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U.S. Fish and Wildlife Service
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In Reply Refer To:
AESO/SE
22410-2009-F-0389

October 30, 2013

Mr. Jim Upchurch, Forest Supervisor
Coronado National Forest
300 West Congress Street
Tucson, Arizona 85701

RE: Final Biological and Conference Opinion for the Rosemont Copper Mine, Pima County, Arizona

Dear Mr. Upchurch:

Thank you for your request for formal consultation with the U.S. Fish and Wildlife Service (FWS) pursuant to section 7 of the Endangered Species Act of 1973 (16 U.S.C. 1531-1544), as amended (Act). Your initial request was dated June 6, 2012, and was received by us on June 8, 2012. A subsequent request for conference was dated October 19, 2012 and received by us on October 22, 2012. Additional consultation information dated February 8, 2013, was received by us on the same date. Further information regarding conference was transmitted to us via electronic mail on October 22, 2013. At issue are the effects that may result from your proposed approval of the Mine Plan of Operations for the Rosemont Copper Company Project in Pima County, Arizona.

Your June 6, 2012, October 19, 2012, and February 8, 2013, letters concluded that proposed mining activities associated with the Barrel Alternative (as modified; hereafter referred to as the proposed action for the purposes of this consultation) may affect, and will likely adversely affect, the endangered Gila chub (*Gila intermedia*) and its critical habitat, the endangered Gila topminnow (*Poeciliopsis occidentalis occidentalis*), the endangered Huachuca water umbel (*Lilaeopsis schaffneriana* var. *recurva*), the endangered southwestern willow flycatcher (*Empidonax traillii extimus*) and its critical habitat, the threatened Chiricahua leopard frog (*Lithobates chiricahuensis*), the endangered lesser long-nosed bat (*Leptonycteris curasoae yerbabuenae*), the endangered jaguar (*Panthera onca*), the endangered ocelot (*Felis pardalis*), the endangered Pima pineapple cactus (*Coryphantha scheeri* var. *robustispina*), and, via conference, proposed critical habitat for the jaguar and the candidate (at that time) yellow-billed cuckoo (*Coccyzus americanus*). Your letter also requested our concurrence with your determination that the proposed action may affect, but is not likely to adversely affect the threatened Mexican spotted owl (*Strix occidentalis lucida*). We concur with your determination and have provided our rationale in Appendix A.

We will conference, in response to your October 19, 2012, request, pursuant to section 7(a)(4) of the Act and its implementing regulations at 50 CFR §402.10(d), on proposed critical habitat for the jaguar. We issued a proposed rule to list the narrow-headed gartersnake (*Thamnophis rufipunctatus*) and northern Mexican gartersnake (*T. eques megalops*) as threatened species and a proposed rule to designate critical habitat (78 FR 41500 and 78 FR 41550, respectively) on July 10, 2013. We published a proposed rule (78 FR 61622) to list the yellow-billed cuckoo as a threatened species on October 3, 2013. These species (and the former's proposed critical habitat) occur within portions of the area that will be affected by the proposed action. In accordance with an October 22, 2013, communication from your agency, this document will not include conference on these species.

This draft biological and conference opinion is based on information provided in: (1) your September 2011 *Draft Environmental Impact Statement for the Rosemont Copper Project, a Proposed Mining Operation, Coronado National Forest, Pima County, Arizona* (Draft EIS); (2) your June 2012 *Biological Assessment, Rosemont Copper Company Project, Santa Rita Mountains, Nogales Ranger District* (BA); (3) your October 2012 *Supplement to the Biological Assessment, Proposed Rosemont Copper Mine, Santa Rita Mountains, Arizona, Coronado National Forest* (Supplemental BA); (4) your February 2013 *Supplement to the Biological Assessment – Proposed Rosemont Copper Mine - Santa Rita Mountains, Pima County, Arizona - Nogales Ranger District* (Second Supplemental BA); (5) your October 22, 2013, determination that that the proposed action would not jeopardize the proposed-threatened northern Mexican gartersnake or yellow-billed cuckoo nor adversely modify or destroy proposed critical habitat for the former; (6) the results of discussions and exchanges of scientific information between our respective agencies, other Federal, State, and local agencies, the Rosemont Copper Company, and consultants; and (7) other published and unpublished sources of information. Literature cited in this biological opinion is not a complete bibliography of all literature available on the species of concern, and its effects, or on other subjects considered in this opinion. A complete administrative record of this consultation is on file at this office.

Please note that 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 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" (FWS and NMFS 1998).

Also note that, in reaching our findings that there is a reasonable certainty that lesser long-nosed bat, Chiricahua leopard frog, Gila chub, Gila topminnow, and jaguar will be incidentally taken, we considered the following:

- Section 9 of the Act and our implementing regulations in the Code of Federal Regulations (CFR) at 50 CFR part 17 prohibit the ``take" of fish or wildlife species listed as endangered or threatened.

- Take of listed fish or wildlife is defined under the Act as ``to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or to attempt to engage in any such conduct".
- The term ``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).
- The term ``harm" is defined in the regulations as ``an act which actually kills or injures wildlife. Such act may include significant habitat modification or degradation where it actually kills or injures wildlife by significantly impairing essential behavioral patterns, including breeding, feeding, and sheltering" (50 CFR 17.3).
- "Incidental take" refers to takings that result from, but are not the purpose of, carrying out an otherwise lawful activity conducted by the Federal agency or applicant"(50 CFR 402.02).

Consultation History
(*most recent listed first***)**

<u>October 28, 2013</u>: We received a copy of an October 25, 2013, letter from the Arizona Game and Fish Department (AGFD) to the Forest Service (USFS). The letter described an agreement, in principle, for AGFD to work with and receive lands and funding from the Rosemont Copper Company to implement measures to mitigate the project's effects to State trust resources.

<u>October 25, 2013</u>*:* We received an updated version of the Mitigation and Monitoring Plan from SWCA, Inc., on behalf of the USFS. The plan, once finalized, will appear in the Final EIS as Appendix B. Appendix B will not be included in this Final BO, as it is subject to ongoing revisions, but we did consider its contents in our effects analyses.

<u>October 24, 2013</u>: We received your letter to AGFD stating that references to the State agency were to be removed from the Final Environmental Impact Statement (Final EIS). The FWS had already implemented the AGFD request.

October 23, 2013:
We received an electronic mail message from your staff stating that formal conference consultation for the yellow-billed cuckoo and northern Mexican gartersnake would not be pursued, as it had been determined that the proposed action would not jeopardize either proposed-threatened species nor adversely modify or destroy proposed critical habitat for the latter.

October 8, 2013:
We received an October 3, 2013, letter from AGFD requesting that the State agency be removed from all conservation measure and mitigation-related references in the Final EIS and Final BO.

October 3, 2013:
We published a proposed rule (78 FR 61622) to list the yellow-billed cuckoo as a threatened species.

September 26, 2013: We received a revised version of Appendix B, from SWCA, Inc., on behalf of the USFS. Also note that an earlier draft version of Appendix B was included in our July 3, 2013, Draft BO.

September 19 through October 22, 2013:
We received updated hydrologic criteria and conducted additional analyses to employ those data in the respective Amount or Extent of Take sections for the Gila chub and Gila topminnow.

September 18, 2013:
We received information on the number of additional Pima pineapple cactus and acreage of the species' habitat that will be affected by the rerouting of a utility right-of-way serving the project area.

September 13 and 14, 2013:
We received a series of comments and updated maps and graphics prepared by SWCA, Inc. on behalf of the Forest Service for incorporation into the final BO.

September 13, 2013:
We met with your staff to discuss outstanding issues related to transmitting a final BO. We agreed to revisit the Amount or Extent of Take subsections for the Gila chub and Gila topminnow, pending receipt of updated groundwater-based criteria. We also viewed maps describing a change in the alignment of the utility right-of-way.

August 27, 2013:
We received additional Draft BO comments from the U.S. Army Corps of Engineers (Corps) via electronic mail.

August 7, 2013:
We received input from your staff's and SWCA, regarding the use of monitoring wells to assist in tracking take of Gila chub and Gila topminnow via electronic mail.

August 5, 2013:
We received your and SWCA's review of Rosemont Copper Company's comments on the Draft BO.

July 24, 2013:
We received comments on the Draft BO from the U.S. Army Corps of Engineers (Corps) via electronic mail.

July 22, 2013:
We met with your staff, SWCA, representatives of the Rosemont Copper Company, WestLand Resources, Inc., and the Corps to discuss the Draft BO.

July 19, 2013:
We received your initial comments on the Draft BO via electronic mail.

July 18, 2013:
We received initial comments on the Draft BO, from your agency's legal counsel via electronic mail.

July 16, 2013:
We received AGFD's comments on the preliminary, administrative draft BO via electronic mail.

July 16, 2013:
We were forwarded the Bureau of Land Management's (BLM) July 15, 2013, comments on the Draft BO by your staff via electronic mail.

July 15, 2013:
We received the Rosemont Copper Company's comments on the Draft BO via electronic mail.

July 9, 2013:
We informed your staff in advance of the July 10, 2013, publication of a proposed rule (78 FR 41500) to designate the northern Mexican and narrow-headed gartersnakes as threatened species and to designate critical habitat (78 FR 41550) for the species.

July 3, 2013:
We transmitted a Draft Biological Opinion to you, and note that it did not include analyses based on revisions to proposed jaguar critical habitat (78 FR 39237) (see event of July 1, 2013, below).

July 1, 2013:
We announced: (1) revisions to our proposed designation of critical habitat for the jaguar; (2) the availability of a draft economic analysis; (3) the availability of a draft environmental assessment; (4) an amended required determinations section for the proposal; and (5) a reopening of the comment period.

June 26, 2013:
We received your comments on our June 21, 2013, preliminary, administrative draft analysis of the proposed action's effects to the jaguar and its critical habitat via electronic mail. You also forwarded the comments made by the Rosemont Copper Company.

June 25, 2013:
We received comments on our June 21, 2013, preliminary, administrative draft analysis of the proposed action's effects to the jaguar and its critical habitat from Rosemont Copper Company's counsel via electronic mail.

June 21, 2013:
We transmitted, via electronic mail, a preliminary, administrative draft analysis of the proposed action's effects to the jaguar and its critical habitat. This section was not included in our April 19, 2013, or May 20, 2013, transmittals.

May 30, 2013:
Our respective staffs as well as representatives of AGFD concluded negotiations regarding potential updates to the Proposed Conservation Measures for the Chiricahua leopard frog, finally determining that the measures would appear in the Draft BO as Terms and Conditions.

May 30, 2013:
Your staff transmitted to us, via electronic mail, four documents responding to our May 20, 2013, preliminary, administrative draft effects analyses for aquatic and riparian ecosystem and the southwestern willow flycatcher. The review documents included: (1) a package entitled Comments from Rosemont Copper on Preliminary Draft Biological Opinion Language Regarding Aquatic and Riparian Habitat, and Southwestern Willow Flycatcher authored by WestLand and incorporating additional SWCA reviews comments; (2) FS and SWCA reviews of the Effects to Aquatic Ecosystems, Effects to Riparian Ecosystems, and Effects to the Southwestern Willow Flycatcher.

May 20, 2013:
We transmitted, via electronic mail, preliminary, administrative draft analyses of the proposed action's effects to aquatic ecosystems, riparian ecosystems, and the southwestern willow flycatcher. These sections were not included in our April 19, 2013, transmittal.

May 17, 2013:
We received, via electronic mail, reviews of the Description of the Preferred Alternative and the Description of the Proposed Action conducted by SWCA Environmental Consultants (SWCA) on behalf of the Forest Service. The reviews were also accompanied by a brief description of the heretofore unknown Sycamore Connector Road component of the proposed action.

May 7, 2013:
Your staff transmitted, via electronic mail, additional comments on the preliminary, administrative draft BO.

May 6, 2013*:*
We received the Rosemont Copper Company's collected comments on the April 19, 2013, preliminary, administrative draft BO from WestLand Resources, Inc. (WestLand) via electronic mail.

April 19, 2013:
We transmitted a preliminary, administrative draft of this BO to you via electronic mail. The preliminary draft did not contain analyses of effects to aquatic ecosystems, riparian ecosystems, the southwestern willow flycatcher, and the jaguar.

April 12, 2013:
We received Rosemont Copper Company's comments on the April 1, 2013, draft narrative of the Description of the Proposed Action and Description of the Proposed Conservation Measures.

April 9, 2013:
We transmitted a letter to you stating that we would transmit the core findings of our eventual Draft BO to you during the week of April 15, 2013. The core findings would include, at a minimum, the respective affected species' Environmental Baseline and Conclusion section and, when applicable, an Incidental Take Statement including Reasonable and Prudent Measures (or a Reasonable and Prudent Alternative), and Terms and Conditions section.

April 8, 2013:
We received electronic mail messages from SWCA containing a review of the April 1, 2013, draft narrative of the Description of the Proposed Action and Description of the Proposed Conservation Measures and an updated mitigation and monitoring table.

April 1, 2013:
We transmitted a draft narrative of the Description of the Proposed Action and Description of the Proposed Conservation Measures to you. We received your response on April 8, 2013. We also participated in a conference call with your staff as well as representatives of Rosemont Copper Company, including their biological consultant, WestLand and counsel, Norm James.

March 29, 2013:
We participated in a conference call with your staff as well as representatives of Rosemont Copper Company, WestLand and Norm James.

March 14, 2013:
We received a copy of correspondence entitled *Clarification and Supplemental Information in Support of Supplemental Biological Assessment Prepared for the Coronado National Forest and SWCA, Inc., for the Rosemont Copper Project* sent from WestLand.

February 12, 2013:
We met with AGFD to discuss the consultation.

<u>February 8, 2013</u>:
We received your February 2013 *Supplement to the Biological Assessment – Proposed Rosemont Copper Mine - Santa Rita Mountains, Pima County, Arizona - Nogales Ranger District* (Second Supplemental BA).

<u>January 31, 2013</u>:
We met with your staff, the AGFD, and Westland Resources, Inc. to discuss further revisions to the proposed conservation measures.

<u>January 23, 2013</u>:
We met with your staff, biologists from SWCA, and representatives of the Rosemont Copper Company to assist in finalizing a second supplemental Biological Assessment.

<u>January 9, 2013</u>:
We transmitted a letter to you discussing the outcome of the January 3, 2012, meeting and addressing the concerns found in Norman D. James' December 19, 2012, letter.

<u>January 3, 2013</u>:
We met with your staff, biologists from SWCA, and representatives of the Rosemont Copper Company to discuss conservation measures and the content of an anticipated second supplemental Biological Assessment.

<u>December 21, 2012</u>:
We received a December 19, 2012, letter from Norman D. James of Fennemore Craig P.C., counsel for the Rosemont Copper Company, regarding our December 13, 2012, letter to you.

<u>December 21, 2012</u>:
We received documents entitled Rosemont Copper Project Biological Assessment Supplement - Cienega Creek Watershed Habitat Restoration And Enhancement Program, Rosemont Copper Project: Biological Assessment Supplement - Lesser Long-Nosed Bat Forage And Roost Conservation Measures, and Rosemont Copper Project: Section 7 Consultation Grazing Management Conservation Measures from Westland Resources, Inc.

<u>December 13, 2012</u>:
We transmitted a letter to you documenting outstanding information needs requesting additional time to complete formal consultation on the proposed action.

<u>December 7, 2012</u>:
We received a revised version of the *Rosemont Copper Project: Potential Effects of Lighting Associated with the Rosemont Project on Endangered Species* from Westland Resources, Inc.

<u>December 5, 2012</u>:
We received a document entitled *Rosemont Copper Project: Potential Effects of Lighting Associated with the Rosemont Project on Endangered Species* from Westland Resources, Inc.

<u>November 18, 2012</u>:
We met with your staff and staff from SWCA to receive information regarding the biological effects resulting from the groundwater impacts discussed at the aforementioned October 18, 2012, meeting.

<u>November 14, 2012</u>:
We received a documents entitled *Rosemont Copper Project: Conservation Measures – Water Features and Rosemont Copper Project: Potential Effects Of The Rosemont Project on Lower Cienega Creek* from Westland Resources, Inc.

<u>November 13, 2012</u>:
We met with your staff, biologists from SWCA, Inc., and representatives of the Rosemont Copper Company to discuss conservation measures and progress in the consultation. We received a document entitled *Rosemont Copper Project: Conservation Measures – Water Resources* from Westland Resources, Inc.

<u>November 9, 2012</u>:
We received documents entitled *Rosemont Copper Project: Conservation Measures Provided by Clean Water Act Section 404 Mitigation* and *Rosemont Copper Project: Potential Effects of the Rosemont Project to Jaguar and Proposed Jaguar Critical Habitat* from Westland Resources, Inc. via electronic mail.

<u>November 8, 2012</u>:
We received the draft *Rosemont Copper Company Habitat Mitigation and Monitoring Plan Permit No. SPL-2008-00816-MB* (HMMP) prepared by Westland Resources, Inc.

<u>October 22, 2012</u>:
We received, via electronic mail, your October 19, 2012, letter requesting formal conference on the proposed critical habitat for the jaguar and southwestern willow flycatcher. Your October 19, 2012, letter also transmitted your October 2012 *Supplement to the Biological Assessment, Proposed Rosemont Copper Mine, Santa Rita Mountains, Arizona, Coronado National Forest* (Supplemental BA).

<u>October 18, 2012</u>:
We attended a forum attended by your staff and well representatives of the U.S. Geological Survey (USGS), Bureau of Land Management (BLM), SWCA, Inc., the Rosemont Copper Company, Tetra Tech, Engineering Analysis, Inc., and SRK Consulting to discuss the validity and results of groundwater modeling efforts associated with proposed action. These analyses form part of the basis of the BA and Supplemental BA's analyses of effects to aquatic and riparian species.

September 13, 2012:
We received, via electronic mail, your September 12, 2012, granting of the 60-day extension we requested on August 29, 2012.

September 6, 2012:
We met with your staff, biologists from SWCA, and representatives of the Rosemont Copper Company to discuss conference consultation on proposed critical habitat for the jaguar (77 FR 50214).

August 29, 2012:
We transmitted a request for a 60-day extension to the consultation timeline, stating we would deliver a Draft BO by November 5, 2012 and, following timely receipt of your comments, a Final BO by December 20, 2012.

August 2, 2012:
My staff met with your staff and other Cooperating Agencies (as defined under the National Environmental Policy Act; NEPA) to discuss the biological outcomes of the proposed action's effects to surface and groundwater hydrology and to help develop conservation measures and monitoring programs for them. It should be noted that the FWS is not a formal Cooperating Agency.

July 24, 2012:
My staff participated in a meeting with your staff and the Cooperating Agencies to assist in the development of mitigation measures for the impacts of the propose action.

July 9, 2012:
My staff participated in a meeting with your staff and the Cooperating Agencies to assist in the development of mitigation measures for the impacts of the proposed action.

June 28, 2012:
My staff participated in a meeting with your staff and the Cooperating Agencies to assist in the development of protocols to verify impacts to riparian resources and monitor those effects for the life of the proposed action.

June 11, 2012:
My staff participated in a meeting with your staff and the Cooperating Agencies to assist in the development of mitigation measures for the impacts of the proposed action.

July 20, 2012:
We transmitted a letter to you indicating that we had received all of the information required of you to initiate formal consultation required by the regulations governing section 7(a)(2) interagency consultation at 50 CFR §402.14.

May 24, 2012:
My staff met with staff from the U.S. Geological Survey water resource and geology disciplines to discuss the hydrologic effects of the proposed action as well as the monitoring needed to measure them.

May 16, 2012:
We transmitted you a letter containing our review of the January 2012 deliberative *Draft Biological Assessment, Rosemont Copper Project, Santa Rita Mountains, Nogales Ranger District* (Draft BA), including recommended conservation measures.

April 9, 2012:
We met with AGFD staff to jointly develop conservation measures for our respective trust species.

March 8, 2012:
We met with your staff as well as representatives of the AGFD, Bureau of Land Management (BLM), SWCA, Inc., Rosemont Copper Company, and Westland Resources, Inc. to be presented with a groundwater model overview and to engage in continued discussions on the Draft BA.

March 5, 2012:
My staff transmitted comments regarding the Draft BA's effects analysis for the lesser long-nosed bat to your staff via electronic mail.

February 29, 2012:
My staff transmitted comments regarding the Draft BA's effects analysis for the Mexican spotted owl to your staff via electronic mail.

February 14, 2012:
We met with your staff as well as representatives of the AGFD,BLM, SWCA, Inc., Rosemont Copper Company, and Westland Resources, Inc. to engage in initial discussions on the content of the Draft BA.

January 25, 2012:
We received the electronic version of your Draft BA

January 19, 2012:
We transmitted a letter (File No. 02EAAZ00-2012-CPA-0015) to the U.S. Army Corps of Engineers (Corps), commenting on Public Notice 02EAAZ00-2012-CPA-0015. Our letter, a copy of which was provided to you, preliminarily identified our concerns with the proposed action's effects to threatened and endangered species.

October 11, 2011:
My staff met with representatives of the Rosemont Copper Company near the mine site to discuss the project and engage in early discussions on potential conservation measures.

August 24, 2011:
Our respective staffs met with representative of the Rosemont Copper Company and Westland Resources to discuss the potentially affected species and conceptual conservation measures.

January 11, 2011:
Our staff met with representative of the Rosemont Copper Company and Westland Resources to receive a project overview and visit the proposed mine site.

October 18, 2010:
We met with your staff to discuss the threatened and endangered species potentially affected by the proposed action.

December 10, 2009:
My staff participated in a field trip to examine issues related to the biological outcomes of the proposed action's hydrologic effects.

November 23, 2009:
My staff participated in a Karst formation and groundwater hydrology discussion with staff from Arizona State Parks and other agencies.

November 19, 2009:
My staff participated in a meeting with your staff and the Cooperating Agencies to discuss the potential for acquisition of off-site lands to mitigate the impacts of the proposed action.

October 13, 2009:
Staff from our agencies, AGFD, and representatives of the Rosemont Copper Company attended a site visit to examine habitat for bats, including lesser long-nosed bats.

September 18, 2009:
Staff from our agencies, AGFD, and representatives of the Rosemont Copper Company attended a site visit to examine habitat for talussnails (*Sonorella* spp.).

September 15, 2009:
My staff participated in a site visit to examine Chiricahua leopard frog habitat within the proposed mine site and on adjacent ranchlands.

September 1, 2009: –
Staff from our agencies, the AGFD, and representatives of the Rosemont Copper Company attended a site visit to examine habitat for Chiricahua leopard frogs.

August 5, 2009:
We met with your staff as well as representatives of, SWCA, Inc., Rosemont Copper Company, and Westland Resources, Inc. to begin discussions regarding the proposed action's effects to threatened and endangered species and the preparation of a BA to address those effects. This meeting also served as an initiation of early consultation pursuant to section 7(a)(3) of the Act and its implementing regulations at 50 CFR § 402.11.

BIOLOGICAL AND CONFERENCE OPINION

Description of the Proposed Action

Rosemont Copper Company (Rosemont) submitted a proposed mine plan of operations (MPO) to the Coronado National Forest, an administrative unit of the U.S. Department of Agriculture Forest Service (Forest Service), for development of the Rosemont ore deposit. The proposed mine site is located on the east side of the Santa Rita Mountains, approximately 30 miles south of Tucson, Arizona. Activity is proposed on approximately 995 acres of private land owned by Rosemont Copper, 3,670 acres of Coronado National Forest land, and 75 acres of land administered by the Arizona State Land Department. This area includes a utility corridor that is needed to provide power and water to the project area. The mine life, including construction, operation, reclamation, and closure, is approximately 25 to 30 years.

Two Federal agencies have authority regarding MPO approval: the Forest Service and U.S. Army Corps of Engineers. The Forest Service is responsible for administering Coronado National Forest land, including the approval of MPOs under that agency's surface management regulations. The Corps of Engineers is responsible for administering Section 404 of the Clean Water Act. Rosemont has applied for a permit from the Corps of Engineers to discharge tailings and waste rock into ephemeral drainages that are considered to be waters of the United States. The agency actions thus consist of approval of an MPO and a permit under Section 404 of the CWA.

The Forest Service, as the lead agency and land manager for the Coronado National Forest, prepared the *Draft Environmental Impact Statement for the Rosemont Copper Project, a Proposed Mining Operation, Coronado National Forest Pima County, Arizona* (Sept. 2011) (DEIS). In the DEIS, the Forest Service identified the Barrel Alternative as the preferred alternative (see Figure I-1).

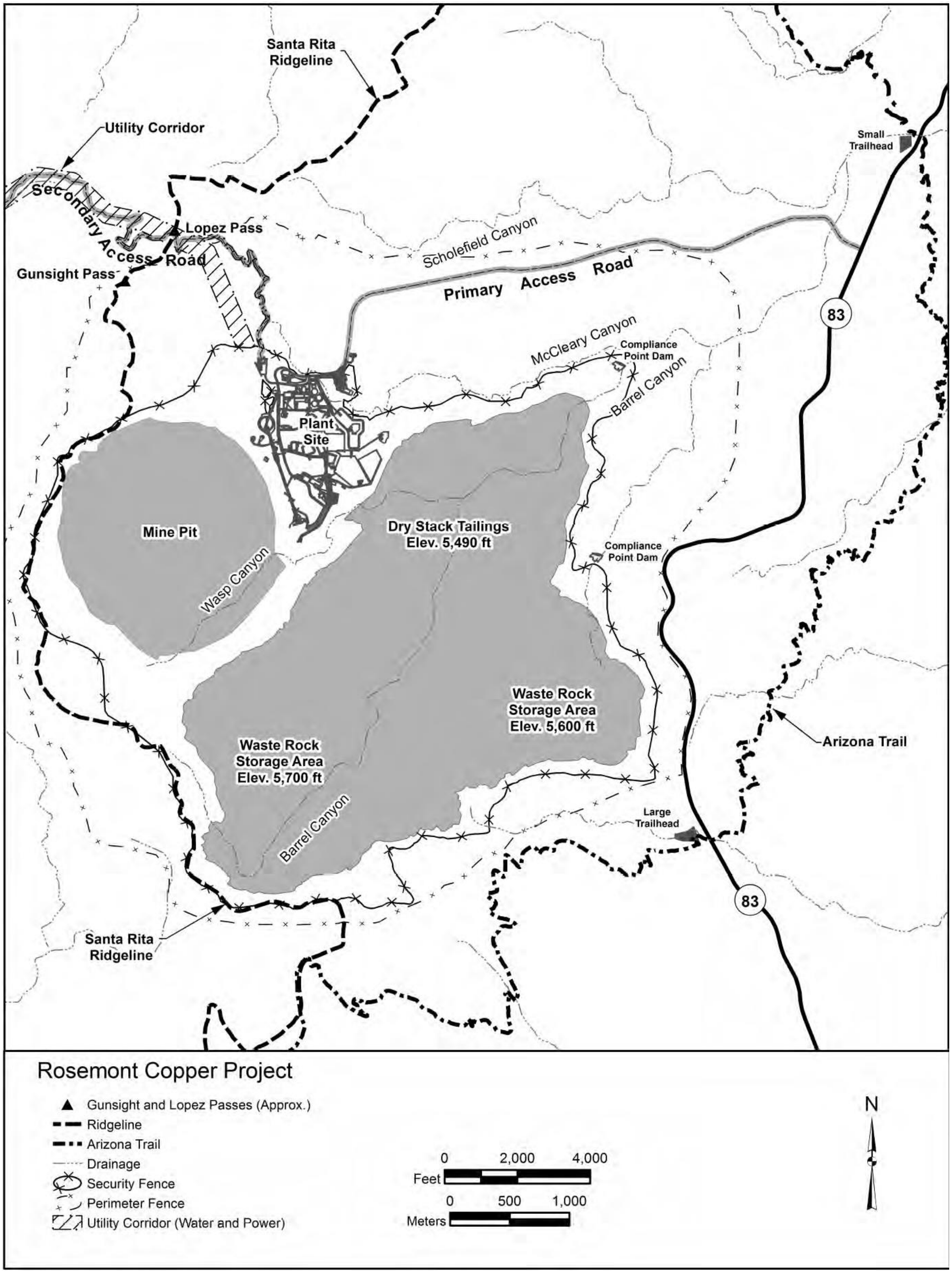

Figure I-1: The Barrel Alternative Footprint (Proposed Action)
(Note: This figure does not illustrate the proposed Sycamore Connector Road; see Figure I-2)

The Barrel Alternative, which places all of the tailings and waste rock in upper Barrel Canyon and the lower portion of Wasp Canyon, was developed during the NEPA process to respond to the significant issues regarding potential impacts on biological resources, cultural resources, and the surface water component of water resources. The Forest Service interdisciplinary team biologist determined this alternative to have the least impact on plant and animal resources because it avoids the McCleary Canyon drainage; it is the most physically and biologically diverse of the nearby canyons, and harbors the rare plant Coleman's coral-root (*Hexalectris colemanii*) (SWCA 2011). Prohibiting mine tailings or waste in McCleary Canyon permanently maintains its contribution of surface water flow to the Barrel Canyon drainage system. Stormwater flow through McCleary Canyon would be somewhat decreased during mine operations because runoff from the plant site would be retained. However, there are also increases to the drainage area that will be diverted through the McCleary Canyon channel, due to diversions from upstream of the pit and the plant site.

The Barrel Alternative incorporates a waste rock perimeter buttress that completely surrounds the dry-stack tailings. Heap leaching facilities are not included in the current iterations of alternative. In order to maintain concurrent reclamation of final outer slopes, waste rock will initially be placed in berms along the outside edge of the waste rock and tailings area, followed by waste rock or tailings placement behind the berms. The tailings conveyor system will be modified to accommodate the relocated tailings facility. Surface water management facilities include diversions around the facility to convey storm events upgradient of the pit, operating facilities, and waste rock and tailings storage areas and to place the water back into drains or other control structures. Diversion and stormwater control facilities include the following:

- Stormwater redesign, including removing the underdrains, eliminating storage on the top and benches of the tailings and waste rock facilities, and incorporating more stormwater routing downstream. The redesign reduced post-closure flow loss from 34 percent to 17 percent (compared to baseline conditions).
- The Barrel Alternative permits no storage of stormwater on the top or benches of the waste rock/tailings landform post-closure. Instead, waste rock and tailings facilities will shed runoff after closure. The tops of the facilities will be graded to discharge stormwater to the lower benches, which in turn are designed to move stormwater laterally along the benches until it reaches several concrete or natural stone drop structures. The runoff from these drop structures will either be discharged into the natural washes (Barrel Canyon or a tributary) or discharged into a diversion channel that will carry runoff along the toe of the waste rock and tailings facilities and then discharge that runoff into the natural washes. In this manner, as much water as possible will be allowed to flow downstream after reclamation is complete.

The flow-through drains beneath the tailings and waste rock facilities are not part of the Barrel Alternative because of concerns about intermingling of stormwater and tailings seepage and long-term maintenance. Post-closure, stormwater from the former plant site will instead be diverted to flow into McCleary Canyon via a surface channel.

- Modifying the process water temporary storage pond and adding a double liner with a leak collection and removal system to the process water containment to improve the containment of process water and separate stormwater from process water.
- Realigning the primary access road to avoid Scholefield Canyon, reduce its visibility, decrease stormwater runoff into the Barrel Canyon drainage system, and reduce impacts to riparian vegetation.

Extraction of ore will be from an open-pit mine located primarily on Rosemont private land (approximately 590 acres of the 955 acre site). Processing, waste management, and other support facilities are proposed to be located on the Coronado National Forest; project infrastructure, such as utilities, will be located on Coronado National Forest ASLD lands and Rosemont lands. Access to the mine site will originate on SR 83 east of the pit and facilities. The complete mine life, as described in the Supplemental BA, is as follows:

- Premining phase: 18 to 24 months. (Includes initial clearing vegetation, soil stockpiling, construction of facilities and roads, construction of electric and water lines, fence construction, decommissioning of forest roads, initial construction of pit, initial construction of the perimeter waste rock buttress, and construction of compliance wells).
- Active mining phase: 20 to 25 years. (Includes additional vegetation removal, continued pit development, continued construction of the perimeter waste rock buttress, placement of tailings, concurrent reclamation activities).
- Final reclamation and closure phase: 3 years. (Includes removal of plant site facilities, completion of reclamation, potential staining of pit walls, removal of perimeter fence, and removal of water and electrical lines on Coronado National Forest lands).
- Post-closure phase. Indeterminate amount of time. (Includes monitoring and maintenance).

Project-related activities that will be conducted over the aforementioned timeframe include the following:

- Construction and operation of an open-pit copper, molybdenum, and silver mine primarily on private land;
- Construction, operation, and reclamation of an ore processing plant, tailings, and waste rock facilities on National Forest System land adjacent to the pit;
- Construction and operation of infrastructure, such as utilities and their corridors, on State, private and National Forest System lands;
- Construction of a new access road, retention structures, wells, ore transportation systems, and reclamation test plots;
- Use of existing roads, new road construction, and maintenance of both;
- Labor requirements for construction, operation, processing, reclamation, and closure;

- Implementation of conservation measures for minimization and mitigation to avoid or minimize impacts;
- Reclamation, closure, and maintenance of the mine and related facilities; and
- Resource monitoring during construction, operation, reclamation, closure, and post-closure.

Calculation of Acres of Disturbance

The proposed mine will be surrounded by a perimeter fence within which public access will not be allowed. The October 2011 DEIS and June 2012 BA both assumed that any lands within the perimeter fence would be disturbed; however, upon further review, not all of those lands will undergo surface disturbance. Within the perimeter fence, a separate security fence/road that will be erected roughly 750 feet from the toe of the waste rock/tailings facilities. Except where specific features such as the primary access road, utility corridor, groundwater monitoring wells and compliance point dam are located, the land between the perimeter fence and the security fence will not be disturbed. This more focused and refined calculation has resulted in a reduced acreage of disturbance as compared to earlier estimates. The June 2012 BA indicated that 7,016 acres of land would be directly disturbed. Owing to the changes described above and in USFS (2013d), this acreage was refined to 5,421, which includes areas within the security fence (4,013 acres), the primary access road (226 acres), the utility line corridor (889 acres), decommissioned or new forest roads (59 acres), and the rerouted Arizona National Scenic Trail and trailheads (19 acres).

The facilities and activities described in this section are typical of open-pit mine sites. The descriptions below, however, are specific to the components for the proposed action . The mine pit is where blasting and drilling activities would occur. The waste rock and tailings will be transported and processed within the corresponding facilities. Lighting and waste disposal will take place at the plant site and support facilities. A perimeter fence will be constructed, encompassing the main mining and processing operations and excluding portions of the access roads, and some Coronado National Forest lands will be unavailable for public use during the 25 to 30-year mine life. A legal closure order will be issued by the Coronado National Forest, and notices will be posted along the fencing. Perimeter fencing will consist of a standard 4-strand barbed wire fence (with a smooth bottom wire, in accordance with BLM and AGFD fencing standards). Sections of the perimeter fence are expected to be removed following closure after considering grazing and safety needs. Portions of the site, including the mine pit, will likely remain fenced off and closed to the public indefinitely for safety reasons.

Pit

Preproduction stripping of overlying rock is expected to require 18 to 24 months to prepare for full-scale mining operations, train work crews, construct access and haul roads, and clear and grub the pit and waste rock storage areas that will be disturbed during the initial years of operation. Open-pit mining methods will be used to excavate ore to recover copper, molybdenum, and silver. The roughly circular open-pit mine will measure between 6,000 and 6,500 feet in diameter at the end of mine life, with a final depth of up to 3,000 feet (3,050 feet above mean sea level). Pit slope angles between roads will be controlled by rock strength and will range between 33 and 50 degrees. The pit will disturb approximately 955 acres: 590 acres on private land and 365 acres on Coronado National Forest lands.

Blasting and Drilling

Blasting will be required prior to excavation of the ore and waste rock, and will generally be conducted daily. Explosives storage, transport, and use will adhere to all rules, regulations, and safety standards. Once a day on average, an ammonium nitrate and fuel oil explosive will be detonated in the mine pit. This will occur during daylight hours only, generally between 9 a.m. and 4 p.m. Dry bulk ammonium nitrate will be transported for use from storage silos at the adjacent plant site. Blasting detonators, such as caps, delays, cord, and boosters, will be stored in special magazines and transported to the pit in separate vehicles. If wet-hole blasting is necessary, an emulsion and/or slurry will be transported to the pit from onsite storage tanks. Mixed ammonium nitrate and fuel oil will be loaded and transported using trucks specifically designed for that purpose.

Ore Processing

Originally, Rosemont proposed two different types of ore processing methods: a conventional flotation method and a heap leach-solvent extraction-electrowinning method. Based on the proposed action selected by the Forest Service, which imposed engineering constraints that affect the operation of a heap leach pad, and comments on the DEIS, Rosemont Copper removed the heap leach-solution extraction circuit, and will process ore only by means of a conventional flotation method.

Ore will be sent through a circuit of crushers, grinding mills, and ball mills to reduce the rock size to a fine sand consistency. A flotation circuit will concentrate the copper and molybdenum minerals from the rest of the ore material. The concentrates will then be dewatered, thickened, filtered, and loaded for shipment. Water from the filtering and thickening process will be returned to the process and recycled.

Waste Rock and Tailings Placement

Waste rock, which consists largely of chemically basic limestone and other largely non-acid-generating rocks, will be placed in areas located outside the open pit. The tailing is the material remaining after the floatation process to recover the copper and molybdenum minerals are removed. These tailings are thickened and then further dewatered through filtering. The water from the dewatering process is returned to the mill for reuse. The tailings are transported via conveyor belt to the unlined dry-stack tailings disposal area, where the tailings will be deposited, stacked, and compacted as needed. Ultimately, the tailings will be placed behind a waste rock buttress and, ultimately, encapsulated, or covered completely by a layer of waste rock.

Transportation of ore, waste rock, and tailings will occur only in the mine area, which will be closed to the public for safety reasons. Ore and waste rock will be moved in large, off-highway haul trucks. Roads for the haul trucks will be constructed both within the open pit and between the pit and the plant, tailings facility, and waste rock storage area. In accordance with Mine Safety and Health Administration (MSHA) regulations, haul roads will be approximately 125 feet wide, including safety berms and drainage ditches, and no steeper than 10% to 12%. Maximum truck speed will be 35 miles per hour. Haul roads are temporary and regularly move based on the locations of material placement.

Plant Site and Support Facilities

Facilities necessary to support Rosemont's mining and ore processing operations will be constructed during the premining phase, and removed during final reclamation and closure. These facilities include buildings and structures, such as administration buildings, change house, warehouse with laydown yards, analytical laboratory, light vehicle and process maintenance building, mine truck shop, mine truck wash and lube facility, powder magazines and ammonium nitrate storage, main guard shack with truck scale, and fuel and lubricant storage and dispensing facilities. The facilities are located generally in one centralized area near the open pit.

Lighting

The proposed action lies within an area of concern relative to the effects of light pollution (Monrad *et al.* 2012). Neither the existing 2006 Pima County Outdoor Lighting Code (PCOLC) nor the draft 2011 PCOLC have jurisdiction over the proposed action area; however, Rosemont will employ an advanced light pollution mitigation plan. The plan includes the use of state of the art lighting equipment and controls to minimize environmental impact to levels below the intent of the PCOLC, including other comparable modern light pollution control standards, while simultaneously complying with the proposed action's operation safety requirements prescribed by the Mine Safety and Health Administration (MSHA).

The proposed action is expected to generate approximately 10% to 15% of the amount of environmental light over the entire site that, under the PCOLC, would normally be allowed by a similar commercial development of the same scale in the same location using conventional lighting systems on a similarly sized parcel (Monrad *et al.* 2012). The proposed action is expected to produce approximately 6.4 million lumens, which takes into account all lighting sources, including equipment-mounted lighting systems.

Solid, Hazardous, and Sanitary Waste

Solid waste will be recycled as appropriate and feasible. Non-recyclable inert waste will be disposed of at a state licensed on-site landfill located on Rosemont's private property. The landfill will cover approximately 2 acres on Rosemont's private property and will be permitted and regulated by the Arizona Department of Environmental Quality (ADEQ). The excavated depth of the landfill will range from 5 to 43 feet, with a minimum excavation elevation of approximately 5,190 feet above mean sea level; maximum height of the landfill at closure will be no more than 5,280 feet above mean sea level. All putrescent materials or other items that cannot be appropriately disposed of in the solid waste facility will be transported of off-site by a commercial vendor. Large (greater than 3 feet in diameter) equipment tires, such as those on the haul trucks, will be recycled if practicable, or otherwise disposed of on-site in specific tire burial cells located within the waste rock and tailings facility. The USFS has requested that the burial cells be situated on private lands. Hazardous waste will be handled and disposed of in accordance with applicable regulations, and no hazardous waste will be disposed of on-site. All hazardous waste will be transported by licensed haulers and disposed of at regulated facilities. Sanitary waste at the project site will be handled by septic systems, with leach fields located in the vicinity of each building. During the construction phase and where necessary during operations, portable toilets will be used in various locations throughout the plant and mine sites.

Electrical Power Supply

The total power requirement for the proposed action is 108 to 112 megawatts and will require a minimum transmission voltage of 138 kilovolts. Tucson Electric Power (TEP) has entered into an agreement with Rosemont to construct a transmission line to the mine site. All costs of the line will be borne by Rosemont. In addition to traditional electrical service from TEP, the proposed action will also generate energy on-site using solar technologies, such as solar technologies to partially power the administration buildings and potentially other areas.

On June 12, 2012, the Arizona Corporation Commission approved the Certificate of Environmental Compatibility authorizing the construction of an aboveground 138-kilovolt electrical transmission line and associated facilities from the proposed Toro Switchyard to the Rosemont Substation (Figure 2 in the October 2012 Supplemental BA and figure I-1 in this document). Following a hearing, the Certificate of Environmental Compatibility was issued by the Arizona Power Plant and Line Siting Committee, approving the preferred route. Thereafter the Arizona Corporation Commission approved the Certificate of Environmental Compatibility with certain modifications that included the issuance of the Record of Decision. The water supply (see Water Supply section) and secondary access road (see Utility Maintenance Road section) are co-located with the lines. The route generally parallels the existing South Santa Rita Road before entering private property held by Rosemont and crosses the ridgeline at Lopez Pass. The alignment then enters Coronado National Forest lands before entering the mine facility area.

Water Supply

During construction of the water supply pipeline, water would be drawn from existing wells in and around the project site in order to supply construction activities. It is estimated that approximately 600 to 900 gallons per minute would be necessary to support facility construction. The project is permitted by the Arizona Department of Water Resources (ADWR) to draw up to 6,000 acre-feet per annum (afa). However, it is currently estimated that the project would use between 4,700 and 5,400 afa of fresh water, for a total use over the mine life of approximately 100,000 acre-feet. Water would be pumped from four to six wells located on land owned or leased by Rosemont Copper near the community of Sahuarita in the Santa Cruz Valley at a maximum rate of 5,000 gallons per minute (total pumpage). The well locations, proposed pipeline route, and pipeline route are shown in Figures PPC-1 and PPC-2. Four booster stations would be needed to maintain waterflow in the line.

Total fresh water to be used during operation is estimated to be about 4.8 million gallons per day. Most of this would be supplied by groundwater wells in the Santa Cruz Valley. Much smaller quantities would be obtained from stormwater and pit dewatering on the mine site. Water would primarily be allocated to ore processing. Other water uses would include dust control, fire protection, drinking water, sanitary waste management, and other miscellaneous uses. It is estimated that up to 18,500 acre-feet could be obtained from pit dewatering over the life of the mine. Water acquired through pit dewatering would either be used in processing or dust control. Because the quality of the water supply is expected to approach potable standards, it would not require any additional processing to be used in various mining processes.

Where feasible, an estimated 37 million gallons of water per day would be reclaimed from a variety of uses on the mine and returned for use in processing. Water used to process ore (referred to as process water) and other water impacted by the project would be controlled as described below.

Water Supply Pipeline

A 20-inch carbon steel water pipeline would be constructed. While it is expected that most drainage crossings would only require backfill of the previously removed material, some crossings may require non-erosive material, such as concrete, below calculated scour depth where wash composition is soil and gravel. Where rock prohibits burial, the pipeline would be placed above the rock and covered with soil, as previously specified, depending on slope, topography, and the availability of cover material.

The pipe bedding requirements would follow the manufacturer's recommendations. Isolation valves would be installed in the pipeline at intervals of approximately 3,000 feet and at elevation changes of 250 feet. Construction of the pipeline would include up to four booster stations that would consist of a concrete sump, four vertical turbine pumps, and a pneumatic tank housed within secured buildings or structures and requiring power, as described above. The reservoirs and pump stations would be built outside jurisdictional Waters of the U.S.

Water Control

The primary water control objective is to reduce the risk of discharging potentially contaminated water into the environment. Three major areas of water contamination control are as follows: process water, groundwater, and stormwater that comes into contact with process facilities or tailings. Control of process water consists of containing the process water in engineered structures, such as tanks, pipes, sumps, lined ponds, and lined ditches, and maintaining the water content of the dry-stack tailings at a level that reduces seepage from the dry-stack tailings facility. The engineering design and performance of the various process water control facilities, including seepage and leakage monitoring and recovery, will meet or exceed the best available demonstrated control technology criteria used by the ADEQ and will be regulated under their permits issued pursuant to the State Aquifer Protection Permit issues for the project.

Groundwater control includes those activities and facilities intended to protect and monitor the quality of the groundwater in the area, as well as the investigation and modeling used to predict the response of the groundwater systems to both the withdrawal of groundwater and the influence of seepage and leakage from project facilities. Implementation of groundwater control requirements will be monitored as part of the aquifer protection permit that has been issued by the ADEQ. This includes monitoring of the seepage and leakage detection systems required to be designed into processing facilities by the aquifer protection permit.

Of particular importance to the long-term groundwater protection is the acid rock drainage protection and monitoring program. Monitoring to ensure that off-site groundwater quality is not impacted beyond the level allowed by the aquifer protection permit is accomplished through the installation and scheduled sampling and testing of specific groundwater monitoring wells as required by the aquifer protection permit and by applying best available demonstrated control technology (i.e., engineering controls and practices). Protection of groundwater quality following mine closure is achieved by the following: the closure and reclamation of the process facilities: elimination or reduction of acid rock drainage generation in the tailings and waste rock from the design and operation of the facilities; monitoring and testing required by the aquifer protection permit following mine closure; and capture of possible impacted mine site groundwater by localized groundwater flowing into the pit.

Stormwater management involves three basic ideas: (1) process water or stormwater that comes into contact with process areas cannot be discharged; (2) water that runs off of waste rock and tailings where process water is not present can be discharged downstream; and (3) water that is diverted around the process is merely runoff and not regulated. For the purposes of this document the water referred to in number one above is considered process or “contact” water while all other water is considered stormwater.

The general design concept for managing stormwater from the dry-stack tailings facility is to minimize infiltration of water in the tailings and prevent the discharge of stormwater that comes into contact with the tailings. The top surface of the dry-stack tailings will be exposed to precipitation only during operations. All tailings will be covered with waste rock at closure. Constructing uniform lifts of dry tailings that are buttressed by waste rock ensure containment and erosion control. The top of the tailings facility will be relatively impervious. That is, during operations, all precipitation will remain on top of the tailings facility to evaporate. If water ponds on top of the tailings facility, it will be pumped to the process water temporary storage pond to limit infiltration into the tailings facility. Diversion channels will be constructed to direct surface runoff from the outer waste rock shell slopes into either sediment ponds or adjacent drainages to a sediment control structure.

Stormwater from above the mine pit will be diverted around the pit and plant site. During operations, stormwater that falls within the mine pit and associated disturbed areas, and all stormwater that comes into contact with ore, will be contained onsite and used for mining and mineral processing purposes. Post-closure, any stormwater that enters the pit will contribute to the pit lake. The small ridge just east of the plant site will be eliminated post-closure in order to enable stormwater from the reclaimed plant site area to flow downstream into McCleary Canyon. Precipitation that comes into contact with waste rock does not need to be retained, but can be released downstream. Regardless of this, much of the runoff from the waste rock facilities will be retained during operations, with the exception of the perimeter waste rock buttresses. For perimeter buttresses, concurrent reclamation and appropriate best management practices will progress up the outer slopes as the buttresses are constructed. This will limit erosion potential and allow stormwater runoff to discharge to down-gradient sediment ponds and eventually to the watershed.

Stormwater management at the waste rock facilities is similar to that for the dry-stack tailings facility. For the construction of the initial perimeter buttresses, concurrent reclamation and appropriate best management practices will progress up the outer slopes as the buttresses are constructed. This will limit erosion potential, while minor diversion channels will be used to direct non-contact runoff to downgradient sediment ponds. The sediment ponds at the toe of the outer slopes will be designed to store and release up to the 10-year, 24-hour storm event so that suspended sediment concentrations of discharged water are no greater than background conditions.

Stormwater from the waste rock and tailings facilities, including the waste rock buttresses that are not reclaimed or stabilized, will be routed to sediment control structures, where any overflow discharging off-site will be monitored for constituent and sediment content in accordance with ADEQ's Arizona Pollutant Discharge Elimination System Multi-Sector General Industrial Stormwater Permit.

General stormwater management structures are designed using a precipitation-runoff simulation computer program developed by the USACE. Two calculations have been evaluated (the peak flow and the runoff volumes) for Rosemont's selection of the most practical and protective methodology and criteria for use (Tetra Tech 2010a, 2010b).

Active stormwater management will continue after the mine closes, as required by the mining stormwater general permit and the erosion control provisions of the mine land reclamation plan, administered by the Arizona State Mine Inspector. The Arizona State Mine Inspector has jurisdiction for reclamation under Title 27 Arizona Revised Statutes (ARS Chapter 5; this is the Reclamation Act statute for reclamation of hardrock mining, which pertains to private lands with more than 5 acres of mining disturbance. In general, reclamation and closure is designed to shed all stormwater from the waste rock facility, the tailings facility (which will have been capped with waste rock), stormwater that is diverted around the northeast side of the pit, and the plant site. Post-closure precipitation falling in the pit itself and stormwater diverted around the northwest side of the pit will not discharge downstream.

Compliance Point Dam

A compliance point dam will serve as the final compliance point where stormwater can be monitored. Each of the two dams included in the Barrel alternative will be approximately 6 feet tall and approximately 100 to 200 feet wide, with a storage capacity of approximately 2 acre-feet. They will be constructed in year 0, prior to the commencement of mining, using inert waste rock, and be classified as an Arizona Department of Water Resources nonjurisdictional, unlined embankment. Normally, the area upstream of and behind the embankment will be empty. During storm events, water will be temporarily impounded and slowly released through the porous rock-fill dam. Large storm events will overtop the dam and proceed downstream. The compliance point dam will be removed after closure of the proposed action facilities or if the facilities reach final stabilization through concurrent reclamation and sediment runoff is within acceptable limits.

Primary Access Road

A new 2-lane paved road, referred to as the “primary access road,” will be constructed to provide access between SR 83 and the mine (see Figure 1 in the BA and Figure I-1 in this document). The primary access road will leave SR 83 along a straight section of the highway. At the intersection, SR 83 will be widened and provided with additional lanes. Public use will be restricted on portions of the primary access road during construction and operation of the mine because of safety considerations, but will be reopened to the public after closure. Segments of the primary access road will be added to the national forest system road inventory.

