populations in the United States either occur at low densities or are extirpated. Harmful nonnative species are a concern in almost every northern Mexican gartersnake locality in the United States (Table NMGS1) and the most significant reason for their decline, as discussed in depth in our threats analysis below.

Listed as threatened throughout its range in Mexico by the Mexican Government, our understanding of the northern Mexican gartersnake's specific population status throughout its range in Mexico is less precise than that for its United States distribution because survey efforts are less, and sufficient, available records do not exist or are difficult to obtain. However, we have assembled and reviewed an extensive body of scientific information on known, regional threats to northern Mexican gartersnakes and to their primary prey species.

Threats to the Northern Mexican Gartersnake

Riparian and aquatic communities in both the United States and Mexico have been significantly impacted by a shift in species' composition, from one of primarily native fauna, to one being increasingly dominated by an expanding assemblage of nonnative animal species. These nonnative species have been intentionally or accidentally introduced, including crayfish, bullfrogs, and nonnative, spiny-rayed fish. Harmful nonnative species have been introduced or have spread into new areas through a variety of mechanisms, by sport stocking, aquaculture, aquarium releases, and bait-bucket release. The overall effect of these harmful nonnative species on gartersnake populations is two-fold. Harmful nonnative species contribute to starvation of gartersnake populations through competitive mechanisms, and reduce or eliminate recruitment of young gartersnakes through predation. The threat from harmful nonnative species is the most severe and geographically pervasive of all threats affecting the northern Mexican gartersnake.

Harmful Nonnative Species—Negative Ecological Interactions

The occurrence of harmful nonnative species, such as the bullfrog, the northern (virile) crayfish (*Orconectes virilis*), red swamp crayfish (*Procambarus clarkii*), and numerous species of nonnative, spiny-rayed fish (often referred to as "warm water sportfish"), has contributed to rangewide declines in the northern Mexican gartersnake, and continues to be the most significant threat to the species and to its prey base, as a result of direct predation, competition, and modification of habitat as evidenced in a broad body of literature, the most recent of which extends from 1985 to the present (Papoulias et al. 1989, Inman et al. 1998, Knapp 2005, Luja and Rodríguez-Estrella 2008, Emmons and Nowak 2013). Tail injuries are also a concern for gartersnake populations that occur with harmful nonnative species (Willis et al. 1982, Rosen and Schwalbe1988, Mushinsky and Miller 1993, Fitch 2003) and can affect the majority of individuals within a population (Rosen and Schwalbe1988).

The documented decline of northern Mexican gartersnakes was typically after declines in its primary prey base (native amphibian and fish populations). The declines in their prey base result from predation following the establishment of nonnative bullfrogs, crayfish, and numerous species of nonnative, spiny-rayed fish as supported by an extensive body of literature referenced in the proposed rule (USFWS 2013c).

A wide variety of native fish species, now listed as endangered, threatened, or candidates for listing, were historically primary prey species for northern Mexican gartersnakes (Rosen and Schwalbe 1988). A "substantial and growing body of evidence derived from case studies" (Marsh and Pacey 2005) suggests that nonnative species are uniquely responsible for prohibiting

the recovery of native fish species. Holycross et al. (2006) documented significantly depressed or extirpated native fish prey bases for northern Mexican gartersnakes along the Mogollon Rim in Arizona and New Mexico. Recovery of native fishes in the Southwest has been fraught with complicating factors, both natural and sociopolitical, which have presented significant challenges to the recovery of many imperiled native fish species (Minckley and Marsh 2009), including many that are important prey species for northern Mexican gartersnakes.

Native fish communities are also rapidly declining within the northern Mexican gartersnake's range in Mexico. The first tabulations of freshwater fish species at risk in Mexico occurred in 1961, when 11 species were identified as being at risk (Contreras-Balderas et al. 2003). As of 2003, of the 506 species of freshwater fish recorded in Mexico, 185 (37 percent) have been listed by the Mexican Federal Government as either endangered, facing extinction, under special protection, or likely extinct (Alvarez-Torres et al. 2003); 25 species are believed to have gone extinct (Contreras-Balderas et al. 2003).

Rosen et al. (2001) and Holycross et al. (2006) conducted large-scale surveys for northern Mexican gartersnakes in southeastern and central Arizona and documented the presence of nonnative fish at many locations. Holycross et al. (2006) found nonnative fish species in 64 percent of the sample sites in the Agua Fria subbasin, 85 percent of the sample sites in the Verde River subbasin, 75 percent of the sample sites in the Salt River subbasin, and 56 percent of the sample sites in the Gila River subbasin. In total, nonnative fish were observed at 41 of the 57 sites surveyed (72%) across the Mogollon Rim (Holycross et al. 2006). Entirely native fish communities were detected in only 8 of 57 sites surveyed (14%)(Holycross et al. 2006).

Survey data indicate that declines of leopard frog populations, often correlated with nonnative species introductions, the spread of a chytrid fungus, and habitat modification and destruction, have occurred throughout much of the northern Mexican gartersnake's U.S. distribution (Nickerson and Mays 1970, Holm and Lowe 1995, Rosen and Schwalbe 1995, Fernandez and Rosen 1996, Nowak and Spille 2001). Specifically, Holycross et al. (2006,) documented potential extirpations of the northern Mexican gartersnake's native leopard frog prey base at many currently, historically, or potentially occupied locations. Northern Mexican gartersnakes appear to be particularly vulnerable to the loss of native prey species (Rosen and Schwalbe 1988).

Native ranid frog species, such as lowland leopard frogs, northern leopard frogs, and federally threatened Chiricahua leopard frogs, have all experienced declines in various degrees throughout their distribution in the Southwest, partially due to predation and competition with nonnative species (Hayes and Jennings 1986, Clarkson and Rorabaugh 1989). Rosen et al. (1995) found that Chiricahua leopard frog distribution in the Chiricahua Mountain region of Arizona was inversely related to nonnative species distribution and, without corrective action, predicted that the Chiricahua leopard frog may be difficult to conserve in this region. Examples of where declining population trends in leopard frogs triggered the same in northern Mexican gartersnakes have been found with long-term monitoring in Scotia Canyon in the Huachuca Mountains of Arizona (Holm and Lowe 1995, Rosen et al. 2001), and within the San Bernardino National Wildlife Refuge (Rosen and Schwalbe 1988, 1995, 2002b; Rosen et al. 1996b, 2001).

In addition to harmful nonnative species, disease and nonnative parasites have been implicated in the decline of the prey base of the northern Mexican gartersnake. In particular, the outbreak of Bd has been identified as a chief causative agent in significant declines of many native ranid frogs and other amphibians. In Arizona, Bd infections have been reported in several native prey species of the northern Mexican gartersnake within the distribution of the snake (Morell 1999, Sredl and Caldwell 2000, Hale 2001, Bradley et al. 2002, USFWS 2007d). Declines of native prey species of the northern Mexican gartersnake from Bd infections have contributed to the decline of this species in the United States (Morell 1999, Sredl and Caldwell 2000, Hale 2001, Bradley et al. 2002, USFWS 2002b).

Bullfrogs are generally considered one of the most serious threats to northern Mexican gartersnakes throughout their range (Conant 1974, Rosen and Schwalbe 1988, Rosen et al. 2001). Bullfrogs adversely affect northern Mexican gartersnakes through direct predation of juveniles and sub-adults. Bullfrogs also compete with northern Mexican gartersnakes. Bullfrogs are extremely prolific, strong colonizers, and may disperse distances of up to 10 mi (16 km) across uplands, and likely further within drainages (Bautista 2002, Rosen and Schwalbe 2002a, Casper and Hendricks 2005; D. Suhre, UA, pers. comm., 2008).

Bullfrogs are large-bodied, voracious, opportunistic, predators that readily attempt to consume any living thing smaller than them. In one study, three different species of gartersnakes (*Thamnophis sirtalis*, *T. elegans*, and *T. ordinoides*) totaling 11 snakes were found inside the stomachs of resident bullfrogs from a single region (Jancowski and Orchard 2013). Bullfrogs can significantly reduce or eliminate native amphibian populations (Moyle 1973, Kupferberg 1994, Lawler et al. 1999, Bury and Whelan 1986, Jones and Timmons 2010), which are vital for northern Mexican gartersnakes. Different age classes of bullfrogs within a community can affect native ranid populations via different mechanisms.

Bullfrogs were observed at 22 of the 57 sites surveyed (39%) across the Mogollon Rim (Holycross et al. 2006). A number of authors have documented the presence of bullfrogs through their surveys in southern Arizona (Rosen and Schwalbe 1988, 1997, Rosen et al. 1995, Sredl et al. 2000, Turner 2007). In one of the more conspicuous examples, bullfrogs were identified as the primary cause for collapse of both the northern Mexican gartersnake and its prey base on the SBNWR (Rosen and Schwalbe 1995, 1996, 2002b, 2002b; Rosen et al. 1996b).

A common observation in northern Mexican gartersnake populations that co-occur with bullfrogs is a preponderance of large, mature adult snakes with conspicuously low numbers of individuals in the newborn and juvenile age size classes due to bullfrogs more effectively preying on small snakes, which ultimately leads to low reproductive rates and survival of young (Rosen and Schwalbe 1988, Holm and Lowe 1995). In lotic (flowing water) systems, bullfrogs prefer sites with low or limited flow, such as backwaters, side channels, and pool habitat. These areas are also used frequently by northern Mexican gartersnakes, which likely results in increased predation rates and depressed recruitment of gartersnakes. Potential recruitment problems for northern Mexican gartersnakes due to effects from nonnative species are suspected at Tonto Creek (Wallace et al. 2008).

Bullfrogs have recently been documented as a significant threat to native aquatic and riparian species throughout Mexico. Luja and Rodríguez-Estrella (2008) examined the invasion of the bullfrog in Mexico. The earliest records of bullfrogs in Mexico were Nuevo Leon (1853), Tamaulipas (1898), Morelos (1968), and Sinaloa (1969)(Luja and Rodríguez-Estrella 2008). By 1976, the bullfrog was documented in seven more states: Aguacalientes, Baja California Sur, Chihuahua, Distrito Federal, Puebla, San Luis Potosi, and Sonora (Luja and Rodríguez-Estrella 2008).

Certain crayfish are a nonnative species in Arizona and New Mexico and are a primary threat to many prey species of northern Mexican gartersnakes, and may also prey upon juvenile gartersnakes themselves (Fernandez and Rosen 1996, Voeltz 2002, USFWS 2007c). Fernandez and Rosen (1996) studied the effects of crayfish introductions on two stream communities in Arizona, a low-elevation semi-desert stream and a high mountain stream, and concluded that crayfish can noticeably reduce species diversity and destabilize food chains in riparian and aquatic ecosystems through their effect on vegetative structure, stream substrate (stream bottom; i.e., silt, sand, cobble, boulder) composition, and predation on eggs, larval, and adult forms of native invertebrate and vertebrate species.

Crayfish have been found to be a host for the amphibian disease-causing fungus, Bd (McMahon et al. 2013). This could have serious implications for northern Mexican gartersnakes because crayfish can now be considered a source of disease in habitat that is devoid of amphibians but otherwise potentially suitable habitat for immigrating amphibians, such as leopard frogs, which could serve as a prey base. Because crayfish are so widespread throughout Arizona, New Mexico, and portions of Mexico, this could have broad, negative implications for the recovery of native leopard frogs, and therefore the recovery of northern Mexican gartersnakes.

Inman et al. (1998) documented crayfish as widely distributed and locally abundant in a broad array of natural and artificial free-flowing and still-water habitats throughout Arizona, many of which overlap the historical and current distribution of northern Mexican gartersnakes (Rosen and Schwalbe 1988, Inman et al. 1998, Sredl et al. 2000, Rosen et al. 2001). Holycross et al. (2006) observed crayfish at 35 (61%) of the 57 sites surveyed across the Mogollon Rim, most of which were sites historically or currently occupied by northern Mexican or gartersnakes, or sites the investigators believed possessed suitable habitat and may be occupied by these gartersnakes based upon the their known historical distributions. Crayfish can be very difficult, if not impossible, to eradicate once they have become established in an area, depending on the complexity of the habitat (Rosen and Schwalbe 1996a, 2002a; Rogowski et al. 2013).

The Relationship between Harmful Nonnative Species and Adverse Effects to Physical Habitat

The scientific literature confirms that harmful nonnative species are the most significant and widespread factor that continues to drive further declines in and extirpations of northern Mexican gartersnake populations. Additional threats to their habitat can also contribute to population declines but should be evaluated in the context of the presence or absence of harmful nonnative species. Researchers agree that the period from 1850 to 1940 marked the greatest loss and degradation of riparian and aquatic communities in Arizona, many of which were caused by anthropogenic (human-caused) land uses and the primary and secondary effects of those uses

(Davis 1986, Stromberg et al. 1996, Webb and Leake 2005, Brown et al. 2009). Degradation of habitats is a well-recognized factor in establishment of nonnative species (Courtenay and Stauffer 1984, Arthington et al. 1990, Soule 1990, Aquatic Nuisance Species Task Force 1994).

However, not all aquatic and riparian habitats in the United States that support northern Mexican gartersnakes have been significantly degraded or lost. Despite the loss or modification of aquatic and riparian habitat we describe below, large reaches of the Verde, Salt, San Pedro, and Gila Rivers, as well as several of their tributaries, remain functionally suitable as physical habitat for either gartersnake species. When we use the term "physical habitat," we refer to the structural integrity of aquatic and terrestrial components to habitat, such as plant species richness, density, available water, and any feature of habitat that does not pertain to the animal community. The animal community (the prey and predator species that co-occur within habitat) is not considered in our usage of "physical habitat," for reasons described immediately below.

In 2007, two groups consisting of agency biologists (including USFWS staff), species experts, and field technicians conducted numerous gartersnake surveys in Durango and Chihuahua, Mexico (Burger 2007). In the state of Durango, 19 survey sites provided observation records for 144 gartersnakes, including the northern Mexican gartersnake (Burger et al. 2010). In the state of Chihuahua, 12 survey sites provided observation records for 50 gartersnakes, including the northern Mexican gartersnake (Burger et al. 2010).

While considerable gartersnake habitat in Mexico is affected by the presence of harmful nonnative species (Contreras Balderas and Lozano 1994, Unmack and Fagan 2004, Rosen and Melendez 2006, Luja and Rodríguez-Estrella 2008), Burger (2007) surveyed several sites in remote areas that appeared to be free of nonnative species. In some sites, the physical habitat for northern Mexican gartersnakes appeared to be in good condition, but few or no gartersnakes were detected. At other sites, the physical habitat was drastically affected by overgrazing, rural development, or road crossings; however, gartersnakes were relatively easily detected, which indicated that population densities were adequate. Riparian and aquatic habitats in Arizona and New Mexico are in better physical condition compared to these habitats made in Durango and Chihuahua, Mexico. However, nonnative species are also ubiquitous in these same habitats across the landscape in the southwestern United States, based on our literature review and GIS modeling. Several sites visited by Burger (2007) in Durango and Chihuahua, Mexico, had physical habitat in poor to very poor condition, but were largely free of nonnative species.

Burger (2007) detected moderate to high densities of gartersnakes at six sites where their physical habitat was moderately to highly impacted by land uses, but were largely free of nonnatives. Burger (2007) also detected either low densities or no gartersnakes at nine sites where the physical habitat was in moderate to good condition, but where nonnative species were detected.

Our observations of gartersnake populations in Mexico provide evidence for the relative importance of native prey species and the lack of nonnative species in comparison to the physical attributes of gartersnake habitat. As a result, we have formulated three general hypotheses: 1) Northern Mexican gartersnakes may be more resilient to adverse effects to physical habitat in the absence of harmful nonnative species, and therefore, more sensitive to adverse effects to physical

habitat in the presence of harmful nonnative species; 2) the presence of an adequate prey base is important for persistence of gartersnake populations regardless of whether or not harmful nonnative species are present; and 3) detections and effects from harmful nonnative species appear to decrease from north to south in the Mexican states of Chihuahua and Durango (from the United States–Mexico International Border), as discussed in Unmack and Fagan (2004).

Based on field data collected by Burger (2007) and on the above hypotheses, we evaluated the significance of effects to physical habitat in the context of the presence or absence of nonnative species. Effects to the physical habitat of gartersnakes can have varying effects on the gartersnakes themselves depending on the composition of their biotic community. In the presence of harmful nonnative species, effects to physical habitat that negatively affect the prey base for northern Mexican gartersnakes are believed to be comparatively more significant than those that do not. As previously discussed, harmful nonnative species are largely ubiquitous throughout the range of northern Mexican gartersnakes and therefore exacerbate the effects from threats to their physical habitat.

Altering or Dewatering Aquatic Habitat

Dams and Diversions

The presence of water is critical for northern Mexican gartersnakes, as well as their prey base. Of all the activities that may threaten their physical habitat, none are more serious than those that reduce flows or dewater habitat over large reaches or locally. Structures or activities that can cause these effects include dams, diversions, flood-control projects, and groundwater pumping and are widespread in Arizona, largely in response to human population growth. For example, municipal water use in central Arizona increased by 39 percent from 1998 to 2006 (American Rivers 2006), and at least 35 percent of Arizona's perennial rivers have been dewatered, assisted by about 95 dams that are in operation in Arizona today (Turner and List 2007).

Flow regimes within streams are a primary factor that shape fish communities. The timing, duration, intensity, and frequency of flood events has been altered to varying degrees by the presence of dams, which effects fish communities. Specifically, Haney et al. (2008) suggested that flood pulses may help to reduce populations of nonnative species (Minckley and Meffe 1987) and efforts to increase baseflows may assist in sustaining native prey species for northern Mexican gartersnakes. However, the investigators in this study also suggest that, because the northern Mexican gartersnake preys on both fish and frogs, it may be less affected by reductions in baseflow of streams (Haney et al. 2008). Unregulated flows with elevated discharge events favor native species, and regulated flows, absent significant discharge events, favor nonnative species (Rinne and Miller 2006, Propst et al. 2008).

The Effect of Population Growth and Development on Water Demands and Gartersnake Habitat

Arizona's population is expected to double from 5 million to 10 million people by the year 2030, which will increase the demand for water (Overpeck 2008). If this increase occurs as expected, it could indirectly affect (through increased recreation pressure and demand for water) currently occupied habitat for the northern Mexican gartersnake, particularly regional populations in

Redrock Canyon in extreme south-central Arizona, lower Cienega Creek near Vail, Arizona, and the Verde Valley. The effect of increased water withdrawals may be exacerbated by the current, long-term drought facing the arid southwestern United States. Philips and Thomas (2005) provided stream flow records that indicate that the drought Arizona experienced between 1999 and 2004 was the worst drought since the early 1940s and possibly earlier. Ongoing drought conditions have depleted recharge of aquifers and decreased base flows in the region (MacDonald 2010). While drought periods have been relatively numerous in the arid Southwest from the mid-1800s to the present, the effects of human-caused impacts on riparian and aquatic communities have compromised the ability of these communities to function under the additional stress of prolonged drought conditions.

Climate Change and Drought

Refer to the Environmental Baseline/Action Area section above for a discussion of climate change and drought. The ecology and natural history of northern Mexican gartersnakes is linked to water. As discussed above, the northern Mexican gartersnake is an aquatic species and relies largely upon other aquatic species, such as ranid frogs and native and nonnative, soft-rayed fish as prey. Therefore, these factors are likely to make northern Mexican gartersnakes vulnerable to effects of climate change and drought.

Potential drought associated with changing climatic patterns may adversely affect the amphibian prey base for the northern Mexican gartersnake. Amphibians may be among the first vertebrates to exhibit broad-scale changes in response to changes in global climatic patters due to their sensitivity to changes in moisture and temperature (Reaser and Blaustein 2005). Of the 30 different vertebrate species in the Sky Island region of southeastern Arizona, the northern Mexican gartersnake was found to be the fifth-most vulnerable (total combined score) to predicted climate change; one of its primary prey species, the Chiricahua leopard frog, was determined the fourth most vulnerable (Coe et al. 2012). Both the northern Mexican gartersnake and the Chiricahua leopard frog ranked the highest of all species assessed for vulnerability of their habitat to predicted climate change, and the Chiricahua leopard frog was also found to be the most vulnerable in terms of its physiology (Coe et al. 2012). Relative uncertainty for the vulnerability assessment provided by Coe et al. (2012) ranged from 0 to 8 (higher score means greater uncertainty), and the northern Mexican gartersnake score was 3, meaning that the vulnerability assessment was more certain than not. Coe et al. (2012) focused their assessment of species vulnerability to climate change on those occurring on the Coronado National Forest in southeastern Arizona.

The bullfrog, also assessed by Coe et al. (2012), was shown to be significantly less vulnerable to predicted climate change than either northern Mexican gartersnakes or Chiricahua leopard frogs with an uncertainty score of 1 (very certain). Based upon climate change models, nonnative species biology, and ecological observations, Rahel et al. (2008) concluded that climate change could foster the expansion of nonnative aquatic species into new areas, magnify the effects of existing aquatic nonnative species where they currently occur, increase nonnative predation rates, and heighten the virulence of disease outbreaks in North America.

The effects from changing climatic conditions may have profound effects on the amount, permanency, and quality of habitat for northern Mexican gartersnakes as well as their prey base. Harmful nonnative species such as largemouth bass are expected to benefit from prolonged periods of low flow (Rahel and Olden 2008). Propst et al. (2008) also suggested that nonnative fish species may benefit from drought. Species that are particularly harmful to northern Mexican gartersnake populations such as the green sunfish, channel catfish, largemouth bass, and bluegill are expected to increase their distribution (Eaton and Scheller 1996).

Many other factors have contributed to the decline of the northern Mexican gartersnake, and in some cases, continue to present a significant threat to low-density populations through synergistic mechanisms. These factors, and their effects to northern Mexican gartersnake populations, were discussed in detail in our 2013 proposed rule to list the subspecies (78 FR 41500, USFWS 2013c) which is incorporated by reference here. For more information on these additional threats, please review our proposed rule and its references cited.

Critical Habitat

Three units of proposed critical habitat for the northern Mexican gartersnake partially overlap the action area (USFWS 2013d). They are the Upper Santa Cruz River Subbasin Unit, the Babocomari River Subbasin Unit, and the San Pedro River Subbasin Unit; the latter two are pertinent to this proposed action and are therefore described below.

(1) Aquatic or riparian habitat that includes:

a. Perennial or spatially intermittent streams of low to moderate gradient that possess appropriate amounts of in-channel pools, off-channel pools, or backwater habitat, and that possess a natural, unregulated flow regime that allows for periodic flooding or, if flows are modified or regulated, a flow regime that allows for adequate river functions, such as flows capable of processing sediment loads; or

b. Lentic wetlands such as livestock tanks, springs, and cienegas; and

c. Shoreline habitat with adequate organic and inorganic structural complexity to allow for thermoregulation, gestation, shelter, protection from predators, and foraging opportunities (e.g., boulders, rocks, organic debris such as downed trees or logs, debris jams, small mammal burrows, or leaf litter); and

d. Aquatic habitat with characteristics that support a native amphibian prey base, such as salinities less than 5 parts per thousand, pH greater than or equal to 5.6, and pollutants absent or minimally present at levels that do not affect survival of any age class of the northern Mexican gartersnake or the maintenance of prey populations.

(2) Adequate terrestrial space (600 ft [182.9 m] lateral extent to either side of bankfull stage) adjacent to designated stream systems with sufficient structural characteristics to support life-history functions such as gestation, immigration, emigration, and brumation (extended inactivity).

(3) A prey base consisting of viable populations of native amphibian and native fish species.

(4) An absence of nonnative fish species of the families Centrarchidae and Ictaluridae, bullfrogs, and/or crayfish (*O. virilis, P. clarki*, etc.), or occurrence of these nonnative species at low enough

levels such that recruitment of northern Mexican gartersnakes and maintenance of viable native fish or soft-rayed, nonnative fish populations (prey) is still occurring.

Environmental Baseline and Action Area

Refer to the general Environmental Baseline section of this biological opinion.

Status of the Northern Mexican Gartersnake in the Action Area

Within the action area, the northern Mexican gartersnake is known from the San Pedro River, the Babocomari River, and upper Scotia Canyon in the Huachuca Mountains.

San Pedro River

Numerous historical records document the occurrence of the northern Mexican gartersnake in the upper San Pedro River, upstream (south) of Interstate 10: Lewis Springs (1919, 1986, two records; 1996, photo-voucher in AGFD Heritage database), Hereford (1920, five records), "2 East Palominas" (1959), and Arizona State Route 90 crossing (1965; 1986, two records)(Rosen and Schwalbe 1988, Rosen et al. 2001, Holycross et al. 2006). Rosen et al. (2001) surveyed the upper San Pedro River in 1996, 1998, and 2000 at the State Route 90 crossing, in 1998 at Lewis Springs, and 1996 at Curtis Flat, and documented crayfish, bullfrogs, nonnative, spiny-rayed fish, as well as two species of native fish, all occurring at various densities along their survey routes. However, they did not detect any northern Mexican gartersnakes. Kesner and Marsh (2010) also found both native fish, as well as nonnative, spiny-rayed fish, in the upper San Pedro River, although native fish or nonnative, soft-rayed fish outnumbered harmful nonnative fish species significantly. Jakle (1992) and Minckley (1987) also reported nonnative, spiny-rayed species such as channel catfish, flathead catfish, and smallmouth bass the San Pedro River. Inman et al. (1998) reported crayfish from the San Pedro River.

Babocomari River and Cienega

In the past, the Babocomari River and Cienega was considered by Rosen and Schwalbe (1988) as a possible regional stronghold for northern Mexican gartersnakes (Rosen et al. 2001). The first species record is dated 1892, labeled "Babocomari," and likely occurred at the cienega, subsequent records from 1958 and 1986 also document the species there (Rosen and Schwalbe 1988). Other historical records from 1958 document the species at "Elgin" (Holycross et al. 2006) and we presume that to mean the upper Babocomari River. The last known record for the lower Babocomari River was from 1985 at the Sanders Road crossing, approximately 3.3 river miles (5.3 km) upstream of the San Pedro River confluence (Rosen and Schwalbe 1988). Several surveys, of varying effort, of both the cienega and the river conducted in 2000 failed to detect the northern Mexican gartersnake (Rosen et al. 2001). The cienega was surveyed intensively in 2000, which documented bullfrogs and nonnative, spiny-rayed fish as abundant and crayfish as common. Surveys from the mid-1980s failed to detect bullfrogs at the cienega, but did detect several species of nonnative, spiny-rayed fish. This suggests that, post-1986,

bullfrogs either naturally colonized the Babocomari system in a regional dispersal event or they were artificially introduced. Despite the influence of harmful nonnative predators in the Babocomari system, northern Mexican gartersnakes could immigrate from regional source populations along the San Pedro River or from the Canelo Hills-Sonoita Grasslands area and intermittently exist as low density populations.

Scotia Canyon

There are numerous records of the northern Mexican gartersnake from Scotia Canyon in the Huachuca Mountains; many of which occurred at Peterson Ranch Ponds (Rosen and Schwalbe 1988, Holm and Lowe 1995, Rosen et al. 2001, Holycross et al. 2006). Scotia Canyon was intensively resurveyed for northern Mexican gartersnakes by Rosen et al. (2001). In comparing capture rates of northern Mexican gartersnakes from Holm and Lowe (1995) to capture rate data from 1980 to 1982, northern Mexican gartersnake populations in this area appear to have declined based on reduced capture rates in 1993, and even lower capture rates in 2000 (Boyarski 2008). In 2008, Scotia Canyon was again resurveyed for northern Mexican gartersnakes with no detections of the target species. Also in 2008, a multi-agency, multi-year effort was initiated within a five mi (8 km) radius of Scotia Canyon, including the Peterson Ranch Ponds and vicinity, to eradicate bullfrogs and reestablish Chiricahua leopard frogs (G. Frederick, USFS, 2008a, 2008b, pers. comm.). This effort included many surveys of herpetofauna (reptiles and amphibians) to identify the presence of bullfrogs for eradication and monitor the status of reestablished Chiricahua leopard frogs. As a result of repeated surveys in the area, a single, large adult northern Mexican gartersnake was observed in 2008 and again in 2009; the first observations of northern Mexican gartersnakes in over eight years of informal surveys at this site (Frederick 2008b, 2010, pers. comm.). These observations were the last known for the northern Mexican gartersnake in Scotia Canyon, and suggest that the species continues to occur in the upper Scotia Canyon area in low densities. With the reestablishment of Chiricahua leopard frogs to the Peterson Ranch Ponds in 2009 and their subsequent reproduction in 2010, we expect the northern Mexican gartersnake population will persist, and possibly improve, due to improved availability of prey and reduced predation by harmful nonnative species.

Critical Habitat

Three units of proposed critical habitat for the northern Mexican gartersnake partially overlap the action area. They are the Upper Santa Cruz River Subbasin Unit, the Babocomari River Subbasin Unit, and the San Pedro River Subbasin Unit which are described below.

Upper Santa Cruz River Subbasin Unit

The Upper Santa Cruz River Subbasin Unit is generally located in southeastern Arizona, east of Nogales, southeast of Patagonia, and southwest of Sierra Vista, in the San Rafael Valley, in Santa Cruz and Cochise Counties, Arizona. This unit consists of springs, seeps, streams, stock tanks, and terrestrial space (overland areas) in between these features within a total of 113,895 acres (46,092 ha) of proposed critical habitat in the San Rafael Valley, including portions of Parker and Scotia canyons of the Huachuca Mountains, Arizona. For the streams within this unit, we are proposing the reach of Parker Canyon that includes 5.8 stream mi (9.3 km) from

Duquesne Road south of Loop Road, upstream to and including Parker Canyon Lake. The reach of Scotia Canyon we are proposing as critical habitat includes 3.7 stream mi (5.9 km) from its confluence with an unnamed drainage at the junction with Bodie Canyon, upstream to its origin west of the Coronado National Forest-Fort Huachuca Boundary. The upper Santa Cruz River occurs within the San Rafael Valley, flowing south into Mexico. We are proposing 13.8 stream mi (22.2 km) of the upper Santa Cruz River, from the International Border, upstream to its headwaters at the top of Sheep Ridge Canyon. The Upper Santa Cruz River Subbasin Unit occurs on lands primarily managed by the Coronado National Forest, with remaining land management under the Arizona State Parks Department. This unit also contains private lands. All identified areas described in this unit have records for northern Mexican gartersnakes, and all identified areas are considered as being currently within the geographical area occupied by the species. Therefore, we are proposing this unit under section 3(5)(A)(i) of the Act because it is occupied by the species and because it contains sufficient amounts of the essential physical or biological features that may require special management considerations or protection.

This unit contains adequate populations of Chiricahua and lowland leopard frogs, as well as native fish species in various locations and densities, with the former being actively recovered in Scotia Canyon. Bullfrogs and nonnative, spiny-rayed fish are also known to occur at various densities within this unit, and Parker Canyon Lake is managed as a warm-water sport fishery. Crayfish are also likely to occur in various locations and densities within this unit. Within this unit, PCEs 1 (aquatic habitat characteristics), 2 (terrestrial habitat characteristics) and 3 (prey base) are generally met, but PCE 4 (absence or low level of harmful nonnative species) is deficient. Special management may be required to maintain or develop the physical or biological features, including continuing to promote the recovery or expansion of native leopard frogs and fish, and eliminating or reducing harmful nonnative species. The San Rafael Ranch is being considered for exclusion from the final rule for critical habitat under section 4(b)(2) of the Act (see Application of Section 4(b)(2) of the Act section below).

The Upper Santa Cruz River Subbasin Unit is proposed as critical habitat for the northern Mexican gartersnake because it is occupied at the time of listing and contains sufficient physical or biological features to support life-history functions essential for the conservation of the species. The physical or biological features in this unit may require special management consideration due to competition with, and predation by, harmful nonnative species that are present in this unit and potential effects from future high-intensity wildfires.

Babocomari River Subbasin Unit

The Babocomari River Subbasin Unit is in southeastern Arizona, east of Santa Rita Mountains, north of the Canelo Hills and Huachuca Mountains, south of the Whetstone Mountains, and west of the San Pedro River, in Santa Cruz and Cochise Counties. This unit consists of springs, seeps, streams, stock tanks, and terrestrial space in between these features in a total of 14,334 ac. All identified areas described in the Babocomari River Subbasin Unit have records for northern Mexican gartersnakes, and all identified areas are considered as being currently within the geographical area occupied by the species.

Babocomari River/Cienega Subunit. Crayfish, bullfrogs, and nonnative, spiny-rayed fish all occur within this subunit at various densities, reducing the likelihood of maintaining a suitable native prey base for northern Mexican gartersnakes. This subunit contains sufficient physical or biological features, including PCEs 1 (aquatic habitat characteristics) and 2 (terrestrial habitat characteristics), but PCEs 3 (prey base) and 4 (absence or low level of harmful nonnative species) are deficient.

O'Donnell Canyon Subunit. This critical habitat subunit along 2.5 stream mi (4.0 km) of O'Donnell Canyon, is about 5 mi (8.1 km) from the western boundary of Fort Huachuca. The area proposed along O'Donnell Canyon is within the area considered occupied by the northern Mexican gartersnake. This subunit contains sufficient physical or biological features, including PCEs 1 (aquatic habitat characteristics), 2 (terrestrial habitat characteristics), and 3 (prey base), but PCE 4 (absence or low level of harmful nonnative species) is deficient.

Turkey Creek Subunit. This critical habitat subunit along 12.0 stream mi (19.4 km) of Turkey Creek, is about 4 mi (6.6 km) from the western boundary of Fort Huachuca. This subunit contains sufficient physical or biological features, including PCEs 1 (aquatic habitat characteristics), 2 (terrestrial habitat characteristics), and 4 (absence or low level of harmful nonnative species), but PCE 3 (prey base) may be deficient.

Canelo Hills Cienega Preserve Subunit. This critical habitat subunit is about 4 mi (6.6 km) from the western boundary of Fort Huachuca, and contains springs, seeps, streams, stock tanks, and terrestrial space in between these features. Native fish (Crowder and Robinson 2012) and leopard frogs occur within this subunit.

The Babocomari River Subbasin Unit is proposed as critical habitat for the northern Mexican gartersnake because it is occupied at the time of listing and contains sufficient physical or biological features to support life-history functions essential for the conservation of the species. The physical or biological features in this unit may require special management consideration due to competition with, and predation by, harmful nonnative species that are present in this unit.

San Pedro River Subbasin Unit

The San Pedro River Subbasin Unit is in southeastern Arizona, east of Sierra Vista, Tucson, and Florence and west Douglas, Wilcox, and Safford, in Cochise, Pima, and Pinal Counties. This unit contains 23,690 ac (9,587 ha) along 165 stream mi (266 km) of proposed critical habitat along the San Pedro River and Bear Creek. All identified areas described in the San Pedro River Subbasin Unit have records for northern Mexican gartersnakes, and all identified areas are considered as being within the area occupied by the species.

San Pedro River Subunit. We are proposing to designate 22,669 ac (9,174 ha) of critical habitat along 158.4 stream mi (254.9 km) of the San Pedro River from its confluence with the Gila River at Winkelman, upstream to the International Border. Native fish and lowland leopard frogs occur throughout the San Pedro River and provide a prey base for northern Mexican gartersnakes, with prey population densities increasing downstream. Crayfish, bullfrogs, and nonnative, spiny-rayed fish occur predominately upstream of the Interstate 10 crossing. In

general, this subunit contains sufficient physical or biological features, including PCEs 1 (aquatic habitat characteristics), 2 (terrestrial habitat characteristics), and 3 (prey base), but PCE 4 (absence or low level of harmful nonnative species) is deficient.

The San Pedro River Subbasin Unit is proposed as critical habitat for the northern Mexican gartersnake because it is occupied at the time of proposal and contains sufficient physical or biological features to support life-history functions essential for the conservation of the species. The physical or biological features in this unit may require special management consideration due to competition with, and predation by, harmful nonnative species that are present in this unit. Within the Babocomari River Subbasin Unit and the San Pedro River Subbasin Unit, only the Babocomari River Subunit and the San Pedro River Subunit partially reside within the action area.

Effects of the Proposed Action – Northern Mexican Gartersnake

Effects of the action refer to the direct and indirect effects of an action on the species or critical habitat, together with the effects of other activities that are interrelated and interdependent with that action, which will be added to the environmental baseline. Interrelated actions are those that are part of a larger action and depend on the larger action for their justification. Interdependent actions are those that have no independent utility apart from the action under consideration. Indirect effects are those that are caused by the proposed action and are later in time, but are still reasonably certain to occur.

Effects of Recreational Activities

Some recreational activities made available to soldiers, their families, and to the public may adversely affect the northern Mexican gartersnake and its habitat. There are three picnic areas at upper, middle, and lower Garden Canyon accessible by vehicle that are primarily used by Fort Huachuca personnel. Boulders placed around Upper Garden Canyon Pond limit vehicle assess and the Fort has closed Gate 7 which prevents vehicular access to the upper Garden Canyon watershed from the west through Scotia Canyon. Hiking may occur in Garden Canyon and Tinker Canyon on Fort Huachuca with on-post trails providing access to Ramsey, Brown, and Scotia canyons off-post, although hiking trails on Fort Huachuca receive less use than picnic areas by recreationists. Recreationists could potentially serve as a vector for Bd between aquatic habitats; however this is not likely. There is potential for recreationists near aquatic sites on post to introduce nonnative predators such as centrarchid fishes, bullfrogs, and crayfish. Release of barred tiger salamanders and nonnative fishes on Fort Huachuca has likely occurred in the past (Storfer et al. 1999). Future release of these species into aquatic habitat could harm the species through predation, competition and trophic effects.

Conservation Measures

Fort Huachuca does not propose any specific conservation measures for the northern Mexican gartersnake in their November, 2013, PBA. However, several conservation measures may directly or indirectly benefit northern Mexican gartersnake populations within the action area.

For example, measures HWU-7, SWFL-2, and CHLT-1 all commit to securing or expanding regional water conservation efforts that are expected to address concerns for protecting surface flow in streams such as the San Pedro and Babocomari Rivers where northern Mexican gartersnakes occur. Conservation measure CLF-3 will help mitigate the risk of elevated erosion concerns from activities on the Fort; these measures may indirectly benefit habitat occupied by northern Mexican gartersnakes. Finally, all conservation measures that are specific to Chiricahua leopard frogs and Sonora tiger salamanders will directly or indirectly benefit northern Mexican gartersnakes by helping to maintain their habitat and prey bases.

HWU-7: The Fort will continue with water conservation efforts, effluent reuse or recharge, purchase of conservation easements, and storm water recharge (PBA Section 2.13.2). Continued implementation of conservation measure HWU-7 will ensure that water mitigation - a crucial aspect of Fort Huachuca's proposed action – proceeds such that both riparian and aquatic species and its critical habitat are conserved; and

CLF-3: Erosion control measures will be implemented as required to protect habitat. This conservation measure will minimize the adverse effects of human activities and related erosion within northern Mexican gartersnake habitat.

Fire/Erosion

Fort Huachuca is participating with other federal agencies in the FireScape program (USDA FS 2009a), which provides for fuels management in the Huachuca Mountains. Fort Huachuca's Integrated Wildfire Management Plan (Gebow and Hessil 2006) provides a planning framework for reducing the risk of fire and fire suppression effects on listed species. The risk of a fire originating in lower-elevation training areas reaching forested habitat in the upper elevations is reduced to some extent by fuel management activities in lowland habitats and to a network of fire breaks that the Fort has established along ridgelines. The FireScape consultation is not current, however, so this BO will include an analysis of the effects of Fort Huachuca's fire and fuel treatment activities.

Section 5.3 of Fort Huachuca's Programmatic Biological Assessment addresses potential effects from the use of prescribed fire and the potential, although unlikely, effects of escaped prescribed fire. In this unlikely event, indirect effects to occupied northern gartersnake habitat could result. These indirect effects would most likely be the result of high soil erosion that may occur post-burn in affected areas. Elevated sedimentation of streams could result in the temporarily diminished permanency of backwater or pool habitats in the Babocomari or San Pedro Rivers that support the gartersnakes prey species. Any fires on the Fort near the Babocomari River would probably not yield much sediment, as slopes are nearly level. Subsequent flood pulses would continue to process sediment through the system and again provide backwater and pool habitats for northern Mexican gartersnakes and their prey. Conservation measures proposed by the Fort to address erosion should effectively mitigate the risk of severe effects from erosion in occupied northern Mexican gartersnake habitat. However, the use of common erosion control products that are constructed of netting pose unique entanglement hazards to snakes which most likely result in mortality (Stuart et al. 2001, Barton and Kinkead 2005, Kapfer and Paloski 2011).

Significant discretion should be used at all times when considering the use of these products in areas that could be occupied by northern Mexican gartersnakes to minimize this risk.

Should a prescribed burn escape the Fort boundary and move over the ridgeline into upper Scotia Canyon, we would expect some unknown quantity of sedimentation would similarly affect occupied habitat in the upper-most reaches of Scotia Canyon, and some minimal level of harm or harassment to occur to individual northern Mexican gartersnakes that may be surface active in the terrestrial habitat adjacent to the canyon bottom. We expect the chances of an escaped prescribed fire from the Fort crossing the ridgeline and affecting Scotia Canyon as remote and therefore uncertain to occur.

In general, direct effects to more extensive, wetted, riparian habitat such as immediately adjacent to the Babocomari or San Pedro River, are not expected to be significant as these habitat conditions rarely support or carry fire. However, radio telemetry has shown that northern Mexican gartersnakes use terrestrial or upland habitat up to (and likely greater than) 528 ft away from water (Emmons 2014). Should individual gartersnakes be present and surface active at such distances away from the Babocomari River (the closest known occupied habitat to the Fort boundary and to possible prescribed fire activity), prescribed fire in the grasslands may result in injury or death to individuals caught within the fire perimeter.

Effects to Baseflows in the Babocomari and San Pedro Rivers

The analysis and background attributed potential effects to baseflow on the Huachuca water umbel and yellow-billed cuckoo in this biological opinion are attributable to northern Mexican gartersnake populations, because of the umbels' and cuckoo's ecological connection to wetted habitat. Therefore, those discussions are incorporated here by reference. As discussed in both our analysis of effects to Huachuca water umbel and section 5.8 of the PBA, modeling indicates that, "At no point during 2012 to 2030, does the Fort-attributable groundwater withdrawal reduce the baseflow in the mainstem of the San Pedro River." Therefore, we do not expect effects of their proposed action on the northern Mexican gartersnake or its proposed critical habitat along the San Pedro River.

However, the model did find that the regional groundwater component of baseflow in the lower Babocomari River is projected to decline by 0.1 cfs due to the Fort. Fort Huachuca described the general unavailability of hydrologic data for the Babocomari River and surmised how baseflow may be expected to be affected by their proposed action (from page 3-22 of Fort Huachuca's Programmatic Biological Assessment):

In summary, Fort Huachuca estimated its impacts on baseflow with two scenarios, the "With Fort-attributable" (WFA) and the "No Fort-attributable" (NFA) simulations (see the Groundwater Modeling Report contained in PBA Appendix G). The WFA simulation includes all Fort-attributable groundwater withdrawals and all completed and in-progress mitigation measures that could feasibly be modeled. (conservation easements were not modeled; see below). The NFA simulation removes all Fort-attributable pumping and recharge both on- and off-Fort while maintaining all other groundwater pumping and recharge within the Basin. The

difference between the WFA and NFA simulations represents future Fort Huachuca impacts to the regional groundwater component of baseflows in the San Pedro and Babocomari rivers. Because the groundwater modeling did not include the effects of the existing conservation easements to the baseflow of the lower Babocomari River, we performed an analysis to estimate how the conservation easements would affect streamflow. What we considered in that analysis and the complete rationale for it is in the effects section for the yellow-billed cuckoo. That section is oncorporated here by reference. However, we will summarize the outcome of our analysis here.

The methodology and underlying hydrologic principles by which the mitigative value of conservation easements may be estimated is introduced briefly here.

1. The credited water yield of the 3,628 acres of Babocomari River watershed conservation easements acquired to date is 299 acre feet per annum (AFA). An additional 3,000 acres of easement acquisitions – credited with 248 AFA of yield - are planned. The effects of the potential future easements are therefore not analyzed.

2. The credited water yields were apportioned to effects to groundwater storage and capture. A range of capture fractions at 10 and 50 years were estimated by examining the maps found in Figures 4A and 4B, respectively, in Leake et al. (2008) (Figures YBC-4 and YBC-5 in this BO).

3. The credited water yields' effects to capture were then apportioned to riparian evapotranspiration (ET) and stream discharge (baseflow). The proportions of capture that would be discharged as riparian ET (77%) and baseflow (23%) were determined using data from USPP (2013) and Scott (2008).

4. The easements' annual baseflows in AFA were then converted to cubic feet per second to enable comparisons of the modeled declines in streamflow, also expressed in CFS.

5. The easement's resulting yield in baseflow was subtracted from the decline in lower Babocomari River baseflows from the groundwater model's simulations of hydrologic conditions with Fort Huachuca present (including all of the installation's water-related conservation measures).

6. The resulting lessened impact to baseflow then had the modeled decline in baseflows from the groundwater model's simulation of hydrologic conditions as if Fort Huachuca was not present subtracted from it.

7. The resulting, residual declines in baseflows on the lower Babocomari River, at both the 10 and 50-year time scales; in summer, winter, and average conditions; and considering only the already-acquired conservation easements, represent the proposed action's range of net effect to the northern Mexican gartersnake on the Babocomari River.

The outcome that is reasonably certain to occur, whereby we consider the 299 AFA of water credits Babocomari River watershed easements that have already been acquired, indicates the following:

- The summer-season residual decline (Fort Huachuca's net, negative effect to baseflows, considering all water conservation measures as well as the beneficial effects of conservation easements) in lower Babocomari River baseflows will range from 0.05 CFS to 0.09 CFS at 10 years. At 50 years, the residual summer-season decline in lower Babocomari River baseflows resulting from all water conservation measures and the existing easements will range from 0.04 CFS to 0.09 CFS. Without easement acquisition (but with the Fort's water conservation measures), the summer modeled net decline at both 10 and 50 years would have been 0.12 CFS.

- The winter-season residual decline (Fort Huachuca's net, negative effect to baseflows, considering all water conservation measures as well as the beneficial effects of conservation easements) in lower Babocomari River baseflows will range from 0.06 CFS to 0.1 CFS at 10 years. At 50 years, the residual winter-season decline in lower Babocomari River baseflows resulting from all water conservation measures and the existing easements will range from 0.05 CFS to 0.1 CFS. We note that the winter season declines appear the most severe, but they are also highly conservative. It is very likely that riparian ET represents an appreciably smaller fraction of discharge (i.e less than 77 percent) during the non-growing season, meaning that more of the easements' water credits would be discharged as baseflow. Without easement acquisition (but with the Fort's water conservation measures), the winter modeled net decline at both 10 and 50 years would have been 0.13 CFS.

- The weighted average residual decline (Fort Huachuca's net, negative effect to baseflows, considering all water conservation measures as well as the beneficial effects of conservation easements) in lower Babocomari River baseflows will range from 0.05 CFS to 0.09 CFS at 10 years. At 50 years, the weighted average residual decline in lower Babocomari River baseflows resulting from all water conservation measures and the existing easements will range from 0.04 CFS to 0.09 CFS. Without easement acquisition (but with the Fort's water conservation measures), the weighted average modeled net decline at both 10 and 50 years would have been 0.12 CFS.

As stated previously, northern Mexican gartersnake populations along the Babocomari and San Pedro River are thought to be in poor condition and likely not viable in the long-term due to competitive and predation pressure from harmful nonnative species that co-occur. We expect these harmful nonnative species continue to keep northern Mexican gartersnake populations at low to very low densities along these two streams. The expected reduction in baseflow within the lower Babocomari River will ultimately seasonally reduce the foraging area for the northern Mexican gartersnake in this reach and therefore may concentrate available prey resulting in the beneficial effect of greater foraging efficacy; and, concentrate harmful nonnative predators resulting in greater predation pressure on resident snakes. Large adult northern Mexican gartersnakes have more resistance to the effects of harmful nonnative species due to their size, and may actually benefit from concentrated foraging opportunities, even in the presence of harmful nonnative species. However, neonatal or juvenile northern Mexican gartersnakes may

be disproportionately affected by increased predation in this situation and therefore we expect local recruitment to be very low.

Northern Mexican gartersnakes are known to be opportunistic foragers, meaning they will move on the landscape to areas that present the best foraging potential. Therefore, we believe it is reasonable to conclude that if any individuals are using the lower Babocomari River when flows become too slight or temporarily disappear, they will either move upstream into more suitable reaches of the Babocomari River (~10 km) or they will move downstream into the San Pedro River in search of more suitable foraging habitat. Because we believe the resident populations in this area are at low or very low densities, we do not anticipate adverse effects to the receiving populations associated with concerns over carrying capacity. These types of anticipated behaviors ultimately attenuate the effects of less surface water in this area on this population.

Effects to Critical Habitat

In our analysis of the effects of the action on critical habitat, we consider whether or not a proposed action will result in the destruction or adverse modification of critical habitat. In doing so, we must determine if the proposed action will result in effects that appreciably diminish the value of critical habitat for the recovery of a listed species. To determine this, we analyze whether the proposed action will adversely modify any of the PCEs that were the basis for determining the habitat to be critical. To determine if an action results in adverse modification of critical habitat, we must also evaluate the current condition of all designated CHUs, and the PCEs of those units, to determine the overall ability of all designated critical habitat to support recovery. Further, the functional role of each of the CHUs in recovery must also be considered because, collectively, they represent the best available scientific information as to the recovery needs of the species.

As stated previously, three units of proposed critical habitat for the northern Mexican gartersnake partially overlap the action area. They are the Upper Santa Cruz River Subbasin Unit, the Babocomari River/Cienega Subunit of the Babocomari River Subbasin Unit, and the San Pedro River Subunit of the San Pedro River Subbasin Unit. Within the Upper Santa Cruz River Subbasin Unit, only the uppermost of Scotia Canyon could conceivably be affected by the proposed action which we considered a remote possibility and therefore uncertain to occur.

Currently, we consider the Babocomari River/Cienega Subunit to contain sufficient physical or biological features, including PCEs 1 (aquatic habitat characteristics) and 2 (terrestrial habitat characteristics), but PCEs 3 (prey base) and 4 (absence or low level of harmful nonnative species) are deficient. In the San Pedro River Subunit, we consider all PCEs present with the exception of PCE 4 (absence or low level of harmful nonnative species). Because modeling indicates that through 2030, there is not expected to be a net loss in surface flow in the San Pedro River attributed to groundwater use by Fort Huachuca, we are reasonably certain there will not be measurable effects to any proposed PCEs for northern Mexican gartersnake critical habitat proposed in San Pedro River Subunit of the San Pedro River Subbasin Unit.

Due to the expectation that baseflow in the lower Babocomari River may be reduced by less than 0.1 cfs, we anticipate that PCE 1a for the Babocomari River/Cienega Subunit will be only

minimally affected by the proposed action. We anticipate that small, and difficult to measure expected reduction in baseflow will have minimal seasonal, and regionally localized effects on the wetted environment within occupied habitat. This small effect is expected to occur in the lower Babocomari River only, as currently modeled and reported by Fort Huachuca.

We also anticipate that prescribed burns within the Babocomari River/Cienega Subunit will have a short term adverse effect on vegetation density and structure within terrestrial habitat used by northern Mexican gartersnakes but ultimately a long-term benefit to this fire-adapted community, provided the burn is properly implemented. We do not anticipate any other proposed PCEs within any other proposed critical habitat units to be adversely affected by proposed ongoing and future military operations and activities at Fort Huachuca over the analysis period.

Cumulative Effects

See the Cumulative Effects section for the Huachuca water umbel for a general definition of cumulative effects and a discussion of the limited analysis of those effects permitted per Section 321 of the Defense Authorization Act of 2004.

Much of the land in the project area is managed by Federal agencies, particularly the BLM, Coronado National Forest, and Coronado National Memorial. Activities on state and private lands may require permits or funding from Federal agencies. Thus, many of the actions that are reasonably expected to occur in the project area that may adversely affect the northern Mexican gartersnake would be subject to section 7 consultation.

The only occupied habitat within the action area that is not federally managed occurs along the Babocomari River, upstream of the SPRNCA. The primary activity on these private lands is livestock grazing. The Borderlands Restoration LLLP is conducting watershed restoration in cooperation with the Babacomari Ranch. One of their goals is to increase surface and groundwater flows in the Babocomari and San Pedro rivers. The effects of grazing, development, and other activities occur on large tracts of state and private lands within the project area, and within the known range of the northern Mexican gartersnake are not interrelated or interdependent actions of Fort Huachuca and therefore not subject to section 7. Activities such as residential and commercial development, road maintenance, recreation, OHV use, farming, livestock grazing, surface mining, or actions that result in or benefit the persistence of harmful nonnative species occur on these lands and, while difficult to predict and quantify, are expected to continue into the foreseeable future. These actions can cumulatively adversely affect the northern Mexican gartersnake, especially in the presence of harmful nonnative species. Additional cumulative effects on northern Mexican gartersnakes include cross-border activities such as human traffic, deposition of trash, new trails from human traffic, increased fire risk from human traffic, intentional killing of gartersnakes, and water depletion and contamination. These actions, the effects of which are considered cumulative, may result in further degradation of northern Mexican gartersnake populations and habitat and are reasonably certain to occur in the action area. Compliance with the Act for activities on state and private lands that may adversely affect the northern Mexican gartersnake, but are not addressed by section 7 consultation, could occur through section 10(a)(1)(B) of the Act, once the species is listed.

Conclusion

After reviewing the current status of the northern Mexican gartersnake, the environmental baseline for the action area, the effects of the proposed ongoing and future military operations and activities at Fort Huachuca and the cumulative effects, it is our conference opinion that the action, as proposed, is not likely to jeopardize the continued existence of the proposed northern Mexican gartersnake, and is not likely to destroy or adversely modify proposed critical habitat. We base this decision on:

- the limited scope and seasonal duration of the anticipated effect of a small reduction in baseflow in the lower Babocomari River;
- the availability of wetted habitat upstream and downstream of the affected reach to this transient and opportunistic forager;
- recovery is the process that stops the decline of an endangered or threatened species by removing or reducing threats. Recovery ensures the long-term survival of the species in the wild. At that point, the species is recovered, and protection of the ESA is no longer necessary. The aforementioned effects will not appreciably reduce the likelihood of recovery of the northern Mexican gartersnake; and
- Effects of prescribed burns within adjacent shrubland habitat near the Babocomari are expected to be of short-term adverse nature but beneficial to this habitat in the long-term.

The proposed action is not likely to appreciably reduce the likelihood recovery of the northern Mexican gartersnake, should it be listed. The adverse effects that do occur in the action area are small and do not reach the scale where recovery of the species would be delayed or precluded. We make this conclusion for the following reasons:

- The potential area of effect is a small part of the range of the species;
- The Fort is no longer contributing to the groundwater deficit in the San Pedro River, having a "positive" water budget balance beginning in 2014;
- The proposed conservation measures reduce the effect of impacts to the northern Mexican gartersnake; and
- The populations of the species on Fort Huachuca, the lower Babocomari, and the San Pedro River occur in low densities, which minimizes the total number of individuals that can be adversely affected by the proposed action.

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FWS is unable to identify a reliable recovery "tipping point" or threshold for the northern Mexican gartersnake since there is so little information on the species. Because we cannot identify a tipping point, we cannot determine whether that tipping point would be reached as a result of agency operations. Since the impacts of the proposed action are minimal and the action area is small compared to the range of the species, it is highly unlikely that the proposed action would cause a tipping point away from recovery to be reached. The adverse effects that do occur in the action area do not reach the scale where recovery of the species would be delayed or precluded. Adverse effects and associated incidental take from the proposed action are anticipated to be small scale, and are unlikely to destroy or adversely modify the critical habitat in the action area to the extent that recovery would be delayed or precluded for many of the

reasons found in the conclusion and discussion above, should the species be listed or critical habitat designated.

The conclusions of this biological opinion are based on full implementation of the project as described in the Description of the Proposed Action section of this document, including any Conservation Measures that were incorporated into the project design.

This concludes the conference for the proposed ongoing and future military operations and activities at Fort Huachuca. You may ask us to confirm the conference opinion as a biological opinion issued through formal consultation if the northern Mexican gartersnake is listed or critical habitat is designated. The request must be in writing. If we review the proposed action and find that there have been no significant changes in the action as planned or in the information used during the conference, we will confirm the conference opinion as the biological opinion on this project and no further section 7 consultation will be necessary. After listing of the northern Mexican gartersnake as threatened, designation of its critical habitat, and any subsequent adoption of this conference opinion, the Fort may request reinitiation of consultation if: 1) the amount or extent of incidental take is exceeded; 2) new information reveals effects of the action that may affect the species or critical habitat in a manner or to an extent not considered in this conference opinion; 3) the action is subsequently modified in a manner that causes an effect to the species or critical habitat that was not considered in this conference opinion; or 4) a new species is listed or critical habitat designated that may be affected by the action.

The incidental take statement provided in this conference opinion does not become effective until the species is listed and the conference opinion is adopted as the biological opinion issued through formal consultation. At that time, the project will be reviewed to determine whether any take of the northern Mexican gartersnake has occurred. Modifications of the opinion and incidental take statement may be appropriate to reflect that take. No take of the northern Mexican gartersnake may occur between listing of the species and the adoption of the conference opinion through formal consultation, or the completion of a subsequent formal consultation.

INCIDENTAL TAKE STATEMENT

Please see the Incidental Take Statement for the ocelot, for a narrative and the statute and policy governing the content of this Incidental Take Statement. Under the terms of sections 7(b)(4) and 7(o)(2), taking that is incidental to and not intended as part of the agency action is not considered to be prohibited taking under the Act provided that such taking is in compliance with the terms and conditions of this incidental take statement. The prohibitions against taking the species found in section 9 of the Act do not apply until the species is listed. We are not recommending any reasonable or prudent measures at this time.

Amount or Extent of the Take

We anticipate the following incidental take of northern Mexican gartersnake as a result of authorized activities that are part of the proposed action:

- Ten (10) northern Mexican gartersnakes over the life of the project in the form of direct mortality, injury, or harassment as an indirect result of a reduction in baseflow resulting in the concentration and seasonal removal of wetted habitat in the lower Babocomari River that can be attributed to groundwater withdrawals associated with Fort Huachuca; and

- Five (5) northern Mexican gartersnakes over the life of the project in the form of direct mortality, injury, or harassment as an indirect result of prescribed burns in the East Range, adjacent to the lower Babocomari River.

Effect of the Take

In this conference opinion, we find that this level of anticipated take is not likely to jeopardize the continued existence of the northern Mexican gartersnake for the reasons discussed above in the Conclusion section.

If the incidental take anticipated in the paragraph entitled "Amount or Extent of Take" is met, the Fort shall immediately notify us in writing. If, during the course of the action, the level of anticipated incidental take is exceeded, such incidental take represents new information requiring reinitiation of consultation. In the interim, the Fort must cease the activity resulting in the take if it is determined that the impact of additional taking will cause an irreversible and adverse impact on the species. Fort Huachuca must immediately provide an explanation of the causes of the taking and review with us the need for possible reasonable and prudent measures.

Reasonable and Prudent Measures and Terms and Conditions

We believe that no reasonable and prudent measures are necessary because the conservation measures proposed by Fort Huachuca include sufficient measures to minimize impacts of incidental take of the northern Mexican gartersnake. Absent Reasonable and Prudent Measures, there is no need for their implementing Terms and Conditions. Please see the "Conservation Recommendations" for opportunities the Fort can seize to improve the baseline for northern Mexican gartersnake within the action area.

CONSERVATION RECOMMENDATIONS

Section 7(a)(1) of the Act directs Federal agencies to utilize their authorities to further the purposes of the Act by carrying out conservation programs for the benefit of endangered and threatened species. Conservation recommendations are discretionary agency activities to minimize or avoid adverse effects of a proposed action on listed species or critical habitat, to help implement recovery plans, or to develop information.

To conserve the northern Mexican gartersnake, we recommend that Fort Huachuca implement the following:

- We recommend that Fort Huachuca proactively explore opportunities to partner with regional conservation- and industry-based stakeholders and cooperators on participating in harmful nonnative species removal, contributing funding to such projects, or actively lobbying

decision-makers against policies that promote the existence of harmful nonnative species on the landscape, specifically within the San Pedro and Babocomari River systems.

- We recommend that Fort Huachuca refrain from using erosion control products, such as wattles, that contain a mesh size of 0.5” (or 1.27 cm). This mesh size has been documented in the literature as being associated with direct mortality, via entanglement, in numerous species of snakes, including those in the gartersnakes genus Thamnophis. Alternatively, please consider using the smallest mesh size possible (<0.5”) or preferably, products that do not contain any mesh- or net-like attributes near occupied northern Mexican gartersnake habitat.

- We recommend that when possible, Fort Huachuca schedule prescribed burns that occur within proposed northern Mexican gartersnake critical habitat, from November through February when the species is less likely to be surface active and therefore, less likely to be harmed by the burn.

Table NMGS 1. Current population status of the northern Mexican gartersnake in the United States.

Location	Last Record	Suitable Physical Habitat Present	Native Prey Species Present	Harmful Nonnative Species Present	Population Status
Gila River (NM, AZ)	2002	Yes	Yes	Yes	Likely not viable
Spring Canyon (NM)	1937	Yes	Possible	Likely	Likely extirpated
Mule Creek (NM)	1983	Yes	Yes	Yes	Likely not viable
Mimbres River (NM)	Likely early 1900s	Yes	Yes	Yes	Likely extirpated
Lower Colorado River (AZ)	1904	Yes	Yes	Yes	Likely extirpated
Bill Williams River (AZ)	2012	Yes	Yes	Yes	Likely viable
Agua Fria River (AZ)	1986	Yes	Yes	Yes	Likely not viable
Little Ash Creek (AZ)	1984	Yes	Yes	Yes	Likely not viable
Lower Salt River (AZ)	1964	Yes	Yes	Yes	Likely extirpated
Black River (AZ)	1982	Yes	Yes	Yes	Likely not viable
Big Bonito Creek (AZ)	1986	Yes	Yes	Yes	Likely not viable
Tonto Creek (AZ)	2005	Yes	Yes	Yes	Likely viable
Upper Verde River (AZ)	2012	Yes	Yes	Yes	Likely viable
Oak Creek (AZ) (Page Springs and Bubbling Ponds State Fish Hatcheries)	2012	Yes	Yes	Yes	Likely viable
Spring Creek (AZ)	1986	Yes	Yes	Yes	Likely not viable
Sycamore Creek (AZ)	1954	Yes	Possible	Yes	Likely extirpated
Upper Santa Cruz River/San Rafael Valley (AZ)	2012	Yes	Yes	Yes	Likely viable
Redrock Canyon (AZ)	2008	Yes	Yes	Yes	Likely not viable

Sonoita Creek (AZ)	1974	Yes	Possible	Yes	Likely extirpated
Scotia Canyon (AZ)	2009	Yes	Yes	No	Likely not viable
Parker Canyon (AZ)	1986	Yes	Possible	Yes	Likely not viable
Las Cienegas National Conservation Area and Cienega Creek Natural Preserve (AZ)	2012	Yes	Yes	Possible	Likely not viable
Lower Santa Cruz River (AZ)	1956	Yes	Yes	Yes	Likely extirpated
Buenos Aires National Wildlife Refuge (AZ)	2000	Yes	Yes	Yes	Likely not viable
Bear Creek (AZ)	1987	Yes	Yes	Yes	Likely not viable
Canelo Hills-Sonoita Grasslands Area (AZ)	2012	Yes	Yes	Yes	Likely not viable
San Bernardino National Wildlife Refuge (AZ)	1997	Yes	Yes	Yes	Likely not viable
Notes: "Possible" means there were no conclusive data found. "Likely extirpated" means the last record for an area pre-dated 1980 and existing threats suggest the species is likely extirpated. "Likely not viable" means the last record for an area post-dated 1980 and existing threats suggest the species is likely extirpated. "Likely viable" means that the species is reliably found with minimal to moderate survey effort and the population is generally considered viable.					

CONFERENCE OPINION - YELLOW BILLED CUCKOO, WESTERN DISTINCT POPULATION SEGMENT

Status the Species

The Western Distinct Population Segment (DPS) of the yellow-billed cuckoo became a candidate for listing under the ESA in 2001, after a 12-month finding determined that listing was warranted but precluded by higher listing priorities (Service 2001a). The Service published a proposed rule (78 FR 61622) to list the Western DPS of the yellow-billed cuckoo (*Coccyzus americanus*) as a threatened species on October 3, 2013 (Service 2013b).

Physical Characteristics

Adult yellow-billed cuckoos have moderate to heavy bills, somewhat elongated bodies and a narrow yellow ring of colored bare skin around the eye. The plumage is grayish-brown above and white below, with reddish primary flight feathers. The tail feathers are boldly patterned with black and white below. They are a medium-sized bird about 12 in (30cm) in length, and about 2 oz (60 g) in weight. Males and females differ slightly; the males have a slightly smaller body size, smaller bill, and the white portions of the tail tend to form distinct oval spots. In females the white spots are less distinct and tend to be connected (Hughes 1999, Service 2013b).

Morphologically, the yellow-billed cuckoos throughout the western continental United States and Mexico are generally larger, with significantly longer wings, longer tails, and longer and deeper bills (Franzreb and Laymon 1993). Birds with these characteristics occupy the Western DPS and are we refer to them as the "western yellow-billed cuckoo." Only the Western DPS has been proposed for listing as a threatened species (78 FR 61622). Yellow-billed cuckoos in the west arrive on the breeding grounds 4 to 8 weeks later than eastern yellow-billed cuckoos at similar latitude (Franzreb and Laymon 1993, Hughes 1999, Laymon 2000, in. litt.). Some information exists suggesting that the western population segment described in the scientific literature as the western yellow-billed cuckoo (Coccyzus americanus occidentalis) is distinguishable at the subspecific level; however, there is enough literature to conclude that recognition of the subspecies is not justified at this time (Service 2013b).

Distribution

The yellow-billed cuckoo is a member of the avian family Cuculidae and is a Neotropical migrant bird that winters in South America and breeds in North America. The breeding range of the entire species formerly included most of North America from southeastern and western Canada (southern Ontario and Quebec and southwestern British Colombia) to the Greater Antilles and northern Mexico (AOU 1957, AOU 1983, AOU 1998).

Based on historical accounts, the western yellow-billed cuckoo was formerly widespread and locally common in California and Arizona, more narrowly distributed but locally common in New Mexico, Oregon, and Washington and uncommon along the western front of the Rocky Mountains north to British Columbia (AOU 1998, Hughes 1999). The species may be extirpated from British Colombia, Washington, and Oregon (Hughes 1999). The western yellow-billed cuckoo is now very rare in scattered drainages in western Colorado, Idaho, Nevada, and Utah, with single, nonbreeding birds most likely to occur (Service 2001a). The largest remaining breeding areas are in southern and central California, Arizona, along the Rio Grande in New Mexico, and in northwestern Mexico (Service 2013b).

The current breeding population is low, with estimates of approximately 350 to 495 pairs north of the Mexican border and another 330 to 530 pairs in Mexico for a total of 680 to 1,025 breeding pairs (Service 2013b).

Yellow-billed cuckoos spend the winter in South America, east of the Andes, primarily south of the Amazon Basin in southern Brazil, Paraguay, Uruguay, eastern Bolivia, and northern

Argentina (Ehrlich et al. 1992, AOU 1998, Johnson et al. 2008b). The species as a whole winters in woody vegetation bordering fresh water in the lowlands to 1,500 m (4,921 ft), including dense scrub, deciduous broadleaf forest, gallery forest, secondary forest, subhumid and scrub forest, and arid and semiarid forest edges (Hughes 1999). Wintering habitat of the western yellow-billed cuckoo is poorly known.

Migration

Little is known about migratory habitat for the western yellow-billed cuckoo. Yellow-billed cuckoos may be found in a variety of vegetation types during migration, including coastal scrub, secondary growth woodland, hedgerows, humid lowland forests, and forest edges from sea level to 8,125 ft (2,500 m)(Hughes 1999). Additionally, during migration they may be found in smaller riparian patches than those in which they typically nest. This variety of vegetation types suggests that the habitat needs of the yellow-billed cuckoo during migration are not as restricted as their habitat needs when nesting and tending young.

Habitat and Life History

Food

Yellow-billed cuckoos forage primarily by gleaning insects from vegetation, but they may also capture flying insects or small vertebrates such as tree frogs and lizards (Hughes 1999). They specialize on relatively large invertebrate prey, including caterpillars (Lepidoptera sp.), katydids (Tettigoniidae sp.), cicadas (Cicadidae sp.), and grasshoppers (Caelifera sp.)(Laymon et al. 1997). Minor prey include beetles (Coleoptera sp.), dragonflies (Odonata sp.), praying mantis (Mantidae sp.), flies (Diptera sp.), spiders (Araneae sp.), butterflies (Lepidoptera sp.), caddis flies (Trichoptera sp.), crickets (Gryllidae sp.), wild berries, and bird eggs and young (Laymon et al. 1997, Hughes 1999). Prey species composition varies geographically. Their breeding season may be timed to coincide with outbreaks of insect species, particularly tent caterpillars (Hughes 1999, Service 2001a) or cicadas (Johnson et al. 2007, Halterman 2009). In Arizona, fledging occurred at the peak emergence of cicadas (Rosenberg et al. 1982).

In the arid West, these conditions are usually found in cottonwood-willow riparian associations along water courses. The arrival of birds and the timing of nesting are geared to take advantage of any short-term abundance of prey. In years of high insect abundance, western yellow-billed cuckoos lay larger clutches (3-5 eggs rather than two), a larger percentage of eggs produce fledged young, and they breed multiple times (2-3 nesting attempts rather than one)(Laymon et al. 1997). Western yellow-billed cuckoo food availability is largely influenced by the health, density, and species of vegetation. Desiccated riparian sites produce fewer suitable insects than healthy moist sites.

Breeding Habitat

Western populations of yellow-billed cuckoos breed in dense riparian woodlands, primarily of cottonwood (Populus fremontii), willow (Salix spp.), and mesquite (Prosopis spp.), along riparian corridors in otherwise arid areas (Laymon and Halterman 1989, Hughes 1999). Dense

undergrowth may be an important factor in selection of nest sites. Occupied habitat in Arizona may also contain box elder (*Acer negundo*), Arizona alder (*Alnus oblongifolia*), Arizona walnut (*Juglans major*), Arizona sycamore (*Platanus wrightii*), oak (*Quercus* spp.), netleaf hackberry (*Celtis reticulata*), velvet ash (*Fraxinus velutina*), Mexican elderberry (*Sambuccus mexicanus*), tamarisk (*Tamarix* spp.; also called salt cedar), and seepwillow (*Baccharis glutinosa*)(Corman and Magill 2000). Surveys conducted by the Arizona Breeding Bird Atlas (Corman and Wise-Gervais 2005) reported 68 percent of the yellow-billed cuckoo observations were in lowland riparian woodlands, often containing a variable combination of Fremont cottonwood, willow, velvet ash, Arizona walnut, mesquite, and tamarisk (Corman and Wise-Gervais 2005). Narrow bands of riparian woodland can contribute to the overall extent of suitable habitat. Adjacent habitat on terraces or in the upland (such as mesquite) can enhance the value of these narrow bands of riparian woodland.

Throughout the western yellow-billed cuckoo range, a large majority of nests are placed in willow trees, but alder (*Alnus* spp.), cottonwood, mesquite, walnut (*Juglans* spp.), box elder, sycamore, netleaf hackberry (*Celtis laevigata* var. *reticulata*), soapberry (*Sapindus saponaria*), and tamarisk are also used (Laymon 1980, Hughes 1999, Corman and Magill 2000 , Corman and Wise-Gervais 2005, Holmes et al. 2008). Tamarisk is also a riparian species that may be associated with breeding under limited conditions; western yellow-billed cuckoo will sometimes build their nests and forage in tamarisk, but there is usually a native riparian tree component within the occupied habitat (Gaines and Laymon 1984, Johnson et al. 2008a).

Western yellow-billed cuckoos reach their breeding range later than most other migratory breeders, often in June (Rosenberg et al. 1982). They construct an unkempt stick nest on a horizontal limb in a tree or large shrub. Nest height ranges from 4 ft to (rarely) 100 ft, but most are typically below 30 ft (Hughes 1999). The incubation period for the western yellow-billed cuckoo is 9 to 11 days, and young leave the nest at 7 to 9 days old. Although other species of cuckoos are often or always brood parasites of other birds, yellow-billed cuckoos do so only infrequently, possibly in response to high food resources that allow rapid egg production (Fleischer et al. 1985). Nesting usually occurs between late June and late July, but can begin as early as late May and continue until late September (Hughes 1999). In a study on the lower Colorado River, three nests were estimated to have first fledged young during August 25 to 28 had they not failed. If these nests had successfully fledged young, the birds may still have been present at their respective breeding sites at least until September 15 to 18 (previously discussed in McNeil et al. 2012).

The western yellow-billed cuckoo primarily breeds in riparian habitat along low-gradient (surface slope less than 3%) rivers and streams, and in open riverine valleys that provide wide floodplain conditions (greater than 325 ft [100 m]). In the southwest, it can also breed in narrower reaches of riparian habitat. Within the boundaries of the distinct population segment (DPS)(see Figure 2 at 78 FR 61631,) these riparian areas are located from southern British Columbia, Canada, to southern Sinaloa, Mexico, and may occur from sea level to 7,000 ft (2,154 m)(or slightly higher in western Colorado, Utah, and Wyoming) in elevation. The moist conditions that support riparian plant communities that provide western yellow-billed cuckoo habitat typically exist in lower elevation, broad floodplains, as well as where rivers and streams enter impoundments. In southeastern Arizona, however, cuckoos were often found nesting along

intermittent drainages with dense stands of velvet mesquite and netleaf hackberry (Corman and Wise-Gervais 2005, AGFD 2011b). Yellow-billed cuckoos are infrequently encountered along higher mountain drainages where Arizona sycamore or Arizona alder are the dominant riparian species. Dense understory foliage appears to be an important factor in nest site selection, while cottonwood trees are an important foraging habitat in areas where the species has been studied in California (USFWS 2001). In the extreme southern portion of their summer range in the States of Sonora (southern quarter) and Sinaloa, Mexico, western yellow-billed cuckoos also nest in upland thorn scrub and dry deciduous habitats away from the riparian zone (Russell and Monson 1988), though their densities are lower in these habitats than they are in adjacent riparian areas. At the landscape level, the available information suggests the western yellow-billed cuckoo requires large tracts of willow-cottonwood or mesquite forest or woodland for their nesting season habitat. Habitat can be relatively dense, contiguous stands, irregularly shaped mosaics of dense vegetation with open areas, or narrow and linear.

Canopy cover directly above the nest is generally dense and averages 89 percent and is denser at the South Fork Kern River (93 percent) and Bill Williams River (94 percent) than at the San Pedro River (82 percent). Canopy closure in a plot around the nest averages 71 percent and was higher at the Bill Williams River (80 percent) than at the South Fork Kern River (74 percent) or San Pedro River (64 percent)(Laymon et al. 1997, Halterman 2003, Halterman 2004, Halterman 2005, Halterman 2006).

The optimal size of habitat patches for the species are generally greater than 200 ac (81 ha) and have dense canopy closure and high foliage volume of willows and cottonwoods (Laymon and Halterman 1989) and thus provide adequate space for foraging and nesting. Tamarisk, a nonnative tree species, may be a component of the habitat, especially in Arizona and New Mexico. Sites with a monoculture of tamarisk are unsuitable habitat for the species. The association of breeding with large tracts of suitable riparian habitat is likely related to home range size. Individual home ranges during the breeding season average over 100 ac (40 ha), and home ranges up to 500 ac (202 ha) have been recorded (Laymon and Halterman 1987, Halterman 2009, Sechrist et al. 2009, McNeil et al. 2011, McNeil et al. 2012).

In addition to the dense nesting grove, western yellow-billed cuckoos need adequate foraging areas near the nest. Foraging areas can be less dense or patchy with lower levels of canopy cover and often have a high proportion of cottonwoods in the canopy. Optimal breeding habitat contains groves with dense canopy closure and well-foliaged branches for nest building with nearby foraging areas consisting of a mixture of cottonwoods, willows, or mesquite with a high volume of healthy foliage (Service 2013b).

Riparian habitat is dynamic, and species may move from one area to another over time. Western yellow-billed cuckoos may nest at more than one location in a year. Some individuals also roam widely (several hundred miles), apparently assessing food resources before selecting a nest site (Sechrist et al. 2012).

During movements between nesting attempts western yellow-billed cuckoos are found at riparian sites with small groves or strips of trees, sometimes less than 10 ac (4 ha) in extent (Laymon and

Halterman 1989). These stopover and foraging sites can be similar to breeding sites, but are smaller, narrower, and lack understory vegetation when compared to nesting sites.

Water and Humidity

Habitat for the western yellow-billed cuckoo is largely associated with perennial rivers and streams that support the expanse of vegetation characteristics needed by breeding western yellow-billed cuckoos. The range and variation of stream flow frequency, magnitude, duration, and timing that will establish and maintain western yellow-billed cuckoo habitat can occur in different types of regulated and unregulated flows depending on the interaction of the water and the physical characteristics of the landscape (Poff et al. 1997; Service 2002c, 2013b).

Hydrologic conditions at western yellow-billed cuckoo breeding sites can vary widely between years. At some locations during low rainfall years, water or saturated soil is not available. At other locations, particularly at reservoir inlets, riparian vegetation can be inundated for extended periods in some years and be totally dry in other years. This is particularly true of reservoirs like Lake Isabella in California, Roosevelt and Horseshoe Reservoirs in Arizona, and Elephant Butte Reservoir in New Mexico, all of which have relatively large western yellow-billed cuckoo populations. This year-to-year change in hydrology can affect food availability and habitat suitability for western yellow-billed cuckoos. In some areas, managed hydrologic cycles above or below dams can create temporary western yellow-billed cuckoo habitat, but may not be able to support it for an extended time, or may support varying amounts of habitat at different points of the cycle and in different years. Water management operations create varied situations that allow different plant species to thrive when water is released below a dam, held in a reservoir, or removed from a lakebed, and consequently, varying amounts of western yellow-billed cuckoo habitat are available from month to month and year to year as a result of dam operations. During wet years, habitat within a lake and below a dam can be flooded for extended periods and stressed or killed. During dry years, habitat can be desiccated and stressed or killed because of lack of water (Poff et al. 1997, Greco 1999, National Academy of Sciences 2002; USFWS 2002a, 2013b).

Humid conditions created by surface and subsurface moisture appear to be important habitat parameters for western yellow-billed cuckoo. The species has been observed as being restricted to nesting in moist riparian habitat in the arid West because of humidity requirements for successful hatching and rearing of young (Hamilton and Hamilton 1965, Gaines and Laymon 1984, Rosenberg et al. 1991). Western yellow-billed cuckoos have evolved larger eggs and thicker eggshells, which would help them cope with potential higher egg water loss in the hotter, dryer conditions (Hamilton and Hamilton 1965, Ar et al. 1974, Rahn and Ar 1974). A study on the South Fork Kern River showed that lower temperatures and higher humidity were found at nest sites when compared to areas along the riparian forest edge or outside the forest (Launer et al. 1990). Recent research on the lower Colorado River has confirmed that western yellow-billed cuckoo nest sites had significantly higher daytime relative humidity (6–13% higher) and significantly lower daytime temperatures (2–4o F [1–2o C] lower) than average forested sites (McNeil et al. 2011, McNeil et al. 2012).

Subsurface hydrologic conditions are equally important to surface water conditions in determining riparian vegetation patterns. Depth to groundwater plays an important part in the distribution of riparian vegetation and western yellow-billed cuckoo habitat. Where groundwater levels are elevated so riparian forest trees can access the water, habitat for nesting, foraging, and migrating western yellow-billed cuckoos can develop and thrive. Goodding's willows (*Salix gooddingii*) and Fremont cottonwoods do not regenerate if the groundwater levels fall below 6 ft (2 m)(Shafroth et al. 2000). Goodding's willows cannot survive if groundwater levels drop below 10 ft (3 m), and Fremont cottonwoods cannot survive if groundwater drops below 16 ft (5 m)(Stromberg et al. 1996). Abundant and healthy riparian vegetation decreases and habitat becomes stressed and less productive when groundwater levels are lowered (Stromberg et al. 1996).

Conditions for Germination and Regeneration of Riparian Zone Trees

The abundance and distribution of fine sediment deposited on floodplains is critical for the development, abundance, distribution, maintenance, and germination of trees in the riparian zone that become western yellow-billed cuckoo habitat. These sediments become seedbeds for germination and growth of the riparian vegetation upon which western yellow-billed cuckoos depend. These sediments must be accompanied by sufficient surface moisture for seed germination and sufficient ground water levels for survival of seedlings and saplings (Stromberg 2001). The lack of hydrologic processes, which deposit such sediments, may lead riparian forested areas to senesce and become degraded and unable to support the varied vegetative structure required for western yellow-billed cuckoo nesting and foraging.

Arizona

At present, it appears that the State's population could be as low as 170 pairs of yellow-billed cuckoos, and probably does not exceed 250 pairs. The population of the western yellow-billed cuckoo in Arizona is the largest in the United States (Service 2013b).

The yellow-billed cuckoo was historically widespread and locally common in Arizona (Phillips et al. 1964, Groschupf 1987). Although Arizona probably contains the largest remaining western yellow-billed cuckoo population among states west of the Rocky Mountains, the population has reportedly declined significantly in distribution and abundance over the past 80 years (Corman and Wise-Gervais 2005). During Arizona Breeding Bird Atlas surveys, nesting birds were found to be concentrated in western, central, and southeastern Arizona. According to Corman and Wise-Gervais (2005), western yellow-billed cuckoos were found along most of the 25 drainages where they were reported historically but they are now much more local in distribution. It is believed that the San Pedro River likely sustains the largest single remaining population of yellow-billed cuckoos (Brand et al. 2009).

A 1976 study based on existing habitat and known yellow-billed cuckoo population densities estimated 846 pairs were present on the lower Colorado River and its five major tributaries in Arizona (Groschupf 1987). In a statewide survey in 1999 that covered 265 mi (426 km) of river and creek bottoms, 172 yellow-billed cuckoo pairs and 81 single birds were located in Arizona (Corman and Magill 2000). Yellow-billed cuckoo populations greater than 10 pairs are found at

12 locations in Arizona: Bill Williams River, Colorado River, Gila River, Upper Cienega Creek, Hassayampa River, San Pedro River, Santa Maria River, Verde River, Sonoita Creek, Santa Cruz River, Altar Valley, and Agua Fria River. Sites with smaller populations are found at the Roosevelt Lake complex, Upper Tonto Creek, Pinto Creek, Sycamore Creek in Pajarito Mountains, Oak Creek, Lower Cienega Creek, Babocomari River, Pinal Creek, Bonita Creek, San Bernardino NWR, Hooker Hot Springs, Big Sandy River, and many smaller drainages. However, many drainages have not been thoroughly surveyed and it is likely that some additional yellow-billed cuckoo locations will be discovered. These include, but are not limited to the mountain ranges of southeastern Arizona, Eagle Creek, and along the Gila, San Francisco, and Blue Rivers. Yellow-billed cuckoo sightings reported by birders between 15 June and 31 August, 1998 to 2012, in more than one year in southeastern Arizona mountain ranges include Walker, Madera, and Montosa canyons in the Santa Rita Mountains; Carr Canyon, Ash Canyon, Garden Canyon, Ramsey Canyon, and Miller Canyon in the Huachuca Mountains; Scotia Canyon and Sycamore Canyon in the Atascosa/Pajarito Mountains; French Joe Canyon in the Whetstone Mountains; Kitt Peak on Baboquivari Mountain; Harshaw Canyon and Paymaster Spring in the Patagonia Mountains; and a few locations in the Chiricahua Mountains (Cornell Laboratory of Ornithology 2012). Yellow-billed cuckoos are breeding in at least some of these locations, with nesting confirmed at Sycamore Canyon (AGFD, unpublished data).

Documented Decline at Some Arizona Sites

Bill Williams River—In the mid-1970s, an estimated 57 pairs of yellow-billed cuckoos bred in the riparian forest of the Bill Williams River delta (Gaines and Laymon 1984). Following the sustained high water levels of 1983 to 1984 and 1986, which inundated and killed most of the cottonwoods and willows along the Colorado River, yellow-billed cuckoo numbers also declined on the Bill Williams River delta where similar habitat mortality occurred (Rosenberg et al. 1991). In 1987, 17 pairs of yellow-billed cuckoos were located at this site and a total of 25 to 30 pairs estimated to be present, a decline of 47 to 56 percent over 10 years (Laymon and Halterman 1987a). Surveys were conducted regularly at this site from 1993 to 2002. The breeding population fluctuated from a low of 6 to 9 pairs in 1999 to a high of 28 to 39 pairs in 2001 (Halterman 2003). In 2010, 12 to 31 pairs were estimated, and the most recent survey in 2011 estimated 9 to 23 pairs (McNeil et al. 2010, McNeil et al. 2012). Bill Williams River NWR is considered the largest, highest quality stand of suitable habitat for the yellow-billed cuckoo along the lower Colorado River (Johnson et al. 2008a). Data from this site show an important, but fluctuating, breeding population that has not recovered to 1977 levels.

Lower Colorado River—The lower Colorado River on the California-Arizona border supported an estimated 180 yellow-billed cuckoo pairs in 1976 to 1977 (Gaines and Laymon 1984), a number that had declined an estimated 80 to 90 percent by 1986 (Laymon and Halterman 1987a). In 2010, based on intensive surveys, 8 to 18 pairs were estimated, and the most recent survey in 2011 estimated 9 to 23 pairs on the Arizona side of the Colorado River, excluding the Bill Williams River (McNeil et al. 2010, McNeil et al. 2012). Recent population estimates are well below the breeding population in 1977, even though more area was surveyed.

Other Arizona Sites with at Least 10 years of Survey Data

Upper San Pedro River—see Environmental Baseline

Sonoita Creek—A 4-mi (6-km) segment of Sonoita Creek was surveyed seven years between 1976 and 1986 (Groschupf 1987). Yellow-billed cuckoo pairs were not estimated, but lows of 5 and 6 individuals were found in 1976 and 1986, respectively, and highs of 24 to 28 individuals were found between 1977 and 1979. The site was surveyed again in 1998 and 1999, with 11 to 12 pairs and 8 to 9 single yellow-billed cuckoos located (Corman and Magill 2000). In 2005, 17 individuals were found while conducting bird surveys for Important Bird Area designation (Arizona Audubon 2012, http://iba.audubon.org/iba). This population, while fluctuating, does not appear to have decreased in size from 1976 to 2005.

Verde River—Surveys conducted in 2004 and 2005 at 37 sites within the Verde River watershed were done at historical sites (16) where yellow-billed cuckoos were previously detected in 1998 to 1999 and at random sites (21) with riparian forest that appeared to be suitable nesting habitat (Holmes et al. 2008). In the 2 years, 59 percent of sites had detections; 75 percent of historical sites and 48 percent of random sites (Holmes et al. 2008). Holmes et al. (2008) confirmed nesting at five sites and found evidence of probable breeding at nine additional sites. The maximum number of detections during any one survey period was 23 in 2004 and 31 in 2005.

Mexican Breeding Range

In Sonora, Mexico, yellow-billed cuckoos were summer residents in willow-cottonwood riparian woodland, older mesquite woodland, tropical deciduous forest, and tropical thorn scrub habitats (Russell and Monson 1998). In southern Sonora, Mexico, Short (1974) found the yellow-billed cuckoos breeding in upland thorn forest, but they were more common in the riparian zone. In a study focusing on cactus ferruginous pygmy-owls (*Glaucidium brasilianum cactorum*) during late spring and summer from 2001 through 2010, Flesch (2012 in litt.) found yellow-billed cuckoos at 95 sites from June to September at elevations from 328 to 6,902 ft (100-2,104 m). The number of birds at each site ranged from 1 to 15 individuals. Flesch also confirmed breeding at four sites in thornscrub habitats and at one site in upland Sonoran Desert habitat. These records indicate a broader use of habitat by yellow-billed cuckoos in Sonora, Mexico (Service 2013b).

Threats

The western yellow-billed cuckoo is threatened by two of the five threat factors evaluated (A and E).

Factor A. The Present or Threatened Destruction, Modification, or Curtailment of Its Habitat or Range

Within the three States with the highest historical number of yellow-billed cuckoo pairs, past riparian habitat losses are estimated to be about 90 to 95 percent in Arizona, 90 percent in New Mexico, and 90 to 99 percent in California (Ohmart 1994, U.S. Department of Interior 1994, Noss et al. 1995, Greco 2008).

The primary threat to the western yellow-billed cuckoo is loss or fragmentation of high-quality riparian habitat suitable for nesting (Corman and Wise-Gervais 2005). Habitat loss and degradation from several interrelated factors include alteration of flows in rivers and streams, encroachment into the floodplain from agricultural and other development activities, stream channelization and stabilization, diversion of surface and ground water for agricultural and municipal purposes, livestock grazing, wildfire, establishment of nonnative vegetation, drought, and prey scarcity due to pesticides (Ehrlich et al. 1992, Wiggins 2005, USFWS 2013b). Drought and prey scarcity (especially the loss of sphinx moth caterpillars to pesticides in the West) appear to play a role in yellow-billed cuckoo declines even where suitable nesting habitat remains (Ehrlich et al. 1992). These factors also contribute to fragmentation and promote conversion to nonnative plant species and increased incidence of wildfire (Krueper 1993; USFWS 2001, 2013e). A potential factor contributing to declines across the species' range in North America is the loss of forested habitat on its wintering grounds in South America where little is known of its ecology or distribution (Ehrlich et al. 1992). The threats affecting western yellow-billed cuckoo habitat are ongoing. Such a loss of riparian habitat leads not only to a direct reduction in yellow-billed cuckoo numbers but also leaves a highly fragmented landscape, which can reduce breeding success through increased predation rates and barriers to dispersal by juvenile and adult yellow-billed cuckoos (Service 2013b).

Factor E. Other Natural or Manmade Factors Affecting Its Continued Existence

Factor E threats, including habitat rarity and small, isolated populations of the western yellow-billed cuckoo, cause the remaining populations in western North America to be increasingly susceptible to further declines through lack of immigration, chance weather events, fluctuating availability of prey populations, pesticides, collisions with tall vertical structures during migration, spread of the introduced tamarisk leaf beetle (*Diorhabda* spp.) as a biocontrol agent in the Southwest, and climate change. The ongoing threat of small overall population size leads to an increased chance of local extirpations through random events (Thompson 1961, McGill 1975, Wilcove et al. 1986).

Habitat for the western yellow-billed cuckoo has been modified and curtailed, resulting in only remnants of formerly large tracts of native riparian forests, many of which are no longer occupied by western yellow-billed cuckoos. Despite recent efforts to protect existing, and restore additional, riparian habitat in the Sacramento, Kern, and Colorado Rivers, and other rivers in the range of the western yellow-billed cuckoo, these efforts offset only a small fraction of historical habitat that has been lost. Therefore, we expect the threat resulting from the combined effects associated with small and widely separated habitat patches to continue to affect a large portion of the range of the western yellow-billed cuckoo. This threat is particularly persistent where small habitat patches are in proximity to human-altered landscapes, such as near agricultural fields that dominate the landscape in many areas where the western yellow-billed cuckoo occurs. As a result, the potential exists for pesticides to directly affect (poisoning individual cuckoos) and indirectly affect (reducing the prey base) a large portion of the species. These effects could ultimately result in lower population abundance and curtailment of its occupied range. Mortality from collisions with tall structures is also an ongoing, but largely unquantified effect. We recognize that climate change is a critical issue with potentially severe

wide-ranging effects on the species and its habitat. The available scientific literature suggests that the effects of climate change will likely exacerbate multiple existing threats to the western yellow-billed cuckoo and its habitat.