Utility Maintenance Road

Referred to as the “secondary access road” in the DEIS, a better understanding of this road and its function resulted in its being renamed the “utility maintenance road.” This road would be located within the utility corridor to serve as access to the power supply line, water supply line, and water booster pump stations. The road would consist of two discrete segments: one from the plant site, over Lopez Pass, to a major wash on private land; and another from the supply well area near Sahuarita to the other side of the major wash, generally following the electrical transmission and water line location. Overall, this road would require more than 11.5 miles of new construction and 4.5 miles of reconstruction or upgrade to an existing road.

A gravel road would be constructed from the plant site to Lopez Pass to serve as a maintenance road for the utility supply lines. The existing road over Lopez Pass [National Forest System Road (NFSR) 505] is on National Forest System (NFS) land and private land. While NFSR 505 is considered a Forest Service system road, the Forest Service does not have legal access across private land. There are small portions of the new road construction that overlap existing NFSR 505, and those would be reconstructed as part of the utility maintenance road. However, most of the alignment would require new construction from the plant site to its western terminus. The rocky, hilly portion of the road would be reconstructed, and a new road would be created that would run west across private land. The road would intercept a major wash at its western terminus. There are no plans to construct a crossing of this wash, which would require an engineered structure. The second segment of the utility maintenance road would begin at the area of mine water supply wells near Sahuarita and follow the location of the electrical transmission and water lines. This road segment would cross land administered by the Arizona State Land Department (ASLD) and private lands and would generally parallel Country Club and Santa Rita Roads.

Where the water pipeline to the mine travels under Santa Rita Road, the utility maintenance road intersects the public roadway. It would be gated here to prevent unauthorized access. Because there are different mine water supply well locations, the utility maintenance road would include spurs that extend to these locations as required. See Figure 5 in this chapter. The waterline segment to the northern most well will not require a new road and will use the existing adjacent Santa Rita Road for construction and maintenance until it intersects with Country Club Road. A right-of-way (ROW) permit from ASLD is required for the sections of the utility maintenance road and utility corridor on State land. A ROW application has been filed; the ROW permit itself will not be issued until approval of the project by the Forest Service. The sections of the road within the ASLD ROW would be new construction. ASLD will also decide at a later date whether they intend to require an additional fence between the Utility Maintenance Road and the rest of the Santa Rita Experimental Range. The Town of Sahuarita also signed an agreement with Rosemont allowing use of a portion of its current ROW alongside Santa Rita Road (Town of Sahuarita and Rosemont Copper Company 2013). This license agreement provides access to the northern most well via Santa Rita Road. Use of Santa Rita Road for construction, maintenance or crossing of the waterline, may require additional permitting by Pima County.

The utility maintenance road would be required to meet MSHA standards by including truck axle-high berms (anticipated to be about 3 feet high) on the sides of the section of roadway located on Rosemont Copper private lands. Some road reconstruction would be on NFS lands before the road intersects private lands, and the Coronado would negotiate with Mine Safety and Health Administration (MSHA) to accommodate safety while minimizing impacts to NFS surface resources. Otherwise, the segments on ASLD and would be a standard 14-foot-wide native surface road without any additional MSHA requirements.

The utility maintenance road would be closed to the public during construction and operation of the mine, and portions may be reopened to the public after closure, depending on safety concerns. It is the intent of the Coronado to restore public access over Lopez Pass. However, a section of this road crosses private land, and there is currently no legal right of public access. While the Coronado would work with the landowner to secure a permanent public easement for this segment of road, it is unknown at this time whether legal public access would be available postclosure. The portions of this road on private lands would remain after the pipeline and booster stations are removed. For sections on State land, ASLD would ultimately decide which portions would be retained, removed, or revegetated through their ROW permitting process.

Sycamore Connector Road

The Sycamore Connector Road is a new road that was identified by the Coronado National Forest. The perimeter fence will cut off legal public access to National Forest System Roads (NFSR) in the Sycamore Canyon area, north of the project area. The Sycamore Connector road would be a new road that would be constructed from a point on the primary access road outside the perimeter fence, to connect with NFSR 4050-0.36R-1 (which intersects NFSR 4050 about 0.3 mile farther west). For the Barrel alternative, the Sycamore Connector road is about 12,184 feet long (2.3 miles) and impacts about 26 acres.

The NFSRs in Sycamore Canyon currently connect to public roads out the bottom (north) end of the canyon. However, the roads cross numerous private ownerships, and a public easement for the road does not exist. Public access from this direction into Sycamore Canyon is thereby controlled by these private landowners. While public access is sometimes granted, it cannot be guaranteed. Constructing the Sycamore Connector Road as a NFSR will continue to provide legal public access to the roads that currently exist on Coronado National Forest lands in this area.

Refer to Figures I-1, I-2, J-2, and J-7 for depictions of the Sycamore Canyon Connector road, as well as other roads being constructed and decommissioned as part of the Barrel alternative.

Other Area Roads – Including Decommissioned and New Forest Road Segments

Those NFSRs that are open to the public or have restricted public access and that enter the perimeter fence will either be decommissioned, rerouted to connect to another area road, or have a built-in turnaround area near the fenceline. The June 2012 BA did not explicitly recognize that changes will occur to the NFSRs that intersect the perimeter fence. The location of the roads to be decommissioned and segments to be constructed is shown in Figure I-2 below and Appendix 1, Figure 18 of the Supplemental BA. This and other new road segments designed to connect remnant NFSRs are shown in Figure I-2 below and Figure 18 in what will become chapter 2 of the FEIS (USFS 2013b). This includes the construction of a new road from the primary access road to NFSR 4050-0.36R-1 (which intersects NFSR 4050 about 0.3 mile farther west), in order to continue to provide public legal access to the Sycamore Canyon area. Because Open-Authorized-Restricted roads are typically used in the project area for access to adjoining grazing allotments, these will mostly remain intact to allow administrative and permitted use postclosure. During operations, Rosemont Copper will be responsible for providing access, in some form, to the grazing lease holders for management of their allotments and to the Forest Service for permit administration.

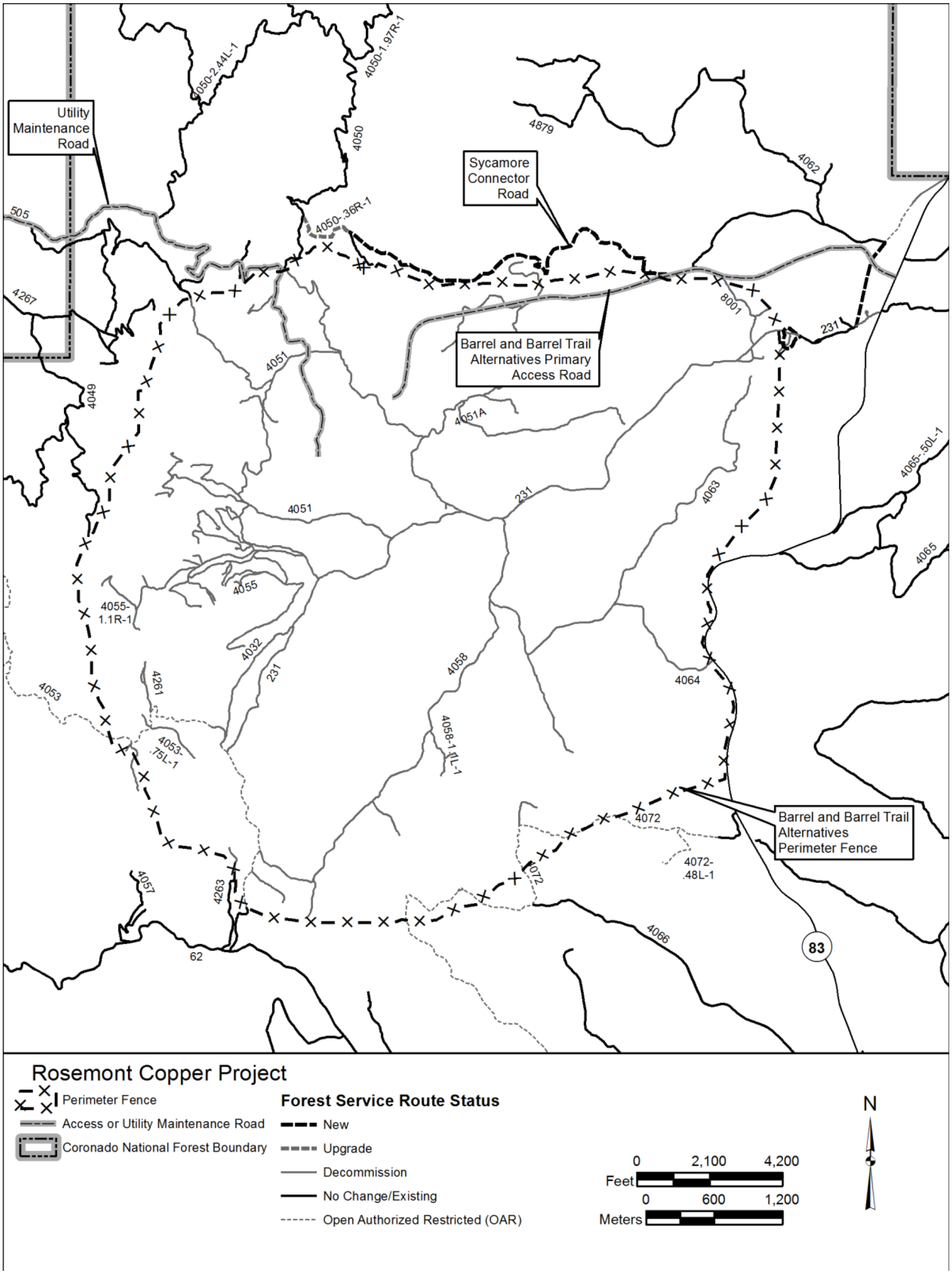

Figure I-2: Location of the roads to be decommissioned and segments to be constructed.

Transportation on State Route 83

Mine-related traffic on SR 83 during operations will primarily consist of trucks carrying supplies to the proposed action , trucks carrying concentrate from the proposed action , and employee traffic. Mine-related traffic on SR 83 during operations would primarily consist of trucks carrying supplies to the project area, trucks carrying concentrate from the project area, and employee traffic. Copper and molybdenum concentrate shipments would form the largest number of routine truck shipments, with approximately 50 round trips per day and 350 trips per week. The largest concentrated volume of mine traffic during a 24-hour period will occur during workforce shift change which will vary between 6 a.m. to 8 a.m. and 4 p.m. to 6 p.m. In addition, there will be equipment, construction material, and mining material deliveries to the project area. Major equipment arriving by rail will likely be received at the Port of Tucson, which is located near Vail, Arizona. Traffic during the pre-mining phase will use SR 83 and existing Forest Road 231 to access the project area until the new primary access road is constructed. This may require an upgrade to Forest Road 231 within the existing easement, in addition to an upgrade of the entrance to SR 83. Table 1 in the October 2012 Supplemental BA identified mine-related truck traffic and stated that there would be 470 trips per week and 69 per day; however these figures have been revised and the updated number of trips is 455 trips per week (55 on weekends, 69 on weekdays). This does not include other forms of vehicular access, such as by mine staff entering and leaving the site.

Although there have been no studies or indication of increased traffic on Box Canyon Road (Forest Road 62), it is possible that the road might receive increased traffic as an alternate around SR 83 to avoid slow mining traffic (i.e., a bypass from Tucson to Sonoita). This could be important because the road crosses the north-south spine of the Santa Rita Mountains, an area that might be important for resident or migrating animals (e.g., golden eagle, jaguar, Chiricahua leopard frog).

Arizona National Scenic Trail Location

The June 2012 BA did not explicitly recognize that approximately 10 miles of the Arizona National Scenic Trail would need to be rerouted, resulting in some additional surface disturbance, including several trailheads. The additional acreage of disturbance from the rerouting of the Arizona National Scenic Trail is included in the revised calculation of disturbance. The location of the rerouted trail is shown in Appendix 1, Figure 15 of the October 2012 Supplemental BA.

Reclamation and Closure/Concurrent Reclamation

Reclamation of the proposed action will be administered and regulated by the Coronado National Forest [36 Code of Federal Regulations (CFR) 228] on Coronado National Forest lands; and administered and regulated for the State of Arizona by the Arizona State Mine Inspector (Arizona Revised Statutes 27-901 through 27-1026; and Arizona Administrative Code 11-2-101 through 11-2-822), and the ADEQ (Arizona Revised Statutes 49-241 through 49-252; and Arizona Administrative Code 18-9-101 through 403).

The June 2012 BA did not include details of reclamation and closure activities specific to the Barrel alternative. A July 2012 *Preliminary Reclamation and Closure Plan for the Preferred Alternative* (CDM Smith 2012) was incorporated into the Supplemental BA. Appendix 2 of the Supplemental BA includes detailed descriptions of the reclamation activities, including locations and handling of stockpiled salvaged soils, detailed phasing of concurrent reclamation, and revegetation/reclamation procedures and techniques. Table I-1, below, shows a summary of concurrent reclamation phasing from the preliminary plan.

Table I-1: (Table 2 from Supplemental BA): Phasing of Concurrent Reclamation

Project Phase	**Total Acres Undergoing Reclamation**	**Total Acres Reclaimed**
End of year 1 of active mining	114	0
End of year 2 of active mining	169	114
End of year 3 of active mining	259	283
End of year 4 of active mining	75	542
End of year 5 of active mining	93	617
End of year 10 of active mining	390	710
End of year 15 of active mining	383	1,100
End of year 22 of active mining	1,764	1,483
Postclosure	0	3,589

Almost half of the reclamation to be done at Rosemont will have been completed by the end of year 15 of active mining (1,500 of 3,600 acres).

Soil Salvage Plans

Detailed plans for soil salvage have been identified for the proposed action (CDM Smith 2012 Soil Salvage Management Plan) as part of the preliminary reclamation and closure planning effort.

- Soil salvaging in specific areas will not take place until it is necessary to disturb those areas for mine activities.
- At soil salvage locations, pits will be dug to verify removal depth of salvage soils.
- Erosion and sediment controls will be installed, both upslope and downslope of soil removal areas. These controls are required under the stormwater pollution prevention plan that will be mandatory under the mine’s Arizona Pollutant Discharge Elimination System Multi-sector General Permit for stormwater. Dust controls will also be implemented.
- Soil will be transported using haul trucks or other equipment to a stockpile location or directly to the waste rock/tailings facilities. If possible, transportation will be direct rather than incorporating long-term stockpiles. Stockpiles will be located in four different areas over the life of the mine.

- Stockpile 1 is located immediately east of the phase 2 dry-stack tailings facility, with a footprint of approximately 18 acres and a capacity of 501,000 cubic yards. This stockpile will be used generally through the first 8 years of operation.
- Stockpile 2 is located south of stockpile 1 and will be used for years 8 through 14 of operations. Stockpile 2 has a footprint of approximately 39 acres and a capacity of 502,000 cubic yards.
- Stockpile 3 is located on the top of the waste rock storage area and will be used for years 14 through 22 of operations. Stockpile 3 has a footprint of 22 acres and a capacity of 335,000 cubic yards.
- Stockpile 4 is also located on the top of the waste rock storage area and will be used for years 14 through 22 of operations and during closure. Stockpile 4 has a footprint of 18 acres and a capacity of 283,000 cubic yards.
- Soil stockpiles will be managed to reduce potential erosion, designed to reduce potential for compaction to maintain air circulation and drainage, and if anticipated to be in existence for at least 1 year, will have vegetative cover using a broadcast seed mix and possibly stabilizers like straw mulch with tackifier

Revegetation and Expected Revegetation Success

Concurrent reclamation will take place over the life of the project, with initial reclamation beginning on the lowest levels of the waste rock buttresses when tailings are placed behind the buttress. The proposed acreage of reclamation activities over time is shown above, and in Appendix 2 of the October 2012 Supplemental BA and Table I-2, below.

Revegetation would only be considered complete when certain reclamation criteria have been met. It is the responsibility of the Coronado National Forest to determine these success criteria and the responsibility of Rosemont Copper to develop methodologies and techniques, including adaptive management that can meet the revegetation criteria. The final reclamation and closure plan would provide further detail on the techniques to be employed, as well as monitoring and success criteria required for approval by the Coronado National Forest. The long-term purpose of undertaking revegetation is to create a self-sustainable ecosystem that would promote site stability and repair hydrologic function.

Revegetation procedures will differ, depending on whether upland or riparian areas are being revegetated. Most of the landform, which consists of the waste rock and tailings facilities, will be covered with growth medium and revegetated with upland vegetation, as will the upper pit benches and the plant site. However, there may be limited areas along drainages where riparian revegetation would be appropriate. Upland revegetation will generally follow these steps: regrading, placement of salvage soils, ripping, transplantation of trees and shrubs, seed application, mulch and tackifier and maintenance/monitoring activities.

Areas will be regraded to obtain stable, permanent slope condition as designated in the final reclamation plans. Where possible, such as at the plant site, grading is intended to restore more natural slopes and minimize erosion. The potential for restoring natural slopes is limited with respect to the waste rock and tailings facility, but such shaping will be incorporated to the extent practicable, primarily on top of the facilities.

Soils will be salvaged onsite, as previously described, and will be used as surface cover for revegetation. Almost all slopes will receive either a cover of soil or a mixture of soil and rock cover. In the most recent reclamation closure plan developed for the Barrel Alternative, several steep slopes on the side of the landform adjacent to the pit will remain solely rock with no soil cover. Specific surface treatment locations for the waste rock and tailings facilities will be shown in the Soils and Revegetation section in Chapter 3 of the FEIS, which is in preparation (USFS 2013a). For shorter slope runs between benches (less than 300 feet), the surface treatment is likely to be primarily soil cover. For longer slope runs between benches (over 300 feet), the soil cover could be limited to the upper 300 feet of the slope to prevent erosion. The lower 300 feet may consist of rock or a combination of soil/rock. Other configurations may also be considered, such as the use of soil islands; these are small areas (probably less than 10 acres) in which soil of greater depth is placed to improve species' diversity and benefit planted trees and shrubs. Where present, the total depth of soil cover will vary, but is estimated to be approximately 12 inches. Mulched vegetation material available from site clearance could be used as a soil additive if appropriate.

After placement of salvage soil, the soil surface will be ripped or otherwise mechanically manipulated in order to create an optimal seedbed. Ripping and furrowing generally will follow contours to minimize erosion. The seed mix and application techniques could vary, depending on slope, aspect, elevation, and underlying growth media. The seed mix may also incorporate native plant species that are culturally important to tribes.

The native seed mix will be agreed upon and approved by the Coronado National Forest and will be informed by the greenhouse studies, test-plot data, reference sites and results from previously revegetated areas.

Appropriate site preparation may include lightly dragging the area after seed application, soil amendments, and/or application of certified weed-free straw mulch with a tackifier. Slow release fertilizer may be incorporated to promote plant growth.

Desired Condition

The Coronado National Forest has determined the general desired vegetation condition for the reclaimed waste rock and tailings facilities over time. The desired vegetation condition represents what can reasonably be expected on disturbed, reclaimed growth medium that would exhibit more xeric soil moisture conditions than those found on natural areas. Desired conditions are included in the FEIS as a somewhat general, qualitative description of what the reclaimed sites will support following revegetation, at different time periods. The desired conditions have been developed through a review of the Natural Resources Conservation Service Ecological Site Descriptions, test plot data, and expertise of Coronado National Forest staff and others.

It should be noted that the desired condition is not the same as reclamation success criteria, which are more site specific and quantitative, and will be fully described in the revegetation plan currently being developed and to be approved with the final MPO. Most importantly, success criteria would be informed by data collection on the final reference sites once they are selected by the USFS. This process is underway, and these data will be available for incorporation into the revegatation plan in the final MPO. This plan will use the process described in the Adaptive Management Technical Guide developed by the U.S. Department of the Interior (Williams *et al.* 2009), and further detail is shown in the "Revegetation Success Criteria" part of this resource section. Desired vegetation condition varies across the site, influenced primarily by aspect and soil texture and chemistry. There are six revegetation site types that are considered for the reclaimed waste rock and tailings facilities, as summarized in Table I-2 below. The spatial distribution over time of these areas across the site is summarized in the Soils and Revegetation section of the EIS.

Table I-2: Desired vegetation condition over time

Revegetation Site Type	**Vegetation Type**	**Number of Species**	**Percent Canopy Cover – 5 Years after Planting**	**Percent Canopy Cover – 10 Years after Planting**	**Percent Canopy Cover – 15 Years after Planting**	**Percent Canopy Cover – 20 Years after Planting**
East-facing slopes	Grasses	5 to 10	10 to 30	10 to 30	10 to 30	10 to 30
	Shrubs	3 to 5	1 to 5	1 to 5	1 to 15	1 to 15
West-facing slopes	Grasses	5 to 10	10 to 20	10 to 30	10 to 30	10 to 30
	Shrubs	3 to 5	1 to 5	1 to 5	1 to 15	1 to 15
Slopes with increased rock cover	Grasses	3 to 7	5 to 20	10 to 20	10 to 20	10 to 20
	Shrubs	1 to 3	0 to 5	1 to 5	3 to 5	3 to 5
South-facing slopes	Grasses	5 to 10	5 to 15	10 to 20	10 to 20	10 to 30
	Shrubs	1 to 3	1 to 5	1 to 5	1 to 5	1 to 5
	Succulents	1 to 3	1 to 3	1 to 5	1 to 5	1 to 5
North-facing slopes	Grasses	5 to 10	10 to 30	10 to 30	15 to 45	15 to 45
	Shrubs	3 to 7 (<10 years after planting) 3 to 10 (>10 years after planting)	3 to 10	3 to 10	5 to 10	5 to 15
	Trees	1 to 2	0 to 3	1 to 5	1 to 5	2 to 5
Level areas	Grasses	5 to 10	10 to 30	10 to 30	15 to 40	15 to 40
	Shrubs	3 to 5	1 to 5	1 to 10	1 to 10	1 to 10
	Trees	1 to 2	0 to 3	0 to 3	1 to 3	1 to 3

As shown in Table I-2, while grasses and shrubs would occur across all revegetation site types, trees are likely only to consistently occur on north-facing slopes and level areas, and succulents are most likely to consistently occur on southern exposures. Note that succulents do not offer significant cover, so although the cover would not change over time, the density of these plants still would increase. Each revegetation site type is described below. Slope aspect influences soil moisture, with the greatest amount of soil moisture being retained on the north slopes and the least on south-facing slopes. More soil moisture is also retained on flat areas, compared with angled slopes such as on the sides of the waste rock and tailings facilities. Elevation also influences plant communities. The waste rock and tailings facilities fall roughly from 4,600 to 5,500 feet above mean sea level, with some areas extending as high as 5,700 feet above mean sea level.

East-facing slopes - Vegetation would be composed primarily of warm season perennial grasses, some forbs, and small shrubs. Small shrubs or sub-shrubs may be present but would not be clearly visible from a distance. Trees may be present but would be very widely distributed and would make up a small amount of the plant community. Long slope runs may require additional rock cover for soil stabilization.

West-facing slopes - Vegetation would be composed primarily of warm season perennial grasses, some forbs, and small shrubs. Small shrubs or sub-shrubs may be present but would not be clearly visible from a distance. Trees may be present, but would be very widely distributed and would make up a small amount of the plant community. West-facing aspects would look similar to east-facing aspects but may be composed of different species within the same functional groups.

Slopes with increased rock cover - Vegetation would be composed primarily of warm season perennial grasses, mixed forbs, and a minor component of small shrubs, compared with east- and west-facing slopes. Because of the steepness of these slopes, increased rock cover would be placed over the soil cap for erosion protection and increased stability. Species that favor rocky soils would be used. These areas are expected to be stable, even with relatively low amounts of vegetation cover; they would primarily be on the western side of the facilities and would not be visible from SR 83.

South-facing slopes - Vegetation would be composed primarily of warm season perennial grasses, some forbs, and small shrubs. Small shrubs or sub-shrubs may be present but would not be clearly visible from a distance. Trees may be present but would be very widely distributed and would make up a small amount of the plant community. Palmer's agaves (*Agave palmeri*) would be transplanted in clumps to mimic how they appear on undisturbed sites. Other culturally significant plans, such as sotol (*Dasylrion wheeleri*) and beargrass (*Nolina microcarpa*), may also be planted in clumped distribution on these portions of the facility. The greater amount of surface rock and less grass cover in these areas would be clearly visible.

North-facing slopes - Vegetation would be composed of warm season perennial grasses and forbs, mixed with shrubs and dispersed trees. A higher density of shrubs and trees would establish on these slopes, compared with savannas or level-ground grasslands. It would take a number of years for shrubs and trees to grow large enough to be visible from a distance. Some species of trees may be deciduous, losing their leaves during the winter.

Level areas - Vegetation would be composed primarily of warm season perennial grasses, mixed forbs, an increased amount of small shrubs, compared with east- and west-facing slopes, and widely dispersed trees. Shrubs and trees would give a savanna-like appearance and would be visible from a distance once the plant community matures, which would take a number of years.

Plant species - A variety of plant species would be incorporated into the seed mixes used for revegetation, informed in part by greenhouse and test plot studies conducted by Rosemont Copper, reference area vegetation, and the success of previously revegetated areas on the mine site, and the need to plant species of cultural importance. This seed mix would be expected to adaptively change over time based on the success of different species. In addition, other species not specifically seeded would be expected to opportunistically grow, including those that might be in the natural seed bed in the salvaged soil. It is important to note that the seed/planting mix and desired conditions do not account for mesquite, acacia, mimosa, or one-seed juniper. It is expected that these species would readily colonize the reclaimed sites and therefore would not be seeded. They are not included in desired condition estimates of species richness or canopy cover. Their presence would contribute additional species richness and cover beyond what is described here. The strategy for salvaging and using soil is intended to preserve the biological component within the soil to the extent practicable during the mining operation to promote the natural reestablishment of plant species native to the area. This strategy includes selectively stripping the upper soil layers and either directly placing that material on the reclaimed landform or storing that material in shallow stockpiles for as short a time as possible. This approach would be developed more fully in the final MPO.

The species currently proposed for the seed mix are summarized in Table I-3, below, along with a list of additional species that are being considered for seeding/planting.

Table I-3: Species expected to be present

Grasses		**Forbs**		**Shrubs/Succulents**		**Trees**	
Planned Seed Mix							
Scientific Name	**Common Name**	**Scientific Name**	**Common Name**	**Scientific Name**	**Common Name**	**Scientific Name**	**Common Name**
Bouteloua curtipendula	Sideoats grama	*Baileya multiradiata*	Desert marigold	*Agave palmeri*	Palmer's agave	*Juniperus deppeana*	Alligator juniper
Eragrostis intermedia	Plains lovegrass	*Eschscholzia minutiflora*	Mexican gold poppy	*Atriplex canescens*	Four-wing saltbush	*Quercus arizonica*	White oak
Bouteloua gracilis	Blue grama			*Calliandra eriophylla*	Fairy duster	*Quercus emoryi*	Emory oak
Elymus sp.	Bottlebrush squirreltail			*Celtis pallida*	Desert hackberry	*Quercus oblongifolia*	Mexican blue oak
Digitaria californica	Arizona cottontop			*Cercocarpus sp.*	Mountain mahogany		
Hilaria belangeri	Curly-mesquite			*Dasylirion wheeleri*	Desert spoon or sotol		
Leptochloa dubia	Green sprangletop			*Fouquieria splendens*	Ocotillo		

Grasses		Forbs		Shrubs/Succulents		Trees	
				Garrya wrightii	Wright's silktassel		
				Nolina microcarpa	Beargrass		
				Rhus trilobata	Skunkbush sumac		
				Rhus virens	Evergreen sumac		
				Yucca elata	Soaptree yucca		
				Yucca schottii	Schott's yucca		
Potential Additions							
Bothriochloa barbinodis	Cane beardgrass			*Dalea sp.*	Dalea		
Bouteloua hirsuta	Hairy grama			*Eriogonum spp.*	Buckwheat		
Bouteloua chondrosioides	Sprucetop grama			*Krameria sp.*	Range ratany		
Bouteloua repens	Slender grama			*Krascheninnikovia sp.*	Winterfat (on calcareous soils)		
Heteropogon contortus	Tanglehead			*Menodora sp.*	Menodora (on calcareous soils)		
Lycurus sp.	Wolfstail			*Parthenium incanum*	Mariola (on calcareous soils)		
Sporobolus cryptandrus	Sand dropseed			*Zinnia sp.*	Zinnia (on calcareous soils)		
				Lippia sp.	Lippia (on calcareous soils)		

Mine Closure

At closure, fence construction for the mine pit will be a minimum of three-strand barbed wire with warning signs. Arizona Administrative Code R11-2-401 specifies measures that include fencing and signage. Additionally, Rosemont will construct structures to provide additional safety protections if needed, such as berms around the pit, possible "tank traps" as necessary to restrict unauthorized road access, and upgraded fencing (i.e., chain link) if necessary on steeper slope areas above the pit or other areas. Operating facilities at the proposed action site will be demolished and removed, and building foundations will be demolished, covered with soil, and graded or removed. All areas will be investigated for contaminants, and any contaminated soils, reagents, or fuels will be disposed of off-site at licensed facilities. Post-mine land use on

Coronado National Forest lands will follow the direction in the forest plan that is in place at that time. Post-mining/closure reclamation objectives for Rosemont's private property could include dispersed recreation, wildlife habitat, and ranching.

Mitigation and Monitoring

Council on Environmental Quality (CEQ) regulations (40 CFR 1508.20) define mitigation measures as follows:

- Avoiding an impact by not taking a certain action or parts of an action;
- Minimizing an impact by limiting the degree or magnitude of the action and its implementation;
- Rectifying an impact by repairing, rehabilitating, or restoring the affected environment;
- Reducing or eliminating an impact over time, through preservation and maintenance operations during the life of the action; and
- Compensating for an impact by replacing or providing substitute resources or environments.

Mitigation measures can be an integral component in the design of a project [Council on Environmental Quality (CEQ) 2011]. The Rosemont project contains numerous measures designed to avoid, minimize, rectify, reduce or eliminate, or compensate for environmental impacts. Measures designed to mitigate impacts have been identified from a variety of sources, including the ID team, cooperating agencies, Rosemont Copper, and public comments.

In its regulations, the Forest Service is directed to minimize adverse environmental impacts to Coronado National Forest surface resources, where feasible (36 CFR 228.8). The Coronado National Forest has developed a mitigation and monitoring plan that meets the guidance and direction specified by the CEQ and applicable laws and regulations. The plan is to be incorporated into the Final EIS as Appendix B. The plan also appeared as Appendix B in our July 3, 2013, Draft BO. It is important to note that the full suite of mitigation and monitoring requirements will be finalized once all required permits have been issued, as they contain measures required by resource agencies (including FWS) to avoid, reduce, and monitor environmental effects. These measures will appear as a definitive version of Appendix B in the Final EIS. Several drafts of Appendix B were provided to FWS during consultation and were considered in our effects analyses, but will not be included in this Final BO due to the aforementioned ongoing revisions to the former's content.

Guidance provided to Federal agencies by the CEQ states that agencies should not commit to mitigation measures absent the authority or expectation of resources to ensure the mitigation is performed (CEQ 2011). All suggested mitigation measures were screened by the ID team and recommended measures reviewed by the responsible official. Part of that review involved determining whether the Forest Service has the authority to require certain mitigation; whether the proposed mitigation would effectively avoid, reduce, eliminate, or compensate for predicted effects; and whether the Forest Service or another regulatory permitting agency can ensure that the mitigation will be implemented.

While most of mitigation measures specified in this FEIS will be required as a condition of the ROD, Rosemont Copper has proposed to implement a number of mitigation measures that are beyond the scope of authority of the Forest Service or other regulatory permitting agencies. The listing and description of mitigation measures and monitoring in this BO indicate which measures are mandated by either the Forest Service or other regulatory agencies and which are being proposed by Rosemont Copper. It is important to note that mitigation measures that are proposed by Rosemont Copper are addressed separately from mitigation that is within the authority of the Forest Service or other regulatory and permitting agencies, with the understanding that measures proposed by Rosemont Copper may or may not be implemented.

A description of mitigation and monitoring has appeared in drafts of Appendix B, which were considered by FWS during our effects analyses. A definitive version will appear in the Final EIS. The discussion that follows provides information pertaining to specific resource topics that provide a context for the specific mitigation and monitoring items.

Air Resources

An air quality permit is a requirement under the Clean Air Act, whose regulatory authority has been delegated from the EPA to the Arizona Department of Environmental Quality to implement and enforce applicable federal air quality standards. The Arizona Department of Environmental Quality issued an Air Quality Permit to Rosemont Copper on January 31, 2013. It is the responsibility of the mine owner/operator to maintain compliance with their air permit, which contains conditions to limit fugitive dust and other potential emissions.

The Barrel alternative contains a number of mitigation and monitoring measures designed to reduce potential impacts to air quality and to meet federal National Ambient Air Quality Standards (NAAQS). These are described in the Mitigation and Monitoring – Other Regulatory and Permitting Agencies in Appendix B, which will be included in the Final EIS. Air quality modeling indicates that the Barrel alternative will meet NAAQS for air quality at the location of the perimeter fence. Further details can be found within the January 31, 2013 Air Quality Permit (ADEQ, Air Quality Permit Number 55223).

Hazardous Materials

In order to reduce potential human health and environmental risks, hazardous materials and substances would be managed and contained within facilities that are designed, constructed, and maintained to meet applicable laws and regulations. These facilities will include leak containment and recovery systems as required and adequate stormwater management and drainage systems to prevent contamination outside containment areas.

Specific mitigation and monitoring related to hazardous materials are described in the Mitigation and Monitoring – Forest Service section of Appendix B, which will be included in the Final EIS.

Land Impact

The design of the project includes efforts to restrict mine activities within a mine footprint that is substantially smaller than conventional mines with similar production capacity. This is achieved through the use of dry-stack tailings technology, which will have an overall crest-to-toe slope of 3.5:1 (horizontal: vertical) on the outer surface of the dry-stack tailings facility and waste rock facilities; and concurrent revegetation requirements. Slopes will be 3:1 between benches. The use of dry-stack tailings facilities will avoid impacts to cultural sites; wildlife habitat; soils; waters of the United States; and surface water due to its smaller footprint. It will also reduce impacts related to water use; reduced seepage resulting from lower moisture content of the tailings would avoid or reduce impacts to potential groundwater contamination; and reduced evaporation would reduce water use. Reclamation can begin earlier, improving vegetative recovery. Filtered tailings will be transported, spread, and compacted to form an unsaturated, dense, stable tailings stack that will include a surrounding rock and soil buttress that will be seeded for revegetation during operations. These design features are a combination of requirements by the Forest Service and permit requirements under the Aquifer Protection Permit, issued by the Arizona Department of Environmental Quality on April 3, 2012.

Specific mitigation and monitoring related to design features that will reduce land impact are described in both the Mitigation and Monitoring – Forest Service, and Mitigation and Monitoring – Other Regulatory and Permitting Agencies sections of Appendix B, which will be included in the Final EIS.

Noise

Rosemont will use noise management techniques and operational tools to minimize noise generated during mine operations. Blasting only during daylight hours and sequenced blasting using time-delay technology have been incorporated into the proposed action design. Another tool to be used is attenuated back-up alarms on trucks and similar equipment that are electronically modulated to meet federal requirements.

Specific mitigation and monitoring related to noise are described in the Mitigation and Monitoring – Forest Service section of Appendix B, which will be included in the Final EIS.

Night Lighting

To the extent allowed under MSHA regulations, all exterior and access route lighting will be designed and operated with the intent to reduce nighttime light pollution. Rosemont has developed a revised lighting plan that identified steps that will be taken to achieve the goals of the 2006 City of Tucson and Pima County Outdoor Lighting Code while also protecting the safety of the workers and visitors to the proposed action facilities (Monrad *et al.* 2012). The revised lighting plan reduces the amount of light proposed for the site by at least 75% and incorporates additional mitigation measures. Where safety requirements allow, outdoor lighting design incorporated the following: appropriate shields; dimmers and/or full cutoff lighting fixtures; timers; motion detectors; directional lighting; limited spectrum technologies; and production of the minimum lumens practicable. In addition, structures are to be designed and painted to be non-reflective to reduce glare and are to incorporate strategic placement of lighting fixtures.

The light pollution mitigation recommendation report identifies the six principal mitigation strategies that were used to develop a lighting design plan (Monrad *et al.* 2012):

1. Employ twenty-first century light sources (e.g., light emitting diodes [LED], induction, organic LED, or plasma) and use strategies such as adaptive lighting and on-demand lighting
2. Employ very well shielded and aimed light sources
3. Employ spectral control with the ability to manage the emission of certain wavelengths
4. Use the smallest necessary light source (i.e., "lumen package")
5. Address the environmental concerns of native flora and fauna
6. Use solid-state lighting for vehicular-mounted task lighting to impart less stray light and direct more useful light to critical task and operation areas

The primary mitigation strategy that specifically addresses the environmental concerns relative to native flora and fauna includes the use of specific LED lighting solutions (Monrad *et al.* 2012). This strategy includes limitations on the use of sub-500 nanometer lighting spectra (generally blue light) that will be applied to minimize the impact to the night environment. The control of sub-500 nanometer wavelengths is a known factor in minimizing artificial lighting effects on nighttime insects and their predators.

Specific mitigation and monitoring related to artificial night lighting are described in the Mitigation and Monitoring – Forest Service section of Appendix B (the definitive version of which will be included in the Final EIS) under both the Dark Skies and Biological Resources headings.

Plants and Animals

Rosemont will revegetate disturbed areas with native vegetation, excluding the pit area. A preliminary site seed mix has been developed from tests with native plant species that can be used to reclaim the proposed project site (Fehmi 2007; Fehmi *et al.* 2008). Seed mixes and methodology for revegetation will be determined in a Final Reclamation and Closure Plan currently under development to include the most recent changes to stormwater design, and ongoing investigation into revegetation potential. The selected seed mix would be informed by the greenhouse studies, test-plot data, reference sites, and results from previously revegetated areas. The Final Reclamation and Closure Plan will be completed after approval of the Record of Decision, but prior to approval of the final MPO. Linear features such as utilities and pipelines would be reclaimed to avoid fragmentation of native biological communities. Specifications are anticipated to be the same as those for other disturbed sites. Specific mitigation and monitoring related to revegetation are described in the Mitigation and Monitoring – Forest Service section of Appendix B (the definitive version of which will be included in the Final EIS), under the Soils and Revegetation heading.

Process water ponds or chemical or fuel storage areas will be enclosed, covered, or otherwise managed to protect wildlife, livestock, and public safety. Location and construction criteria for the proposed action facilities will prevent deleterious exposure of livestock, wildlife, and birds to toxic chemicals or hazardous conditions created by, used in, or resulting from processing operations. Mitigation and monitoring related to enclosing or covering these facilities are described in the Mitigation and Monitoring – Forest Service section of Appendix B (the definitive version of which will be included in the Final EIS), under the Biological Resources heading. Additional requirements are contained in measures listed in the Mitigation and Monitoring – Other Regulatory and Permitting Agencies, under Air Quality.

In order to reduce or avoid impacts to habitat specific to rocky slopes on the east side of the Santa Rita Mountains, construction of the electrical power line that provides electricity to the pit will be located on the west-side of pit operations and within the disturbance perimeter of the pit and diversion structures. This will reduce disturbance to talus slopes and talussnail habitat, as well as reducing impacts to visual resources by avoiding construction on the ridgeline. This measure is described in the Mitigation and Monitoring – Forest Service section of Appendix B (the definitive version of which will be included in the Final EIS), under the Biological Resources heading.

Invasive Species Control Plan

Invasive species must be addressed as directed by Executive Order 13112, “Invasive Species.” Rosemont has prepared a preliminary invasive species control plan which will be updated prior to approval of the final MPO. Mitigation and monitoring requirements are contained in measures described in the Mitigation and Monitoring – Forest Service section of Appendix B (the definitive version of which will be included in the Final EIS), under the Soils and Revegetation and Biological Resources headings.

Transportation Plan

Rosemont has agreed to develop a comprehensive Transportation Plan for all project related roads on Coronado National Forest lands. The transportation plan will address maintenance standards; levels of appropriate use; methods to maintain the roadways sufficiently to prevent washboard, rutting, and drainage problems; commitment to replace surfacing lost to drainage; commitment to repair roads damaged by use; commitment to restore temporary roads to pre-operation conditions during reclamation/closure; and installation and maintenance of wildlife crossing structures (e.g., corrugated metal pipes) under the primary access road at locations of known wildlife concentration. The transportation plan would be developed after approval of the Record of Decision and prior to approval of the final MPO.

These measures are described in the Mitigation and Monitoring – Forest Service section of Appendix B (the definitive version of which will be included in the Final EIS), under the Transportation and Access heading.

Water Resources

In order to conserve water, Rosemont has committed to filter the tailings and maximize water conservation, as detailed in the preliminary MPO (WestLand 2007). The filtered tailings will reduce Rosemont Copper Company's consumption of water by 50% to 60% over traditional industry designs. This is a primary component of dry stack tailings previously described.

In addition to filtering the tailings, Rosemont has also included in their facility designs a number of ways in which they will maximize the reuse of process water and stormwater. These measures are primarily required by the Aquifer Protection Permit, and are described in the Mitigation and Monitoring – Other Regulatory and Permitting Agencies section of Appendix B (the definitive version of which will be included in the Final EIS), under the Groundwater Quantity and Quality heading. Further detail can be found in the Aquifer Protection Permit.

Rosemont has voluntarily committed to implement regional groundwater mitigation measures within the Tucson Active Management Area that will use available Central Arizona Project water as a source to conduct recharge within the Tucson Active Management Area. To date, Rosemont has recharged 45,000 acre-feet of water within the Tucson Active Management Area. Note that this compensatory mitigation is dependent on Central Arizona Water Project water's being available to Rosemont. Further details are contained in a measures described in the Mitigation and Monitoring – Rosemont Copper Company section of Appendix B (the definitive version of which will be included in the Final EIS), under the Groundwater Quantity and Quality heading.

Rosemont has stated they will annually fund the U.S. Geological Survey (USGS) to operate and maintain the existing surface water flow measurement gage at Barrel Canyon. After 5 years post-mining, the USGS may fund the gage or remove it at their discretion. Further details are contained in measures described in the Mitigation and Monitoring – Rosemont Copper Company section of Appendix B (the definitive version of which will be included in the Final EIS), under the Groundwater Quantity and Quality heading.

Rosemont will manage water on the tailings storage and waste rock facilities to avoid or reduce erosion as previously described. Where mine facilities remain over the long term, specific dam safety permit limits require Rosemont to install permanent water control structures that may exist beyond the life of the mine. Specific permit conditions provide for periodic monitoring and maintenance of spillways, diversions, and other permanent facilities. Specific information is contained in a variety of measures, including those described as follows: Mitigation and Monitoring – Forest Service section of Appendix B (the definitive version of which will be included in the Final EIS), under the Surface Water Quantity and Quality heading; Mitigation and Monitoring – Other Regulatory and Permitting Agencies section of Appendix B (the definitive version of which will also be included in the Final EIS), under the Groundwater Quantity and Quality and Surface Water Quantity and Quality headings. Further details are contained in the Aquifer Protection Permit, and will be contained in the Stormwater Pollution Prevention Plan (developed after approval of the Record of Decision but prior to approval of the final MPO).

In addition to monitoring required under the Aquifer Protection Permit (described below) Rosemont will monitor water quality in up to 10 springs and 16 wells located in the vicinity of the mine, will monitor the waste rock pile for potential seepage, and during operations will conduct additional waste rock characterization tests not required by ADEQ through the Aquifer Protection Permit. Specific information is contained in the Mitigation and Monitoring – Forest Service section of Appendix B (the definitive version of which will be included in the Final EIS), under the Groundwater Quantity and Quality heading.

Water Source Enhancement and Mitigation

Rosemont will construct, manage and maintain water features to reduce potential impacts to wildlife and livestock from reduced flow in seeps, springs, surface water and groundwater. Existing water features, including stock ponds, will be enhanced, and additional water features added as needed. Seven water features will be managed for sustainability of surface water. Up to 30 water features will be managed or constructed if needed for threatened and endangered species. This is further described in a measure in Mitigation and Monitoring – Forest Service section of Appendix B (the definitive version of which will be included in the Final EIS), under the Biological Resources heading.

Aquifer Protection Permit

On April 3, 2012, ADEQ issued its decision granting Aquifer Protection Permit No. P-106100 to Rosemont. Among other things, the aquifer protection plan requires Rosemont to manage discharges from its facilities so that they do not cause or contribute to a violation of aquifer water quality standards at the point of compliance; or, if the ambient groundwater quality already exceeds aquifer water quality standards at the time of permit issuance, then the discharges must be managed so that they do not cause further degradation of the water quality.

Under the aquifer protection permit, Rosemont will implement a Waste Rock Segregation Plan, to identify and manage materials using geochemical analysis and acid-base accounting methods. This plan requires that a geologist or trained technician will inspect each pile of blasted and broken rock before removal from the active mining face and any rock that is identified as potentially acid-generating will be isolated from other waste rock.

The aquifer protection permit also requires Rosemont to install monitoring wells (called “point of compliance” or “POC” wells) at locations around the project area approved by ADEQ. Rosemont is required to sample and test the groundwater in these wells on a quarterly basis and to report the results to ADEQ. A baseline monitoring program has been implemented as part of the monitoring plan in the aquifer protection permit in order to establish ambient groundwater conditions prior to operations. This program is in place to determine the amount of chemical constituents, such as sulfate and chloride, already in the aquifer. Ambient groundwater quality will be established before aquifer protection permit regulated facilities begin operation. A contingency plan is addressed in the APP.

Stormwater Pollution Prevention Plan

This plan is required by the ADEQ as part of the process for obtaining coverage under the Multisector General Permit, which is also required under Section 402 of the CWA. This permit requires the preparation of a stormwater pollution prevention plan and implementation of control measures, as outlined by the ADEQ's Arizona Pollutant Discharge Elimination System Multi-sector General Permit program. Coverage under this program was obtained from ADEQ by Rosemont Copper on February 7, 2013. The use of best management practices is an integral part of these plans and permits. The stormwater pollution prevention plan was prepared and the permit issued by ADEQ on February 7, 2013. ADEQ will review a copy of the updated SWPPP prior to construction.

Mitigation and Monitoring – Evaluation and Reporting

Rosemont Copper will fund the monitoring to which the Forest Service commits in the ROD and that will be defined in the final MPO. Other monitoring activities may be associated with the regulatory authority of Federal and State agencies and would be funded by permit fees or the agencies themselves as part of their normal activities. Title 36 CFR 219.11(d) states:

Use of monitoring information. Where monitoring and evaluation is required by the plan monitoring strategy, the responsible official must ensure that monitoring information is used to determine one or more of the following:

1. If site-specific actions are completed as specified in applicable decision documents;
2. If the aggregated outcomes and effects of completed and ongoing actions are achieving or contributing to the desired conditions;
3. If key assumptions identified for monitoring in plan decisions remain valid; and/or
4. If plan or site-specific decisions need to be modified.

Monitoring and evaluation activities will be prescribed, conducted, and/or reviewed by Rosemont, the Coronado National Forest, the Army Corps of Engineers, and other agencies and groups participating in a multiagency monitoring and evaluation task force. The Coronado Forest Supervisor will invite County, State, and Federal agencies with permitting or other regulatory authority, Rosemont Copper, and additional agencies and groups who would bring expertise to monitoring efforts to participate on this task force. The task force will meet at least annually to review and evaluate monitoring results and make recommendations to the forest supervisor. Evaluation will indicate: (1) whether monitoring requirements have been completed according to the final monitoring plan; (2) whether monitoring results indicate that the effects and results of mining and related activities are within the range of those predicted in the eventual FEIS and ROD (USFS 2013b; (3) whether monitoring activities and methods remain valid and whether continued monitoring is warranted going forward; and (4) whether changed conditions, if any, dictate modification of the final MPO and/or ROD.

Rosemont Copper will be required to compile monitoring results into a monitoring report that will be provided to the Forest Service on a quarterly basis. Any monitoring result that is not in compliance with the effectiveness criteria will be reported to the Forest Service within 72 hours. After reviewing the results of these reporting requirements, the Forest Service will notify members of the multiagency monitoring group should conditions warrant interim or emergency meetings.

In addition to quarterly monitoring reports, Rosemont Copper will submit an annual report to the Coronado National Forest and the multiagency monitoring group that contains a description of all activities conducted during the previous year and a summary of applicable information as approved by the Forest Service, along with annual results of all monitoring plans in a format approved by the Forest Service, including a complete data summary and any data trends, a mining status plan, and plans for the coming year. Significant changes will be incorporated into the final MPO and reflected in financial assurance. Past, ongoing, or projected impacts on the environment may also require amendment of the final MPO, ROD, and/or financial assurance held for the project.

Rosemont Copper will fund work performed by Coronado National Forest employees, consultants, and/or cooperators assigned to administer and monitor the project. This includes a minerals administrator and a biological monitor, whose role in overseeing monitoring activities is described in this Biological Opinion within the Description of the Proposed Conservation Measures. Details regarding other Coronado National Forest positions that will be necessary for administering the project and overseeing monitoring are still being developed.

Postclosure Monitoring

While the Rosemont Copper Project has been designed with the intent of minimizing long-term maintenance and monitoring, it is recognized that the potential exists for continued monitoring of postmine conditions. To that end, all reclaimed sites will be monitored a minimum of twice a year for a period to be determined, in order to evaluate the success of reclamation work. Any areas not meeting reclamation goals will be analyzed to determine the underlying problems, which would be addressed with a modified plan.

In addition, groundwater will be monitored for a specific period of time to be decided by ADEQ closure requirements under the Aquifer Protection Permit, as well as at other well and spring locations determined by the Forest. Surface water will be monitored as required in the Arizona Pollutant Discharge Elimination System program following cessation of mining operations. Final monitoring details and locations will be decided when the ADEQ reviews the Stormwater Pollution Prevention Plan (SWPPP). Results of this monitoring will be used to evaluate the success of the measures taken to protect the water resources. Any changes in water quality will be evaluated to determine whether the changes are related to the reclaimed mining features, and appropriate steps will be taken to address the problem. Financial assurance will be adjusted to the extent allowed by law and regulation related to these ongoing activities.

Conservation Measures

These conservation measures appear in the February 2013 Supplemental BA and are additive to, or help clarify those in, the initial and the October 2012 Supplemental BA.

On behalf of the Coronado National Forest, Rosemont agrees to implement the following conservation measures for the Rosemont Copper project.

A. General Monitoring and Reporting Requirements

1. The Coronado National Forest shall identify a Coronado National Forest journey-level biologist (GS-9 or higher grade), the Biological Monitor, to provide oversight and assess compliance with these conservation measures and any Reasonable and Prudent Measures and Terms and Conditions. Rosemont shall reimburse the Coronado National Forest for work performed by the Biological Monitor, along with necessary overhead and supervisory support to the extent necessary to perform the duties as outlined below.

1.1. The Biological Monitor shall support biological monitoring for listed and non-listed species and biological resources, as well as other mitigation and monitoring measures that may be required by the Coronado National Forest.

1.2. The Biological Monitor will coordinate directly with Rosemont and Rosemont's consultants on behalf of the Forest Service, as well as the Coronado National Forest Project Implementation Monitor, and shall be responsible for reviewing and approving submitted reports and analyses.