Environmental Baseline – Yellow-Billed Cuckoo

The environmental baseline includes past and present impacts of all Federal, State, or private actions in the action area, the anticipated impacts of all proposed Federal actions in the action area that have undergone formal or early section 7 consultation, and the impact of State and private actions that are contemporaneous with the consultation process. The environmental baseline defines the current status of the species and its habitat in the action area to provide a platform to assess the effects of the action now under consultation. Also refer to the General Environmental Baseline and Action Area earlier in this biological and conference opinion.

Moderate to heavy grazing by domestic livestock has occurred in southern Arizona for at least 300 years (Allen 1989, Krueper 1996). In 1694, approximately 100,000 cattle were present within the headwaters of the San Pedro River Valley (Allen 1989). By the late 1880s, up to 1.5 million cattle were estimated to be using the grasslands of southern Arizona annually, primarily south of the Gila River (Dobyns 1981, Bahre 1991, Ohmart 1996). Overstocking of the range during the 1880s severely degraded grasslands in the Upper San Pedro River Valley and throughout the Southwest (Hastings and Turner 1965, Bahre 1999, Donahue 1999). Overgrazing within the San Pedro River Valley caused erosion and increased siltation and entrenchment (Stromberg et al. 1996). The cienegas maintained by beavers (*Castor canadensis*) were drained and replaced by mesquite, Fremont cottonwood, Gooding's willow, and seepwillow. Following exclusion of cattle in 1986 and partial recovery of riparian habitat from overgrazing, yellow-billed cuckoo numbers increased along the upper San Pedro River (Krueper et al. 2003). Riparian habitat that has developed post-cattle removal and the yellow-billed cuckoo population it supports is considered the baseline condition for proposed land and water management.

The San Pedro River supports one of the largest remaining populations of yellow-billed cuckoos in the western U.S. (Brand et al. 2009). Krueper (1993) provides data on the density of western yellow billed cuckoos and other obligate riparian songbirds in the SPRNCA between 1986 through 1991, during which grazing was retired in 1987, and understory vegetation increased significantly. According to Halterman (2009), the river channel in the SPRNCA is lined with cottonwood and willow, with mesquite and netleaf hackberry common on the upper floodplain. The floodplain vegetation in the SPRNCA varies in width from 50 to 1,000 m (160-3,300 ft)(Halterman 2009).

With home ranges averaging more than 100 ac (40 ha) per individual, and nesting at densities of less than 1 pair per 100 ac (40 ha), a large amount of habitat is required to support even a small population of western yellow-billed cuckoos (Laymon et al. 1997, Laymon and Williams 2002, Halterman 2009, Sechrist et al. 2009, McNeil et al. 2012,). As a result, a large amount of habitat is required to support even a small population of western yellow-billed cuckoos.

The habitat patches used by western yellow-billed cuckoos vary in size and shape with optimal areal extent being over 200 ac (81 ha). The larger the site, the more likely it will provide suitable

habitat for the western yellow-billed cuckoos and be occupied by nesting pairs (Laymon and Halterman 1989). Sites can be relatively dense, contiguous stands or irregularly-shaped mosaics of dense vegetation with open areas.

In 2000 and 2001, Fort Huachuca established eight long-term transects for monitoring the southwestern willow flycatcher in the SPRNCA (Vernadero Group 2009). Since 2001, southwestern willow flycatcher surveys conducted in the SPRNCA on behalf of Fort Huachuca have also systematically recorded and reported detections of yellow-billed cuckoo. During seven surveys conducted by the Fort between 2001 and 2009, between 22 and 81 (median 31) yellow-billed cuckoo detections were made on the SPRNCA. Because cuckoos have such large home ranges, it is difficult to determine how many individual cuckoos these detections represent. Therefore, numbers are presented as the total number of cuckoo detections during the breeding season. Other yellow-billed cuckoo populations have shown annual fluctuation in detections (Halterman 2009b). Since 2003, these surveys have also included a transect in the Babocomari Cienega, and two to four birds were detected per survey in the Babocomari Cienega during the five surveys conducted between 2003 and 2009.

During breeding season willow flycatcher surveys conducted in 2009 (Vernadero Group 2009), yellow-billed cuckoos were opportunistically detected in each of the eight transects surveyed in the SPRNCA and in the single transect at Babocomari Cienega, for a total of 28 confirmed yellow-billed cuckoo detections. During these surveys, yellow-billed cuckoos were observed in linear cottonwood-willow habitat along the streambed and in adjacent mesquite bosques (Vernadero Group 2009).

In 2012, a total of 25 yellow-billed cuckoo detections were made. No individuals were detected in the Babocomari Cienega during 2012 (AGFD 2012a). See Figure YBC-1 for a summary of the yellow-billed cuckoo sightings from 2001 through 2012.

Systematic surveys for yellow-billed cuckoos have not been conducted on Fort Huachuca or on the lower Babocomari River. Although the status of breeding yellow-billed cuckoos on Ft. Huachuca is unknown, breeding season observations are not uncommon. Little is known about the breeding status of cuckoos in these higher elevation drainages in the Sky Islands. Yellow-billed cuckoo records on Ft. Huachuca include 13 birder-reported detections between July and mid-September in Scheelite, Huachuca, Sawmill, and Garden canyons between 1985 and 2013 (American Birding Association 2013, Cornell Lab of Ornithology 2013). Five of these detections were in 2013. On 22 August 2013, two yellow-billed cuckoos were observed perched about two feet apart, one with what appeared to be a large insect in its bill. One record exists for yellow-billed cuckoo eggs collected from an active July 6, 1932 nest at the mouth of Garden Canyon (Western Foundation of Vertebrate Zoology 2012). The INRMP notes that a single male cuckoo was documented calling at Middle Garden Pond on the Fort in September 2001 (Vernadero Group 2010). Because these Ft. Huachuca observations were at higher elevations than where groundwater withdrawal occurs, we do not anticipate adverse effects to cuckoos using these areas. Given that yellow-billed cuckoos occur in appreciable numbers on the mainstem San Pedro River and have been detected at the Babocomari Cienega, it is likely that the riparian vegetation along the lower Babocomari River supports breeding pairs or provides portions of the home ranges of birds in either or both locations.

Areas of both meso- and xeroriparian habitat (typically, cottonwood/willow forests and mesquite bosques), are present along the mainstem San Pedro River as well as on the lower Babocomari River; these sites are suitable for yellow-billed cuckoo. These riparian ecosystems, in turn, depend on the availability of water at a depth at which it can be accessed by all life stages of the applicable plant species. Given that yellow-billed cuckoo are known to occur in relatively large numbers within the aforementioned habitat types along the upper San Pedro River, such habitat along the lowermost reaches of the Babocomari River is also likely occupied. Reductions in the vigor or extent of these habitat types will adversely affect the yellow-billed cuckoos that occur there.

Leenhouts et al. (2006) examined interactions between hydrologic processes and riparian vegetation within the San Pedro RNCA on the San Pedro River. The specific objectives of the study were to: 1) determine the water needs of riparian vegetation through the growing season; 2) to quantify the total water use of riparian vegetation; and 3) to determine the source of water used by key riparian plant species. The authors integrated analyses of vegetation functional groups, groundwater and surface water hydrology, and spatial and temporal variations thereof. Leenhouts et al. (2006) further identified surface flows as a useful surrogate for streamflow permanence, and subdivided river reaches into three Condition Classes based on the observed permanence as well as the dominant overstory vegetation type (Figure YBC-2, below).

Condition Class 1 is indicative of sites with low water availability, often dominated by tamarisk. Condition Class 2 indicates intermediate conditions and mesoriparian trees, such as cottonwood and willow, dominate the overstory. Cottonwoods in the Class 2 reaches suffer drying-related stress as groundwater depths increase in midsummer; tamarisk is also present in Class 2 reaches, though less so than in Class 1. Condition Class 3 represents sites with the most mesic (wettest) conditions. The rich riparian species diversity observed in Class 3 reaches is markedly diminished in Class 2 reaches where water limits riparian plant growth (Leenhouts et al. 2006).

Condition Classes 2 and 3 occur along the mainstem San Pedro River within the SPRNCA (stream segments 1 through 12 and 14)(Figure YBC-2). Each of these reaches is hydrologically capable of supporting yellow-billed cuckoo breeding habitat and foraging habitat, though the habitat within the Condition Class 2 reaches (1, 3, 8 through 12, and 14) are likely to experience stress during low-flow. Most detections of the species have been in reaches 3 through 8 (Figure YBC-1). Additional groundwater withdrawals could exacerbate this condition and result in downgrades from the existing Condition Class 3 to Condition Class 2 or Condition Class 1 or from the existing Condition Class 1 to a reach characterized by even further decreases in streamflow permanence and greater depth to and fluctuation of groundwater (2, and 4 through 7) (Leenhouts et al. 2006). Segment 13 is Condition Class 1 and the xeroriparian habitat contained within it likely only supports migration, some feeding, and dispersal.

The data contained in Table YBC-2 and stream segments 8 and 9 in Figure YBC-2, below (Leenhouts et al. 2006) indicate that there are no areas within the cottonwood/willow habitat type adjacent to reaches with permanent surface flow on the lower Babocomari River; the reach is categorized as Condition Class 2. It is therefore likely that the cottonwood-willow habitat type

on the lower Babocomari River exists entirely under at least somewhat-diminished conditions and is relatively more vulnerable to changes in groundwater elevation.

Further, recruitment of cottonwood/willow forests requires near-surface groundwater following spring flood events, and will be negatively affected if it does not exist at the appropriate magnitude, duration, and time of year. Mesquite trees can be rooted at depths of 30 to 50 ft (Leenhouts et al. 2006, Arizona-Sonora Desert Museum 2013), and are therefore likely to be less vulnerable to small decreases in groundwater elevation. The yellow-billed cuckoo was proposed for listing as a threatened species on October 3, 2013 (78 FR 61622), but, to date, we have completed no informal or formal conference consultations within the action area.

Effects of the Action – Yellow-Billed Cuckoo

Effects of the action refer to the direct and indirect effects of an action on the species or critical habitat, together with the effects of other activities that are interrelated and interdependent with that action, which will be added to the environmental baseline. Interrelated actions are those that are part of a larger action and depend on the larger action for their justification. Interdependent actions are those that have no independent utility apart from the action under consideration. Indirect effects are those that are caused by the proposed action and are later in time, but are still reasonably certain to occur.

As discussed in the species' Environmental baseline section, yellow-billed cuckoos are closely associated with the presence of mesoriparian and xeroriparian vegetation along stream courses and thus, its habitat and prey base are affected by changes in the groundwater and surface water hydrology associated with those sites. The effects of Fort Huachuca's operations on the hydrology of the area was analyzed in detail in the Effects to Huachuca Water Umbel in the San Pedro Riparian National Conservation Area subsection of the Effects of the Proposed Action – Huachuca Water Umbel section, and these analyses are incorporated here by reference.

In summary, Fort Huachuca estimated its impacts on baseflow with two scenarios, the "With Fort-attributable" (WFA) and the "No Fort-attributable" (NFA) simulations (see the Groundwater Modeling Report contained in PBA Appendix G). The WFA simulation includes all Fort-attributable groundwater withdrawals and all completed and in-progress mitigation measures that could feasibly be modeled. The NFA simulation removes all Fort-attributable pumping and recharge both on- and off-Fort while maintaining all other groundwater pumping and recharge within the Basin. The difference between the WFA and NFA simulations represents future Fort Huachuca impacts to the regional groundwater component of baseflows in the San Pedro and Babocomari rivers.

Figure 5-3 in the PBA, and Figure HWU-1 in this document provide the simulated regional groundwater component of baseflow for the winter and summer for various locations on the San Pedro and Babocomari rivers. PBA Figure 5-4 (Figure HWU-2 in this BO) presents the changes in baseflow between the WFA simulation and the NFA simulation. PBA Figure 5-5 (BO Figure HWU-3) provides the graph of the simulated regional groundwater baseflow at the Tombstone Gage, which marks the downstream end of the overall Action Area.

Overall, the groundwater model predicts positive impacts of Fort-attributable activities on the net regional groundwater component of baseflow leaving the Sierra Vista Subwatershed from 2012 to 2030 (Figures HWU-1, HWU-2, and HWU-3). This does not include the additional benefits from the conservation easements. For the San Pedro River in the SPRNCA, the Fort-attributable activities, including completed and in-progress mitigation measures that could be feasibly modeled, are simulated to increase the regional groundwater component of baseflow by 0.3 cfs at the Charleston gage (Figure 5-3) and 0.4 cfs at the Tombstone gage by 2030 (Figure 5-5). At no point during the period from 2012 to 2030, does the Fort-attributable groundwater withdrawal reduce the baseflow in the mainstem of the San Pedro River. The Fort anticipates in 2014 (Table 5-1), there will be a net surplus in the groundwater demand accounting, and beyond 2014 the Fort attributable impacts to the regional groundwater component of baseflow would be positive as a result of the Proposed Action. These net-positive effects will have modest, beneficial effects to the habitat supporting those yellow-billed cuckoos that occur along the mainstem San Pedro River.

The modeling simulated that the proposed action would not affect the groundwater component of baseflow in the upstream reaches of the stream, near the Babocomari Cienega. Modeling did, however, simulate negative impacts to the groundwater component of baseflow in the lower Babocomari River, which is projected to experience a continual decline in the groundwater component of baseflows (Figures in this BO and 5.3 in the PBA). By 2030, the magnitude of the decline was modeled to be -0.1 cfs due to Fort Huachuca's activities (Figures in this BO and 5-4 in the PBA). The lower Babocomari River already exhibits baseflows that are low (see Figures 5-2 and 5-3 in the PBA), with winter low-flows already at or below 1.0 cfs the majority of the time (Figure 3-13 in the PBA) and zero flows evident during the pre-monsoon season in late June and early July (PBA Figure 3-12). Additionally, other modeling efforts have shown that groundwater pumping has already negatively affected the Babocomari River flow (GeoSystems Analysis 2010, Lacher 2011) and will continue to do (see Figure 5-3 in the PBA and Figure HWU-1in this document).

Riparian vegetation persists depending on groundwater and water availability, which drives trophic interactions among terrestrial animals (Sabo et al. 2008, McCluney and Sabo 2009), including arthropods and reptiles. Yellow-billed cuckoos will thus be directly or indirectly affected within the occupied habitat on the lower reaches of the Babocomari River via loss of nesting substrates and reduced prey abundance under more xeric conditions.

As stated in the Environmental Baseline – Yellow-Billed Cuckoo section, above, the species' habitat on the lower Babocomari River exists in Condition Class 2, an already somewhat hydrologically-stressed state. The cottonwood trees in the Class 2 reaches suffer drying-related stress as groundwater depths increase in midsummer under baseline conditions (without the effects of proposed action). The proposed action will further reduce groundwater levels and their contribution to surface flows in the reach. The worst-case effects scenario, therefore, would be if the groundwater declines result in an appreciable reduction of the cottonwood-willow habitat type and a diminished vigor in the mesquite bosques.

The best scientific information available to us regarding yellow-billed cuckoo occupancy of habitat along the lower Babocomari River is based on the 100-ac minimum home range size per

individual (Laymon et al. 1997, Laymon and Williams 2002, Halterman 2009, Sechrist et al. 2009, McNeil et al. 2012). Home ranges may overlap, but for the purpose of calculating the number of cuckoos that can be supported we assume there is no overlap. Given that the maximum possible amount of suitable cuckoo habitat is 1,003 ac (consisting of 175 ac of cottonwood-willow forest along intermittent reaches and up to 828 ac of mesquite trees), we anticipate that up to 10 individual breeding-season home ranges, and the reproductive output from pairings of those birds, will be affected by the proposed action by 2030 and will propagate onward through time. We do not, however, anticipate that the habitat modifications attributable to the effects of the proposed action will so modify or destroy the riparian habitat that they will be extirpated from the lower Babocomari River.

Cumulative Effects – Yellow-Billed Cuckoo

Cumulative effects include the effects of future State, tribal, local, or private actions that are reasonably certain to occur in the action area considered in this biological opinion. Future Federal actions that are unrelated to the proposed action are not considered in this section because they require separate consultation pursuant to section 7 of the Act.

Section 321 of the Defense Authorization Act of 2004 (Public Law 108-136) describes the manner in which section 7 of the Act is to be applied during interagency consultation with Fort Huachuca. Specifically, Section 321 states "For purposes of section 7 of the Endangered Species Act of 1973 (16 U.S.C. 1536), concerning any present and future Federal agency action at Fort Huachuca, Arizona, water consumption by State, local, and private entities off of the installation that is not a direct or indirect effect of the agency action or an effect of other actions that are interrelated or interdependent with that agency action, shall not be considered in determining whether such agency action is likely to jeopardize the continued existence of any endangered or threatened species or result in the destruction or adverse modification of designated critical habitat."

For the yellow-billed cuckoo, the most appreciable cumulative effect is the pumping of ground water from the Sierra Vista Subwatershed by and for individuals whose presence is not related to Fort Huachuca or another Federal entity. The subwatershed exists with a 2011 annual deficit of 4,600 acre-feet, an appreciable proportion of which is the result of local, non-Federal actions cumulative to the operation of Fort Huachuca and which we anticipate will continue into the foreseeable future. Nevertheless, these effects cannot be considered when determining if the proposed action will jeopardize the continued existence of the yellow-billed cuckoo.

Section 321 does not preclude our analysis of other-than-water-consumption-related effects of cumulative actions. There are, however, relatively few other activities that may impact the yellow-billed cuckoo within the action area; most are the result of Federal actions conducted by Fort Huachuca or the BLM, and thus are not considered cumulative effects. The effects of undocumented immigrants (UDI) within the SPRNCA have not been analyzed in detail, but the use of warming or diversionary fires set by UDIs could result in wildfires within the riparian system. Compliance with the Act for activities on state and private lands that may affect the yellow billed cuckoo, but are not addressed by section 7 consultation, could occur through section 10(a)(1)(B) of the Act, once the species is listed.

Status the Species

The Western Distinct Population Segment (DPS) of the yellow-billed cuckoo became a candidate for listing under the ESA in 2001, after a 12-month finding determined that listing was warranted but precluded by higher listing priorities (USFWS 2001a). The USFWS published a proposed rule (78 FR 61622) to list the Western DPS of the yellow-billed cuckoo (*Coccyzus americanus*) as a threatened species on October 3, 2013 (USFWS 2010e).

Physical Characteristics

Adult yellow-billed cuckoos have moderate to heavy bills, somewhat elongated bodies and a narrow yellow ring of colored bare skin around the eye. The plumage is grayish-brown above and white below, with reddish primary flight feathers. The tail feathers are boldly patterned with black and white below. They are a medium-sized bird about 12 in (30cm) in length, and about 2 oz (60 g) in weight. Males and females differ slightly; the males have a slightly smaller body size, smaller bill, and the white portions of the tail tend to form distinct oval spots. In females the white spots are less distinct and tend to be connected (Hughes 1999, USFWS 2010e).

Morphologically, the yellow-billed cuckoos throughout the western continental United States and Mexico are generally larger, with significantly longer wings, longer tails, and longer and deeper bills (Franzreb and Laymon 1993). Birds with these characteristics occupy the Western DPS and are we refer to them as the "western yellow-billed cuckoo." Only the Western DPS has been proposed for listing as a threatened species (78 FR 61622). Yellow-billed cuckoos in the west arrive on the breeding grounds 4 to 8 weeks later than eastern yellow-billed cuckoos at similar latitude (Franzreb and Laymon 1993, Hughes 1999, Laymon 2000, in. litt.). Some information exists suggesting that the western population segment described in the scientific literature as the western yellow-billed cuckoo (Coccyzus americanus occidentalis) is distinguishable at the subspecific level; however, there is enough literature to conclude that recognition of the subspecies is not justified at this time (USFWS 2010e).

Distribution

The yellow-billed cuckoo is a member of the avian family Cuculidae and is a Neotropical migrant bird that winters in South America and breeds in North America. The breeding range of the entire species formerly included most of North America from southeastern and western Canada (southern Ontario and Quebec and southwestern British Colombia) to the Greater Antilles and northern Mexico (AOU 1957, AOU 1983, AOU 1998).

Based on historical accounts, the western yellow-billed cuckoo was formerly widespread and locally common in California and Arizona, more narrowly distributed but locally common in New Mexico, Oregon, and Washington and uncommon along the western front of the Rocky Mountains north to British Columbia (AOU 1998, Hughes 1999). The species may be extirpated from British Colombia, Washington, and Oregon (Hughes 1999). The western yellow-billed cuckoo is now very rare in scattered drainages in western Colorado, Idaho,

Nevada, and Utah, with single, nonbreeding birds most likely to occur (USFWS 2001a). The largest remaining breeding areas are in southern and central California, Arizona, along the Rio Grande in New Mexico, and in northwestern Mexico (USFWS 2010e).

The current breeding population is low, with estimates of approximately 350 to 495 pairs north of the Mexican border and another 330 to 530 pairs in Mexico for a total of 680 to 1,025 breeding pairs (USFWS 2010e).

Yellow-billed cuckoos spend the winter in South America, east of the Andes, primarily south of the Amazon Basin in southern Brazil, Paraguay, Uruguay, eastern Bolivia, and northern Argentina (Ehrlich *et al*. 1992, AOU 1998, Johnson *et al*. 2008b). The species as a whole winters in woody vegetation bordering fresh water in the lowlands to 1,500 m (4,921 ft), including dense scrub, deciduous broadleaf forest, gallery forest, secondary forest, subhumid and scrub forest, and arid and semiarid forest edges (Hughes 1999). Wintering habitat of the western yellow-billed cuckoo is poorly known.

Migration

Little is known about migratory habitat for the western yellow-billed cuckoo. Yellow-billed cuckoos may be found in a variety of vegetation types during migration, including coastal scrub, secondary growth woodland, hedgerows, humid lowland forests, and forest edges from sea level to 8,125 ft (2,500 m)(Hughes 1999). Additionally, during migration they may be found in smaller riparian patches than those in which they typically nest. This variety of vegetation types suggests that the habitat needs of the yellow-billed cuckoo during migration are not as restricted as their habitat needs when nesting and tending young.

Habitat and Life History

Food

Yellow-billed cuckoos forage primarily by gleaning insects from vegetation, but they may also capture flying insects or small vertebrates such as tree frogs and lizards (Hughes 1999). They specialize on relatively large invertebrate prey, including caterpillars (Lepidoptera sp.), katydids (Tettigoniidae sp.), cicadas (Cicadidae sp.), and grasshoppers (Caelifera sp.)(Laymon *et al*. 1997). Minor prey include beetles (Coleoptera sp.), dragonflies (Odonata sp.), praying mantis (Mantidae sp.), flies (Diptera sp.), spiders (Araneae sp.), butterflies (Lepidoptera sp.), caddis flies (Trichoptera sp.), crickets (Gryllidae sp.), wild berries, and bird eggs and young (Laymon *et al*. 1997, Hughes 1999). Prey species composition varies geographically. Their breeding season may be timed to coincide with outbreaks of insect species, particularly tent caterpillars (Hughes 1999, USFWS 2001a) or cicadas (Johnson *et al*. 2007, Halterman 2009). In Arizona, fledging occurred at the peak emergence of cicadas (Rosenberg *et al*. 1982).

In the arid West, these conditions are usually found in cottonwood-willow riparian associations along water courses. The arrival of birds and the timing of nesting are geared to take advantage of any short-term abundance of prey. In years of high insect abundance, western yellow-billed cuckoos lay larger clutches (3-5 eggs rather than two), a larger percentage of eggs produce

fledged young, and they breed multiple times (2-3 nesting attempts rather than one)(Laymon *et al*. 1997). Western yellow-billed cuckoo food availability is largely influenced by the health, density, and species of vegetation. Desiccated riparian sites produce fewer suitable insects than healthy moist sites.

Breeding Habitat

Western populations of yellow-billed cuckoos breed in dense riparian woodlands, primarily of cottonwood (Populus fremontii), willow (Salix spp.), and mesquite (Prosopis spp.), along riparian corridors in otherwise arid areas (Laymon and Halterman 1989, Hughes 1999). Dense undergrowth may be an important factor in selection of nest sites. Occupied habitat in Arizona may also contain box elder (*Acer negundo*), Arizona alder (*Alnus oblongifolia*), Arizona walnut (*Juglans major*), Arizona sycamore (*Platanus wrightii*), oak (*Quercus* spp.), netleaf hackberry (*Celtis reticulata*), velvet ash (*Fraxinus velutina*), Mexican elderberry (*Sambuccus mexicanus*), tamarisk (*Tamarix* spp.; also called salt cedar), and seepwillow (*Baccharis glutinosa*)(Corman and Magill 2000). Surveys conducted by the Arizona Breeding Bird Atlas (Corman and Wise-Gervais 2005) reported 68 percent of the yellow-billed cuckoo observations were in lowland riparian woodlands, often containing a variable combination of Fremont cottonwood, willow, velvet ash, Arizona walnut, mesquite, and tamarisk (Corman and Wise-Gervais 2005). Narrow bands of riparian woodland can contribute to the overall extent of suitable habitat. Adjacent habitat on terraces or in the upland (such as mesquite) can enhance the value of these narrow bands of riparian woodland.

Throughout the western yellow-billed cuckoo range, a large majority of nests are placed in willow trees, but alder (*Alnus* spp.), cottonwood, mesquite, walnut (*Juglans* spp.), box elder, sycamore, netleaf hackberry (*Celtis laevigata* var. *reticulata*), soapberry (*Sapindus saponaria*), and tamarisk are also used (Laymon 1980, Hughes 1999, Corman and Magill 2000 , Corman and Wise-Gervais 2005, Holmes *et al*. 2008). Tamarisk is also a riparian species that may be associated with breeding under limited conditions; western yellow-billed cuckoo will sometimes build their nests and forage in tamarisk, but there is usually a native riparian tree component within the occupied habitat (Gaines and Laymon 1984, Johnson *et al*. 2008a).

Western yellow-billed cuckoos reach their breeding range later than most other migratory breeders, often in June (Rosenberg *et al*. 1982). They construct an unkempt stick nest on a horizontal limb in a tree or large shrub. Nest height ranges from 4 ft to (rarely) 100 ft, but most are typically below 30 ft (Hughes 1999). The incubation period for the western yellow-billed cuckoo is 9 to 11 days, and young leave the nest at 7 to 9 days old. Although other species of cuckoos are often or always brood parasites of other birds, yellow-billed cuckoos do so only infrequently, possibly in response to high food resources that allow rapid egg production (Fleischer *et al*. 1985). Nesting usually occurs between late June and late July, but can begin as early as late May and continue until late September (Hughes 1999). In a study on the lower Colorado River, three nests were estimated to have first fledged young during August 25 to 28 had they not failed. If these nests had successfully fledged young, the birds may still have been present at their respective breeding sites at least until September 15 to 18 (previously discussed in McNeil *et al*. 2012).

The western yellow-billed cuckoo primarily breeds in riparian habitat along low-gradient (surface slope less than 3%) rivers and streams, and in open riverine valleys that provide wide floodplain conditions (greater than 325 ft [100 m]). In the southwest, it can also breed in narrower reaches of riparian habitat. Within the boundaries of the distinct population segment (DPS)(see Figure 2 at 78 FR 61631,) these riparian areas are located from southern British Columbia, Canada, to southern Sinaloa, Mexico, and may occur from sea level to 7,000 ft (2,154 m)(or slightly higher in western Colorado, Utah, and Wyoming) in elevation. The moist conditions that support riparian plant communities that provide western yellow-billed cuckoo habitat typically exist in lower elevation, broad floodplains, as well as where rivers and streams enter impoundments. In southeastern Arizona, however, cuckoos were often found nesting along intermittent drainages with dense stands of velvet mesquite and netleaf hackberry (Corman and Wise-Gervais 2005, AGFD 2011). Yellow-billed cuckoos are infrequently encountered along higher mountain drainages where Arizona sycamore or Arizona alder are the dominant riparian species. Dense understory foliage appears to be an important factor in nest site selection, while cottonwood trees are an important foraging habitat in areas where the species has been studied in California (USFWS 2001b). In the extreme southern portion of their summer range in the States of Sonora (southern quarter) and Sinaloa, Mexico, western yellow-billed cuckoos also nest in upland thorn scrub and dry deciduous habitats away from the riparian zone (Russell and Monson 1988), though their densities are lower in these habitats than they are in adjacent riparian areas. At the landscape level, the available information suggests the western yellow-billed cuckoo requires large tracts of willow-cottonwood or mesquite forest or woodland for their nesting season habitat. Habitat can be relatively dense, contiguous stands, irregularly shaped mosaics of dense vegetation with open areas, or narrow and linear.

Canopy cover directly above the nest is generally dense and averages 89 percent and is denser at the South Fork Kern River (93 percent) and Bill Williams River (94 percent) than at the San Pedro River (82 percent). Canopy closure in a plot around the nest averages 71 percent and was higher at the Bill Williams River (80 percent) than at the South Fork Kern River (74 percent) or San Pedro River (64 percent)(Laymon *et al*. 1997, Halterman 2003, Halterman 2004, Halterman 2005, Halterman 2006).

The optimal size of habitat patches for the species are generally greater than 200 ac (81 ha) and have dense canopy closure and high foliage volume of willows and cottonwoods (Laymon and Halterman 1989) and thus provide adequate space for foraging and nesting. Tamarisk, a nonnative tree species, may be a component of the habitat, especially in Arizona and New Mexico. Sites with a monoculture of tamarisk are unsuitable habitat for the species. The association of breeding with large tracts of suitable riparian habitat is likely related to home range size. Individual home ranges during the breeding season average over 100 ac (40 ha), and home ranges up to 500 ac (202 ha) have been recorded (Laymon and Halterman 1987, Halterman 2009, Sechrist *et al*. 2009, McNeil *et al*. 2011, McNeil *et al*. 2012).

In addition to the dense nesting grove, western yellow-billed cuckoos need adequate foraging areas near the nest. Foraging areas can be less dense or patchy with lower levels of canopy cover and often have a high proportion of cottonwoods in the canopy. Optimal breeding habitat contains groves with dense canopy closure and well-foliaged branches for nest building with

nearby foraging areas consisting of a mixture of cottonwoods, willows, or mesquite with a high volume of healthy foliage (USFWS 2010e).

Riparian habitat is dynamic, and species may move from one area to another over time. Western yellow-billed cuckoos may nest at more than one location in a year. Some individuals also roam widely (several hundred miles), apparently assessing food resources before selecting a nest site (Sechrist *et al*. 2012).

During movements between nesting attempts western yellow-billed cuckoos are found at riparian sites with small groves or strips of trees, sometimes less than 10 ac (4 ha) in extent (Laymon and Halterman 1989). These stopover and foraging sites can be similar to breeding sites, but are smaller, narrower, and lack understory vegetation when compared to nesting sites.

Water and Humidity

Habitat for the western yellow-billed cuckoo is largely associated with perennial rivers and streams that support the expanse of vegetation characteristics needed by breeding western yellow-billed cuckoos. The range and variation of stream flow frequency, magnitude, duration, and timing that will establish and maintain western yellow-billed cuckoo habitat can occur in different types of regulated and unregulated flows depending on the interaction of the water and the physical characteristics of the landscape (Poff *et al*. 1997; USFWS2002, 2013b).

Hydrologic conditions at western yellow-billed cuckoo breeding sites can vary widely between years. At some locations during low rainfall years, water or saturated soil is not available. At other locations, particularly at reservoir inlets, riparian vegetation can be inundated for extended periods in some years and be totally dry in other years. This is particularly true of reservoirs like Lake Isabella in California, Roosevelt and Horseshoe Reservoirs in Arizona, and Elephant Butte Reservoir in New Mexico, all of which have relatively large western yellow-billed cuckoo populations. This year-to-year change in hydrology can affect food availability and habitat suitability for western yellow-billed cuckoos. In some areas, managed hydrologic cycles above or below dams can create temporary western yellow-billed cuckoo habitat, but may not be able to support it for an extended time, or may support varying amounts of habitat at different points of the cycle and in different years. Water management operations create varied situations that allow different plant species to thrive when water is released below a dam, held in a reservoir, or removed from a lakebed, and consequently, varying amounts of western yellow-billed cuckoo habitat are available from month to month and year to year as a result of dam operations. During wet years, habitat within a lake and below a dam can be flooded for extended periods and stressed or killed. During dry years, habitat can be desiccated and stressed or killed because of lack of water (Poff *et al*. 1997, Greco 1999, National Academy of Sciences 2002; USFWS 2002, 2013b).

Humid conditions created by surface and subsurface moisture appear to be important habitat parameters for western yellow-billed cuckoo. The species has been observed as being restricted to nesting in moist riparian habitat in the arid West because of humidity requirements for successful hatching and rearing of young (Hamilton and Hamilton 1965, Gaines and Laymon 1984, Rosenberg *et al*. 1991). Western yellow-billed cuckoos have evolved larger eggs and

thicker eggshells, which would help them cope with potential higher egg water loss in the hotter, dryer conditions (Hamilton and Hamilton 1965, Ar *et al*. 1974, Rahn and Ar 1974). A study on the South Fork Kern River showed that lower temperatures and higher humidity were found at nest sites when compared to areas along the riparian forest edge or outside the forest (Launer *et al*. 1990). Recent research on the lower Colorado River has confirmed that western yellow-billed cuckoo nest sites had significantly higher daytime relative humidity (6–13% higher) and significantly lower daytime temperatures (2–4o F [1–2o C] lower) than average forested sites (McNeil *et al*. 2011, McNeil *et al*. 2012).

Subsurface hydrologic conditions are equally important to surface water conditions in determining riparian vegetation patterns. Depth to groundwater plays an important part in the distribution of riparian vegetation and western yellow-billed cuckoo habitat. Where groundwater levels are elevated so riparian forest trees can access the water, habitat for nesting, foraging, and migrating western yellow-billed cuckoos can develop and thrive. Goodding's willows (*Salix gooddingii*) and Fremont cottonwoods do not regenerate if the groundwater levels fall below 6 ft (2 m)(Shafroth *et al*. 2000). Goodding's willows cannot survive if groundwater levels drop below 10 ft (3 m), and Fremont cottonwoods cannot survive if groundwater drops below 16 ft (5 m)(Stromberg *et al*. 1996). Abundant and healthy riparian vegetation decreases and habitat becomes stressed and less productive when groundwater levels are lowered (Stromberg *et al*. 1996).

Conditions for Germination and Regeneration of Riparian Zone Trees

The abundance and distribution of fine sediment deposited on floodplains is critical for the development, abundance, distribution, maintenance, and germination of trees in the riparian zone that become western yellow-billed cuckoo habitat. These sediments become seedbeds for germination and growth of the riparian vegetation upon which western yellow-billed cuckoos depend. These sediments must be accompanied by sufficient surface moisture for seed germination and sufficient ground water levels for survival of seedlings and saplings (Stromberg 2001). The lack of hydrologic processes, which deposit such sediments, may lead riparian forested areas to senesce and become degraded and unable to support the varied vegetative structure required for western yellow-billed cuckoo nesting and foraging.

Arizona

At present, it appears that the State's population could be as low as 170 pairs of yellow-billed cuckoos, and probably does not exceed 250 pairs. The population of the western yellow-billed cuckoo in Arizona is the largest in the United States (USFWS 2010e).

The yellow-billed cuckoo was historically widespread and locally common in Arizona (Phillips *et al*. 1964, Groschupf 1987). Although Arizona probably contains the largest remaining western yellow-billed cuckoo population among states west of the Rocky Mountains, the population has reportedly declined significantly in distribution and abundance over the past 80 years (Corman and Wise-Gervais 2005). During Arizona Breeding Bird Atlas surveys, nesting birds were found to be concentrated in western, central, and southeastern Arizona. According to Corman and Wise-Gervais (2005), western yellow-billed cuckoos were found along most of the 25 drainages

where they were reported historically but they are now much more local in distribution. It is believed that the San Pedro River likely sustains the largest single remaining population of yellow-billed cuckoos (Brand *et al*. 2009).

A 1976 study based on existing habitat and known yellow-billed cuckoo population densities estimated 846 pairs were present on the lower Colorado River and its five major tributaries in Arizona (Groschupf 1987). In a statewide survey in 1999 that covered 265 mi (426 km) of river and creek bottoms, 172 yellow-billed cuckoo pairs and 81 single birds were located in Arizona (Corman and Magill 2000). Yellow-billed cuckoo populations greater than 10 pairs are found at 12 locations in Arizona: Bill Williams River, Colorado River, Gila River, Upper Cienega Creek, Hassayampa River, San Pedro River, Santa Maria River, Verde River, Sonoita Creek, Santa Cruz River, Altar Valley, and Agua Fria River. Sites with smaller populations are found at the Roosevelt Lake complex, Upper Tonto Creek, Pinto Creek, Sycamore Creek in Pajarito Mountains, Oak Creek, Lower Cienega Creek, Babocomari River, Pinal Creek, Bonita Creek, San Bernardino NWR, Hooker Hot Springs, Big Sandy River, and many smaller drainages. However, many drainages have not been thoroughly surveyed and it is likely that some additional yellow-billed cuckoo locations will be discovered. These include, but are not limited to the mountain ranges of southeastern Arizona, Eagle Creek, and along the Gila, San Francisco, and Blue Rivers. Yellow-billed cuckoo sightings reported by birders between 15 June and 31 August, 1998 to 2012, in more than one year in southeastern Arizona mountain ranges include Walker, Madera, and Montosa canyons in the Santa Rita Mountains; Carr Canyon, Ash Canyon, Garden Canyon, Ramsey Canyon, and Miller Canyon in the Huachuca Mountains; Scotia Canyon and Sycamore Canyon in the Atascosa/Pajarito Mountains; French Joe Canyon in the Whetstone Mountains; Kitt Peak on Baboquivari Mountain; Harshaw Canyon and Paymaster Spring in the Patagonia Mountains; and a few locations in the Chiricahua Mountains (Cornell Laboratory of Ornithology 2012). Yellow-billed cuckoos are breeding in at least some of these locations, with nesting confirmed at Sycamore Canyon (AGFD, unpublished data).

Documented Decline at Some Arizona Sites

Bill Williams River—In the mid-1970s, an estimated 57 pairs of yellow-billed cuckoos bred in the riparian forest of the Bill Williams River delta (Gaines and Laymon 1984). Following the sustained high water levels of 1983 to 1984 and 1986, which inundated and killed most of the cottonwoods and willows along the Colorado River, yellow-billed cuckoo numbers also declined on the Bill Williams River delta where similar habitat mortality occurred (Rosenberg *et al*. 1991). In 1987, 17 pairs of yellow-billed cuckoos were located at this site and a total of 25 to 30 pairs estimated to be present, a decline of 47 to 56 percent over 10 years (Laymon and Halterman 1987a). Surveys were conducted regularly at this site from 1993 to 2002. The breeding population fluctuated from a low of 6 to 9 pairs in 1999 to a high of 28 to 39 pairs in 2001 (Halterman 2003). In 2010, 12 to 31 pairs were estimated, and the most recent survey in 2011 estimated 9 to 23 pairs (McNeil *et al*. 2010, McNeil *et al*. 2012). Bill Williams River NWR is considered the largest, highest quality stand of suitable habitat for the yellow-billed cuckoo along the lower Colorado River (Johnson *et al*. 2008a). Data from this site show an important, but fluctuating, breeding population that has not recovered to 1977 levels.

Lower Colorado River—The lower Colorado River on the California-Arizona border supported an estimated 180 yellow-billed cuckoo pairs in 1976 to 1977 (Gaines and Laymon 1984), a number that had declined an estimated 80 to 90 percent by 1986 (Laymon and Halterman 1987a). In 2010, based on intensive surveys, 8 to 18 pairs were estimated, and the most recent survey in 2011 estimated 9 to 23 pairs on the Arizona side of the Colorado River, excluding the Bill Williams River (McNeil *et al*. 2010, McNeil *et al*. 2012). Recent population estimates are well below the breeding population in 1977, even though more area was surveyed.

Other Arizona Sites with at Least 10 years of Survey Data

Upper San Pedro River—see Environmental Baseline

Sonoita Creek—A 4-mi (6-km) segment of Sonoita Creek was surveyed seven years between 1976 and 1986 (Groschupf 1987). Yellow-billed cuckoo pairs were not estimated, but lows of 5 and 6 individuals were found in 1976 and 1986, respectively, and highs of 24 to 28 individuals were found between 1977 and 1979. The site was surveyed again in 1998 and 1999, with 11 to 12 pairs and 8 to 9 single yellow-billed cuckoos located (Corman and Magill 2000). In 2005, 17 individuals were found while conducting bird surveys for Important Bird Area designation (Arizona Audubon 2012, http://iba.audubon.org/iba). This population, while fluctuating, does not appear to have decreased in size from 1976 to 2005.

Verde River—Surveys conducted in 2004 and 2005 at 37 sites within the Verde River watershed were done at historical sites (16) where yellow-billed cuckoos were previously detected in 1998 to 1999 and at random sites (21) with riparian forest that appeared to be suitable nesting habitat (Holmes *et al*. 2008). In the 2 years, 59 percent of sites had detections; 75 percent of historical sites and 48 percent of random sites (Holmes *et al*. 2008). Holmes *et al*. (2008) confirmed nesting at five sites and found evidence of probable breeding at nine additional sites. The maximum number of detections during any one survey period was 23 in 2004 and 31 in 2005.

Mexican Breeding Range

In Sonora, Mexico, yellow-billed cuckoos were summer residents in willow-cottonwood riparian woodland, older mesquite woodland, tropical deciduous forest, and tropical thorn scrub habitats (Russell and Monson 1998). In southern Sonora, Mexico, Short (1974) found the yellow-billed cuckoos breeding in upland thorn forest, but they were more common in the riparian zone. In a study focusing on cactus ferruginous pygmy-owls (*Glaucidium brasilianum cactorum*) during late spring and summer from 2001 through 2010, Flesch (2012 in litt.) found yellow-billed cuckoos at 95 sites from June to September at elevations from 328 to 6,902 ft (100-2,104 m). The number of birds at each site ranged from 1 to 15 individuals. Flesch also confirmed breeding at four sites in thornscrub habitats and at one site in upland Sonoran Desert habitat. These records indicate a broader use of habitat by yellow-billed cuckoos in Sonora, Mexico (USFWS 2013e).

Threats

The western yellow-billed cuckoo is threatened by two of the five threat factors evaluated (A and E).

Factor A. The Present or Threatened Destruction, Modification, or Curtailment of Its Habitat or Range

Within the three States with the highest historical number of yellow-billed cuckoo pairs, past riparian habitat losses are estimated to be about 90 to 95 percent in Arizona, 90 percent in New Mexico, and 90 to 99 percent in California (Ohmart 1994, U.S. Department of Interior 1994, Noss *et al*. 1995, Greco 2008).

The primary threat to the western yellow-billed cuckoo is loss or fragmentation of high-quality riparian habitat suitable for nesting (Corman and Wise-Gervais 2005). Habitat loss and degradation from several interrelated factors include alteration of flows in rivers and streams, encroachment into the floodplain from agricultural and other development activities, stream channelization and stabilization, diversion of surface and ground water for agricultural and municipal purposes, livestock grazing, wildfire, establishment of nonnative vegetation, drought, and prey scarcity due to pesticides (Ehrlich *et al*. 1992, Wiggins 2005, USFWS 2010e). Drought and prey scarcity (especially the loss of sphinx moth caterpillars to pesticides in the West) appear to play a role in yellow-billed cuckoo declines even where suitable nesting habitat remains (Ehrlich *et al*. 1992). These factors also contribute to fragmentation and promote conversion to nonnative plant species and increased incidence of wildfire (Krueper 1993; USFWS 2001, 2013e). A potential factor contributing to declines across the species' range in North America is the loss of forested habitat on its wintering grounds in South America where little is known of its ecology or distribution (Ehrlich *et al*. 1992). The threats affecting western yellow-billed cuckoo habitat are ongoing. Such a loss of riparian habitat leads not only to a direct reduction in yellow-billed cuckoo numbers but also leaves a highly fragmented landscape, which can reduce breeding success through increased predation rates and barriers to dispersal by juvenile and adult yellow-billed cuckoos (USFWS 2010e).

Factor E. Other Natural or Manmade Factors Affecting Its Continued Existence

Factor E threats, including habitat rarity and small, isolated populations of the western yellow-billed cuckoo, cause the remaining populations in western North America to be increasingly susceptible to further declines through lack of immigration, chance weather events, fluctuating availability of prey populations, pesticides, collisions with tall vertical structures during migration, spread of the introduced tamarisk leaf beetle (*Diorhabda* spp.) as a biocontrol agent in the Southwest, and climate change. The ongoing threat of small overall population size leads to an increased chance of local extirpations through random events (Thompson 1961, McGill 1975, Wilcove *et al*. 1986).

Habitat for the western yellow-billed cuckoo has been modified and curtailed, resulting in only remnants of formerly large tracts of native riparian forests, many of which are no longer occupied by western yellow-billed cuckoos. Despite recent efforts to protect existing, and restore additional, riparian habitat in the Sacramento, Kern, and Colorado Rivers, and other rivers in the range of the western yellow-billed cuckoo, these efforts offset only a small fraction

of historical habitat that has been lost. Therefore, we expect the threat resulting from the combined effects associated with small and widely separated habitat patches to continue to affect a large portion of the range of the western yellow-billed cuckoo. This threat is particularly persistent where small habitat patches are in proximity to human-altered landscapes, such as near agricultural fields that dominate the landscape in many areas where the western yellow-billed cuckoo occurs. As a result, the potential exists for pesticides to directly affect (poisoning individual cuckoos) and indirectly affect (reducing the prey base) a large portion of the species. These effects could ultimately result in lower population abundance and curtailment of its occupied range. Mortality from collisions with tall structures is also an ongoing, but largely unquantified effect. We recognize that climate change is a critical issue with potentially severe wide-ranging effects on the species and its habitat. The available scientific literature suggests that the effects of climate change will likely exacerbate multiple existing threats to the western yellow-billed cuckoo and its habitat.

Environmental Baseline – Yellow-Billed Cuckoo

The environmental baseline includes past and present impacts of all Federal, State, or private actions in the action area, the anticipated impacts of all proposed Federal actions in the action area that have undergone formal or early section 7 consultation, and the impact of State and private actions that are contemporaneous with the consultation process. The environmental baseline defines the current status of the species and its habitat in the action area to provide a platform to assess the effects of the action now under consultation. Also refer to the General Environmental Baseline and Action Area earlier in this biological and conference opinion.

Moderate to heavy grazing by domestic livestock has occurred in southern Arizona for at least 300 years (Allen 1989, Krueper 1996). In 1694, approximately 100,000 cattle were present within the headwaters of the San Pedro River Valley (Allen 1989). By the late 1880s, up to 1.5 million cattle were estimated to be using the grasslands of southern Arizona annually, primarily south of the Gila River (Dobyns 1981, Bahre 1991, Ohmart 1996). Overstocking of the range during the 1880s severely degraded grasslands in the Upper San Pedro River Valley and throughout the Southwest (Hastings and Turner 1965, Bahre 1999, Donahue 1999). Overgrazing within the San Pedro River Valley caused erosion and increased siltation and entrenchment (Stromberg *et al*. 1996). The cienegas maintained by beavers (*Castor canadensis*) were drained and replaced by mesquite, Fremont cottonwood, Gooding's willow, and seepwillow. Following exclusion of cattle in 1986 and partial recovery of riparian habitat from overgrazing, yellow-billed cuckoo numbers increased along the upper San Pedro River (Krueper *et al*. 2003). Riparian habitat that has developed post-cattle removal and the yellow-billed cuckoo population it supports is considered the baseline condition for proposed land and water management.

The San Pedro River supports one of the largest remaining populations of yellow-billed cuckoos in the western U.S. (Brand *et al*. 2009). Krueper (1993) provides data on the density of western yellow billed cuckoos and other obligate riparian songbirds in the SPRNCA between 1986 through 1991, during which grazing was retired in 1987, and understory vegetation increased significantly. According to Halterman (2009), the river channel in the SPRNCA is lined with cottonwood and willow, with mesquite and netleaf hackberry common on the upper floodplain.

The floodplain vegetation in the SPRNCA varies in width from 50 to 1,000 m (160-3,300 ft)(Halterman 2009).

With home ranges averaging more than 100 ac (40 ha) per individual, and nesting at densities of less than 1 pair per 100 ac (40 ha), a large amount of habitat is required to support even a small population of western yellow-billed cuckoos (Laymon *et al*. 1997, Laymon and Williams 2002, Halterman 2009, Sechrist *et al*. 2009, McNeil *et al*. 2012,). As a result, a large amount of habitat is required to support even a small population of western yellow-billed cuckoos.

The habitat patches used by western yellow-billed cuckoos vary in size and shape with optimal areal extent being over 200 ac (81 ha). The larger the site, the more likely it will provide suitable habitat for the western yellow-billed cuckoos and be occupied by nesting pairs (Laymon and Halterman 1989). Sites can be relatively dense, contiguous stands or irregularly-shaped mosaics of dense vegetation with open areas.

In 2000 and 2001, Fort Huachuca established eight long-term transects for monitoring the southwestern willow flycatcher in the SPRNCA (Vernadero Group 2009b). Since 2001, southwestern willow flycatcher surveys conducted in the SPRNCA on behalf of Fort Huachuca have also systematically recorded and reported detections of yellow-billed cuckoo. During seven surveys conducted by the Fort between 2001 and 2009, between 22 and 81 (median 31) yellow-billed cuckoo detections were made on the SPRNCA. Because cuckoos have such large home ranges, it is difficult to determine how many individual cuckoos these detections represent. Therefore, numbers are presented as the total number of cuckoo detections during the breeding season. Other yellow-billed cuckoo populations have shown annual fluctuation in detections (Halterman 2009b). Since 2003, these surveys have also included a transect in the Babocomari Cienega, and two to four birds were detected per survey in the Babocomari Cienega during the five surveys conducted between 2003 and 2009.

During breeding season willow flycatcher surveys conducted in 2009 (Vernadero Group 2009b), yellow-billed cuckoos were opportunistically detected in each of the eight transects surveyed in the SPRNCA and in the single transect at Babocomari Cienega, for a total of 28 confirmed yellow-billed cuckoo detections. During these surveys, yellow-billed cuckoos were observed in linear cottonwood-willow habitat along the streambed and in adjacent mesquite bosques (Vernadero Group 2009b).

In 2012, a total of 25 yellow-billed cuckoo detections were made. No individuals were detected in the Babocomari Cienega during 2012 (AGFD 2012a). See Figure YBC1 for a summary of the yellow-billed cuckoo sightings from 2001 through 2012.

Systematic surveys for yellow-billed cuckoos have not been conducted on Fort Huachuca or on the lower Babocomari River. Although the status of breeding yellow-billed cuckoos on Ft. Huachuca is unknown, breeding season observations are not uncommon. Little is known about the breeding status of cuckoos in these higher elevation drainages in the Sky Islands. Yellow-billed cuckoo records on Ft. Huachuca include 13 birder-reported detections between July and mid-September in Scheelite, Huachuca, Sawmill, and Garden canyons between 1985 and 2013 (American Birding Association 2013, Cornell Lab of Ornithology 2013). Five of these

detections were in 2013. On 22 August 2013, two yellow-billed cuckoos were observed perched about two feet apart, one with what appeared to be a large insect in its bill. One record exists for yellow-billed cuckoo eggs collected from an active July 6, 1932 nest at the mouth of Garden Canyon (Western Foundation of Vertebrate Zoology 2012). The INRMP notes that a single male cuckoo was documented calling at Middle Garden Pond on the Fort in September 2001 (Vernadero Group 2010b). Because these Ft. Huachuca observations were at higher elevations than where groundwater withdrawal occurs, we do not anticipate adverse effects to cuckoos using these areas. Given that yellow-billed cuckoos occur in appreciable numbers on the mainstem San Pedro River and have been detected at the Babocomari Cienega, it is likely that the riparian vegetation along the lower Babocomari River supports breeding pairs or provides portions of the home ranges of birds in either or both locations.

Areas of both meso- and xeroriparian habitat (typically, cottonwood/willow forests and mesquite bosques), are present along the mainstem San Pedro River as well as on the lower Babocomari River; these sites are suitable for yellow-billed cuckoo. These riparian ecosystems, in turn, depend on the availability of water at a depth at which it can be accessed by all life stages of the applicable plant species. Given that yellow-billed cuckoo are known to occur in relatively large numbers within the aforementioned habitat types along the upper San Pedro River, such habitat along the lowermost reaches of the Babocomari River is also likely occupied. Reductions in the vigor or extent of these habitat types will adversely affect the yellow-billed cuckoos that occur there.

Leenhouts *et al*. (2006) examined interactions between hydrologic processes and riparian vegetation within the San Pedro RNCA on the San Pedro River. The specific objectives of the study were to: 1) determine the water needs of riparian vegetation through the growing season; 2) to quantify the total water use of riparian vegetation; and 3) to determine the source of water used by key riparian plant species. The authors integrated analyses of vegetation functional groups, groundwater and surface water hydrology, and spatial and temporal variations thereof. Leenhouts *et al*. (2006) further identified surface flows as a useful surrogate for streamflow permanence, and subdivided river reaches into three Condition Classes based on the observed permanence as well as the dominant overstory vegetation type (Figure YBC2, below).

Condition Class 1 is indicative of sites with low water availability, often dominated by tamarisk. Condition Class 2 indicates intermediate conditions and mesoriparian trees, such as cottonwood and willow, dominate the overstory. Cottonwoods in the Class 2 reaches suffer drying-related stress as groundwater depths increase in midsummer; tamarisk is also present in Class 2 reaches, though less so than in Class 1. Condition Class 3 represents sites with the most mesic (wettest) conditions. The rich riparian species diversity observed in Class 3 reaches is markedly diminished in Class 2 reaches where water limits riparian plant growth (Leenhouts *et al*. 2006).

Condition Classes 2 and 3 occur along the mainstem San Pedro River within the SPRNCA (stream segments 1 through 12 and 14)(Figure YBC2). Each of these reaches is hydrologically capable of supporting yellow-billed cuckoo breeding habitat and foraging habitat, though the habitat within the Condition Class 2 reaches (1, 3, 8 through 12, and 14) are likely to experience stress during low-flow. Most detections of the species have been in reaches 3 through 8 (Figure YBC1). Additional groundwater withdrawals could exacerbate this condition and result in

downgrades from the existing Condition Class 3 to Condition Class 2 or Condition Class 1 or from the existing Condition Class 1 to a reach characterized by even further decreases in streamflow permanence and greater depth to and fluctuation of groundwater (2, and 4 through 7) (Leenhouts *et al*. 2006). Segment 13 is Condition Class 1 and the xeroriparian habitat contained within it likely only supports migration, some feeding, and dispersal.

The data contained in Table YBC2 and stream segments 8 and 9 in Figure YBC2, below (Leenhouts *et al*. 2006) indicate that there are no areas within the cottonwood/willow habitat type adjacent to reaches with permanent surface flow on the lower Babocomari River; the reach is categorized as Condition Class 2. It is therefore likely that the cottonwood-willow habitat type on the lower Babocomari River exists entirely under at least somewhat-diminished conditions and is relatively more vulnerable to changes in groundwater elevation.

Further, recruitment of cottonwood/willow forests requires near-surface groundwater following spring flood events, and will be negatively affected if it does not exist at the appropriate magnitude, duration, and time of year. Mesquite trees can be rooted at depths of 30 to 50 ft (Leenhouts *et al*. 2006, Arizona-Sonora Desert Museum 2013), and are therefore likely to be less vulnerable to small decreases in groundwater elevation. The yellow-billed cuckoo was proposed for listing as a threatened species on October 3, 2013 (78 FR 61622), but, to date, we have completed no informal or formal conference consultations within the action area.

Effects of the Action – Yellow-Billed Cuckoo

Effects of the action refer to the direct and indirect effects of an action on the species or critical habitat, together with the effects of other activities that are interrelated and interdependent with that action, which will be added to the environmental baseline. Interrelated actions are those that are part of a larger action and depend on the larger action for their justification. Interdependent actions are those that have no independent utility apart from the action under consideration. Indirect effects are those that are caused by the proposed action and are later in time, but are still reasonably certain to occur.

As discussed in the species' Environmental baseline section, yellow-billed cuckoos are closely associated with the presence of mesoriparian and xeroriparian vegetation along stream courses and thus, its habitat and prey base are affected by changes in the groundwater and surface water hydrology associated with those sites. The effects of Fort Huachuca on the hydrology of the area was subjected to detailed analyses in the Effects to Huachuca Water Umbel in the San Pedro Riparian National Conservation Area subsection of the Effects of the Proposed Action – Huachuca Water Umbel section, and these analyses are incorporated here by reference.

In summary, Fort Huachuca estimated its impacts on baseflow with two scenarios, the "With Fort-attributable" (WFA) and the "No Fort-attributable" (NFA) simulations (see the Groundwater Modeling Report contained in PBA Appendix G). The WFA simulation includes all Fort-attributable groundwater withdrawals and all completed and in-progress mitigation measures that could feasibly be modeled (conservation easements were not modeled; see below). The NFA simulation removes all Fort-attributable pumping and recharge both on- and off-Fort while maintaining all other groundwater pumping and recharge within the Basin. The difference

between the WFA and NFA simulations represents future Fort Huachuca impacts to the regional groundwater component of baseflows in the San Pedro and Babocomari rivers.

Figure 5-3 in the PBA, and Figure HWU1 in this document provide the simulated regional groundwater component of baseflow for the winter and summer for various locations on the San Pedro and Babocomari rivers. PBA Figure 5-4 (Figure HWU2 in this BO) presents the changes in baseflow between the WFA simulation and the NFA simulation. PBA Figure 5-5 (BO Figure HWU3) provides the graph of the simulated regional groundwater baseflow at the Tombstone Gage, which marks the downstream end of the overall Action Area.

Overall, the groundwater model predicts positive impacts of Fort-attributable activities on the net regional groundwater component of baseflow leaving the Sierra Vista Subwatershed from 2012 to 2030 (Figures HWU1, HWU2, and HWU3). This does not include the additional benefits from the conservation easements. For the San Pedro River in the SPRNCA, the Fort-attributable activities, including completed and in-progress mitigation measures that could be feasibly modeled, are simulated to increase the regional groundwater component of baseflow by 0.3 cfs at the Charleston gage (Revised PBA Figure 5-3) and 0.4 cfs at the Tombstone gage by 2030 (Revised PBA Figure 5-5). At no point during the period from 2012 to 2030, does the Fort-attributable groundwater withdrawal reduce the baseflow in the mainstem of the San Pedro River. The Fort anticipates in 2014 (Revised PBA Table 5-1), there will be a net surplus in the groundwater demand accounting, and beyond 2014 the Fort attributable impacts to the regional groundwater component of baseflow would be positive as a result of the Proposed Action. These net-positive effects will have modest, beneficial effects to the habitat supporting those yellow-billed cuckoos that occur along the mainstem San Pedro River.

The groundwater modeling conducted by Fort Huachuca simulated that the proposed action would not affect the groundwater component of baseflow in the upstream reaches of the Babocomari River, near the Babocomari Cienega. Modeling did, however, simulate negative impacts to the groundwater component of baseflow in the lower Babocomari River, which is projected to experience a continual decline in the groundwater component of baseflows (Figures HWU1 and HWU2 in this BO and 5.3 in the PBA). By 2030, the magnitude of the decline was modeled to be -0.1 cfs due to Fort Huachuca's activities (Figures in this BO and 5-4 in the PBA). The lower Babocomari River already exhibits baseflows that are low (see Figures 5-2 and 5-3 in the PBA), with winter low-flows already at or below 1.0 cfs the majority of the time (Figure 3-13 in the PBA) and zero flows evident during the pre-monsoon season in late June and early July (PBA Figure 3-12). Additionally, other modeling efforts have shown that groundwater pumping has already negatively affected the Babocomari River flow (GeoSystems Analysis 2010, Lacher 2011) and will continue to do so (see Figure 5-3 in the PBA and Figure HWU1in this document).

As stated in the Environmental Baseline – Yellow-Billed Cuckoo section, above, the species' habitat on the lower Babocomari River exists in Condition Class 2, a state characterized by somewhat reduced water availability relative to more-mesic condition classes. The cottonwood trees in the Class 2 reaches suffer drying-related stress as groundwater depths increase in midsummer under baseline conditions (without the effects of proposed action). Most of the habitat, however, is composed of mesquite bosque. Table 3-5 on Page 3-47 of the PBA indicates that there are approximately 180 acres of cottonwood/willow forest existing in reaches with

intermittent flow (none exists adjacent to perennial flow reaches) while there are approximately 550 to 830 acres of mesquite.

Riparian vegetation persists on groundwater and water availability drives trophic interactions among terrestrial animals (Sabo *et al*. 2008, McCluney and Sabo 2009), including arthropods and reptiles. Given the potential for the proposed action to diminish already-reduced baseflows along the lower Babocomari River, we initially anticipated effects to the entire riparian ecosystem (both mesquite and cottonwood/willow types). In our February 28, 2014, Draft BO, we anticipated that the proposed action would result in a measurable loss of nesting substrates and reduced prey abundance as the lower Babocomari transitioned to more-xeric conditions. Accordingly, we anticipated incidental take of yellow-billed cuckoos. Analyses conducted subsequent to the date of our Draft BO have resulted in a revised effects analysis for the yellow billed cuckoo. Specifically, we have determined that Fort Huachuca's acquisitions of conservation easements within the Babocomari River watershed are likely to reduce the proposed action's effects to yellow-billed cuckoos to insignificant and discountable levels.

Conservation easements were considered in the PBA's groundwater demand accounting (see PBA Appendix K), but they were not incorporated into the groundwater model (see PBA Appendix G). It is not feasible to model conservation easements due to uncertainty in estimating precisely where and when future development would occur (on easements intended to preclude residential or commercial development) or when agricultural pumping would recommence (on easements intended to retire or prevent future agricultural pumping). We acknowledge that conservation easements do not result in an increase in flows in adjoining streams unless an active water use is retired. What the other conservation easements do accomplish is to preclude future increases in water use; the areas acquired will not be developed or farmed and thus, will not require new municipal or agricultural water uses, respectively. In this regard, conservation easements ensure that water uses do not grow as quickly or to as great a magnitude as they would absent the easements.

The Off-Post/San Pedro RNCA Effects subsection of the Effects of the Proposed Action - Huachuca Water Umbel section in our 2007 BO (pages 114-122) described a method (initially appearing in the 2007 Revised PBA) whereby the effect of Fort Huachuca's groundwater pumping on surface flows could reasonably be determined absent a groundwater model.

If the effects of pumping can be estimated, then the effects of foregoing that pumping (via preclusion of future water demands), or of recharge (the addition of groundwater to the regional aquifer), can also be determined. Moreover, given that the current groundwater model *does* explicitly consider future population growth and the groundwater use that will support it, it is possible to develop a construct whereby the groundwater benefits of the *removal* of the effects of that future growth can be estimated. To this end, we have employed a revised version of the aforementioned 2007 methodology.

The pumping of wells within the Sierra Vista Subwatershed [Fort Huachuca's pumping (direct and interrelated) results in both removal of groundwater from *storage* in the regional aquifer and the *capture* of water from discharge. Groundwater in storage is that which resides in an aquifer. Such stored water may be *discharging* to a spring or waterway. Water used by plants through

evapotranspiration (ET) is also categorized as a *discharge*. Under unaffected conditions (i.e. no pumping), infiltration of rainfall and runoff maintains storage in equilibrium with discharge. Water withdrawn from the ground by wells initially derives exclusively from storage. As pumping continues, increasing proportions of water are derived from the capture of discharge, and decreasing proportions are derived from storage. In other words, over time, groundwater wells are withdrawing not only water residing in the aquifer, but also water that was otherwise destined to become the surface flow of a stream or be available to sustain riparian vegetation. If water withdrawal continues unmitigated, it will eventually deplete storage, reverse the flow direction of groundwater, and capture (dewater) streams. Capture-derived deprivation of the base flow of the lower Babocomari River, for instance, could eventually cause intermittent reaches to become ephemeral. Such changes in the hydrologic regime of the Babocomari River, depending upon the reach in which they occur, could result in losses of the stands of relatively more shallow-rooted cottonwood and willow, or reduce the recruitment of new trees of these species into the reach.

The groundwater demand accounting method outlined in the 2007 Final BO (pages 114-115) involved an analysis of several key values: (1) the human population in the Sierra Vista Subwatershed attributable to Fort Huachuca; (2) the distribution of that population between urban and unincorporated (rural) areas of the subwatershed; (3) the average per capita water consumption rates for the Fort Huachuca/Sierra Vista area and the unincorporated areas of the subwatershed; (4) the average percentage of ground water pumped that is derived from aquifer storage versus capture, as described previously; and (5) the amount of recharged effluent and storm water, which serves to offset the effects of pumping. Fort Huachuca's conservation easements that reduced ground water pumping near the San Pedro River were not accounted for in the storage change calculations; they were credited with reductions in capture of water otherwise destined for discharge to stream of riparian vegetation.

The current PBA's spatially- and temporally-explicit groundwater demand accounting methodology, combined with the results of the groundwater model (an updated version of Pool and Dickinson 2007; see PBA Appendix G) represent the best available scientific information and thus supersede Items 1, 2, 3, and 5 in the prior paragraph's list. Determining the specifics of Item 4 – the relative proportions of storage and capture – still requires some elements used in the 2007 consultation but can also be informed by the Pool and Dickinson (2007) model, as had been done by Leake *et al*. (2008).

The proposed action includes 299 acre feet per annum (AFA) of precluded water use resulting from 3,628 acres of already-acquired conservation easements in the Babocomari River watershed (see Table 2-3 on Page 2-35 in the Revised PBA). An additional 248 AFA of water savings is associated with planned, future acquisitions of 3,000 acres of easements in the Babocomari River watershed (again, see Table 2-3). These future easements, and their effects, do not appear in subsequent analyses.

Again, the annual volume of water perpetually precluded from withdrawal by the acquisition of the conservation easements is considered in the current groundwater accounting methodology; the values are subtracted from the Fort's direct and attributable water use. Also, as stated above, the mitigative value of conservation easements may also be quantified as reduction in the storage

or capture of groundwater. If the conservation easements are acquired on parcels relatively more distant from the Babocomari River, their value would be credited to both storage and capture. If the easements are acquired on parcels relatively close to or adjoining the Babocomari River, their value could be predominately in reducing capture. In either case, it is possible to convert an annual yield in acre feet – through a series of calculations - to a range of discharges in cubic feet per second. The resulting discharges may then be subtracted from the model-driven declines in lower Babocomari River baseflows to determine the net effect of the proposed action.

The methodology and underlying hydrologic principles by which the mitigative value of conservation easements may be estimated is discussed in great detail in the following sections but is introduced briefly here.

1. The credited water yield of the 3,628 acres of Babocomari River watershed conservation easements acquired to date is 299 acre feet per annum (AFA). An additional 3,000 acres of easement acquisitions – credited with 248 AFA of yield - are planned, but not assured of implementation. The effects of the potential future easements are therefore not analyzed.

2. The credited water yields were apportioned to effects to groundwater storage and capture. A range of capture fractions at 10 and 50 years were estimated by examining the maps found in Figures 4A and 4B, respectively, in Leake *et al*. (2008) (Figures YBC4 and YBC5 in tis BO).

3. The credited water yields' effects to capture were then apportioned to riparian evapotranspiration (ET) and stream discharge (baseflow). The proportions of capture that would be discharged as riparian ET (77 percent) and baseflow (23 percent) were determined using data from USPP (2013) and Scott (2008).

4. The easements' annual baseflows in AFA were then converted to cubic feet per second (CFS) to enable comparisons of the modeled declines in streamflow, also expressed in CFS.

5. The easement's resulting yield in baseflow was subtracted from the decline in lower Babocomari River baseflows from the groundwater model's simulations of hydrologic conditions with Fort Huachuca present (including all of the installation's water-related conservation measures).

6. The resulting lessened impact to baseflow then had the modeled decline in baseflows from the groundwater model's simulation of hydrologic conditions as if Fort Huachuca was not present subtracted from it.

7. The resulting, residual declines in baseflows on the lower Babocomari River, at both the 10 and 50-year time scales; in summer, winter, and average conditions; and considering only the already-acquired conservation easements, represent the proposed action's range of net effect to the yellow-billed cuckoo.

We are aware that the various data sources we have employed are not consistent in their timelines. The PBA covers 2011 to 2022. Projections of groundwater and surface flow impacts using the groundwater model found in Appendix G of the PBA covers 2005 to 2030. Pool and

Dickinson (2007) and Leake *et al*. (2008) simulated conditions from 1902 through 2003; the former was, however, employed in the PBA's Appendix G groundwater model report. Despite the divergent and, in cases, non-overlapping timeframes, these hydrologic analyses are comprehensive in scope and scale, and represent the best available scientific information upon which to conduct our biological analyses.

Effects of Conservation Easements to Groundwater Storage and Capture

As discussed previously, pumped ground water derives either from ground water storage or capture of water from basin recharge or discharge. In the case of the Fort Huachuca/Sierra Vista pumping center, some of the ground water pumping captures water that would otherwise discharge to the Babocomari or San Pedro rivers or be consumed through ET. In the 2007 Revised PBA and 2007 Final BO, several modeling studies were employed to provide estimates of this partitioning. Goode and Maddock (2000) stated that by 1997, 65 percent of all ground water pumped from the upper San Pedro watershed came from aquifer storage. Modeling by Freethey (1982), Corell, *et al* (1996), and Vionnet (1992) estimated that 56 percent, 51 percent, and 48 percent of pumping, respectively, was derived from aquifer storage. Based on an average of these published values, roughly 55 percent of water pumped from the regional aquifer in the Sierra Vista Subwatershed was thought to be derived from aquifer storage. The remaining 45 percent was therefore believed to derive from capture. For the 299 afa associated with the past acquisition of conservation easements in the Babocomari River watershed, this would have equated with approximately 164.4 acre feet of groundwater removed from storage and approximately 134.6 acre feet of groundwater captured.

Again, the regional groundwater model prepared by Pool and Dickinson (2007) permitted more detailed analyses of capture fractions. Leake *et al*. (2008) utilized the model to determine capture fractions in a spatially- and temporally-explicit manner. The relationship between proximity to a river (the San Pedro) and the relative fractions of storage removal and capture of discharge is illustrated in the capture and storage fraction curves found in Leake *et al*. (2008) and reproduced below as Figure YBC3.

A visual examination of Figure YBC3 indicates that at 10 years, in locations close to the San Pedro River, groundwater pumping would remove approximately 70 percent of its volume from capture and 30 percent from storage. At 50 years, the effect of pumping on capture would increase to approximately 85 percent.

In locations farther from the San Pedro River, the effects are less severe. In 10 years, groundwater pumping would remove approximately 95 percent of its volume from storage and approximately 5% from capture. At 50 years, distant groundwater pumping's effect to capture would increase to approximately 30 percent.

Again, Figure YBC3 and the subsequent analyses pertain to the San Pedro River. The Babocomari River is a major tributary to the San Pedro, but is likely to exhibit differing capture and storage fraction curves. Absent these curves, we examined Figures 4A and 4B in Leake *et al*. (2008). Figures 4A (Figure YBC4 in this document) and 4b (Figure YBC5) are maps illustrating the distribution of groundwater capture fractions throughout the watershed of the

upper San Pedro River watershed - including within the Babocomari Watershed - at 10 and 50 year time steps, respectively.

A visual examination of these maps indicate that at 10 years of groundwater pumping (Figure YBC4), an appreciable proportion of the area close to lower Babocomari River downstream will experience between 50 and 70 percent groundwater capture. Areas further from the river will experience 30 to 50 percent capture. At 50 years of groundwater pumping (Figure YBC4), capture will increase to 60 to 80 percent areas close to the Babocomari River's lower reaches and to 30 to 60 percent further away.

Effects of Conservation easements on Groundwater Capture and Stream Discharge

Once again, capture of groundwater affects both the discharge of groundwater to a stream (baseflow) and the water available to and used by riparian vegetation (riparian ET). Riparian ET, therefore, must be accounted for in determining the volume of water actually discharged as baseflows. The 2007 Revised PBA and the 2007 Final BO (pages 119-120) included a methodology whereby the partitioning of groundwater capture between the two natural sources of discharge, riparian ET and baseflow, could be estimated.

Leenhouts *et al*. (2006) determined that of the San Pedro River's total natural discharge of 14,010 AFA, ground water-derived ET consumes a maximum of 9,010 afa of ground water between the international border and the Tombstone gage. Baseflow accounts for approximately 5,000 AFA of natural discharge upstream of the Babocomari River. Therefore, groundwater-derived ET accounts for 64 percent and stream discharge for 36 percent of the total, observed natural discharge of the San Pedro River.

These prior calculations, however, are problematic when applied solely to the Babocomari River (J. Degner, Leidos, pers. comm., 2014). The prior methodology employed mean baseflows based on the San Pedro River stream gage at Tombstone that includes input from the Babocomari River but only uses the San Pedro River Riparian ET estimates. A second problem with the prior methodology is that the estimate of 5,000 AFA of baseflow is an average from 1967 to 2005. Riparian vegetation has been increasing (Stromberg *et al*. 2010) and the baseflow has decreased over time (Thomas and Pool 2006); consideration of a more-recent average is more scientifically appropriate.

Degner (Leidos, pers. comm., 2014) suggested utilization of the updated data from the 2011 Upper San Pedro Partnership water budget (USPP 2013) for the Sierra Vista Subwatershed. The USPP report includes a value of 10,800 AFA for riparian ET based on Scott (2008) and 3,250 AFA of stream discharge (baseflow) based on ADWR 2005 (more recent average with the more extensive riparian cover). That would provide a split of about 23 percent baseflow and 77 percent riparian ET. The simulated transient groundwater budget from the groundwater model (Pool and Dickinson 2007, Table 5) has a breakdown of 9,600 cubic meters per day net baseflow (inflow-outflow) compared to 27,600 cubic meters per day of ET. The Pool and Dickinson (2007) values breaks down to 26 percent baseflow and 74 percent riparian ET. We feel that the groundwater model corroborates the USPP water budget and thus, we have elected to employ the 77:23 ratio of riparian ET to stream discharge (baseflow).

Effects of Conservation Easements on Modeled Declines in Stream Discharge

As described in the Huachuca water umbel effects analysis and elsewhere in this species' narrative, Fort Huachuca estimated its impacts on baseflow with two scenarios, the "With Fort-attributable" (WFA) and the "No Fort-attributable" (NFA) simulations (see the Groundwater Modeling Report contained in PBA Appendix G). The WFA simulation includes all Fort-attributable groundwater withdrawals and all completed and in-progress mitigation measures that could feasibly be modeled. The NFA simulation removes all Fort-attributable pumping and recharge both on- and off-Fort while maintaining all other groundwater pumping and recharge within the Basin. The difference between the WFA and NFA simulations represents future Fort Huachuca impacts to the regional groundwater component of baseflows in the San Pedro and Babocomari rivers.

Figure 5-3 in the PBA and Figure HWU1 in this document provide the simulated regional groundwater component of baseflow for the winter and summer for various locations on the San Pedro and Babocomari rivers. Figure 5-4 in the PBA (Figure HWU2 in this BO) presents the changes in baseflow between the WFA simulation and the NFA simulation (0.1 CFS), but we note that the baseflow impacts differ among the summer and winter seasons as well as the weighted average of them (see the following paragraph). We also reiterate that the reported decline is a net value; the NFA simulation also indicates declining baseflows, and this decline is deducted from the gross WFA value.

The declines in the lower Babocomari River baseflows differ by season. J. Degner (Leidos, pers. comm., 2014) states that the summer baseflows will decline by 0.29 CFS under the WFA simulation and by 0.17 CFS under the NFA simulation. Winter baseflows will decline by 0.32 CFS under the WFA simulation and by 0.18 CFS under the NFA simulation. The weighted average (summer and winter season are of different durations) declines are 0.30 for WFA and 0.18 for NFA.

The difference between the WFA and NFA values (0.12 CFS in summer, 0.13 in winter, and 0.12 CFS on average), and the declines' effects to riparian vegetation, represent the Fort's initial (i.e. unmitigated by conservation easement acquisitions) level of adverse effects to yellow-billed cuckoos on the lower Babocomari River.

Prior sections have described how the precluded water use associated with conservation easements can be apportioned to groundwater not captured. The volume of groundwater that will no longer be captured can then be apportioned to the volume of stream discharges protected in the future. The secured stream discharges can then be deducted from the WFA projections of streamflow decline described in the preceding paragraph; the NFA projections are then deducted from the result again, because these will occur regardless of the Fort's presence. A summary of all of these calculations appears below as Table YBC3. We also note that Table 2-3 on Page 2-35 of the Revised PBA includes 248 AFA of planned conservation easements in the Babocomari River watershed. The acquisition of these future easements, however, was not considered in our analyses.

The outcome that is reasonably certain to occur, whereby we consider the 299 AFA of water credits Babocomari River watershed easements that have already been acquired, indicates the following:

- The summer-season residual decline (Fort Huachuca's net, negative effect to baseflows, considering all water conservation measures as well as the beneficial effects of conservation easements) in lower Babocomari River baseflows will range from 0.05 CFS to 0.09 CFS at 10 years. At 50 years, the residual summer-season decline in lower Babocomari River baseflows resulting from all water conservation measures and the existing easements will range from 0.04 CFS to 0.09 CFS. Without easement acquisition (but with the Fort's water conservation measures), the summer modeled net decline at both 10 and 50 years would have been 0.12 CFS.

- The winter-season residual decline (Fort Huachuca's net, negative effect to baseflows, considering all water conservation measures as well as the beneficial effects of conservation easements) in lower Babocomari River baseflows will range from 0.06 CFS to 0.1 CFS at 10 years. At 50 years, the residual winter-season decline in lower Babocomari River baseflows resulting from all water conservation measures and the existing easements will range from 0.05 CFS to 0.1 CFS. We note that the winter season declines appear the most severe, but they are also highly conservative. It is very likely that riparian ET represents an appreciably smaller fraction of discharge (i.e less than 77 percent) during the non-growing season, meaning that more of the easements' water credits would be discharged as baseflow. Without easement acquisition (but with the Fort's water conservation measures), the winter modeled net decline at both 10 and 50 years would have been 0.13 CFS.

- The weighted average residual decline (Fort Huachuca's net, negative effect to baseflows, considering all water conservation measures as well as the beneficial effects of conservation easements) in lower Babocomari River baseflows will range from 0.05 CFS to 0.09 CFS at 10 years. At 50 years, the weighted average residual decline in lower Babocomari River baseflows resulting from all water conservation measures and the existing easements will range from 0.04 CFS to 0.09 CFS. Without easement acquisition (but with the Fort's water conservation measures), the weighted average modeled net decline at both 10 and 50 years would have been 0.12 CFS.

Effects to Yellow-Billed Cuckoo Habitat

Riparian vegetation persists on groundwater and water availability drives trophic interactions among terrestrial animals (Sabo *et al*. 2008, McCluney and Sabo 2009), including arthropods and reptiles. Given the potential for the proposed action to diminish already-reduced baseflows along the lower Babocomari River, we initially anticipated effects to the entire riparian ecosystem (both mesquite and cottonwood/willow types). In our February 28, 2014, Draft BO, we anticipated that the proposed action would result in a measurable loss of nesting substrates and reduced prey abundance as the lower Babocomari transitioned to more-xeric conditions. Accordingly, we anticipated incidental take of yellow-billed cuckoos.

The best scientific information available to us regarding yellow-billed cuckoo occupancy of habitat along the lower Babocomari River is based on the 100-ac minimum home range size per individual (Laymon *et al*. 1997, Laymon and Williams 2002, Halterman 2009, Sechrist *et al*. 2009, McNeil *et al*. 2012). Home ranges may overlap, but for the purpose of calculating the number of cuckoos that can be supported, we assumed there is no overlap. Given that the maximum possible amount of suitable cuckoo habitat on the lower Babocomari River is approximately 1,010 ac (consisting of 180 ac of cottonwood-willow forest along intermittent reaches and up to 828 ac of mesquite trees), we anticipated in our February 28, 2014, Draft BO on the proposed action that up to 10 individual breeding-season home ranges, and the reproductive output from pairings of those birds, could be affected by the proposed action by 2030, and those effects would propagate onward through time.

Analyses conducted subsequent to the date of our Draft BO have resulted in a revised effects analysis for the yellow billed cuckoo. Specifically, we have determined that Fort Huachuca's acquisitions of conservation easements within the Babocomari River watershed are likely to reduce the proposed action's effects to yellow-billed cuckoos to insignificant and discountable levels.

The hydrologic analyses contained in the prior sections indicate that the summer-season residual baseflow decline (the decline streamflow due to Fort Huachuca, taking into consideration all conservation measures, including easements) in lower Babocomari River baseflows will range from 0.05 CFS to 0.09 CFS at 10 years. At 50 years, the residual summer-season decline in lower Babocomari River baseflows resulting from the Fort's water conservation projects (including the existing conservation easements) will range from 0.04 CFS to 0.09 CFS.

The winter-season baseflow residual decline will range from 0.06 CFS to 0.1 CFS at 10 years. At 50 years, the residual winter-season decline will range from 0.05 CFS to 0.1 CFS. Again, we have given the winter declines less weight in our analyses because: 1) they are likely overestimated due to having assigned a growing-season riparian ET fraction to a non-growing season time of the year; 2) riparian trees are unlikely to experience stress during the non-growing season; and 3) yellow-billed cuckoos are not present during the winter. We nevertheless include winter season values in subsequent analyses because of their value in determining maximum hydrologic fluctuations throughout the year; weighted average values would mask such changes.

The year-round, weighted average residual decline will range from 0.05 CFS to 0.09 CFS at 10 years. At 50 years, the weighted average residual decline will range from 0.04 CFS to 0.09 CFS.

The aforementioned declines in lower Babocomari River baseflows are measurable effects, but we must consider the subsequent effects on yellow-billed cuckoo habitat to make an overall determination. As stated previously, the species' habitat on the lower Babocomari River exists in Condition Class 2, where alluvial groundwater is relatively less available relative to more xeric condition classes with shallower groundwater and extensive areas of perennial flow. The cottonwood trees in the Class 2 reaches suffer drying-related stress as groundwater depths increase in midsummer under baseline conditions (without the effects of proposed action). Most of the habitat, however, is composed of mesquite bosque. Table 3-5 on Page 3-47 of the PBA indicates that there are approximately 180 acres of cottonwood/willow forest existing in reaches

with intermittent flow (none exists adjacent to perennial flow reaches) while there are about 550 to 830 acres of mesquite.

Fremont cottonwood and Goodding's willow are sensitive to changes in water availability; they are shallow-rooted, obligate to near-obligate phreatophytes (Busch *et al*. 1992; Smith *et al*. 1998; Snyder and Williams 2000). Cottonwood and willow are sensitive to drought at all life stages and undergo stem dieback as water tables decline (Tyree *et al*. 1994, Horton *et al*. 2001b). Declines in alluvial groundwater during the hot summer dry season can strand roots above the water level, reduce tree productivity and, in some cases, cause death. Seasonal declines of 1 m (3.3 ft) have caused mortality of saplings of cottonwood and willow (Shafroth *et al*. 2000). Mature cottonwood trees have been killed by abrupt, permanent drops in the water table of 1 m (3.2 ft), with lesser declines (0.5 m, 1.6 ft) reducing stem growth (Scott *et al*. 1999, 2000).

Leenhouts *et al*. (2006) found that, although ground-water depth and fluctuation were related to measures of abundance of cottonwood and willow along the upper San Pedro River, the variable that explained most variance in the basal area of these species was streamflow permanence. Directly or indirectly, streamflow permanence is an important indicator of San Pedro River forest composition and structure. Surface water can provide a water source for young trees that line the low-flow channel (Smith *et al*. 1991), and surface water can raise local humidity levels and provide an essential buffer to high evaporation rates along arid region rivers (Horton *et al*. 2001a). Streamflow permanence, however, as analyzed by Leenhouts *et al*. (2006), served as a surrogate for the degree of long-term ground-water fluctuation under the flood plain, rather than as a direct influence on vegetation. Sites with perennial flow tended to be situated in gaining reaches, where inflowing groundwater would sustain stable, shallow ground-water levels even during extended drought. At the highly intermittent sites, which typically are in losing reaches, groundwater depths and fluctuations were thought to be likely to have periodically exceeded the levels observed in this short-term study, and exceeded survivorship tolerance ranges for cottonwood and willow. Leenhouts *et al*. (2006) found that cottonwood/willow forests were dense and multi-aged among sites where annual maximum ground-water depths averaged less than about 3 m (9.8 ft), streamflow permanence was greater than about 60 percent, and intra-annual ground-water fluctuation was less than about 1 m (3.3 ft). Beyond these values, size-class diversity or overall abundance was low.

Mesquite trees are facultative phreatophytes that use a combination of ground water and soil water depending on environmental setting (Williams *et al*. 1998; Galuszka and Kolb 2002, Hultine *et al*. 2003). Mesquite has a dimorphic root system, with deep tap roots (15 m [49.2 ft] or more) that allow for uptake of ground water, and wide-spreading lateral roots that allow for uptake of rain and flood water from surface soils (Stromberg 1993, Stromberg *et al*. 1993, Snyder and Williams 2003). The observation that the lower Babocomari River supports from 550 to 830 acres of mesquite bosque and only 180 acres of cottonwood/willow forest (along intermittent flow segments) would seem to indicate that the reach's level of streamflow permanence, depth to groundwater, and groundwater fluctuations groundwater hydrology are well within the former species' requirements but provide marginal conditions for the latter. Leenhouts *et al*. (2006) states that Condition Class stream 2 reaches – such as the lower Babocomari River – are characterized by 60 to 100 percent streamflow permanence, and average

dry-season floodplain groundwater depth of between 2.5 and 3.5 meters (m)(8.2-11.5 ft), and an annual groundwater fluctuation of between 0.5 and 1.0 m (1.6-3.3 ft).

Once again, we have calculated a net, summer-season decline (due to Fort Huachuca, including all conservation measures and easements) of lower Babocomari River baseflows of 0.05 CFS to 0.09 CFS at 10 years and 0.04 CFS to 0.09 CFS at 50 years. We calculated a winter-season decline in Babocomari River baseflows (due to the Fort, including all conservation measures and easements) from 0.06 CFS to 0.1 CFS at 10 years and 0.05 CFS to 0.1 CFS at 50 years. We calculated a year-round, average decline in Babocomari River baseflows (due to the Fort, including all conservation measures and easements) of 0.05 CFS to 0.09 CFS at 10 years and 0.04 CFS to 0.09 CFS at 50 years. These changes are minimal and functionally immeasurable. Changes in stream flow of less than one-tenth of a CFS would be difficult to measure in the field, and nearly impossible to separate from other sources of variation, such as the presence of runoff (which is distinct from baseflow and is also unaffected by the proposed action) and diurnal variation in riparian ET. Further, as defined in the PBA, baseflows are those discharges that result from discharges from the regional aquifer and do not, by definition, include direct runoff or discharges from water stored for shorter periods of time within the alluvium (such as after elevated periods of flood flows). The fact that Fort Huachuca's proposed action will have no effect to runoff means that there will be at least some unquantifiable amelioration of the minimal declines in baseflow.

We have no data before us to determine the annual fluctuation in groundwater elevation along the lower Babocomari River, but recall that streamflow permanence, as analyzed by Leenhouts *et al*. (2006), serves as a surrogate for the degree of long-term ground-water fluctuation under the flood plain, rather than as a direct influence on vegetation. The minimal declines in baseflow will result in similarly minimal declines in the wetted length of the stream and/or minimal decreases in the duration of streamflow (the streamflow permanence for condition class 2 streams is 60 to 100 percent).

Inasmuch as surface flows are also related to depth to alluvial groundwater, it is possible that the maximum 0.09 CFS (at both 10 and 50 years) calculated Fort-attributable decline (which includes the effects of conservation measures and easements) in summer (i.e. growing-season) baseflows could result from the critical groundwater depth dropping below the 9.8 ft required to sustain cottonwood/willow forests along the upstream and downstream and/or lateral (landward) limits of the vegetation types' occurrence. The resulting shortening and narrowing of the area occupied by cottonwood and willow trees is likely to result in increases in the area occupied by mesquite trees, which can cope with both deeper alluvial water sources and larger annual variations in depth to groundwater. The existing mesquite trees are both shallow- and deeply-rooted and are therefore most likely to be immune to small decreases in streamflow and modest increases in the annual fluctuation of in depth to groundwater.

In summary, the modeled declines in lower Babocomari River baseflows are small and difficult to measure. The potential changes in the riparian ecosystem that includes up to 10 yellow-billed cuckoo home ranges will be similarly small and difficult to measure. Any losses of cottonwood/willow forest are likely to be accompanied by increases in mesquite bosque, which will continue to serve as yellow-billed cuckoo habitat

Cumulative Effects – Yellow-Billed Cuckoo

Cumulative effects include the effects of future State, tribal, local, or private actions that are reasonably certain to occur in the action area considered in this biological opinion. Future Federal actions that are unrelated to the proposed action are not considered in this section because they require separate consultation pursuant to section 7 of the Act.

Section 321 of the Defense Authorization Act of 2004 (Public Law 108-136) describes the manner in which section 7 of the Act is to be applied during interagency consultation with Fort Huachuca. Specifically, Section 321 states "For purposes of section 7 of the Endangered Species Act of 1973 (16 U.S.C. 1536), concerning any present and future Federal agency action at Fort Huachuca, Arizona, water consumption by State, local, and private entities off of the installation that is not a direct or indirect effect of the agency action or an effect of other actions that are interrelated or interdependent with that agency action, shall not be considered in determining whether such agency action is likely to jeopardize the continued existence of any endangered or threatened species or result in the destruction or adverse modification of designated critical habitat."

For the yellow-billed cuckoo, the most appreciable cumulative effect is the pumping of ground water from the Sierra Vista Subwatershed by and for individuals whose presence is not related to Fort Huachuca or another Federal entity. The subwatershed exists with a 2011 annual deficit of 4,600 acre-feet, an appreciable proportion of which is the result of local, non-Federal actions cumulative to the operation of Fort Huachuca and which we anticipate will continue into the foreseeable future. Nevertheless, these effects cannot be considered when determining if the proposed action will jeopardize the continued existence of the yellow-billed cuckoo.

We should note, however, that the past withdrawals of groundwater and the accumulated deficit they represent are part of the Environmental Baseline, not the effects of a cumulative action. As stated by Thomas and Pool (2006) regional ground-water pumping often has a delayed effect on streamflows. We have explicitly considered the effects of the standing groundwater deficit because the groundwater model that underlies our hydrologic analyses (Appendix G in the PBA) is based on the Pool and Dickinson (2007) groundwater model, which explicitly incorporates past deficits into its groundwater budget.