1.3. Initially, the level of effort anticipated to perform the role outlined above (specifically for ESA commitments) is estimated at approximately 20 percent of a full-time employee position. Additional cost recovery for the Biological Monitor may also be needed for oversight on reclamation, invasive species management, and mitigation measures for migratory birds and sensitive species. The funding requirements will be reviewed and updated annually, and shall continue through the life of the project and for five years following mine closure. Monitoring activities, unless specifically stated otherwise in the conservation measures described below, are anticipated to occur throughout the life of the project and for 5 years following mine closure. Rosemont and the Biological Monitor, with the FWS, shall review the monitoring results annually. If appropriate, monitoring requirements and methods may be reduced or eliminated.

1.4. The Biological Monitor shall be Rosemont's primary point of contact with the Coronado National Forest for all activities related to biological resources. The Biological Monitor will be the principal liaison with all other stakeholder agencies. Rosemont shall report significant findings, its reports, etc., to the Biological Monitor first, rather than providing such information directly to FWS, AGFD, or BLM. This requirement shall not prohibit or limit the reporting obligations established in Rosemont's consultant's or biological contractor's scientific collecting permits. The Biological Monitor will coordinate biological monitoring activities with the Rosemont Environmental Manager or other designated representative as identified by Rosemont.

2. Rosemont shall be responsible for all monitoring and reporting. The Biological Monitor will assess compliance with conservation measures through field visits and inspection and by review of an Annual Report. This conservation measure is augmented by Term and Condition 2 for the Chiricahua leopard frog which also requires the monitoring of suitable habitat on National Forest System and Rosemont-owned land within one mile of the active operations area, including on-site stormwater ponds, twice monthly from July 1 through September 30, while the mine is in operation. If Chiricahua leopard frogs are

detected on site or within a mile of the active operations area, they will be relocated to suitable habitat within the management area under close coordination with the local recovery group.

3. Rosemont shall prepare an Annual Conservation Measure Implementation and Monitoring Report ("Annual Report") at the end of each calendar year. The Annual Report shall be due to Coronado National Forest by January 31 of the next calendar year throughout the life of the project and for five years post- closure. This report will include, but is not limited to, the following:

3.1. A brief narrative or tabular description of the specific actions accomplished with regard to each specific conservation measure (and Reasonable and Prudent Measures' Terms and Conditions, also a condition of reporting).

3.2. A brief narrative or tabular description/summary of the objective of each of the conservation measures and whether the objective of that conservation measure was or was not met.

3.3. A brief narrative or tabular description/summary of the status of concurrent reclamation efforts.

3.4. A brief narrative or tabular description on the status of invasive species management.

3.5. For each conservation measure description and summary a change in baseline (e.g., number of water features with breeding Chiricahua Leopard Frogs CLF) from previous years' surveys) condition will be provided.

3.6. Amount of take of threatened and endangered species

3.7. A brief narrative or tabular summary of any problems, issues, or opportunities encountered in the prior calendar year with regard to the implementation of the conservation measures, Reasonable and Prudent Measures and Terms and Conditions that may be authorized by the FWS, or other biological mitigation and monitoring measures.

3.8. A brief narrative or summary of any adaptive management actions taken, and recommendations for future adaptive management actions to be considered by Rosemont, Coronado National Forest, and the FWS.

3.9. Along with hard-copy reports, Rosemont will provide editable electronic files, including GIS files, in a format that can be used by Coronado National Forest. The Coronado National Forest will convert editable files to uneditable files before sharing outside the agency.

4. Rosemont will ensure that anyone dealing directly with threatened and endangered species (e.g., surveys, salvage, translocation, etc.) for the Project has valid state and federal scientific collecting permits, or are agents on Coronado National Forest's or other suitable permits. Surveyors must send copies of permits with the year-end reports to the Biological Monitor as proof of compliance.

5. The Coronado National Forest will reinitiate section 7 consultation pursuant to the Act if the Coronado National Forest and FWS determine that Conservation Measures and/or Reasonable and Prudent Measures' Terms and Conditions have not been met.

B. Sonoita Creek Ranch:

Please note that Sonoita Creek Ranch Conservation Measures appearing below have been revised based on the input of the U.S. Army Corps of Engineers, with additional clarifying text subsequently added by FWS.

1. Rosemont has acquired the right to purchase Sonoita Creek Ranch, which contains approximately 1,200 acres of land along Sonoita Creek with an estimated 590 acre-feet of certificated surface water rights from Monkey Spring along Sonoita Creek. The Sonoita Creek Ranch parcel is part of the Conservation Measures for the Chiricahua leopard frog, Gila chub, Gila topminnow, Huachuca water umbel, lesser long-nosed bat, jaguar, ocelot, and the candidate yellow-billed cuckoo. The Sonoita Creek Ranch lands will be made available to a suitable agency, land trust or conservation organization via the in-lieu fee (ILF) mitigation program, which may be used to mitigate for impacts to waters of the U.S., in conformance with the Corps' 2008 mitigation rule (73 FR 19594). The ILF mitigation program allows a project proponent (e.g. Rosemont) to transfer funding to a governmental or non-profit natural resource management entity with which the Corps has an approved enabling instrument (the agreement entered into between the Corps and the management entity allowing the latter to be an ILF sponsor and to accept and expend funds for mitigation projects). If an ILF mitigation program is not able to be developed, Rosemont will be responsible for either implementing conservation measures and/or any mitigation activities required as part of the Section 404 permit on Sonoita Creek Ranch, or finding a conservation partner to implement such conservation measures and mitigation activities. Whether an ILF program is developed or other conservation arrangements are made by Rosemont, Sonoita Creek Ranch will be managed for conservation purposes, as stated below.

2. In the event that the property is used for an ILF program, it is not anticipated that the wildlife conservation benefits described below will be affected. If modification to any conservation measures is ultimately determined to be required, the Corps will work with USFS, FWS, and Rosemont to modify the conservation measures in a manner that would not change the evaluation for each species and which would result in the same benefits for each species but would not conflict with Section 404 mitigation requirements.

3. Rosemont will record a restrictive covenant or conservation easement on the Sonoita Creek Ranch property that precludes real estate development and similar land use activities and livestock grazing and other agricultural uses subject to the limitations outlined below. This restrictive covenant shall not restrict access for recreational or traditional cultural purposes to these lands provided that these uses are not incompatible with the conservation uses of the property as determined by the Land Manager and the FWS. If ILF program is not employed and the Sonoita Creek Ranch property is instead used for permittee responsible Section 404 mitigation (meaning that the Rosemont Copper Company will implement mitigative measures rather than funding an ILF

sponsor), the Corps shall determine the type of site protection instrument (a conservation easement or similar land encumbrance) for the property and the stipulations required for protection giving consideration to access for traditional cultural purposes. In the event that the Sonoita Creek Ranch will serve as an ILF project, the site protection instrument shall be as described in the enabling instrument of the Corps-approved ILF sponsor. For example, if the site is developed by an entity as an ILF project, the site protection instrument shall be a conservation agreement in accordance with that entities' Corps-approved ILF enabling instrument.

4. Rosemont anticipates transferring ownership of Sonoita Creek Ranch, including the appurtenant water rights, to a suitable owner for conservation purposes consistent with the conservation and public benefits contemplated by these conservation measures.

5. Unless the property is used for an ILF program, funding for long-term management will be provided by Rosemont to a conservation partner via a payment of $150,000 per year to a management account for a period of 10 years commencing with the production of copper concentrates at the project. Under an ILF program, funding for the approved mitigation plan (which will include long term maintenance and adaptive management) shall be developed through the sale of mitigation credits.

6. Surface water rights will be used to support the existing ponds that will be managed for threatened and endangered species. Water available after the needs of the existing ponds have been met will be discharged onto the floodplain terrace of Sonoita Creek that is currently an agricultural field to facilitate the restoration of wetland and/or riparian habitat.

   The two perennial ponds, adjacent wetland habitat, and earthen-lined channel between the ponds on Sonoita Creek Ranch will be renovated to provide habitat for the threatened and endangered species. Requirements for specific recovery activities pertaining to Chiricahua leopard frogs are set forth in Term and Condition 4 for Chiricahua leopard frog. We anticipate that an approved conservation partner will implement the proposed renovation efforts. In addition to the payments described in #5 above, Rosemont will provide a total of $100,000 in support of these renovation efforts. Funding for this effort will be provided by Rosemont via a payment of $20,000 per year to a management account for a period of 5 years commencing with the production of copper concentrates at the Project. If the pond renovation is incorporated into a Corps-approved ILF project, funding for the pond renovation shall be developed through the sale of mitigation credits.

7. Sonoita Creek Ranch will be managed for conservation purposes to provide habitat and connectivity for the Jaguar and Ocelot between the Canelo Hills/Patagonia Mountains and the Santa Rita Mountains, slightly over a mile away to the west of the ranch, in perpetuity. The southern portion of the ranch has been identified by the Arizona Wildlife

Linkages Workgroup and the Arizona Missing Linkages Corridor design as a likely corridor between these two Coronado National Forest land blocks.

8. Management actions in Sonoita Creek Ranch will not compromise the ability to manage for threatened and endangered species. This includes species that are not currently present, but could recolonize the area if habitat were improved.

9. Wildlife-friendly fencing will be installed to discourage use by cattle and encourage use by threatened and endangered species. If an ILF program is not developed, Rosemont will construct wildlife fence along the west boundary of the property to enhance the utilization of the SR 82 crossing of Big Casa Blanca Canyon and Smith Canyon. The balance of fence repaired or replaced at Sonoita Creek Ranch will be wildlife-friendly for-strand wire fence built in accordance with AGFD standards. Under an ILF program, fencing would be designed to exclude cattle and be wildlife friendly, but details for the fencing would be finalized by the Corps and the ILF sponsor.

C. Davidson Canyon Watershed Parcels

1. Rosemont owns six parcels of land on the eastern side of the Santa Rita Mountains, containing approximately 574 acres of land with semidesert grassland and riparian habitat.
2. Rosemont will record a restrictive covenant or conservation easement on the Davidson Canyon Watershed Parcels that precludes real estate development and similar land use activities and restricts grazing.
3. The Davidson Canyon Watershed Parcels will be included as available land for the establishment of water features beneficial to listed species and to provide general wildlife benefits.
4. Portions of the Davidson Canyon Watershed Parcels have been identified as culturally important by Native Americans. None of the conservation actions outlined for the Davidson Canyon Watershed Parcels will preclude reasonable access to these parcels by interested Native American groups.

D. Helvetia Ranch Annex North Parcels

1. Rosemont will record a restrictive covenant or conservation easement on the Helvetia Ranch Annex North Parcels that precludes real estate development and similar land use activities.
2. The Helvetia Ranch Annex North Parcels will be included as available land for the establishment of water features beneficial to listed species such as the Chiricahua Leopard Frog, jaguar, and ocelot and to provide general wildlife benefits. See elements of Conservation Measures G, H, and I.

E. Cienega Creek Watershed

Rosemont has acquired the right to purchase approximately 1,122 ac-ft of surface water rights held by the Del Lago Golf Course. These surface water rights will be used to enhance aquatic habitat values in the Cienega Creek Watershed. The acquired rights are:

• 1908 Right (ADWR Certificate 610.0002) of 597.755 ac-ft per annum,
• 1933 Right (ADWR Certificate 665.0003) of 477.545 ac-ft per annum, and
• 1935 Right (ADWR Certificate 617.0002) of 46.455 ac-ft per annum.

1. Rosemont will provide funding for stream renovation and restoration projects to increase water flows and enhance wetlands in the Cienega Creek watershed. The location and design of these projects will be determined by the Bureau of Land Management (BLM) and other necessary agencies, with input from other key stakeholders in the watershed, including the Coronado National Forest and the FWS.

1.1. Rosemont will provide funding for these projects by establishing a $2,000,000 fund (the Conservation Fund). The Conservation Fund will be established through the annual payment of $200,000 for 10 years to an escrow or other suitable account managed and controlled by a suitable entity (the Conservation Partner). Payments to the fund will commence beginning on April 1 of the year following the year in which copper concentrates are initially produced at the Rosemont Copper Project and will be made on that same day in each succeeding calendar year until a total of $2,000,000 has been contributed to the Conservation Fund. Not more than 15 percent of this fund may be used by the Conservation Partner for fund administration, with the balance used for direct project execution.

1.2. The Conservation Partner shall work cooperatively and in consultation with FWS, Coronado National Forest, the BLM, agencies, organizations, and other landowners in the watershed to fund the development and implementation of conservation measures designed to preserve and enhance aquatic and riparian ecosystems and protect and maintain habitat for federally listed aquatic and riparian species in the watershed. These projects may include surveys for and removal of bullfrogs, crayfish and other nonnative species in the watershed. The funds can be used to support approved management efforts by Pima County to control invasive aquatic species in the Cienega Creek Nature Preserve below and above the Pantano Dam. Project funds are not to be used for remediation of unanticipated issues associated with the Rosemont Project, such as waste rock slope failure. Funds can be used for initial restoration activities and adaptive management. It is recommended that some funds be reserved in anticipation of unforeseen issues (e.g., new invasive species) and adaptive management.

2. Rosemont will transfer 150 acre-feet of the 1933 water right to a suitable entity authorized under Arizona law to hold a surface water right for recreation and wildlife purposes, subject to the conditions described in C-5 below. This water right must be used to preserve and enhance the aquatic and riparian ecosystem in the upper Cienega Creek

watershed for the benefit of federally listed species and other native species of fish, wildlife and plants.

3. Rosemont will transfer 100 acre-feet of the 1933 water right to Pima County (or to another entity authorized under Arizona law to hold a surface water right for recreation and wildlife purposes), subject to the conditions described in C-5 below. Following transfer, these water rights must be used to preserve and enhance the aquatic and riparian ecosystem the County's Cienega Creek Natural Preserve, for the benefit of federally listed species and other native species of fish, wildlife and plants.
4. Rosemont will transfer all of the 1935 water right to Pima County (or to another entity authorized under Arizona law to hold a surface water right for recreation and wildlife purposes), subject to the conditions described in C-5 below to the lower reach of Davidson Wash within the Cienega Creek Nature Preserve that has also been designated an Outstanding Arizona Water. Following transfer, these water rights must be used to enhance and maintain the aquatic and riparian ecosystem in the lower reach of Davidson Canyon within the County's Cienega Creek Natural Preserve, for the benefit of federally listed species and other native species of fish, wildlife and plants.
5. To facilitate the transfer, Rosemont will file an application to sever 250 acre-feet of the 1933 water right and all of the 1935 water right and transfer the place of diversion and beneficial use to the Cienega Creek watershed, at such location(s) as may be determined in coordination and consultation Pima County and other entities. Such application will be filed with the Arizona Department of Water Resources (ADWR) within 30 days of issuance of the ROD or Section 404 permit, whichever is issued later. The severance and transfer of the water right is subject to approval by ADWR. It is anticipated that it will take approximately two years for ADWR to review and approve the application. It is also possible that irrigation districts and other water rights holders will object to the severance and transfer application, which may delay the approval process and could cause ADWR to deny the application in whole or in part. In addition, due to the nature of Rosemont's agreement with the current owner of the water right, the transfer of the water right may be delayed until January 1, 2016. Rosemont will work diligently and in good faith to prepare and prosecute the severance and transfer application and will bear all costs associated with the application.
6. The balance of the surface water rights, approximately 825 ac-ft per annum, will be used for aquifer recharge below Pantano Dam. To accomplish this, a "managed underground storage facility" (MUSF) will be permitted through the Arizona Department of Water Resources (ADWR). This will allow surface water flows currently diverted for golf course irrigation to be captured and discharged back to the stream bed below the Pantano Dam within the Cienega Creek Nature Preserve. In the event that an ILF program is established in this area, a portion of this water right may not be directly discharged to the MUSF, but instead used for irrigation of floodplain habitat. Regardless, the entirety of

the 825 ac-ft per annum will be discharged to the Pantano Wash system downstream of the Pantano Dam.

6.1. Additional benefits may be realized beyond the benefits associated with CWA Section 404 mitigation for the Rosemont project. Pima County, the Pima County Regional Flood Control District and the Tucson Audubon Society may, at their discretion develop an ILF mitigation program in reliance on the waters discharged to the MUSF in excess of the benefits expected to support in part, Rosemont's CWA Section 404 mitigation requirements. These potential future ILF mitigation credits that may or may not be developed here are not considered part of Rosemont's proposed conservation measures. A groundwater well is located on lands associated with the Pantano Dam. Rosemont will acquire and retire this well to so that any potential effects of that well on the surface water of Cienega Creek and the Pantano Wash from its use and operation do not occur.

F. Water Features and Grazing Management

1. Rosemont's Allotments (Thurber, Debaud, Greaterville, and Rosemont) are subject to the requirements of the Federal Land Management and Policy Act, 43 U.S.C. § 1752, and the Forest Service's regulations governing grazing management, codified at 36 C.F.R. Part 222. In accordance with those requirements, Rosemont will prepare and submit to the Coronado National Forest a request to modify the Allotment Management Plans (AMP) for the allotments within one year after the issuance of the ROD. The modifications will be developed in consultation, cooperation and coordination with the Coronado National Forest range staff and the Biological Monitor, with input from other entities.
2. Rosemont will request modification of the AMPs specifying that to compensate for the permanent loss of flowering agaves for lesser long-nosed bats (LLNB) due the proposed mine (security fence and roads; 4,013) acres, grazing by cattle will be restricted during the April 1 to June 15 period through rotation to alternative pastures on approximately 8,000 acres of portions of the Debaud, Greaterville and Rosemont allotments that currently are permitted to be grazed during the agave bolting period.
3. Portions of the pastures within Coronado National Forest grazing allotments leased to Rosemont will be put on a winter rotation to limit grazing during the growing season within riparian areas.
4. Key pastures will be rested for extended periods of time and made available for grazing when forage production on active pastures is reduced because of drought or other factors. This "grass bank" element within the modified AMP is similarly expected to enhance overall forage production within the Allotments without a reduction in current cattle stocking rates.
5. Rosemont will enhance existing water features, including stock ponds, and add additional water features throughout the allotments to mitigate for potential project impacts to seeps and springs on their grazing allotments. Up to 30 potential water features will be

managed or constructed, if needed, for metapopulation management (persistence) of CLF, and to meet the minimum requirements of Jaguar proposed/designated critical habitat PCEs. This Conservation Measure (5.1 through 5.3) is augmented in part by Term and Condition 5 for Chiricahua leopard frog which requires coordination with the local recovery group with respect to locations and design specifications for water features intended to benefit Chiricahua leopard frogs.

5.1 Water feature enhancements and construction proposed to support a CLF metapopulation will be implemented within one year from the start of mining activities. A summary of the water features and proposed mitigation measures is provided in section for CLF Conservation Measures.

5.2. Additional water features proposed for construction within the Rosemont-controlled grazing allotments will be implemented as needed and based on the findings of ongoing groundwater and seep and spring monitoring activities. [See CLF and Aquatic Species conservation measures for description of monitoring activities.] Rosemont will work cooperatively with the Biological Monitor to identify specific springs and seeps impacted by the proposed action and will construct water features to mitigate for those losses.

5.3. Rosemont will establish a long-term management and maintenance fund to maintain the water features constructed in furtherance of this conservation measure.

G. Chiricahua Leopard Frog

1. Conservation measures included for Sonoita Creek Ranch, Cienega Creek Watershed, and the section on Water Features and Grazing that benefit CLF are incorporated here by reference.

2. Rosemont will conduct pre-disturbance surveys, following AGFD/FWS survey protocols, of suitable habitat within the footprint of the proposed construction area and a ¼ mile buffer of the security fence prior to construction.

2.1. Surveys will be conducted in the survey season prior to the initiation of construction activities.

2.2. Surveyors shall use the latest version of standard disinfection techniques to guard against spread of disease between surveyed tanks and other water features.

2.3. If CLF are found in the survey area, Rosemont will contact the Biological Monitor to facilitate capture and relocation of CLF or otherwise determine their fate. Prior to relocation, captured frogs will be tested for chytridiomycosis.

2.4. Surveyors will swab dead and dying frogs to test for chytridiomycosis. Periodic swabbing of live frogs will also be required. Rosemont will pay for testing on up to ten frogs. Alternatively, environmental DNA testing may be useful for advanced testing, when methods are refined, and cost effective, and may be substituted for testing of individual frogs.

2.5. The Biological Monitor shall approve the list of vendors where samples will be sent for chytridiomycosis testing.

3. Rosemont will conduct annual monitoring for CLF. This Conservation Measure (G-3.1 – G-3.6) is augmented in part by Term and Condition 2 for Chiricahua leopard frog which requires a specific monitoring strategy and corrective action for potential Chiricahua leopard frog habitat within one mile (overland) of the project area.

3.1. Surveys will be conducted annually commencing from the first spring survey period after construction activities begins through closure.

3.2. Surveys will be conducted using established survey protocols.

3.3. Surveys will be conducted in suitable habitat within the perimeter fence area and within suitable habitat within one mile of the perimeter fence area.

3.4. Any dead or dying frog encountered during annual monitoring surveys will be swabbed to test for chytridiomycosis.

3.5. During annual monitoring surveys, periodic swabbing of live, healthy appearing frogs will be required to test for the presence of chytridiomycosis. Up to 10 samples will be collected during each annual survey effort. Alternatively, environmental DNA testing may be useful for advanced testing, when methods are refined, and cost effect, and may be substituted for testing of individual frogs.

3.6. Surveyors will note any American Bullfrogs and other non-native, invasive aquatic species encountered during survey.

4. Tank/water feature construction will be implemented, if needed, to support maintenance of the metapopulation in the Greaterville area (see Water Feature and Grazing Conservation Measures for additional discussion). This Conservation Measure (G-4.1 through G-4.6) is replaced in part by Term and Condition 5 for Chiricahua leopard frog which does not call for specific tanks to be renovated but rather requires coordination with the local recovery group with respect to locations and design specifications for water features intended to benefit Chiricahua leopard frogs.

4.1. The following tanks will be renovated to increase the reliability of water features available to support the CLF Greaterville metapopulation

Table I-4: Excerpt from February 2013 Supplemental BA Table entitled Tanks within the Greaterville Chiricahua Leopard Frog metapopulation that will be renovated to enhance the reliability of the tanks to support the species

Tank Name	**Proposed Improvements**
Bowman Tank	Renovations and improvements to earthen stock tanks to increase water holding capacity and duration. Renovations to stock tanks would involve removal of sediments to increase their volume, compaction of substrates (i.e., fines, if available) in the tank basin and berm to decrease infiltration, and/or installation of impervious liners to impede infiltration in all or part of the basin. Design consideration will be given to installation of structures (e.g., gabions, silt traps) for erosion and sediment control. Supplement surface
California Gulch Tank East	
California Gulch Tank West	
Enzenberg Canyon Tank	
Granite Mountain Tank	

Granite Tank	waters with structure for breeding, thermoregulation, and hiding. Examples of structure include submergent and emergent vegetation, bank vegetation, shrub branches above and below the surface.
North Greaterville Tank	

4.2. Renovation activities will commence within one year of initiation of construction activities to develop the Project. We presume this to mean that renovation activities will commence within one year of the implementation of water feature enhancements and construction proposed to support a CLF metapopulation (see Conservation Measure F. 5(1), above), which itself is to be implemented within one year of the initiation of the proposed action.

4.3. Rosemont will monitor the integrity of the seven renovated tanks listed above annually during the life of the mine and for five years post closure.

4.4. Rosemont will participate in CLF recovery team meetings for the Southeastern Arizona Working Group and Recovery Unit 2 to find opportunities and solutions toward species recovery in Recovery Unit 2.

5. To the extent determined necessary by the Biological Monitor, Rosemont will create up to 23 new water features to support CLF in the northern Santa Rita Mountains, in the area within the 5-ft, 150-year drawdown area, mapped by WestLand (2012a). This Conservation Measure (G-5.1 through G-5.3) is augmented in part by Term and Condition 5 for Chiricahua leopard frog which requires coordination with the local recovery group with respect to locations and design specifications for water features intended to benefit Chiricahua leopard frogs.

5.1 The water features will be constructed within Rosemont-controlled grazing allotments, the Helvetia Ranch Parcels, and the Davidson Watershed Parcels.

5.2 They will generally follow the conceptual designs and locations provided in WestLand (2012a). The selection of the appropriate design and location shall be made in consultation with the Biological Monitor.

5.3 The new structures are intended to enhance metapopulation dynamics, but not at the expense of encouraging rapid colonization between recovery unit populations, dispersal of invasive aquatic species, or spread of chytridiomycosis.

6.0. As part of the Invasive Species Management Plan, Rosemont will implement control measures to remove invasive aquatic species that have the potential to negatively affect CLF such as American Bullfrog, crayfish, and spiny-rayed, warm water fish species. Methods for implementation of this program will be outlined in an updated Invasive Species Management Plan.

6.1. The program will be implemented beginning in the first year copper is produced.

6.2 The program will include the seven tanks renovated as part of the CLF conservation measures near Greaterville, new tanks constructed as part of these conservation measures during the life of the Project, and at other suitable CLF habitats within the perimeter fence.

7. Up to four of the stormwater ponds located along the perimeter of the reclamation footprint and included in the reclamation plan will be designed in a fashion that will

facilitate their use by CLF following the general principals outlined in WestLand (2012a). The timing of construction of these features will be dictated by the timing of concurrent reclamation programs, in coordination with the Biological Monitor. This conservation measure is superseded by Term and Condition 3 for Chiricahua leopard frog.

8. If it is determined that CLF are or may be exposed to process water harmful to CLF, Rosemont will construct barriers to exclude CLF from these areas. This work will be conducted in coordination with the Biological Monitor.

H. Aquatic Species: Gila Chub, Gila Topminnow, Huachuca Water Umbel

1. Conservation measures included for Sonoita Creek Ranch and Cienega Creek Watershed that benefit these species are incorporated here by reference.
2. Rosemont will implement the conceptual monitoring plan prepared by Water and Earth Technologies (2012) to evaluate impacts of groundwater drawdown to surface water features to the extent that authorization to install and access proposed monitoring sites are obtained. Two of the sites identified in this report have been installed and monitoring is being conducted at these sites. Application for the other monitoring locations has been made to the Arizona State Land Department. As authorizations for these sites are obtained, monitoring will commence at these sites.
3. Groundwater monitoring wells constructed and being constructed for the Aquifer Protection Permit (APP) will be monitored on quarterly basis for depth to ground water and water quality as prescribed by the APP. These data will be provided to the FS for comparison to the model predicted impacts to groundwater elevation changes. In addition, a suite of 21 existing wells and one new well within and beyond the footprint of the proposed mine will be monitored for depth to ground water over the long term. Certain of these existing wells are placed and will allow monitoring of water levels between the project area and:
   - Lower Cienega Creek
   - Upper Cienega Creek
   - Empire Gulch
   - Lower Davidson Canyon
   - Box Canyon
4. Should groundwater quality data reach alert or compliance standards Rosemont will comply with the requirements of the APP.
5. The stormwater permit for the project imposes specific requirements for surface water sampling and it will be implemented in accordance with the requirements of ADEQ as specified by EPA. Should impacts over and above the levels predicted in the EIS be anticipated by monitoring efforts, the funding provided by the Cienega Creek Watershed Conservation Fund will be used to implement adaptive management strategies to offset unanticipated effects.
6. Monitor geomorphic changes to Davidson Canyon.

6.1 Initial monitoring will begin at the start of construction and then conducted at the same monitoring sites every five years until five years after closure.

6.2 Four sample sites will be established by Rosemont. The Biological Monitor will approve site location.

6.3 Geomorphic monitoring will be conducted using the Forest Service Protocol or an agreed upon alternative approved by the Biological Monitor.

7. If monitoring shows the Cienega Creek Watershed is being affected, the Cienega Creek Watershed Conservation Fund should be used as a resource to fund mitigation projects.

8. The Cienega Creek Watershed Conservation Fund cannot be used outside of the Cienega Creek Watershed or to implement other conservation measures proposed by Rosemont (WestLand 2013a).

I. Southwestern Willow Flycatcher

1. Conservation measures included in sections for Cienega Creek Watershed, CLF, and Aquatic Species that benefit Southwestern Willow Flycatcher are incorporated here by reference.

J. Jaguar and Ocelot

1. Conservation measures included in sections for Sonoita Creek Ranch, Cienega Creek Watershed, Davidson Watershed Parcels, Helvetia Ranch Annex North Parcels, Water Features and Grazing, and Aquatic Species (particularly monitoring aspects within the current configuration of proposed Jaguar critical habitat) that benefit Jaguar and Ocelot are incorporated here by reference.

2. Rosemont will ensure that restored or replaced springs (see Water Features Conservation Measures, above) within Jaguar critical habitat (most current delineation) are constructed in accordance with Jaguar PCEs for surface water.

3. As part of the concurrent reclamation program Rosemont will establish a percentage of woody vegetation cover consistent with the elements of jaguar critical habitat (note that the relevant PCE is from >1 to 50 percent) as averaged over reclamation area, excluding the pit. This shall be established as a prescriptive obligation of the concurrent reclamation program in appropriate areas as determined in conjunction with the Biological Monitor during project development.

4. Monitor road-kill weekly on SR 83, adjacent to mine site, from the northern extent of currently proposed critical habitat to Gardner Canyon Road, to assess loss of Jaguar, Ocelot, or Jaguar prey base (white-tailed and mule deer, collared peccary, white-nosed coati, in particular). Monitoring will begin at the commencement of mine construction and continue through the second year of mine operation, a total of four years. After the initial four years of monitoring, the Biological Monitor, working with Rosemont, FWS, and other entities, will determine if additional field data collection is necessary to inform determination of crossing need and location. Report road-kill in the annual report.

Smaller Ocelot prey (lagomorphs, rodents) do not need to be reported. Mortality of any FS and BLM sensitive species should also be reported. This work may be conducted by the Biological Monitor as part of their regular site visits funded by Rosemont, with funding from the proponent. In addition to increasing knowledge regarding the movement of wildlife in the area, information collected during this investigation may identify a suitable wildlife crossing structure location that could be constructed using Regional Transportation Authority funds dedicated for that purpose.

5. Report all Jaguar and Ocelot sightings immediately to the Biological Monitor.

6. Rosemont will provide $50,000 to a suitable entity approved by the Coronado National Forest to support camera studies for large predators including Jaguar and Ocelot. The money will be provided for additional monitoring efforts between the Santa Rita and the Whetstone Mountains and along the Santa Rita Mountains. In addition to increasing knowledge regarding the movement of wildlife in the area, information collected during this investigation may identify a suitable wildlife crossing structure location that could be constructed using Regional Transportation Authority funds dedicated for that purpose.

K. Lesser Long-nosed Bat:

The June 2012 BA includes some Conservation Measures which have been updated in subsequent versions of the BA and through discussions with Rosemont and the Coronado National Forest. For example: Bullet 1: there is not a final MPO yet, so we cannot confirm content, hence, what conservation measures may be included; Bullet 2: there is no detailed Palmer Agave management strategy; and Bullet 3: these are multi-species minimization measures (multiple-species design criteria).

Conservation measures included in sections for Sonoita Creek Ranch, Davidson Watershed Parcels, Helvetia Ranch Annex North Parcels, and Water Features and Grazing that benefit LLNB are incorporated here by reference. Additional conservation measures include:

1. Prior to submittal of proposed modification of the Allotment Management Plan (Conservation Measure D.2), Rosemont shall refine existing estimates of Palmer Agave that will be impacted within the security fence area and conduct studies sufficient to identify and establish baseline conditions of pastures that will be proposed in the AMP modification for seasonal grazing restrictions to increase flowering success of agave.

2. Rosemont shall include Palmer's Agave in its concurrent reclamation plan.

3. Rosemont shall plant (transplanted or nursery grown stock) at least 35,850 Palmer Agaves as outlined in Table 1 of WestLand (2012b). The average density of plantings as proposed is 10.3 per acre. A record of the agave transplanted and planted from nursery-grown stock during concurrent reclamation efforts and the general location and density of transplants shall be maintained and reported to the Biological Monitor and in the Annual Report.

3.1 Rosemont shall include Palmer's Agave seed in its seed mix provided such seed are commercially available.

3.2 Rosemont shall conduct a scientifically designed study to document the efficacy of seasonal grazing restrictions to enhance agave flowering success. The study shall be implemented annually for five years following approval of the AMP and implementation of grazing management practices.

4. During the sixth year of implementation of conservation measures Rosemont, FWS, and the Biological Monitor will evaluate the success of these conservation measures. If warranted, appropriate adaptive management actions will be developed by the Biological Monitor, FWS and Rosemont.

5. Rosemont will monitor the Helena Mine complex and Adit R2 plus any newly discovered large LLNB roost sites (>100 bats) within 1 mile of the Perimeter Fence annually for LLNB. (Note if the mine feature is not controlled by Rosemont or if for any other reason access cannot be obtained by the Biological Monitor this monitoring obligation shall not apply.)

6.1 Monitoring of each site shall be conducted three times during the late summer LLNB survey period – July, August and September. One of the surveys during the survey season at the Helena Mine will be scheduled to coincide with the region wide count.

6.2 Monitoring of Helena Mine complex, Adit R2, and other Large LLNB Roost Sites shall be conducted annually until five years after mine closure. Monitoring surveys area anticipated to commence beginning in 2013.

6.3 Surveys shall be conducted by evening emergence counts. Infrared tape recordings of the exit shall be recorded during each survey. The number of cameras used to capture emergence on tape will be sufficient to fully document monitored emergence events. Digital copies of the recordings will be provided to the Biological Monitor. The exit counts will be reported in the Annual Report.

6.4 Monitored roost sites shall not be entered, except as authorized by the Biological Monitor in coordination with FWS.

6.5 Rosemont shall provide a brief tabular summary of monitoring results to the Biological Monitor within two working days of each monitoring effort.

7. Rosemont will conduct reconnaissance-level surveys of other known cave and mine features capable of supporting bats within in the perimeter fence and within 1 mile of the perimeter fence for LLNB and other bat species.

7.1 Reconnaissance-level surveys shall be conducted on other known cave and mine features capable of support LLNB or other bats that have only minor numbers of LLNB (<100).

7.2 Reconnaissance-level surveys shall consist of one visit to each monitored feature during the late summer (July through September).

7.3 Reconnaissance-level surveys of these other known caves and mine features shall be conducted annually for the life of the Project and for five years following closure.

7.4 Features known or suspected to have minor numbers of LLNB (<100) will be monitored by external exit count or other remote sensing method approved by the Biological Monitor.

7.5 Caves or mine features suspected to be occupied by LLNB shall not be entered. Caves or mine features that are not suspected to have LLNB may be entered, if determined safe, or may be monitored by external exit count, placement of IR cameras, or other suitable means.

7.6 Rosemont shall provide a brief tabular summary of reconnaissance-level survey results to the Biological Monitor within 10 working days of completion of the reconnaissance surveys.

8. Rosemont will close 20 mine features, including the Chicago Mine prior to Project construction (WestLand 2012b). If other sites are identified by Rosemont in proximity to the Project that may require closure for safety purposes, Rosemont will coordinate with the Biological Monitor. The mine and cave closure process is described in WestLand (2012b). Basically, the site is surveyed for bats or other species, and then closed with chicken wire (to allow bats to escape and not re-enter). Prior to exclusion, Rosemont will notify the Biological Monitor.

9. Following construction of the mine and during the initial year of operation, Rosemont shall work with the Biological Monitor to review the efficacy of light mitigation measures at key resource areas around the mine, such as the Helena Mine, as identified by the Biological Monitor. If additional shielding can be placed to further reduce lighting effects without adverse consequences to safety and unreasonable operational expectations, Rosemont shall implement the additional requested shielding in a manner consistent with safe mining practices.

10. Fence the R2 Mine and Helena Mine complex to exclude unauthorized human access. Fence construction shall be as described in Rosemont's summary of the conservation measures. If during the life of the Project any new major roost sites (greater than 100 LLNB at peak count) are detected within one mile of the perimeter fence it will be fenced or otherwise protected from unauthorized human access in a manner approved by the Biological Monitor.

11. During the life of the Project Rosemont shall work with the Biological Monitor to identify potential restoration areas outside of the security fence and within 2 miles of the perimeter fence that are suitable for Palmer's Agave. Using the seed mix being used for concurrent reclamation programs where appropriate, Rosemont will assist the Coronado National Forest with the revegetation of these areas. In addition to seeding, revegetation efforts will include planting Palmer's Agave transplants or nursery-grown Palmer's Agave. This effort will include portions of the old Arizona Trail being abandoned as part of these conservation measures.

12. Rosemont shall work with the Coronado National Forest to relocate the Arizona Trail away from the Helena Mine complex.

L. Pima Pineapple Cactus

1. Conservation measures included in sections for Helvetia Ranch Annex North Parcels are incorporated here by reference.

2. Construction practices along the proposed utility corridors will be employed to keep surface disturbance to the minimum practicable and to avoid Pima Pineapple cactus.

2.1. Before ground disturbance, the utility corridor routes will be surveyed. Known Pima Pineapple cactus localities will be flagged and to the extent possible will be avoided.

2.2. Rosemont will protect Pima Pineapple cactus that can be avoided with clear limit fencing, and construction/reclamation activity in the vicinity of these plants will be monitored during construction.

2.3. Educate construction personnel for the power and water line in the offsite utility corridor how to identify Pima Pineapple cactus and marking/avoidance methods.

2.4. Pima Pineapple Cactus that cannot be avoided by utility construction/reclamation will be transplanted within the corridor into suitable habitat. A monitoring and maintenance program will be initiated to facilitate establishment that will follow similar previous efforts for Pima pineapple cactus transplantation and will involve watering for the first few months after transplant, followed by regular monitoring.

M. Western Yellow-billed Cuckoo:

1. Conservation measures included in sections for Sonoita Creek Ranch, Cienega Creek Watershed, Davidson Watershed Parcels, and Water Features and Grazing that benefit CLF are incorporated here by reference.

2. Rosemont will survey for Yellow-billed Cuckoo (YBC) in those drainages in the Project Area that have potential habitat (e.g., Barrel Canyon, McCleary Canyon) before trees (including large mesquites) within the Perimeter Fence boundary are removed.

2.1 Survey shall be accordance with the current approved protocol and (and have commenced).

2.2 Survey shall be conducted within suitable habitat within undisturbed portions of the Perimeter Fence area annually for the first five years of mine operation.

3. Should vegetation clearing be proposed during the YBC nesting season, Rosemont shall coordinate with the Biological Monitor and FWS prior to vegetation clearing in suitable YBC habitat.

3.1 Vegetation clearing within 50 meters of an active YBC nest or the center of an active YBC territory shall not occur during the YBC nesting period. This conservation measure shall not restrict vegetation clearing for implementation of an approved Plan of Operation outside of the YBC nesting period.

Action Area

Of greater relevance to section 7 consultation is the *action area*; which 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)." The proposed action will adversely affect seven animal and two plant species, each with differing life histories, habitat requirements, and distributions in the areas affected by the proposed action. Given that the proposed action has effects ranging from nearly immediate, direct losses of habitat in the mine's footprint to subtle and longer-term hydrologic changes in distant sites, each species will be affected over a different temporal and spatial scale.

The BA has defined the action area as the aforementioned project area plus a larger, surrounding area that may experience direct or indirect temporal and spatial impacts from the project. Temporally, the potential on-site and off-site impacts resulting from the proposed action encompass all the activities associated with construction, operation, reclamation, and post-closure activities. The action area for this analysis is based on: (1) the area of the mine footprint; (2) areas outside the mine footprint that may be affected by noise, dust, light pollution, and other mining activities; (3) all areas for which mining activity may affect groundwater and surface water; and (4) other areas outside the footprint that are related to mining activity, such as road modifications, power lines, and pipelines (i.e., connected or interrelated/ interdependent actions).

Spatially, the action area totals approximately 146,153 acres, including the footprint of the Barrel and TEP powerline. The action area is located primarily in Pima County but also encompasses a small portion of Santa Cruz County; 65,291 acres are on Forest Service and Bureau of Land Management (BLM) lands, and the remaining 80,934 acres within the action area consist primarily of land administered by the Arizona State Land Department (ASLD), land owned by Pima County, and private land. Included in the BLM acreage within the action area, primarily as a result of expected groundwater drawdown impacts within Cienega Creek and Empire Gulch, is a large portion of Las Cienegas National Conservation Area (NCA). The larger action area was drawn to ensure that the impacts of vibration and noise, dust, artificial night lighting, groundwater drawdown, and surface water alteration on listed species and their critical habitat are considered.

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, etc.) that may be directly affected by the proposed action. The action area also 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 surrounding the proposed action area; and the indirect effects of noise, dust, and light resulting from mining and transportation activities. Therefore, the action area includes the following: (1) drainages that receive surface water discharge from the mine site, including Davidson Canyon Wash past its confluence with Cienega Creek to Pantano Dam; (2) springs and seeps within the area of projected groundwater drawdown associated with the mine pit, including Empire Gulch and Cienega Creek, which contain BLM-administered wetlands; and (3) areas adjacent to the mine site and transportation corridors that may be impacted by vibration, noise, dust, and artificial night lighting. The temporal analysis period includes 24 hours of light and noise for 25 to 30 years and the potential for groundwater drawdown for up to 1,000 years after closure of the mine. Impacts to downstream water quality would occur as a result of runoff from tailings and waste rock piles, and disruption of surface water flow would result from the capture of runoff in the pit. Downstream impacts to water quality and/or disruption of surface water flow resulting from the capture of runoff in the pit are only expected to occur along the Barrel Canyon drainage and through Davidson Canyon to its confluence with Cienega Creek.

Land Ownership and Surrounding Land Uses

The action area is a combination of Federal, state, county and private lands, totaling approximately 146,153 acres. The land immediately surrounding the proposed action includes National Forest System land, Public Land administered by the BLM, State Trust land, and private land. Land use in the vicinity of the proposed action primarily consists of mining, livestock grazing, and dispersed recreation. Sporadic prospecting reportedly began in the northwestern portion of the proposed action area, the Helvetia mining district, sometime in the mid-1800s. By the 1880s, the production from mines on both sides of the northern Santa Rita Mountains was supporting the construction and operation of the Columbia smelter at Helvetia on the west side of the Santa Rita Mountains and the Rosemont smelter in the Rosemont mining district on the east side of the Santa Rita Mountains. Since copper production ceased in 1951, the area stretching from the Peach-Elgin prospect to Rosemont has seen a progression of exploration campaigns. The majority of the land surrounding the proposed action area is currently under permit for livestock grazing. Current rangeland conditions on the district are largely the result of recent drought conditions and an older history of intense grazing pressure that resulted in severe erosion, including arroyo cutting. Recreation activities on lands within and adjacent to the proposed action area include casual or dispersed uses, as well as organized events. Typical recreation activities in the proposed action area consist of motorized vehicle touring (including off-highway vehicle use), dispersed camping, wildlife observation, nature study, bird watching, recreational prospecting, hunting, rock and mineral collection, picnicking, mountain biking, hiking, and horseback riding.

Local and Regional Climate

The climate in the action area is semiarid, with precipitation varying by season and with elevation. The 30-year normal (1971 to 2000) annual average precipitation for the Santa Rita Experimental Range station (approximately 5 miles northwest of the project area) is 23.41 inches (Western Regional Climate Center 2009). Over this 30-year period, nearly one-half of the precipitation occurred in July, August, and September. The smallest amount of precipitation occurred in April, May, and June.

Temperatures regionally are moderate to extreme, with maximums and minimums also varying with elevation. The 30-year normal average monthly maximum temperatures at the Santa Rita Experimental Range station ranged from a low of 60.4 degrees Fahrenheit (°F) in January to a high of 93.3°F in June. Average monthly minimum temperatures ranged from a low of 37.5°F in December and January to a high of 66.8°F in July. A climatological summary appears in Table 27 of the Draft EIS.

Biophysical Features

The action area ranges in elevation from approximately 2,740 to 6,610 feet above mean sea level. The topography is dominated by rolling to steep hills, drainages, and canyons. The Santa Rita Mountain range includes numerous drainages that contain riparian vegetation. Barrel Canyon is the principal drainage system within the action area (see Figure A-1). Wasp, McCleary, and Scholefield Canyons discharge to Barrel Canyon, which discharges to Davidson Canyon and then to Cienega Creek in the northeastern portion of the action area (see Figure A-1). Empire Gulch and Gardner Canyon discharge into upper Cienega Creek in the southeastern portion of the action area. The northwest side of the action area is drained by a series of unnamed headwater tributaries of Sycamore Canyon. Box Canyon is the major drainage system within the southwestern portion of the action area, west of the main ridgeline. There are 95 springs and seeps (i.e., areas where there is moist soil or lotic or lentic surface water systems) and 148 stock tanks in the action area (Figure 3 in the June 2012 BA). Two springs in the action area were identified as being associated with wetlands: Scholefield Spring, located on a tributary to Scholefield Canyon; and Fig Tree Spring, a developed spring near the head of a minor unnamed tributary to Sycamore Canyon (WestLand 2010a, as cited in the BA). The aforementioned water sources provide habitat for aquatic plant and animal species within the action area. Previous mining activity has resulted in a number of mine adits and shafts within the action area (Figure 4 in the June 2012 BA); mine adits and shafts provide roosting habitat for bats and other wildlife species (WestLand 2009a).

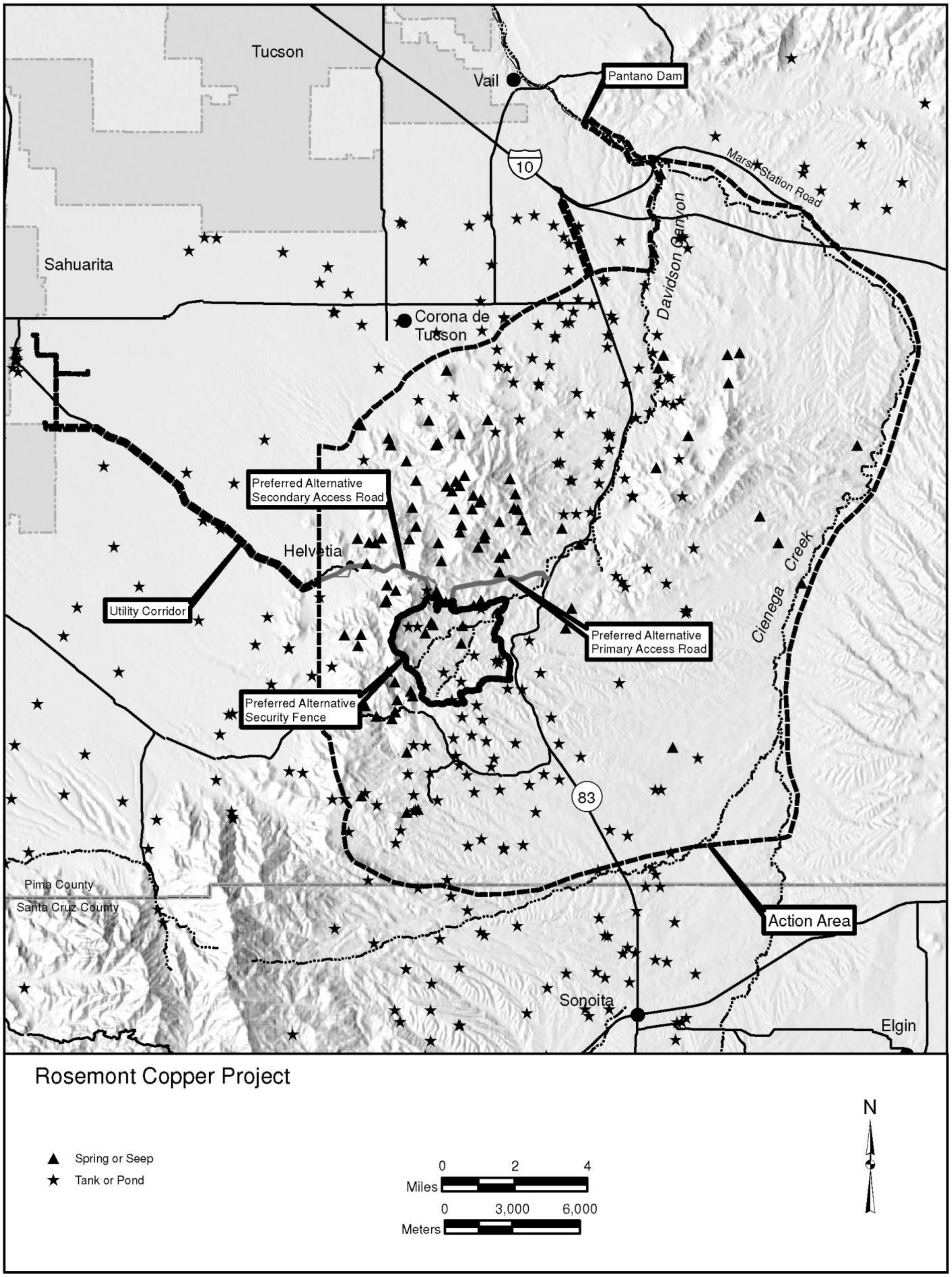

Figure I-3: Water resources within the Action Area of the Rosemont Mine project.

Vegetation Communities

Uplands

The action area is located in three upland vegetation communities: semidesert grassland, Madrean evergreen woodland, and Chihuahuan desertscrub (Brown 1994) (see Figure I-4). Semidesert grassland, characterized by open grasslands with widely scattered shrubs and cacti, generally covers the lower elevations of the action area. Madrean evergreen woodland mostly covers the higher elevations of the action area, generally in the western and southern areas, and is characterized by open woodlands or savanna, primarily consisting of trees interspersed with grasses and forbs. Chihuahuan desertscrub is dominated by the shrub, creosotebush (*Larrea tridentata* var. *tridentata*), on plains, low hills, and valleys on the uplands surrounding middle Cienega Creek.

Semidesert Grassland

There is a total of approximately 94,797 acres of the semidesert grassland vegetation community in the action area. In the semidesert grassland vegetation type, composition, and density varies with geographic location, precipitation, and topography. Some areas within this vegetation community are nearly barren with an abundance of sand, rock, gravel, scree, or talus, while other areas may have sparse to dense vegetation cover that includes succulent species, grasses, shrubs, scattered trees, and some herbaceous cover (Brown 1994; Forest Service 2009b, as cited in the BA, USFS 2013d). Within the action area, semidesert grassland is characterized by grasses interspersed with a variety of low-growing trees, shrubs, and cacti, including whitethorn acacia (*Acacia constricta*), catlaw acacia (*A. greggii*), prickly-pear cactus (*Opuntia* spp.), cholla (*Cylindropuntia* spp.), soaptree yucca (*Yucca elata*), beargrass (*Nolina microcarpa*), desert spoon (*Dasylirion wheeleri*), and agave (principally *Agave schottii* and *A. palmeri*). Native grass species include black grama (*Bouteloua eriopoda*), blue grama (*B. gracilis*), sideoats grama (*B. curtipendula*), hairy grama (*B. hirsuta*), buffalo grass (*B. dactyloides*), plains lovegrass (*Eragrostis intermedia*), little bluestem (*Schizachyrium cirratum*), plains bristlegrass (*Setaria machrostachya*), fluffgrass (*Dasyochloa pulchella*), burrograss (*Scleropogon brevifolius*), and slim tridens (*Tridens muticus*). The non-native Lehmann lovegrass (*E. lehmanniana*) is one of the more abundant nonnative grass species semidesert grassland portions within the action area.