Section 321 also does not preclude our analysis of other-than-water-consumption-related effects of cumulative actions. There are, however, relatively few other activities that may impact the yellow-billed cuckoo within the action area; most are the result of Federal actions conducted by Fort Huachuca or the BLM, and thus are not considered cumulative effects. The effects of undocumented immigrants (UDI) within the SPRNCA have not been analyzed in detail, but the use of warming or diversionary fires set by UDIs could result in wildfires within the riparian system. Compliance with the Act for activities on state and private lands that may affect the yellow billed cuckoo, but are not addressed by section 7 consultation, could occur through section 10(a)(1)(B) of the Act, if and when the species is listed.

Conference Conclusion – Yellow-Billed Cuckoo

After reviewing the current status of the yellow-billed cuckoo, the environmental baseline for the action area, the effects of the proposed action, but excluding the water-consumption-related cumulative effects, it is the FWS's conference opinion that the action, as proposed, is not likely to jeopardize the continued existence of the yellow-billed cuckoo. No critical habitat has been proposed for this species, therefore, none will be affected.

We present this conclusion on the yellow-billed cuckoo for the following reasons:

- The proposed action will result in positive effects to the groundwater-derived portion of baseflows (0.3 cfs at the Charleston gage and 0.4 cfs at the Tombstone gage by 2030) in reaches on the San Pedro River known to be occupied by yellow-billed cuckoos. There will be no long-term effect to yellow-billed cuckoos occurring along the San Pedro River;
- The summer-season residual decline in lower Babocomari River baseflows will range from 0.05 CFS to 0.09 CFS at 10 years. At 50 years, the residual summer-season decline in lower Babocomari River baseflows will range from 0.04 CFS to 0.09 CFS. The winter-season residual decline in lower Babocomari River baseflows will range from 0.06 CFS to 0.1 CFS at 10 years. At 50 years, the residual winter-season decline in lower Babocomari River baseflows will range from 0.05 CFS to 0.1 CFS. The weighted average residual decline in lower Babocomari River baseflows will range from 0.05 CFS to 0.09 CFS at 10 years. At 50 years, the weighted average residual decline in lower Babocomari River baseflows will range from 0.04 CFS to 0.09 CFS. The aforementioned effects include the Fort’s water use, conservation measures, and conservation easements. These changes in Babocomari River baseflow may result in minimal, difficult-to-measure reductions in the extent or health of cottonwood/willow forests along the lower Babocomari River in which yellow-billed cuckoos occur. The baseflow declines are likely to have no effect on the Babocomari River’s mesquite bosques, in which the birds also occur. Declines in the former riparian community are likely to be replaced by increased cover of the latter. Such effects are likely to be insignificant (functionally immeasurable, and unlikely to reach the scale where take occurs) and discountable (unlikely to occur);
- The small magnitude of both the positive and negative effects of the proposed action are not likely to adversely affect the yellow-billed cuckoo and therefore are, by definition, incapable of affecting the recovery of the species; the species is wide-ranging in the southwest; and
- Recovery is the process that stops the decline of an endangered or threatened species by removing or reducing threats. Recovery ensures the long-term survival of the species in the wild. At that point, the species is recovered, and protection of the ESA is no longer necessary. The aforementioned effects will not appreciably reduce the likelihood of recovery of the yellow-billed cuckoo.

The proposed action does not appreciably reduce the likelihood of yellow-billed cuckoo recovery within its historical range. The adverse effects that do occur in the action area do not reach the scale where recovery of the species would be delayed or precluded. We make this conclusion for the following reasons:

- The area of effect on the Lower Babocomari River is a small part of the range of the species and does not rise to the level of take;

FWS is unable to identify a reliable recovery "tipping point" or threshold for the yellow-billed cuckoo because it is not technically feasible, due partly to a lack of rigorous, long-term data sets on population and habitat parameters. Because we cannot identify a tipping point, we cannot determine whether that tipping point would be reached as a result of agency operations. Since the impacts of the proposed action are minimal and the area of effect is small compared to the range of the species, it is highly unlikely that the proposed action would cause a tipping point away from recovery to be reached. The adverse effects that do occur in the action area do not reach the scale where recovery of the species would be delayed or precluded.

The conclusions in this species' conference report is based on full implementation of the project as described in the Description of the Proposed Action section of this document, including any Conservation Measures that were incorporated into the project design. This concludes the conference for the proposed ongoing and future military operations and activities at Fort Huachuca. You may ask us to confirm the conference report as a written concurrence issued through informal consultation if and when the yellow-billed cuckoo is listed. The request must be in writing. If we review the proposed action and find that there have been no significant changes in the action as planned or in the information used during the conference, we will confirm the conference report as a concurrence letter on this project and no further section 7 consultation will be necessary. After listing of the yellow-billed cuckoo, and any subsequent adoption of this conference opinion, the Fort may request reinitiation of consultation if: 1) the amount or extent of incidental take is exceeded; 2) new information reveals effects of the action that may affect the species or critical habitat (which does not exist for the yellow-billed cuckoo) in a manner or to an extent not considered in this conference opinion; 3) the action is subsequently modified in a manner that causes an effect to the species or critical habitat that was not considered in this conference opinion; or 4) a new species is listed or critical habitat designated that may be affected by the action.

The incidental take statement provided in this conference report does not become effective until the species is listed and the conference is adopted as the written concurrence issued through informal consultation. At that time, the project will be reviewed to determine whether any adverse effect to and/or take of the yellow-billed cuckoos has occurred. Modifications of the consultation and incidental take statement may be appropriate to reflect that take. No take of the yellow-billed cuckoo may occur between the listing of species and the adoption of the conference report through informal consultation, or the completion of a subsequent formal consultation.

INCIDENTAL TAKE STATEMENT

Section 9 of the Act and Federal regulation pursuant to section 4(d) of the Act, prohibit take of endangered or threatened species, respectively, without special exemption. "Take" is defined as to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or to attempt to engage in any such conduct. "Harm" is further defined to include significant habitat modification or degradation that results in death or injury to listed species by significantly impairing behavioral patterns, including breeding, feeding, or sheltering. "Harass" is defined in the regulations as `an intentional or negligent act or omission which creates the likelihood of injury to wildlife by

annoying it to such an extent as to significantly disrupt normal behavioral patterns which include, but are not limited to, breeding, feeding, or sheltering (50 CFR §17.3). Incidental take is defined as take that is incidental to, and not the purpose of, the carrying out an otherwise lawful activity. Under the terms of section 7(b)(4) and section 7(o)(2), taking that is incidental to and not intended as part of the proposed action is not considered to be prohibited taking under the Act provided such taking is in compliance with this Incidental Take Statement.

As demonstrated in the Environmental Baseline and Effects of the Proposed Action sections, above, yellow-billed cuckoos are unlikely to be harmed or harassed as a result of the proposed action. While the species composition within the available habitat in the action area may undergo changes, these changes will be small, difficult to measure, and difficult to attribute to the proposed action. As discussed previously, habitat occupied by yellow-billed cuckoos is, by nature, dynamic and can vary widely in suitability, location, and occupancy over relatively short periods of time. We, therefore, do not anticipate that implementation of the proposed action will result in the incidental take of any individuals of the species.

CONSERVATION RECOMMENDATIONS

Section 7(a)(1) of the ESA directs federal agencies to utilize their authorities to further the purposes of the ESA by carrying out conservation programs for the benefit of endangered and threatened species. Conservation recommendations are discretionary agency activities to minimize or avoid adverse effects of a proposed action on listed species or CH, to help implement recovery plans, or to develop information. The FWS recommends the following conservation activities:

1. We recommend that Fort Huachuca monitor the riparian vegetation on the areas of the Babocomari River subject to the effects of the installation's groundwater withdrawals and water conservation measures. Specifically, we recommend that Fort Huachuca employ aerial or satellite imagery to measure changes in the acreage, foliar cover, and size class by species (or other suitable measures of health and extent) to determine if riparian stress or mortality has occurred despite the groundwater model predictions.

2. We recommend that Fort Huachuca survey for yellow-billed cuckoos on the Babocomari River (where landowner permission is granted) and on the installation in higher-elevation drainages where cuckoos may be breeding. Specifically, we recommend that Fort Huachuca survey for yellow-billed cuckoos on the Fort in sites such as Scheelite, Garden, Sawmill, and Huachuca canyons. Surveys of the latter four sites have been prescribed because anecdotal detections of the species have occurred in montane environments in southeastern Arizona. However, little is known about breeding status in these higher elevation drainages.

3. We recommend that Fort Huachuca investigate additional water conservation activities that would further reduce the anticipated residual effects to baseflows in the lower Babocomari River.

Col. Daniel J. McFarland

4. We recommend that Fort Huachuca continue to facilitate studies of avian ecology through the Department of Defense Legacy program as well as other applicable granting authorities.

For the FWS to be kept informed of actions minimizing or avoiding adverse effect or benefiting listed species or their habitats, the FWS requests notification of the implementation of any conservation recommendations.

Table YBC1. Riparian condition class parameters, San Pedro River, Arizona (Leenhouts *et al*. 2006).

Condition Class	Flow Regime	Flow Permanence (percent)	Average dry-Season Floodplain Depth-to-Groundwater (feet)	Annual groundwater fluctuation (feet)
1	Intermittent-dry	<60	>10	>3
2	Intermittent-wet	<100 to ≥60	≥6 to 10	≥1.5 to 3
3	Perennial	100	<6	<1.5

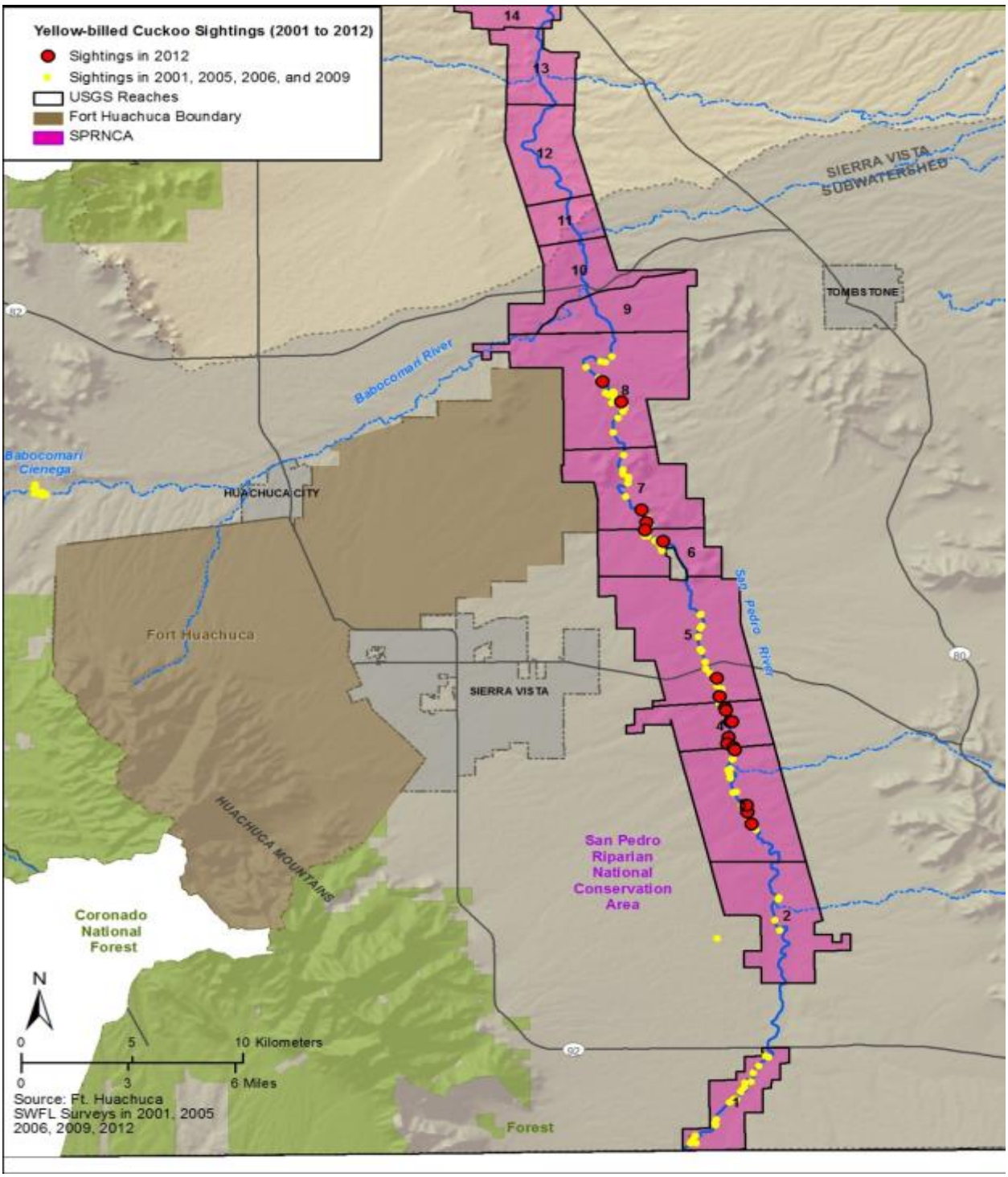
Table YBC2. Estimated Babocomari River, Arizona riparian canopy acreage (Leenhouts *et al*. 2006).

Habitat Type	Canopy Coverage
Mesquite	551- 828 acres
Cottonwood-Willow (perennial streamflow site)	0
Cottonwood-Willow (intermittent streamflow site)	175 acres

Table YBC3. Analysis of impacts to flow in the lower Babocomari River from existing conservation easements.

10 YEARS	**Easements' capture fraction based on location**	**Stream discharge (baseflow) fraction of capture**	**Easements' positive effect on capture (converted from AFA to CFS)**	**WFA modeled decline in baseflow with conservation measures, but without easements (CFS)**	**NFA modeled decline in baseflow (CFS)**	**Net WFA decline in baseflow with conservation measures, without easements, minus NFA (CFS)**	**WFA modeled decline in baseflow with conservation measures, minus easements' effect on capture (CFS)**
SUMMER (low/distant from river)	30%	23%	0.03	0.29	0.17	0.12	0.26
SUMMER (high/close to river)	70%	23%	0.07	0.29	0.17	0.12	0.22
WINTER (low/distant from river)	30%	23%	0.03	0.32	0.19	0.13	0.29
WINTER (high/close to river)	70%	23%	0.07	0.32	0.19	0.13	0.25
AVERAGE (low/distant from river)	30%	23%	0.03	0.30	0.18	0.12	0.27
AVERAGE (high/close to river)	70%	23%	0.07	0.30	0.18	0.12	0.23
50 YEARS	**Easements' capture fraction based on location**	**Stream discharge (baseflow) fraction of capture**	**Easements' positive effect on capture (converted from AFA to CFS)**	**WFA modeled decline in baseflow with conservation measures, but without easements (CFS)**	**NFA modeled decline in baseflow (CFS)**	**Net WFA decline in baseflow with conservation measures, without easements, minus NFA (CFS)**	**WFA modeled decline in baseflow with conservation measures, minus easements' effect on capture (CFS)**

SUMMER (low/distant from river)	30%	23%	0.03	0.29	0.17	0.12	0.26
SUMMER (low/distant from river)	80%	23%	0.08	0.29	0.17	0.12	0.21
SUMMER (high/close to river)	30%	23%	0.03	0.32	0.19	0.13	0.29
WINTER (low/distant from river)	80%	23%	0.08	0.32	0.19	0.13	0.24
WINTER (high/close to river)	30%	23%	0.03	0.30	0.18	0.12	0.27
AVERAGE (low/distant from river)	80%	23%	0.08	0.30	0.18	0.12	0.22
AVERAGE (high/close to river)							



YBC1. Yellow-billed cuckoo detections from 2001 through 2012 on the SPRNCA, Arizona (PBA Figure 4-3). Note that the USGS reaches correspond to the Condition class map displayed in Figure YBC2.

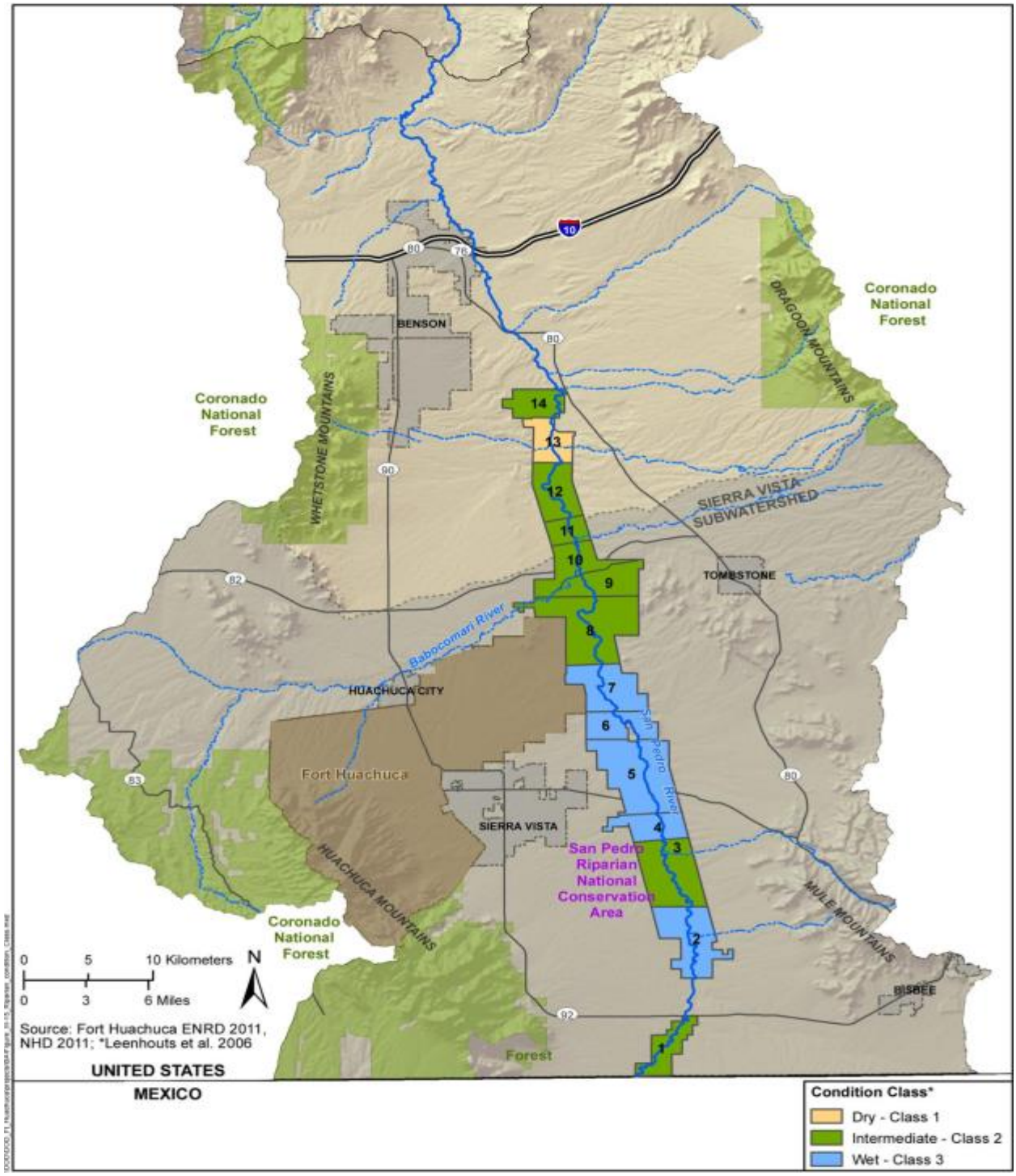


Figure YBC2. Riparian condition classes on the upper San Pedro River, Arizona adapted from Figure 3.15 in the PBA and Leenhouts *et al*. (2006). Note that the numbered reaches also appear in the map of yellow-billed cuckoo detection (Figure YBC1).

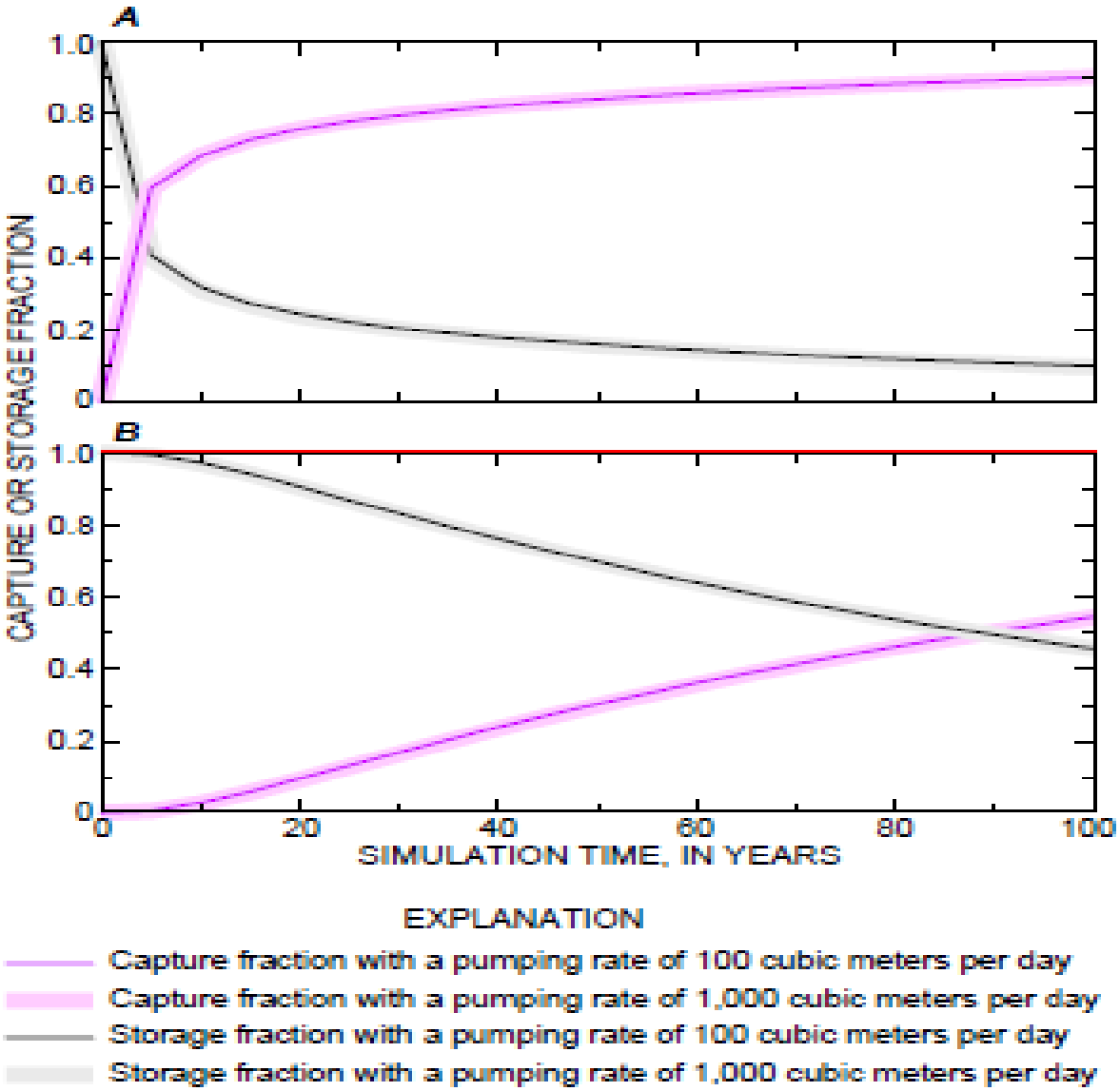


Figure 3. Example capture and storage fraction curves computed by the Upper San Pedro model using discharge rates of 100 and 1,000 cubic meters per day. *A*, curves for a location close to the San Pedro River. *B*, curves for a location distant from the San Pedro River. See figure 1 for locations of curves.

FIGURE YBC3. ILLUSTRATION OF REMOVAL OF GROUNDWATER FROM STORAGE VERSUS CAPTURE OF NATURAL DISCHARGE IN LOCATIONS CLOSER TO AND FARTHER FROM THE SAN PEDRO RIVER, AS APPEARING IN LEAKE *ET AL*. (2008).

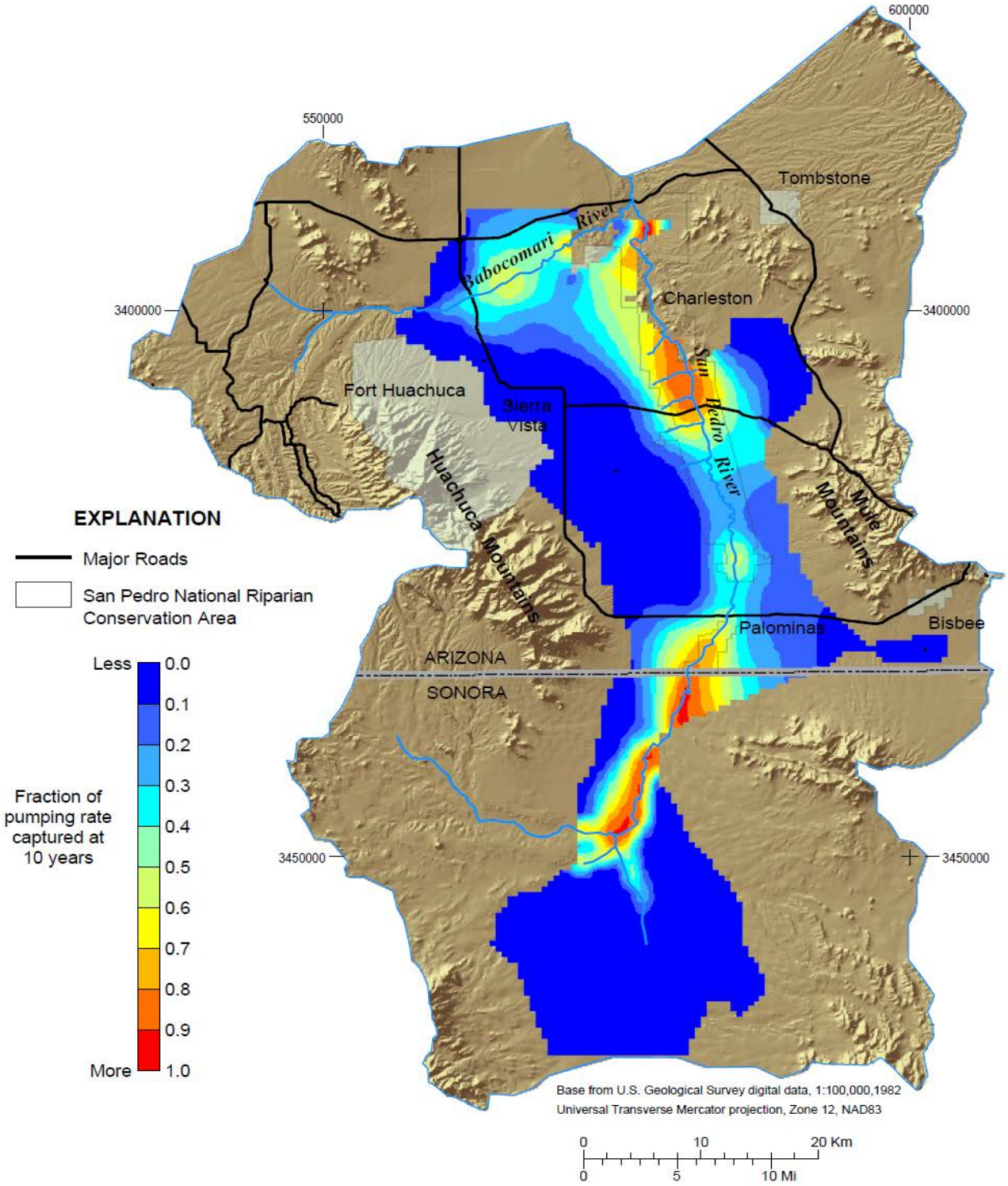


Figure 4A. Computed capture of streamflow, riparian evapotranspiration, and springflow that would result for withdrawal of water from model layer 4 at a constant rate for 10 years. The color at any location represents the fraction of the withdrawal rate by a well at that location that can be accounted for as changes in outflow from and or inflow to the aquifer for model boundaries representing streams, riparian vegetation, and springs.

FIGURE YBC4. CAPTURE FRACTION MAP AT 10 YEARS (LEAKE *ET AL*. 2008).

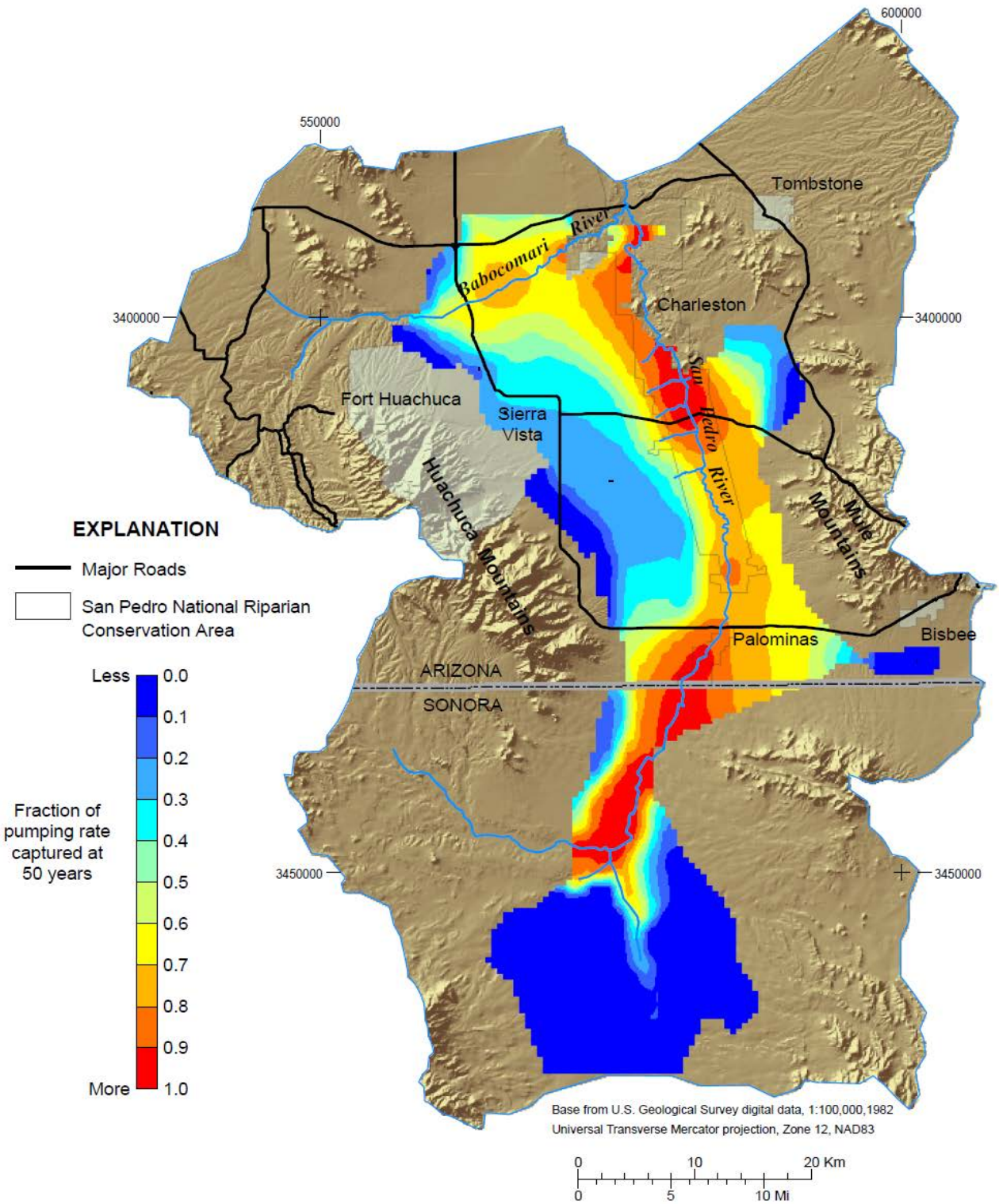


Figure 4*B*. Computed capture of streamflow, riparian evapotranspiration, and springflow that would result for withdrawal of water from model layer 4 at a constant rate for 50 years. The color at any location represents the fraction of the withdrawal rate by a well at that location that can be accounted for as changes in outflow from and or inflow to the aquifer for model boundaries representing streams, riparian vegetation, and springs.

Figure YBC-5. Capture fraction map at 50 years (Leake *et al*. 2008)**.**

CHIRICAHUA LEOPARD FROG

Description, Legal Status, and Recovery Planning

The Chiricahua leopard frog (*Lithobates chiricahuensis*) is distinguished from other members of the *Lithobates pipiens* complex by a combination of characters, including a distinctive pattern on the rear of the thigh consisting of small, raised, cream-colored spots or tubercles on a dark background; dorsolateral folds that are interrupted and deflected medially; stocky body proportions; relatively rough skin on the back and sides; and often green coloration on the head and back (Platz and Mecham 1979). The species also has a distinctive call consisting of a relatively long snore of 1 to 2 seconds (Platz and Mecham 1979, Davidson 1996). Snout-vent lengths of adults range from about 2.1 to 5.4 in (Platz and Mecham 1979, Stebbins 2003).

The Chiricahua leopard frog was listed as a threatened species without critical habitat in 2002 (67 FR 40790). Included was a special rule under Section 4(d) of the Act to exempt operation and maintenance of livestock tanks on non-Federal lands from the section 9 take prohibitions of the Act. The listing covered the entire historical range in the United States and Mexico. A recovery plan for the species was finalized in 2007 (USFWS 2007d). The Ramsey Canyon leopard frog (*Lithobates "subaquavocalis"*), found on the eastern slopes of the Huachuca Mountains, Cochise County, Arizona, has been subsumed into *Lithobates chiricahuensis* (Crother 2008) and recognized by the USFWS as part of the listed entity (USFWS 2009, USFWS 2012c). As a result, reevaluation of the species listing status was needed. A revised final rule was published on March 20, 2012 (77 FR 16324) that listed the species as threatened with critical habitat and included the special rule included in the original listing. Final designation of critical habitat includes 39 areas in Arizona and New Mexico. Loss of natural standing water habitat; predation by non-native fish, bullfrogs, and crayfish; and die offs caused by the fungal skin disease chytridiomycosis have contributed to the current threatened status of the species.

Distribution/Abundance

The range of the Chiricahua leopard frog includes central and southeastern Arizona; west-central and southwestern New Mexico; and, in Mexico, northeastern Sonora, the Sierra Madre Occidental of northwestern and west-central Chihuahua, and possibly as far south as northern Durango (Platz and Mecham 1984, Degenhardt et al. 1996, Lemos-Espinal and Smith 2007, Rorabaugh 2008). The distribution of the species in Mexico is unclear due to limited survey work and the presence of closely related taxa (especially *L. lemosespinali*) in the southern part of the range of the Chiricahua leopard frog.

The species has been extirpated from about 80 percent of its historical localities in Arizona and New Mexico. The species is still extant in the major drainage basins in Arizona and New Mexico where it occurred historically; with the exception of the Little Colorado River drainage in Arizona and possibly the Yaqui drainage in New Mexico. However, it has not been found recently in many rivers within those major drainage basins, valleys, and mountains ranges, including the following in Arizona: White River, West Clear Creek, Tonto Creek, Verde River mainstem, San Francisco River, San Carlos River, upper San Pedro River mainstem, Santa Cruz River mainstem, Aravaipa Creek, Babocomari River mainstem, and Sonoita Creek mainstem. In

many of these regions Chiricahua leopard frog were not found for a decade or more despite repeated surveys. As of 2009, there were 84 sites in Arizona at which Chiricahua leopard frog occur or are likely to occur in the wild, with an additional four captive or partially captive refuge sites. At least 33 of the wild sites support breeding. In New Mexico, 15 to 23 breeding sites were known in 2008; the frogs occur at additional dispersal sites. Nineteen and eight localities are known from Sonora and Chihuahua, respectively. The species' current status in Mexico is poorly understood; however, it has been found in recent years in western Chihuahua. Some threats, such as introduced nonnative predators and the threat of catastrophic wildfire, appear to be less important south of the border, particularly in the mountains where Chiricahua leopard frog have been found (Gingrich 2003, Rosen and Melendez 2006, Rorabaugh 2008).

Habitat

The Chiricahua leopard frog is an inhabitant of montane and river valley cienegas, springs, pools, cattle (stock) tanks, lakes, reservoirs, streams, and rivers. The species requires permanent or semi-permanent pools for breeding and water characterized by low levels of contaminants and moderate pH, and may be excluded or exhibit periodic die-offs where *Batrachochytrium dendrobatidis*, a pathogenic chytridiomycete fungus, is present (see further discussion of this in the threats section below and in USFWS 2011b). The frog is excluded from ephemeral habitats by its requirements for surface moisture for adult survival and a relatively long larval period (minimum of three months). The diet of the Chiricahua leopard frog includes primarily invertebrates such as beetles, true bugs, and flies, but fish and snails are also eaten (Christman and Cummer 2006).

Life History

The life history of the Chiricahua leopard frog can be characterized as a complex life cycle, consisting of eggs and larvae that are entirely aquatic and adults that are primarily aquatic, making the species a habitat specialist (USFWS 2007d). The species has a distinctive call and males can be temporarily territorial (USFWS 2007d). Amplexus is axillary and the male fertilizes the eggs as the female attaches a spherical mass to submerged vegetation. Eggs are laid from February into October, with most masses found in the warmer months (USFWS 2007d). Numbers of eggs in a mass range from 300 to 1,485 (Jennings and Scott 1991) and may be correlated with female body size. The hatching time of egg masses in the wild ranges between 8 to 14 days, depending on water temperature (USFWS 2007d). Upon hatching, tadpoles are mainly herbivorous and remain in the water, where they feed and grow, with growth rates faster in warmer conditions. Tadpoles have a long larval period, from three to nine months, and may overwinter. After metamorphosis, Chiricahua leopard frogs eat an array of invertebrates and small vertebrates and are generally inactive between November and February (USFWS 2007d). Males reach sexual maturity at 2.1 to 2.2 in (5.3-5.6 cm), a size they can attain in less than a year (Sredl and Jennings 2005). Under ideal conditions, Chiricahua leopard frogs may live as long as 10 years in the wild (Platz et al. 1997).

Chiricahua leopard frogs can be active both day and night, but adults tend to be active more at night than juveniles (Sredl and Jennings 2005). Chiricahua leopard frogs presumably experience very high mortality (greater than 90 percent) in the egg and early tadpole stages, high mortality

when the tadpole turns into a juvenile frog, and then relatively low mortality when they are adults (Zug et al. 2001, USFWS 2007d). Adult and juvenile Chiricahua leopard frogs avoid predation by hopping to water (Frost and Bagnara 1977). They also possess an unusual ability among members of the *Rana pipiens* complex; they can also darken their ventral skin under conditions of low reflectance and low temperature (Fernandez and Bagnara 1991, 1993), a trait believed to enhance camouflage and escape predation (USFWS 2007d).

Threats

The primary threats to this species are predation by nonnative organisms and die offs caused by the fungal skin disease chytridiomycosis caused by the skin fungus, Batrachochytrium dendrobatidis. Additional threats include drought, floods, degradation and loss of habitat as a result of water diversions and groundwater pumping, poor livestock management, altered fire regimes due to fire suppression and livestock grazing, mining, development, and other human activities; disruption of metapopulation dynamics, increased chance of extirpation or extinction resulting from small numbers of populations and individuals, and environmental contamination (USFWS 2007d). Loss of Chiricahua leopard frog populations is part of a pattern of global amphibian decline, suggesting other regional or global causes of decline may be important as well (Carey et al. 2001).

The chytridiomycete skin fungus, the organism that causes chytridiomycosis, is responsible for global declines of frogs, toads, and salamanders (Berger et al. 1998, Longcore et al. 1999, Speare and Berger 2000, Hale 2001). Decline or extinction of about 200 amphibian species worldwide has been linked to the disease (Skerratt et al. 2007). In Arizona, Bd infections have been reported from numerous populations of Chiricahua leopard frog in southeastern Arizona and one population on the Tonto National Forest, as well as populations of several other frogs and toads in Arizona (Morell 1999, Davidson et al. 2000, Hale 2001, Bradley et al. 2002, USFWS 2007d). In New Mexico, chytridiomycosis appears to be widespread in populations in west-central New Mexico, where it often leads to population extirpation. Chiricahua leopard frog die-offs from disease typically occur during the cooler months of October to February (USFWS 2007d).

The role of the Bd fungus in the population dynamics of the Chiricahua leopard frog is as yet undefined. Some populations are driven to extirpation soon after the animals become symptomatic; however, other Chiricahua leopard frog populations can exist with the pathogen for years (USFWS 2007d). Even in cases where populations exist with the disease, it is an additional stressor, resulting in periodic die-offs that increase the likelihood of extirpation and extinction. Free-ranging healthy bullfrogs with low-level Bd infections have been found in southern Arizona (Bradley et al. 2002). Tiger salamanders and bullfrogs can carry the disease without exhibiting clinically significant or lethal infections. When these animals move, or are moved by people, among aquatic sites, Bd may be carried with them (Collins et al. 2003, Picco and Collins 2008). Other native or nonnative frogs may serve as disease vectors or reservoirs of infection, as well (Bradley et al. 2002). Bd could also be spread by tourists or biologists sampling aquatic habitats (Halliday 1998). The fungus can exist in water or mud and thus could be spread by wet or muddy boots, vehicles, cattle, fishing gear, and other animals moving among aquatic sites, or during scientific sampling of fish, amphibians, or other aquatic organisms.

Numerous studies indicate that declines and extirpations of Chiricahua leopard frog are at least in part caused by predation and possibly competition by nonnative organisms, including fishes in the family Centrarchidae (*Micropterus* spp., *Lepomis* spp.), bullfrogs, barred tiger salamanders, crayfish (*Orconectes virilis* and possibly others), and several other species of fishes (Clarkson and Rorabaugh 1989, Sredl and Howland 1994, Snyder et al. 1996, Fernandez and Rosen 1998). For instance, in the Chiricahua region of southeastern Arizona, Rosen et al. (1996a) found that almost all perennial waters investigated that lacked introduced predatory vertebrates supported Chiricahua leopard frogs. All waters except three that supported introduced vertebrate predators lacked Chiricahua leopard frogs. Sredl and Howland (1994) noted that Chiricahua leopard frogs were nearly always absent from sites supporting bullfrogs and nonnative predatory fish. Rosen et al. (1996a) suggested further study was needed to evaluate the effects of mosquitofish, trout, and catfish on frog presence.

Disruption of metapopulation dynamics is likely an important factor in regional loss of populations (Sredl and Howland 1994, Sredl et al. 1997). Chiricahua leopard frog populations are often small and habitats are dynamic, resulting in a relatively low probability of long-term population persistence. Historically, populations were more numerous and closer together. If populations became extirpated due to drought, disease, or other causes, these sites could be recolonized via immigration from nearby populations. However, as numbers of populations declined, populations became more isolated and were less likely to be re-colonized if extirpation occurred. Also, most of the larger source populations along major rivers and in cienega complexes have disappeared.

Fire frequency and intensity in Southwestern forests are much altered from historical conditions (Dahms and Geils 1997). Before 1900, surface fires generally occurred at least once per decade in montane forests with a pine component. Beginning about 1870 to 1900, these frequent ground fires ceased to occur due to intensive livestock grazing that removed fine fuels, followed by effective fire suppression in the mid to late 20th century (Swetnam and Baisan 1996). Absence of ground fires allowed a buildup of woody fuels that precipitated infrequent but intense crown fires (Swetnam and Baisan 1996, Danzer et al. 1997). Absence of vegetation and forest litter following intense crown fires exposes soils to surface and rill erosion during storms, often causing high peak flows, sedimentation, and erosion in downstream drainages (DeBano and Neary 1996). These post-fire events have likely resulted in scouring or sedimentation of frog habitats (Wallace 2003).

Wildfires have recently affected Chiricahua leopard frog and its habitat. The first of these fires was the Greaterville Fire. The Greaterville Fire started on May 2, 2011, and may have affected dispersal habitat and designated critical habitat along the eastern bajada of the Santa Rita Mountains. This fire was less severe, comparatively small-sized, and of shorter duration than the following two fires. The second fire, the Wallow Fire, started on May 29, 2011, and became Arizona's largest wildfire in recorded history. The Wallow Fire consumed 538,049 ac of montane conifer forest on the Apache-Sitgreaves National Forest and likely adversely affected habitat and critical habitat on Campbell Blue and Coleman creeks. All five known Chiricahua leopard frog sites on the Alpine Ranger District were within the Wallow Fire boundary. Although wetland vegetation immediately adjacent to these sites was not burned or very patchily burned, several sites had some post-fire inundation of debris and silt from upland burned areas

that experienced low to high soil burn severity (USFWS files). Frogs have not been detected in Coleman Creek since the fire, but the habitat continues to improve (USFWS files). Frogs raised in captivity have been released at several tanks and springs where they had disappeared after the fire. The final fire that affected the species was the Monument Fire, which began on June 12, 2011, four miles east of Hereford, Arizona; ultimately consuming 30,526 ac and significantly affecting a portion of the Huachuca Mountains, including Miller Canyon and the Beatty Guest Ranch. Subsequent monsoon precipitation in the region liberated significant amounts of top soil and sediment which scoured the canyon bottom and filled-in the majority of ponds and suitable habitat for the frog in lower Miller Canyon on the Ranch. Waters at the Beatty's Guest Ranch supported one of the most robust and dense populations of Chiricahua leopard frogs. The remaining population at the Ranch represents a small fraction of its former number.