Madrean Evergreen Woodland

There is a total of approximately 27,274 acres of the Madrean evergreen woodland vegetation community mapped within the action area (Brown 1994; Forest Service 2009b, as cited in the BA, USFS 2013d). The Madrean evergreen woodland vegetation community occurs on foothills, canyons, bajadas, and plateaus between semidesert grasslands and montane conifer forests; however, in the action area, virtually all of the Madrean evergreen woodland (sensu Brown 1994, as cited in the BA) is the lower end, more appropriately termed Madrean encinal (oak) woodland, as opposed to the upper end, usually termed Madrean pine/oak woodland, and trees indicative of the Madrean pine/oak woodland are absent (McLaughlin and Van Asdall n.d.

[1977], as cited in the BA). This community is dominated by evergreen oaks, and in the action area, common oak (*Quercus arizonica*). Other tree species present are alligator bark juniper (*Juniperus deppeana*), one-seed juniper (*J. monsperma*) species include Emory oak (*Q. emoryi*), Mexican blue oak (*Q. oblongifolia*), and Arizona white oak (*Q. monosperma*), velvet mesquite (*Prosopis velutina*), and Mexican pinyon (*Pinus cembroides*). All of the shrub and warm season grass species and other ground cover listed in the semidesert grassland section can also be found in areas dominated by the Madrean evergreen woodland vegetation community.

Chihuahuan Desertscrub

There is a total of approximately 1,976 acres of the Chihuahuan desertscrub vegetation community in the action area. Chihuahuan desertscrub is limited to uplands in the vicinity of Cienega Creek within the action area (Brown 1994). The action area is within the Mexican Highlands Ecoregion, the Chihuahuan Desert influences this ecoregion, and McLaughlin and Van Asdall (1977) noted that Chihuahuan desertscrub vegetation components are present in the mine site area. Shrubs such as creosotebush and whitethorn acacia dominate the Chihuahuan desertscrub vegetation community. Other vegetation in this community includes very large yucca (*Yucca* spp.), which grow among grasses (mostly *Bouteloua* spp.) or scattered shrubs [e.g., desert zinnia (*Zinnia acerosa*) and condalia (*Condalia* sp.)], agave (*Agave* spp.), ocotillo (*Fouquieria splendens*), jatropha (*Jatropha* sp.), and scattered cacti.

Sonoran Desertscrub

Sonoran desertscrub is located at the periphery of the action area, using the coarse-scale mapping of Brown (Brown 1994). Locally, Sonoran desertscrub, or components of its vegetative community, are is present in lower Davidson Canyon, lower Cienega Creek, and in the northwest portion of the action area; however, the Sonoran Desertscrub biotic elements are often ecotonal with the other upland habitat types. There is also a small extent of Sonoran desertscrub vegetation outside of semidesert grassland at the far western terminus of the water and utility ROW. The conspicuous vegetation of the Arizona Upland subdivision of the Sonoran Desert includes saguaro (*Carnegiea gigantea*), palo verdes (*Parkinsonia* spp.), creosotebush, and numerous species of cacti, such as chain fruit cholla (*Cylindropuntia fulgida*), and Engelmann prickly pear (*Opuntia phaeocantha* var. *phaeocantha*). Birds are often associated with (e.g., nest in) the saguaro and cholla cacti, as well as palo verdes.

Riparian

The word “riparian” is used to describe plant communities associated with natural washes, rivers, ponds, and springs. Riparian plant associations occur along a continuum of available soil moisture, and regulatory agencies and researchers have consequently developed numerous and varied definitions of riparian (WestLand Resources Inc. 2010c). Some definitions relate directly to the nature of the water supply (e.g., perennial streams only); others relate to the condition and nature of the habitats associated with the watercourse (e.g., vegetation location, density, and composition), and still others use definitions that incorporate varied combinations of these factors (WestLand Resources Inc. 2010c). Riparian ecosystems provide habitat for approximately one-third of the plant species in western North America, and approximately 60 percent of vertebrate species and 70 percent of threatened and endangered species in the arid Southwest are riparian obligates (Poff *et al*. 2011). These ecosystems provide essential ecological functions and are unique because species diversity, density, and productivity are high in these areas.

There are a total of approximately 22,106 acres of riparian vegetation in the analysis area. These vegetation communities are present in drainages within the analysis area and along downstream portions of Box, McCleary, Sycamore, Scholefield, Wasp, Barrel, Davidson, and Gardner Canyons; Empire Gulch; and Cienega Creek. In addition to the riparian vegetation listed below as occurring in riparian areas in the analysis area, Emory oak, Mexican blue oak, and Arizona white oak are common in Box, McCleary, Sycamore, Scholefield, Wasp, and Barrel Canyons. While many springs support some individuals of species considered to indicate hydroriparian habitat, only two springs had large mappable areas of hydroriparian vegetation: Scholefield No. 1 spring supports about 0.3 acre of wetland, and Fig Tree spring supports about 0.5 acre of riparian habitat, with a very limited wetland area. These water sources provide habitat for aquatic species within the analysis area. Pima County's riparian mapping source is used for this project, and the following riparian habitat types are mapped within the analysis area (Pima County 2013).

Hydroriparian

Hydroriparian habitats are generally associated with perennial watercourses and/or springs. Plant communities are dominated by obligate or preferential wetland plant species such as Goodding's willow (*Salix gooddingii*) and Fremont cottonwood (*Populus fremontii*) and also include velvet ash (*Fraxinus velutina*), seep willow (*Baccharis salicifolia*), Arizona walnut (*Juglans major*), tamarisk (*Tamarisk* spp.), and mesquite. The cottonwood/willow forest is a typical example of this habitat type. The following drainages and associated riparian habitat contain stretches that are mapped as hydroriparian: Cienega Creek, Gardner Canyon, Empire Gulch, Davidson Canyon, and Barrel Canyon. Approximately 7,325 acres of hydroriparian habitat are located within the analysis area.

Aquatic vegetation that is unique to the springs and seeps is present within the analysis area. Vegetation at these springs and seeps includes obligate wetland plants (i.e., almost always occur under natural conditions in wetlands) such as seep monkey flower (*Mimulus guttatus*) and water speedwell (*Veronica anagallis-aquatica*), along with facultative wetland plants (i.e., usually occur in wetlands, but occasionally found in nonwetlands) such as smooth horsetail (*Equisetum laevigatum*) and Arizona giant sedge (*Carex spissa* var. *ultra*) (which is likely a facultative wetland plant). Other riparian plant species documented at springs and seeps in the analysis area include sycamore (*Plantanus wrightii*), willow (*Salix* spp.), netleaf hackberry (*Celtis reticulata*), and deergrass (*Muhlenbergia rigens*). Within the analysis area, moist soil or surface water (both lentic and lotic systems) and associated aquatic vegetation are known to occur at the several springs (e.g., Deering, Upper Empire Gulch, Fig Tree, Mudhole, Oak, Ojo Blanco, Rosemont, Scholefield No. 1, Sycamore, and Water Develop) (WestLand Resources Inc. 2011j). Areas of aquatic habitats are too small to map; therefore, they do not appear on Figure I-4, below.

Xeroriparian

Xeroriparian habitats are generally associated with an ephemeral water supply. These communities typically contain plant species also found in upland habitats; however, these plants are typically larger and/or occur at higher densities than adjacent uplands. Approximately 14,781 acres of xeroriparian habitat are located within the analysis area. Xeroriparian habitat is further divided into four subclasses to reflect the amount of vegetation present. Pima County Regional Flood Control District's Regulated Riparian Habitat Mitigation Standards and Implementation Guidelines (Pima County Department of Transportation and Flood Control District 2001; Pima County Regional Flood Control District 2011) define the xeroriparian subcategories as follows:

• Xeroriparian A: The most dense xeroriparian subcategory with a total vegetative volume greater than 0.856 m^3/m^2. Xeroriparian A habitat is present in stretches of Cienega Creek, Empire Gulch, and Davidson Canyon where vegetation consists of mesquite and netleaf hackberry. Approximately 145 acres of xeroriparian A habitat is located within the analysis area.

• Xeroriparian B: Moderately dense xeroriparian subcategory with a total vegetative volume less than or equal to 0.856 m^3/m^2 and greater than 0.675 m^3/m^2. Xeroriparian B habitat is present in stretches of Cienega Creek, Gardner Canyon, Empire Gulch, Davidson Canyon, and Barrel Canyon where vegetation consists of mesquite, scattered cottonwood, netleaf hackberry, burrobrush (*Hymenoclea monogrya*), juniper (*Juniperus* sp.), and acacia (*Acacia* sp.). Approximately 7,116 acres of xeroriparian B habitat is located within the analysis area.

• Xeroriparian C: Less dense xeroriparian subcategory with a total vegetative volume less than or equal to 0.675 m^3/m^2 and greater than 0.500 m^3/m^2. Xeroriparian C habitat is present in stretches of Cienega Creek, Gardner Canyon, Empire Gulch, and Davidson Canyon where vegetation consists of mesquite, desert broom (*Baccharis sarothroides*), burrobush, desert willow (*Chilopsis linearis*), hackberry (*Celtis* sp.), and juniper. Approximately 7,345 acres of xeroriparian C habitat is located within the analysis area.

• Xeroriparian D: Less to sparse plant density xeroriparian subcategory that provides hydrologic connectivity to other riparian habitat areas with a total vegetative volume less than or equal to 0.500 m^3/m^2. Xeroriparian D habitat is present in stretches of Cienega Creek and Davidson Canyon where vegetation consists of acacia and desert broom. Approximately 174 acres of xeroriparian D habitat is located within the analysis area.

Aquatic Vegetation

Aquatic vegetation is unique to the springs and seeps within the action area and includes obligate wetland plants (i.e., almost always occurs under natural conditions in wetlands) such as seep monkey flower (*Mimulus guttatus*) and water speedwell (*Veronica anagallis-aquatica*), along with facultative wetland plants (i.e., usually occur in wetlands, but occasionally found in non-wetlands) such as smooth horsetail (*Equisetum laevigatum*) and Arizona giant sedge (*Carex spissa* var. *ultra*) (which is likely a facultative wetland plant). Other riparian plant species documented at springs and seeps in the action area include sycamore (*Plantanus wrightii*), willow (*Salix* spp.), netleaf hackberry, and deergrass (*Muhlenbergia rigens*). Within the action area, moist soil or surface water (both lentic and lotic systems) and associated aquatic vegetation are known to occur at the following springs (WestLand 2011a): Basin, Deering, Empire Gulch, Fig Tree, Mudhole, Oak, Ojo Blanco, Rosemont, Scholefield, Sycamore, and Water Develop.

Information provided by the BLM during the review of the draft version of the BO notes that these aquatic vegetation communities, along with those present along cienega-like reaches of Cienega Creek and its tributaries should be classified as Interior (Sonoran) Marshland (Brown 1982). These Cienega communities (Minckley and Brown 1982, Hendrickson and Minckley 1984) are prevalent in the Las Cienegas NCA; the area contains over 30 jurisdictional wetlands, both perennial and seasonal. Most of these wetlands occur on the Cienega Creek floodplain between Cinco Canyon and Oak Tree Canyon. Named wetland complexes include Cieneguita Wetland, Spring Water Wetland, Cinco Ponds Wetland. Another series of wetlands occurs upstream of the Mattie Canyon confluence on Cienega Creek (Cold Spring Wetland). These wetlands cover tens of acres. An inventory of wetlands has been completed by the Arizona Botanical Garden with a report anticipated to be transmitted in September 2013.

Areas of aquatic habitats were considered too small to map by USFS; therefore, they do not appear on Figure I-4, below. The BLM, in comments on the content of the Draft BO, stated that Cienaga Cienega Creek exhibits approximately 7 miles of surface flow. In addition, Empire Gulch has approximately 0.5 mile, Empire Spring approximately 1,000 feet, and Mattie Canyon approximately 1 mile. The BLM also stated that large blocks of wetland also occur which could easily be delineated on a map. We note that aquatic habitat in the context of this section refers to vegetative communities, not solely wetted areas. While we agree that mapping cold be improved, it is likely that the aquatic vegetative community mapping was superseded by mapping of the dominant overstory (i.e. xerioriparian or hydroriparian) that may co-occur with the understory of Interior Marshland in many sites.

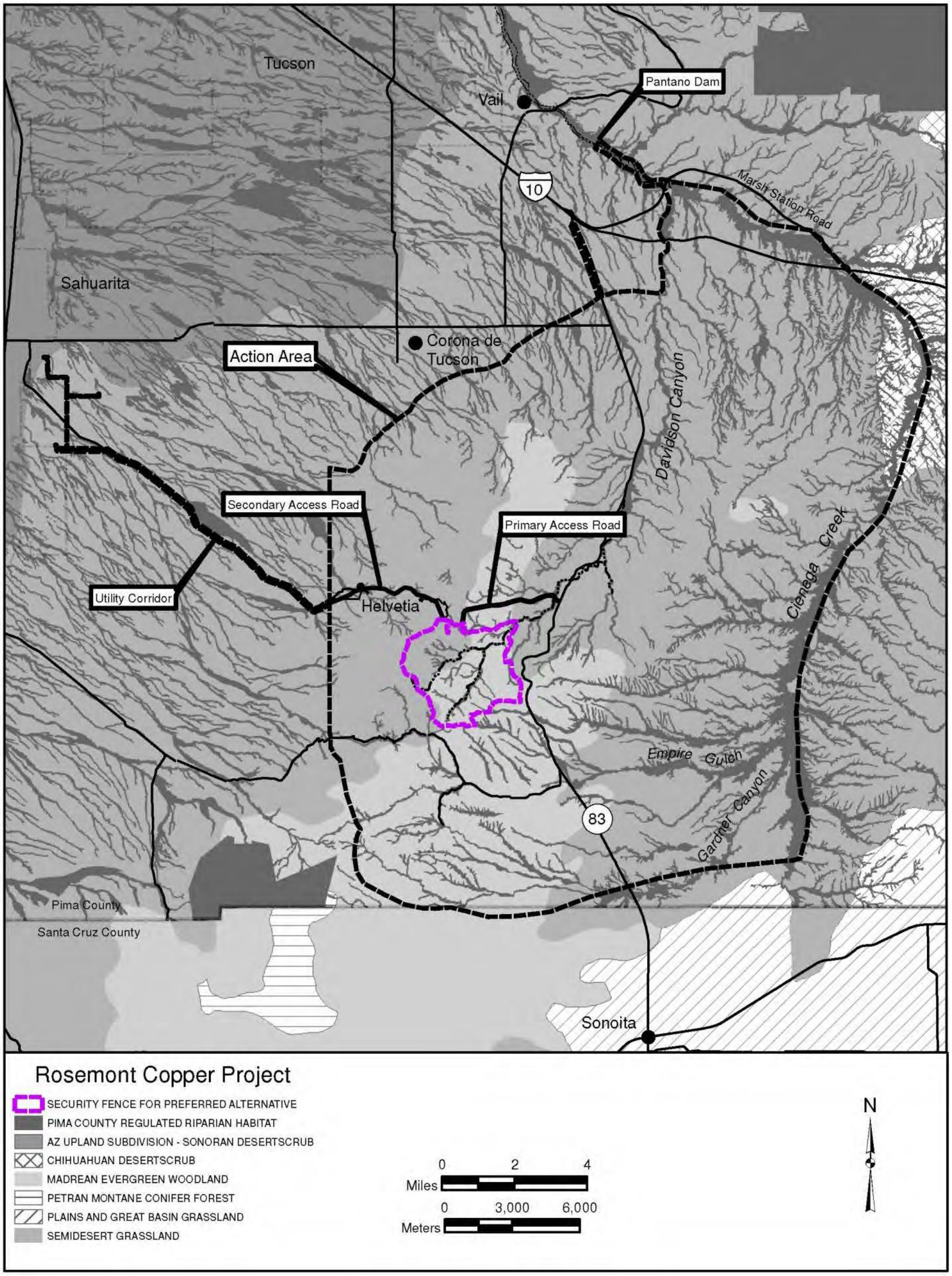

Figure I-4: Vegetation communities within the Action Area for the Rosemont Mine project

Existing Disturbances

Previous mineral exploration and production activities in the proposed action area have resulted in numerous landscape disturbances, such as mine prospects and adits, mine related access roads, and geotechnical drilling sites, that potentially contribute to current light levels in the night sky and fugitive dust. These disturbances are scattered throughout the proposed action area. Additional anthropogenic disturbances have resulted from livestock grazing and all-terrain vehicle (ATV) use. Past wildfires have also affected biological resources in the analysis area: since 1989 there have been 27 fires larger than 10 acres, totaling approximately 49,321 acres. Fires kill vegetation and wildlife to a varying degree, depending on the severity and intensity of the fire, and the recovery can take up to decades, depending on the pre-fire vegetation community and the severity and intensity of the fire. Within and adjacent to the action area, there are numerous wells in the Sonoita area that support residential and ranching uses and contribute to groundwater drawdown in the analysis area.

Historic Mining Activities

Helvetia was the largest mining camp of the Helvetia district, followed by Old Rosemont, New Rosemont, and smaller mining camps established at the "Tiptop, Blue Jay, Proctor and Deering, Beuhman, Cuprite, Pauline, Metallic, Helena, Scholefield and Ridley mines" (Ayres 1984, as cited in the BA). The major era of mining at Rosemont was 1879 to 1915, although Old Rosemont was most active from 1894 to 1915, and New Rosemont was most active from 1915 to 1921.

Ranching and Grazing

Livestock grazing has been an ongoing disturbance in and around the footprint of the proposed mine for over 100 years—historically at much higher levels than at present. One of the earliest ranches in the proposed action area was the VR Ranch, which was established in the 1880s and later homesteaded. By about 1900, the López and Martínez ranches were in operation, but neither of these was homesteaded. In 1903–1904, when the 1905 Patagonia USGS quadrangle map was surveyed, there were three ranches within the proposed action area: López, Martínez, and VR. With the establishment of the Santa Rita Forest Preserve in 1902 and the Coronado National Forest in 1908 (Ayres 1984), the federal government began to require permits to graze cattle on federal land. Smaller ranchers, such as the Lópezes and the Martínezes, were allowed to graze a few head without permits. The Taylor Grazing Act of 1934 established a system of grazing allotments for public lands. Most of the project area lies within the Rosemont grazing allotment, which was established in 1935 and covers 11,369 acres. From 1938 to 1951, this allotment was leased by Chiricahua Ranches. Rosemont holds term grazing permits on four allotments: Rosemont, Thurber, Greaterville, and DeBaud. Rosemont plans to continue all current grazing activities as permitted throughout the course of the proposed action .

Recent Geotechnical and Hydrologic Drilling

In August 2006, Tetra Tech completed a geotechnical investigation on lands within the proposed action area in support of feasibility-level designs of a heap leach pad and associated ponds, dry-stack tailings facilities, plant site facilities, a waste rock storage area, and various water management facilities (Tetra Tech and Schafer 2007). Initial geotechnical site investigations were conducted between November 2006 and March 2007. A total of 10 boreholes and 33 test pits were completed during this initial phase of the work. The boreholes and test pits were confined to the limits of private land (patented claims and fee lands).

On March 6, 2008, the Forest Service approved a proposal for preliminary mineral exploration for short-term geotechnical and hydrologic drilling and related activities on the Coronado National Forest. From May through July 2008, Tetra Tech completed a total of 19 boreholes at 15 drill sites located on Forest Service land (Tetra Tech 2009b, as cited in the BA). Because of the restricted amount of ground disturbance allowed on Forest Service land, 13 of the 15 drill sites were located along existing dirt roads. Two new access roads were constructed in order to reach drill sites located within the plant site area and the footprint of the proposed primary crusher. In accordance with Forest Service instructions, all disturbed areas associated with the geotechnical drilling on Forest Service land was reclaimed (i.e., recontoured and seeded) within 30 days of the completion of drilling, with the exception of boreholes that will be used for groundwater monitoring. Gating of new access roads and the permanent closure of access roads following the completion of drilling activities were also conditions stipulated by the Forest Service.

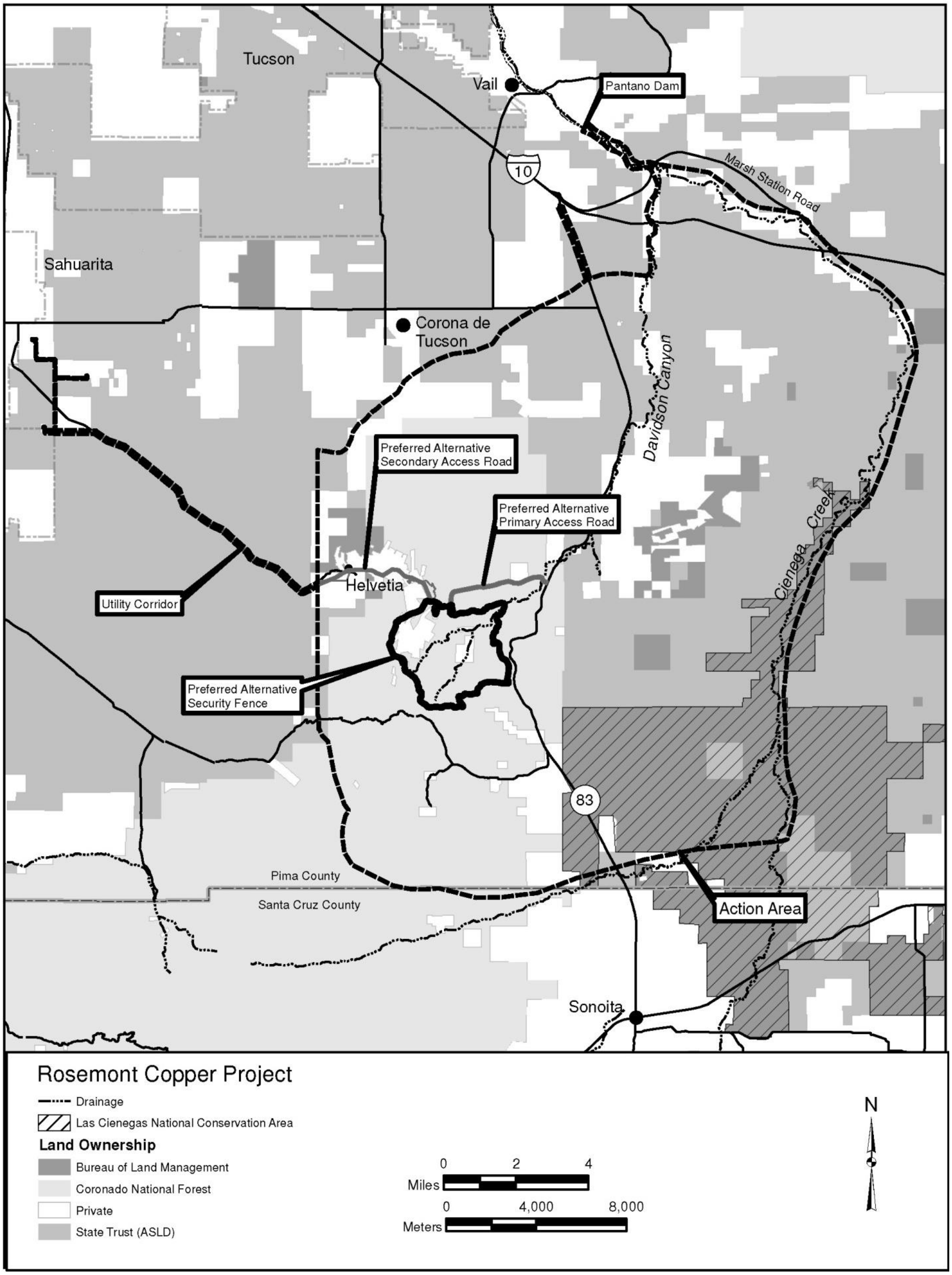

Figure I-5: Action Area for the Rosemont Mine project

Status of the Species - Lesser Long-Nosed Bat

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 (*Agave palmeri*)] (Hoffmeister 1986). The lesser long-nosed bat was listed (originally, as *Leptonycteris sanborni*; Sanborn's long-nosed bat) as endangered in 1988 (U.S. Fish and Wildlife Service 1988). No critical habitat has been designated for this species. A recovery plan was completed in 1997 (U.S. Fish and Wildlife Service 1997). 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, following the approval of the recovery plan. A five-year review has been completed and recommends downlisting to threatened (U.S. Fish and Wildlife Service 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, the lesser long-nosed bat 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 (U.S. Fish and Wildlife Service 1997). 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 time period in Arizona (U.S. Fish and Wildlife Service 1997, Hoffmeister 1986, Sidner and Houser 1990). 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 Mountains and, recently, the Galiuro Mountains (personal communication with Tim Snow, Arizona Game and Fish Department, 1999), but also occur with adult females and young of the year at maternity sites (U.S. Fish and Wildlife Service 1997). Throughout 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 miles, and in Mexico, at 25 miles and 36 miles (one way) (Ober *et al.* 2000; Dalton *et al.* 1994, Ober and Steidl 2004, Lowery *et al.* 2009). Lowery *et al.* 2009 and Steidl (personal communication, 2001) found that typical one-way foraging distance for bats in southeastern Arizona is roughly 6 to 18 miles. A substantial portion of the lesser long-nosed bats at the Pinacate Cave in northwestern Sonora (a maternity colony) fly 25-31 miles each night to foraging areas in OPCNM (U.S. Fish and Wildlife Service 1997). Horner *et al.* (1990) found that lesser long-nosed bats commuted 30-36 miles round trip between an island maternity roost and the mainland in Sonora; the authors suggested these bats regularly flew at least 47 miles 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; personal communication with Yar Petryszyn, University of Arizona 1997).

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 elevational areas of the Sonoran Desert region, and paniculate agaves are found primarily in higher elevation desert scrub areas, 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 roost sites 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.

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 (Arizona Game and Fish Department 2005, Tibbitts 2005, Wolf and Dalton 2005, U.S. Fish and Wildlife Service 2007b; electronic mail from Tim 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, Arizona Game and Fish Department 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, 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 20 – 25 large lesser long-nosed bat roost sites, including maternity and late-summer roosts, have been documented in Arizona. Of these, 10 – 20 are monitored on an annual basis depending on available resources (U.S. Fish and Wildlife Service 2007b). Monitoring in Arizona in 2004 documented approximately 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 (Arizona Game and Fish Department 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 relative number of known large roosts is quite small.

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 extinction 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 for a number of reasons. 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 mortality, 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 (U.S. Fish and Wildlife Service 2005). 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 or 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.

In summary, 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 supported by invasive vegetation in 2005 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 acres) set a new state record, burning a larger area than the 2002 Rodeo-Chediski Fire (468,638 acres). The Horseshoe 2 Fire (222,954 acres) burned approximately 70% 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 a total of 366,679 acres 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 (personal communication with Scott Richardson, FWS, January 11, 2008). 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, p. 2074). Monitoring bats and their forage during drought years is needed to better understand the effects of drought on this species.

The lesser long-nosed bat recovery plan (U.S. Fish and Wildlife Service 1997) identifies the need to protect roost habitats and foraging areas and food plants, such as columnar cacti and agaves. The lesser long-nosed bat recovery plan provides specific discussion and guidance for management and information needs regarding bat roosts and forage resources (U.S. Fish and Wildlife Service 1997). 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.

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 mortality 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 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 (U.S. Fish and Wildlife Service 2010). 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 (U.S. Fish and Wildlife Service 2007c). 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 a period of 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 BMGR 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. The 2007 BO for Department of the Army Activities at and near Fort Huachuca (Fort), Arizona anticipated incidental take in the form of direct mortality or injury (six bats over the life of the project), harassment (20 bats per year), and harm (10 bats over the life of the project) (U.S. Fish and Wildlife Service 2007a).

The lesser long-nosed bat recovery plan (U.S. Fish and Wildlife Service 1997), listing document (U.S. Fish and Wildlife Service 1988), and the 5-year review summary and evaluation for the lesser long-nosed bat (U.S. Fish and Wildlife Service 2007b), all discuss the status of the species, and threats, and are incorporated by reference.

Environmental Baseline - Lesser Long-Nosed Bat

Action Area

As stated previously, the action area is defined as 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). The FWS has described above the general action area for the Rosemont Mine project (see Action Area section above). The action area as it relates specifically to the lesser long-nosed bat extends beyond this general action area and includes the areas directly impacted by the Rosemont mine features identified, including utility corridors and access roads, as well as the area defined by a circle with a radius of 36 miles (the maximum documented one-way foraging distance of the lesser long-nosed bat) around the Rosemont Mine project. Lesser long-nosed bats may occur anywhere within this foraging radius around roosts occupied by lesser long-nosed bats during the time of annual occupancy in the area. The action area represents only a small portion of the lesser long-nosed bat's range. However, using this definition increases the number of lesser long-nosed bat roosts in the action area from three, as described in the various BAs, to 13, which includes 10 lesser long-nosed bat roosts in the Santa Rita, Empire, Mustang, Whetstone, Patagonia, Rincon and Santa Catalina mountains that are within 36 miles of the proposed Rosemont Mine project.

The above description of the action area for lesser long-nosed bats is supplemented by the overall description of the action area used earlier in this document (see Action Area section above) with regard to land management and vegetation community description.

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

Bat surveys of the proposed action area and vicinity were conducted in 2008 (WestLand 2009f), 2009 (Buecher *et al.* 2010), 2010 (Buecher *et al.* 2011), and 2011 (WestLand 2011f). Methods included active and passive ultrasonic acoustic sampling at flowering agaves, infrared photography and observations of flowering agaves, and surveys of potential roost sites.

In 2008, 143 potential bat roost sites (i.e., caves, mine shafts, and adits) were evaluated within the action area and surrounding region (WestLand 2009f). Of these 143 sites, 59 were within the proposed action footprint, and 16 were near the proposed action footprint. Acoustic and/or roost site surveys were conducted on a total of 20 different dates between August 4 and November 12, 2008, and ultrasonic acoustic surveys and infrared surveys were conducted on five evenings between August 11 and September 16, 2008. Because lesser long-nosed bats often remain silent while foraging, several sites also were monitored in 2008 with night vision equipment to further document use of flowering agaves. Lesser long-nosed bats were documented foraging regularly on agaves in the proposed action area from late August to mid-September based on the results of acoustic and infrared surveys. Lesser long-nosed bat calls were recorded at 23 of the 27 Palmer agave sites where acoustic surveys were successful (i.e., no equipment failures), and night vision equipment was successful in detecting frequent lesser long-nosed bat visits to flowering Palmer agaves. Lesser long-nosed bats were documented roosting at three sites within the action area in

2008: Site 9 (the name was changed to Chicago Mine in Buecher *et al.* 2010), Site R-2, and the Helena Mine complex (Figure LLB-1). The Chicago Mine was visited five separate times during 2008; approximately 12 to 15 lesser long-nosed bats were present in August, and none were present in late September. The R-2 site was visited once in 2008, which resulted in the confirmed sighting of one lesser long-nosed bat. A small colony of 20 to 30 lesser long-nosed bats was roosting at the Helena Mine complex in 2008. Only one of these sites (Site 9/Chicago Mine) is within the proposed action footprint and is located within the proposed mine pit. Site R-2 is immediately adjacent to the southwestern portion of the proposed fence line of the Barrel alternative. Lesser long-nosed bats also were found at the Helena Mine complex approximately 1 mile north-northeast of the fence line for the Barrel alternative.

In 2009, 37 sites were examined during eight field visits conducted in August, September, and October (Buecher *et al.* 2010). Survey efforts in 2009 focused on sites that supported nectar-feeding bats in 2008 and sites where the potential for bats was considered high, including the following: 1) the Helena Mine complex, which is characterized by multiple entrances, supported small numbers of *L. yerbabuenae* in 2008; 2) Adit S and Adit R-47, where accumulations of insectivorous bat guano was found in 2008; 3) R-46, which was not visited in 2009 but was thought to have high potential for bat use; 4) Chicago Mine (referred to as Site 9 in WestLand 2009f), which supported small numbers of Leptonycteris in 2008; and 5) R-2 (located in Sycamore Canyon), where one *L. yerbabuenae* was found in 2008. Lesser long-nosed bats were documented at the same three roosts at which they were detected in 2008 (see LLB-1, below). The Chicago Mine was visited two times in 2009, and approximately 32 lesser long-nosed bats were documented exiting the mine. The R-2 site was visited three times in 2009. This resulted in a single lesser long-nosed bat observed on August 25, 2009, more than 50 detected with acoustic sampling and infrared video cameras on September 3, 2009, and the presence of lesser long-nosed bats on October 13, 2009. At the Helena Mine complex, more than 5,000 lesser long-nosed bats were detected during an exit count in September.

In 2010, three of the sites that were previously surveyed, including one site that contained lesser long-nosed bats in 2008 and 2009 (Helena Mine complex), were revisited (Buecher *et al.* 2011). Additionally, the BLM conducted surveys on their lands near Helvetia late in 2010, and lesser long-nosed bats were observed roosting on abandoned mine land features (Hughes 2011). Lesser long-nosed bats were documented roosting only at the Helena Mine complex site; however, the Chicago Mine and R-2 sites were not surveyed. Significantly fewer (approximately 150) lesser long-nosed bats were detected overall during exit counts in 2010 than in 2009 (more than 5,000). However, some of the emergence counts were stopped early because of inclement weather, so it is unclear whether the reduced counts were accurate representations of the number of bats at these roost locations.

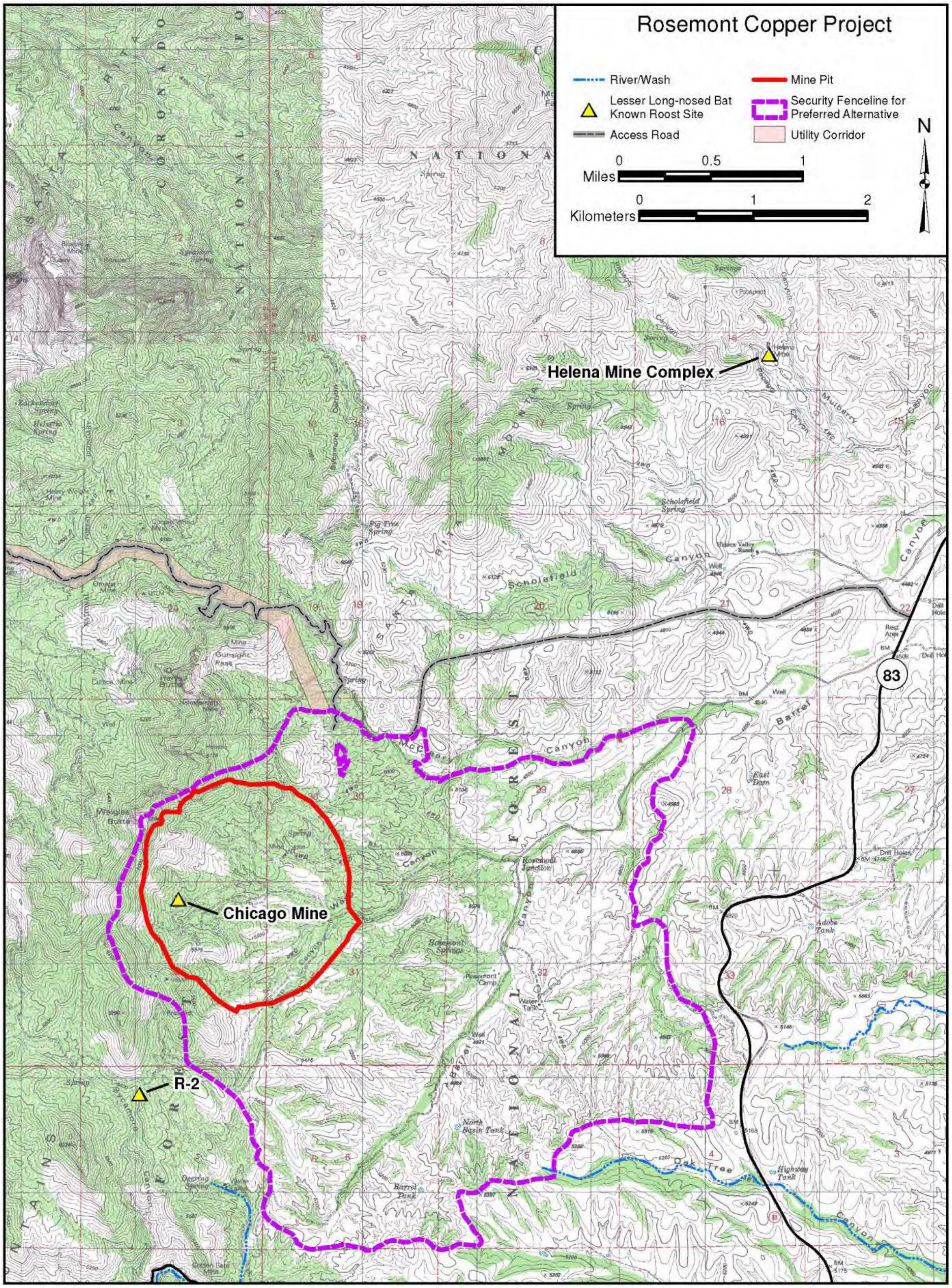

Figure LLB-1: Lesser Long-Nosed Bat roosts in the Action Area of the Rosemont Mine project

In 2011, 33 sites were examined in 10 field visits in July, August, and September (WestLand 2011f). Some sites surveyed were used by bats in previous years, and additional mines not covered during prior surveys were also evaluated. Evaluations included mine entry (internal surveys) and/or external roost evaluations (emergence surveys). Lesser long-nosed bats were documented roosting at the Helena Mine complex site, the Chicago Mine, and R-2 sites (see Figure LLB-1 below). At the Helena Mine complex, approximately 4,650 lesser long-nosed bats were detected during an exit count in August; during a second emergence count in September, approximately 2,021 Lesser Long-nosed Bats were recorded. At the Chicago Mine, one lesser long-nosed bat was detected roosting in July. At the R-2 site, three lesser long-nosed bats were detected roosting in July.

Regional monitoring of lesser long-nosed bats occurs in the vicinity of the Rosemont Mine project, including mountain ranges within 36 miles (maximum documented foraging distance for lesser long-nosed bats) of the Rosemont Mine project. Based on this regional monitoring data, 10 additional lesser long-nosed bat roosts occur within 36 miles of the Rosemont mine site. Bats from these roost sites potentially visit the Rosemont Mine area to forage on available agave plants. The number of lesser long-nosed bats using these additional roosts is generally from 1,000 – 12,000 bats. While it is unlikely that all of the lesser long-nosed bats from these roosts will use the Rosemont Mine area for foraging, it is likely that, in any given year, some of the bats from these roost sites will forage in the area of the Rosemont Mine.

In summary, the action area is located in the post-maternity dispersal region for lesser long-nosed bat (maternity colonies in southwestern Arizona disband in July and August), and there are numerous Palmer agaves and at least thirteen active roosts within the action area (three of which are within or in the immediate vicinity of the proposed action footprint). Of these roosts, only Chicago Mine is in the proposed action footprint. Although dates of arrival at post-maternity sites are variable in Arizona from one year to the next, surveys in the action area in 2008, 2009, 2010, and 2011 indicate that lesser long- nosed bats forage and occupy roosts in the area beginning at least in early August and, based on results at the Helena Complex, continuing into October. The large number of this species present at the Helena Mine complex in 2009 and 2011 indicates that this site could be a roost complex of regional importance to lesser long-nosed bats.

Lesser long-nosed bat numbers at post-maternity or transition roosts tend to fluctuate more than do numbers at maternity roosts. This fluctuation is apparently based on local forage availability (agave blooms). Agave blooming is subject to climatic conditions and during the ongoing, extended drought, some portions of the action area have been subject to forage failures. Lesser long-nosed bats are highly mobile and will switch to areas and roosts where forage is available.

A number of activities occur in the action area that could affect bats. Because of the extent of Federal lands in the action area, most activities that currently, or have recently, affected the lesser long-nosed bats or their habitat in the action area are Federal actions, many of which have undergone formal consultation. Ongoing illegal border activities are an exception. Efforts are ongoing in the action area that contribute to the conservation and protection of lesser long-nosed bat populations and habitat within the action area. For example, the National Park Service and the Coronado National Forest have constructed bat gates at two lesser long-nosed bat roosts in the Huachuca and Canelo Hills, respectively. The effectiveness of these efforts is being monitored. Research and monitoring activities funded by Customs and Border Protection on public and private lands within the action area are contributing to our knowledge of lesser long-nosed bat roost locations and developing appropriate protective measures for lesser long-nosed bat roost sites. In general, the lesser long-nosed bat populations within the action area are stable to increasing, but threats are ongoing, and in some cases increasing (climate change, invasive species, border activities, etc.)

Effects of the Action - Lesser Long-Nosed Bat

Effects to Roosts

The proposed action will directly affect and result in the permanent loss of at least one known lesser long-nosed bat post-maternity roost site (Chicago Mine) within the footprint of the proposed mine, which in August 2008 contained approximately 12 to 15 lesser long-nosed bats, in 2009 contained approximately 32 lesser long-nosed bats, and in July 2011 contained one roosting lesser long-nosed bat. Any individual lesser long-nosed bats present within the footprint of the mine infrastructure (including the pit, buildings, roads, tailings or waste piles, etc.) will either be crushed or forced to relocate. Rosemont will close the Chicago Mine when lesser long-nosed bats are not present in the Chicago Mine (excluded); therefore, no lesser long-nosed bats would be killed by the construction of the mine pit, if no individuals are in the mine during closure.

Given the anticipated levels of project related activity and associated disturbance from noise, vibrations, and light, there exists the potential for effects on two additional lesser long-nosed bat post-maternity roosts adjacent to the proposed mine footprint [i.e., R2 (immediately adjacent to the southwestern portion of the proposed fence line of the proposed action0 and the Helena Mine complex (approximately 1 mile north-northeast of the fence line for the proposed action)]. At the R2 site, one lesser long-nosed bat was detected each year in 2008 and 2009, and three lesser long-nosed bats were detected there in 2011. More than 5,100 lesser long-nosed bats were counted at the Helena Mine complex in 2009, and approximately 4,650 lesser long-nosed bats were detected in 2011. Any individuals present adjacent to the mine footprint would experience effects from light, noise, and vibrations. Although Rosemont has developed a light pollution mitigation plan (Monrad *et al.* 2012), light from artificial illumination will increase light levels at night, and specific impacts of light on lesser long-nosed bats in the habitat within the project and actions areas are unknown; therefore, increased light levels could disrupt this nocturnal species, resulting in changes in dispersal, reproductive behavior, communication patterns, and decreased foraging success (Longcore and Rich 2004). Similarly, noise and vibrations from construction of the mine or blasting will disturb lesser long-nosed bats, likely causing changes in dispersal, reproductive behavior, communication patterns, decreased foraging success, increased predation and stress response, and possibly damaged hearing if the noise is loud enough (NoiseQuest 2013; Pater *et al.* 2009). The magnitude of impacts from noise, vibration, and light are uncertain, but these impacts are expected to decrease as the distance from the mine increases.

While not addressing impacts to lesser long-nosed bat roosts from light, noise, blasting, etc., Rosemont will include a conservation measure as part of the proposed action that addressed the threat of human intrusion at these sites. Rosemont will fence or implement some other form of roost protection at the Helena Mine roost site and the R-2 Adit roost site. While these actions will potentially provide long-term protection of these known lesser long-nosed bat roost site, the fencing or other protective measures may also affect the use of these sites by lesser long-nosed bats. Such measures may alter the microclimate of the roosts, create impediments or hazards within the flight paths of bats entering and exiting the roosts, increase the vulnerability of lesser long-nosed bats to predators, or attract additional human activity to the sites. Rosemont has committed to coordinating these efforts with FWS and suitable entities so that appropriate measures that minimize effects to lesser long-nosed bats will be selected. Many of the potential negative effects of these measures can be avoided or significantly reduced with the selection of appropriate measures and the proper design and implementation of those measures. We are confident that we can work with Rosemont to develop appropriate protective measures for these roost sites, which will also present us with an opportunity to evaluate the effectiveness of the selected protective measures with regard to lesser long-nosed bat roost conservation. Nonetheless, the implementation of protective measures at known lesser long-nosed bat roost sites will have effects and, potentially, take that must be evaluated in this BO.

Effects to Forage

The proposed action will affect lesser long-nosed bats through the removal of potential lesser long-nosed bat forage plants (i.e., paniculate agaves) in the late summer range of the species. Based on surveys, it is estimated that between 196,268 and 306,209 Palmer agave rosettes will be impacted as a result of the proposed action (WestLand 2009e). In terms of acres of lesser long-nosed bat foraging habitat, the mine pit and associated facilities, including roadways, will remove approximately 5,400 acres of foraging habitat. Effects on lesser long-nosed bat forage plants may also result from an increase in dust levels adjacent to access roads and mining areas. Agaves could be negatively impacted by windborne fugitive dust coating leaves, resulting in reduced photosynthetic activity. Physical effects of dust on plants may include blockage and damage to stomata, shading, and abrasion of leaf surface or cuticle (Goodquarry 2011). Reduced food sources could result in reduced reproduction success or could result in the abandonment of the action area and nearby roosts by lesser long-nosed bats. Known lesser long-nosed bat maternity roosts are all more than 75 miles from the proposed action area; therefore, no effects on lesser long-nosed bat maternity roosts are anticipated.

In some of the WestLand technical reports, particularly WestLand (2012j), various aspects of livestock grazing management on Forest Service-managed allotments that are leased by Rosemont are proposed as a conservation measure to increase the availability of agave flower stalks. The grazing proposals address issues relative to grazing intensity and duration, as well as stock tank management. The proposal to reduce grazing pressure is proposed as a measure (in addition to agave planting) to compensate for the effects of the project on forage of lesser long-nosed bat under the premise that reduced livestock grazing pressure during the agave bolting period will increase the number of available agave flower stalks when compared to the current livestock grazing approach. As outlined in Coronado National Forest’s second supplemental

BA, we agree that the revised grazing management cannot completely compensate for the loss of agaves in the project area, nor can any of the other proposed conservation measures (reclamation using agaves and additional agave planting) completely compensate for the loss of agaves. We agree with the rationale outlined in the second supplemental BA emphasizing that (1) some of the project area capable of growing agaves will be permanently removed from the landscape by the action (e.g., formation of the pit); (2) there are uncertainties about the ability to grow, transplant, and recruit Palmer's agave on the potentially capable areas following disturbance (e.g., waste rock facilities, roads, plant site); (3) previous consultation on livestock grazing has shown "no adverse effect" to lesser long-nosed bats from grazing anyway; (4) only 10% of the agaves lost from the project will be mitigated for by being planted; (5) seed mixes containing agave seeds are untested; (6) limited offsite, disturbed areas lacking agaves are proposed for restoration; and (7) conservation lands are not expected to differ significantly from the surrounding areas, with or without grazing (although easements could preclude future development or other actions with negative effects to lesser long-nosed bats). Nevertheless, FWS, like the Coronado National Forest, does support the concept of reduced grazing to help offset the effects of the action on Palmer agaves, the primary food source of the lesser long-nosed bat, although we do not have specific data to determine the extent of this reduction or the potential benefit to lesser long-nosed bats. Additionally, we have found in previous section 7 consultations that there has not been an adverse affect to lesser long-nosed bat from grazing on Palmer agave.

As part of the proposed action, Rosemont will reroute portions of the Arizona Trail. On the one hand, this will reduce the potential for human disturbance at the Helena Mine lesser long-nosed bat roost site, but it will also result in new disturbance of lesser long-nosed bat foraging habitat and increase the human disturbance along the new Arizona Trail route. The proposed reroute of the Arizona Trail will encompass approximately 13 miles and 19 acres of disturbance. The proposed trail reroute will not occur in proximity to any additional, known lesser long-nosed bat roosts. Effects to vegetation will occur, including the possibility of additional impacts to agaves. Rosemont has included the potential planting or revegetation with agaves of the old Arizona trail alignment. This will help offset the additional impacts to lesser long-nosed bat foraging habitat.

Effects from Noise and Lighting

Artificial light from the mine activities was recognized as a source of effects to lesser long-nosed bats in the Coronado National Forest's June BA and October Supplemental BA. The proposed action is expected to produce approximately 6.4 million lumens, which takes into account all lighting sources, including equipment-mounted lighting systems. To date, there is limited information on the existing condition, other than the qualitative observation that there is little existing artificial light, so the area is fairly dark. Because the project will operate around the clock, additional light pollution is of concern to astronomical interests and to the environmental community in general, particularly with regard to nocturnal species such as the lesser long-nosed bat. In the BA and Supplemental BA, there was some information on environmental consequences of light from the mine, but the existing technical reports targeted effects of "light pollution" and sky glow, primarily for astronomy and observatory concerns. More recently, WestLand produced another technical report related to the quantification of effects of the lighting associated with the Rosemont Mine Project (Westland 2012f). This report helped to quantify the intensity and attenuation of light within twelve miles of the project area, using predictive modeling based on known and assumed lighting sources and the topography of the area. This report displayed predicted increases in horizontal light from artificial sources at the proposed copper mine.

Increases in light were displayed as increases to ambient light levels in terms of natural light levels (i.e., increase in artificial night light, based on different phases in the moon). The report also made it easier for us to envisage the amount of light at night from sky glow—it stated the artificial light would emit about the same number of lumens as the towns of Sells or Ajo, Arizona. That can be compared to the previous expectation (related to the initial Mine Plan of Operation) of sky glow similar to Nogales, Arizona. The Monrad (2012) and WestLand (2012g) reports both emphasize the improvements in the most recent lighting plan. The design features (which are not considered species-specific conservation measures) in the revised lighting plan are somewhat responsive to mitigating effects of lighting on plants and animals (Rich and Longcore 2006). In particular, part of this edited book that focuses on birds, Gauthreaux and Belser (2006, p. 87) lists the following "lighting control strategy options" (albeit more geared to office buildings than mines):

• Installing motion-sensitive lighting
• Using desk lamps and task lighting
• Reprogramming timers
• Adopting lower-intensity lighting

Other taxa accounts in Rich and Longcore (2006) mention how certain wavelengths of emitted light can be adjusted to decrease effects to certain animals. At least some of the design features that employ these measures are discussed in Monrad (2012) and WestLand (2012g). These reports do show that there was a significant effort on the part of the proponent to reduce lighting effects, but artificial night-lighting will still affect the lesser long-nosed bat for the next 25 to 30 years, despite the fact that Rosemont has committed to use light sources that minimize short wavelengths of light in an effort to reduce potential effects to wildlife.

Vehicular traffic will be present on SR 83, the west and east access roads, and within the project area. It is important to consider synergistic effects of human activity related to artificial night lighting. Vehicular light, especially, will be compounded by noise at the source of activity. As an example, for a moving vehicle at night, effects of artificial lighting are synergistic with noise pollution and motion, resulting in a loud, bright, moving object).

The Rosemont Mine project will create an epicenter of relatively intense lighting, similar to the light output of "the towns of Sells and Ajo", as mentioned above. This new occurrence of light in an area where such lighting has not occurred in the past can impact wildlife. For example, a migratory bird flying over the area could be affected by this epicenter of artificial light from the project (see Gauthreaux and Belser 2006). Certainly artificial night light in proximity to the source would have a more significant impact on nocturnal species, such as the lesser long-nosed bat, than areas where the light becomes more diffused, such as in areas peripheral to the light source. Another aspect that cannot be readily quantified is the amount of light at an angle above the horizontal, but below the vertical. This is a possible issue for volant species. For example, when lesser long-nosed bats exit their roosts, they will quickly be above the horizontal, in an area experiencing elevated artificial light levels; spatially, this would be an area larger than that depicted by the figures presented by WestLand (2102g).

There are many ways that plants and animals can be affected by artificial night lighting. Beier (2006) discussed some of the major physical and behavioral effects to mammals:

- Disruption of foraging behavior
- Increased risk of predation
- Disruption of biological clocks
- Increased deaths in collisions on roads
- Disruption of dispersal movements
- Disruption of corridor use

While the specific effects of the lighting associated with the proposed Rosemont mine are largely unknown and discussed in terms of our best professional judgment, we do anticipate a real effect on the use of the area in the vicinity of the mine by foraging lesser long-nosed bats, and, potentially, effects on the use of roost sites affected by the lighting of the proposed mine.

In the past century, the extent and intensity of artificial night lighting has increased such that it has substantial effects on the biology and ecology of species in the wild (Longcore and Rich 2004). Recent studies have shown that artificial lights affect the movements of bats through the landscape, particularly slower flying bats. Stone *et al.* (2009) and Rydell (1992) showed in separate studies that street lighting disturbed and even prevented movements by certain species of bats; primarily bats with slower flight behavior. Recent telemetry research conducted by the Arizona Game and Fish Department (AGFD) on foraging lesser long-nosed bats in the Tucson Basin shows that foraging bats travel along washes as they move between foraging areas and roost locations. The AGFD believes that the washes provide areas of reduced lighting that provide pathways for movement while reducing the likelihood of predation and other threats (AGFD 2009). Lesser long-nosed bats use a hovering, slow flight while foraging and, as the AGFD research suggests, may be avoiding areas with artificial lighting. A study by Scanlon and Petit (2008) showed that urban parks without artificial lighting had higher bat use and bat species diversity than urban parks with artificial lighting, further indicating that artificial lighting can affect bat use and movements. A number of other studies also show negative effects on bat emergence, roost sites, movements, feeding behavior, and prey relationships (Boldogh *et al.* 2007, Holsbeek 2008, Fure 2006, Bat Conservation Trust 2008, Downs *et al.* 2003). During a study on a nectar feeding bat species more closely related to the lesser long-nosed bat, Winter *et al.* (2003) found that *Glossophaga soricina* locates forage using ultraviolet light reflected by forage species. Because this attribute has not been researched in lesser long-nosed bats, it is not known whether lesser long-nosed bats have this same ability. However, these bats are in the same taxonomic family, and artificial light may cause interference or redirect foraging lesser long-nosed bats keying on ultraviolet light sources or reflections. We do not, however, have enough information to definitively evaluate this potential effect. Ongoing research by AGFD and others may provide additional information in the future regarding this issue. Information specific to the effects of lighting on lesser long-nosed bats are limited. We know that lesser long-nosed bats forage in areas which have increased levels of light compared to non-urbanized areas. However, given the observations of telemetered lesser long-nosed bats using areas of little or no urban lighting to move within the landscape, we anticipate that the light emitted as a result of the Rosemont will have effects to foraging and, potentially, roosting lesser long-nosed bats evidenced by reduced use or abandonment of the area.

Noise effects to lesser long-nosed bats are related to blasting and drilling, ore processing, and waste rock and tailings placement. Day-to-day operations of the plant and associated travel by trucks and other equipment also contribute to noise impacts in the vicinity of the Rosemont Mine project. While much of the more intense activity will occur during daylight hours, the proximity of known lesser long-nosed bat roosts make it likely that day-roosting bats will be affected by the increased noise levels of the proposed mine. Lighting and noise disturbance will also affect foraging lesser long-nosed bats in the vicinity of the mine as some mine activity will occur around the clock.

<u>Changes in Lesser Long-Nosed Bat Status Within the Action Area</u>

Lesser long-nosed bats exhibit high fidelity to maternity roosts, returning year after year. Fidelity to post-maternity roost sites, such as those located within the action area of the Rosemont Mine project, is not as strong. The numbers of lesser long-nosed bats using post-maternity roost sites varies from year to year, and some sites may not be used every year. This is apparently in response to variability in the quantity and location of available forage resources. In some ways, this makes the conservation and protection of known post-maternity sites equally as important as the protection of maternity roost sites. The availability of post-maternity roost sites distributed across the landscape allows lesser long-nosed bats to take advantage of variable and ephemeral food resources. Without the flexibility of multiple roost sites from which to select, the most efficient and effective use of forage resources by lesser long-nosed bats may be precluded. As a result, altered timing of migration and inability to obtain adequate resources may result in migrating lesser long-nosed bats in poor condition which can contribute to increased mortality and reduced productivity.

A number of the lesser long-nosed bat roosts within the action area occur on private lands and may or may not be subject to section 7 consultation for actions that could be proposed on these lands and which could affect lesser long-nosed bat roost sites. Lesser long-nosed bat roosts on public lands have been affected despite the efforts to protect those sites and despite the fact that such actions underwent section 7 consultation. In recent years, lesser long-nosed bat use at known roost locations has been affected by the occurrence of large wildfires and activities associated with illegal border crossing at these roost sites. These threats to lesser long-nosed bat roosts are not expected to diminish in the future. Ten additional post-maternity lesser long-nosed bat roost sites are located outside of the immediate vicinity of the Rosemont Mine project, but within the action area. Effects to any of these roost sites from fire, illegal border activities, poor forage production, or other threats may necessitate the use of the roost sites near the Rosemont Mine project. The converse is also true if the effects of the Rosemont Mine cause the roost sites near the mine to be abandoned or the use of those roosts to be reduced, necessitating the need for those bats to find and use alternative roost sites within the action area. If lesser long-nosed bats are unable to find alternative roost sites, their migratory patterns, body condition, and, ultimately, productivity may be affected.

We conclude that the availability of post-maternity roost sites across the range of the lesser long-nosed bat is crucial to this species' ability to meet its life history requirements. In particular, this availability contributes to the lesser long-nosed bat's ability to use an ephemeral and variable forage resource, as well as find protection afforded by roost sites if other roost sites within the range of the bat become compromised. The roost sites affected by the Rosemont Mine may reduce the availability of post-maternity roosts in this area of the lesser long-nosed bat's range, and correspondingly reduce options for this species to meet its life history requirements.

The *Lesser Long-nosed bat Recovery Plan* (FWS 1991) states that reclassification of the species from endangered to threatened would be warranted if all of the following criteria are met: (1) each major roost population in Arizona and Mexico is monitored for at least five years; (2) the results of that monitoring show that population numbers are stable or increase over the higher set of population figures appearing in this recovery plan; (3) sufficient progress has been made in the protection of roosts and forage plants from disturbance or destruction; (4) no new threats to the species or its habitat have been identified or there are no increases to currently recognized threats; and (5) the [FWS] Service determines the species is no longer endangered. The *Lesser Long-Nosed Bat* (Leptonycteris curasoae yerbabuenae) *5-Year Review: Summary and Evaluation* (FWS 2007) considered additional data collected since the Recovery Plan was prepared and stated that the primary recovery actions are to monitor and protect known roost sites and foraging habitats.The proposed action will result in the loss of a single roost site as well as an appreciable acreage of forage resources, but the lesser long-nosed bat's flexibility in selecting roosts an foraging areas, the protection of roosts elsewhere, the partial replacement of forage resources on-site, and the continues presence of roosts and forage plants in areas not affected by the Rosemont Copper Mine, make it unlikely that the ability to recover the species (meet the recovery criteria) will be diminished.

Cumulative Effects - Lesser Long-Nosed Bat

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 BO. 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.

The majority of lands within the action area are managed by Federal agencies; thus, most activities that could potentially affect lesser long-nosed bats are Federal activities that are subject to section 7 consultation. The Coronado National Forest and BLM manage approximately 45% of the lands within the action area and administer projects and permits on those lands; therefore, some of the activities that could potentially affect lesser long-nosed bats are likely Federal activities subject to additional Section 7 consultation under the ESA. The effects of these Federal activities are not considered cumulative effects.

Residential and commercial development, farming, livestock grazing, actions resulting in the invasion of buffelgrass, 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 continued road maintenance, grazing activities, and recreation in the action area, current and future development, other nearby mining projects, and unregulated activities on non-federal lands, such as trespass livestock and inappropriate use of OHVs, 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.

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 considered in this BO.

Conclusion - Lesser Long-Nosed Bat

After reviewing the current status of the lesser long-nosed bat; the environmental baseline for the action area; the effects of the proposed action; and the cumulative effects, 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. Our conclusion is based on the following:

1. Take of lesser long-nosed bats will occur as a result of the proposed action. Direct take of individuals is possible related to potential collisions with fencing or other protective structures and/or increased predation associated with the proposed conservation measures related to the Helena and R-2 roost sites. Other direct take associated with the proposed action is not anticipated because of certain proposed conservation measures, including survey and exclusion, which is included in the project design. Indirect take is expected in the form of harm or harass as a result of the complete loss of one lesser long-nosed bat roost site, and effects to two adjacent lesser long-nosed bat roost sites from increased human activity, and associated noise and light effects. Additional indirect take is anticipated from the significant loss of forage resources within the mine footprint, and the reduced availability of forage resources for some distance around the mine due to increased human activity, and associated noise and light effects. However, Rosemont has proposed conservation measures (see Proposed Action section above) to offset and reduce the potential for such indirect take associated with the proposed action. We conclude that these measures address the anticipated effects to lesser long-nosed bats to the extent that the proposed action will not jeopardize the continued existence of the lesser long-nosed bat.

2. Monitoring and adaptive management will be applied to evaluate the effects of the proposed action, as well as the effectiveness of proposed conservation measures. This process will allow the Coronado National Forest and FWS to evaluate and adapt the approach of the proposed conservation measures to be as effective as possible.

3. The acquisition and conservation of lands in the vicinity of the proposed mine will provide conservation benefit to the lesser long-nosed bat. Currently, these lands are subject to potential actions that could affect lesser long-nosed bat forage resources. The conservation, monitoring, and adaptive management approach for these lands will provide a conservation benefit to lesser long-nosed bats.

4. Rosemont has proposed multiple conservation measures and project actions designed to reduce the effects of noise and light on the adjacent lesser long-nosed bat roosts. If these measures are successful or, through adaptive management, can be revised to be successful, the protective measures implemented at the Helena and R-2 roost sites will reduce the potential for roost disturbance by human intrusion at these sites. This provides a conservation benefit for the lesser long-nosed bat.

5. Rosemont has proposed ongoing roost surveys and monitoring, and exclusion of bats prior to closure for small lesser long-nosed bat roosts to be lost as a result of the proposed mine. Currently, only one such small lesser long-nosed bat roost is known within the project area (the Chicago Mine). The potential for direct mortality of lesser long-nosed bats within this roost, as well as any other small lesser long-nosed bat roosts found within the construction area, will be reduced by implementing exclusion of lesser long-nosed bats prior to construction.

6. Agaves will be included in restoration and reclamation activities associated with the proposed Rosemont Mine project. While there will be a temporal loss of forage resources, these restoration and reclamation activities will reduce the long-term loss of lesser long-nosed bat forage resources. Additionally, if the proposed changes to livestock grazing management, as outlined in the conservation measures above, are effective in reducing livestock impacts to agave flowering, some level of additional lesser long-nosed bat forage resources may be available on those allotments within the action area.

7. The effects and actions noted under Conclusions 2 through 6, above, will make the proposed action unlikely to diminish the potential to recover the lesser long-nosed bat.

The conclusions of this BO 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 - LESSER LONG-NOSED BAT

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 included by the USFS as binding conditions of any grant or permit issued to the applicant, as appropriate, for the exemption in section 7(o)(2) to apply. The USFS has a continuing duty to regulate the activity that is covered by this Incidental Take Statement. If the USFS (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 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, the USFS, or the applicant 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 - Lesser Long-Nosed Bat

We anticipate incidental take of lesser long-nosed bats as a result of this proposed action in the form of direct mortality, as well as harm or harassment due to the effects of significant loss of forage resources, and to human disturbance and associated effects of noise and light. These effects are anticipated to cause lesser long-nosed bats to reduce their occupancy or abandon adjacent roost sites and move to alternate roost sites in the area, potentially affecting the regional population of lesser long-nosed bats through overuse of limited forage and roost resources.

Specifically, incidental take for the currently proposed Rosemont Mine project is anticipated as follows:

<u>Take associated with roosts</u> – It is difficult to assess take in the form of harm or harass for individual lesser long-nosed bats at roost sites because the number of individual bats fluctuates over time, and the take of individuals may actually occur away from the original roost site as a result of bats abandoning a known roost. Direct take (mortality of those bats left inside inadvertently and harm of those forced to relocate) resulting from the closure of a known roost

site is more easily quantified, but is still dependent on the number of bats present if the closure occurs while the roost is occupied. Even if bats are excluded prior to closure, or if closure of the roost occurs during a time of year when the bats are not present, take of lesser long-nosed bats in the form of harm can still occur as a result of the loss of necessary habitat elements supporting the life history requirements of lesser long-nosed bats. The effects of noise, lights, and increased human activity in proximity to known lesser long-nosed bat roost sites, to the extent that such effects result in reduced occupancy or abandonment of the roost site, represents take in the form of harass. It is easier to quantify take of lesser long-nosed bats in relation to the number of roosts affected, rather than at the scale of individual lesser long-nosed bats.

For take associated with roosts, we use the number of roosts lost or affected as a surrogate for take, rather than quantifying individual bats. We anticipate the loss of the Chicago Mine roost site as a result of the proposed mine. We also anticipate the loss of the R-2 and Helena roost sites if noise and light conservation measures and best management practices outlined earlier in this BO prove to be ineffective. While there is some potential for loss of other roost sites (Rosemont will continue reconnaissance-level surveys and may close additional occupied small roosts following exclusion of the bats), we conclude this is unlikely to occur because no additional occupied roosts have been found within the action area during previous surveys. If additional roosts are found, closure would be limited to small roost sites and exclusion should eliminate direct take of the bats occupying these small sites. Total take related to lesser long-nosed bat roosts for the Rosemont Mine project is three post-maternity roosts (approximately 6,000 bats); this is a relatively small proportion of the total numbers of bats known from population surveys (see Status of the Species section, above).

While the implementation of protective measures at known lesser long-nosed bat roosts should result in long-term conservation benefits to the species, these measures can also result in mortality of individual bats due to collisions with the structures (gates, fences, etc.) or increased predation due to altered exit and return behavior of the bats. We believe most of these potential issues can be avoided by proper installation and design. However, the potential exists for some mortality of lesser long-nosed bats to occur. Therefore, we anticipate that up to 10 lesser long-nosed bats may be directly taken as a result of the implementation of protective measures at known lesser long-nosed bat roosts.

<u>Indirect take associated with the loss of locally significant lesser long-nosed bat forage resources</u> – Indirect take of lesser long-nosed bats associated with the loss of important forage resources will occur in the form of harm or harass. Harm will occur due to the permanent loss of locally significant forage resources. Take in the form of harass will occur if lesser long-nosed bats are precluded from using available forage resources due to noise, light, or increased human activities associated with the proposed Rosemont Mine. Such take is difficult to quantify and document at the level of individual bats. 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. Loss or reduced availability of lesser long-nosed bat forage resources can result in energetic impacts to lesser long-nosed bats. These effects can result in lesser long-nosed bats having to travel farther to find available forage resources, thereby using additional energetic reserves. If available forage resources are more

limited than those lost due to the Rosemont Mine project, energetic rewards will be reduced, potentially affecting the wellbeing of affected individuals. Because lesser long-nosed bats are migratory, the inability of individual bats to acquire the needed resources for migration, due to reduce forage availability, affects multiple aspects of this species natural history. Additional intra-specific competition for reduced forage resources may also occur. Lesser long-nosed bats have high roost fidelity and increasing the number of bats using particular foraging areas due to lost forage resources resulting from Rosemont's mining project can lead to increased intra-specific conflicts. Increased travel distance to use available forage also exposes lesser long-nosed bats to increased risk of predation, collision, and other environmental threats. As indicated in the Recovery Plan and the 5-Year Review, adequate forage appropriately distributed across the range of the lesser long-nosed bat is needed to achieve recovery of the population. The widespread failure of agave flowering in 2006 impacted the lesser long-nosed bat population through increase use of hummingbird feeders as a source of food and migration out of the area earlier that would occur under normal agave flowering conditions. If lack of forage on the landscape in southeast Arizona results in changes in lesser long-nosed bat migration patterns as was seen in 2006, this can affect whether forage resources are available to the bats along the migration route due to the need to time forage availability with occupancy of the landscape by lesser long-nosed bats. The ability of this species to migrate, breed, and over-winter is dependent on adequate forage available at the time the bats are present. If this does not happen, population level effects to the species could occur. Given a reduced baseline of available lesser long-nosed bat forage due to recent large, intense wildfires in the Chiricahua, Huachuca, and Atascosa mountains, additional forage losses due to the proposed action could limit available forage in the region and result in more widespread, population level impacts to this species resulting from the potential need to switch roosts, travel longer distances to forage, and possible changes to the timing of migration, which, if the timing of migration changes enough, may affect forage availability as the bats migrate south.

Therefore, we will use the number of acres of forage resources lost as a surrogate for take of individual lesser long-nosed bats. With regard to the amount of incidental take authorized under this BO, using habitat as a surrogate for take of individual lesser long-nosed bats, the FWS authorizes take in the form of harm and harass due to the loss of significant forage resources for up to and including 5,401 acres (USFS 2013d) of lesser long-nosed bat foraging habitat (acres of habitat supporting Palmer's agave). This take is anticipated for the long-term loss of foraging habitat within the footprint of the mine pit and mine facilities, including roadways, utility corridors and relocation of the Arizona National Scenic Trail.

In summary, and stated differently, the maximum allowable incidental take of lesser long-nosed bats is: (1) harassment of 6,000 individuals at three post-maternity roosts; (2) harm of ten individuals at known lesser long-nosed bat roosts subject to the implementation of protective measures; and (3) loss of 5,401 acres of affected habitat containing Palmer's agave, a surrogate measure of take (via harm and harassment) of individuals.

Effect of the Take - Lesser Long-Nosed Bat

In this BO, the FWS determines that this level of anticipated take is not likely to result in jeopardy to the species for the reasons stated in the Conclusions section. No critical habitat has been designated for the lesser long-nosed bat; therefore, no critical habitat will be destroyed or adversely modified.

Reasonable and Prudent Measures - Lesser Long-Nosed Bat

The Rosemont Copper Company has included a number of measures and design elements within their proposed action that should, once completely implemented, reduce the proposed action's adverse effects to lesser long-nosed bats. The following Reasonable and Prudent Measures are necessary and appropriate to minimize take of lesser long-nosed bats:

1. Rosemont shall work with the FS, FWS, and other entities to permanently protect a known lesser long-nosed bat roost site within, or as close to the action area as possible.

2. In the event that either the R-2 and/or Helena lesser long-nosed bat roosts are abandoned or experience a significant reduction in occupancy over time, and these occurrences can be reasonably attributed to the proposed Rosemont Mine, Rosemont shall work with the FS, FWS, and other entities to permanently protect an additional lesser long-nosed bat roost site within the action area.

3. Rosemont shall ensure that the effectiveness of protective measures implemented at the Helena and R-2 roost sites, including effects to bat behavior, and bat mortality or predation, and occupancy of the sites, are monitored. Monitoring shall also occur at any other lesser long-nosed bat roosts where protective measures are implemented as part of the conservation measures outlined in the proposed action.

4. In addition to the agave planting outline in Conservation Measure 11 for lesser long-nosed bats, Rosemont shall implement additional agave planting and monitoring within the action area to help offset losses of lesser long-nosed bat forage resources associated with the proposed action.

5. Rosemont shall implement conservation measures and Reasonable and Prudent Measures, except for survey and monitoring activities, during the times of year when lesser long-nosed bats are not present.

6. Rosemont shall annually report to the FWS the results of the implementation and results of the Terms and Conditions outlined below.

Terms and Conditions - Lesser Long-Nosed Bat

In order to be exempt from the prohibitions of section 9 of the Act, Rosemont shall comply with the following terms and conditions, which implement the reasonable and prudent measures described above and outline required reporting/monitoring requirements. These terms and conditions are non-discretionary.

1. The following terms and conditions implement Reasonable and Prudent Measures 1 and 2 for the lesser long-nosed bat:

    a. Rosemont shall implement protective measures at a known lesser long-nosed bat roost site within, or as close to the action area as possible. The known roost where this term and condition will be applied, as well as the appropriate associated protective measures, will be evaluated and selected through coordination with FWS, other entities, and the USFS (for biological and technical input as well as to incorporate concerns with the agency's existing Abandoned Mine Lands program).
    b. Based on information gathered as outlined in the Conservation Measures for lesser long-nosed bats earlier in this document, if Rosemont or their agents observe during monitoring at either the R-2 or Helena lesser long-nosed bat roosts: (1) an up to 25 percent decline in the numbers of lesser long-nosed bats for 3 consecutive years; or (2) a greater than 25 percent decline in each of 2 years; or (3) a complete abandonment of the roost in 1 year, the adaptive management as described in Conservation Measure 9 will include selection of protective measures to be applied to another known lesser long-nosed bat roost within or as close to the action area as possible. Known roosts and associate protective measures will be evaluated and selected through coordination with FWS and other entities.
    c. Protective measures agreed upon by the Coronado National Forest, the FWS, and other entities at the selected roost sites shall include completion of any environmental compliance requirements and initiation of project elements within one year of roost site selection.
    d. Pre- and post-implementation monitoring will occur at these roost sites, with an annual report to the FWS for a period of four years (1 season of pre-implementation monitoring and 3 seasons of post-implementation monitoring).

2. The following term and condition implements reasonable and prudent measure #3 for the lesser long-nosed bat:

    With input from the FWS and other entities, Rosemont shall implement a monitoring program to evaluate the effectiveness of protective measures implemented at known lesser long-nosed bat roosts as part of the conservation measures included in the proposed action. Monitoring shall include a minimum of three visits per season and include methods to evaluate:

    - as appropriate, any collisions, increased predation over existing levels, or other sources of lesser long-nosed bat mortality associated with the protective measures.
    - the long-term integrity of structures installed as part of the protective measures.
    - any impacts to exit and return behavior of lesser long-nosed bats that may be caused by the protective measures. Note that pre-installation monitoring must be conducted so that changes can be detected.

- the effectiveness of the protective measures in reducing disturbance and other impacts to lesser long-nosed bat roosts. Pre-installation assessment of the disturbance and other impacts must be conducted so that changes can be detected

Results of this monitoring program shall be reported in the annual report to FWS as outlined in the Conservation Measures section of this BO.

3. The following terms and conditions implement reasonable and prudent measure #4 for the lesser long-nosed bat. The objective of these terms and conditions is to seek to restore an equivalent acreage of agave habitat affected by the proposed action:

   a. Rosemont shall reclaim the short road segment leading to the R-2 Adit roost site, including the use of agave planting (if the FS, RCC, FWS, and other entities determine site conditions would support the species) to reduce the likelihood of human intrusion at this roost site.

   b. Rosemont shall investigate the feasibility of agave plantings at ecologically appropriate sites on proposed conservation lands, including Sonoita Creek Ranch, Davidson Canyon Watershed parcels, and Helvetia Ranch North parcels. Plant agaves at ecologically appropriate densities (as determined by RCC, FWS, and other entities) and conduct follow-up monitoring at sites where such plantings are feasible and have a high likelihood of success. The status and success of these efforts should be included in the annual report to FWS as outlined in the Conservation Measures section of this BO.

4. The following term and condition implements reasonable and prudent measure #5 for the lesser long-nosed bat:

   a. Rosemont shall implement conservation measures related to known lesser long-nosed bat roost protection measures to rerouting of the Arizona Trail, reclamation and revegetation, and any other project activities that will occur in proximity to known lesser long-nosed bat roosts during the time of year when lesser long-nosed bats are not present in the project action area. Such activities could typically be carried out from November 1 to July 1 of each year.

5. The following term and condition implements reasonable and prudent measure #6 for the lesser long-nosed bat:

   a. In addition to the reporting requirements already specified as part of the proposed action, Rosemont, or their agents shall report to FWS:

      The monitoring and adaptive management process outlined in the BA and this BO is key to reducing take of lesser long-nosed bats resulting from the implementation of this project. Therefore, Rosemont shall report to the FWS the results of all monitoring and adaptive management actions undertaken as a result of this project. Annually, and in compliance with the reporting deadlines outlined above in this BO, Rosemont shall provide a report to FWS that includes: (a) any new lesser long-nosed bat roosts documented as a result of monitoring; (b) monitoring data for all roost sites occupied by lesser long-nosed bats including dates and numbers of lesser long-nosed bats counted; (c) classification of each lesser long-nosed bat roost monitored with regard to season of use; (d) any documented negative effects of the protective measures as discussed in Term and Condition #2 above, e) any recommendations to remove or alter the roost protective measures or change the monitoring protocol; (f) results of monitoring to document the effectiveness of the roost protection measures implemented at the Helena and R-2 roost sites, as well as any additional lesser long-nosed bat roost protected as a result of the implementation of the conservation measures outlined in the proposed action; (g) any other pertinent information related to monitoring and adaptive management under this project.

a. The Biological Monitor shall report to the FWS all data received from Rosemont related to the monitoring of known lesser long-nosed bat roosts and reconnaissance level surveys within 10 working days of each monitoring or survey effort. The Biological Monitor shall report the intent to close any feature that supports 30 or more lesser long-nosed bats to FWS at least 30 days prior to initiating exclusion and closure of the feature. Note that since the Biological Monitor will be employed by the Coronado National Forest, this portion of the Term and Condition applies to the Forest Service.

Review requirement: 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. The Coronado National Forest must immediately provide an explanation of the causes of the taking and review with the FWS the need for possible modification of the reasonable and prudent measures.

Conservation Recommendations-Lesser Long-Nosed Bat

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.

1. We recommend that the Coronado National Forest participate in the development of a revised long-term monitoring protocol for the lesser long-nosed bat as outlined in the most recent Lesser Long-Nosed Bat 5-year review and the recently completed evaluation by the University of Arizona (Cerro 2012).
2. We recommend that the Coronado National Forest participate in the development of a range-wide agave monitoring program with a standardized monitoring protocol.

3. We encourage the Coronado National Forest to initiate or participate in additional lesser long-nosed bat research related to the foraging patterns, roost occupancy patterns, and seasonal behavior of lesser long-nosed bats in southern Arizona.
4. We encourage the Coronado National Forest to work with Border Patrol and the Department of Homeland Security to assess and minimize the impacts of border fences and other facilities on the lesser long-nosed bat.

In order for the FWS to be kept informed of actions minimizing or avoiding adverse effects or benefiting listed species or their habitats, the FWS requests notification of the implementation of any conservation recommendations.

STATUS OF THE SPECIES- JAGUAR

Legal Status

In 1972, the jaguar (*Panthera onca*) was listed as endangered (37 FR 6476; March 30, 1972) in accordance with 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 FWS maintained separate listings for foreign species and species native to the United States. At that time, the jaguar was believed to be extinct in the United States; thus, the jaguar was included only on the foreign species list. On July 25, 1979, the FWS 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 FWS 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 FWS 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 FWS published a proposed rule (45 FR 49844) to list the jaguar and four of the other species referred to above in the United States. The proposal for listing the jaguar and three other species 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 2 years of the proposal. On July 22, 1997, the FWS published a final rule clarifying that endangered status for the jaguar extended into the United States (62 FR 39147).

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, entire) and Brown and López González (2001, entire), among others. Jaguars breed year-round rangewide, but at the southern and northern ends of their 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 2 years. Females begin sexual activity at 3 years of age, males at 4. 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, p. 12), and in Jalisco, Mexico, two wild females were documented to be at least 12 and 13 (Núñez 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, p. 4). 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, p. 4; Núñez *et al.* 2000, pp. iii–iv; Rosas-Rosas 2006, p. 17; Rosas-Rosas *et al.* 2008, pp. 557–558). 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, p. 4). 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, p. 218). 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, p. 51).

Home Range and Movement

Like most large carnivores, jaguars have relatively 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 to vary from 12.8 to 140 square kilometers (km^2)[5 to 52 square miles (mi^2)] during the wet season and 28 to 165.8 km^2 (11 to 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 2011, pers. comm.). Additionally, camera trap data indicated that the average male home range in the municipality of Sahuaripa, Sonora, was 84 km^2 (32 mi^2) (López-González 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, p. 60), 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, p. 6). Therefore, jaguars require more space in arid areas to obtain essential resources such as food, water, and cover.

In coastal Jalisco, jaguars moved up to 20 km (12.4 mi) in one night and one juvenile male dispersed about 70 km (43.5 mi) to the north (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 (1.0 +/- 1.3 mi)] (Crawshaw and Quigley 1991). In Brazil, male jaguars have been documented to disperse up to 64 km (Rabinowitz and Zeller 2010).

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, desertscrub, lowland desert, mesquite grassland, Madrean oak woodland, and pine-oak woodland communities of northwestern Mexico and southwestern U.S. (Boydston and López-González 2005, McCain and Childs 2008, López-González and Brown 2002). 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).

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 prefer tall forest, short forest was used by females but avoided by males. 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 more frequently than expected by chance 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, August 2, 2011, email to FWS.). 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, August 2, 2011, email to FWS). Jaguar presence is affected in different ways by various human activities; however, direct persecution likely has the most significant impact.

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, August 6, 2011, email to FWS) 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 ft and 9,186 ft) in elevation (Núñez-Pérez, August 2, 2011, email to FWS). 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, August 2, 2011, email 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 and 2005), Menke and Hayes (2003), Boydston and López-González (2005), Robinson *et al.* (2006), McCain and Childs (2008), Grigione *et al.* (2009), Sanderson and Fisher (2013a, 2013b). 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 historic 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. One hundred percent of 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, 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, 100 percent 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 and 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 and 8,999 ft). With respect to topography, 92 percent of jaguar sightings occurred in intermediately rugged to extremely rugged terrain, with the remainder (8 percent) in nearly level terrain.

More recently, Sanderson and Fisher (2013a, 2013b) 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. 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: approximately 1,318 jaguars in the Jalisco Core Area, approximately 929 jaguars in the Sinaloa Secondary Area, approximately 1,124 jaguars in the Sonora Core Area, and approximately 42 jaguars in the Borderlands Secondary Area (which include 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 2013a, 2013b).

Distribution, Abundance, Population Trends

The only neotropical large carnivore with a distribution extending north into the Madrean Archipelago is the jaguar. 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 decreasing (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 (Caso *et al.* 2008, Wildlife Conservation Society 2007, Chávez *et al.* 2007, Panthera 2011). During a symposium in November 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 km2 (3.4 million mi2), 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 km2 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% 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 km2 (0.7 million mi2) (Zeller 2007). JCUs were defined either as: (1) areas with a stable prey community, currently known or believed to contain a population of resident jaguars large enough (at least 50 breeding individuals) to be potentially self-sustaining over the next 100 years; or (2) 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 (Valdez *et al.* 2002, Brown and López-González 2001). 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 50-100 and >500, respectively (Zeller 2007). Results of the Mexican National Jaguar Census (Manriquez, July 15, 2011, email to FWS) 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 2000, 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 in the U.S. (i.e., 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. Male jaguars have been documented in southern Arizona, within and near the proposed action area, as recently as August 2013 (see Environmental Baseline section below). The rugged and arid conditions at the northern limit of this distribution contrast sharply to lush tropical forests to the south (Boydston and López González 2005).

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.* 2009:83).

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 the production of fewer offspring, which often 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 (FWS 2012b).

Illegal killing of jaguars is one of the two most significant threats to the jaguar (Medellin 2009, Chávez and Ceballos 2006, Medellín *et al.* 2002, Núñez *et al.* 2002, Nowell and Jackson 1996) and, to recover jaguars, likely requires the most immediate response (FWS 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 (Medellin 2009, Chávez and Ceballos 2006, Medellín *et al.* 2002, Núñez *et al.* 2002, Nowell and Jackson 1996). 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, the 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). These threats are relevant to jaguars throughout most of their range; however, no jaguars have been documented in collisions with vehicles in the U.S. despite the fact that they have documented to cross roads, including two lane highways in Arizona. For example, the same male jaguar has been photo-documented in both the Whetstone and Santa Rita mountains. This jaguar would have had to cross over or through a passage bneath State Route 82 or 83 to move between the mountain ranges.

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 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 extinction 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–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 extinction 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 Red List of the IUCN 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 Ocelot)* (U.S. Fish and Wildlife Service 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 FWS made a 4(f)(1) determination that development of a formal recovery plan at that time would not promote the 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 FWS was subsequently litigated on this determination and the presiding judge remanded the decision regarding recovery planning back to the FWS. Subsequently, in 2010, the FWS made a new determination that development of a recovery plan would contribute to jaguar conservation and that, therefore, the FWS should prepare a recovery plan.

In 2012, a Recovery Outline for the jaguar (FWS 2012b) was finalized by the FWS. 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 FWS, serves as interim guidance for the FWS 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 FWS in coordination with the Jaguar Recovery Team as new information becomes available.
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 J-1 below) and the Pan American Recovery Unit (PARU; 14.9 million km^2; 5.75 million mi^2) (FWS 2012a, p. 58). The analyses in this BO laregely focus on the NRU. Please note that the boundaries and areal extent of the NRU were revised by sanderson and Fisher (2013b); 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 (FWS 2012a, p. 20). Recovery units for the jaguar are further divided into core, secondary, and peripheral areas (FWS 2012a, pp. 20–23). 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 (NRU) and Northwestern Management Unit (NMU)

The NRU is approximately 192,339 km^2 (74,262 mi^2); with [7,663 km^2 (2,959 mi^2)] in the U.S. and 184,676 km^2 [71,304 mi^2] in Mexico) (sanderson and Fisher 2013b). Table J-1, below, describes the subdivisions within the NRU. The Northern Management Unit (NMU), which contains the U.S and Mexico portions of the Borderlands Secondary Area, lies within the NRU and is approximately 32,057 km^2 (12,337 mi^2); with 7,663 km^2 (2,959 mi^2) in the U.S. and 24,394 km^2 (9,419 mi^2) in Mexico (see Figure J-1 and Table J-1).

Table J-1: Modeled habitat and potential jaguar numbers of jaguars in the Northwestern Management Unit (NMU) and Northwestern Recovery Unit (NRU)
(Sanderson and Fisher 2013b)

Population Subunit	**Former Subunit Name (Sanderson and Fisher 2013a)**	**Estimate of Habitat Area**		**Estimated number of potential jaguars**
		km^2	**mi^2**	
Jalisco Core Area	MX Sinaloa Sub-Population	44,510	17,185	1,410
Sinaloa Secondary Area	MX North Sinaloa Connector Area	39,501	15,251	1,198
Sonora Core Area	MX Sonora Sub-Population	76,271	29,448	1,670
Borderlands Secondary Area/NMU – Mexico	MX Northern Sonora Connector Area	24,394	9,419	135
Borderlands Secondary Area/NMU – United States	US South of I-10 Highway[1]	7,663	2,959	27
NMU– Mexico		24,394	9,419	135
NMU – United States		7,663	2,959	27
NMU - Total		32,057	12,337	162

NRU – Mexico	184,676	71,304	4,413
NRU – United States	7,663	2,959	27
NRU – Total	192,339	74,262	4,440
[1] US North of I-10 Highway subunit (Sanderson and Fisher 2013a) has been removed from consideration.			

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, FWS, and Arizona State Land Department. The remaining non-state and non-federal lands within 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 (FWS 2012b).

As mentioned above, the U.S. lands within the Borderlands Secondary area of the Northwestern Recovery Unit are also located within the Northwestern Management Unit. Management units, as described in the Recovery Outline, are areas within a recovery unit that might require different management, be managed by different entities, or encompass different populations (Jaguar Recovery Team 2012:40). The U.S. lands located within the NMU simply acknowledge the existence of different species management on either side of the International Border with Mexico. This differening title for the the U.S. lands as part of the NMU does not mean that the habitat in United States has any less significance within the secondary area of the recovery unit.

Also, and important to note, is that populations at the edge of a species' range play a role in maintaining the total genetic diversity of a species (Jaguar Recovery Team 2012a, pp. 19–20); in some cases, these peripheral populations persist the longest as fragmentation and habitat loss impact the total range (Channell and Lomolino 2000, pp. 84–85). The United States 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, entire). 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, entire). 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. The ability for jaguars in the NRU to utilize physical and biological habitat features in the Northern Management Unit (NMU; a sub-area of the NRU, as described below) is ecologically important to the recovery of the species; therefore, maintaining connectivity to Mexico is essential to the conservation of the jaguar (FWS 2012b).

Proposed Critical Habitat

We are proposing six units as critical habitat for the jaguar. The critical habitat areas we describe below constitute our current best assessment of areas that meet the definition of critical habitat for the jaguar. The six units we have proposed as critical habitat are: (1) Baboquivari Unit divided into subunits (1a) Baboquivari-Coyote Subunit, including the Northern Baboquivari, Saucito, Quinlan, and Coyote Mountains, and (1b) the Southern Baboquivari Subunit; (2) Atascosa Unit, including the Pajarito, Atascosa, and Tumacacori Mountains; (3) Patagonia Unit, including the Patagonia, Santa Rita, Empire, and Huachuca Mountains, and the Canelo and Grosvenor Hills; (4) Whetstone Unit, divided into subunits (4a) Whetstone Subunit, (4b) Whetstone-Santa Rita Subunit, and (4c) Whetstone-Huachuca Subunit; (5) Peloncillo Unit, including the Peloncillo Mountains both in Arizona and New Mexico; and (6) San Luis Unit, including the northern extent of the San Luis Mountains at the New Mexico-Mexico border. The units affected by the proposed action, Units 3 and 4, are described below.

Unit 3: Patagonia Unit

Unit 3 consists of 148,364 ha (366,615 ac) in the Patagonia, Santa Rita, and Huachuca Mountains, as well as the Canelo Hills, in Pima, Santa Cruz, and Cochise counties, Arizona. Unit 3 is generally bounded by Interstate 19 to the west; Interstate 10 to the north; Cienega Creek and Highways 83, 90, and 92 to the east, including the eastern slopes of the Empire Mountains; and the U.S.-Mexico border to the south. Land ownership within the unit includes approximately 107,471 ha (265,566 ac) of Federal lands; 11,847 ha (29,274 ac) of Arizona State lands; and 29,046 ha (71,775 ac) of private lands. The Federal land is administered by the Coronado National Forest, Bureau of Land Management, and Fort Huachuca. We consider the Patagonia Unit occupied at the time of listing (37 FR 6476; March 30, 1972) based on the 1965 record from the Patagonia Mountains, and it is currently occupied based on a series of confirmed sightings from 2011 through August 2013. The mountain ranges within this unit contain all primary constituent elements of the physical or biological feature essential to the conservation of the jaguar.

The primary land uses within Unit 3 include military activities associated with Fort Huachuca, as well as Federal forest management activities, border-related activities, grazing, and recreational activities throughout the year, including, but not limited to, hiking, camping, birding, horseback riding, picnicking, sightseeing, and hunting. Special management considerations or protections needed within the unit address human disturbances through such activities as military ground maneuvers and increased human presence in remote locations through mining and development activities, construction of impermeable fences, and widening or construction of roadways, power lines, or pipelines to ensure all PCEs remain compatible with jaguar use.

Subunit 4a: Whetstone Subunit

Subunit 4a consists of 25,284 ha (62,478 ac) in the Whetstone Mountains in Pima, Santa Cruz, and Cochise Counties, Arizona. Subunit 4a is generally bounded by Cienega Creek to the west, Interstate 10 to the north, Highway 90 to the east, and Highway 82 to the south. Land ownership within the subunit includes approximately 16,066 ha (39,699 ac) of Federal lands; 5,445 ha (13,455 ac) of Arizona State lands; and 3,774 ha (9,325 ac) of private lands. The Federal land is administered primarily by the Coronado National Forest. We consider the Whetstone Subunit occupied at the time of listing (37 FR 6476; March 30, 1972) based on photographs taken in 2011, and it may be currently occupied although the animal recently photographed in the Santa Ritas is the same male photographed in the Whetstones in 2011. The mountain range within this subunit contains all primary constituent elementsessential to the conservation of the jaguar, except for connectivity to Mexico.

The primary land uses within Subunit 4a include Federal forest management activities, grazing, and recreational activities throughout the year, including, but not limited to, hiking, camping, birding, horseback riding, picnicking, sightseeing, and hunting. Special management considerations or protections needed within the subunit addresshuman disturbances through development activities, and widening or construction of roadways, power lines, or pipelines to ensure all PCEs remain compatiblecompatible with jaguar use.

Subunit 4b: Whetstone-Santa Rita Subunit

Subunit 4b consists of 5,143 ha (12,710 ac), including the Empire Mountains, between the Santa Rita Mountains and northern extent of the Whetstone Mountains in Pima County, Arizona. Subunit 4b is generally bounded by (but does not include) the eastern slopes of the Empire Mountains to the west, a line running roughly 6 km (3.7 mi) south of Interstate 10 to the north, the western slopes of the Whetstone Mountains to the east, and Stevenson Canyon to the south. Land ownership within the subunit includes approximately 532 ha (1,313 ac) of Federal lands and 4,612 ha (11,396 ac) of Arizona State lands. According to the proposed rule, the Whetstone-Santa Rita Subunit provides connectivity from the Whetstone Mountains to Mexico and was not known to be occupied at the time of listing, but is essential to the conservation of the jaguar because it contributes to the species' persistence by providing connectivity to occupied areas that support individuals during dispersal movements during cyclical expansion and contraction from the nearest core area and breeding population in the NRU (FWS 2012b).

The primary land uses within Subunit 4b include grazing and recreational activities throughout the year, including, but not limited to, hiking, camping, birding, horseback riding, picnicking, sightseeing, and hunting.

Subunit 4c: Whetstone-Huachuca Subunit

Subunit 4c consists of 8,026 ha (19,832 ac) between the Huachuca Mountains and southern extent of the Whetstone Mountains in Santa Cruz and Cochise Counties, Arizona. Subunit 4c is generally bounded by Highway 83 to the west; Highway 82 to the north; Highway 90 to the east; and up to but not including the Huachuca Mountains to the south. Land ownership within the subunit includes approximately 1,654 ha (4,088 ac) of Federal lands; 2,981 ha (7,366 ac) of Arizona State lands; and 3,391 ha (8,379 ac) of private lands. The Federal land is administered by the Coronado National Forest, Bureau of Land Management, and Fort Huachuca. According to the proposed rule, the Whetstone-Huachuca Subunit provides connectivity from the Whetstone Mountains to Mexico and was not occupied at the time of listing, but is essential to the conservation of the jaguar because it contributes to the species' persistence by providing connectivity to occupied areas that support individuals during dispersal movements during cyclical expansion and contraction of the nearest core area and breeding population in the NRU (FWS 2012b).

The primary land uses within Subunit 4c include military activities associated with Fort Huachuca, as well as Federal forest management activities, grazing, and recreational activities throughout the year, including, but not limited to, hiking, camping, birding, horseback riding, picnicking, sightseeing, and hunting.

Models Used for Proposing Critical Habitat

When we are determining which areas should be designated as critical habitat, the FWS's primary source of information is generally the information developed during the listing process for the species. Additional information sources may include the recovery plan for the species, articles in peer-reviewed journals, conservation plans developed by States and counties, scientific status surveys and studies, biological assessments, other unpublished materials, or experts' opinions or personal knowledge.

The criteria used by the FWS to identify critical habitat included reviewing available information and supporting data that pertained to the habitat requirements of the jaguar. Much of this information was compiled in the Recovery Outline for the Jaguar (Jaguar Recovery Team 2012, entire) and Digital Mapping in Support of Recovery Planning for the Northern Jaguar report (Sanderson and Fisher 2011:1–11), which the FWS regarded as the best available information for the jaguar and its habitat needs in the northern portion of its range. Additionally, the FWS relied on information provided through modeling exercises for Arizona (Hatten *et al.* 2005) and New Mexico (Menke and Hayes 2003; Robinson *et al.* 2006) to further refine the habitat features available in the United States. Because jaguars are secretive animals and generally tend to avoid highly disturbed areas (Quigley and Crawshaw 1992; Hatten *et al.* 2005:1025), human density was afactor considered in jaguar habitat modeling exercises for Arizona (Hatten *et al.* 2005, p. 1025), New Mexico (Menke and Hayes 2003:9–13; Robinson *et al.* 2006, pp. 10, 15, 18–20), and the habitat model developed by Sanderson and Fisher (2011:5–11) for the northwestern Mexico and the U.S.-Mexico borderlands area.

The habitat model developed by Sanderson and Fisher (2011:5–11) included a human influence index (HII) criterion. HII values, calculated worldwide by combining eight input layers (human population density per square km, railroads, major roads, navigable rivers, coastlines, stable nighttime lighting, urban polygons, and land cover) can range from 0 to 64, with 0 representing no human influence and 64 representing the maximum human influence possible (see SEDAC 2012 for more information on how HII was calculated worldwide). Within the northwestern Mexico and the U.S.-Mexico borderlands region considered for their habitat model, Sanderson and Fisher (2011, pp. 5–11) found that roughly 90 percent of the 333 jaguar records used in their model were located in areas where the HII was less than 30 out of 64. They therefore considered lands with an HII of less than 30 as potential jaguar habitat within their modeling exercise, while lands with an HII equal to or greater than 30 were excluded. Similarly, in our analysis of 130 reports of jaguar locations in the United States, we found that approximately 99 percent occurred in areas where the HII was less than 20 (<20). Please note that this was stated as 20 or less (≤20) in the proposed rule (FWS2012b); the correct analysis was employed during preparation of the revised proposed rule (FWS 2013) Therefore, based on this information, the FWS identified areas in which the HII calculated over 1-square km (0.4-square mi) is less than 20 as an essential component of the physical or biological feature essential for the conservation of the jaguar in the United States. These areas 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.

Primary Constituent Elements for Jaguar Critical Habitat

The primary constituent elements of critical habitat essential to the conservation of jaguar within areas of expansive open spaces in the southwestern United States at least 84 to 100 km^2 (32 to 37 mi^2) in size. The primary constituent elements are those which:

1. Provide connectivity to Mexico;

2. Contain adequate levels of native prey species, including deer and collard peccary (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 1 to 50 percent woody species canopy cover within Madrean evergreen woodland, generally recognized by a mixture of oak, juniper, and pine trees on the landscape, or semidesert grassland vegetation communities, with a woody species overstory and an understory 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; and

6. 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 (expressed as an HII of less than 20).

Jaguar Recovery Planning in Relation to Critical Habitat

Jaguar habitat in the U.S. – Mexico borderlands area is part of the secondary area of the NMU within the NRU for the jaguar (see Figure J-1 and Table J-1) (FWS 2012a:58). The United States portion of the NRU is considered a secondary area that provides a recovery function benefitting the overall recovery unit (FWS 2012a:40, 42). By Jaguar Recovery Team guidelines (FWS 2012a), a secondary area for jaguars is an area meeting the following conditions: (1) compared to core areas, secondary areas are generally smaller, likely contain fewer jaguars, maintain jaguars at lower densities, and exhibit more sporadic current and historical records of jaguars; some of the secondary areas may not have not been surveyed through the use of defined survey protocols, thus resulting in the unknown current status of jaguars in some secondary areas; (2) there is no or little evidence of recent reproduction (within 10 years); and (3) quality and quantity of jaguar habitat is lower compared to core areas. Jaguar habitat is likely less optimal due to one or more or a combination of these variables important for jaguar presence, including increased human impact, smaller amount of contiguous habitat, different vegetation types, and lower prey populations. The Jaguar Recovery Team hypothesized that secondary areas may contribute to jaguar persistence by providing habitat to support jaguars during dispersal movements, by providing small patches of habitat (perhaps in some cases with a few resident jaguars), and as areas for cyclic expansion and contraction of the core areas (FWS 2012a).

Because such a small portion of the jaguar's range occurs in the United States, it is anticipated that recovery of the entire species will rely primarily on actions that occur outside of the United States; activities that may adversely or beneficially affect jaguars in the United States are less likely to affect recovery than activities in core areas of their range (FWS 2012a:38).

However, according to the proposed rule, specific areas within this secondary area that provide the physical and biological features essential to jaguar habitat can contribute to the species' persistence and, therefore, overall conservation. As described in the Recovery Outline for the Jaguar, the Northwestern Recovery Unit is essential for the conservation of the species; therefore, consideration of the spatial and biological dynamics that allow this unit to function and that benefit the overall unit is prudent. Providing connectivity between the United States and Mexico is a key element to maintaining those processes.

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.

In the environmental baseline analysis, we discuss the current condition of the critical habitat units in the action area, the factors responsible for that condition, and the conservation roles of the units. In particular, we discuss the relationship of the affected units in the action area to the entire proposed critical habitat with respect to the conservation of the jaguar.

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 NMU, as defined in the Jaguar Recovery Outline (FWS 2012) and at least one jaguar has recently occurred near the project area. For the purposes of the jaguar analysis, we use the Forest Service Action Area definition (i.e., defined by hydrology).

Terrain, Vegetation Communities, and Climate in the Action Area

The Action Area subsection of the Description of the Proposed Conservation Measures 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 (see Status of the Species).

Distribution and Abundance

Confirmed jaguar detections have recently occurred within and near the proposed project and action area. The detections were from trail cameras placed by resident hunters, the Arizona Game and Fish Department, and researchers from the University of Arizona – jaguar survey and monitoring project funded by the Department of Homeland Security via the U.S. Fish and Wildlife Service. All detections, captured by photographs at night, were located on lands administered by the Coronado National Forest within proposed critical habitat (Units 3 and 4). Analysis by jaguar experts of the comparison of rosette patterns concluded that the photographs are of the same male jaguar. The male jaguar photographed by a mountain lion hunter in the Whetstone Mountains (within proposed critical habitat Subunit 4 – Whetstone Unit) in November 2011 was later detected in the Santa Rita Mountains (within proposed critical habitat Unit 3 – Patagonia Unit) by the trail cameras. Detections of this male jaguar have occurred in the Santa Rita Mountains from September 2012 to October 2013.

The Forest Service hypothesizes that this single resident male jaguar has established a territory that includes most of the Santa Rita Mountains (which includes the proposed action area) and possibly the Whetstone Mountains as well (from the June 2012 BA and February 2013 Supplemental BA). To move between the Whetstone and Santa Rita mountains, the male jaguar would have had to cross a two-lane highway, possibly State Route 83, although its exact movement pattern is unknown.

Threats

Threats to the jaguar in the action area are generally 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 thought to be a problem (FWS 2012a). Other threats to jaguars in this region are international border issues such as: (1) infrastructure along and near the U.S. -

Mexico border, including pedestrian and vehicle barriers and towers and their associated roads and lighting; and (2) 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 jaguars. Other infrastructure (e.g., vehicle barriers, towers, roads, 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; this threat was reiterated in the BA. Connectivity to Mexico is essential for maintaining jaguars in the NMU in Arizona and New Mexico.

Proposed Critical Habitat within the Action Area as Defined by the Forest Service

Current Condition of Proposed Critical Habitat - The action area as defined by the Forest Service occurs within the Patagonia Unit (Unit 3) (Figure J-2) which consists of 148,364 ha (366,615 ac) in the Patagonia, Santa Rita, Empire, and Huachuca Mountains, as well as the Canelo Hills, in Pima, Santa Cruz, and Cochise Counties, Arizona. The mountain ranges within this unit contain all primary constituent elements essential to the conservation of the jaguar.