An understanding of the dispersal abilities of Chiricahua leopard frogs is the key to determining the likelihood that suitable habitats will recolonize from a nearby extant population of frogs. As a group, leopard frogs are surprisingly good at dispersal. Dispersal of leopard frogs away from water in the arid Southwest may occur less commonly than in mesic environments; however, there is evidence of substantial movements even in Arizona and movements away from water do not appear to be random. Movement may occur via locomotion of frogs or passive movement of tadpoles along stream courses. Streams are important dispersal corridors for young northern leopard frogs (Seburn et al. 1997). Displaced northern leopard frogs will home, and apparently use olfactory and auditory cues, and possibly celestial orientation, as guides (Dole 1968, 1972). Rainfall or humidity may be an important factor in dispersal because odors carry well in moist air, making it easier for frogs to find other wetland sites (Sinsch 1991).

The maximum distance moved by a radio-telemetered Chiricahua leopard frog in New Mexico was 2.2 mi in one direction (R. Jennings and C. Painter, 2004, pers. comm.). In 1974, Frost and Bagnara (1977) noted passive or active movement of Chiricahua and Plains (*L. blairi*) leopard frogs for five miles or more along East Turkey Creek in the Chiricahua Mountains. In August, 1996, Rosen and Schwalbe (1998) found up to 25 young adult and subadult Chiricahua leopard frog at a roadside puddle in the San Bernardino Valley, Arizona. They believed that the only possible origin of these frogs was a stock tank 3.4 mi away. Rosen et al. (1996a) found small numbers of Chiricahua leopard frog at two locations in Arizona that supported large populations of nonnative predators. The authors suggested these frogs could not have originated at these locations because successful reproduction would have been precluded by predation. They found that the likely source of these animals were populations 1.2 to 4.3 mi distant. In September 2009, 15 to 20 Chiricahua leopard frog were found at Peña Blanca Lake west of Nogales. The nearest likely source population is Summit Tank, a straight line distance of 3.1 mi overland and approximately 4.1 mi along intermittent drainages. Based on these studies, the recovery plan for the Chiricahua leopard frog (USFWS 2007d) provides a general rule on dispersal capabilities. Chiricahua leopard frogs are assumed to be able to disperse one mile overland, three miles along ephemeral drainages, and five miles along perennial water courses.

Critical Habitat

The 2012 critical habitat rule for the Chiricahua leopard frog designated 39 critical habitat units (approximately 10,346 acres [4,187 ha]) in the eight RUs within the range of the species in

Arizona and New Mexico (USFWS 2012c). Critical habitat does not occur on Fort Huachuca, but occurs nearby at Scotia Canyon, Brown Canyon, Ramsey Canyon, and Carr Barn Pond. The purpose of the designation of critical habitat is to conserve the physical or biological features that are essential to the conservation of the species and which may require special management consideration or protection. Based on our current knowledge of the physical or biological features and habitat characteristics required to sustain the species' life-history processes, we determined that the primary constituent elements (PCEs) specific to the Chiricahua leopard frog are:

1. Aquatic breeding habitat and immediately adjacent uplands exhibiting the following characteristics:
   a. Standing bodies of fresh water (with salinities less than 5 parts per thousand, pH greater than or equal to 5.6, and pollutants absent or minimally present), including natural and manmade (e.g., stock) ponds, slow-moving streams or pools within streams, off-channel pools, and other ephemeral or permanent water bodies that typically hold water or rarely dry for more than a month. During periods of drought, or less than average rainfall, these breeding sites may not hold water long enough for individuals to complete metamorphosis, but they would still be considered essential breeding habitat in non-drought years.
   b. Emergent and or submerged vegetation, root masses, undercut banks, fractured rock substrates, or some combination thereof, but emergent vegetation does not completely cover the surface of water bodies.
   c. Nonnative predators (e.g., crayfish (Orconectes virilis), American bullfrogs (Lithobates catesbeiana), nonnative predatory fishes) absent or occurring at levels that do not preclude presence of the Chiricahua leopard frog.
   d. Absence of chytridiomycosis, or if present, then environmental, physiological, and genetic conditions are such that allow persistence of Chiricahua leopard frogs.
   e. Upland areas that provide opportunities for foraging and basking that are immediately adjacent to or surrounding breeding aquatic and riparian habitat.

2. Dispersal and non-breeding habitat, consisting of areas with ephemeral (present for only a short time), intermittent, or perennial water that are generally not suitable for breeding, and associated upland or riparian habitat that provides corridors (overland movement or along wetted drainages) for frogs among breeding sites in a metapopulation with the following characteristics:
   a. Are not more than 1.0 mile (1.6 kilometers) overland, 3.0 miles (4.8 kilometers) along ephemeral or intermittent drainages, 5.0 miles (8.0 kilometers) along perennial drainages, or some combination thereof not to exceed 5.0 miles (8.0 kilometers).
   b. In overland and non-wetted corridors, provides some vegetation cover or structural features (e.g., boulders, rocks, organic debris such as downed trees or logs, small mammal burrows, or leaf litter) for shelter, forage, and protection from predators; in wetted corridors, provides some ephemeral, intermittent, or perennial aquatic habitat.
   c. Are free of barriers that block movement by Chiricahua leopard frogs, including, but not limited to, urban, industrial, or agricultural development; reservoirs that are 50 acres (20 hectares) or more in size and contain predatory nonnative fishes, bullfrogs, or crayfish; highways that do not include frog fencing and culverts; and walls, major dams, or other structures that physically block movement.

With the exception of impoundments, livestock tanks, and other constructed waters, critical habitat does not include manmade structures (such as buildings, aqueducts, runways, roads, and other paved areas) and the land on which they are located existing within the legal boundaries.

All areas designated as critical habitat will require some level of management to address the current and future threats to the Chiricahua leopard frog and to maintain or restore the PCEs. Special management in aquatic breeding sites will be needed to ensure that these sites provide water quantity, quality, and permanence or near permanence; cover; and absence of extraordinary predation and disease that can affect population persistence. In dispersal habitat, special management will be needed to ensure frogs can move through those sites with reasonable success.

Activities that may destroy or adversely modify critical habitat include those that alter the primary constituent elements to the extent that the value of critical habitat for both the survival and recovery of Chiricahua leopard frogs is appreciably diminished. Such activities are also likely to jeopardize the continued existence of the species.

Recovery Planning

Since before the species was listed, state, Federal, and private partners have been engaged in conservation and recovery work for the Chiricahua leopard frog. The first population reestablishments occurred in 1995 in Ramsey Canyon in southeastern Arizona, and in 2011 the 10,000th Chiricahua leopard frog produced by the Phoenix Zoo was released into recovery unit 5. Since population reestablishments have begun, the frog has been reestablished at 30 sites, of which frogs are still persisting at 23 (USFWS 2011b). Refuges have been established at 15 sites, and frogs are still present at 11 of these (USFWS 2011b). Furthermore, many existing populations have been augmented with headstarted tadpoles or metamorphic frogs, and in some cases wild-to-wild translocations of egg masses. Non-native predator control in the Altar Valley and in the Peña Blanca regions of recovery unit 1 have allowed Chiricahua leopard frogs to recolonize, on their own, 13 or more sites (USFWS 2011b). Elimination of bullfrogs and other non-native species have allowed persistence at a number of other sites. Habitat has been created or enhanced at numerous sites in all recovery units. These efforts have been most prevalent in Arizona, where the AGFD has had two or more employees dedicated to ranid frog conservation since before the species was listed, and numerous public and private partners exist.

A recovery plan has been completed (USFWS 2007d), the goal of which is to improve the status of the species to the point that it no longer needs the protection of the Endangered Species Act. The recovery strategy calls for reducing threats to existing populations; maintaining, restoring, and creating habitat that will be managed in the long term; translocation of frogs to establish, reestablish, or augment populations; building support for the recovery effort through outreach and education; monitoring; conducting research needed to provide effective conservation and recovery; and application of research and monitoring through adaptive management. Recovery actions are recommended in each of eight recovery units throughout the range of the species. Geographic “management areas” are also identified within recovery units where the potential for successful recovery actions is greatest. Each management area has one or more local recovery groups made up of landowners and other interested parties that work on recovery actions for the

species. There are also three safe harbor agreements that are contributing to recovery of the species: Safe Harbor Agreement for the Chiricahua leopard frog in the Malpai Borderlands of Arizona and New Mexico and the U.S. Fish and Wildlife Service (Malpai Borderlands Group 2004), Safe Harbor Agreement for the Chiricahua Leopard Frog in Arizona (AGFD and USFWS 2006), and Leslie Canyon Watershed (Bar Boot Ranch/99 Bar Ranch) Safe Harbor Agreement (USFWS 2008b).

Many activities that might affect the frog or its habitat are also subject to Section 7 consultation. Section 7 consultations on Chiricahua leopard frog include programmatic efforts for Forest Land Management Plans that address watershed management and multiple uses (livestock grazing, watershed management, water quality, and other issues), for conservation activities covered under the Safe Harbor Agreements, and more site-specific efforts that are more focused on implementing recovery actions. To address habitat threats to the frog, the Southwest Endangered Species Act Team (2008) published "Chiricahua leopard frog (*Lithobates* [*Rana*] *chiricahuensis*) considerations for making effects determinations and recommendations for reducing and avoiding adverse effects." This document includes detailed descriptions of how fire management, construction, native fish recovery, and livestock management projects may affect the frog and its habitat. This document has been used extensively in conducting Section 7 consultation for the species. Biological opinions on actions potentially affecting frogs may be found at our website www.fws.gov/southwest/es/arizona in the Section 7 Biological Opinion page of the Document Library.

Data and recent recovery efforts suggest the status of the Chiricahua leopard frog is at least stable and improving in Arizona, starting to improve in New Mexico, and unknown in Mexico. In pooled data for the U.S., a worst case analysis shows essentially no change in the number of occupied sites from 2002 to 2009 (133 versus 131, respectively); however, this likely underestimates the status of the species in Arizona, overestimates the status of the species in New Mexico, and includes data that are not standardized to be truly comparable (USFWS 2012c). The actual situation is probably that the status of the species is stable in the U.S overall, but the different conditions between Arizona and New Mexico indicate that improvement is occurring only in Arizona at this time, while in New Mexico, frog numbers continue to decline (USFWS 2012c). Continued and new aggressive recovery actions are needed to address threats to the species rangewide, to maintain positive trends in Arizona, to stabilize population losses in New Mexico, and to assist partners in Mexico with their conservation efforts. If on-going recovery actions are interrupted, drought worsens, or other threats intensify, the status of the species across its range could easily deteriorate.

Environmental Baseline – Chiricahua leopard frog

The environmental baseline includes past and present impacts of all Federal, State, or private actions in the action area, the anticipated impacts of all proposed Federal actions in the action area that have undergone formal or early section 7 consultation, and the impact of State and private actions that are contemporaneous with the consultation process. The environmental baseline defines the current status of the species and its habitat in the action area to provide a platform to assess the effects of the action now under consultation. Also refer to the General Environmental Baseline and Action Area earlier in this biological and conference opinion.

Description of the Action Area

The action area for the proposed action, in which Chiricahua leopard frog will be directly or indirectly affected, includes lands within Fort Huachuca that may provide habitat for the species during the period of the proposed action: Tinker Canyon in training areas Uniform and Yankee and Garden Canyon in training areas Quebec and Uniform, both on the South Range. The action area also includes frog populations and habitat off-post that could be affected by the proposed action, including Brown, Carr, Miller, Ramsey, and Scotia canyons in the Huachuca Mountains. Most of the action area for the frog falls within the Huachuca Mountains Management Area of the Upper San Pedro-Santa Cruz Recovery Unit for the Chiricahua leopard frog, as identified in the species recovery plan (USFWS 2007d). San Pedro RNCA is also included in the action area and most of it falls within the San Pedro-Santa Cruz Recovery Unit for the frog; however, San Pedro RNCA is not included in a management area for the species.

Status of the Species within the Action Area

Huachuca Mountains Management Area

Unconfirmed Chiricahua leopard frog historical records for the Huachuca Mountains include Ash, Bear, Carr, Copper, Garden, Hunter, Miller, Montezuma, Parker, Scotia, and Sunnyside canyons (AGFD 2007). There are no recent records from these sites except for Scotia Canyon (USFWS 2012c). Due to intensive conservation actions and translocation efforts, the frog has recently been extant in Brown, Carr, Garden, Miller, Ramsey, and Tinker canyons on the east side of the Huachuca Mountains (Goldberg et al. 2004) and Scotia Canyon on the west side of the Huachuca Mountains (USFWS 2012c). These sites included Tinker Pond in Tinker Canyon and Lower Garden Canyon Pond in Garden Canyon on Fort Huachuca. Frogs were discovered at Tinker Pond in 1994, but the species has not been observed at Tinker Pond since the pond dried in the early 2000s (USFWS files). In addition, dead frogs found in Tinker Pond tested positive for chytrid fungus in 1996. Frogs were introduced into Lower Garden Canyon Pond in 1996, but the following year only bullfrogs were detected in the pond (USFWS files). Upper Garden Canyon Pond does not hold water well and dries frequently. Currently, Chiricahua leopard frogs are extant only outside Fort Huachuca in Miller, Brown, Ramsey, and Scotia Canyons in the action area. It is conceivable that during the period of the proposed action, frogs could disperse to Fort Huachuca from currently occupied sites off post. For example, frogs in Ramsey Canyon could disperse to Tinker Canyon and frogs in Scotia Canyon could disperse to Garden Canyon.

Ramsey, Brown and Miller canyons are currently managed as a metapopulation for the Chiricahua leopard frog. Lands owned by The Nature Conservancy in Ramsey Canyon are known as the Ramsey Canyon Preserve and are managed for preservation of natural features and species, including the Chiricahua leopard frog. Lands owned by the Beatty family in Miller Canyon, known as the Beatty's Guest Ranch, are also managed for the Chiricahua leopard frog. The Ramsey Canyon Preserve and Beatty's Guest Ranch are both enrolled in AGFD's Statewide Safe Harbor Agreement. Frogs have bred in Ramsey Canyon, and Trout and Meadow Ponds on private lands owned by The Nature Conservancy. In Brown Canyon, frogs have bred in Wild Duck Pond, House Pond, and the Brown Canyon Box. Chytridiomycosis has significantly

reduced populations in both canyons. The House and Wild Duck Ponds, as well as Ramsey Canyon, have a history of chytridiomycosis outbreaks. The Ramsey Canyon population has been eliminated twice and then reestablished; the House and Wild Duck Ponds have also undergone repeated disease-related declines and extirpations followed by reestablishments. The populations tend to persist for months or years after reestablishment only to experience chytridiomycosis outbreaks followed by declines or extirpation. Nonnative species, drying, sedimentation, and fire also threaten the frog in this area. Nonnative predators threaten populations at the House and Wild Duck Ponds, where bullfrogs have been found periodically and goldfish (*Carassius auratus*) were once introduced. Those two ponds are buffered against drought and drying by a pipeline from a spring and a windmill. However, Brown Canyon Box is subject to low water and drying during drought. That latter population depends upon immigration or active reestablishment for long-term persistence. The Trout and Meadow Ponds in Ramsey Canyon are fed by pipelines; thus the water supply is dependable. The Trout Pond could be filled in with sediment during a flood. Further, a fire in the watershed could threaten aquatic breeding sites in Ramsey and Brown canyons, as it already has in Miller Canyon. As described in the Status of the Species, habitat at the Beatty's Guest Ranch in Miller Canyon supported one of the most robust and dense populations of Chiricahua leopard frogs. Frogs and their habitat in Miller Canyon were significantly diminished by the Monument Fire in 2012, and the remaining population at the Beatty's Guest Ranch represents a small fraction of its former number.

Chiricahua leopard frogs were reestablished in Scotia Canyon via a translocation in 2009; the last previous record of a Chiricahua leopard frog in the canyon before that was 1986 (USFWS 2012c). Breeding habitat occurs at Peterson Ranch Pond and possibly at other perennial or nearly perennial pools. Currently, this site is isolated from other populations. Hence this site is managed as such, but there is some potential for creating connectivity to the metapopulation in Ramsey and Brown Canyons via population reestablishment in Garden Canyon at Fort Huachuca. The pond and stream habitats of Scotia Canyon have the potential to host a robust population of frogs. Scotia Canyon and surrounding aquatic sites have been subject to intensive bullfrog eradication and habitat enhancement work before reestablishment of Chiricahua leopard frogs. However, bullfrog reinvasion is a significant, continuing threat, and other nonnative predators could potentially reach Scotia Canyon via natural or human-assisted releases, including from the Fort. In addition, tiger salamanders from Peterson Ranch Pond tested positive for chytridiomycosis in 2009; however, in 2010, the Chiricahua leopard frogs appeared to be persisting in that same pond. Nonetheless, disease is considered a serious threat in Scotia Canyon as elsewhere in the Huachuca Mountains. Further, heavy fuel loads could result in a catastrophic wildfire, which would have significant detrimental effects on the frog and its aquatic habitats as fire had in Miller Canyon. Finally, a road through the canyon is eroded in places and contributes sediment to the stream; it receives much use by recreationists and U.S. Customs and Border Protection.

Before subsuming the Ramsey Canyon leopard frog into the Chiricahua leopard frog species designation, frogs within the Huachuca Mountains Management Area were managed under a formal conservation agreement, Ramsey Canyon Leopard Frog Conservation Agreement and Conservation Assessment and Strategy consistent with the goals and recovery actions described in the Chiricahua leopard frog recovery plan (USFWS 2007d). The aforementioned Beatty Guest Ranch, The Nature Conservancy and several other private landowners participated in this

conservation agreement and currently manage for conservation of the frog as signatories to the state-wide safe harbor agreement for the Chiricahua leopard frog (AGFD and USFWS 2006). These landowners, along with Fort Huachuca, Bureau of Land Management, and Sierra Vista Ranger District of the Coronado National Forest, participate in a Chiricahua leopard frog local recovery group for the Huachuca Mountains Management Area.

There are two critical habitat units for the species in the action area within the Huachuca Mountains MA. The first, Scotia Canyon Unit, is entirely on Federal lands in the Coronado National Forest in Cochise County, including an 1.36-mi (2.19-km) reach of the canyon with perennial pools, as well as a perennial travertine (a form of limestone) seep; a spring-fed, perennial impoundment (Peterson Ranch Pond); and an ephemeral impoundment adjacent to Peterson Ranch Pond. There is also a perennial or nearly perennial impoundment in the channel downstream of the travertine seep. This unit is currently managed for an isolated robust population. This critical habitat unit largely overlaps that of critical habitat for the endangered *Lilaeopsis schaffneriana* var. *recurva* (Huachuca water-umbel). The second critical habitat unit in the action area is Ramsey and Brown Canyons Unit. This unit is also in Cochise County and includes 44 ac (18 ha) of private lands in Ramsey Canyon and 58 ac (24 ha) of Federal lands in the Coronado National Forest in Brown and Ramsey Canyons, including Wild Duck Pond, House Pond, and the Brown Canyon Box. In addition, this critical habitat unit also includes dispersal sites and corridors for connectivity among breeding ponds as follows: (1) From the eastern boundary of The Nature Conservancy's Bledsoe Parcel in the Ramsey Canyon Preserve downstream to a dirt road crossing of Ramsey Canyon at the mouth of the canyon, excluding The Nature Conservancy's University of Toronto Parcel in the Ramsey Canyon Preserve; (2) Brown Canyon from the Box downstream to the Wild Duck Pond and House Pond on the former Barchas Ranch; and (3) from the dirt road crossing of Ramsey Canyon directly overland to House Pond. This unit is currently managed as a metapopulation. Both units currently have PCEs 1 and 2.

San Pedro RNCA

Currently, frogs are not extant in the San Pedro RNCA. The BLM Tucson Field Office, in coordination with the USFWS and AGFD, has plans to reestablish Chiricahua leopard frogs to a maximum of six sites in SPRNCA (USFWS 2008a). Potential reestablishment sites for the frog include Little Joe Spring, Frog Spring, Ben Spring, Murray Spring, Horse Thief Draw Spring, and White House Well Wetland (USFWS 2008a). If successfully established over the long term, these sites may contribute to the recovery of the species.

Factors Affecting Species Environment within the Action Area

The Description of the Proposed Action section, above, described the full range of activities conducted by Fort Huachuca. The elements of the proposed action that may affect Chiricahua leopard frogs and critical habitat include ground based operations, recreational activities, nonnative aquatic species, and natural resource management. The proposed action also includes a series of species-specific conservation measures intended to avoid and minimize the adverse effects of the proposed action and are listed below. Additional conservation measures that

minimize effects to the frog and critical habitat are included in Appendix A and Appendix N of the PBA and are included in the discussion that follows.

CLF-1: The Fort will manage Chiricahua leopard frog habitat on-post that has been degraded or lost, or where potential exists for creating habitat. The Fort does not plan on creating habitat. Implementation of this conservation measure may allow for resurgence of Chiricahua leopard frog recovery implementation on Fort Huachuca;

CLF-2: An inventory of potential habitat on the Fort will be conducted once every 10 years or once during the consultation period. Implementation of this conservation measure will ensure that changes to the status of the species are detected, thus permitting a management response (if the change is negative); and

CLF-3: Erosion control measures will be implemented as required to protect habitat. This conservation measure will minimize the adverse effects of human activities and related erosion within Chiricahua leopard frog habitat

Effects of Military Ground Based Operations

Ground based operations proposed by Fort Huachuca that could adversely affect future populations of Chiricahua leopard frogs and their habitat in Garden and Tinker canyons include land navigation, field training exercises, patrolling and tactics training, and rappelling training. One of the two land navigation courses on Fort Huachuca is near Tinker Canyon in training area Uniform, which could be occupied by the frog during the period of the proposed action. According to the PBA, training is conducted during day and night, and this course was utilized for 48 days in 2011. Similar additional land navigation training is also conducted on post across the West and South Ranges at unspecified locations. Patrolling and tactics training that simulates patrol, search and rescue, and intelligence gathering missions occurs across the South and West Ranges, and could adversely affect potential frog populations and their habitat. Exercises generally lasting up to three days and are conducted during day and night potentially every month of the year. Field training exercises that include bivouacs will not occur in training area Quebec, but they are possible in training areas Uniform and Yankee which includes parts of both Garden and Tinker Canyons. Vehicles maneuvering on existing roads during patrolling and tactics and field training could potentially hit dispersing frogs, especially during the monsoon when frogs are more likely to be dispersing. However, vehicle use near Upper Garden Canyon pond and all occupied habitat of the Huachuca water umbel throughout Garden Canyon is restricted to existing roads, minimizing any potential for direct impact to Chiricahua leopard frogs that also might inhabit these areas. Soldiers travelling on trails or cross-country on foot during land navigation or patrolling and tactics training exercises could potentially trample frogs. All of these training activities will likely cause some level of erosion which has the potential for causing sedimentation in frog habitat downstream. Fort Huachuca will implement erosion control measures as required to protect habitat for the Chiricahua leopard frog which will decrease the likelihood for sedimentation. Also, rappelling training occurs on the cliffs in Garden Canyon. It is possible, but highly unlikely, that future frogs could be trampled by soldiers if rappels end in frog habitat near the bottom of the canyon. The Fort has also placed

large boulders around Upper Garden Canyon Pond to exclude vehicles from potential frog habitat in and surrounding the pond.

Effects of Recreational Activities

Some recreational activities made available to soldiers, their families, and to the public may adversely affect the Chiricahua leopard frog and its habitat. There are three picnic areas at upper, middle, and lower Garden Canyon accessible by vehicle that are primarily used by Fort Huachuca personnel. Boulders placed around Upper Garden Canyon Pond limit vehicle access to this potential frog habitat and the Fort has closed Gate 7 which prevents vehicular access between upper Garden Canyon watershed and Scotia Canyon. Hiking may occur in Garden Canyon and Tinker Canyon on Fort Huachuca with on-post trails providing access to Ramsey, Brown, and Scotia canyons off-post, although hiking trails on Fort Huachuca receive less use than picnic areas by recreationists. Recreationists could potentially serve as a vector for Bd between aquatic habitats; however this is not likely. There is potential for recreationists near aquatic sites on post to introduce nonnative predators such as centrarchid fishes, bullfrogs, barred tiger salamanders, and crayfish into potential frog habitat. Release of barred tiger salamanders and nonnative fishes into potential frog habitat on Fort Huachuca has likely occurred in the past (Storfer et al. 1999). Future release of these species into aquatic habitat occupied by frogs would harm the species through predation, as well as serve as a vector for Bd (Collins et al. 2003, Picco and Collins 2008). Released bullfrogs into Gardner or Tinker canyons could also move to any other aquatic site within seven miles, which includes all sites currently occupied by Chiricahua leopard frogs and critical habitat in the action area. Effects to the frog from fire are described in the following section.

Effects of Natural Resource Management Program

The primary goal of the natural resources management program for Fort Huachuca is to protect naturally-evolved biotic communities and landscapes to support military land-based training. As part of this program, Fort Huachuca has developed environmental and natural resource specific planning documents, including the Integrated Natural Resources Management Plan and Integrated Wildland Fire Management Plan, the effects of which are discussed below. The Fort's natural resource management programs benefit the Chiricahua leopard frog by maintaining healthy ecosystems and managing for wildlife conservation; specific aspects of these programs, however, may adversely affect frogs and their habitat.

Integrated Natural Resources Management Plan (INRMP)

The Fort Huachuca INRMP, updated in March 2010 (Vernadero Group 2010b), is a plan of action for the management of natural resources and military training and operational activities occurring among those resources. The purpose of the INRMP is to guide the implementation and integration of natural resources management on Fort Huachuca including special-status species, terrestrial and aquatic wildlife, migratory birds, airport wildlife and bird-aircraft strike hazard, groundwater resources, floodplain and wetlands, vegetation, land and forest, wildland fire, invasive species, pests, and outdoor recreation. Although specific aspects of the Fort's INRMP (e.g., recreational activities, which are discussed above) may adversely affect Chiricahua leopard

frogs and their habitat, overall the plan benefits the frog by passively managing for the conservation of the species habitat.

Fuels Management/Integrated Wildland Fire Management Plan (IWFMP)

Fort Huachuca is participating with other federal agencies in the FireScape program (USDA FS 2009a), which provides for fuels management in the Huachuca Mountains. Fort Huachuca's Integrated Wildfire Management Plan (Gebow and Hessil 2006) provides a planning framework for reducing the risk of fire and fire suppression effects on listed species. The risk of a fire originating in lower-elevation training areas reaching forested habitat in the upper elevations is reduced to some extent by fuel management activities in lowland habitats and to a network of fire breaks that the Fort has established along ridgelines. The FireScape consultation is not current, however, so this BO will include an analysis of the effects of Fort Huachuca's fire and fuel treatment activities.

Fuels management, prescribed fire, managed natural fire, and wildland firefighting activities have the potential to affect Chiricahua leopard frog and critical habitat. According to the PBA, fuels management on the Fort is ongoing and employs a variety of hand methods, combined with prescribed burning. In the long term, fire management on Fort would provide a long term net conservation benefit to the species by reducing the risk of catastrophic wildfire. Recent studies have shown that fuel treatments, especially those that combine reduction of both surface and crown fuels by treatments such as thinning followed by prescribed burning or other means of removing slash, can alter fire behavior and lower the risk of severe fires (Finney 2001, Graham 2003). The Fort Huachuca IFWMP states that prescribed fire can be used to reduce fuel levels in both Garden and Tinker canyons. Goals for the moderate-gradient alluvial valleys with narrow riparian zones HAPF ecological mapping unit (EMU) in lower Garden Canyon and Tinker Canyon include restoring and maintain historical vegetation to improve watershed condition and function. Goals for the mixed broadleaf riparian forest EMU in the steep, narrow canyon such as that found in Garden Canyon include maintaining overstory trees, thinning understory with low-intensity (backing) fire or non-fire treatments, and minimizing fire effects from erosion and sedimentation. The riparian corridor may act as a barrier to fire because this zone is often cooler and has higher fuel moistures than the surrounding vegetation, effectively slowing a fire. However, there are no studies of fuel loads in these zones, and there is potential for fuel loads to be greater than the surrounding area. Riparian areas are treated separately from the surrounding landscape, which means they are usually not treated, and this may result in a build-up of hazardous fuels. Fires ignited by ordnance, recreational users, or vehicles also have the potential to affect future frogs and their habitat and will be managed by Fort Huachuca as wildland fire use or with fire suppression. According to the IWFMP, Fort Huachuca will manage wildland fire use and suppression in ways that minimize unnecessary impacts to resources and convey the importance of this strategy to all fire management forces. However, wildland fire use and fire suppression are not included in the proposed action. Although the frog was not addressed in the IFWMP, conservation measures specific to effects of fire on the Chiricahua frog are included in Appendix N of the PBA, and conservation measures for other species will also benefit the frog and its habitat are included in the IFWMP. The IFWMP will be updated by 2016 to address effects to this species. As stated above, there are currently no extant sites on Fort Huachuca. In

fire management sites with habitat for the frog, Fort Huachuca will consider unsurveyed sites occupied unless surveyed before project implementation.

Wildland fires, whether controlled or uncontrolled, have effects on frog populations that are poorly known and are dependent on local conditions (Abbott 1998). If potential habitat on Fort Huachuca is occupied by Chiricahua leopard frogs during fire management activities, prescribed fire in these areas could potentially result in direct death or injury of frogs, and temporarily reduced habitat quality or quantity. Immediate direct effects of fire management activities to the frog may include mortality or injury from heat along the shoreline, infusion of the toxic component of smoke into the water, and local depletion of oxygen. Immediate effects of fire management activities can occur to frogs if they are dispersing through grassland vegetation communities or fire escapes into occupied riparian or wetland communities. The likelihood of these effects is not high, as the frogs disperse primarily during humid or wet periods when fires are not likely to spread or escape. Indirect effects of prescribed fire are anticipated through increased sediment and ash flow into occupied waters and critical habitat from project related activities that occur upstream of occupied sites. Fire removes vegetation and consumes organic components of ground cover, thus changing the physical and chemical properties of watersheds and the streams, wetlands, and aquatic habitats to which they contribute. The removal of vegetation can trigger an increase in water yield and storm-flows (Swanston 1991). Elevated peak flows and velocities are associated with increased transport of ash and nutrients (Ffolliott et al. 2004). Heavy ash and soot in water clogs tadpole gills and leads to acute and chronic chemical effects. The runoff of ash contributes phosphoric nutrients to aquatic ecosystems, and the presence of charcoal in water reduces dissolved oxygen concentrations. Both ammonia and phosphorus levels have been documented to be above lethal limits to fish during fires (Spencer and Hauer 1991). Similar effects are anticipated for frog tadpoles and eggs. In addition, inflow of ash and sediment into a water body is capable of smothering eggs and tadpoles, resulting in the loss of individuals and reproductive potential. Sediment and ash flow can also inhibit respiration in macroinvertebrates, resulting in reduced density and composition of macroinvertebrates (a primary food resource for the frogs). A reduction in the amount of prey can ultimately affect frog numbers and reproduction. The conservation measures that are included in this action will minimize these potential indirect effects. The effects of ash and sediment flows are temporary. Aquatic habitats including critical habitat should be habitable after the ash and sediment settles and the aquatic community of invertebrates and plants become reestablished. The Chiricahua leopard frog has a very high reproductive potential and can repopulate sites fairly quickly once the aquatic habitat becomes hospitable if frogs are extent in nearby sites within the frog's dispersal distance.

Appendix N of the PBA includes a conservation measure (RAW-8) that states use of fire retardants or chemical foams in riparian habitats or within 300 ft of aquatic habitats would be avoided; particularly sites occupied by federally listed species. Water is also sometimes extracted from ponds or lakes and used for fire control activities. Such water transfer could result in spread of disease or non-native species. Appendix N of the PBA includes a conservation measure (WFP-18) that mandates no water will be drafted for fire (prescribed fire) control activities from bodies of water known to be occupied by the frog and that no waters would be transferred between sources.

A network of firebreaks has been constructed on ridgelines, canyons, and slopes on Fort Huachuca to reduce risk of catastrophic fire. Construction and maintenance of roads, trails, and firebreaks can negatively affect leopard frog habitats by increasing runoff, erosion, and siltation. However, roads and firebreaks can reduce the incidence or extent of wildfire and protect against ash flow and sedimentation of frog habitats. Establishment of fire crew camps, equipment staging areas, and landing strips; use of off-road vehicles, particularly tracked vehicles; and creation of fire lines during prescribed fire could all result in direct mortality of terrestrial Chiricahua leopard frogs. Frogs could be killed if active on the surface or they could be harmed if habitat was degraded. Conservation Measure WFP-19 included in Appendix N of the PBA, which limits project-related activities within 1,650 ft of occupied stock tanks, would limit take of frogs if they inhabit upper Garden Canyon Pond, Tinker Pond, or other ponds within the action area. Conservation measure RAW-7 (crossings for motorized vehicles across a perennial stream would not be permitted, unless an established road already exists or where dry, intermittent sections occur) and RAW-9 (placement of prescribed fire support sites [e.g., camps, staging areas and, refueling sites] would be outside riparian areas or river/stream corridors) would also limit incidental mortality of frogs.

If potential populations of frogs in Garden and Tinker canyons or existing populations in Scotia, Brown, Ramsey, and Miller canyons are eliminated due to effects from disease, ash flow, increased turbidity, but the habitat remains suitable (i.e., habitat is not silted in or erodes away, and fish are not introduced), habitats are likely to be recolonized by dispersing frogs from nearby occupied sites. As a result, effects of the action that result in destruction of breeding sites or introduction of nonnative predators are much more serious to the viability of the species than death or injury of individuals.

Effects of groundwater use to the San Pedro RNCA

Potential Chiricahua leopard frog populations at five springs and one wetland on the San Pedro RNCA would be affected indirectly by the pumping of groundwater from the regional aquifer. To the extent that groundwater withdrawals by Fort Huachuca reduce the contribution of regional groundwater baseflow, surface flows including those at springs and wetlands would also be affected. The groundwater modeling presented in the PBA, which represents the best available information, indicates that it is unlikely that there will be a Fort-attributable decrease in the regional groundwater component of baseflow in the mainstem of the San Pedro River beginning in 2014 and continuing through the end of the modeling period in 2030. Therefore, it would appear to be unlikely that there will be measurable adverse effects to Chiricahua leopard frogs and habitat on San Pedro RNCA that may potentially be occupied by frogs during the period of the proposed action. Please refer to the “Status of Huachuca Water Umbel in the San Pedro RNCA” section of this biological opinion for a complete description of groundwater trends in the regional aquifer, alluvial aquifer, and surface water that are applicable to potential frog habitat on San Pedro RNCA. Also refer to the “Effects to Huachuca Water Umbel in the San Pedro RNCA” section of this biological opinion for a complete analysis of the Fort’s magnitudes of groundwater withdrawal, recharge, and water conservation.

Cumulative Effects

Cumulative effects include the effects of future State, tribal, local or private actions that are reasonably certain to occur in the action area considered in this biological opinion. Future Federal actions that are unrelated to the proposed action are not considered in this section because they require separate consultation pursuant to section 7 of the Act.

Section 321 of the Defense Authorization Act of 2004 (Public Law 108-136) describes the manner in which section 7 of the Act is to be applied during interagency consultation with Fort Huachuca. Specifically, Section 321 states "For purposes of section 7 of the Endangered Species Act of 1973 (16 U.S.C. 1536), concerning any present and future Federal agency action at Fort Huachuca, Arizona, water consumption by State, local, and private entities off of the installation that is not a direct or indirect effect of the agency action or an effect of other actions that are interrelated or interdependent with that agency action, shall not be considered in determining whether such agency action is likely to jeopardize the continued existence of any endangered or threatened species or result in the destruction or adverse modification of designated critical habitat."

Many lands within the action area are managed by Federal agencies; thus, many activities that could potentially affect Chiricahua leopard frogs are Federal activities that are subject to section 7 consultation. The effects of these Federal activities are not cumulative effects. However, regional population growth coupled with urban development continues to encroach on amphibian habitats in foothill grassland habitats on State and local lands in the Sierra Vista subbasin. With this growth, the frequency of intentional and unintentional introductions of non-natives is likely to increase. Well-intentioned, but misguided, individuals are known to intentionally release unwanted pets in aquatic systems in the Huachuca Mountains. Backyard pond enthusiasts could unintentionally create a conflict between native and non-native species, because these ponds are usually stocked with non-native plants (e.g., lilies), fish (primarily goldfish and their relatives), and bullfrogs. At least one Sierra Vista vendor of backyard pond supplies sells bullfrog tadpoles (A. Craven, pers. comm.). Increased growth is also likely to result in an increase in recreational activities in the Fort Huachuca/Sierra Vista region, including the Coronado National Forest. Increased recreation may increase the potential for degradation or loss of habitat for Chiricahua leopard frogs (e.g., from wildfires, off-road vehicle use). Illegal activities associated with cross-border smuggling and illegal immigration (e.g., human traffic, deposition of trash, creation of trails and routes, and increased fire risk from human traffic) also occur in the action area. These activities can also degrade frog habitat.

Conclusion

After reviewing the current status of the species, the environmental baseline for the action area, and the effects of the proposed action, but not the cumulative effects, it is our biological opinion that the proposed action is not likely to jeopardize the continued existence of the Chiricahua leopard frog. We base our conclusion on the following:

- Although we anticipate the proposed action will result in impacts to habitat that may potentially be occupied by Chiricahua leopard frogs, the impacts are short-term and relatively small in the context of the range of the species;
- Although we anticipate the proposed action will result in harm to Chiricahua leopard frogs currently extant within the action area off post and potentially extant within the action area on Fort Huachuca, the number of frogs that may be harmed is small in comparison to the number of frogs throughout the range of the species;
- Recovery is the process that stops the decline of an endangered or threatened species by removing or reducing threats. Recovery ensures the long-term survival of the species in the wild. At that point, the species is recovered, and protection of the ESA is no longer necessary. The aforementioned effects will not appreciably reduce the likelihood of recovery of the Chiricahua leopard frog based on the long-term stable to increasing status of of the Chiricahua leopard frog in Arizona;
- Conservation measures in the proposed action are anticipated to avoid, minimize, and offset the adverse effects of the proposed action to Chiricahua leopard frogs and critical habitat; and
- Prescribed fire included in the proposed action is anticipated to have a net conservation benefit Chiricahua leopard frogs by maintaining habitat and critical habitat for the species.

Critical habitat is defined in section 3 of the Act "as the specific areas within the geographical area occupied by the species, at the time it is listed in accordance with the Act, on which are found those physical and biological features essential to the conservation of the species and that may require special management considerations or protection; and specific areas outside the geographical area occupied by a species at the time it is listed, upon a determination that such areas are essential for the conservation of the species." We have also relied upon the Consultation Handbook which provides guidance on determining adverse modification of critical habitat and jeopardy pursuant to the following: "Adverse effects on individuals of a species or constituent elements or segments of critical habitat generally do not result in jeopardy or adverse modification determinations unless that loss, when added to the environmental baseline, is likely to result in significant adverse effects throughout the species' range, or appreciably diminish the capability of the critical habitat to satisfy essential requirements of the species" (U.S. Fish and Wildlife Service and National Marine Fisheries Service 1998:4-34).

The proposed action does not appreciably reduce the likelihood of Chiricahua leopard frog recovery within their historical range. The adverse effects that do occur in the action area do not reach the scale where recovery of the species would be delayed or precluded. We make this conclusion for the following reasons:

- The Fort is does not currently have leopard frogs on it;

- The potential area of effect is only a small part of the recovery unit, and a smaller part still of the range of the species;

- The proposed conservation measures reduce the chance for some impacts to Chiricahua leopard frogs which may occur on Fort Huachuca; and

- Monitoring and recovery actions continue to occur within the species' historical range.

FWS is unable to identify a recovery "tipping point" or threshold for the Chiricahua leopard frog because it is not technically feasible, due partly to a lack or rigorous, long-term data sets on population and habitat parameters. Because we cannot identify a tipping point, we cannot determine whether that tipping point would be reached as a result of agency operations. Since the impacts of the proposed action are minimal and the action area is small compared to the recovery unit and the range of the species, it is highly unlikely that the proposed action would cause a tipping point away from recovery to be reached. The effects to critical habitat are anticipated to be of a similar small scale, and are unlikely to destroy or adversely modify the critical habitat in the action area to the extent that recovery would be delayed or precluded for many of the reasons found in the conclusion and discussion above.

INCIDENTAL TAKE STATEMENT

Section 9 of the ESA and Federal regulation pursuant to section 4(d) of the ESA prohibit the take of endangered and threatened species, respectively, without special exemption. "Take" is defined as to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture or collect, or to attempt to engage in any such conduct. "Harm" is defined to include significant habitat modification or degradation that results in death or injury to listed species by significantly impairing essential behavioral patterns, including breeding, feeding, or sheltering (50 CFR 17.3). "Harass" is defined as intentional or negligent actions that create the likelihood of injury to listed species to such an extent as to significantly disrupt normal behavior patterns which include, but are not limited to, breeding, feeding or sheltering (50 CFR 17.3). "Incidental take" is defined as take that is incidental to, and not the purpose of, the carrying out of an otherwise lawful activity. Under the terms of sections 7(b)(4) and 7(o)(2), taking that is incidental to and not intended as part of the agency action is not considered to be prohibited taking under the Act provided that such taking is in compliance with the terms and conditions of this incidental take statement.

The measures described below are non-discretionary, and must be undertaken by Fort Huachuca so that they become binding conditions of any grant or permit issued to the applicant, as appropriate, for the exemption in section 7(o)(2) to apply. Fort Huachuca has a continuing duty to regulate the activity covered by this incidental take statement. If Fort Huachuca: (1) fails to assume and implement the terms and conditions; or (2) fails to require the applicant to adhere to the terms and conditions of the incidental take statement through enforceable terms that are added to the permit or grant document, the protective coverage of section 7(o)(2) may lapse. In order to monitor the impact of incidental take, Fort Huachuca must report the progress of the action and its impact on the species to the USFWS as specified in the incidental take statement (50 CFR §402.14(i)(3)).

Amount or Extent of Take

Take of Chiricahua leopard frogs is reasonably certain to occur as a result of implementation of military ground based operations and recreational activities included in the proposed action. This incidental take is expected to be in the forms of harm (including direct fatality) and harassment. Implementation of the proposed conservation measures will minimize the potential for these events to occur, but the possibility cannot

be eliminated and is reasonably certain to occur. We recognize that providing a numerical estimate of incidental take is the preferred method of measuring take and that for some animals this method is biologically defensible as the ecology of the animal lends itself to them being more detectible (e.g., long- lived, territorial species such as the desert tortoise). However, it is impossible to quantify the number of individual frogs taken because: 1) dead or impaired individuals are almost impossible to find (and are readily consumed by predators) and losses may be masked by seasonal fluctuations in environmental conditions; 2) the status of the species is changing over time through immigration, emigration, and natural loss or active creation of habitat through management; and, 3) the species is small-bodied, well camouflaged, and occurs under water of varying clarity, and thus individuals are difficult to detect.

It is not meaningful to provide a number for incidental take of frogs associated with this action because all a surveyor can count is what they see and there is much we cannot see under the water, in root wads, and in other hiding locations. We are capable of counting frogs (particularly if we put a certain number of frogs into an unoccupied site), but weather conditions (wind blowing), the presence of predators, and many other factors can all modify the number of frogs we see at a tank on any given visit. "Detectability" refers to the reality that even in locations actually occupied by a species of interest, it is very common for individual animals and even species to be missed and go undetected (MacKenzie et al. 2006). Based upon our knowledge of Chiricahua leopard frog ecology, we know that this species can have very low detectability. Even very experienced surveyors can miss frogs, egg masses, and tadpoles or think they hear frogs when none are actually there. In addition, it is one thing to reintroduce a known number of frogs at a pond and then try to find them soon after they were put there and when little fatality, emigration, or immigration has occurred (i.e., there is a known number and it can appear that you are precise in your estimate of animals) and an entirely different scenario to have an unknown number of frogs at a pond and then try to "guesstimate" the number of animals present based on surveys (see discussion below).

All of these factors result in even the most experienced leopard frog biologist being unable to show that any estimated numerical take occurred or did not occur at a site. There is no means of equating one dead frog (assuming one was found) to a number of dead frogs not observed. Establishing a number for incidental take becomes even more impracticable when we acknowledge that Chiricahua leopard frogs naturally experience very high mortality rates (greater than 90%) in the egg and early tadpole stages, high mortality when the tadpole turns into a juvenile frog, and then relatively lower mortality rates when the frogs become adults (USFWS 2007d). Even the recovery strategy and delisting criteria in the Recovery Plan for the Chiricahua leopard frog are built upon numbers of populations (not individuals) and we use counts of frogs only to define a "robust" population, which depending upon the habitat can range from an estimate of 40 to 60 adults, depending upon whether the habitat is drought-resistant (USFWS 2007d). The standard Visual Encounter Surveys (VES) method is the survey protocol used to conduct Chiricahua leopard frog surveys (USFWS 2007d, Appendix E). The VES method will generate presence/absence data if used independently and generate information from which inferences about relative frog abundance and trends can be made

at a specific site. This method was not developed to census frogs or to identify thresholds, such as incidental take. We do not have a means of counting or conducting a census of all individual frogs at a site.

As noted above, we cannot measure the number of frogs taken as a result of this action because these frogs are almost impossible to find, particularly if they are already dead or impaired; the frog is challenging to see when it is alive due to its size, cryptic coloring, and complex habitat. In addition, egg masses and tadpoles are frequently hidden in submerged vegetation and cannot be counted precisely. Therefore, though we can generate counts of frogs seen by surveyors, results from these surveys do not consistently provide an accurate estimate of the number of frogs present at the site. If we are unable to provide a reliable, predictive number of frogs at a site (particularly since it changes each year due to emigration, immigration, and fatality), it follows logically that we would be unable to provide a numerical estimate of the number of frogs incidentally taken as a result of the proposed action. Since we cannot estimate the number of individual frogs that will be incidentally taken for the reasons listed above, the USFWS is providing a mechanism to quantify when take would be considered to be exceeded as a result of implementing the proposed action: We will use the existing number of core breeding sites in the action area to determine when take is exceeded. By setting a threshold of one site, we have set an incidental take limit that is measurable, irrefutable, and indicates that the frogs are being impacted. We are confident that repeated VES surveys can tell us whether a site is occupied or not, which will clearly show if incidental take is exceeded. Surveys at occupied habitat off of the Fort are done at least annually by the Arizona Game and Fish Department. <u>We conclude that the incidental take of Chiricahua leopard frogs will be considered exceeded if there is a net loss of any one of the currently occupied core breeding sites for one year (Trout and Meadow ponds in Ramsey Canyon; House and Wild Duck ponds, and Brown Canyon Box in Brown Canyon; and Peterson Ranch Pond in Scotia Canyon),</u> as a result of implementing the proposed action, as determined by Fort Huachuca and the USFWS.