The action area is situated west of the Whetstone-Santa Rita Unit (Subunit 4b) (Figure 2) which consists of 5,143 ha (12,710 ac) between the Santa Rita Mountains and northern extent of the Whetstone Mountains in Pima County, Arizona. The Whetstone-Santa Rita Subunit may provide connectivity from the Whetstone Mountains to Mexico through Unit 3, was not known to be occupied at the time of listing (FWS 2012b, FWS 2013),and is not known to have ever been used by jaguars.

***Factors Responsible for the Current Condition of Proposed Critical Habitat* -** The Patagonia Unit was proposed as critical habitat because areas such as the Santa Rita Mountains contain the primary constituent elements essential to the conservation of the jaguar. In the jaguar habitat model developed for northwestern Mexico and the U.S.-Mexico borderlands area, Sanderson and Fisher (2011:11) described how low human influence is perhaps the most important feature defining jaguar habitat, as jaguars most often avoid areas with too much human pressure. The Santa Rita Mountains, where the proposed project is located, was identified by the model as having HII values between 14 and 18. As stated above, an HII value of less than 20 was the parameter identified as an essential component for the conservation of the jaguar in the United States (FWS 2013).

According to the proposed rule, connectivity between the United States and Mexico is necessary if viable habitat for the jaguar is to be maintained (FWS 2012b, FWS 2013). The intent of Subunit 4b is to connect Subunit 4a to Mexico via Unit 3, although connectivity is also provided through Subunit 4c, which is not affected by the proposed action. Jaguar habitat and the features essential to their conservation are threatened by the direct and indirect effects of increasing human influence into remote, rugged areas, as well as projects and activities that sever connectivity to Mexico. These may include, but are not limited to: significant increases in border-related activities, both legal and illegal; widening or construction of roadways, power lines, or pipelines; construction or expansion of human developments; mineral extraction and mining operations; military activities in remote locations; and human disturbance related to increased activities in or access to remote areas (FWS 2012b, FWS 2013).

***Conservation Role of the Proposed Critical Habitat Units* –** The FWS considers the Patagonia Unit 3 to have been occupied at the time of listing based on the 1965 record from the Patagonia Mountains. The Patagonia Unit is currently occupied based on the series of recent jaguar sightings in the Whetstone and Santa Rita Mountains (see above). The mountain ranges within this unit contain all primary constituent elements essential to the conservation of the jaguar. Connectivity between the United States and Mexico was referenced throughout the proposed critical habitat rule as essential for the conservation of jaguars. Therefore, the intent of the proposed rule was to provide connectivity of Subunit 4a to Mexico through Unit 3 via Subunits 4b and 4c, although there are no records indicating that either of these subunits have been used by jaguars.

Past and Ongoing Federal Actions in the Action Area

The respective Environmental Baseline sections for affected species describe completed consultations for past and ongoing Federal actions in the action area. Three projects have undergone formal section 7 consultation for effects to jaguar in southern Arizona,, but there have been no previous consultations on proposed critical habitat. Incidental take of one jaguar has been authorized and no jeopardy opinions have been issued. A summary of these consultations is below:

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, M-44s, etc. 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 associated 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. Specifically, pedestrian fence segments were constructed in Sasabe (7 mi, all of which were included in this consultation), Nogales (about 6 mi, roughly 2 of which were included in this consultation), Naco (about 25 mi, 15 of which were in this consultation), and Douglas (about 17 mi, 7 of which were included in this consultation). 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. 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.

Under section 10 of the Act, which prescribes permits for scientific purposes or incidental take while carrying out lawful activities, the following has been authorized for specific approved activities of the Arizona Game and Fish Department: 1) incidental take of one jaguar in the form of mortality or harm, and 2) unlimited take in the form of harass.

EFFECTS OF THE ACTION - JAGUAR

The 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 or interdependent with that action (50 CFR §402.02). Indirect effects occur later in time but are reasonably certain to occur. 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 (50 CFR §402.02). In the effects of the action analysis, we also characterize the direct and indirect effects of the action and those of interrelated and interdependent actions on the proposed critical habitat. We describe how the primary constituent elements or habitat qualities essential to the conservation of the species are likely to be affected and, in turn, how that will influence the function and conservation role of the affected critical habitat unit(s).

Effects of the Action on the Jaguar

As analyzed at length in the BA, Supplemental BA, and Second Supplemental BA, and supported by additional analyses below, the proposed project will result in degradation of jaguar habitat and disturbance to jaguars. Construction and operations of the mine, including the associated roads, will result in removal, destruction, and degradation of jaguar habitat and jaguar prey habitat and is likely to disturb jaguars, causing changes in, among other things, their habitat use and movement patterns. Conservation measures included in the project description may help offset adverse effects to jaguars to some extent.

1. Project Construction

The June 2012 BA defined the project area (BA Figure 3) as all areas in which any ground disturbance would take place as a result of the proposed project, including the mine pit, waste rock piles, tailings, access roads, utility corridors, and on-site facilities (i.e., the mine "footprint" or area within the security fence plus roads, corridors, and trails). The BA indicated that 7,016 acres of land would be directly disturbed. The acreage of direct disturbance was later refined to 5,421 acres, which includes areas within the security fence (4,228 acres), the primary access road (226 acres), the utility line corridor (889 acres), decommissioned or new forest roads (59 acres), and the rerouted Arizona National Scenic Trail and trailheads (19 acres). The affected area appears in Figure J-2.

Vegetation types within this area are Madrean evergreen woodland and semidesert grassland, both important vegetation types for jaguars in the NMU; and both xero- and hydroriparian. Therefore, the project will result in long term (30 years, after which the perimeter fence will be removed), direct effects to 7,016 acres (perimeter fence, roads, trails, and ROW) and the permanent removal of about 5,401 acres of jaguar habitat (security fence, new roads, and ROW; 20 acres of decommissioned roads are omitted from the calculation permanent effects).

Although we do not know the home range size of jaguars in Arizona, home ranges in Sonora range from 84 to 200 km^2 (20,757 to 49,421 acres). There will be a 7,016-acre temporal loss of up to approximately 14.2 to 33.8 percent of a jaguar home range. In the future, once the perimeter fence has been removed, the 5,401-acre will be approximately 10.9 percent to 26.0 percent of a jaguar home range, with slightly lesser percentages of affected acreage if reclamation succeeds in reestablishing sufficient permanent canopy cover. It is also likely that the effects are slightly overestimated due to the fact that not all of the 889 acres of utility ROW are within the Madrean evergreen woodland or semidesert grassland vegetation types; the far westernmost portion is within the Arizona upland subdivision vegetation type, if not within human-disturbed habitats such as other, existing ROWs and similar features. Again, these are direct effects associated with the footprint of various mine features; indirect effects (light, noise, traffic, etc.) are discussed in subsequent sections. Regardless of the exact, directly-affected acreage, the jaguar known to be in the northern Santa Rita Mountains recently will most likely lose some portion of its home range. The extent of that loss is unknown since the animal's home range has not been determined.

Throughout most of the jaguar distribution, we know that home ranges most often overlap (Seymour 1989); however, we have not documented this overlap in Arizona so do not know whether the project footprint will impact additional jaguar 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 Santa Rita Mountains by a male jaguar, we hypothesize that he has established a home range in the U.S. that encompasses these mountains. Due to loss of habitat and additional human disturbance near the project area (e.g. lights, noises, etc. - see below for further discussion), the male jaguar detected in the Santa Rita Mountains will most likely adjust its home range southward.

In addition to eliminating jaguar habitat, the project will also result in the direct removal of jaguar prey habitat, leading to a reduced prey base for jaguars. According to AGFD (2012), the proposed project will result in the estimated loss of 14 white-tailed deer and 56 collared peccary (javelina), both key prey species for jaguar. This loss was calculated by multiplying the average density of these species per square mile by the total square miles then anticipated to be directly affected by the project. Also, while the AGFD estimate did not take into consideration the potential indirect impacts (future) of the project on prey species, it likely did not consider the postclosure state of the project area, at which point only the mine pit may remain unsuited to these prey species.

Outside of the security fence, a perimeter barbed-wire fence will be constructed. The area between the security fence and the perimeter fence will not be subject to extensive ground disturbance. Given the influence of human and vehicular activity, noise, and lighting (see discussion below for information on effects of noise, lights, and traffic on jaguars) in the area between the security and perimeter fences, we anticipate that jaguars will likely avoid most or all of the area.

Construction activities associated with all aspects of the project may disturb jaguars and cause them to flee and/or avoid the areas affected by light, noise, traffic, and other human activities. We are concerned that the jaguar recently and repeatedly detected in the vicinity of the proposed action has established a home range will be subject to such effects, but other jaguars occurring in the area in the future would also be affected. Dispersing jaguars or jaguars moving through the proposed project area may exhibit greater tolerance for some disturbance; however, we anticipate they would still generally avoid areas of high human influence. Once project construction is complete and operations are underway, jaguars would be excluded from the area as it will be devoid of habitat, as described above. Following operations, and presuming tailings piles are successfully revegetated, jaguars will be excluded from only the pit area. Jaguar avoidance of the project area, particularly the jaguar that has previously established a likely home range in the area, may cause them to shift southwest-, south-, or eastward, possibly into less suitable habitat..

Such shifts could result in increased home range size and energy expenditure (due to presumed reductions in prey densities, risk for encounters with humans and vehicles (state highways are situated east and south of the mine, and the community of Sonoita is to the south-southeast), and potential competitors (i.e., cougars and other jaguars that have or may establish home ranges in adjacent areas), and other stresses.

2. Lighting

In addition to the direct project footprint, jaguars that occur within the vicinity of the project may be adversely affected by light associated with the project; this likelihood was explored in detail in the Second Supplemental BA (USFS 2013a). The area in and adjacent to the project area currently is dark at night because there are few artificial light sources and no developed areas to affect night sky views or the natural light conditions and cycles that are important to native plants and animals. Although general aspects of overall sky brightness have been studied (STEM Laboratory 2011) there is little other information on the current baseline night light levels in the area surrounding the proposed action. According to the Forest Service, the majority of the action area (as defined by the Forest Service) is relatively dark on moonless nights; the Border Patrol Station near Sonoita does illuminate the sky (STEM Laboratory 2011), but the lights of the Station and greater Tucson metropolitan area are blocked by the surrounding topography in the project area (Monrad 2012). Background lighting in the action area comes from a number of sources, including headlights from vehicles traveling at night along SR 83 and along forest roads; adjacent private lands; mine exploration activity; and an existing limestone quarry (Imerys) located just west of the proposed mine. The Imerys Quarry occupies approximately 22 acres and roughly twenty truckloads of materials depart the mine site via Santa Rita Road each day (Green Valley Recreation Hiking Club 2013). According to the Green Valley Recreation Hiking Club, the quarry operates 24 hours a day, seven days a week; however according to the BLM work occurs during the daytime only; however lights are operated 24 hours per day. Lights from the Imerys Quarry are sufficiently bright to be remotely sensed (see Figures J-5 and J-6). The quarry likely influences sky glow, but the extent is not known. Horizontal light emanating from the quarry is unlikely to enter the Rosemont Mine site, as illustrated by the simulated extent of Rosemont's northward-oriented horizontal light seen in Figure J-4. Should horizontal light from the Imerys Quarry already be illuminating the northern flanks of the topographic features that are blocking Rosemont's northward-oriented lighting, the end result would be an area with appreciably more horizontal lighting than currently exists. The proposed action includes the use of night lighting which will originate from the Rosemont Mine site itself (i.e., mine-site illumination is needed for conducting mining operations, per Mine Safety and Health Administration standards) as well as from vehicle headlights on roads associated with the mine.

Although Rosemont Copper Company has developed a light pollution mitigation plan, artificial illumination will increase light levels at night, which could impact jaguars, resulting in a wide variety of effects, including, but not limited to changes in behavior, habitat use, and movement patterns; disruption of dispersal movements, corridor use, and circadian clocks; and increased deaths due to in collision on roads (Beir 1995, Longcore and Rich 2004, Beier 2006). Artificial lighting will be persistent at night for 20 years of operation plus a period of reclamation and closure. In some areas, horizontal light will extend at least 12 miles beyond the project, and sky glow from the project is expected to be comparable to, but less than, sky glow from Ajo, Arizona (a town of about 3,300 people) (WestLand Resources, Inc, 2012). The light intensity will be highest at the mine and attenuate farther from the mine. Many areas within a 12-mile radius will be blocked from line of sight horizontal light emanating from the project area (WestLand Resources, Inc, 2012) (Figure 4); however, jaguars are mobile animals that travel over hills and ridgetops, and therefore would likely see the lighting (horizontal) during regular movement activities or during dispersal. Additionally, sky glow will likely be visible to jaguars in the vicinity of the mine at all times of night. In addition to the lighting from the proposed action, the Imerys Quarry will also contribute to nighttime lighting (see Figures 5 and 6).

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 2010). Although lighting intensity in a corral would likely be more intense than the lighting spilling outside the perimeter fence, the above studies suggest some avoidance of lighted areas by large felids.

Because jaguars are extremely secretive and generally avoid human-disturbed areas, we anticipate that the jaguar may be reluctant to regularly use areas wherever horizontal light and possibly sky glow from the mine is visible. It is difficult to understand how sky glow may be perceived by jaguars; however according to the DEIS, nocturnal animals may be adversely affected by the light glow in night skies (USDA 2012:5). Sky glow may increase the ambient illumination in the area, which we anticipate could adversely affect jaguars to some degree.

The Rosemont Copper Mine (measured from the edge of the perimeter fence) would constrict the semidesert grassland jaguar habitat between it and the existing Imerys Quarry (see Figure J-5) to a strip approximately 1.5 km (0.93 mi) in width (see Figure J-8); light and noise effects would also enter this area (see Figures J-4, J-9, J-10, and J-11). If jaguars do attempt to go through the narrower corridor between the mine and quarry(see discussion of effects to critical habitat, below), movement may be made more difficult due to the existing topography between the two facilities. In areas with rugged terrain, large carnivores' (including jaguars') travel patterns generally follow canyon bottoms and ridgelines (Beier 1995). Consistent with Beier's findings, Dickson *et al.* (2005) found that cougars consistently used travel paths that were less rugged than their general surroundings. This suggests that individuals consider the energetic cost of alternative paths; hunting or traveling individuals minimize energetic expense by frequenting landscape features that cost the least. Based on the aforementioned information, jaguars moving through or within the proposed project area likely follow the numerous canyon bottoms occurring throughout the area within the proposed perimeter fence. The canyon bottoms and ridgelines in the aforementioned constricted corridor between the proposed mine and Imerys mine, however, generally run north-south, meaning that, after project construction, if a jaguar attempted to move through the corridor it would likely have to travel perpendicular to its normal travel patterns (i.e., up and down slope faces instead of via canyon bottoms and ridgelines). However, while this travel pattern could result in increased energetic cost to jaguars, jaguars are known to move large distances in rugged terrain, so this topography would not present a barrier to jaguar movement. Because areas immediately southeast of the mine contain habitat less suitable for jaguars (i.e. they were not included as proposed critical habitat), it is less likely that jaguar will move around the mine to the south.

In conclusion, while much of the light will be confined to the pit area and thus minimally affect jaguars, the additional escaped horizontal lighting and sky glow may have an impact on jaguar movements. Jaguars may curtail their movements in the vicinity of the mine due the influence of nighttime lighting.

3. <u>Noise</u>

In addition to lights, jaguars that occur within the vicinity of the project may also be adversely affected by noise associated with the project. There will be increased noise associated with the proposed project due to construction,machinery, vehicle traffic, and blasting. Blasting will typically occur once a day and be limited to daylight hours. Some noise- management techniques and operational tools to minimize noise generated during mine operations have been incorporated into the project design.

The nature of anthropogenic noise is multifaceted and complex in terms of how it affects wildlife. Noise is typically presented in terms of decibels (dB), and for the majority of noise assessments, including the one completed for the proposed project (Tetra Tech 2008, 2009c), it is quantified in terms of dBA, which is an “A-weighted” sound level scale that more closely describes how a person perceives sound. Thus, the sound level when defined as dBA does not always transfer to wildlife since species groups have different hearing sensitivities and ranges (Pater *et al.* 2006). Weighting is species-specific, and received sound levels depend on many factors (e.g., distance from source to receiver, source emission strength, source directivity, atmospheric attenuation, terrain, ground cover, weather, and frequency energy) (Pater *et al.* 2009).

According to the WestLand Resources, Inc. November 9, 2012, memo, much of the maximal intermittent equipment noise associated with the project will be within the perimeter fenceline, with the exception of low noise contours (30-40 dBA) that extend to the south across Box Canyon Road (Tetra Tech 2009). Blasting will generate brief maximum noise levels that would drop from about 52 to 57 dBA at three miles from the Open Pit to about 41 to 47 dBA at locations six miles from the center of the proposed Open Pit, and to 36 to 42 dBA at eight miles from the center of the Open Pit. These noise levels would be comparable to or less than the maximum noise levels of 55 to 60 dBA that currently occur several times per hour during daytime periods (Tetra Tech 2009). Noise contour maps for various mining activities appear in Figures J-9, J-10, and J-11. Noise levels (measured in dBA) associated with increased traffic volumes on SR 83 are predicted to increase, but it is not known how these will be perceived by jaguars. Increased noise levels due to traffic on the Sycamore connector road and the primary and utility maintenance roads, as well as possible increased traffic on Box Canyon road were not analyzed.

Noise from construction and operation of the mine, including blasting and vehicle noise, is anticipated to disrupt jaguars' normal movement patterns, possibly causing, among other things, changes in home range (size and location), habitat use, activity, foraging patterns and increased stress response. (NoiseQuest 2013; Pater *et al.* 2009). As stated above, jaguars selectively use large areas of relatively intact habitat away from certain forms of human influence (Zarza *et al.* 2007, Monroy-Vichis *et al.* 2007) and are therefore likely to avoid human disturbance such as noise produced by the proposed project. As with lighting, the magnitude of impacts from noise is uncertain, but these impacts are expected to decrease as the distance from the mine increases.

In the same or similar manner that noises affect jaguars, these anthropogenic disturbances may also adversely affect jaguar prey, leading to a reduced prey base for jaguars. Sawyer *et al.* (2006) reported mule deer were significantly more likely to select habitat away from noise-producing oil and gas developments. Barber *et al.* (2009) document the costs of chronic noise exposure for terrestrial organisms and state that animal responses probably depend upon the intensity of perceived threats rather than on the intensity of noise. So, while the project is estimated to result in the permanent estimated loss of 14 white-tailed deer and 56 collared peccary (javelina) (AGFD 2012), we anticipate the project may also result in changes in prey distribution in surrounding areas.

4. <u>Roads and Utility Maintenance Corridor</u>

The detrimental effects of roads have been reported for a wide variety of large carnivores (Noss *et al.* 1996). Because large carnivores occur at low densities and have low reproductive rates, the effects of human disturbance are often magnified (Kerley *et al.* 2002). Roads are a serious threat to many large-carnivore populations because they can lead to increased mortality from vehicle strikes, disturbance, habitat fragmentation, access for legal or illegal harvest, and decreased prey numbers or changed prey distribution (Murphy 1983, Beier and Barrett 1993, Caso 1994, Menke and Hayes 2003, Colchero *et al.* 2010). The effects of roads can vary among large carnivore species and among sex and age classes within species. Colchero *et al.* (2010) note that jaguars move preferentially to undisturbed forests and that females avoid moving close to roads and to areas with even low levels of human occupation, while males also avoid roads, but to a lesser degree. According to Conde *et al.* (2010), female jaguars avoided roads while males appeared less likely to avoid them. Monroy-Vichis *et al.* (2007) report that jaguars occur with greater frequency in areas relatively distant from roads and human populations. Zarza *et al.* (2007) report that towns and roads have an impact on the spatial distribution of jaguars (jaguars used more frequently than expected by chance areas located more than 6.5 km from human settlements and 4.5 km from roads). However, in recent times, male jaguars in Arizona are known to have crossed roads, including two-lane highways. For example, the jaguar recently detected in the vicinity of the Rosemont Mine was formerly detected in the Whetstone Mountains. While we cannot determine the path taken by the animal to arrive in the Santa Rita Mountains, either or both SR 82 or 83 would need to have been crossed.

Vehicle strikes are a significant source of mortality for some felid populations (Beier and Barrett 1993, FWS 2010). For example, in the Santa Ana Mountain Range in Southern California, vehicle collisions are the leading cause of mortality of cougars, comprising 32% of all deaths of radiotagged cougars and their offspring (Beier and Barrett 1993). Less is known about the level of mortality of jaguars caused by vehicle strikes. Jaguar road kill has been documented (Colchero *et al.* 2010), but not in the U.S.

Pursuant to the Forest Service's first supplemental Biological Assessment, no major paved roads are expected to be built to accommodate the mine, but the nearby major road (State Route 83) will experience an increase in traffic, and problems associated with traffic, such as more cars, more lights, more trucks, closer distance between vehicles, and so on. Mine-related traffic on SR 83 during operations will primarily consist of trucks carrying supplies to the proposed project, trucks carrying concentrate from the proposed project, and employee traffic. A summary of mine-related truck traffic reports that 69 truck trips per day (455 per week) will occur on SR 83 and the primary access road for the life of the project. This does not include other forms of vehicular access, such as by mine staff entering and leaving the site. The largest concentrated volume of mine traffic during a 24-hour period will occur during workforce shift change which will vary between 6 a.m. to 8 a.m. and 4 p.m. to 6 p.m. Vehicular use of SR 83 associated with the proposed project is anticipated day and night, although according to Rosemont, heavy vehicular use of SR 83 and primary access road generally will not occur at night.

Traffic during the pre-mining phase will use SR 83 and existing Forest Road 231 to access the project area until the new primary access road is constructed. This may require an upgrade to Forest Road 231 within the existing easement, in addition to an upgrade of the entrance to SR 83. At the intersection of SR 83 and the primary access road (see below), SR 83 will be widened and provided with additional lanes. As anticipated by the Forest Service in the BA, to accommodate such increases in traffic, additional portions of SR 83 may need to be upgraded. If this occurs, SR83 may further fragment jaguar habitat and lead to an increased risk of vehicle collision with jaguars. Additionally, if travelers attempt to avoid heavier traffic on SR 83, they may use Box Canyon Road as an alternative route. Increased traffic on SR 83 (regardless of widening) and possibly on Box Canyon will lead to an increased risk of jaguars being struck by vehicles. However, because jaguars in Arizona are scarce and no jaguars are known to have been struck by a vehicle in Arizona, it seems unlikely that there is great risk of vehicles striking jaguars on either road.

While we are aware that male jaguars will cross roads, increased traffic on SR 83 may also lead to increased avoidance of areas near the road which may prevent them from crossing the road and using habitat on either side (Monroy-Vichis *et al.* 2007, Zarza *et al.* 2007, Conde *et al.* 2010). After mine closure and reclamation/restoration activities end, the mine should cease being an influence on traffic on SR 83 and Box Canyon Road.

Increased vehicular traffic on these roads will also likely lead to increased collisions with jaguar prey. Rosemont will monitor road-kill weekly on SR 83, adjacent to mine site, from the northern extent of currently proposed critical habitat to Gardner Canyon Road, to assess loss of jaguar, ocelot, or jaguar prey base (white-tailed and mule deer, collared peccary, and white-nosed coati, in particular). Monitoring will begin at the commencement of mine construction and continue through the second year of mine operation, a total of four years.

The primary access road to the mine will be a newly constructed, two-lane paved road which will provide access to SR83 see (Figure J-3). During mine operations, the primary access road between the perimeter fence and the mine will be closed to the public; however, after mine closure, it will be open to public use. The primary access road will experience all mine-related traffic and some level of public use while the mine is in operation. Once operations have concluded and the primary access road between the perimeter and security fences is opened to public use, it will experience an unknown, but likely small level of vehicular use. Although we anticipate that jaguars will generally avoid the project area due to human disturbance associated with the mine, operation of this new road may increase the likelihood of vehicle collisions with jaguars. However, because jaguars in Arizona are scarce and no jaguars are known to have been struck by a vehicle in Arizona, it seems unlikely that there is great risk of vehicles striking jaguars on the primary access road. Vehicles could collide with potential jaguar prey; however, we do not anticipate it will have a significant impact on the jaguar prey base. The road will fragment suitable habitat between the mine footprint and areas to the north (Figure J-3). However, we anticipate jaguars will avoid most or all areas within the perimeter fence given the human influence between the project footprint and perimeter fence.

The utility maintenance road, located within the utility corridor (Figure J-3) to serve as access to the power supply line, water supply line, and water booster pump stations, crosses through semidesert grassland northwest of the mine. Vehicle traffic on this road is expected to be much lighter in comparison to that on the primary access road. Therefore, we anticipate the chance of vehicles colliding with jaguars is even lower than on the primary access road. The road will be closed to the public during mine construction and operation; however, after the mine is closed, portions of the road, which will have been improved to permit access by lower-clearance, 2-wheel drive vehicles, may be reopened to the public. Because we do not know if it will be reopened or, if reopened, the extent of public use that will occur on the road, it is impossible to predict the effects to jaguars that may occur from this road in the future. That said, in general, roads can lead to increased public access to areas, in this case to areas of jaguar habitat, which could lead to somewhat increased: (1) disturbance to jaguars in the area; (2) habitat degradation; (3) risk of human-caused fire; and (4) risk of illegal killing of jaguars and their prey. Additionally, the public may illegally use the road during mine operations and thereby increase the risk of the four aforementioned threats to jaguars. The Forest Service has indicated that illegal off-road vehicle use has been a problem for the Imerys mine.

The Sycamore connector road (Figures J-3 and J-5) will be a new road constructed from a point on the primary access road outside the north edge of perimeter fence, to connect with National Forest System Road (NFSR) 4050-0.36R-1 (which intersects NFSR 4050 about 0.3 mile farther west). NFSR 4050-0.36R-1 is a road that traverses the aforementioned (and described below) narrowed corridor between the proposed Rosemont Mine and Imerys mine. Per the Forest Service, the Sycamore connector road is needed because the proposed perimeter fence will cut off legal public access to NFSRs in the Sycamore Canyon area, north of the project area. The

Sycamore connector road will be about 12,184 feet long (2.3 miles) and impact about 26 acres. The NFSRs in Sycamore Canyon currently connect to public roads out the bottom (north) end of the canyon. However, the roads cross numerous private ownerships, and a public easement for the road does not exist. Public access from this direction into Sycamore Canyon is thereby controlled by these private landowners. While public access is sometimes granted, it cannot be guaranteed. Constructing the Sycamore Connector Road as a NFSR will continue to provide legal public access to the roads that currently exist on Forest Service lands in this area. Improved accessibility in this area will likely result in increased public access to jaguar habitat which may lead to an increase in the four aforementioned threats above plus increased human presence in remote areas (i.e., roads may facilitate increased off-road vehicle and pedestrian traffic in the area). Likely increased traffic and resulting human disturbance would occur in an area already narrowed by the proposed project (i.e., between the proposed mine and Imerys mine).

Disturbed ground will be susceptible to colonization by invasive nonnative plants such as buffelgrass and Lehmann lovegrass. Nonnative species may outcompete native species and the introduced grasses also carry fire better and burn hotter than the native species, which would degrade potential ocelot habitat. The invasive species monitoring and control measures (see Appendix B (the definitive version of which will be included in the Final EIS) will minimize this potential effect on NFS lands, but private and ASLD lands may be subject to lesser requirements.

5. Increase in Human Disturbance

As stated above, jaguars avoid areas of human activity. The project and action areas could subjectively be classified as relatively unpopulated; the action area has a low human density and contains no large communities. The major road in the vicinity is SR 83 immediately east of the project area, a paved two-lane highway between Sonoita and the Tucson metropolitan area. A certain level of recreation already exists in the area and thus, the primary adverse effect from an increase in human disturbance to the jaguar will be from the activities associated with the mine such as human presence, machinery, lighting, noise from blasting, and increased vehicles using SR 83. Due to the construction of two access roads and a connector road, there will be an increased possibility of legal and illegal access to the area which increases the risk of threats to jaguars as described above.

In the same or similar manner that human activity affects jaguars, this anthropogenic disturbance may also adversely affect jaguar prey, leading to a reduced prey base for jaguars. So, as stated above, while the project will directly impact and result in the estimated loss of 14 white-tailed deer and 56 collared peccary (javelina) during the mine's active construction and operation period (AGFD 2012); this may include additional impacts to prey due to increased human disturbance and possible increased legal and illegal access to the area. Upon conclusion of mining, and presuming that revegetation is effective over the long term, the area-based prey base losses will be reduced to only those attributable to the pit.

Effects of the Action on Proposed Critical Habitat

Role and definitions of occupied (at the time of listing) versus unoccupied (at the time of listing) critical habitat

According to the proposed rule, the conservation role or value of jaguar critical habitat (both occupied and unoccupied at the time of listing) is to provide areas to support some individuals during transient movements by providing patches of habitat (perhaps in some cases with a few resident jaguars), and as areas for cyclic expansion and contraction of the nearest core area and breeding population in the Northwestern Recovery Unit (NRU) (FWS 2012b). As explained in the proposed rule (FWS 2012b), occupied critical habitat requires all PCEs to be present; however if PCE 1 (connectivity to Mexico) is not present, then it must be provided by a unit not known to have been occupied at the time of listing. Per the proposed rule, unoccupied critical habitat (i.e., areas essential for the conservation of jaguars outside of occupied areas) does not require the presence of all PCEs; however it must: (1) connect an area that may have been occupied that is isolated within the United States to Mexico, either through a direct connection to the international border or through another area that may have been occupied; and (2) contain low human influence and impact, and either adequate vegetative cover or rugged terrain.

The effects of the action on proposed critical habitat, including each of the primary constituent elements, are discussed below.

Overarching requirement for jaguar critical habitat

<u>Expansive open spaces in the southwestern United States of at least 100 square kilometers (37 square miles; 24,710 acres)</u>

The proposed action will permanently affect open spaces because the security fence will encircle and directly affect 3,513 acres of proposed critical habitat in Unit 3; new roads and trails will directly affect an additional 499 acres (17 miles of decommissioned roads are not permanent effects). These 4,017 acres of effects represent 1.1 percent of the 366,615-acre proposed critical habitat Unit 3 and 0.47 percent of all proposed critical habitat rangewide (858,137 acres).

Outside of the security fence, a perimeter barbed-wire fence will be constructed to AGFD wildlife-compliant standards, but the area between it and the security fence will be subject to road, powerline, and water line construction and use, light, noise, and prey base effects. The perimeter fence will enclose an additional 2,291 acres beyond the security fence, thus affecting a total of 5,804 acres of jaguar proposed critical habitat for up to 30 years, with some areas potentially becoming more suitable if vegetation reclamation is successful over the long term. The area of proposed critical habitat permanently affected by roads and trails remains at 499-acres (17 acres of to-be-decommissioned roads are not a permanent effect). These 6,304 acres of combined long-term and permanent effects from both fences and the associated roads, trails, and rights-of-way represent 1.72 percent of the 366,615-acre proposed critical habitat Unit 3, and 0.73 percent of all proposed critical habitat rangewide (858,137 acres).

Although the proposed action will diminish the amount of expansive open space in Unit 3, it will still contain sufficient open space to retain its function (i.e., the proposed project will not reduce the remaining size of Unit 3 to less than 100 km^2).

Primary Constituent Elements

PCE 1: Connectivity to Mexico

Connectivity to Mexico is a trait of the proposed critical habitat and exists throughout each unit. Should a project be constructed such that it directly excludes any of the proposed critical habitat from access by jaguars moving to or from Mexico, the areal extent of the PCE is reduced. The proposed action will permanently remove connectivity to Mexico on 3,513 acres of land that will be encircled by the security fence, which will not be permeable to large, terrestrial animals such as jaguars. The perimeter fence and the section of access road between it and the security fence will likely remove or appreciably reduce connectivity to Mexico on 5,805 acres (2,291 acres more than the security fenced area) for 25 to 30 years. If connectivity to Mexico is to be stated in terms of width, rather than area, the mine (measured from the edge of the perimeter fence) will narrow the northern portion of Unit 3 from its present width of 3.6 km (2.2 mi) to approximately 1.5 km (0.93 mi) (see analysis in subsequent paragraph and Figure J-8, below). Proposed critical habitat will remain in place outside of the perimeter fence, north of the proposed mine, south of the Imerys Quarry, and thus our analysis must consider if connectivity to Mexico is retained in that largely indirectly-affected area.

The location of the proposed project in the northern portion of Patagonia Unit 3 would constrict the width of the northeastern portion of the unit which, in turn, could restrict the connection between Unit 3 and the Whetstone-Santa Rita Subunit 4b to the east which, as stated in the proposed critical habitat rule (FWS 2012b), may provide connectivity from the Whetstone Mountains to Mexico via the western portion of Unit 3 (see Figure J-2). We note, however, that no jaguar has ever been documented using Subunit 4b, and that other, more direct connectivity to Mexico would be through Subunit 4c (which also does not have documented jaguar occurrence records). The mine (measured from the edge of the perimeter fence) would constrict the northern portion of Unit 3 to a strip approximately 1.5 km (0.93 mi) in width from its present minimum width of 3.6 km (2.2 mi) (see Figure J-8 below). The 1.5 km area of semidesert grassland would thus be between the existing mine (Imerys Quarry) and the proposed action.

As explained above under Effects of the Proposed Action on the Jaguar, a portion of this 1.5 km bottlenecked area will be impacted by noise, lights, vehicle traffic, and human recreation from the proposed project, making it less likely that jaguars will travel through the area. Refer to figures 4, 5 and 6 in the December 7, 2012, WestLand Resources report on the potential effects of lighting from the Rosemont project for a depiction of simulated light levels within jaguar critical habitat (Figure 6 from this report is included below as Figure J-6). Furthermore, construction and operation of the Sycamore connector road will ensure legal (to the extent that current access involved private lands) public access (vehicle and pedestrian) to the 1.5 km constricted corridor. The direct (noise, lights, dust) and indirect effects (likely increased public access and resulting increase in threats to jaguars) of this road will likely further reduce the likelihood that jaguars will travel through the narrowed corridor between the proposed mine and critical habitat. The secondary access road, although not situated in the narrowest corridor, will be constructed/reconstructed across a narrowed portion of the corridor between the mine and edge of critical habitat and may permit modest increases in access (in that current access involves private lands). The effects of this road (presence and use) will likely further reduce the likelihood that jaguar will travel through the corridor between the two mines within critical habitat. If jaguars avoid movement through this narrowed corridor, they would be unable to move from the Whetstones to Mexico via subunit 4b.

Figures 3, 4, and 5 from Tetra Tech (2009) depict the noise contours of surface blasting, pit blasting, and construction, respectively, and are included here as Figures J-9, J-10, and J-11. Some level of increased sound will enter the corridor between the proposed action and the Imerys Quarry. We reiterate that Tetra Tech (2009) stated the modeled noise values will not exceed current noise maxima at the site, but also that jaguars' hearing sensitivities and ranges may differ from humans (Pater *et al.* 2006).

As explained above, we acknowledge that the effects of human influence from the proposed project may reduce the likelihood that jaguars will move through the corridor between the two mines. However, we do not have enough information on the ability of jaguars to move through habitat affected by human influence in Arizona to determine with a reasonable degree of certainty whether or not a jaguar will move through the constricted corridor between the mines. Depending on jaguar response to the mine (i.e., if they will move through the constricted corridor or not), the possible effects to critical habitat from the proposed project would vary. For example, if jaguars will move through the constricted corridor, then the most significant effects of the proposed project would stem from the direct loss of critical habitat acres due to the project footprint. However, if jaguars will not move through the constricted corridor remaining within Unit 3, then the role of Subunit 4b, as defined in the proposed critical habitat rule (i.e., to connect Subunit 4a to Mexico via Unit 3) would be lost, in addition to the direct loss of critical habitat from the project footprint. That said, connectivity of Subunit 4a to Mexico would still exist via Subunit 4c (Whetstone-Huachuca Subunit). Further, there is no evidence that jaguars ever have used this area for travel and we cannot speculate whether they will use this area for travel in the future.

At this time, we are uncertain which direction a jaguar may move to travel between the Whetstone Mountains and Mexico (i.e., via 4b or 4c), therefore, maintaining all critical habitat that allows for this movement could be important to jaguar conservation. We note that jaguar movement in the U.S. is poorly understood, but also that no established movement pathways have been documented here.

PCE 2: Adequate levels of prey species

Please refer to the discussion of this effect under the Effects of the Proposed Action on the Jaguar section, above.

PCE 3: Surface water sources within 12.4 miles (20 km) of each other

In the action area (as defined by the Forest Service) perennial streams are known to exist at Box Canyon, Empire Gulch, and Cienega Creek; all of these are intermittent during dry periods (early summer low flow and drought) but tend to have some pools remaining. There are several named ephemeral streams (e.g., Barrel, McCleary, Scholefield, Wasp, and Davidson Canyons), numerous constructed waters (primarily stock tanks and drinkers), and some seeps with surface water in the project and action areas.

All surface water will be eliminated within the footprint of the mine and thus impact PCE 3. As a result of groundwater drawdown after the life of the mine, the amount or volume of water within regional perennial pools could decrease, which could result in indirect effects on PCE 3. Disruptions of surface water flow resulting from the capture of runoff in the pit are expected to occur along the Barrel Canyon drainage through Davidson Canyon to its confluence with Cienega Creek. Groundwater flow models were designed to simulate conditions prior to pit development, during pit dewatering, and for a 1,000-year post-closure period of groundwater level recovery and potential pit lake development (Montgomery and Associates 2010; Tetra Tech 2010c), and it was determined that groundwater level drawdown could result in the dewatering of streams, seeps, and springs, which may serve as water sources for jaguars. Uncertainties in the variables used to build the models, however, could be manifested as greater reductions of groundwater and greater impact to surface water levels (e.g., lower water level, more extensive dry reaches) and riparian vegetation than modeled. Conversely, impacts may not prove to be as severe. The timing and amount of groundwater drawdown at Box Canyon Dam Structure, Ophir Gulch Well, and South Sycamore Canyon have been modeled, but not specifically reported beyond the groundwater contour information in Tetra Tech (2010c), Montgomery (2010), and Myers (2010) and displayed in SWCA (2012) (citations refer to the Effects to Aquatic Ecosystems section). Any effects to waters of interest would be more pronounced during periods of low flow (May and June, or during an extended drought) because even small flow reductions could cause some portions of Cienega Creek, or other aquatic areas, to stop flowing. These modeled decreases in groundwater (less than 1 foot) would occur over a long period of time but could cause changes in riparian vegetation extent or health; if there are reductions in stream flow in a large area, this could impact jaguars, which need free-standing water sources within 20 km of each other. The Water Source Enhancement mitigation measure, however, calls for seven already-located and 23 not-yet-located water sources to be installed or enhanced. Should these sites be advantageously situated – and siting will be guided, in part, by the Terms and Conditions associated with the Chiricahua leopard frog analysis - they could prevent the 20 km distance from being exceeded.

Although the amount of available water will be reduced by the proposed action, there is no indication that PCE 3 will be reduced to a level that water will not be available in any 20-km area. Because of the numerous water sources such as stock tanks and drinkers, PCE 3 will not be reduced to below the threshold established in the proposed critical habitat rule. Further, Rosemont will ensure that restored or replaced springs within jaguar critical habitat are constructed in accordance with jaguar PCEs for surface water (see Proposed Conservation Measures and their effects, below).

PCE 4: Madrean evergreen woodland or semidesert grassland vegetation community between 1 to 50 percent canopy cover

Within the project area (as described in the BA and above) and most of the action area (as described in the BA), the vegetation community is composed of semidesert grassland and Madrean evergreen woodland. The only part of the project area not in this vegetation type is along the spine of the mountains, where some rock outcrops and talus slopes may have less than 1% cover. The area also contains moderate to highly rugged terrain. The proposed action will affect PCE 4 within the project footprint because the security fence will encircle and directly affect and remove (for the construction and operational life of the mine) 3,513 acres of proposed critical habitat in Unit 3; roads and trails will directly and permanently affect an additional 499 acres.

PCE 5: Moderate to highly rugged terrain

The area also contains moderate to highly rugged terrain. During operations, effects to ruggedness will be immaterial relative to effects to PCEs 2 (prey) and 6 (human disturbance). The proposed action's permanent effect to ruggedness, assuming the extent of the PCE related to vegetative cover (PCE 4) is adequately addressed by reclamation and revegetation, is primarily within the pit which, while topographically rugged, will be permanently excluded from access.

PCE 6: Little human influence or disturbance

This PCE was developed using research that highlights the fact that jaguars generally avoid areas of human activity. Pursuant to the proposed rule, an HII of 20 or less is an essential element of PCE 6. Specifically, this PCE includes minimal to no human population density, no major roads, and no stable nighttime lighting over any 0.4-square-mile (1-km^2) area (FWS 2012b). The proposed project and action areas currently have a low human density and contain no large communities. The proposed project is currently in an area with an HII values between 14 and 18.

As described below, as a result of the proposed project, overall human influence and disturbance (from roads, lights, etc.) will increase which will likely remove PCE 6 from the project area and a portion of the action area. Although the level of human influence will increase, at this time we cannot quantify the extent by which the HII will be affected due to the complicated way a number of variables interact to create HII. For example, road density is a component of HII, but we cannot determine if the existing roads in the area (i.e. the current Sycamore Canyon access), already drive observed human disturbance to the same extent that the proposed Primary Access Road will. Similarly, although overall human influence and disturbance will increase within the areas between Imerys Quarry and the proposed action, we cannot determine the resulting value of the HII in that area.

As described above, primary and secondary access roads and the Sycamore connector road will be constructed as part of the proposed project. The physical construction of these roads and their associated traffic, as well as likely increased public access to and use of areas around the mine (due to the roads), will further contribute to increased human influence in the area, and possibly increased HII. Additionally, increased traffic on SR 83, and possible upgrades to SR 83 (as described above) and on Box Canyon will further contribute to increased human influence in the area, and possibly increased HII. Increased traffic on SR 83 may further limit jaguar access to the northeastern portion of Unit 3. Lighting from the proposed mine, as discussed in detail under the Effects of the Proposed Action on Jaguar, will result in increased horizontal lighting and sky glow in jaguar habitat, will further contribute to increased human influence in the area, and possibly result in increased HII.

The presence of a jaguar in the action area in 2012 and 2013 suggests that the amount of ambient light present is not great enough to repel the jaguar, indicating the area is currently “dark enough” for jaguars. It also suggests that the current HII is currently “low enough” for jaguars. The September 2012 camera detection of the jaguar was particularly close to the proposed mine site and was approximately 6.4 km (4 mi) away from the existing mine (Imerys). However, once the proposed action is in place, jaguars may avoid the area between the proposed mine and the Imerys mine because of the decreased width of the corridor and increased human disturbance (roads, lighting, etc.), which may further functionally narrow the corridor.

Summary of Effects to PCEs

In summary, the mine’s project footprint will adversely affect all PCEs (i.e., connectivity to Mexico, prey, surface water, canopy cover, rugged terrain, and little human influence) to some degree in the northern portion of Unit 3 for 25 to 30 years, although some of the effects will be offset to varying degrees by the proposed conservation measures. Many PCEs outside of the project footprint but within portions of the action area will also be indirectly adversely affected by the proposed project (from increased lighting, noise, traffic, human use, etc.). While the extent to which jaguars will traverse the constricted portion of Unit 3 is unknown, it is reasonable to conclude that access through this area will be hampered to some extent. We reiterate, however, that we are unable to predict whether jaguars will use this connection between the Whetstones and Santa Ritas. If jaguars will not move through the constricted area of Unit 3, then the role of Subunit 4b to the east, as defined in the proposed critical habitat rule (i.e., to connect Subunit 4a to Mexico via Unit 3) would be lost. That said, connectivity of Subunit 4a to Mexico would still exist via Subunit 4c. Additionally, if the constricted corridor creates a barrier to jaguar movement, the function of the northeastern portion of Unit 3 could be diminished. Again, however, the remaining portion of Unit 3 (i.e., south of the mine) would still remain functional. The direct loss of critical habitat (in Unit 3) and possible indirect loss of critical habitat (in Unit 4b) will somewhat reduce the conservation value of those critical habitat units for the jaguars.

Effects to the Conservation Value of Critical Habitat with the Proposed Action

Critical habitat is defined as: (1) 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 or biological features (a) Essential to the conservation of the species and (b) Which may require special management considerations or protection; and (2) Specific areas outside the geographical area occupied by the species at the time it is listed, upon a determination that such areas are essential for the conservation of the species. Conservation, as defined under section 3 of the Act, means to use and the use of all methods and procedures that are necessary to bring an endangered or threatened species to the point at which the measures provided under the Act are no longer necessary. Such methods and procedures include, but are not limited to, all activities associated with scientific resources management such as research, census, law enforcement, habitat acquisition and maintenance, propagation, live trapping, and transplantation, and, in the extraordinary case where population pressures within a given ecosystem cannot be otherwise relieved, may include regulated taking.

Specific areas within the U.S. that provide the physical and biological features essential to jaguar habitat can contribute to the species' persistence and, therefore, overall conservation by providing areas to support some individuals during dispersal movements, by providing small patches of habitat (perhaps in some cases with a few resident jaguars), and as areas for cyclic expansion and contraction of the nearest core area and breeding population in the NRU. As such, critical habitat was developed to allow the above functions to occur. Specifically, as explained above, critical habitat for the jaguar was defined as expansive open spaces in the southwestern United States with adequate connectivity to Mexico that contain a sufficient native prey base and available surface water, have suitable vegetative cover and rugged topography to provide sites for resting, and have minimal human impact (FWS 2012b, FWS 2013). These areas are limited within the U.S. and therefore have an important conservation role for the jaguar.

Unit 3 connects with Mexico in two separate areas, to the east/southeast through the Huachuca Mountains and to the south through the Patagonia Mountains. Subunit 4 contains three subunits (4a, 4b, and 4c), one of which (4a) is considered to have been occupied at the time of listing. According to the proposed rule, the Whetstone-Santa Rita Subunit (4b) and Whetstone-Huachuca Subunit (4c) are essential to the conservation of the jaguar because they provide connectivity from the Whetstone Mountains to Mexico (FWS 2012b, FWS 2013). Both 4b and 4c were included in critical habitat because we do not know which route(s) are most conducive to providing the connectivity function. We also have no records that either Subunit has ever been used for this purpose by jaguars. Because we cannot predict which way jaguars may move between the Whetstone Mountains and Mexico, either or both subunits may (or may not) be important to the conservation of jaguars in the NRU.

The loss of proposed jaguar critical habitat within the project footprint and partial loss of PCEs within portions of the action area (as described above) reduces the conservation value of Unit 3 by reducing the amount of area that may support: (1) some individual jaguars during dispersal movements, by providing small patches of habitat (perhaps in some cases with a few resident jaguars); and (2) cyclic expansion and contraction of the nearest core area and breeding population in the NRU. That said, the majority of Unit 3, and therefore its conservation value, will not be affected by the proposed action.

We do not know if a jaguar will move through the constricted portion of Unit 3 between the proposed mine and the Imerys Quarry. If jaguars cannot traverse the constriction, the role of Subunit 4b, as defined in the proposed critical habitat rule (i.e., to connect Subunit 4a to Mexico via Unit 3) could be lost, but connectivity of Subunit 4a to Mexico would still exist via Subunit 4c. However, the integrity of the critical habitat complex comprised of Units 3 and 4 will be weakened to some extent.

This possible reduction in function of Subunit 4b and partial loss of function of Unit 3 will somewhat diminish the conservation value of critical habitat as a whole. As explained above, areas that provide the primary constituent elements essential to jaguar habitat are limited within the U.S. and therefore have an important conservation role for the jaguar. Losing portions of these areas (i.e., critical habitat areas), as is likely to occur with the proposed project, reduces the ability of critical habitat to function as intended by the proposed rule. That said, the majority of critical habitat will be unaffected by the proposed action and will therefore retain its function and conservation value. Further, the effects of the action on the proposed critical habitat will not considerably reduce the capability of critical habitat to be used in a way such that research, census, law enforcement, habitat acquisition and maintenance, propagation, live trapping and transplantation and other similar conservation measures are precluded.

Effects of the Action on Proposed Critical Habitat in Relation to Recovery

As described above in the Status of the Species, a draft recovery plan for the jaguar has not been finalized, thus no recovery criteria exist to date to be used in this opinion. However, the 2012 Recovery Outline for the Jaguar developed eight "recovery objectives," which, at this time, provide FWS with the best information based on the opinion of jaguar experts. Recovery objectives collectively describe the specific conditions under which the goals (i.e., delisting) for recovery of the jaguar, throughout its range (including within and outside of the proposed critical habitat in the U.S.) will be met. As described below, the proposed action may adversely impact five out of eight recovery objectives within the Jaguar Recovery Outline:

"1) Assess, protect, and restore sufficient habitat to support viable populations of jaguars in the two recovery units." This objective is adversely impacted to an extent, but a loss of less than one percent of critical habitat, and a much smaller percentage of the NRU, cannot be expected to preclude achievement of this objective.

"2) Mediate or mitigate the effects of human population growth and development on jaguar survival and mortality where possible." This objective is adversely impacted to an extent. The proposed action will increase human influence in the portion of the range where the action would be implemented, but we have no evidence to conclude that the action will appreciably influence survival and mortality at the Recovery Unit level; attainment of this recovery objective is not precluded by the proposed action.

"3) Reduce direct human-caused (i.e., illegal and legal killing) mortality of jaguars." This objective is adversely impacted to an extent. Our analysis contemplates that increased human access to the action area and surrounding lands could lead to an increased risk of intentional (e.g. shooting) and unintentional (e.g., vehicle collisions) jaguar fatalities. However, this is somewhat speculative and, even if true, does not appreciably affect attainment of this objective in the NRU.

"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)." This objective is adversely impacted to an extent. Our analysis estimates a minimum estimated reduction (in carrying capacity) equaling 14 white-tailed deer and 56 javelina. This is not significant at the Recovery Unit level.

"5) Maintain or improve genetic fitness, demographic conditions, and health of the jaguar." This objective is adversely impacted to an extent. Our analysis shows that connectivity to Mexico will remain after implementation of the proposed action, so we do not anticipate that genetic fitness, demographic conditions, or the health of the jaguar will be significantly compromised.

"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." This recovery objective will not be adversely affected by the proposed action.

"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." This proposed action has no applicability to this recovery objective; the objective will not be adversely impacted.

"8) Support international efforts to ascertain the status and conservation needs of the jaguar in the two recovery units." This proposed action has no applicability to this recovery objective; the objective will not be adversely impacted.

Although five of these objectives may be adversely impacted by the proposed project, it is unlikely that the level of the impact will lead to measurable delays in the recovery of jaguars within the NRU, within and/or outside of the proposed critical habitat.

Proposed Conservation Measures and their effects

The conservation measures that are part of the proposed action are meant to avoid or offset some adverse effects. The Forest Service provided jaguar-specific conservation measures in the BA that include:

1. Mitigation with regard to lighting (see Monrad 2012) includes the reduction of lumens to 5.2 million lumens, though we note that USFS (2013b) later revised its estimates upward to 5.8 and 6.4 million lumens, the latter of which will appear in the Final EIS (see USGS 2013d, as cited in the Description of the Proposed Action section).
2. Rosemont will ensure that restored or replaced springs within jaguar critical habitat are constructed in accordance with jaguar PCEs for surface water.
3. As part of the concurrent reclamation program, Rosemont will establish 1 to 50 percent woody vegetation cover averaged over the reclamation area, excluding the pit. This shall be established as a prescriptive obligation of the concurrent reclamation program in

appropriate areas as determined in conjunction with the biological monitor during project development.

4. Rosemont will monitor road-kill weekly on SR 83, adjacent to the mine site, from the northern extent of currently proposed critical habitat to Gardner Canyon Road, to assess loss of jaguar, ocelot, or jaguar prey base (white-tailed and mule deer, collared peccary, white-nosed coati, in particular). Monitoring will begin at the commencement of mine construction and continue through the second year of mine operation, a total of four years. After the initial four years of monitoring, the Biological Monitor, working with Rosemont, other entities, and FWS, will determine if additional field data collection is necessary to inform determination of whether or not a man-made wildlife crossing structure is needed and, if it is required, where it might be located. Rosemont will report road-kill in the annual report. Smaller jaguar prey (lagomorphs, rodents) will not be reported. Fatalities of any FS and BLM sensitive species will also be reported. This work may be conducted by the Biological Monitor as part of their regular site visits funded by Rosemont. In addition to increasing knowledge regarding the movement of wildlife in the area, information collected during this investigation may identify a suitable wildlife crossing structure location. We note that this Conservation Measure does not ensure that such a crossing will be constructed.
5. Rosemont will report all jaguar and ocelot sightings immediately to the Biological Monitor.
6. Rosemont will provide $50,000 to an entity approved by the CNF to support camera studies for large predators including jaguar and ocelot. The money will be provided for additional monitoring efforts between the Santa Rita and the Whetstone Mountains and along the Santa Rita Mountains. In addition to increasing knowledge regarding the movement of wildlife in the area, information collected during this investigation may identify a suitable wildlife crossing structure location. Again, we note that this Conservation Measure does not ensure that such a crossing will be constructed.
7. Rosemont will acquire or record restrictive covenants or conservation easements on the following parcels of land:

    a. Sonoita Creek Ranch: This land will be purchased and either made available to an approved ILF Sponsor (see Sonoita Creek Ranch Conservation Measure for an explanation of the ILF program) approved by the Corps or managed for conservation by Rosemont or a conservation partner. In any case, the land will provide wildlife conservation benefits as described in the conservation measures. It contains a total of approximately 1,200 acres of semidesert grassland, Madrean evergreen woodland, and riparian habitat along upper Sonoita Creek and includes surface water rights that support two perennial ponds and associated riparian vegetation. It is within proposed jaguar critical habitat. Sonoita Creek Ranch will be managed for conservation purposes to provide habitat and connectivity for jaguars and ocelots between the Canelo Hills/Patagonia Mountains and the Santa Rita Mountains, slightly over a mile away to the west of the ranch, in perpetuity. The southern portion of the ranch has been identified by the Arizona Wildlife Linkages Workgroup and the Arizona Missing Linkages Corridor design as a likely corridor between these two CNF land blocks.

b. <u>Davidson Canyon Watershed Parcels</u>: Rosemont will record a restrictive covenant or conservation easement on these parcels. These properties consist of six parcels on the eastern side of the Santa Rita Mountains and total approximately 574 acres of semidesert grassland and associated xero- or mesoriparian habitat. All but one of these parcels are within proposed jaguar critical habitat (a total of 527 acres within proposed critical habitat). These will be included as available land for the establishment of water features beneficial to listed species such as jaguars.

c. <u>Helvetia Ranch North</u>: Rosemont will record a restrictive covenant or conservation easement on these parcels which contain approximately 940 acres of semidesert grassland on the west side of the northern Santa Rita Mountains near the proposed project's infrastructure corridor. The parcels are outside of proposed jaguar critical habitat. These will be included as available land for the establishment of water features beneficial to listed species such as jaguars.

The conservation measures listed above are anticipated to help avoid and offset adverse effects of the proposed project to jaguars to some extent. Sonoita Creek Ranch and five of the Davidson Canyon parcels are located within proposed jaguar critical habitat and therefore may help protect connectivity within critical habitat. The other conservation lands are not located within proposed critical habitat and thus will not contribute to the protection of connectivity within critical habitat. They will, however, likely contribute to some extent to jaguar conservation in general. Although the funding to conduct carnivore monitoring may provide some information on jaguar use of the area, $50,000 is likely only enough funding to conduct carnivore monitoring in a limited geographic area for about six months, which is generally not a sufficient amount of time to collect quality data on cryptic carnivore movement.

The Forest Service also proposed a series of general conservation measures as well as conservation measures for other listed species, some of which have elements that may provide conservation benefits to the jaguar. For example, the species-specific conservation measures for the Chiricahua leopard frog, as modified by the Terms and Conditions appearing in the frog's Incidental Take Statement, include establishment of new waters. The USFS (2013b) has stated that site selection for these aquatic habitats will include consideration for the between-water travel distance associated with jaguars. The Second Supplemental BA section entitled Additional Considerations for Aquatic and Riparian Species and their Habitat, and Seeps and Springs will further ensure that jaguars (and ocelots) are considered in the replacement of affected waters.

The Second Supplemental BA section entitled Mechanism for Monitoring and Adaptive Management will help ensure that measures are implemented and that their biological efficacy is monitored, with changes made to ensure their intended mitigative purpose is achieved.

Summary of Effects of the Action

<u>Jaguar</u>

The proposed project will directly and indirectly affect jaguars and jaguar habitat within the NMU. The proposed action will result in an up to 30-year temporal loss of up to approximately 14.2 to 33.8 percent of a jaguar home range. The proposed action will result in a permanent loss of up to approximately 10.9 to 26.0 percent of a jaguar home range. Lesser effects may be anticipated as reclamation activities proceed and successfully reestablish sufficient permanent canopy cover; permanent habitat losses will then be largely due to the security-fenced area and pit.

The mine will also permanently reduce the abundance of jaguar prey, estimated by AGFD (2012) to amount to 14 white-tailed deer and 56 collared peccary (javelina), both key prey species for jaguar. However, this habitat loss will be partially offset by Rosemont's conservation commitment to protect 2,714 acres of jaguar habitat (and currently, proposed critical habitat) in perpetuity.

In addition to the direct habitat loss, lighting and noise from the proposed project are anticipated to disturb jaguars. Should the human activity associated with this mine disturb jaguars significantly, the result would likely be a shift in home range, perhaps to an area further south in the Santa Rita and/or Patagonia Mountains. These disturbances, along with additional roads and traffic, may also make jaguars reluctant to travel through the narrowed portion of habitat in the northern Santa Rita Mountains, and thence to the Whetstone Mountains. The conservation measures listed above are anticipated to avoid and offset adverse effects of the proposed project to jaguars to some extent.

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. The project may, however, adversely impact 5 out of 8 recovery objectives, but not to the extent that those objectives are precluded. The analyses contained in Items 1 through 8 in the section entitled Effects of the Action on Proposed Critical Habitat in Relation to Recovery, above, apply to the jaguar and the species' habitat, both within and outside of the proposed critical habitat. Also as stated in these prior analyses, although these objectives may be affected by the proposed project, it is unlikely that the level of the effect will lead to measurable delays in the recovery of jaguars within the NRU.

<u>Proposed Jaguar Critical Habitat</u>

1. Direct loss of proposed critical habitat due to the proposed project footprint:

The security fence will encircle and directly affect 3,513 acres of proposed critical habitat in Unit 3; the direct effects of new roads and trails bring the total affected area to 4,017 acres. This 4,017 acres of effects represent 1.1 percent of the 366,615-acre proposed critical habitat Unit 3 and 0.47 percent of all proposed critical habitat rangewide (858,137 acres).

The perimeter fence will enclose an additional 2,291 acres beyond the security fence, thus affecting a total of 5,804 acres of jaguar proposed critical habitat for up to 30 years, with some areas potentially becoming more suitable if vegetation reclamation is successful over the long term. The addition of road and trail effects brings the affected area to 6,304 acres of combined long-term and permanent effects, which represents 1.72 percent of proposed critical habitat Unit 3, and 0.73 percent of all proposed critical habitat rangewide. Conservation lands (totaling 1,727 acres), however, will be protected and managed in perpetuity within proposed jaguar critical habitat, and therefore will offset some of this habitat loss.

2. Indirect effects to proposed critical habitat and reduced connectivity due to the proposed project:

As described above, the location of the proposed project in the northern portion of Patagonia Unit 3 will likely restrict connectivity between Patagonia Critical Habitat Unit 3 and the Whetstone-Santa Rita Subunit 4b to some unknown extent. The latter unit, according to the proposed rule, provides connectivity from the Whetstone Mountains and to Mexico through Unit 3 (see Figures J-2 and J-3). We do not have enough information on the ability of jaguars to move through habitat affected by human influence in Arizona to determine definitively whether or not a jaguar will move through the constricted corridor between the mines. However, if jaguars will not move through the constricted portion of northeastern Unit 3, then the functional role of Subunit 4b, as defined in the proposed critical habitat rule (i.e., to connect Subunit 4a to Mexico via Unit 3), would be removed. That said, connectivity of Subunit 4a to Mexico would still exist via Subunit 4c. Additionally, if the constricted corridor area creates a barrier to jaguar movement, the function of the northeastern portion of Unit 3 (i.e., the portion of Unit 3 from the constricted corridor to the western boundary of Subunit 4b) would also be diminished. Again, however, the remaining portion of Unit 3 (i.e., south of the mine) would still remain functional. Further, Rosemont's permanent protection of 1,727 acres of private lands within critical habitat will further protect connectivity within critical habitat.

3. Effects to recovery:

By definition, critical habitat is habitat determined to be essential for the conservation (i.e., recovery) of the species. Adverse effects to some of these limited critical habitat areas and to one potential pathway from the Whetstones to Mexico, as may occur with the proposed project (as described above), somewhat reduces the ability of critical habitat and the northernmost secondary area (i.e., NMU) to contribute to the recovery of jaguars in the NRU. That said, the majority of proposed critical habitat will remain unaffected and therefore retain its ability to contribute to jaguar recovery in the NRU. Additionally, although some recovery objectives for the jaguar may be affected by the proposed project, it is unlikely that the level of the effect will lead to measurable delays in the recovery of jaguars within the NRU.

4. Effects to conservation:

This partial loss of function of Unit 3 and possible reduction in function of Subunit 4b will somewhat diminish the conservation value of proposed critical habitat as a whole. As explained above, areas that provide the primary constituent elements essential to jaguar habitat are limited within the U.S. and therefore have an important conservation role for the jaguar. Adverse effects to portions of these areas (i.e., proposed critical habitat areas), as are likely to occur as a result of the proposed action, reduce the ability of proposed critical habitat to function as intended by the proposed rule. That said, the vast majority of proposed critical habitat will be unaffected by the proposed action and will therefore retain its function and conservation value. Further, the effects of the proposed action on the proposed critical habitat will not considerably reduce the capability of proposed critical habitat to be used in a way such that research, census, law enforcement, habitat acquisition and maintenance, propagation, live trapping and transplantation and other similar conservation measures are precluded.

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 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.

Critical Habitat Units 3 and 4 are closer to rapidly expanding urban areas than any other units and therefore more vulnerable to loss of connectivity. Tucson, Patagonia, and Sierra Vista are all expanding populations with increasing land development. Immediately southwest of the Mustang Mountains (Subunit 4c) is the proposed Rain Valley development. On the other (east) side of the Mustang Mountains, the community of Huachuca City is poised for additional development with the impending completion of a new wastewater treatment plant. Subunit 4b, through the Empire Mountains, lies between growth both to the north (Tucson) and the south (Patagonia and Sonoita). The aforementioned actions, the effects of which are considered to be cumulative, may result in fragmentation, loss, or degradation of jaguar habitat and disturbance to jaguars. Although not documented recently in the U.S., illegal hunting of jaguars adversely affects the species. 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.

CONCLUSIONS - JAGUAR

Jaguar

After reviewing the current status of the jaguar, the environmental baseline for the action area, the effects of the proposed action, and the cumulative effects, it is our opinion that the Rosemont Copper Mine, as proposed, is not likely to jeopardize the continued existence of the jaguar. Pursuant to 50 CFR §402.02, "jeopardize the continued existence of" means to engage in an action that reasonably would be expected, directly or indirectly, to reduce appreciably the likelihood of both survival and recovery of a listed species in the wild by reducing the reproduction, numbers, or distribution of that species. We base this conclusion on the following:

1. Jaguars range from southern U.S., i.e., Arizona and New Mexico, to south America, i.e., Argentina, Belize, Bolivia, Brazil, Colombia, Costa Rica, Ecuador, French Guiana, Guatemala, Guyana, Honduras, Mexico, Nicaragua, Panama, Paraguay, Peru, Suriname, Venezuela (Swank and Teer 1989, Caso *et al.* 2008). Habitat loss (assuming a 5,401-acre/8.4 mi^2 area) from the proposed action will affect a miniscule amount of habitat from this global perspective. The proposed action's effect to the 15.1 million km^2 (5.8 million mi^2) combined NRU and Pan-American Recovery Units, which encompass the entire range of the jaguar, is immeasurably small, at 1.4×10^{-6} percent. The effects of habitat loss are also small at the recovery and management unit scales. The proposed action will permanently affect approximately 0.01 percent of the 74,262 mi^2 NRU, approximately 0.07 percent of the entire 12,337 mi^2 NMU, and 0.3 percent of the 2,959 mi^2 portion of the NMU in the U.S.

2. Only one jaguar may be incidentally taken via harassment under the proposed action, and there are an estimated 30,000 jaguars throughout the species' range. Sanderson and Fisher (2013b) estimate a carrying capacity of 27 jaguars in the U.S. portion of the NMU, 162 jaguars in the entire NMU, and 4,400 jaguars within the NRU; actual population numbers are unknown.

3. Although abundance and population trends for the jaguar range-wide are not well known and populations throughout the species' range continue to be at risk, the Rosemont Copper mine will not have an appreciable impact on the population at the rangewide, NRU-specific, or NMU-specific scales. 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.

Proposed Critical Habitat

<u>Legal Standards and Definitions</u>

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 Act to complete the following analysis with respect to critical habitat. From section 3(3) of the Endangered Species Act: "The terms 'conserve,' 'conserving,' and 'conservation' mean the use of all methods and procedures which are necessary to bring any endangered species or threatened species to the point at which the measures provided under the Endangered Species Act are no longer necessary. Thus, designation of critical habitat helps ensure that proposed Federal actions will not result in the adverse modification of habitat to the point that the species will not be able achieve recovery, i.e. not able to be removed from the threatened or endangered species list.

Section 7(a)(2) of the Endangered Species Act of 1973, as amended, states: "Each Federal agency shall…insure that any action funded, authorized, or carried out…is not *likely* to…result in the destruction or adverse modification of (critical) habitat…" (emphasis added). *Merriam Webster's Collegiate Dictionary*, *Tenth Editio*n, defines "likely" as "1: having a high probability of occurring or being true; very probable." Therefore, in order to reach a conclusion of destruction or adverse modification of critical habitat from a Federal action, we must determine that preclusion of recovery is "very probable" due to that action.

We used four documents to determine how to analyze whether the threshold for destruction or adverse modification will be reached by the proposed action. These include: 1) 2004 guidance regarding the application of the "Destruction of Adverse Modification" standard under Section 7(a)(2) of the Endangered Species Act (FWS 2004); 2) Section 7 Consultation Handbook; 3) the proposed rule for jaguar critical habitat; and 4) our letter regarding Incremental Effects for the economic analysis for the proposed rule to designate critical habitat for the jaguar (FWS, August 28, 2012).

Our 2004 guidance indicates that destruction or adverse modification may be reached when critical habitat would not remain functional to serve the intended conservation role for the species.

Our Section 7 Consultation Handbook notes that the adverse modification threshold is exceeded when the proposed action will adversely affect the critical habitat's constituent elements or their management in a manner likely to appreciably diminish or preclude the role of that habitat for recovery of the species.

The 2012 proposed rule (FWS 2012b) to designate critical habitat for the jaguar states that activities that may destroy or adversely modify critical habitat are those that alter the physical or biological feature and PCEs to an extent that appreciably reduces the conservation value of critical habitat for the jaguar.

The Incremental Effects Letter (FWS August 28, 2012) states that destruction or adverse modification is potentially reached when connectivity is severed either between the U.S. and Mexico or within a critical habitat unit or subunit. According to the incremental effects letter, "major construction projects (such as new highways, significant widening of existing highways), or construction of large facilities (such as large mining operations) could constitute adverse modification to jaguar critical habitat in both occupied and unoccupied subunits if connectivity within a critical habitat unit is severed." Additionally, the letter states that "major construction projects (such as new highways, significant widening of existing highways, or construction of large facilities) that could sever connectivity within these critical habitat subunits could constitute adverse modification. The most likely unoccupied subunits in which these activities may occur are 4b and 4c". The destruction or adverse modification of critical habitat could occur if the function of one or more critical habitat units is affected by, for example, the construction of impenetrable fencing across a portion of the currently open areas of vegetated, rugged terrain at the U.S.-Mexico border. This could create a situation in which a unit of critical habitat could become inaccessible to jaguars. The Incremental Effects Letter (FWS 2012) also states that "The loss of one critical habitat unit would not constitute jeopardy to the species, but it could constitute destruction or adverse modification".

Therefore, following guidance from each of these four sources and considering the effects noted above, it is our conference opinion that implementation of the proposed action will not likely destroy or adversely modify proposed critical habitat. We base this conclusion on the following rationale:

Habitat Loss

1. Although the proposed action will result in the direct loss of proposed critical habitat in Unit 3, the majority of Unit 3 will retain its PCEs and function. The security fence and roads will permanently remove 4,013 acres of proposed critical habitat in Unit 3. This 4,013 acres of permanent effects represent 1.1 percent of proposed critical habitat Unit 3 and 0.47 percent of all proposed critical habitat rangewide. The perimeter fence and roads are a long term (25-30 years) effect to 6,304 acres, which represents 1.72 percent of proposed critical habitat Unit 3, and 0.73 percent of all proposed critical habitat rangewide. Further, proposed conservation measures will permanently protect 1,727 acres within proposed critical habitat that could otherwise be subject to development or other adverse effects. This provides a significant offset (27.3 to 42.8 percent) to the habitat expected to be lost.

2. If the constriction of the proposed critical habitat between the proposed Rosemont Mine and Imerys Quarry render the northeastern portion of Unit 3 inaccessible (but see discussion below), an additional 32,992 acres of Unit 3 would be removed from its function in jaguar conservation. The perimeter fence and roads will affect 6,304 acres of proposed critical habitat for the long term (25 to 30 years). Adding this acreage to that of the inaccessible portion of Unit 3, the areal extent of the long-term loss of proposed critical habitat containing all the PCEs to support jaguars would be 39,296 acres. This would constitute approximately 10.7 percent of Unit 3 and 4.6 percent of all proposed critical habitat rangewide. Adding the acreage of the inaccessible portion of Unit 3 to the 4,013 acres of proposed critical habitat in which all PCEs are permanently affected by the security fence and roads brings the total impact to 37,005 acres. This would constitute a permanent loss of 10.1 percent of Unit 3 and 4.3 percent of all proposed critical habitat rangewide. Both the long-term and permanent hypothetical losses are partially offset by the aforementioned permanent protection of 1,727 acres of conservation lands. Although the proposed action could potentially cause long-term and permanent, direct and indirect losses of function in Unit 3, function would be retained in 89.3 (long-term) to 89.9 (permanent) percent of Unit 3 and in 95.4 (long-term) to 95.7 (permanent) percent of all proposed critical habitat.

3. If the lost function of northeastern Unit 3 analyzed in Item 2, above, removed the connectivity-to-Mexico role of the 12,710-acre Subunit 4b and also rendered the 62,478-acre Subunit 4a inaccessible via northeast Unit 3, the resulting 75,188-acre loss of function would represent 8.8 percent of the overall proposed critical habitat (7.3 percent

in Subunit 4a, 1.5 percent in Subunit 4b). We note, however, that connectivity to Mexico for Subunit 4a exists through Subunit 4c and the southeastern portion of Unit 3 in the Huachuca Mountains, regardless of the potential functional loss of Subunit 4b.

4. When the 6,304 acres occupied by the perimeter fence and roads are added to the potential for a functional losses of 32,992 acres of northeastern Unit 3 and all of the 12,719-acre Subunit 4b (as in Items 2 and 3, above), there would be a 52,006-acre long-term loss of function within the 379,325-acre combined area of Unit 3 and Subunit 4b. Considering the 4,013-acre security-fenced area and roads, there would be a 49,715-acre permanent loss of function to the combined area of Unit 3 and Subunit 4b. Under these hypothetical scenarios, function would be retained in 86.3 to 86.9 percent of the combined acreage of Unit 3 and Subunit 4b and in 93.9 to 94.2 percent of all proposed critical habitat. We reiterate that connectivity to Mexico for Subunit 4a exists through Subunit 4c and the southeastern portion of Unit 3 in the Huachuca Mountains, regardless of the potential functional loss of Subunit 4b. We again note that both the long-term and permanent potential losses would be partially offset by the aforementioned permanent protection of 1,727 acres of conservation lands.

5. When the 6,304 acres occupied by the perimeter fence and roads are added to the potential for a functional losses of 32,992 acres of northeastern Unit 3, the 62,478-acre Subunit 4a, and the 12,719-acre Subunit 4b (as in Items 2 and 3, above), there would be a 114,484-acre long-term loss of function within the 441,803-acre combined area of Unit 3 and Subunits 4a and 4b. Considering the 4,013-acre security-fenced area and roads, there would be a 112,193-acre permanent loss of function to the combined area of Unit 3 and Subunits 4a and 4b. Under these hypothetical. Worst-case scenarios, function would be retained in 74.1 to 74.6 percent of the combined acreage of Unit 3 and Subunits 4a and 4b and in 86.7 to 86.9 percent of all proposed critical habitat. We reiterate that connectivity to Mexico for Subunit 4a exists through Subunit 4c and the southeastern portion of Unit 3 in the Huachuca Mountains, regardless of the potential functional loss of Subunit 4b; and that both the long-term and permanent potential losses would be partially offset by the aforementioned permanent protection of 1,727 acres of conservation lands.

Effects to Jaguar Movement

In order to reach a conclusion that the proposed action is "likely" to result in destruction or adverse modification of critical habitat, the analysis would have to show a "high probability" for ***each*** of the following: (1) that the jaguar would be unable to traverse the constricted area in Unit 3 and access Subunit 4b; (2) that such a preclusion would render Subunits 4b and 4a inaccessible to jaguars and/or preclude connectivity between the U.S. and Mexico; and (3) that both of those results would preclude or significantly diminish the conservation value of proposed critical habitat for jaguar recovery. It is our conference opinion that the standard of "highly probable" is not met for any of these arguments singly, let alone all of them combined.

1. Our analysis makes a plausible argument that jaguar movement between units 3 and 4b will become somewhat restricted, but does not reach the level that such movement will

likely be precluded. Known male jaguars have been documented as having traveled widely around southern Arizona in recent years, apparently despite the presence of numerous roads, lit areas, and other human disturbances. Even if movement through the constricted corridor were completely blocked, our analysis would have to show that precluding such movement would appreciably reduce the functionality of the currently proposed array of critical habitat. Two arguments might be made in this regard: that both units 4a and 4b will become inaccessible to jaguars if movement through the 1.5 km strip is curtailed, thus removing another 8.8 percent of critical habitat (7.3 percent in 4a, 1.5 percent in 4b) (see Item 3 in Habitat Loss analysis, above); and that preclusion of this connectivity will significantly impair jaguar movement into and out of Mexico. Neither of these arguments is adequately supported by the best available information. Further, we have analyzed three other hypothetical combinations, including: (1) the loss of function in Subunits 4a and 4b (see Item 3 under Habitat Loss section, above); (2) the effects of the action, the loss of function in Unit 3 and Subunit 4b (see Item 4, above); and (3) the effects of the action, the loss of function in Unit 3 and Subunits 4a and 4b (see Item 5, above). These hypothetical, and increasingly worst-case effects, are similarly unsupported by the best available information.

2. Although we know that a jaguar moved from the Whetstones (Unit 4a) to the Santa Ritas (Unit 3), we do not know what travel pathway it took. Subunit 4b connects Units 4a and 3; however, we have no evidence that 4b has ever been or ever will be used by a jaguar, and it is difficult for us to determine whether Subunit 4b is so important to jaguar movement that loss of this connectivity would lead to an adverse modification conclusion. Furthermore, there are other connections between Units 3 and 4 within Subunit 4c. Finally, the occupied critical habitat in both the Whetstones and the Santa Ritas remains connected to Mexico through at least two mountain ranges (the Patagonia and Huachuca mountains).

3. Supposing that connectivity between Unit 3 and Subunit 4a were completely precluded, and that such preclusion would sever connectivity to Mexico, we would then analyze the effect these factors would have on the conservation (recovery) of the jaguar. Three of the four guidance documents mentioned above - the 2004 guidance regarding the application of the “Destruction of Adverse Modification” standard under Section 7(a)(2) of the Endangered Species Act (FWS 2004), the Section 7 Consultation Handbook, and the proposed rule for jaguar critical habitat) - refer to either “conservation” or “recovery” of the species under analysis.

The question then becomes “What constitutes jaguar recovery?” The Jaguar Recovery Team, in its Recovery Outline for the species (FWS 2012a), recognizes the “Northwestern Recovery Unit” (NRU). By definition, the NRU is Essential to the recovery of the species rangewide. Therefore, we are analyzing the effect of the overall impact to critical habitat at the recovery unit level rather than rangewide. As described above, the proposed action may impact five out of eight recovery objectives in the Jaguar Recovery Outline (FWS 2012a), including the following: (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; and (5) Maintain or improve genetic fitness, demographic conditions, and health of the jaguar. Although these objectives may be affected by the proposed project, by itself, it is unlikely that the level of the effect will lead to measurable delays in the recovery of jaguars within the NRU.

We also examined the effects of the proposed action in relation to the definition of "conservation". Conservation, as defined under section 3 of the Act, means "to use and the use of all methods and procedures that are necessary to bring an endangered or threatened species to the point at which the measures provided under the Act are no longer necessary. Such methods and procedures include, but are not limited to, all activities associated with scientific resources management such as research, census, law enforcement, habitat acquisition and maintenance, propagation, live trapping, and transplantation, and, in the extraordinary case where population pressures within a given ecosystem cannot be otherwise relieved, may include regulated taking". The proposed action should have no significant effect on any of these activities.

Finally we examine the "Incremental Effects memo" which postulates, for purposes of assessing the economic impacts of proposed critical habitat, scenarios where an adverse modification opinion may occur. That memo says, in part, that adverse modification may result if "major construction projects (such as new highways, significant widening of existing highways), or construction of large facilities (such as large mining operations) could constitute adverse modification to jaguar critical habitat in both occupied and unoccupied subunits if connectivity within a critical habitat unit is severed." Additionally, the letter states that "major construction projects (such as new highways, significant widening of existing highways, or construction of large facilities) that could sever connectivity within these critical habitat subunits could constitute adverse modification. The most likely unoccupied subunits in which these activities may occur are 4b and 4c". The best available information indicates that connectivity is not likely to be "severed" by the proposed action.

Losing a portion of Unit 3 and possibly reducing connectivity to Subunit 4a, both areas considered by the proposed rule as essential to the conservation of jaguars, reduces the ability of critical habitat to function as intended by the proposed rule and somewhat diminishes the conservation value of critical habitat as a whole. That said, because the vast majority of critical habitat will be unaffected by the proposed action, its value will not be appreciably reduced. Overall, critical habitat will retain its function and ability to contribute to survival and recovery of the jaguar.

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.

The measures described below are non-discretionary, and must be included by the USFS as binding conditions of any grant or permit issued to the applicant, as appropriate, for the exemption in section 7(o)(2) to apply. The USFS has a continuing duty to regulate the activity that is covered by this Incidental Take Statement. If the USFS (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 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, the USFS, or the applicant 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

Confirmed jaguar detections have occurred within the action area as recently as October 2013. The detections were from trail cameras placed by resident hunters and/or researchers from the University of Arizona – jaguar and ocelot survey and monitoring project funded by the FWS and the Department of Homeland Security. All detections were located on lands administered by the Coronado National Forest, photographed at night, and all are suspected to be of a single male jaguar. One of the detections was from a trail camera located to the west of and adjacent to the proposed action area. Thus, incidental take of a jaguar is likely to occur because trail cameras have detected a male jaguar within the area subject to direct and/or indirect effects of the proposed (the action area).

Incidental take of one jaguar over the life of the project in the form of harassment is anticipated for the following activity:

1. Disturbance of jaguars due to construction, operation, and restoration of the mine and associated roads which disrupts normal behavior patterns which include, but are not limited to, breeding, feeding or sheltering. Construction and operation of the mine is anticipated to cause jaguars to shift home range location and travel longer distances, possibly through less suitable habitat. Extra travel would require jaguars to expend additional energy and increase the potential for encounters with humans, vehicles, potential competitors, and other stresses.

We anticipate the above anticipated incidental take will be difficult to detect. However, monitoring and reporting requirements will allow us to assess the effects of proposed project activities on jaguars. In addition, Rosemont will report to us any mortality or injury of jaguars due to collisions with vehicles or other activities. The amount of anticipated incidental take will have been exceeded, triggering a requirement for reinitiation (50 CFR §402.16[c]) if, for example:

1. Based on the annual and emergency reporting on the status of the proposed project:
   a. A jaguar is injured or killed through collision with a vehicle(s) associated with the proposed project;
   b. Unanticipated events occur that are attributable to the proposed action (e.g. toxic spills or plumes, wildfires, landslides) that are reasonably certain to have resulted in take; or
   c. Additional jaguars are documented in the action area that are reasonably certain to be taken by the proposed action.

In summary, and stated differently, the maximum allowable incidental take of jaguar is the harassment of one individual.

Effect of the Take

We conclude that this level of anticipated take is not likely to result in jeopardy to the jaguar, for the effects are not expected to appreciably reduce the survival and recovery of the species. Jaguars range from southern United States all the way to Argentina and thus, take of one jaguar in the form of harassment in the U.S. will not jeopardize the species.

REASONABLE AND PRUDENT MEASURES

The FWS believes the following Reasonable and Prudent Measures are necessary and appropriate to minimize impacts of incidental take of jaguar:

1. Minimize the effects of disturbance from noise and roads to the jaguar.
2. Monitor jaguars in the Santa Rita Mountains.
3. Monitor incidental take resulting from the proposed action and report to the FWS the findings of that monitoring.

TERMS AND CONDITIONS

To be exempt from the prohibitions of section 9 of the Act, Rosemont 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 Conditions implement Reasonable and Prudent Measure Number 1:

a. Minimize road-related noise, especially at night, through the use of techniques such as avoiding, to the extent practicable (i.e., that allows for safe driving conditions), horn use and "Jake-braking" (the use of an engine's compression combined with downshifting the transmission to slow a vehicle). Compliance with this Term and Condition may be demonstrated by placing signs advising vehicle operators to not employ "Jake-brakes" at both ends and the midpoint of the primary access road.

b. Limit speeds on the primary and secondary access roads and the Sycamore connector road no more than 25 miles per hour and employ the use of wildlife crossing signs. Speed limits will be made known to employees and contractors during safety training or equivalent and via the use of speed limit signs. Compliance with this term and condition may be demonstrated by placing speed limit signs in appropriate locations. Compliance may also be demonstrated by placing signs cautioning vehicle operators of the presence of wildlife both ends and the midpoint of the primary access road and at any other locations determined necessary by the Biological Monitor and/or other entities (while implementing the wildlife movement-related Conservation Measure).

2. The following Term and Condition implements Reasonable and Prudent Measure Number 2:

Rosemont shall conduct (or provide funding to conduct) jaguar surveys and monitoring for the life of the proposed mine plus the 5-year post-closure period. Jaguar surveys and monitoring shall be conducted by a contractor with expertise in large felid survey and monitoring, sampling design, GIS, and data analysis. Objectives of the study include, but are not limited to the following: (1) determine if the male jaguar previously detected near the proposed mine continues to use the area; (2) determine if additional jaguars are present in the vicinity of the mine; (3) gather basic information on jaguar movement and habitat use patterns in the vicinity of the mine, including, if possible, determining travel routes; and (4) enable operations to take into account the presence of jaguars in the immediate vicinity. The exact design, scope, and location of the study will be determined in the study plan and updated as needed to gather the best possible information on jaguars. Unless another study design of equal or lesser effort is determined to be potentially more scientifically effective (i.e., to allow for the best scientific information possible to be obtained), surveys and monitoring will be conducted for the first five years in a 200 km^2 area of jaguar proposed critical habitat roughly centered on the perimeter fence of the mine. Jaguars detected in this area will then be subject to focused monitoring. We note that 200km^2 is the largest, radio-telemetered home range noted from the northern portion of the species range by Rosas-Rosas and Bender (2012) (see Home Range and Movement section, above). After five years, FWS, FS, other entities, and Rosemont will meet to discuss and determine if the existing study design should be continued with the same level of effort, or if a new study design with a similar level of effort should be employed; the goal of either effort will be to continue to obtain the best information possible on jaguars in the action area. Rosemont shall implement the new study design, if warranted, for the life of project plus the 5-year post-closure period, unless another design of equal or lesser effort is determined to be more effective.

All jaguar detections will be reported to FWS and AGFD within 24 hours.

Jaguar survey and monitoring must commence prior to significant surface disturbance. Jaguar survey and monitoring will be conducted through non-invasive means, including, but not limited to the use of trail cameras,, and/or scat-detection dogs. Prior to the commencement of any field work: (1) a study plan (draft and final) will be submitted to and approved by the FWS and other entities; and (2) all necessary permits will be obtained, copies of which must be sent to FWS and other entities as applicable.

The study plan will include, among other information: (1) the study objectives; (2) a detailed description of survey and monitoring methods and analysis techniques to be employed, including the location and spatial array of paired cameras, track plots, or scat-detection dog transects, and frequency with which photos will be downloaded and viewed (at least monthly), track plots read, or scat-detection transects ran; (3) a communications plan that explains, among other things, how jaguar detections will be relayed to the FWS, AGFD, and the general public; and how media requests will be handled; (4) reporting format and schedule (reporting will include draft and final reports, as well as monthly updates); and (5) qualifications of the survey and monitoring team. All aspects of the study plan and implementation of the plan (including, but not limited to, who will conduct the study, how the study will be conducted, and when reports will be due) must be coordinated with FWS and other entities and approved by FWS. Additionally, all survey and monitoring efforts must be coordinated with the FWS, FS, other entities, affected land owners and managers, and other parties determined to be appropriate by the FWS.

The aforementioned survey and monitoring effort expands on the Conservation Measure in the Description of the Proposed Action of the BA which states "Rosemont will provide $50,000 to AGFD or other suitable entity approved by the CNF to support camera studies for large predators including jaguar and ocelot. The money will be provided for additional monitoring efforts between the Santa Rita and the Whetstone Mountains and along the Santa Rita Mountains. In addition to increasing knowledge regarding the movement of wildlife in the area, information collected during this investigation may identify a suitable wildlife crossing structure location." Please note that AGFD has requested that the agency not be referred to within task-oriented conservation measures; it only appears here due to the agency name appearing in quoted text. Reasonable and Prudent Measure Number 1 is required because the $50,000 camera study identified in the Conservation Measures is a small fraction of funding needed to conduct jaguar surveys and monitoring for the life of the proposed mine, plus 5-year post-closure period. To reduce study redundancy and possible disturbance to jaguars in the area, this Conservation Measure and the aforementioned survey and monitoring effort should be conducted by the same entity.

3. The following Term and Condition implements Reasonable and Prudent Measure Number 3:

To monitor incidental take resulting from the proposed action, Rosemont shall monitor the impacts of the action as they relate to jaguar and report these to the FWS for the life of the project. A report will be due to the FWS annually on March 1. 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 email and telephone.

Review requirement: The FWS believes that no more than one jaguar 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. FS must immediately provide an explanation of the causes of the taking and review with the FWS-AESO the need for possible modification of the reasonable and prudent measures.

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.

We recommend that the Forest Service and Rosemont further minimize the effects of night lighting and noise within the action area by:

a. Minimizing the light levels and the distance light emanates from the project site through the use of techniques such as decreasing the use of bright lights, employing methods to deflect lights coming out of project site, and minimizing the lights coming from buildings at the project site;
b. Coordinating the aforementioned Conservation Recommendations with FWS and other entities before the measures are employed.

Mr. Jim Upchurch, Forest Supervisor

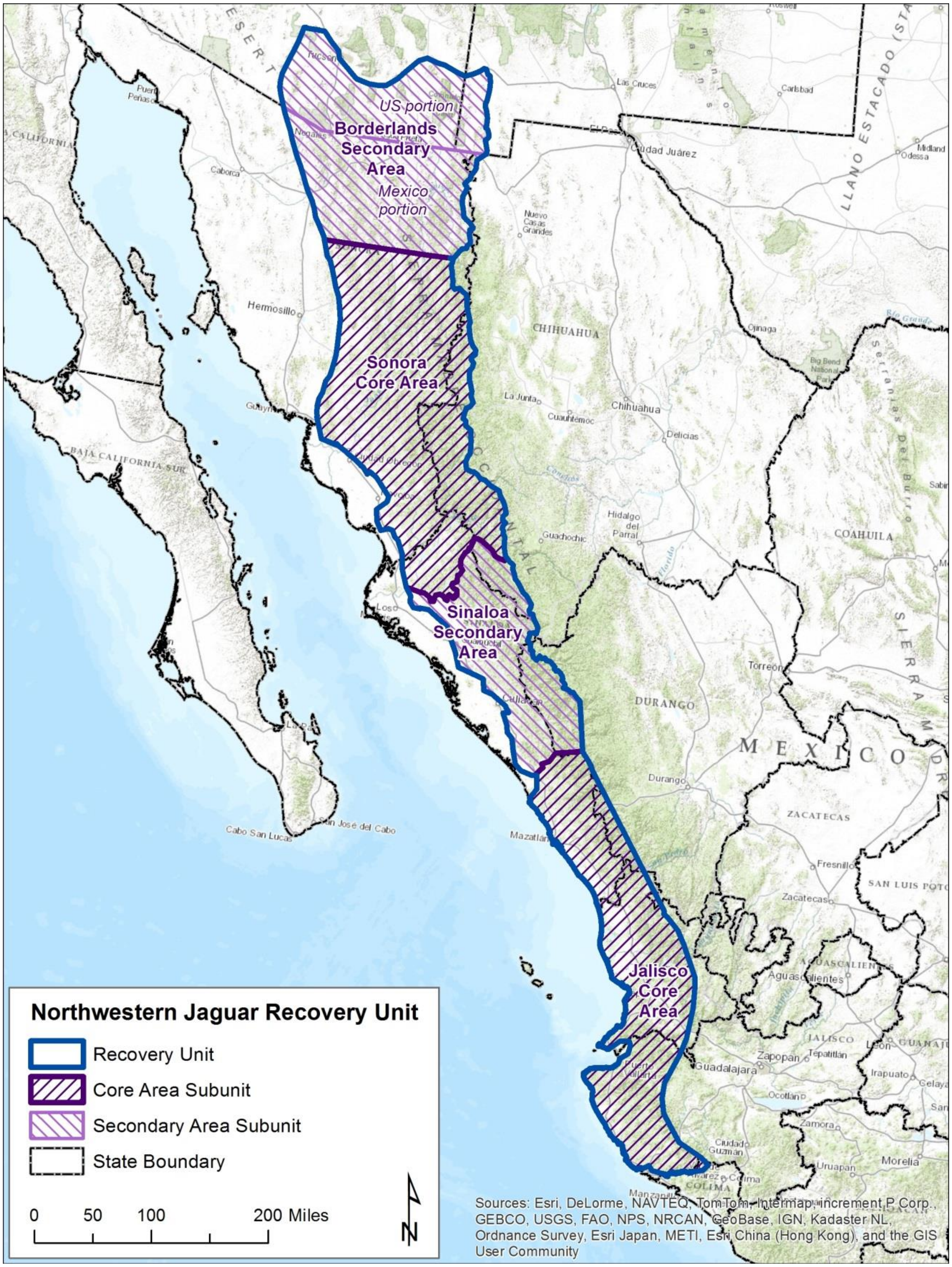

Figure J-1: Northwestern Jaguar Recovery Unit

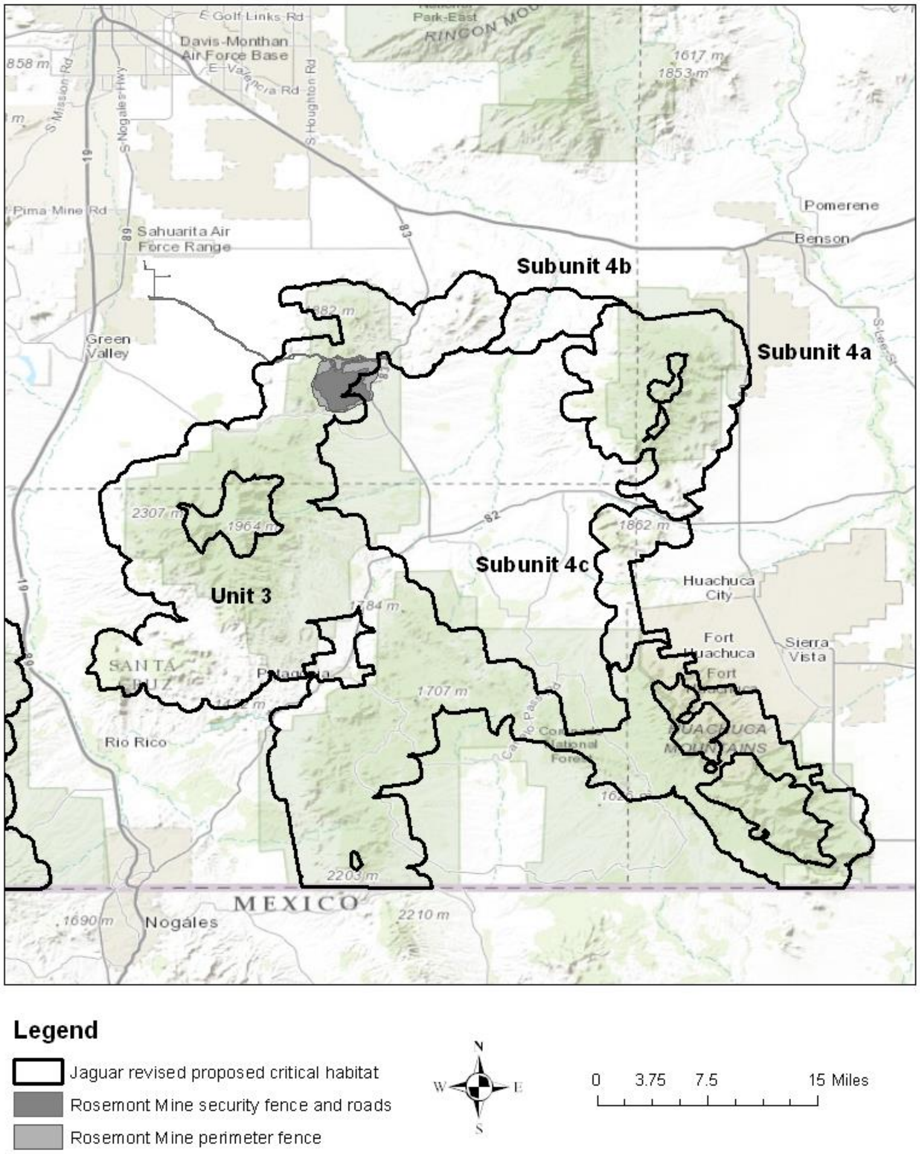

Figure J-2: Map showing the proposed action within proposed critical habitat Unit 3 in relation to Critical Habitat Unit 4 (Subunits a, b, and c).

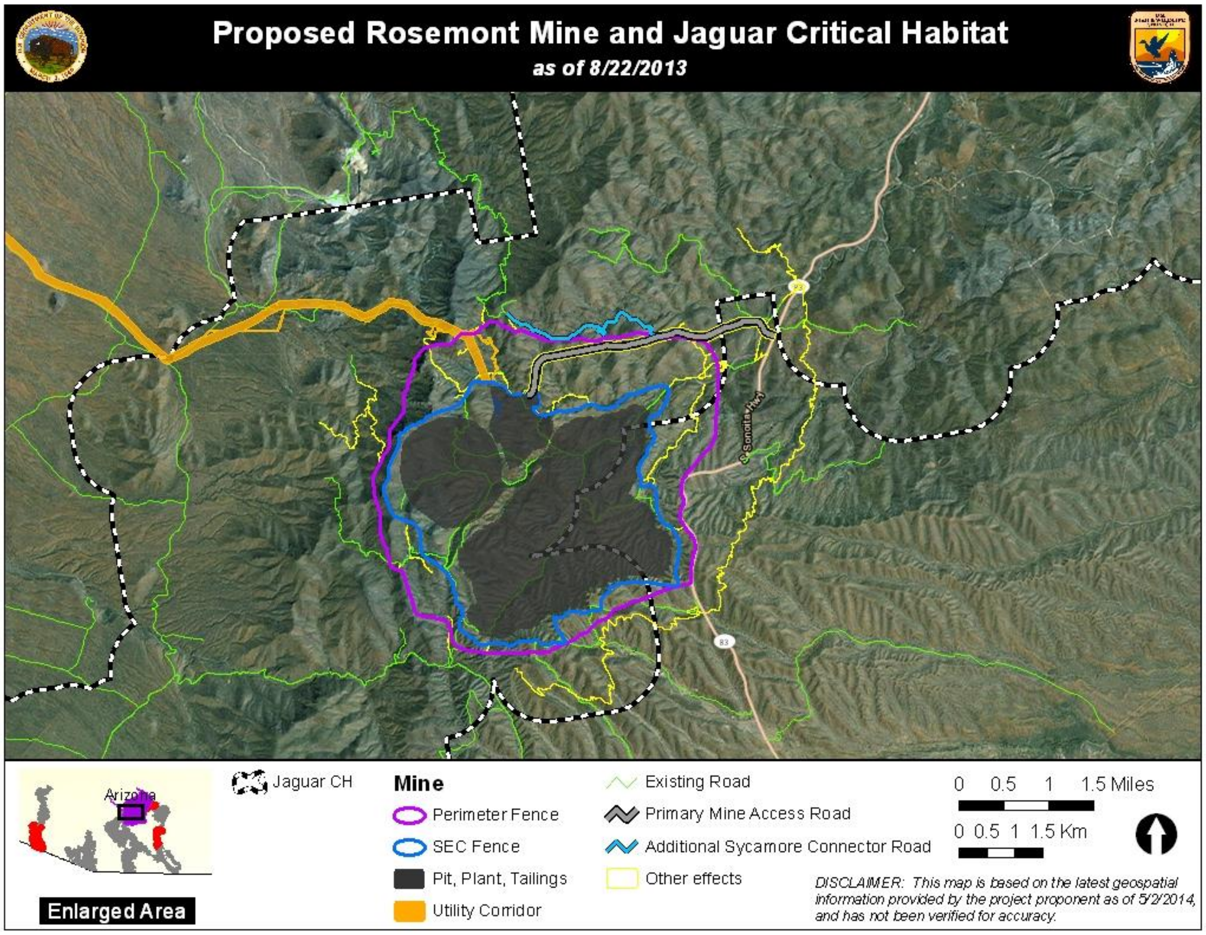

Figure J-3: Proposed Rosemont Mine Project and Jaguar Critical Habitat.

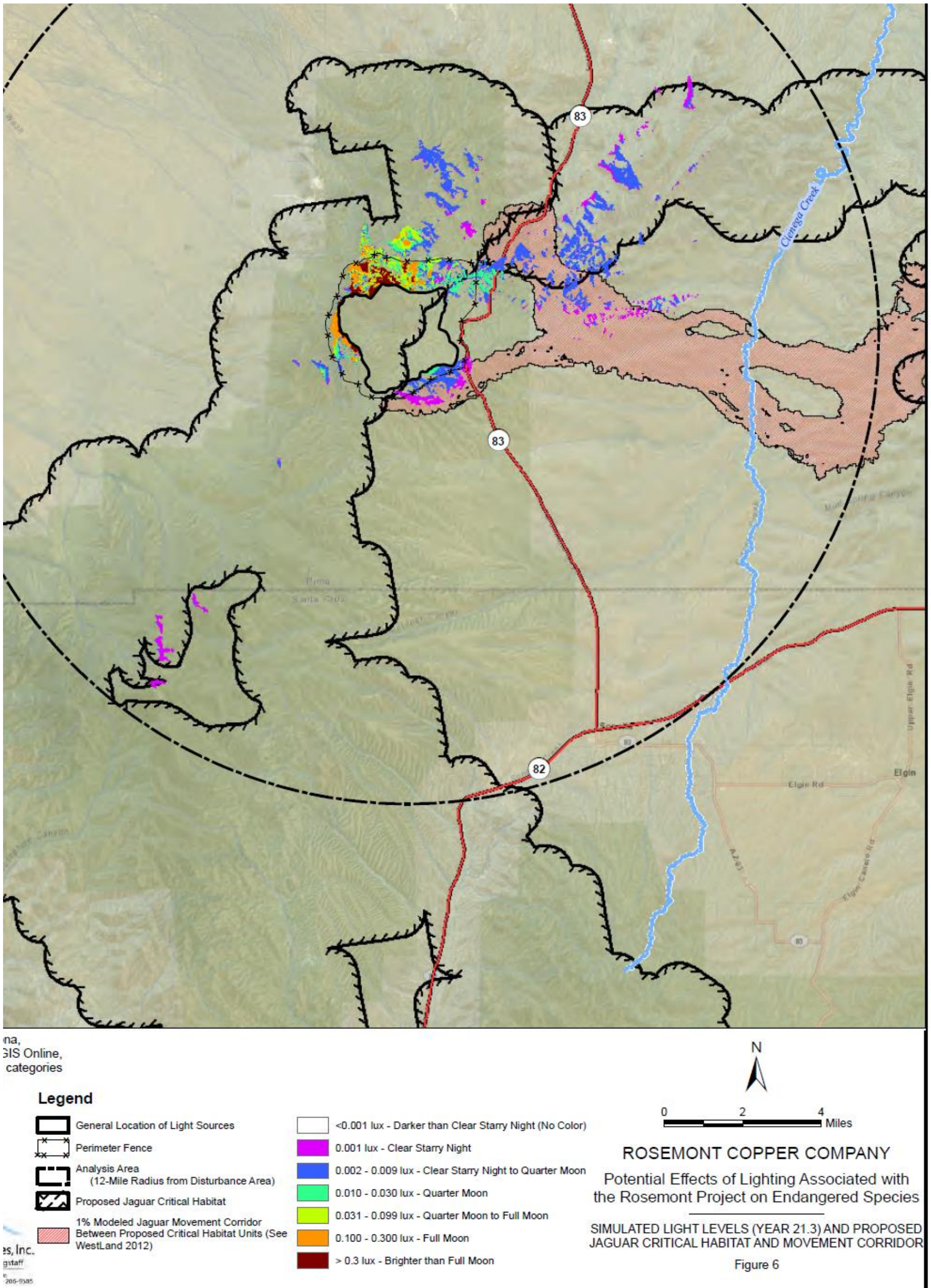

Figure J-4: Simulated light (horizontal) levels as a result of the proposed Rosemont Mine project in relation to jaguar critical habitat (Figure 6 of WestLand Resources Inc, 2012). Please note that this map uses a version of the proposed critical habitat boundaries superseded by the July 1, 2013, revised proposed rule (78 FR 39237).