We have identified Fort activities that may result in the incidental take of individual frogs; however, we do not anticipate the complete loss of an entire occupied site as a result of any action authorized under the proposed action. The activities analyzed herein could take individual frogs of various life stages including frogs, tadpoles, and eggs (though we are unable to count the exact number) through direct fatality or harm from trampling (human or machine); and harm or harassment through habitat modification resulting from effects of prescribed fire, escaped prescribed fire (e.g., contamination of aquatic sites with ash, loss of aquatic sites due to sedimentation, loss of downed wood and other terrestrial refugia), and introduction of nonnative fish, bullfrogs, and other harmful aquatic species and diseases. If the loss of a currently occupied core breeding site occurs, in coordination with Fort Huachuca, we will determine whether it was the result of the proposed action or if environmental conditions such as drought or Bd that is prevalent within the action area (see Environmental Baseline), caused the loss. If the loss of a core breeding site is a result of the proposed action, then as provided in 50 CFR Section 402.16, reinitiation of formal consultation would be required as the amount or extent of incidental take would be exceeded.

The reasonable and prudent measures, with their implementing terms and conditions, are designed to minimize the impact of incidental take that might otherwise result from the proposed action. This biological opinion does not authorize any form of take not incidental to implementation of the proposed action as described in this biological opinion and in the PBA.

Effect of the Take

In this biological opinion, we find that this level of anticipated take is not likely to jeopardize the continued existence of the Chiricahua leopard frog for the reasons discussed above in the Conclusion section.

Reasonable and Prudent Measure

1. Remove nonnative American bullfrogs that could disperse from water sources on Fort Huachuca to extant sites of Chiricahua leopard frog.

Term and Condition

1. The following term and condition implements reasonable and prudent measure number one:

    1.1. Fort Huachuca shall remove bullfrogs that could disperse from water sources on Fort Huachuca to extant sites of Chiricahua leopard frog in Scotia, Brown, Ramsey, and Miller canyons. Any aquatic site on Fort Huachuca within seven miles of extant Chiricahua leopard frog sites shall be monitored annually for American bullfrogs. If bullfrogs are found at a site on Fort Huachuca, then Fort Huachuca will ensure their removal as soon as possible to prevent breeding and dispersing from occurring. Quick action will minimize effort required to remove these predators.

CONSERVATION RECOMMENDATIONS

Sections 2(c) and 7(a)(1) of the Act direct Federal agencies to use their authorities to further the purposes of the Act by carrying out conservation programs for the benefit of listed species. Conservation recommendations are discretionary agency activities to minimize or avoid effects of a proposed action on listed species or critical habitat, to help implement recovery plans, or to develop information.

- We recommend that Fort Huachuca continue to participate in implementing recovery actions for the Chiricahua leopard frog.

- We recommend that the Fort attempt to prevent the introduction or movement and remove nonnative aquatic species on the Fort.

- We recommend that Fort Huachuca investigate and monitor the presence of Bd in aquatic habitats on Fort Huachuca.

- We recommend that the Fort fully implement the proposed conservation measures for the Chiricahua leopard frog to assist conservation of the species, and help meet the intent of Section 7(a)(1), or remove some conservation measures.

For the USFWS to be kept informed of actions minimizing or avoiding adverse effects or benefiting listed species or their habitat, we request notification of the implementation of any conservation recommendations.

Please note that surveys for Chiricahua leopard frogs, or other frogs, that involve capture or take, require appropriate permits from the USFWS and AGFD).

MEXICAN SPOTTED OWL

Status of the Species

In 1993, the USFWS listed the Mexican spotted owl (hereafter, also referred to as spotted owl, MSO, and owl) as threatened under the ESA (58 FR 14248, USFWS 1993). The USFWS appointed the Mexican spotted owl Recovery Team in 1993, which produced the Recovery Plan for the Mexican spotted owl in 1995 (USFWS 1995). The USFWS released the Mexican spotted owl Recovery Plan, First Revision in December 2012 (USFWS 2012d). Critical habitat was designated for the spotted owl in 2004 (69 FR 53182, USFWS 2004).

A detailed account of the threats, taxonomy, biology, and reproductive characteristics of the Mexican spotted owl is found in the rule listing the owl as a threatened species (USFWS 1993), the original Recovery Plan (USFWS 1995), and the revised Recovery Plan (USFWS 2012d). The information in those documents is included herein by reference.

The Mexican spotted owl occurs in forested mountains and canyonlands throughout the southwestern United States and northwestern Mexico (Gutiérrez et al. 1995, USFWS 2012d). It ranges from Utah, Colorado, Arizona, New Mexico, and the western portions of Texas south into several States of Mexico. Although the owl's entire range covers a broad area of the southwestern United States and adjacent Mexico, it does not occur uniformly throughout its range. Instead, the Mexican spotted owl occurs in disjunct localities that correspond to isolated forested mountain systems, canyons, and in some cases steep, rocky canyon lands. Known owl locations indicate that the species has an affinity for older, uneven-aged forest, and the species is known to inhabit a physically diverse landscape in the United States and Mexico.

In addition to this natural variability in habitat influencing owl distribution, human activities also vary across the owl's range. The combination of natural habitat variability, human influences on owls, international boundaries, and logistics of implementation of the Recovery Plan (USFWS 2012d) necessitates subdivision of the owl's range into smaller management areas. The Plan subdivided the owl's range into 10 Ecological Management Units (EMUs): five in the United States and five in Mexico. This is in accord with current USFWS guidelines (NMFS and USFWS 2010). The United States EMUs are: Colorado Plateau (CP), Southern Rocky Mountains (SRM), Upper Gila Mountains (UGM), Basin and Range-West (BRW), and Basin and Range-

East (BRE)(Figure MSO1). In Mexico, the EMUs are: Sierra Madre Occidental Norte, Sierra Madre Occidental Sur, Sierra Madre Oriental Norte, Sierra Madre Oriental Sur, and Eje Neovolcanico.

Mexican spotted owl surveys since the 1995 Recovery Plan have increased our knowledge of owl distribution, but not necessarily of owl abundance. Population estimates, based upon owl surveys, recorded 758 owl sites from 1990 to 1993, and 1,222 owl sites from 1990 to 2004 in the United States. The Recovery Plan (USFWS 2012d) lists 1,324 known owl sites in the United States. An owl site is an area used by a single or a pair of adult or subadult owls for nesting, roosting, or foraging. The increase in number of known owl sites is mainly a product of owl surveys being completed within previously unsurveyed areas (e.g., several National Parks within southern Utah, Grand Canyon National Park in Arizona, Guadalupe National Park in West Texas, Guadalupe Mountains in southeastern New Mexico and West Texas, Dinosaur National Monument in Colorado, Cibola National Forest in New Mexico, and Gila National Forest in New Mexico). Thus, an increase in abundance in the species range-wide cannot be inferred from these data (USFWS 2012d). However, we do assume that an increase in the number of areas considered to be occupied is a positive indicator regarding owl abundance. As recommended in the Recovery Plan (USFWS 2012d), the U.S. Forest Service is funding Rocky Mountain Bird Observatory to implement a pilot population monitoring study for Mexican spotted owls on National Forest System lands in Arizona and New Mexico in 2014. This study will aid the USFWS, Forest Service, and other partners in designing and implementing range wide population monitoring.

Two primary reasons were cited for listing the Mexican spotted owl in 1993: 1) the historical alteration of its habitat as the result of timber-management practices; and, 2) the threat of these practices continuing. The danger of stand-replacing fire was also cited as a looming threat. Since publication of the Recovery Plan (USFWS 1995), we have acquired new information on the biology, threats, and habitat needs of the Mexican spotted owl (USFWS 2012d). Threats to its population in the U.S. (but likely not in Mexico) have transitioned from commercial-based timber harvest to the risk of stand-replacing wildland fire. Recent forest management has moved away from a commodity focus and now emphasizes sustainable ecological function and a return toward pre-settlement fire regimes, both of which have potential to benefit the spotted owl. Southwestern forests have experienced larger and more severe wildland fires from 1995 to the present, than before 1995 (USFWS 2012d). Climate variability combined with unhealthy forest conditions may also synergistically result in increased negative effects to habitat from fire (see Environmental Baseline). The intensification of natural drought cycles and climate change (Garfin et al. 2013) and the ensuing stress placed upon overstocked forested habitats could result in even larger and more severe fires in owl habitat. Several fatality factors have been identified as particularly detrimental to the MSO, including predation, starvation, accidents, disease, and parasites.

Historical and current anthropogenic uses of Mexican spotted owl habitat include livestock grazing, recreation, fuels reduction treatments, resource extraction (e.g., timber, oil, gas), and development. These activities have the potential to reduce the quality of owl nesting, roosting, and foraging habitat, and may cause disturbance during the breeding season. Livestock and wild ungulate grazing is prevalent throughout the range of the owl and is thought to have a negative

effect on the availability of grass cover for prey species. Recreation impacts are increasing throughout the Southwest, especially in meadow and riparian areas. There is anecdotal evidence and research that indicates that owls in heavily used recreation areas are much more erratic in their movement patterns and behavior. Fuels reduction treatments, though critical to reducing the risk of severe wildland fire, can have short-term adverse effects to owls through habitat modification and disturbance. As the human population grows in the southwestern United States, small communities within and adjacent to wildlands are being developed. This trend may have detrimental effects to spotted owls by further fragmenting habitat and increasing disturbance during the breeding season.

Several fatality factors have been identified as particularly detrimental to the Mexican spotted owl, including predation, starvation, accidents, disease, and parasites. For example, West Nile Virus has the potential to adversely impact the spotted owl. The virus has been documented in Arizona, New Mexico, and Colorado, and preliminary information suggests that owls may be highly vulnerable to this disease (Courtney et al. 2004). Unfortunately, due to the secretive nature of spotted owls and the lack of intensive monitoring of banded birds, we will most likely not know when owls contract the disease or the extent of its impact to the owl range- wide.

Currently, high-intensity, stand-replacing fires are influencing ponderosa pine and mixed conifer forest types in Arizona and New Mexico. Uncharacteristic, high-severity, stand-replacing wildland fire is probably the greatest threat to the Mexican spotted owl within the action area (Fulé et al. 2004). As throughout the West, fire severity and size have been increasing within this geographic area. Landscape level wildland fires, such as the Rodeo-Chediski Fire (2002), the Wallow Fire (2011), and the Whitewater-Baldy Complex (2012) have resulted in the loss of tens of thousands of acres of occupied and potential nest and roost habitat across significant portions of the Mexican spotted owl's range.

Finally, climate change may also be a threat to the owl (USFWS 2012d). Changing climate conditions may interact with fire, management actions, and other factors discussed above, to increase impacts to owl habitat. Studies have shown that since 1950, the snowmelt season in some watersheds of the western U.S. has advanced by about 10 days (Dettinger and Cayan 1995, Dettinger and Diaz 2000, Stewart et al. 2004). Such changes in the timing and amount of snowmelt are thought to be signals of climate-related change in high elevations (Smith et al. 2000, Reiners et al. 2003). The impact of climate change is the intensification of natural drought cycles and the ensuing stress placed upon high-elevation montane habitats (Cook et al. 2004, Breshears et al. 2005, Mueller et al. 2005, IPCC 2007b). The increased stress put on these habitats is likely to result in long-term changes to vegetation, and to invertebrate and vertebrate populations within coniferous forests and canyon habitats that affect ecosystem function and processes.

Critical Habitat

We designated critical habitat for the Mexican spotted owl in 2004 on about 8.6 million acres (3.5 million ha) of Federal lands in Arizona, Colorado, New Mexico, and Utah (69 FR 53182, USFWS 2004). There is no designated critical habitat on Fort Huachuca, but critical habitat is designated in the adjacent Coronado National Forest, which could be affected by the proposed

action. In the designated boundaries, critical habitat includes only those areas defined as protected habitats (defined as PACs and unoccupied slopes >40% in the mixed conifer and pine-oak forest types that have not had timber harvest in the last 20 years) and restricted (now called "recovery") habitats (unoccupied owl foraging, dispersal, and future nest/roost habitat) as defined in the 1995 Recovery Plan (USFWS 1995). The primary constituent elements (PCEs) for Mexican spotted owl critical habitat were determined from studies of their habitat requirements and information provided in the Recovery Plan (USFWS 1995). Since owl habitat can include both canyon and forested areas, PCEs were identified in both areas. The PCEs identified for the owl within mixed-conifer, pine-oak, and riparian forest types that provide for one or more of the owl's habitat needs for nesting, roosting, foraging, and dispersing are:

- A range of tree species, including mixed conifer, pine-oak, and riparian forest types, composed of different tree sizes reflecting different ages of trees, 30 to 45 percent of which are large trees with diameter at breast height of 12 inches or more;
- A shade canopy created by the tree branches covering 40 percent or more of the ground;
- Large, dead trees (snags) with a dbh of at least 12 inches;
- High volumes of fallen trees and other woody debris;
- A wide range of tree and plant species, including hardwoods; and,
- Adequate levels of residual plant cover to maintain fruits and seeds, and allow plant regeneration.

The PCEs listed above usually are present with increasing forest age, but their occurrence may vary by location, past forest management practices or natural disturbance events, forest-type productivity, and plant succession. These PCEs may also be observed in younger stands, especially when the stands contain remnant large trees or patches of large trees. Certain forest management practices may also enhance tree growth and mature stand characteristics where the older, larger trees are allowed to persist.

Steep-walled rocky canyonlands occur typically within the Colorado Plateau EMU, but also in other EMUs. Canyon habitat is used by owls for nesting, roosting, and foraging, and includes landscapes dominated by vertical-walled rocky cliffs within complex watersheds, including tributary side canyons. These areas typically include parallel-walled canyons up to 1.2 mi (2 kilometers) in width (from rim to rim), with canyon reaches often 1.2 mi (2 km) or greater, and with cool north-facing aspects. The PCEs related to canyon habitat include one or more of the following:

- Presence of water (often cooler and with higher humidity than surrounding areas);
- Clumps or stringers of mixed-conifer, pine-oak, pinyon-juniper, or riparian vegetation;
- Canyon walls containing crevices, ledges, or caves; and,
- High percent of ground litter and woody debris.

Summary of Rangewide Status of the Mexican spotted owl and critical habitat

Overall, the status of the owl and its designated critical habitat has not changed significantly rangewide in the U.S., based upon the information we have, since issuance of the Recovery Plan (USFWS 2012d) and the last formal consultation conducted for the owl on Fort Huachuca. What

we mean by this is that the distribution of owls continues to cover the same area and critical habitat is continuing to provide for the life history needs of the Mexican spotted owl throughout all of the EMUs in the U.S. We do not have detailed information regarding the status of the Mexican spotted owl in Mexico, so we cannot make inferences regarding its overall status.

However, this is not to say that significant changes have not occurred within the owl's U.S. range. Wildland fire has resulted in the greatest loss of PACs and critical habitat relative to other actions (e.g., such as forest management, livestock grazing, recreation) throughout the U.S. range of the Mexican spotted owl. These wildland fire impacts have mainly impacted Mexican spotted owls within the UGM EMU (e.g., Rodeo-Chediski and Wallow Fires on the Apache- Sitgreaves National Forest and Whitewater-Baldy Complex on the Gila NF) and BRW EMU (e.g., Horseshoe 2 Fire on the Coronado NF); but other EMUs have been impacted as well (SRM EMU by the Las Conchas Fire, CP EMU by the Warm Fire). However, we do not know the extent of the effects of these wildland fires on actual owl numbers or the long-term persistence of nest or roost habitat (see discussion in USFWS 2012d).

Environmental Baseline/Status of the Species in the Action Area

The environmental baseline includes past and present impacts of all Federal, State, or private actions in the action area, the anticipated impacts of all proposed Federal actions in the action area that have undergone formal or early section 7 consultation, and the impact of State and private actions that are contemporaneous with the consultation process. The environmental baseline defines the current status of the species and its habitat in the action area to provide a platform to assess the effects of the action now under consultation.

Status of the species within the action area

The Mexican spotted owl occupies a fairly specific niche primarily within isolated mountain ranges of southwestern U.S. and northwestern Mexico (USFWS 2012d), including on Fort Huachuca. Fort Huachuca is in the Basin and Range-West recovery EMU. This unit is characterized by mountain ranges isolated by desert basins (USFWS 1995a, 2012d) and includes most of southern Arizona and a small portion of southwestern New Mexico. Since the availability of nest and roost habitat is thought to be limited for the owl, recommended management is centered on protecting known Mexican spotted owl nest or roost sites. The Recovery Plan (USFWS 1995, 2012d) recommends delineating protected activity centers (PACs) around owl activity centers to protect the activity center of each owl territory. Fort Huachuca has designated 11 PACs within the action area. The Fort has not identified Inventory Areas, which include currently unoccupied potential foraging, nesting, or roosting habitats.

Consistent with the first Recovery Plan (USFWS 1995), Fort Huachuca defined conservation goals and updated its Endangered Species Management Plan for this subspecies and its habitat on the Fort in 2007 (ENRD 2012c). Fort Huachuca has supported Mexican spotted owl surveys in current and potential nesting and roosting habitat on Fort Huachuca in 1990 and 2012 (ENRD 2012c). Twenty-seven Mexican spotted owl PACs are known to occur in the Huachuca Mountains, including one on National Park Service lands, 11 within Fort Huachuca boundaries, and 15 on Coronado National Forest lands south of Fort Huachuca (Vernadero Group 2010e).

The 11 PACs and one Inventory Area (IA) totaling 6,729 ac were identified on Fort Huachuca (Figure MSO2; ENRD 2012c). Fort-supported research has included color banding to document Mexican spotted owl dispersal, and collection of blood samples and feathers for genetic studies during the 1990s (Duncan et al. 1993). The Fort is currently outlining an Endangered Species Management Plan for the owl and its habitat. No potential spotted owl nesting or roosting habitat occurs on the East Range. Thus, the action area includes the Fort and the rest of the Huachuca Mountains.

From 1990 to 2011, the average confirmed pair occupancy was 58 percent for the 11 PACs on Fort Huachuca (Tables MSO1 and MSO2). A total of 54 young have been produced out of 36 documented successful nesting attempts in all PACs, for an average success rate of 1.5 young per successful nest (ENRD 2012c). This information indicates that Mexican spotted owls seem to be relatively successful in terms of survival and reproduction on Fort Huachuca.

Effects of the Action - Mexican Spotted Owl

Mexican spotted owls occurring on Fort Huachuca are directly and indirectly affected by human disturbance, potential direct fatality, noise, and fuels reduction activities, including mechanical thinning and fire. The Description of the Proposed Action section, above, described the full range of activities conducted by Fort Huachuca. The proposed action also includes a series of species-specific conservation measures intended to avoid and minimize the adverse effects of the proposed action. These measures, and their effects to both the species and, as applicable, its critical habitat, are as follows:

Effect of Human Disturbance

Mexican spotted owl PACs are in canyons of the Huachuca Mountains where ground-based military training is limited primarily to existing routes of travel. Most human use of these areas is non-military, and occurs primarily as recreational pursuits such as birding, butterfly observation, hunting, and hiking.

Recreational use in most canyons where territorial Mexican spotted owls have been recorded, or that contain PACs, is light because to reach these areas often requires considerable hiking over steep terrain. An exception is the PAC in Scheelite Canyon, which is well-known by birders as an easily accessible site to view Mexican spotted owls. Davis and Russell (1995) and Taylor (1995), popular birding guides for southeastern Arizona, provide directions to the site, and in the case of Taylor (1995), specific information on where the birds can be found. Most birders visiting Scheelite Canyon stay on the trail, and are conscientious and unobtrusive; however, there are recreationists whose actions may result in disturbance to these owls.

Recreational activities including hiking, camping, equestrian use, and mountain biking may affect the Mexican spotted owl depending on location, intensity, frequency, and duration (USFWS 1995, 2012d). Direct effects may occur when these activities impact individual birds at nests, roosts, and foraging sites. Indirect effects may occur when recreational activities degrade habitat through vegetation modification (trampling, removal, accidental burning, and soil

compaction) or when human-caused disturbance stimuli act as a form of predation risk (Frid and Dill 2002).

There are a growing number of studies attempting to describe and quantify the impacts of non-lethal disturbance on the behavior and reproduction of wildlife, and MSO in particular. Delaney et al. (1997) reviewed literature on the response of owls and other birds to noise and concluded the following: 1) raptors are more susceptible to disturbance-caused nest abandonment early in the nesting season; 2) birds generally flush in response to disturbance when distances to the source are less than 200 ft and when sound levels are in excess of 95 dBA; and 3) the tendency to flush from a nest declines with experience or habituation to the noise, although the startle response cannot be completely eliminated by habituation. Delaney et al. (1999) found that ground-based disturbances elicited a greater flush response than aerial disturbances. Our guidance is to limit potentially disturbing activities to areas ≥0.25 mi from MSO nest sites during the breeding season (March 1 through August 31). This corresponds well with the Delaney et al.'s (1999) 0.25 mi threshold for alert responses to helicopter flights. In addition, Delaney et al. (1999) found that MSO did not flee from helicopters when caring for young at the nest, but fled readily during the post-fledgling period. This may be a result of optimal fleeing decisions that balance the cost-benefit of fleeing. Frid and Dill (2002) hypothesize that this may be explained using predator risk-disturbance theory and perhaps the cost of an adult MSO fleeing during the nestling period may be higher than during the post-fledgling period.

Swarthout and Steidl (2001) found that MSO modified their behavior (e.g., increased perch height) or flushed in response to recreationists (hikers). Based on their results, they recommended placing buffer zones (conservative buffer = 180 ft; less conservative buffer = 40 ft) around known roosting sites to minimize impacts. In a study to assess the effects of hikers on the behavior of nesting MSO, Swarthout and Steidl (2003) noted that female MSOs decreased the amount of time they handled prey by 57 percent and decreased the amount of time they performed daytime maintenance activities by 30 percent while hikers were present. In addition, hikers caused both female and male owls to increase the frequency of contact vocalizations. They concluded cumulative disturbance by hikers could potentially be detrimental to the owls, but likely only in canyons with 50 or more hikers a day (Swarthout and Steidl 2001, 2003).

Birds may also respond to disturbance during the breeding season by abandoning their nests or young; by altering their behavior such that they are less attentive to the young, which increases the risk of the young being preyed upon or disrupting feeding patterns; or by exposing young to adverse environmental stress (Knight and Cole 1995). There is also evidence that disturbance during years of a diminished prey base can result in lost foraging time which, in turn, may cause some raptors to leave an area or not to breed at all (Knight and Cole 1995). Topographic screening between the area of disturbance and the bird's location creates a noise buffer, and may assist in the reduction of noise disturbance (Knight and Cole 1995).

Research on all subspecies of the spotted owl indicate that it exhibits docile behavior when approached by researchers, and there is no clear evidence of significant impact by research activity except for a negative effect on reproduction from back-pack radio transmitters (Gutierrez et al. 1995). However, researchers usually minimize disturbance to the extent possible, which may not be the case for recreational trail users. In the long-term, some species may become less

responsive to human disturbance if they are not deliberately harassed; others may become very stress-prone towards humans (Bowles 1995, Hammitt and Cole 1987). Excessive interaction with humans may cause a lowering of call response rates or habituation; the effects of habituation on spotted owls are unknown (Gutierrez et al. 1995). Habituation, though it may occur to some extent, often is partial or negligible (Frid and Dill 2002). However, it would be logical to assume that wildlife rarely have perfect information and we would expect them to maximize fitness by overestimating rather than underestimating predator risk. It may be that MSO which appear to be "habituated" to recreationists, in reality may have no suitable alternative habitats and remain within areas because other suitable habitat is not available. Conversely, habitat may be of such high quality in terms of prey resources that spotted owls, such as the Scheelite Canyon birds, are able to deal with increased energy expenditures related to human disturbance.

The owls in Scheelite Canyon appear to be mostly oblivious to human presence; however, as stated above, the effects of habituation are unknown. There is some evidence of trampling and soil compaction off the established trail, and in years passed large groups of birders, apparently birding tour groups, have visited the canyon. Russell Duncan (pers. comm., 1998 as cited in the PBA) reported a group of about 50 birders led by a trip leader that was calling or hooting for owls in Scheelite Canyon. As discussed, a group of 50 individuals may be a large enough presence to elicit an alarm response or to otherwise harm or harass the spotted owls in Scheelite Canyon, or disturb habitat (Swarthout and Steidl 2001, 2003). In December 1992, Duncan et al. (1993) found an adult female spotted owl in Scheelite Canyon on the ground in a lethargic state. The bird was taken to a veterinarian in Tucson where it died after seven days. The cause of death was a pneumonia-like lung infection complicated by a subdermal hematoma probably caused by a blow to the back of the head. Duncan (1993) stated that a human-related cause of the hematoma cannot be ruled out.

The Recovery Plan states that groups of more than 12 hikers or a steady stream of hikers may be especially disturbing to owls. The spotted owl breeding season, which extends from March 1 through August 31, is an especially popular time for birders and other recreationists to visit Fort Huachuca. In addition, during high use periods, large groups of hikers may use the trail, whether intentionally hiking in groups, or because groups are formed unintentionally due to hikers backed up behind each other. The potential for disturbance to Mexican spotted owls in the Scheelite Canyon PAC exists given the trail location relative to past owl locations, as well as the high recreational use level on the trail during the breeding season.

Owls have more sensitive hearing than other birds (Bowles 1995). If a sound source arouses an animal, it has the potential to affect its metabolic rate by making it more active. Increased activity can, in turn, deplete energy reserves (Bowles 1995). Noisy human activity can cause raptors to expand their home ranges, but often the birds return to normal use patterns when humans are not present (Bowles 1995). Such expansions in home ranges could affect the fitness of the birds, and thus their ability to successfully reproduce and raise young. Species that are sensitive to the presence of people may be displaced permanently, which may be more detrimental to wildlife than recreation-induced habitat changes (Hammitt and Cole 1987, Gutzwiller 1995, Knight and Cole 1995). If animals are denied access to areas that are essential for reproduction and survival, then that population will decline. Likewise, if animals are

disturbed while performing essential behaviors such as foraging or breeding, that population will also likely decline (Knight and Cole 1995). There is also evidence that disturbance during years of a diminished prey base can result in lost foraging time which, in turn, may cause some raptors to leave an area or not to breed at all (Knight and Cole 1995).

The physical characteristics of a canyon may provide topographic screening. Topographic screening between the area of disturbance and a bird's location creates a noise buffer, and may assist in the reduction of noise disturbance (Knight and Cole 1995). The physical structure of canyons can also tend to magnify disturbances and limit escape and avoidance routes for owls (USFWS 1995). Scheelite Canyon is a narrow, deep canyon with limited perching and roosting sites, and the owls are typically perched close to the trail.

The Mexican spotted owl Recovery Plan notes that birders and wildlife photographers actively seek spotted owls and are therefore more disruptive than the accidental encounters associated with other recreational activities. The Recovery Plan finds that most owls appear to be relatively undisturbed by groups of people 12 or less. In response to the recommendations of the Recovery Plan, Fort Huachuca has posted and maintained a sign at the mouth of Scheelite Canyon that informs visitors that groups are limited to 12 or less; calling, hooting, or playing taped recordings to elicit responses from owls is prohibited; and that visitors should stay on the trail and be as quiet and unobtrusive as possible. This is intended to reduce possible harassment or disruption of spotted owls in the canyon. The USFWS requires a Section 10(a)(1)(A) permit for use of tape recorded calls or hooting to locate Mexican spotted owls. The USFWS does not issue such permits for commercial or recreational viewing of listed species.

Hunting for big and small game is allowed within spotted owl habitat at Fort Huachuca. Potentially, a hunter could discharge a firearm near a roosting or nesting spotted owl and cause an owl to flush or elicit a startle response. However, this type of disturbance is likely to be infrequent. Most hunting occurs during the fall and winter months, outside of the spotted owl breeding season, and at lower elevations.

Ecologists suspect that spotted owls select habitats partially because of the availability of prey (USFWS 1995). Ward and Block (1995) found that the reproductive success of the Mexican spotted owl was not influenced by a single prey species, but rather by many species in combination. Trails in riparian areas affect the soil and riparian vegetation adjacent to the trail, as well as the aquatic system itself. By directly impacting these components, recreationists affect an animal's food supply and availability as well as its habitat; in turn, impacts on food and habitat influence behavior, survival, reproduction, and distribution (Cole and Landres 1995). Impacts on soil include compaction of mineral soil, reductions in total porosity, reductions in infiltration rates, and increased soil erosion (Cole and Landres 1995). These changes in soil characteristics can adversely affect the germination, establishment, growth, and reproduction of plants. Direct impacts to vegetation also come from crushing and uprooting of vegetation. Consequently, recreation areas characteristically have vegetation that is less abundant (reduced density and cover), of a reduced stature, and with different species composition from undisturbed areas (Cole and Landres 1995). Removal of living vegetation affects the habitat and food sources of small mammals (Hammitt and Cole 1987) that comprise owl prey items.

Rappelling or rock climbing on cliffs supporting active Mexican spotted owl nests could result in disturbance of nesting owls. Recreational rappelling and rock climbing are prohibited on Fort Huachuca; however, rappelling as part of military training occurs on cliffs in Garden Canyon. The rappelling cliff is located outside of current spotted owl PACs, and if owls are found nesting within 0.25 mi of the rappelling cliff, rappelling shall be moved at least 0.25 mi away during March 1 through August 31, or until nestlings fledge. These measures are intended to reduce the potential for adverse effects to the Mexican spotted owl.

Effects of Direct Fatality

PACs in Training Area Papa are within portions of the firing fan of tank gunnery range 12C. However, this firing range is inactive and, if proposed for use in the future, would be the subject of section 7 consultation. PACs in Training Areas Oscar and Sierra fall within portions of firing ranges 12A & B and 9. Range 12B is a tank gunnery range that is not in use. As with 12C, if 12B is proposed for future use, it would be the subject of separate consultation. Machine guns (.50 and 90mm caliber) and recoilless rifles are discharged at Range 9. At Range 12A, .50 caliber, 7.62mm, and 40mm weapons are discharged. The PACs are in the upper reaches of the firing ranges, at least 2.4 mi from where weapons would be fired. Ordnance and shells would reach PACs only if the targets were overshot. The likelihood that ordnance or shells would strike a spotted owl or nest is highly unlikely. Occasional stray bullets have much greater implications for igniting fire with its associated impacts, as discussed below.

Fatality or injury of Mexican spotted owls could also occur due to collisions with vehicles, aircraft, power and communications lines, or as a result of electrocution on power lines. However, reports of such mortality are rare in Arizona. Fatality or injury from collisions or electrocution could possibly occur during the life of the project, but are unlikely. Moreover, the recently-privatized electrical distribution system on Fort Huachuca will result in the installation of safety devices to reduce the risk of electrocution of raptors.

Effects of Noise

Sources of noise other than those made by hikers, birders, or other recreationists may also disturb spotted owls and include explosive ordnance discharge and delivery, discharge of firearms by hunters, small arms ammunition firing on the South Range, roads, and aircraft overflights. Delaney et al. (1997) reviewed literature on the response of owls and other birds `to noise and drew the following conclusions: 1) raptors are more susceptible to disturbance-caused nest abandonment early in the nesting season; 2) birds generally flush in response to disturbance when distances to the source are less than about 200 ft and when sound levels are in excess of 95 dBA; and 3) the tendency to flush from a nest declines with experience or habituation to the noise, although the startle response cannot be completely eliminated by habituation.

Hayward et al. (2011) determined that northern spotted owls close to noisy roads fledged significantly fewer young than owls close to other roads. Small arms firing on the South Range could potentially disturb Mexican spotted owls. However, the firing ranges are all at least 2.4 mi from spotted owl PACs, and any noise from such firing that reaches the PACs is likely to

attenuate well below 95 dBA. Artillery and mortar firing occurs at several areas on the East Range. Ordnance is directed eastward from these sites and is delivered into Impact Area Zulu, also on the East Range. Noise from these sources is likely louder than the small arms firing on the South Range. However, mortar and artillery firing on the East Range occur at a much greater distance from owl territories. All mortar and artillery firing sites and the impact zone in Impact Area Zulu are over seven mi from the nearest PAC. No effects to spotted owls are anticipated as a result of mortar and artillery firing on the East Range.

Low-level flights are sometimes authorized over the canyons of the Huachuca Mountains where Mexican spotted owls nest. Propeller-driven, fixed-wing aircraft are typically operated at low levels, though they are also generally limited to elevations of 500 ft above ground level (agl) or higher on Fort Huachuca. The AGFD is granted authority to fly lower to conduct wildlife surveys on Post. Helicopter flights may occur at elevations below 500 ft agl. Unmanned aircraft system flights may also occur at low levels over the Huachuca Mountains. Low-level flights are infrequent and of short duration. During extensive wildlife and plant field work at Fort Huachuca, Russell Duncan (pers. comm., 1998 as cited in the PBA) has not observed low-level fixed wing or helicopter flights in montane canyons, but had observed occasional UASs flying at low levels. To reduce the potential for noise effects, the Fort is committed to minimizing low-level helicopter flights within one mi of active nests and has prohibited helicopter flights within 0.25 mi of an active nest from March 1 to August 31.

According to the Report to Congress on Effects of Aircraft Overflights on the National Park System (NPS 1994), wildlife respond to low-level aircraft overflights, although the manner in which they do so depends on life-history characteristics of the species, characteristics of the aircraft, flight activities, and a variety of factors such as habitat type and previous exposure to aircraft. The primary concern stemming from these low-level overflights are the physiological and behavioral responses caused by the flights to wildlife. These responses may reduce the wildlife's fitness or ability to survive. Overflights may cause stress, and if chronic, stress can compromise the general health of an animal. Overflights may interfere with raising young, habitat use, and physiological energy budget. Indirect effects, such as accidental injury, energy loss, habitat avoidance, and abandonment are very difficult to detect, but some experts suspect they occur (NPS 1994).

Other studies have investigated the effects of low-level aircraft overflights on birds and determined that such flights disturb raptors (Manci et al. 1987). Disturbances include interrupting activities by flushing from nest and roost, displacing birds returning to nests, flushing or displacing birds from foraging areas, provoking interactions with raptors, and exposing eggs and nestlings to predators and extreme heat. Studies have also suggested that human activities in breeding and nesting territories may affect raptors by changing home range movements (Anderson et al. 1990) and causing nest abandonment (Porter et al. 1973, Postovit and Postovit 1987). While these studies have not demonstrated a causal link between low-level overflights and reproductive success, they do document a level of disturbance that clearly is equivalent to harassment.

Johnson and Reynolds (2002) observed the responses of Mexican spotted owls in Colorado to low-level flights by F-16 aircraft. The authors found that owl responses to low-altitude F-16

overflights did not exceed, and were often less than, responses to naturally occurring events (such as thunderclaps).

Compared to jets and light planes, helicopters tend to elicit a heightened response from nesting raptors (Watson 1993, Grubb and Bowerman 1997). Noise from low-level jets and sonic booms has been found to have little effect on nesting peregrine falcons and other raptors (Ellis 1981, Ellis et al. 1991). UASs are small and relatively quiet, and are expected to elicit less of a response than either helicopters or fixed-wing aircraft. Studies of the effects of aircraft overflights on nesting raptors often show slight, but non-significant decreases in reproductive success and number of young fledged (Platt 1977, Windsor 1977, Anderson et al. 1989, Ellis et al. 1991, Delaney, et al. 1997). Nest abandonment due to disturbance is most likely to occur early in the season (Knight and Temple 1986). White and Sherrod (1973) found that nesting raptors flushed from nests when overflown by helicopters that approached unseen, suggesting that raptors may be more likely to flush if the noise or sight of the aircraft is sudden and close.

Of the authorized flights over spotted owl habitat, low-level helicopter flights have the greatest potential to disturb owls (Delaney et al. 1997), because they move slowly and are relatively noisy. Delaney et al. (1999) evaluated the effects of the Sikorsky, HH-60G, and Pave Hawk helicopter overflights on Mexican spotted owls in the Lincoln National Forest, New Mexico. Owl territories were randomly presented with one of three helicopter flight profiles, including 50 ft vertical, 100 ft vertical/100 ft lateral, and 200 ft vertical. Territories with overflights did not differ in reproductive success from territories without overflights. As the distance to the helicopter decreased, owl flush response increased. Owls did not flush in response to helicopters beyond 345 ft, and no owls flushed during incubation and nestling. Flush responses occurred at a rate of 14 percent within 345 ft, 19 percent within 200 ft, and 50 percent within 100 ft. Flushing responses also did not occur when noise levels were less than 92 dBA; however, distance to the helicopter was a better predictor of spotted owl response than sound level. Net differences in prey deliveries for the 24 hours after and before noise manipulations were highly correlated with stimulus distance. Delaney et al. (1999) estimated that the threshold for negative effect on prey deliveries was 315 ft. On average, an alert response (i.e., head movements) was elicited when helicopters approached within 1,330 ft, but no response was noted when helicopters were beyond 2,165 ft from an owl. Short duration, single pass aircraft flights appeared to have little effects on spotted owls; diurnal flights affected owls less than nocturnal flights; and although multiple low-level flights were not recommended, the authors believed spotted owls would habituate with repeated exposures and as the nesting season progresses (Delaney et al. 1997, 1999). Although the effects of overflights may vary with locations, specific conditions, and aircraft type, the following management implications emerged from the results of Delaney et al. (1997, 1999):

1. A 345-ft hemispherical management/protective zone should minimize, and possibly eliminate, spotted owl flush response and negative effects to prey delivery rates associated with helicopter overflights;

2. Flights over owls should be separated by at least seven days;

3. Overflights should be limited to diurnal flights if possible, and nocturnal flights, particularly within three hours of sunrise or sunset, should be minimized; and

4. Helicopter flights near roosts or nests that are single pass and of short duration may be less disturbing than other flight maneuvers such as circling, hovering, and landing.

The USFWS recommends disturbing activities be limited within PACs during the breeding season (March 1-August 31)(USFWS 2012d); this corresponds well with the Delaney et al. 1,330-ft threshold for alert responses to helicopters. Low-level UAS flights are more common, but UASs are smaller and quieter than helicopters, and are expected to elicit minimal response from spotted owls. The Fort has committed to minimizing low-level helicopter flights within 1 mi of spotted owl nests, or the last previously known nest. Helicopters closer than 0.25 mi of active nests will be prohibited from March 1 to August 31. These commitments should minimize adverse effects associated with low-level aircraft flights.

Effects of Fire

Fort Huachuca is participating with other federal agencies in the FireScape program (USDA FS 2009a), which provides for fuels management in the Huachuca Mountains. Fort Huachuca's Integrated Wildfire Management Plan (Gebow and Hessil 2006) provides a planning framework for reducing the risk of fire and fire suppression effects on listed species. The risk of a fire originating in lower-elevation training areas reaching forested habitat in the upper elevations is reduced to some extent by fuel management activities in lowland habitats and to a network of fire breaks that the Fort has established along ridgelines. The FireScape consultation is not current, however, so this BO will include an analysis of the effects of Fort Huachuca's fire and fuel treatment activities.

The Fort has adopted the recommendations of the Mexican spotted owl Recovery Plan (USFWS 1995) in regard to prescribed fire, managed natural fire, and fuel treatments, with some modifications as suggested by the USFWS (see the conservation measures section). Commitments include not burning within the 100-ac core areas, enhancement or retention of owl habitat components during treatments, limiting prescribed or managed natural fire within PACs to 100 ac at a time and only outside of the breeding season, and other measures as described. Although fire is an imprecise tool, these measures greatly reduce the likelihood that treatments will damage Mexican spotted owl habitat or result in death of Mexican spotted owls. Properly applied, a fire program should provide long term protection of owl habitat from catastrophic wildfire.

Fire has always been a major disturbance agent in southwestern forests (Swetnam 1990), and MSOs co-evolved with this disturbance. However, the structure of southwestern forests, the frequency with which they experience fire, and the types of fires experienced have changed greatly following increased human settlement (Covington and Moore 1994, Graham et al. 2004, National Wildfire Coordinating Group 2009, Hudak et al. 2011). Historically, natural fires in ponderosa pine were light, its intensity depending on fuel load and weather. This created a situation whereby some areas did not burn, some areas burned intensely with crown fires, and most areas burned lightly leaving large fire resistant trees, killing shrub top growth, and

removing dead fuels (Wright and Bailey 1982). In mixed conifer forests, historical fires were often intense, with crown-replacement in small patches.

Fire history data have been collected at Fort Huachuca since 1973 with a gap from 1975 to 1977. Historical data have been mapped through 2006 and are shown in PBA Figure 5-1. Most areas of Fort Huachuca have experienced no more than one fire greater than one acre in size every ten years. Higher incidences of wildfires occur in Training Area Tango in portions of the area used for live ammunition fire. These areas consist predominantly of open grassland, mesquite-grass savanna, oak-grass savanna, and oak woodland vegetation. Fires have been rare to non-existent in the upper elevation plant communities (pine woodlands, pinyon/juniper and mixed woodlands) in the South Range from 1973 to 2006 (PBA Figure 5-1). In June 2011 the Monument Fire, which started near the Mexican Border and burned extensive areas in the Coronado National Forest, approached from the south but did not reach the Fort. At the same time, a fire known as the Garden Fire burned 3,622 ac on Fort Huachuca but did not reach Mexican spotted owl or Huachuca water umbel habitat.

Relatively few wildfires have burned in the montane portion of the Fort recently (PBA Figure 5-1); however, fuel loads are high in some areas (Robinett et al. 1997), and several stand-replacing fires have occurred in the Huachuca Mountains south of the Fort recently. The Monument Fire of June 2011, in the Huachuca Mountains, and burned 30,526 ac. Thus, a very hot, stand-replacing fire could potentially burn in owl territories on Fort Huachuca, perhaps with much more severe impacts than those observed by Stacy and Hodgson (1995) in New Mexico.

The Recovery Plan (USFWS 2012d) provides a detailed review of the literature regarding the effects of high-severity fire on MSOs. The potential effects of severe fire include: whether or not the fire and suppression activities are within owl habitat; severity and intensity of unplanned fire; type of habitat involved; areal extent, location, and intensity of suppression activities; frequency and cumulative effects of the suppression activities; and time of year. Many of the key habitat components of owl habitat may be destroyed or severely degraded in high-severity fires. The direct and indirect effects of fire on owl habitat involves the alteration of vegetation structure, soil, and watershed conditions; and may be negative, positive, or both depending on the variables above (USFWS 2012e).

Based upon what we know, in many cases (but probably not all) adult owls are able to fly to relative safety during fire and may survive the initial fire effects (Bond et al. 2002). However, it is unlikely that eggs or nestlings in a nest would survive moderate-to-high severity fire due to direct effects from burning or smoke inhalation (for nestlings). Fledgling MSOs are not likely to survive high-severity fire as they are not skilled at flying and may fly into the fire or become easy prey due to their weak flying skills.

Prescribed (planned) fire, managed natural fire, or wildfire, could result in adverse effects to owls and their habitat (Danzer 2005). Direct effects to Mexican spotted owls may include death of adults or juveniles, flushing of owls off nests and roosts, smoke inhalation, and human disturbance related to fire suppression actions. Indirect effects may include loss or degradation of nesting or foraging habitat, and reduced prey densities and availability.

Stacey and Hodgson (1995) evaluated the impacts of a 24,000-ac natural fire on Mexican spotted owls in the San Mateo Mountains, New Mexico. Birds present in four territories before the fire remained within their same territories after the fire. However, a small sample size of owls combined with an apparent low-intensity fire (the fire burned patchily, only 600 ac burned hot enough to kill all trees, and much undamaged roosting and foraging habitat remained) makes the applicability of the study results to owls range wide or stand-replacing fires questionable.

Stand-replacing fire has been identified as the greatest threat to Mexican spotted owl critical habitat near Fort Huachuca. Fires on Fort Huachuca (planned and unplanned) could become wildfire off of the Fort, and affect critical habitat. The proposed fuels treatments and prescribed burning proposed by Fort Huachuca should greatly reduce the chance of severe wildfires on Fort Huachuca. Wildland fire has the potential to displace or kill adults or nestlings, destroy nest sites and adjacent habitat and affect the prey base. However localized enclaves of trees in the steep-walled canyon habitats of the type often occupied by Mexican spotted owl on Fort Huachuca may escape fire due to a combination of site configuration, vegetation cover, cooler, moister microclimate, and chance even when surrounding habitats are burned by a severe and extensive wildfire. Wildfire is not an effect we consider, as it would be considered under emergency section 7 consultation.

Fires that could affect Mexican spotted owl on Fort Huachuca could originate on Post or off Post. Fort Huachuca's Proposed Action includes measures to reduce the risk of catastrophic wildfire originating on the Fort and measures to minimize the effects of fire suppression as spelled out in the Fort's IWFMP (Gebow and Hessil 2006). Despite use of live ordnance and other training activities that provide sources of ignition, and regularly occurring fires in the low elevation grassland and savanna communities, fires have been infrequent in the upper elevation plant communities on Fort Huachuca (pine woodlands, pinyon/juniper, and mixed woodlands). Most of the areas occupied by Mexican spotted owl PACs have not burned at all or have burned only once since 1973 (Gebow and Hessil 2006).

A system of firebreaks has been developed to help control the spread of fires from low-elevation grasslands, shrublands, and shrub savannas to the higher elevations. The Fort has taken precautions to help reduce the potential for accidental fires by recreational activities. Some of these include restricting camping areas, smoking, canyon access and vehicle use as well as educating recreational users of fire danger and reducing fuel loads in high use recreational areas. Fires associated with on-going and future operational activities could result in impacts to federally-listed species and designated critical habitat including direct fatality, direct habitat destruction or degradation, and indirect destruction or degradation of habitat through post-fire expansion of invasive species, flooding, erosion, and sedimentation. Fire risk would be associated primarily with weapons training, exhaust systems of trucks and other vehicles, and with recreational use. Tracer rounds are often used with machine gun fire, and these contribute to increased risk of fire ignition during training operations. The use of tracer rounds is prohibited by Range Control during extremely dry periods. Vehicle traffic is limited to existing roads and trails at all times, where fuel load is relatively low or absent. The Range Control Officer and Fort Huachuca Fire Chief are responsible for determining fire risk based on weather conditions and trends, using the National Fire Danger Rating System. Recreational use of camp sites or the discarding of cigarettes by recreational users could lead to a wildfire.

Implementation of the FireScape Program (USDA FS 2009a) and the IWFMP as part of the Proposed Action is not anticipated to modify the key habitat components of owl nesting, roosting, or recovery habitat, such as the amount and distribution of large trees, the amount of canopy cover, or amount and distribution of snags. Implementation of the FireScape Program coupled with the IWFMP is also anticipated to allow plant regeneration while retaining sufficient volumes of fallen trees and other woody debris, as well as maintaining a wide range of tree and plant species, and adequate levels of residual plant cover to provide fruits and seeds.

The Fort's IWFMP (Gebow and Hessil 2006) is due to be updated in coordination with USFWS by 2016. The Fort is currently engaged in modeling, mapping and analysis to plan future fuels management activities in collaboration with USFS Fire Modeling Institute, Rocky Mountain Research Station. The purpose of the fuels modeling and management plan is to protect endangered and threatened species habitat, to include the jaguar, ocelot and Mexican spotted owl, from high severity, stand-replacing wildfire due to unnatural high fuel load conditions. USFWS staff involved in the fuels modeling and development of the management plan USFWS. Conducting thinning in strategically placed units to restore low-intensity fire to fire-adapted communities is very important to the Fort. Thinning and burning treatments will be designed in coordination with USFWS to ensure endangered and threatened species are effectively considered in the proposed fuels management.

The FireScape Program (USDA FS 2009a) being implemented cooperatively by USFS, NPS, and the Fort is also aimed at reducing fuels in the mountains. In addition, the IWFMP describes measures to reduce fire hazard related to fuel buildup including prescribed fires (generally at lower elevations) and other fuels treatments. The plan includes conservation measures for Mexican spotted owl and other listed species worked out in consultation with the USFWS. Continued implementation of these plans promises to gradually lessen but cannot eliminate the risk of wildland fires in montane habitat originating from training activities at lower elevations, where fires may originate. Implementation also promises to reduce the potential adverse effects of fire suppression activities.

Bond et al. (2009) monitored movements and habitat use of radio-marked California spotted owls from four territories in the southern Sierra Nevada, California for four years following a large wildfire. California spotted owls nested in all four territories: two nests were located in moderate-severity burned mixed-conifer forest, one in low severity burned mixed-conifer forest, and one in unburned mixed-conifer-hardwood forest. One nesting pair in a moderate-severity burned area successfully fledged a single owl. The others were not successful. Research indicates that spotted owls studied continued to occupy burned areas, even following relatively high-severity fires, except in the territory that experienced the highest burn severity (Bond et al. 2002). Results further suggest that survival rates and mate and site fidelity in these California spotted owls were relatively high in the year following fire. California spotted owls roosted selectively in low-severity burned forest, avoided moderate severity and high-severity burned forest, and used unburned forest in proportion to availability. Within 0.6 mi (1 km) of their nest, California spotted owls foraged selectively in all severities of burned forests and avoided unburned forests. These results collectively suggest that the post-fire landscapes studied contained enough suitable habitat to support pair occupancy and at least attempted nesting. They

further suggest that burned areas may provide benefits to foraging California spotted owls. Bond et al. (2009) concluded that assessments of fire impacts should not assume that all fires have negative impacts on spotted owls and recommended that burned forests within 1 mile (1.5 km) of spotted owl roosts or nests not be salvage-logged.

In addition to the above studies, there are numerous anecdotal observations of MSOs occupying territories following wildfires and prescribed burns (Paul Boucher, Gila National Forest retired, pers. comm.; Shaula Hedwall, USFWS, pers. comm.), as well as evidence of radio-marked Mexican spotted owls moving into and foraging in burned areas during winter (J. P. Ward, Jr. and J. L. Ganey, unpublished data). Most wildland fires burn in a patchy nature and leave pockets of useable habitat for owls, and they appear able to locate and use these patches for nesting and roosting. Thus, MSOs appear to be somewhat resilient to wildfire, at least in the short term. However, we have no data on long-term effects of these fires on occupancy patterns or on components of owl fitness such as survival and reproduction. Therefore, it is unclear how Mexican spotted owls may respond to habitat modification resulting from the three wildfires discussed above and the associated suppression activities.

Patton et al. (1991) found lower survival rates among radio-tagged female northern spotted owls following a forest fire. This was attributed to radio tags, but the birds in this study were exposed to dense smoke and high levels of carbon monoxide by an inversion that trapped smoke near the ground for 25 days following a fire which burned for 50 days. Bond et al. (2002) monitored 21 marked owls of all three (northern, California, and Mexican) spotted owl subspecies. They concluded that when relatively large wildland fires burned known nest and roost sites, the fires appeared to have a short-term effect on survival, site fidelity, mate fidelity, and reproductive success. Flames and smoke from fire may cause spotted owls to flush from nests or roosts, and may impair hunting through interfering with audio and visual detection of prey. If fire occurs within PACs, is possible that nest and roost trees may be killed through crowning or heat. All of these may result in direct fatality, failed reproductive efforts, and starvation of young and adult Mexican spotted owls.

Disturbance to the Mexican spotted owl may also be caused by human activities in, adjacent, and above PACs and other habitat during fire suppression or management. Disturbance may be caused by fire personnel digging fire lines, walking and igniting with drip torches, the dropping of slurry, use of chainsaws and heavy equipment, and monitoring fire conditions from the ground or air. Human disturbance in an occupied PAC during the breeding season may result in failed reproductive efforts, abandonment of the nest, and starvation of young. However, fire suppression fire tactics can also be used to reduce fire severity and canopy losses (USFWS 2012d).

After severe fires, emergency stabilization and rehabilitation are completed within one to three years after the fire (USFWS 2012d). The soil stabilization, reseeding, and tree planting are likely beneficial over the long term, but the activities could disturb spotted owls still using the area, but are probably not a significant impact (USFWS 2012d).

The indirect effects of wild and prescribed fire include both negative and beneficial effects on spotted owl habitat. Beneficial aspects would include increased response of herbaceous

vegetation after a fire and possible reduced future occurrence of stand-replacing fire. Negative effects would include the loss of Mexican spotted owl nest and roost habitat (Franklin et al. 2000), and prey habitat components such as herbaceous cover, down logs, and snags (Kyle and Block 2000). The effects of fire on the prey base are complex and dependent on the variations in fire characteristics and in prey habitat. Fire intensity, size, and behavior are influenced by numerous factors such as vegetation type, moisture, fuel loads, weather, season, and topography. Fire can effectively alter vegetation structure and composition thereby affecting small mammal habitat. The initial effects of fire are likely to be detrimental to rodent populations as cover and plant forage species would be reduced.

It is suspected that the effects of stand-replacing wildfires that dramatically alter forest structure and move the system to earlier successional stages would have longer-term effects on some rodent populations. Likely, early successional species such as deer mice and those that require open habitat with a well-developed herbaceous understory, such as pocket gophers, would benefit. In contrast, species that require a wooded or forested overstory would exhibit population declines. The net effect of such fires on MSO prey is unclear. A fire that removes large areas of the tree canopy would likely render a portion of the area unusable for foraging by spotted owls, but if the spatial extent of crown loss is limited, a mosaic is created that could provide a diversity of prey for the owl and actually be beneficial (Ward and Block 1995). Because owl prey species evolved in ecosystems where fire was a natural process, we assume that historically, these species survived, and some even benefited from the occurrence of fire. Fire has been excluded from most southwestern ecosystems during the 20th century, thus resulting in systems where fire behavior may deviate substantially from historical conditions. Effects of fire on small mammals under present environmental conditions are unclear (Ward and Block 1995).

Population responses by small mammals to fire-induced changes in their habitat vary. For example, deer mouse populations might increase immediately following fire and then decrease through time (Ward and Block 1995). Campbell et al. (1977) noted that populations of peromycid mice decreased immediately following fire in an Arizona ponderosa pine forest that removed one-fourth (moderately burned) to two-thirds (severely burned) of the basal area; populations then returned to pre-fire numbers two years following the burn. Furthermore, no differences were found in rodent populations between moderately and severely burned areas. They concluded that the effects of the fire that they studied were short-term, and the short-term positive numerical responses of mice were attributed to an increase in forage, particularly grasses and forbs after the fire (Ward and Block 1995). Irvine (1991) documented post-fire declines in deer mice populations at study sites on the Coconino National Forest. Irvine attributed these declines to reduced food supplies. Lowe et al. (1978) noted an increase in deer mice populations the first year after a fire in ponderosa pine near Flagstaff, Arizona. Small mammal diversity and densities are typically depressed for one to three years after a fire (Wright and Bailey 1982). Biswell et al. (1973) suggested that rodent populations would be less affected during fall fires, because at that time of year rodents have accumulated seed caches that will mitigate loss of food sources. Predation of surviving rodents that are part of the diet of the Mexican spotted owl may increase immediately after the fire. In one study in northern California, radio-collared northern spotted owls spent considerable time in burned-over areas. This activity was assumed to be due to easy capture of prey (Patton and Gordon 1995).

Fire is likely to have immediate short-term adverse effects to Mexican spotted owl prey habitat. Although fire may enhance vegetative density and abundance in the long-term, short-term effects of burning, particularly in the spring and early summer when herbaceous vegetation is most critical for reproducing rodents, may limit available forage immediately after the fire. Wildfire would most likely occur in June before the onset of the summer rains. Nesting Mexican spotted owls would be most affected during this time, as they would be nesting and require a consistent supply of prey to successfully fledge young. Prescribed fire may be expected to alter mixed conifer habitats of the Mexican spotted owl in the short-term to a greater extent now than historically because the fuel accumulations that are characteristic of many Mexican spotted owl nest and roost sites generally place them at higher fire risk.

Prescribed and managed natural fires are extremely important management tools needed to enhance or restore many ecosystem functions and processes. Reduction in habitat and various habitat-based threats have contributed to the listing of the Mexican spotted owl. The long-term benefits to the Mexican spotted owl of many land management actions may contribute, in the short-term, to certain adverse effects to the owl. Prescribed and natural fire projects often fall into this category. Species such as the owl, whose habitats have been reduced, degraded, or altered, may currently respond to fire differently than they did historically when fire occurred in a more natural setting. Therefore, it is important to address such concerns by minimizing, to the greatest extent practical, those short-term adverse effects, and move forward with proactive land management as fire is applied in efforts to restore ecosystem function and community dynamics.

Prescribed or managed natural fires are likely to create small openings in the canopy caused by single or groups of trees crowning. The risk of trees crowning is more probable in Mexican spotted owl nesting and roosting habitat. The location of quality owl habitat often corresponds to characteristics that put these sites at higher risk of crowning such as dense, multi-layered canopies, and high fuel loadings resulting from high densities of down logs. Where fire does not crown, some loss of the lower canopy is expected. This is likely to be particularly true in mixed conifer habitats which are usually denser and contain more of the "ladder fuels" created by smaller conifer trees. The loss of some of the lower branches in the canopy may have some effect on Mexican spotted owl foraging. Mexican spotted owls utilize the "perch and pounce" method of hunting, using the lower branches of trees for perching. The loss of some perching sites when burning within prescription is not expected to significantly affect the ability of Mexican spotted owl to forage successfully.

The owl Recovery Plan encourages fire management programs that take an active role in fuels management and understand the ecological role of fire. The Recovery Plan also recognizes that high severity, stand replacing wildfire is a primary threat to the owl. Therefore, fire plays the dual role of being both potentially beneficial and catastrophic to the owl and its habitat. The USFWS stresses the need to apply adaptive management when using fire. Prescriptions that maintain key structural features of owl and small prey habitats should be developed and tested. These features include large trees, snags, logs, and overstory. Treatments to produce or maintain such habitat components must be assessed by monitoring to evaluate if treatment objectives were met in both the short and long term. Wholesale use of fire without understanding or monitoring its effects on habitat may render these areas unusable by owls, and may also miss opportunities to improve our knowledge of fire effects on these habitats (Moir et al. 1995).

Prescribed fire should be used carefully in owl habitat (USFWS 2012d). Fire is one of the most rapidly acting of natural disturbances. A crown fire can quickly consume vast tracts of forest. After a large crown fire, habitat components for Mexican spotted owl nesting, roosting, and foraging are reduced or eliminated. Small-scale natural fires and prescribed burns, however, can reduce fuel load and create small openings and thinned stands that increase horizontal diversity and reduce the spread of catastrophic fire. Small-scale fires and lightning strikes also create snags, canopy gaps, and large downed logs, plus they perpetuate understory shrubs, grasses, and forbs which are important habitat components to the owl and its prey (Moir et al. 1995).

Mechanical Treatments

Refer to the ocelot section of this BO for a discussion of the Fort's proposed fuel treatments. Fuel reduction projects follow the guidelines in the 1995 MSO Recovery Plan (USFWS 1995).

Empirical data on the effects of thinning and other mechanical forest treatments on Mexican spotted owls are nonexistent. This is unfortunate, because thinning and other mechanical forest treatments are emphasized heavily in plans for landscape-restoration of southwestern forests , and these activities could affect large areas of Mexican spotted owl habitat. Consequently, understanding how these treatments affect Mexican spotted owls is one of the major questions faced in integrating recovering this owl with plans for restoring southwestern forests. Although this has been clearly noted for years (e.g., USFWS 1995, Beier and Maschinski 2003, Ganey et al. 2011), no studies on this topic have been funded. Consequently, we can only extrapolate from the sparse data available on this topic resulting from studies of other subspecies of spotted owls, which we summarize below.

Meiman et al. (2003) conducted a case study of a single male northern spotted owl before, during, and after a commercial thinning operation conducted within the home range of this owl. About 96 ha (237 ac) of forest lands were commercially thinned in this operation. Treatments occurred outside of a 28-ha (70-ac) designated core area, but within 70 m (230 ft) of nest trees used by the resident owls. About 55 ha (136 ac) were thinned to a basal area of 39 m^2 ha-1 (170 ft^2 ac-1), a 4.5-ha (11.1-ac) area was thinned to 20.7 m^2 ha-1 (90.2 ft^2 ac-1) basal area, and a third area was thinned to 29.9 m^2 ha-1 (130.2 ft^2 ac-1). Breeding-season home range size of the radio-marked male declined slightly after thinning (from 895-753 ha [2,212-1,861 ac]), but shifted geographically to exclude part of the thinned area and include unthinned areas elsewhere. In contrast, the non-breeding season home range was 2.3 times larger after harvest (2,825 ha [6,978 ac]) than before harvest (1,204 ha [2,974 ac]). The radiomarked owl was located up to 7 km (4.4 mi) from the nest area during the non-breeding season after thinning, versus 3.4 km (2.1 mi) before thinning. Size of core use areas did not differ significantly between pre- and post-harvest periods, but as with home range, geographic shifts were observed away from the thinned area. Based on number of locations, use of the thinned stand was significantly reduced after harvest. Thus, results suggest some spatial shifts in areas used following harvest, as well as reduced use of the thinned stand following harvest. However, results are difficult to interpret because we generally lack information about temporal variation in space and stand use. Further, this study is unlikely to shed much light on how restoration treatments might affect Mexican spotted owls, because the residual basal areas in treated stands (20.7-39 m^2 ha-1 [90.2-170 ft^2 ac-

1]) were far greater than residual basal areas typical of restoration projects in the southwestern U.S. (11.5-16.1 m2 ha-1 [50-70 ft2 ac-1;USDA FS 2011]).

Seamans and Gutiérrez (2007) examined the relationship between habitat selection of California spotted owls and variation in habitat in the Sierra Nevada. They modeled the probability of territory colonization, territory extirpation, and breeding dispersal in relation to the amount of mature forest within and among territories, and included a covariate to evaluate the effects of alteration of mature conifer forest habitat by timber harvest on these parameters. Estimates of habitat variables were based on 400-ha (988-ac) circles centered on the geometric center of all owl locations for a territory within a given year. The probability of territory colonization was related to both area of mature conifer forest within a territory and alteration of that habitat. The top model for colonization indicated that territories in which ≥20 ha (49 ac) of mature conifer forest habitat was altered by timber harvest experienced a 2.5 percent decline in occupancy probability. The top model for territory extirpation suggested that this parameter was negatively related to amount of mature forest within a territory. The structure of this top model did not allow them to separate the effects of habitat alteration within territories from variation in amount of mature forest among territories. Assuming that the variation in territory extirpation probability was due to variation in amount of mature conifer forest among territories, this model suggested that occupancy probability increased approximately 1.1 percent for every 20-ha difference in amount of mature conifer forest among territories.

The probability of breeding dispersal (i.e., leaving an established territory in year t to move to another territory in year t+1) was related to both amount of mature conifer forest and alteration of that habitat. The top-ranked model suggested that probability of breeding dispersal was negatively related to the amount of mature conifer forest within a territory and positively related to alteration of ≥20 ha (49 ac) of mature conifer forest. This model also included an interaction between amount of mature conifer forest and alteration of that habitat. This interaction term suggested that breeding dispersal was much more likely to occur in territories with <150 ha (371 ac) of mature conifer forest that experienced habitat alteration than in territories with greater amounts of mature conifer forest that did not experience habitat alteration.

Seamans and Gutiérrez (2007) did not provide details on what types of treatments were involved in habitat alteration in this study, nor on spatial extent of those treatments. That is, they modeled a covariate based on alteration of ≥20 ha (49 ac) of mature mixed-conifer forest, but provided no information on how frequently territories experienced alteration of that magnitude versus larger areas. These limitations complicate interpretation of their results. Nevertheless, those results generally indicate positive effects of amounts of mature conifer forest and negative effects of alteration of ≥20 ha (49 ac) of mature conifer forest on demographic parameters.

Gallagher (2010) monitored movements and habitat use of 10 radiomarked California spotted owls in the northern Sierra Nevada in a landscape recently modified by fuels treatments. Fuels treatments included: Defensible Fuel Profile Zones (DFPZs), understory thin, understory thin followed by underburn, and group selection. DFPZs were about 0.4 to 0.8 km (0.2-0.5 mi) wide where surface, ladder, and crown fuels loadings were reduced (USDA FS 2009b). They were typically constructed along roads and ridge tops to reduce fuel continuity across the landscape

and provide a defensible zone for fire suppression activities, and were designed to function effectively under 90th percentile weather conditions.

Understory thin treatments allowed removal of trees <25.4 cm (10 in) in dbh. Understory thin with underburn allowed for use of surface fire following thinning. Group selection treatments allowed removal of all trees <76.2 cm (30 in) in patches <0.8 ha (2 ac) in area.

Radio-marked owls avoided DFPZs, but use of all other treatments was variable, and results were confounded by spatial orientation of treatments relative to owl core areas. Noting these complicating factors, Gallagher (2010:2) noted that "Conclusions from this study are exploratory and are intended to provide a baseline for further research."

Dugger et al. (2011) evaluated relationships between northern spotted owls and barred owls in the southern Cascades of Oregon. They modeled the effects of barred owl presence on northern spotted owl territory occupancy, using amount of suitable spotted owl habitat as a covariate.

Northern spotted owl territory colonization rates were strongly and negatively related to detections of barred owls, and territory extirpation rates were strongly and positively related to barred owl detections. Extirpation rates increased in response to decreased amounts of old forest habitat within territory cores, and colonization rates were greater where old forest habitat was less fragmented. Dugger et al. (2011) concluded that the combined barred owl and habitat effects observed suggested that interference competition was occurring between these owl species. They further concluded that these effects suggested that maintaining northern spotted owls on the landscape in the face of this competition would require conserving large amounts of contiguous old forest habitats.

As noted earlier, empirical data on effects of forest treatments on spotted owls are sparse and difficult to interpret. Although all of the studies discussed above individually present limits to interpretation, collectively they suggest that at least some kinds of mechanical forest treatments may negatively impact spotted owls. No clear guidance emerges from these studies relative to types, extents, or spatial arrangement of treatment that might minimize impacts to owls. Such information is badly needed if management is to proceed in owl habitat. Some treatments may have beneficial or neutral effects, but we do not know which types and intensities of treatments may be beneficial, neutral, or harmful. Lacking such information, managers should proceed cautiously in terms of treatment intensity and extent. That is, initial treatments should be limited in spatial extent and treatment intensity, and should be aimed at balancing reduced fire risk with maintaining the mature forest structure that seems to be favored by Mexican spotted owls. All treatments in owl habitat should be linked to rigorous monitoring of owl response, to allow us to evaluate the effects of different types of treatments in an adaptive management context. The Mexican spotted owl Recovery Plan recognizes that managed natural fire may be beneficial to owl habitat in several ways: 1) it can aid in reducing fuel loads and the risk of stand replacing wildfire which may result in the loss of habitat over large areas; 2) it can create a diverse landscape with considerable horizontal heterogeneity which seems to be relatively characteristic of many areas occupied by spotted owls and also provides for a diverse prey base; and 3) it can create conditions that maintain shade-intolerant species in the landscape.

Effects to critical habitat are similar to those described for nominal Mexican spotted owl critical habitat, above. Again, stand-replacing fire is most likely the greatest threat to critical habitat near Fort Huachuca. Fort Huachuca's proposed action includes both efforts to reduce the risk of high severity wildfire and to minimize the effects of fire suppression. The proposed action is not anticipated to: 1) change the distribution of tree species and sizes within critical habitat; 2) reduce canopy shade below 40 percent of the ground; or 3) appreciably reduce the number of snags. The proposed action is also anticipated to retain: 1) high volumes of fallen trees and other woody debris; 2) a wide range of tree and plant species, including hardwoods; 3) and adequate levels of residual plant cover to maintain fruits and seeds, and allow plant regeneration.

Cumulative Effects

See the Cumulative Effects section for the Huachuca water umbel, above, for a general definition of cumulative effects and a discussion of our limitations regarding analysis of those effects per Section 321 of the Defense Authorization Act of 2004.

Cumulative effects within the portion of the action area within which Mexican spotted owl occur are limited. UDI traffic occurs throughout the Huachuca Mountains, including on Fort Huachuca, and it is likely that individuals and groups of individuals have crossed PACs and disturbed Mexican spotted owls. The presence of UDIs is also anticipated to increase the risk of wildfire. Interdiction of UDIs by Federal authorities is not a cumulative effect.

Population growth on State and local lands in the Sierra Vista Subwatershed is likely to result in an increase in recreational activities in the Fort Huachuca/Sierra Vista region, including the SPRNCA and the Coronado National Forest. Increased recreation will increase the potential for human disturbance, habitat degradation or loss associated with recreation, and a higher risk of wildfires with the potential to affect the Mexican spotted owl in the Action Area. In addition, private lands at the mouths of many canyons to the south of Fort Huachuca are being developed as housing tracts or ranchettes. The lower reaches of these canyons may provide wintering spotted owl habitat. This increasing human presence is likely to result in increased disturbance of Mexican spotted that ordinarily reside on Fort Huachuca. The effects of this development, however, are not considered cumulative to the proposed action because they do not occur within the action area. Compliance with the Act for activities on state and private lands that may affect the Mexican spotted owl, but are not addressed by section 7 consultation, could occur through section 10(a)(1)(B) of the Act.

Conclusion

We reviewed the current status of the Mexican spotted owl, the environmental baseline for the action area, and the effects of the proposed action. We could not consider some cumulative effects in our conclusion pursuant to Section 321 of the Defense Authorization Act of 2004. It is our biological opinion that the proposed action is not likely to jeopardize the species or adversely modify or destroy critical habitat. In making our determination we considered the following:

- Based on the effects evaluation above, potential effects on Mexican spotted owl or its habitat on the Fort could come from fire, noise from training activities, human disturbance, and

cumulative effects (climate change). There would be little effect on the species from habitat loss, direct fatality, erosion, or groundwater use associated with the Proposed Action;

- Mexican spotted owls at Fort Huachuca occur primarily in remote canyons of the Huachuca Mountains that few recreationists visit (an exception being Scheelite Canyon) and where little or no military training occurs;
- Few military overflights occur in the canyons of the Huachuca Mountains where spotted owls are located, and most flights occur above 500 ft AGL;

- Recreational rock climbing and rappelling are prohibited at Fort Huachuca. Rappelling as part of military training is restricted to a cliff in Garden Canyon, which is outside of known owl PACs;
- The threat of wildfire is being addressed by the Fort through a comprehensive fire management plan that calls for prescribed fire and reduction of fuel loads. Implementation of the plan will help reduce the chance of high-severity stand-replacing fire that could adversely affect owl nesting and foraging habitat;
- The proposed action affects a relatively small part of the range and total critical habitat of this threatened species;
- The Fort proposes substantial conservation measures, including specific measures contained in the Mexican spotted owl Recovery Plan, that reduce the effects of the proposed action on the species and to the key habitat components of owl habitat;
- The chance that actions on Fort Huachuca would cause wildfires negatively affecting critical habitat outside of the Fort is slim;
- The aforementioned effects will not affect the ability to recover the Mexican spotted owl because negative impacts to individuals is minimal, and fuels management will reduce the chance that stand-replacing fire would remove spotted owl habitat;
- Monitoring will be performed to verify the status of the species within the action area and to evaluate the effectiveness of the conservation measures, both in minimizing the effects of the proposed action and in retaining the primary constituent elements of critical habitat;
- Recovery is the process that stops the decline of an endangered or threatened species by removing or reducing threats. Recovery ensures the long-term survival of the species in the wild. At that point, the species is recovered, and protection of the ESA is no longer necessary. The aforementioned effects will not appreciably reduce the likelihood of recovery of the lesser long-nosed bat based on the long-term stable to increasing status of lesser long-nosed bat, as described above, appear to be effective based on the long-term stable to increasing status of lesser long-nosed bat roosts and forage resources on the Fort, and the relatively minor contribution that the lesser long-nosed bat roosts and forage found within the action area represent to the species throughout its range. Specifically, the following conservation measures included in the proposed action meet recovery actions outlined in the Mexican spotted owl recovery plan, including 1) manage against catastrophic fire, reduce human disturbance, seasonal restrictions, and limit access (Recovery Action 6); restricting access to known roosts (Recovery Action 1); and monitor PACS (Recovery Action 7);
- There would not be effects on the Primary Constituent Elements of their habitat, and the Army has implemented impact avoidance and species conservation measures for each of these sources of impact; and
- Despite the implementation of effective species conservation measures by the Fort, there remains a potential for take from recreational use in the habitat, noise from military training,

and the potential for high severity fires during severe weather conditions that preclude fire suppression.

The proposed action does not appreciably reduce the likelihood of Mexican spotted owl recovery within their historical range. The adverse effects that do occur in the action area do not reach the scale where recovery of the species would be delayed or precluded. We make this conclusion for the following reasons:

- The Fort has been monitoring owls and engaging in conservation actions that reduce impacts to them and their habitat for years. Monitoring at Fort Huachuca is more regular than most areas of the Basin and Range West recovery unit;
- The Fort proposes substantial conservation measures, including specific measures contained in the Mexican spotted owl Recovery Plan, that reduce the effects of the proposed action on the species and to the key habitat components of owl habitat;
- The aforementioned effects will not affect the ability to recover the Mexican spotted owl because negative impacts to individuals is minimal, and fuels management will reduce the chance that stand-replacing fire would remove spotted owl habitat
- The potential area of effect is only a small part of the recovery unit, and a smaller part still of the range of the species;
- The proposed conservation measures reduce the chance for impacts to Mexican spotted owls which occur on Fort Huachuca; and
- Monitoring and recovery actions continue to occur within the species' historical range.

FWS is unable to identify a recovery "tipping point" or threshold for the Mexican spotted owl, because even with the relatively long-term information that is available for the owl, the available information cannot be used to determine recovery thresholds. Because we cannot identify a tipping point, we cannot determine whether that tipping point would be reached as a result of agency operations. Since the impacts of the proposed action are largely mitigated by the proposed conservation measures and the action area is small compared to the recovery unit and the range of the species, it is highly unlikely that the proposed action would, or even could, cause a tipping point away from recovery to be reached. The adverse effects that do occur in the action area do not reach the scale where recovery of the Mexican spotted owl would be delayed or precluded because looking at the totality of the Fort Huachuca's actions they actually contribute to recovery of Mexican spotted owl. Adverse effects and associated incidental take from the proposed action off of Fort Huachuca are anticipated to be minimal, and are unlikely to destroy or adversely modify the critical habitat in the action area to the extent that recovery would be delayed or precluded for many of the reasons found in the conclusion and discussion above.

INCIDENTAL TAKE STATEMENT

Please see the Incidental Take Statement for the ocelot, above, for a narrative and the statute and policy governing the content of this Incidental Take Statement. Under the terms of sections 7(b)(4) and 7(o)(2), taking that is incidental to and not intended as part of the agency action is not considered to be prohibited taking under the Act provided that such taking is in compliance with the terms and conditions of this incidental take statement.

The measures described below are non-discretionary, and must be undertaken by Fort Huachuca so that they become binding conditions of any grant or permit issued to the applicant, as appropriate, for the exemption in section 7(o)(2) to apply. Fort Huachuca has a continuing duty to regulate the activity covered by this incidental take statement. If Fort Huachuca: (1) fails to assume and implement the terms and conditions; or (2) fails to require the applicant to adhere to the terms and conditions of the incidental take statement through enforceable terms that are added to the permit or grant document, the protective coverage of section 7(o)(2) may lapse. To monitor the impact of incidental take, Fort Huachuca must report the progress of the action and its impact on the species to the USFWS as specified in the incidental take statement (50 CFR §402.14(i)(3)).

Amount or Extent of the Take

We anticipate that the proposed action is reasonably certain to result in incidental take of Mexican spotted owls. Take may be in the form of harm, harassment, injury, or death resulting from the loss of a nesting site, loss or disturbance of a nest by recreational or military activities, loss or degradation of protected or recovery habitat as a result of fire, and collision of a Mexican spotted owl with a vehicle, antennae, fences, or other project features. The USFWS anticipates incidental take of Mexican spotted owl will be difficult to detect or determine because: 1) dead or impaired individuals are difficult to find and losses may be masked by seasonal fluctuations in environmental conditions; 2) the status of the species could change over time through immigration, emigration, and loss or creation of habitat; and 3) the species is secretive and we rarely have information regarding the number of owls occupying a PAC or their reproductive status. The Fort's proposed conservation measures greatly reduce the chance that take would occur; however, we anticipate the take, through direct injury or fatality, or harm of a total of two Mexican spotted owls, or one nest with eggs or nestlings as a result of the above causes over the life of the project at Fort Huachuca.

In addition, take of one Mexican spotted owl is anticipated in the Scheelite Canyon PAC and one Mexican spotted owl elsewhere at Fort Huachuca over the life of the project as a result of harassment due primarily to recreational activities, but also possibly as a result of other causes listed above.

This biological opinion does not authorize any form of take not incidental to implementation of the proposed action as described in this biological opinion and the Revised PBA.

Effect of the Take

We have determined that the level of anticipated take is not likely to jeopardize the continued existence of the Mexican spotted owl because it represents a small proportion of the species' population within the recovery unit and a yet-smaller proportion of the greater population. We have also determined that the level of anticipated take will not destroy or adversely modify designated critical habitat because the take is in the form of mortality and harm resulting from habitat alterations that are small in relation to the amount of critical habitat in the recovery unit and rangewide. We will not refer the incidental take of Mexican spotted owl for prosecution

under the Migratory Bird Treaty Act of 1918, as amended (16 U.S.C. §§703-712), if such take is in compliance with the terms and conditions (including amount and/or number) specified herein.

Reasonable and Prudent Measures

The USFWS believes that no reasonable and prudent measures are necessary because the conservation measures proposed by Fort Huachuca include sufficient measures, including many contained in the Mexican spotted owl Recovery Plan, to minimize impacts of incidental take of the species. Therefore, because there are no reasonable and prudent measures, there are no terms and conditions.

If the incidental take anticipated in the paragraph entitled "Amount or Extent of Take is met, the Fort shall immediately notify the USFWS in writing. If, during the course of the action, the level of anticipated incidental take is exceeded, such incidental take represents new information requiring reinitiation of consultation. In the interim, the Fort must cease the activity resulting in the take if it is determined that the impact of additional taking will cause an irreversible and adverse impact on the species. Fort Huachuca must immediately provide an explanation of the causes of the taking and review with the USFWS the need for possible modification of the reasonable and prudent measures.

CONSERVATION RECOMMENDATIONS

See the Conservation Recommendations section for the Huachuca water umbel, above, for information regarding the statute and policy governing Fort Huachuca's implementation of the following recommendations:

- Fort Huachuca should study the effects of recreational activity on Mexican spotted owls and their habitat in Scheelite Canyon. The study should quantify recreational use, effects on owl behavior, energetics, movements, and reproduction, as well as effects to the habitat resulting from trampling, potential for fire, etc.; and
- Fort Huachuca should follow guidelines from the 2012 Mexican spotted owl recovery plan, and not the 1995 recovery plan.

In order for the USFWS to be kept informed of actions minimizing or avoiding adverse effects or benefiting listed species or their habitat, the USFWS requests notification of the implementation of any conservation recommendations.

Table MSO1. Mexican spotted owl reproductive success based on the number of years the PAC was occupied by a pair, 1990 to 2005 Fort Huachuca, Arizona (PBA).

PAC Name	PAC Number	Years Young Produced	Years Occupied by a Pair	Average Percent Reproductive Success
Rock Springs Canyon Trail	5001001	3	8	38
McClure Canyon	5001002	5	14	36
Upper Huachuca Canyon	5001003	6	14	43
Cave Spring Canyon	5001004	1	3	33
Scheelite Canyon	5001005	4	15	26
Split Rock Canyon	5001006	0	5	0
Blacktail Canyon	5001007	0	0	0
Lower Huachuca Canyon	5001008	3	6	50
Upper Tinker	5001009			
Sawmill Canyon	50010010			
Lower Garden Canyon	50011011			

Table MSO2. Mexican spotted owl occupancy and reproduction at Fort Huachuca, Arizona PACs 1990 to 2005 (PBA).

PAC	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	Total Confirmed Young
Rock Springs Canyon Trail 5001001	ND	O, 1Y	O, 2Y	O, NN	O, NN	O, NN	O, 1Y	A	A	A	A	A	ND	1F	O, NU	O, NN	4
McClure Canyon 5001002	ND	O, 1Y	O, 3Y	O, NN	O, NN	O, NN	O, NF	O, 2Y	O, NN	O, NN	O, NU	1M, 1F	O, NU, (1Y2)	O, NN	F	O, 1Y	8
Upper Huachuca Canyon 5001003	ND	O, NU	O, 1Y	O, NN	O, NN	O, NN	O, NN	O, 2Y	O, 1Y	O, NN	O, 1Y	O, 2Y	1M	O, 1Y	O, NU	O, NN	8
Cave Springs Canyon 5001004	O, NN	A	O, NU	A	A	A	A	A	A	A	ND	ND	ND	ND	ND	O, 2Y	2
Scheelite Canyon 5001005	O, NN	O, 2Y	O, NN	O, NN	O, NN	O, 1M	O, NN+ M	O, NN	O, NN	O, NN	O, NU	O, 2Y	1M	O, 1Y, 1U	O, 2Y	O, NF	7
Split Rock Canyon 5001006	ND	O, NF	O, NN	O, NN	O, NN	O, NN	M	A	A	A	A	A	ND	A	A	ND	0
Blacktail Canyon 5001007	ND	A	A	A	A	A	M	A	A	A	A	A	ND	ND	A	ND	0
Huachuca Canyon-Lower 5001008	ND	A	A	A	A	A	A	A	O, NU	A	O, 2Y	O, NN	O, 1Y	O, 2Y	F, NU	O, NF	5

DRAFT

Upper Tinker3 5001009											A	ND	ND	ND	ND	ND	
Sawmill Canyon 5001010											O, + 1M	O, (?) Y4	ND	ND	ND	A5	
Lower Garden Canyon 5001011																	

1 This table has been adapted from previous Mexican spotted owl annual monitoring reports provided to Fort Huachuca. 2 One young observed post survey season (24 September 2002) an estimated 200 meters west of 2002 roost grove.
3 Upper Tinker Canyon Inventory Area designated as unsuitable habitat for Mexican spotted owl (S. Stone, FH, pers. comm., 2001)
4 Confirmed pair nested in Sunnyside PAC, Coronado National Forest. Nest success undetermined (P. T. Deecken, USFS, pers. comm., 2001)
5 Male detected once on Sawmill PAC side and once on Sunnyside PAC, never detected further into Sawmill Canyon.

Legend for Tables MSO1 and MSO2 (From USDA Forest Service, Southwestern Regional Office Report Direction, 1992.):
O: Pair occupancy inferred or confirmed NN: Non-nesting Y: Number of young fledged P: Presence of lone Mexican spotted owl, sex unknown M: Male inferred or confirmed NU: Nesting status unknown YD: Young found dead A: Absent or unoccupied F: Female inferred or confirmed NF: Nest failed NA: Nest abandoned ND: No data

Figure MSO1. Ecological Management Units for the Mexican spotted owl in the southwestern United States (USFWS 2012d).

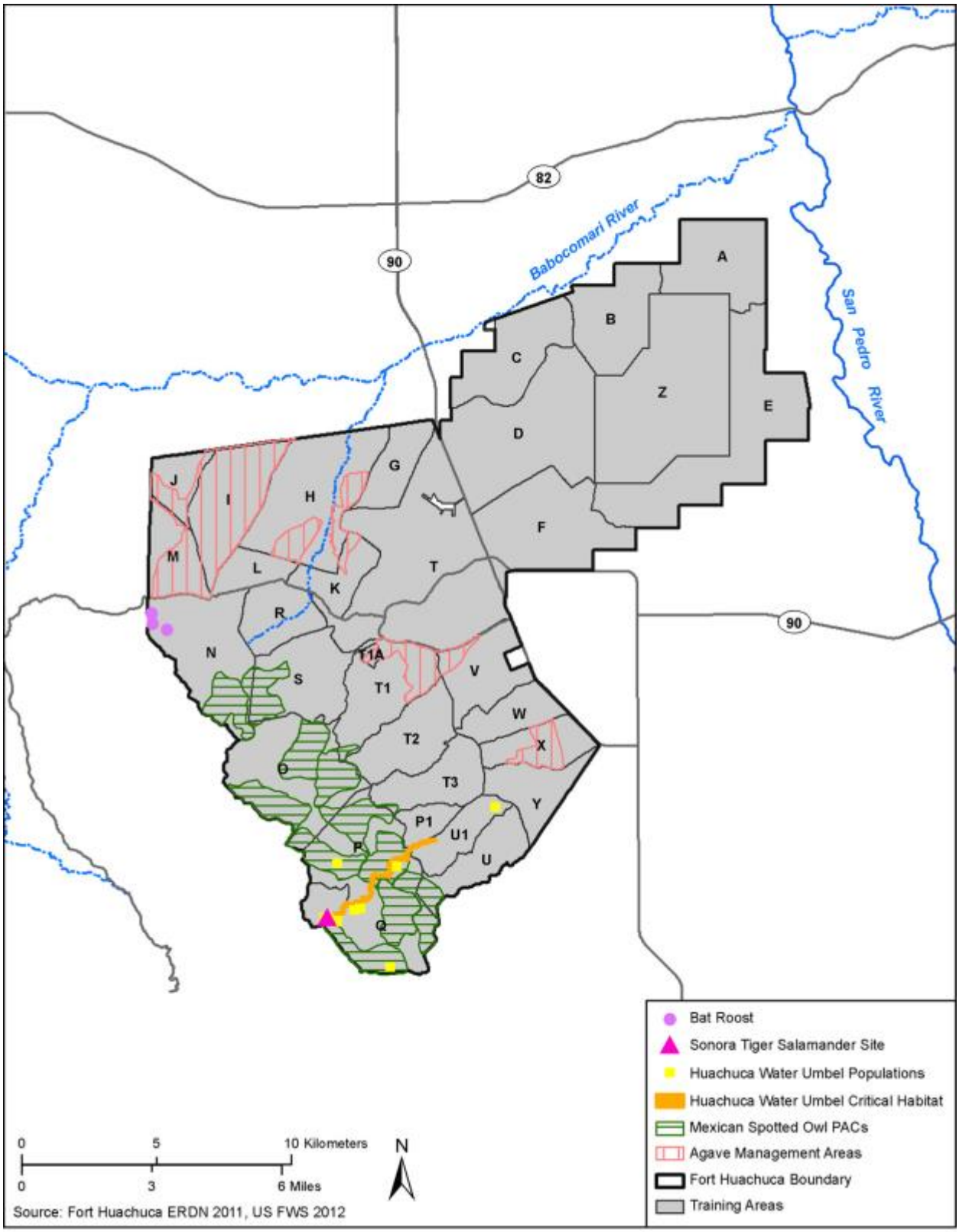


Figure MSO2. Location of listed species and habitats on Fort Huachuca, Arizona (PBA Figure 4-4).

REINITIATION AND CLOSING STATEMENTS

Reporting Requirements/Disposition of Dead or Injured Listed Animals

Upon finding a dead or injured threatened or endangered animal, initial notification must be made to the USFWS's Division of Law Enforcement, 2450 West Broadway, Mesa, Arizona (480-967-7900) within three working days of its finding. Written notification must be made within five calendar days and include the date, time, and location of the animal, a photograph, and any other pertinent information. Care must be taken in handling injured animals to ensure effective treatment and care, and in handling dead specimens to preserve biological material in the best possible condition. If feasible, the remains of intact specimens of listed animal species shall be submitted as soon as possible to the nearest USFWS or AGFD office, educational, or research institutions (e.g., University of Arizona in Tucson) holding appropriate state and Federal permits.

Arrangements regarding proper disposition of potential museum specimens shall be made with the institution before implementation of the action. A qualified biologist should transport injured animals to a qualified veterinarian. Should any treated listed animal survive, the USFWS should be contacted regarding the final disposition of the animal.

Conclusion

This concludes formal and conference consultation on the Department of the Army's proposed land use, military operations, and training range utilization at and near Fort Huachuca, Arizona, for 10 years. As provided in 50 CFR §402.16, reinitiation of formal consultation is required where discretionary Federal agency involvement or control over the action has been maintained (or is authorized by law) and if: 1) the amount or extent of incidental take is exceeded; 2) new information reveals effects of the agency action that may adversely affect listed species or critical habitat in a manner or to an extent not considered in this opinion; 3) the agency action is subsequently modified in a manner that causes an effect to a listed species or critical habitat that was not considered in this opinion; or 4) a new species is listed or critical habitat designated that may be affected by this action.

Regarding the proposed action‘s effects to the proposed threatened northern Mexican gartersnake with proposed critical habitat and the proposed threatened yellow-billed cuckoo, you may request that the USFWS confirm the conference opinion as a biological opinion issued through formal consultation if the species are listed or critical habitat is designated. The request must be in writing. If the USFWS reviews the proposed action and finds that there have been no significant changes in the action as planned or in the information used during the conference, the USFWS will confirm the conference opinion as the biological opinion on the project and no further section 7 consultation will be necessary.

Certain project activities may also affect species that are protected under the Migratory Bird Treaty Act (MBTA) of 1918, as amended (16 U.S.C. sec. 703-712) and/ bald and golden eagles protected under the Bald and Golden Eagle Protection Act (BGEPA). The Migratory Bird Treaty Act (MBTA) prohibits the taking, killing, possession, transportation, and importation of migratory birds, their eggs, parts, and nests, except when specifically authorized by the USFWS. BGEPA prohibits anyone, without a permit issued by the USFWS, from taking (including

disturbing) eagles, and including their parts, nests, or eggs. If you believe migratory birds will be affected by the project, we recommend you contact our Migratory Bird Permit Office, P.O. Box 709, Albuquerque, NM 87103, (505) 248-7882, or permitsR2mb@fws.gov. For more information regarding the MBTA, please visit the following websites: http://www.fws.gov/migratorybirds and http://www.fws.gov/migratorybirds/mbpermits.html.

In instances where the amount or extent of incidental take is exceeded, any operations causing such take must cease pending reinitiation, if it is determined that the impact of such taking will cause an irreversible and adverse impact to the species. We appreciate Fort Huachuca's efforts to identify and minimize effects to listed species from this project. Please refer to the consultation number, 22410-2112-R-0173 in future correspondence concerning this project. Any questions or comments should be directed to Doug Duncan (520) 670-6150 x236, Jason Douglas (520) 670-6150 x226, or Jean Calhoun (520) 670-6150 x223.

Sincerely,

/s/ Steven L. Spangle
Field Supervisor

cc: Assistant Regional Director, Fish and Wildlife Service, Albuquerque, NM
(Attn: Susan Jacobsen)
Assistant Field Supervisor, Fish and Wildlife Service, Tucson, AZ
Dawn Rohr, Environment and Natural Resource Division, Fort Huachuca, AZ
Chief, Habitat Branch, Arizona Game and Fish Department, Phoenix, AZ
Regional Manager, Arizona Game and Fish Department, Tucson, AZ

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