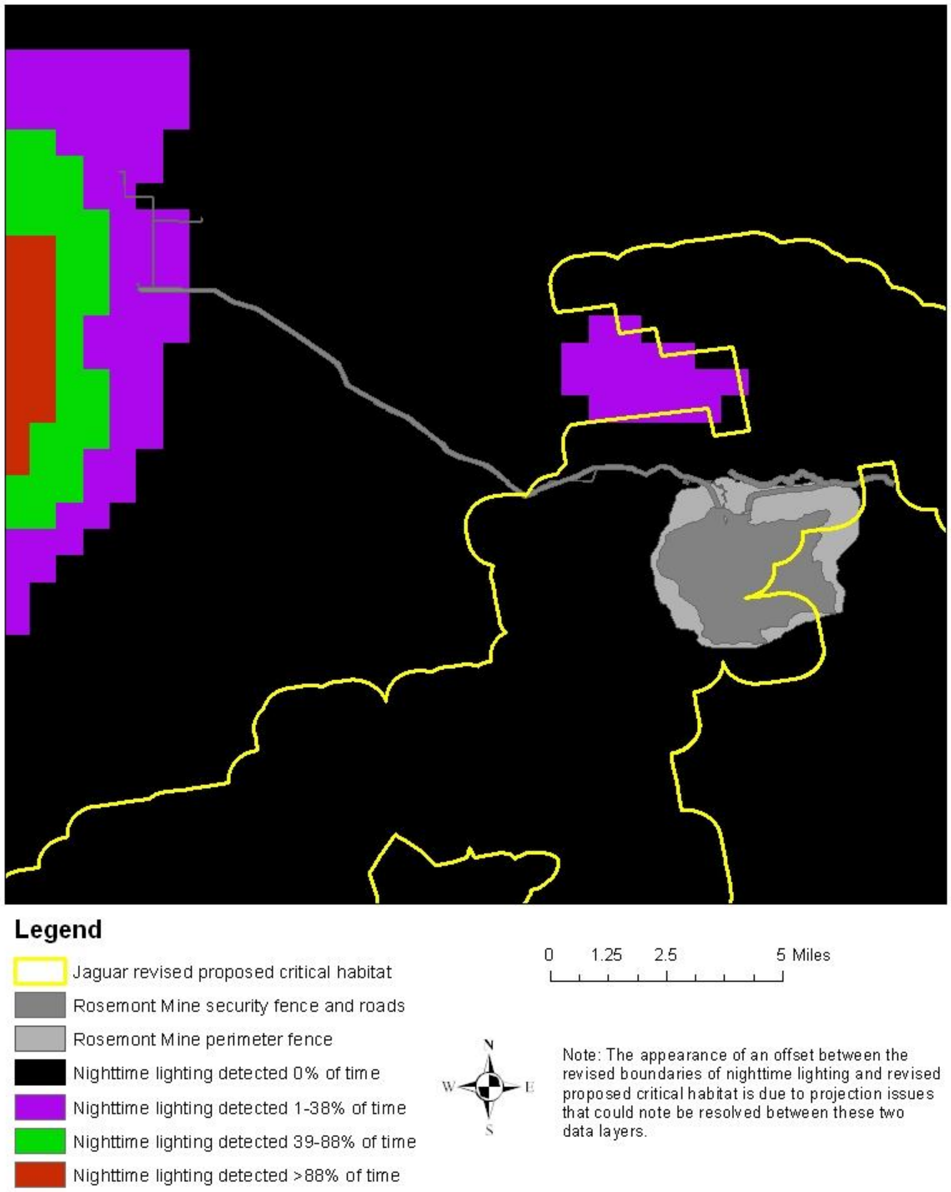

Figure J-5: Map showing nighttime lighting (based on data provided to FWS by the Wildlife Conservation Society) from the current Imerys Quarry (purple area) in relation to the proposed Rosemont mine and proposed jaguar critical habitat.

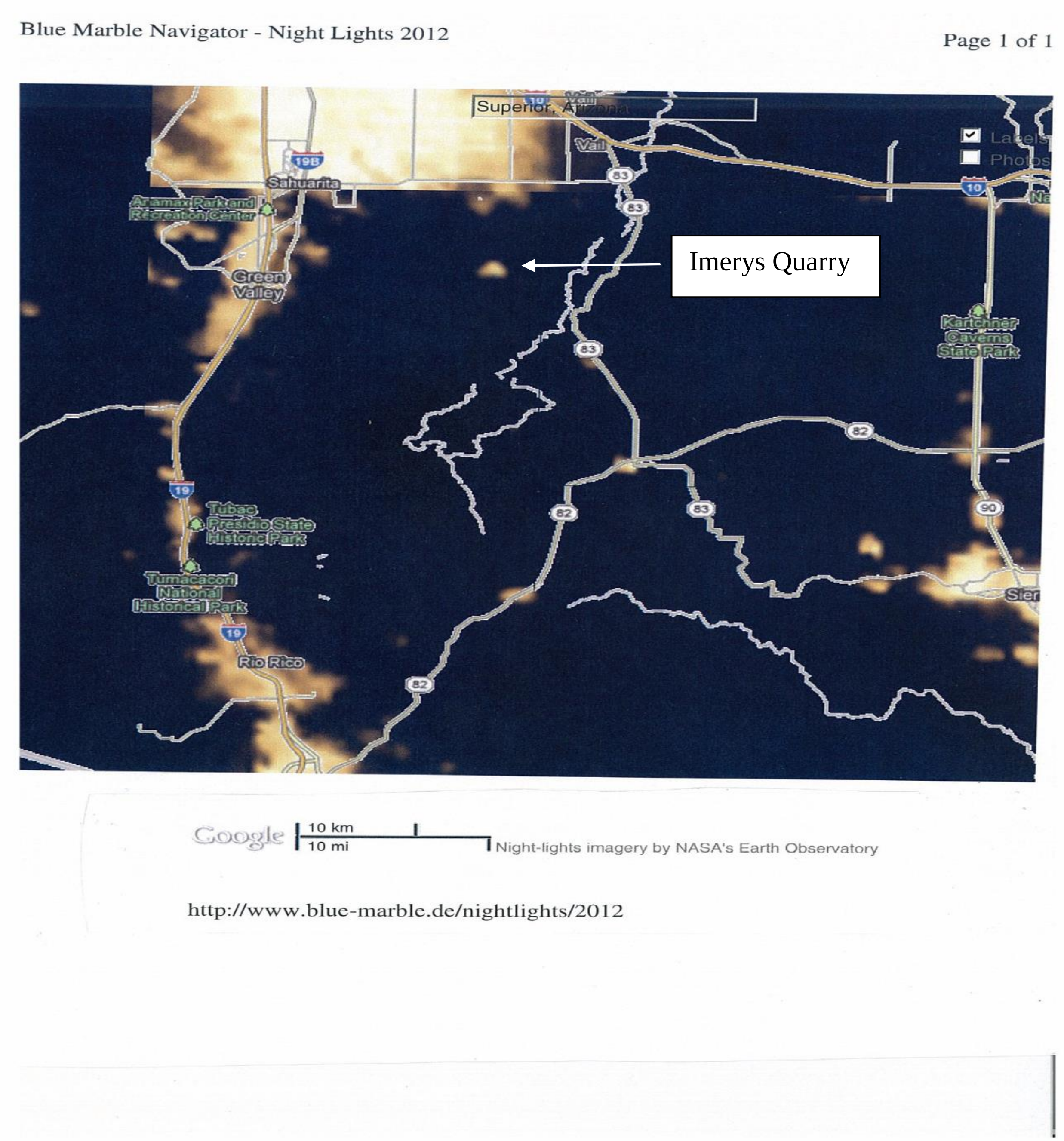

Figure J-6: Image of the currently operating mine known as Imerys Quarry located north of the proposed action at night. Image is from Blue Marble Navigator 2012 (http://www.blue-marble.de/nightlights/2012).

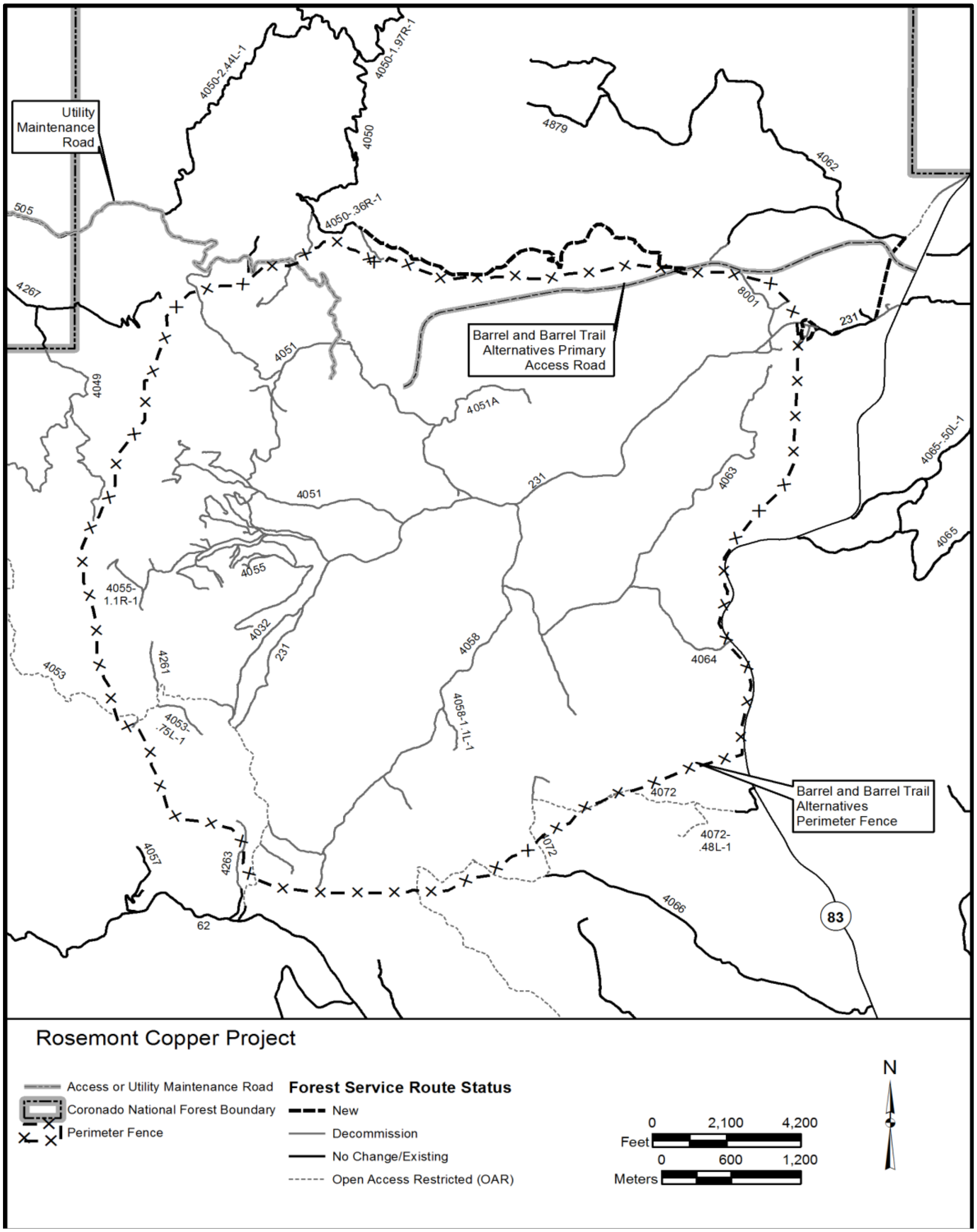

Figure J-7: Proposed location of the Sycamore Canyon Connector Road and existing National Forest System Roads.

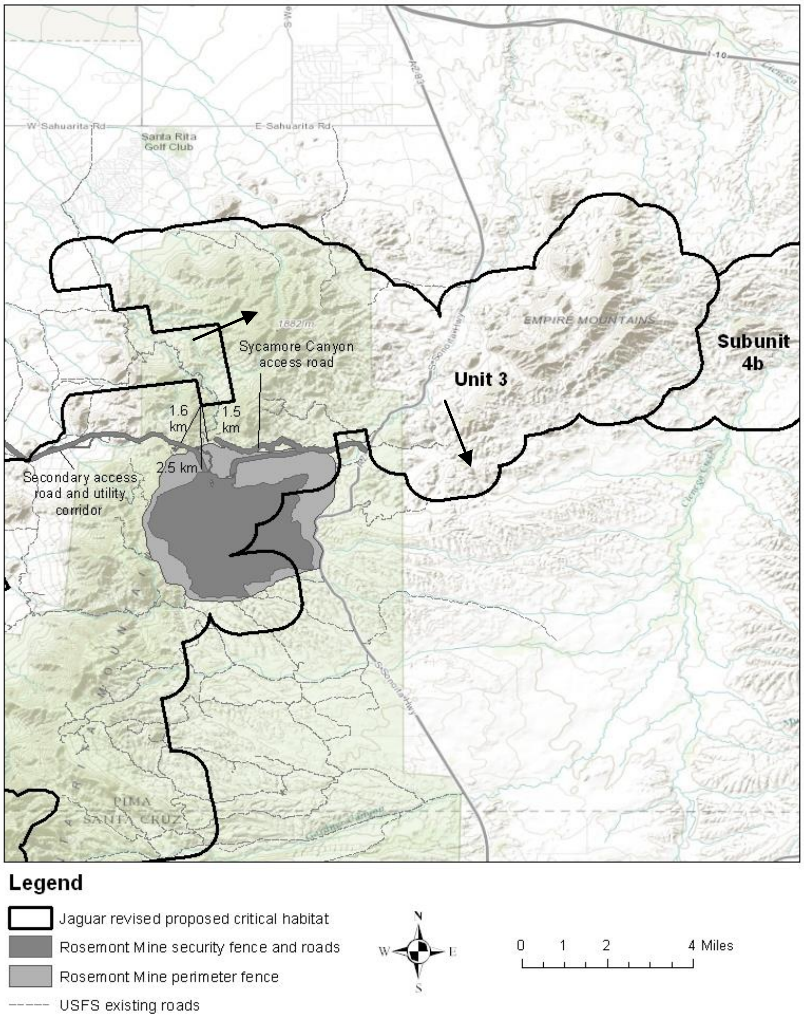

Figure J-8: The proposed action within proposed critical habitat Unit 3 and the distances between the perimeter fence of the proposed action and the active mine to the north (i.e., Imerys Quarry). Note that the area of the northeastern portion of Unit 3 between the 1.5km line and the western boundary of Subunit 4b is 32,992 acres (13,351 hectares).

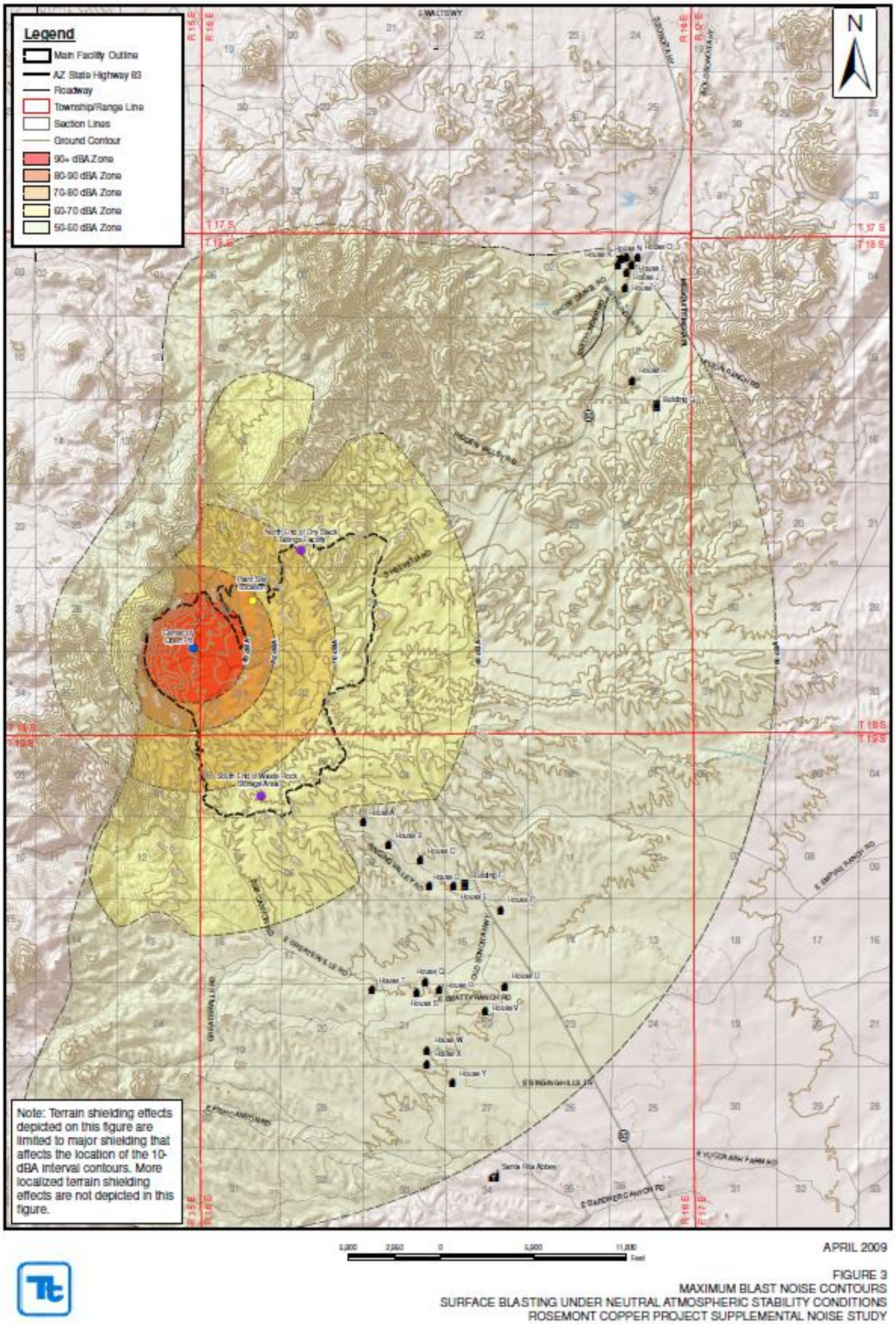

Figure J-9: Maximum noise contours for surface blasting (Tetra Tech 2009)

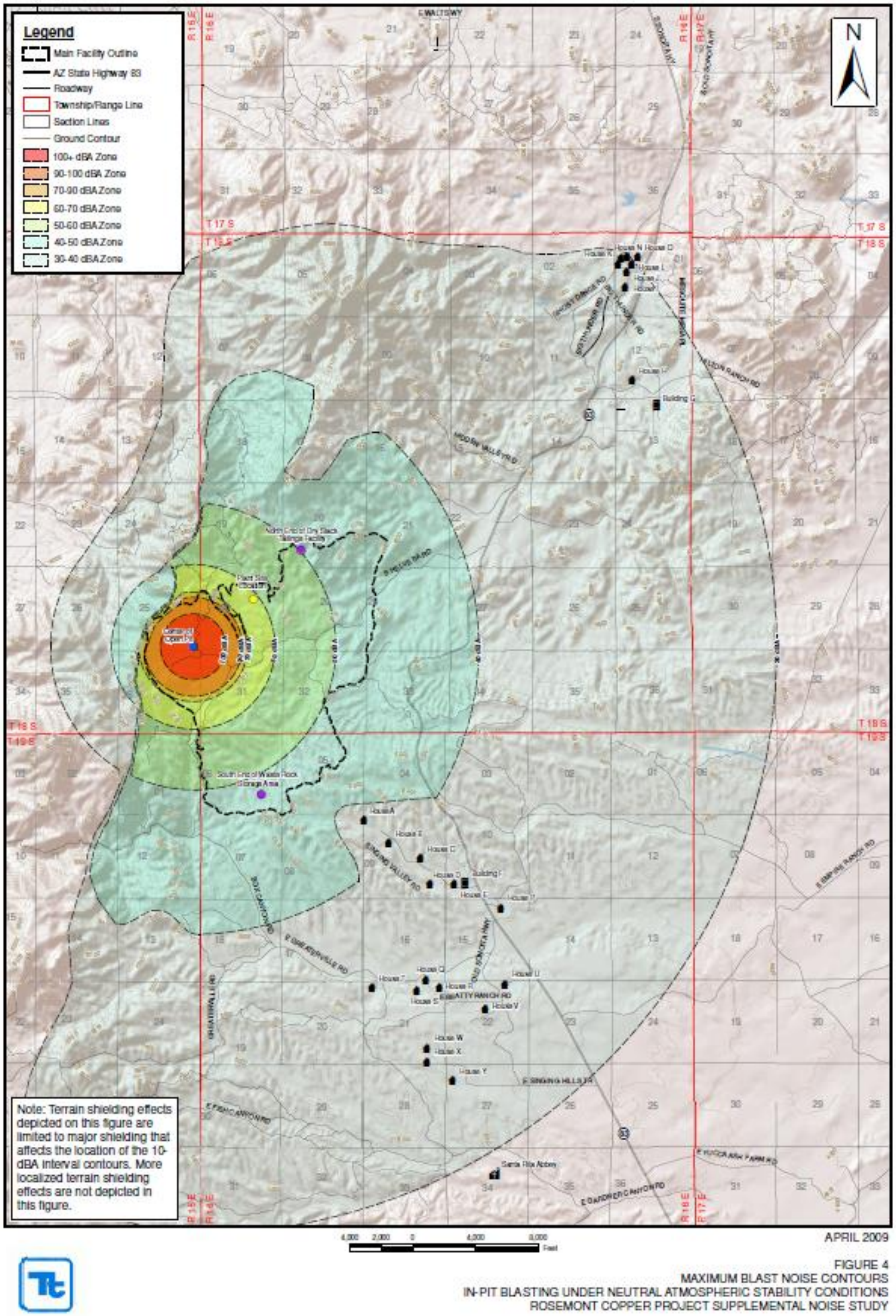

Figure J-10: Maximum noise contours for in-pit blasting (Tetra Tech 2009)

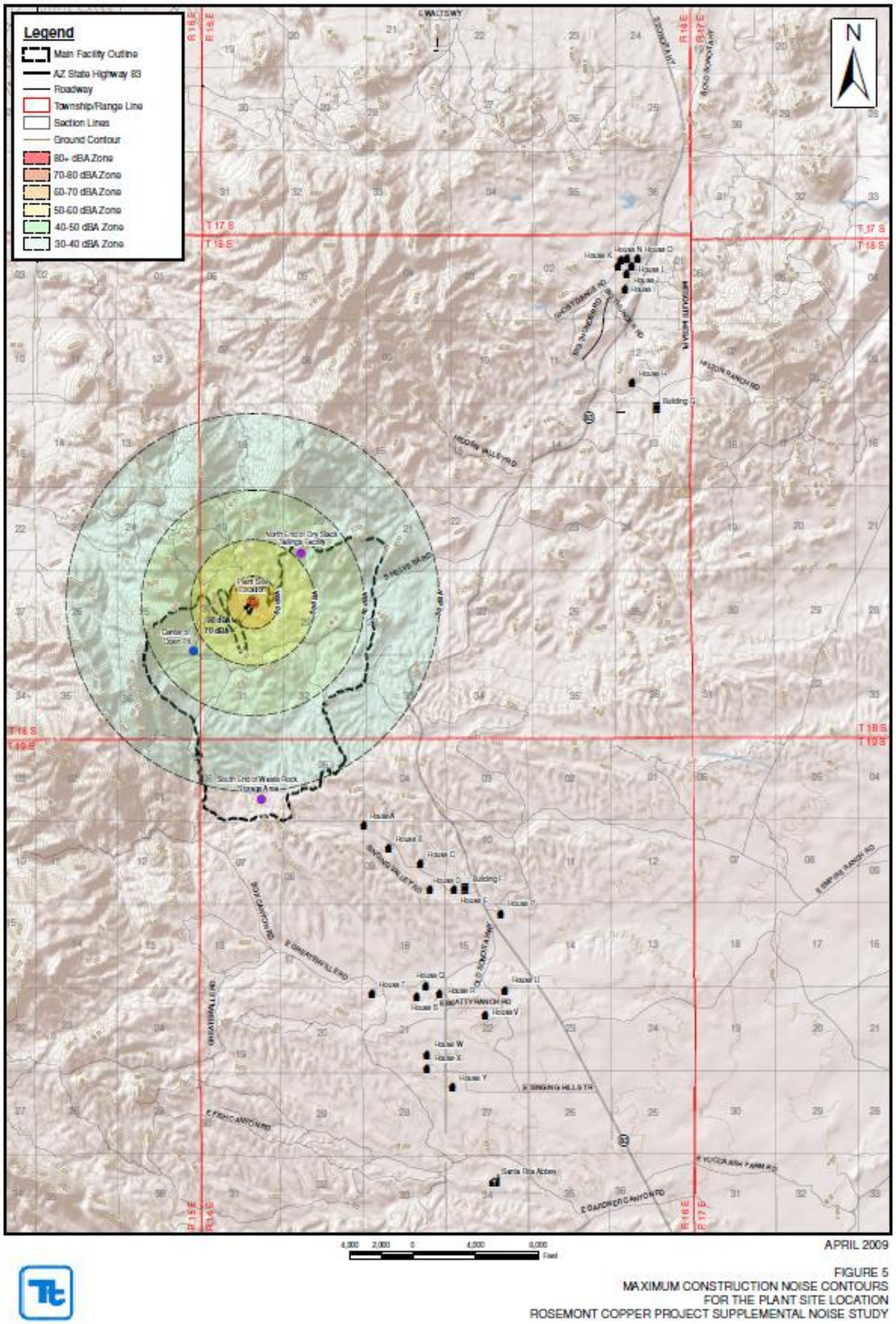

Figure J-11: Maximum noise contours for construction activities (Tetra Tech 2009)

Status of the Species - Ocelot

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 ranged from the southwestern U.S. to northern Argentina (FWS 2010). Two subspecies occur in the United States: the Texas ocelot (*L. pardalis albescens*) and the 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 (FWS 1972). The 1969 Act maintained separate lists for foreign and native wildlife. The ocelot appeared on the foreign list, but due to an oversight, not 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 (FWS 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 (FWS 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 (FWS 2003) 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 2002).

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)* (FWS 1990). A draft revised recovery plan was made available for public comment in 2010 (FWS 2010), 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 1) the assessment, protection, and restoration of sufficient habitat to support viable populations of the ocelot in the borderlands of the U.S. and Mexico; 2) the reduction of effects of human population growth and development to ocelot survival and mortality; 3) the maintenance or improvement of genetic fitness, demographic conditions, and health of the ocelot; 4) 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; 5) the use of adaptive management, in which recovery is monitored and recovery tasks are revised by the FWS in coordination with the Recovery Team as new information becomes available; and 6) 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 is 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. 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; 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 7-16 kg (15-35 lbs), with males weighing more than females (FWS 2010). 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.* (1991 and 2005), Tewes and Schmidly (1987), and others. Ocelots may live greater than 10 years in the wild and can live longer (18 years plus) in captivity (Murray and Gardner 1997). Gestation lasts about 70-80 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 (Laack *et al.* 2005, Mora *et al.* 2000, Murray and Gardner 1997). 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, FWS 2010).

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 km and 42.5 km (Navarro-Lopez 1985, Tewes 1986, Laack 1991, FWS 2010). 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 Jessica Lamberton-Moreno 2012) and Huachuca Mountains (detections from 2011 to 2013) (email from Tim Snow, AGFD, March 13, 2013). The nearest recently (in 2011) documented female with young (one kitten) was located about 48 km (30 miles) south of the international border in the Sierra Azul of Sonora, Mexico (Avila-Villegas and Jessica Lamberton-Moreno 2012). 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 miles) to Globe; 55 km (35 miles) to the Huachuca Mountains (email from Tim Snow, AGFD, March 18, 2013), and 110 km (70 miles) to the Whetstone Mountains (Avila-Villegas and Jessica Lamberton-Moreno 2012). Avila-Villegas and Jessica Lamberton-Moreno (2012), however, believe that travel from northern Sonora to Globe seems unlikely.

Ocelots are solitary animals that maintain home ranges (Emmons 1988, Ludlow and Sunquist 1987, Laack 1991, Crawshaw 1995). Home range for the ocelot varies throughout its range. Adult female home range sizes vary from approximately 2 km^2 to 17 km^2 (494 to 4,201 acres) while adult male home range sizes vary from approximately 5 km^2 to 38 km^2 (1,235 to 9,390 acres), both depending on the habitat type in which they are found (Tewes 1986, Ludlow and Sunquist, 1987, Crawshaw and Quigley 1989, Emmons 1988, Konecny 1989, Laack 1991, Caso 1994, 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 acres) for males, 2.87 km^2 (709 acres) for females; Navarro-Lopez (1985): 2.5 km^2 (623 acres) for males, 2.1 km^2 (512 acres) for females; Tewes (1986): 12.3 km^2 (3,039 acres) for males and 7.0 km^2 (1,730 acres) for females; and Caso (1994): 8.1 km^2 (2,006 acres) for males, 9.6 km^2 (2,372 acres) 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 acres) and for females was 5.8 km^2 (1,433 acres); average home range size using the 95% Minimum Convex Polygon estimator was 16.26 km^2 (4,018 acres) for males and 7.34 km^2 (1,814 acres) 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 (Tewes 1986, Ludlow and Sunquist 1987, Crawshaw and Quigley 1989, Crawshaw 1995, Fernandez 2002). 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 the open pastures much less often.

In Sonora, López González *et al.* (2003) reported 27 of 36 (75%) of 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 meters (2,297 +/- 1,476 feet), at which altitudes 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 relatively thicker than the surrounding areas. Avila-Villegas and Jessica Lamberton-Moreno (2012) collected 68 camera photographs of ocelots in the Sierra Azul in northern Sonora, all of which were taken at elevation ranges between 1,275 and 1,625 meters (4,183 and 5,331 feet) 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 Jessica Lamberton-Moreno 2012); and, based on photographs, the two in the Huachuca Mountains most likely occur in Madrean Lower Montane Pine-Oak Forest and Woodland (email from Tim Snow, AGFD, March 13, 2013). This habitat is described as from 1,710 to 2,560 meters (5,600 to 8,400 feet), containing more than 50 percent oak, and can hold dense manzanita, silk tassel, and silverleaf oak (email from Tim Snow, AGFD, March 13, 2013).

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 Jessica Lamberton-Moreno 2012). 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, FWS 2010). In Mexico, it has disappeared from much of its historic range on the west coast (Caso *et al.* 2008). There are reports of the species up to 3,000 meters (9,842 feet) (Caso *et al.* 2008).

Estimating population sizes of secretive nocturnal carnivores, especially species that inhabit dense vegetative cover, such as the ocelot, is difficult. Currently the U.S. population of the Texas ocelot subspecies has fewer than 100 individuals, found in two separated populations in southern Texas (FWS 2010). A third and larger population of the Texas/Tamaulipas ocelot subspecies occurs more than 200 km (~124 mi) south of the Texas/Mexico border in the Sierra of Tamaulipas, Mexico (Caso 1994).

In Arizona, four individuals have recently been documented, including the following: 1) one ocelot in the Whetstone Mountains in 2009; 2) one subadult male (road-killed) near Globe in 2010; 3) one male in the Huachuca Mountains in 2011; and 4) one ocelot (sex unknown) in the Huachuca Mountains in 2012 (email from Tim Snow, AGFD, March 13, 2013). Both ocelots in the Huachuca Mountains have been re-detected on multiple occasions. However, detections of ocelots in southern Arizona remain an uncommon occurrence.

In addition to the recent Arizona sightings, a number of ocelots have been documented just south of the U.S. border in Sonora, Mexico. Specifically, with the use of camera traps, 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 (Avila-Villegas and Jessica Lamberton-Moreno 2012). Additionally, one ocelot was documented in 2009 in the Sierra de Los Ajos, about 30 miles south of the U.S. border near Naco, Mexico (FWS 2010).

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 + 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).

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); 25/100 km^2 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, FWS 2010, Caso *et al.* 2008). 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 Mexico-United States 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 and accounted for 45 percent of deaths of 80 radio-tagged ocelots between 1983 and 2002 (FWS 2010). Twenty-six of 61 ocelot deaths between 1983 and 2004 were caused by vehicle collisions in Texas (FWS 2010). 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 2, between Imuris and Cananea, Sonora; and two ocelots illegally killed in the Sierra Azul (email from Sergio Avila, Sky Island Alliance, March 15, 2013).

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 FWS 2010 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 hectares (45,000 acres) 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. Sky Island Alliance (2013) is also conducting felid surveys and landowner outreach in northern Sonora. During this effort, they documented the most recent ocelot occurrences in the extreme northern Sonora, including a female with a kitten. Lastly, it is possible that the proposd critical habitat for jaguar will afford some protection to ocelots occurring in the U.S., though the species respective habitat preferences differ.

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.

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 (FWS 2010). Although ocelots have not been documented in the Santa Rita Mountains, it is believed that they may occur there. For the purposes of the ocelot analysis, we use the Forest Service Action Area definition (i.e., defined by hydrology).

Terrain, Vegetation Communities, and Climate in the Action Area

See the Action Area Section above for a description of terrain, vegetation communities, and climate in the action area.

Status of the Ocelot in the Action Area

Life History and Habitat

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 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 Jessica Lamberton-Moreno 2012). Based on limited records, in Arizona ocelots appear to be associated with Madrean evergreen woodland (Avila-Villegas and Jessica Lamberton-Moreno 2012) and

Madrean lower montane pine-oak forest and woodland email from Tim Snow, AGFD, March 13, 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, etc.) continue in Sonora. Ocelots in Arizona and Sonora represent a distributional extreme and the important genetic/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

The Arizona/Sonora ocelot subspecies occurs in southern Arizona and northwestern Mexico (Sonora and northern Sinaloa) (FWS 2010). Breeding populations occur in the States of Sonora and northern Sinaloa (FWS 2010). As stated above in the "Status of the Species", estimating population sizes of secretive nocturnal carnivores, especially species that inhabit dense vegetative cover, such as the ocelot, is difficult. 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 + 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). In northern Sonora, a number of ocelots have recently been documented just south of the U.S. border in Sonora, Mexico. Specifically, with the use of camera traps, six live 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 Jessica Lamberton-Moreno 2012). Additionally, one ocelot was documented in 2009 in the Sierra de Los Ajos, about 30 miles south of the U.S. border near Naco, Mexico (FWS 2010).

No ocelots have been detected in the Santa Rita Mountains, site of the proposed action. However, based on habitat type (i.e., Madrean evergreen woodland) it is believed that ocelots may or could occur in these mountains (personal communication with Tim Snow, AGFD, March 18, 2013, and Sergio Avila, SIA, March 18, 2013). If ocelots occur in the Santa Rita Mountains, they are likely part of a population occurring primarily to the south. As stated above, ocelots are known to occur in the Huachuca Mountains in Arizona and the Sierra Azul in Sonora; however they have also been documented in the Whetstone Mountains and Globe (i.e., to the east and northeast of the Santa Rita Mountains, respectively). In between the Santa Ritas and the Sierra Azul lie the Patagonia Mountains. Although no ocelots have been documented in the Patagonias, this range is connected to areas south of the border, does not have an impermeable border fence, and habitat there is similar to that found in the Sierra Azul.

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/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 or colonization of new habitats is discouraged by the proliferation of highways.

Other threats to ocelots in this region are international border issues such as 1) infrastructure along and near the U.S. - Mexico border, including pedestrian and vehicle barriers and towers and their associated roads and lighting; and 2) illegal and U.S. Border Patrol traffic (pedestrian and vehicle). Fences designed to prevent the passage of humans (i.e., pedestrian barriers) undoubtedly 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 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 Proposed 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 or interdependent with that action (50 CFR §402.02). Indirect effects occur later in time but are reasonably certain to occur. "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 (50 CFR §402.02).

The proposed action may result in degradation of potential ocelot habitat and disturbance to ocelots, if they occur in the action area. Construction and operations of the mine, including the associated roads, will result in removal, destruction, and degradation of potential ocelot and ocelot prey habitat and may disturb ocelots, if they occur in the action area, causing changes in, among other things, their habitat use and movement patterns. Conservation measures included in the project description may help offset adverse effects to ocelots to some extent.

Direct and Indirect Effects of Project Construction

The BA defines the project area as all areas in which any ground disturbance would take place as a result of the proposed action, including the mine pit, waste rock facilities, tailings, access roads, utility corridors, and on-site facilities (i.e., the mine "footprint" or area within the security fence plus roads, corridors, and trails). The project area acreage, expected to result in direct impacts owing to project activities, is 5,401 acres, which includes areas within the security fence (4,228 acres), the primary access road (226 acres), the utility line corridor (889 acres), the Sycamore connector road (26 acres), decommissioned or new forest roads (59 acres), and the rerouted Arizona National Scenic Trail (19 acres) (see USFS 2013d, as cited in the Description of the Proposed Action section). Please note that the 5,401-acre value does not include 20 acres of decommissioned roads.

According to our calculations using ArcMap, the footprint of the facilities contained within the security fence plus roads (primary and secondary access) will permanently remove 2,519 acres of Madrean evergreen woodland, 2,301 acres of semidesert grassland, and 581 acres of riparian vegetation (see USFS 2013d, as cited in the Description of the Proposed Action section). Madrean evergreen woodland is more likely to be used by ocelots than semidesert grassland; however, ocelots have been occasionally documented using grasslands in areas outside of Arizona. Therefore, it is possible that ocelots may use semidesert grassland and/or riparian vegetation, 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 to 9,390 acres), using only the area of Madrean evergreen woodland that will be removed by the project, an equivalent of about 0.3 to 5.1 potential ocelot home ranges may be directly impacted (eliminated) by the project footprint assuming no overlap in home ranges. However, because ocelot home ranges overlap (Murray and Gardner 1997, Fernandez 2002, Dillon and Kelly 2008), the project footprint could impact additional ocelot home ranges. Removal of semidesert grassland may also impact ocelots, particularly their movement between patches of more suitable habitat. In addition to eliminating potential ocelot habitat (5,401 acres of combined madean evergreen woodland, semidesert grassland, and riparian vegetation), the project will also result in the direct removal of the same acreage of ocelot prey habitat, possibly leading to a reduced prey base for ocelots.

Outside of the security fence, a perimeter barbed-wire fence will be constructed. The perimeter fence will encompass 6,990 acres of land (USFS 2013b); however, except where specific features such as the primary or secondary access roads are located, the land between the perimeter fence and the security fence will not be disturbed. Together, the perimeter fence plus roads will affect 3,479 acres (1,407 ha) of Madrean evergreen woodland and 4,071 acres (1,647 ha) of semidesert grassland. Effects to riparian vegetation will be similar to the permanent effects (581 acres), as most of these impacts are within the security-fenced mine site itself. Given the influence of human and vehicular activity, noise, and lighting (see discussion below for information on effects of noise, lights, and traffic on ocelots) within the perimeter fence, we anticipate that ocelots, if they occur in the area, would likely avoid most or all areas within the perimeter fence. If this is the case, then the mine will impact (using only the area of Madrean evergreen woodland that will be affected over the long term) an equivalent of about 0.4 to 7 potential ocelot home ranges, possibly more considering home range overlap and potential ocelot use of semidesert grassland.

Because the project footprint completely bisects a north-south oriented swath of Madrean evergreen woodland (see Figure I-4), potential ocelot movement to and from the northern portion of the Madrean evergreen woodland swath from the main portion of Madrean evergreen woodland in the Santa Ritas (or vice-versa) may be impeded. If ocelots occurring in the main portion of Madrean evergreen woodland were completely cut-off from the northern portion, this would mean an additional ~5,000 acres of suitable potential ocelot habitat (all Madrean evergreen woodland) would become unavailable to ocelots, if they occur in the area. If ocelots currently occur to the north of the mine, after project construction, they may become isolated from ocelots to the south. It may be possible for ocelots to move around the mine; however, the semidesert grassland to the east and west of the mine does not appear to provide as much cover for ocelots as the Madrean evergreen woodland, therefore making it less likely that ocelots would use it. Additionally, because some areas to the east and west of the mine will be subjected to the effects of lighting, noise, and vibrations (see discussion below on effects of lighting, noise, and vibrations), it seems even more unlikely that ocelots, if they occur in the area, would move around the mine to reach the northern portion of the Madrean evergreen woodland swath. Habitat loss associated with the project may cause any ocelots that might occur in the area, to shift their home ranges to the south which could result in increased intra- and inter-specific competition.

Construction activities associated with all aspects of the project may disturb ocelots, if they occur in the area, and cause them to flee and/or avoid the area. Construction of the primary access road, over half of which is in Madrean evergreen woodland, is more likely to result in disturbance to ocelots than construction of and upgrades to the utility maintenance road which crosses through semidesert grassland. Disturbance to ocelots can result in behavioral changes, increased energetic expenditures, and interference with habitat use, including use of movement corridors. These could lead to decreased dispersal opportunities; changes in home range size and location; increased inter- and intra-specific competition; increased difficulty meeting energetic needs; etc. Once project construction is complete, ocelots would be excluded from the area as it will be devoid of habitat, as described above. Ocelot avoidance of the project area could cause them 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., cougars, jaguars), and other stresses.

Disturbed ground associated with mine and road construction will be susceptible to colonization by invasive nonnative plants such as Lehmann lovegrass. Nonnative species may outcompete native species and the introduced grasses also carry fire better and burn hotter than the native species, which would degrade ocelot habitat. That said, the project proponent plans to monitor and control invasive nonnative plants throughout the project area.

Effects of Lighting, Noise, and Vibrations from Mining Operations

In addition to the direct project footprint, ocelots that might occur within the vicinity of the project footprint may also be adversely affected by light, noise, and vibrations associated with the project. Although Rosemont has developed a light pollution mitigation plan, artificial illumination will increase light levels at night, which could impact ocelots, if they occur in the area, resulting in a wide variety of effects, including, but not limited to, changes in behavior, habitat use, and dispersal and movement patterns (Beir 1995, Longcore and Rich 2004). Artificial lighting will originate from mine-site illumination and also from vehicles in the project area and beyond. Horizontal light will extend to at least 12 miles beyond the project, in some areas, and sky glow from the project is expected to be comparable, but less than, sky glow from Ajo, Arizona (a town of about 3,300 people) (WestLand 2012). The light intensity will be highest at the mine and attenuate farther from the mine. Most areas within a 12-mile radius will be blocked from line of sight horizontal light emanating from the project area; however, ocelots are mobile animals that travel over hills and ridgetops, and therefore would likely see the horizontal lighting (mapped by WestLand 2012 and reproduced in Figure J-4 in this document) during regular movement activities or during dispersal. Additionally, sky glow will likely be visible to ocelots in the vicinity of the mine at all times at night.

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 and/or shift from open areas to cover as light level of moonlight increases (Grigione and Mrykalo 2004).

Although the effects of artificial lighting on ocelots is not known, given that they use denser cover during bright moon light conditions, we anticipate that they will seek areas of denser vegetation wherever horizontal light enters habitat. It is difficult to understand how sky glow may be perceived by ocelots, but because it is not shining down from above, it may not have the same effect as bright moon conditions. Never-the-less, sky glow may increase the ambient illumination in the area, which could potentially affect ocelots to some degree.

Because areas to the east, southeast, west, and northwest of the project area appear (on Google Earth) less densely vegetated than areas within the perimeter fence, and because those areas will be affected by light, noise, and vibrations, ocelots may avoid or reduce their movement past or around the mine altogether. This could mean that potential east-west ocelot movement (dispersal) between the Santa Rita and Whetstone mountains could be restricted. If they do move around, as mentioned above, extra travel would require ocelots to expend additional energy and increase the potential for encounters with humans, vehicles, potential predators (i.e., cougars, jaguars), and other stresses.

Similarly, noise and vibrations from construction of the mine or blasting could disturb ocelots, if they occur in the area, 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 (NoiseQuest 2013; Pater *et al.* 2009). As with lighting, the magnitude of impacts from vibration and light are uncertain, but these impacts are expected to decrease as the distance from the mine increases. In the same or similar manner that lighting, noise, and vibrations affect ocelots, these anthropogenic disturbances may also adversely affect ocelot prey, leading to a reduced prey base for ocelots.

Indirect Effects of Roads

The primary access road, a new 2-lane paved road, will be constructed to provide access between SR83 and the mine. The primary access road will leave SR 83 along a straight section of the highway, just to the east of the northern portion of the perimeter fence. The majority of the primary access road skirts the northeastern portion of the perimeter fence. In addition to the primary access road, Rosemont and the Coronado National Forest will build a new access road into Sycamore Canyon. This road will also occur along the northern portion of the perimeter fence, but north of the fence. The primary access road from SR 83 to the perimeter fence will be open to the public at all times. During mine operations, the primary access road between the perimeter fence and the mine will be closed to the public; however, after mine closure, it will be open to public use. The Sycamore connector road will also be open to the public at all times. Because these roads cut across Madrean evergreen woodland and heavy vehicular use of the primary access road (which will vary from passenger vehicles to haul trucks and heavy equipment) is anticipated day and night (traffic along the new access road into Sycamore Canyon is anticipated to be limited), vehicle collisions with ocelots could occur. However, given that ocelots in Arizona are scarce and only one ocelot is known to have been struck by a vehicle in Arizona, it seems unlikely that there is great risk of vehicles striking ocelots on the primary access road. 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 Primary Access and Sycamore Connector roads will fragment suitable habitat between the mine footprint and areas to the north (see Figure 1 of the June 2012 BA and Figures I-1, I-2, and J-3 in this document). However, as stated above, we anticipate ocelots, if they occur in the area, would avoid most or all areas within the perimeter fence given the human influence between the project footprint and perimeter fence. The Sycamore connector road will also fragment suitable habitat outside of the perimeter fence, and provide public access to areas north of the mine. Improved accessibility in this area will likely result in increased public use in suitable ocelot habitat which may lead to somewhat increased: (1) disturbance to ocelots in the area, (2) risk of collision with ocelots, (3) habitat degradation, (4) risk of human-caused fire, (5) risk of illegal killing of ocelots, and (6) human presence in remote areas (i.e., roads may facilitate increased off-road vehicle and pedestrian traffic in the area).

The utility maintenance road (previously called the secondary access road), located within the utility corridor, crosses through semidesert grassland to the northwest of the mine. Vehicle traffic is expected to be much lighter on this road in comparison to that on the primary access road. Therefore, we anticipate the chance of vehicles colliding with ocelots is very low. The road will be closed to the public during mine construction and operation; however, after the mine is closed, portions of the improved road may be reopened to the public. The road will have been made passable to low-clearance, 2-wheel drive vehicles as part of the proposed action. This could result in increased public access to ocelot habitat which could lead to an increase in the six aforementioned threats.

Disturbed ground will be susceptible to colonization by invasive nonnative plants such as buffelgrass and Lehmann lovegrass. Nonnative species may outcompete native species and the introduced grasses also carry fire better and burn hotter than the native species, which would degrade potential ocelot habitat. The invasive species monitoring and control measures (see Appendix B) will minimize this potential effect on NFS lands, but private and ASLD lands may be subject to lesser requirements.

As a result of the mine, increased traffic is anticipated on SR83 (likely primarily on the part of the road that heads from the mine to the north, located within semidesert grassland) and possibly on Box Canyon Road (part of which crosses through Madrean evergreen woodland) which may lead to an increased risk of ocelots being struck by vehicles. However, as stated above, this risk is likely fairly low. Increased vehicular traffic on these roads will likely lead to increased collisions with ocelot prey; however, we do not anticipate this will have a significant impact on the ocelot prey base.

Effects of Conservation Measures

The conservation measures that are part of the proposed action act to some extent to offset some adverse effects to ocelots. For example, purchase of land parcels, particularly Sonoita Creek Ranch (1,200 acre parcel) which contains some Madrean evergreen woodland and riparian habitat and provides habitat connectivity between the Patagonia and Santa Rita Mountains, may benefit ocelots. Additionally, the project proponent will provide $50,000 to an entity approved by the Coronado National Forest to support camera studies for predators including jaguar and ocelot. The money will be provided for additional monitoring efforts between the Santa Rita and the Whetstone Mountains and along the Santa Rita Mountains. In addition to increasing knowledge regarding the movement of wildlife in the area, information collected during this investigation may identify a suitable wildlife crossing structure location that could be constructed. That said, $50,000 is likely only enough funding to conduct carnivore monitoring in a limited geographic area for about six months which is generally not a sufficient amount of time to collect quality data on cryptic carnivore movement.

Effects to Recovery of the Ocelot in the ASMU with the Project

As stated in the “Status of the Species” 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. Although the northern part of the ASMU, where the proposed action is located, is likely important to the recovery of the ocelot in the ASMU, we do not anticipate that the proposed action will preclude recovery of the ASMU. The proposed action may directly and indirectly impact sufficient habitat to support a handful of ocelot home ranges and may also reduce connectivity with areas to the north and east. That said, because the project will affect a relatively small area of the overall ASMU, it is likely that the ASMU population goal of 2,000 ocelots could still be reached even with the impacts from the mine, particularly given that most of the ASMU occurs in Sonora. Because habitat linkages to facilitate an ASMU metapopulation 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. 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, the effects of the proposed action, and the cumulative effects, 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 following:

1. Although we anticipate the proposed action will result in the loss of potential ocelot habitat, the loss is relatively small in the context of the range of the ASMU of ocelot. Thus, the project is not expected to significantly affect the distribution, numbers, and reproduction of ocelots in the ASMU.
2. Although connectivity to ocelot habitat to the north and east may be reduced, connectivity of ocelot habitat south of the mine to Mexico will remain intact. Thus, the project is not expected to significantly affect the distribution, numbers, and reproduction of ocelots in the ASMU.
3. Conservation measures in the proposed action are anticipated to offset adverse effects of the proposed action to ocelots to some extent.

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.

Amount or Extent of Take Anticipated - Ocelot

Occupancy is difficult to document for rare and secretive animals. While there are no documented occurrences of ocelots in the Santa Rita Mountains, we conclude that, based on the consistent and increasing occurrence of ocelots in adjacent areas and the presence of appropriate habitat and habitat connectivity, ocelots are likely to occur in the project area. However, we do not anticipate the proposed action will result in incidental take of ocelots because, although we consider the action area likely to be occupied by ocelots, we do not believe it meets the standards relating to documented occupancy 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). If, however, ocelots are definitively documented in the action area in the future, reinitiation of consultation would be prudent to reexamine incidental take.

Status of the Species - Pima Pineapple Cactus

The Pima Pineapple cactus was listed as an endangered species without critical habitat on September 23, 1993 (58 FR 49875). Factors that contributed to the listing include habitat loss and degradation, habitat modification and fragmentation, limited geographical distribution and species rareness, illegal collection, and difficulties in protecting areas large enough to maintain functioning populations. In 2005, a 5-year review was initiated for the Pima Pineapple cactus (70 FR 5460). This review was completed in 2007 and recommended no change to the cactus's classification as an endangered species (U.S. Fish and Wildlife Service 2007).

Recent investigations of taxonomy and geographical distribution focused in part on assessing the validity of the taxon (see Baker 2004, Baker 2005, and Schmalzel *et al.* 2004). Although there is evidence for a general pattern of clinal variation across the range of the species (Schmalzel *et al.* 2004), this does not preclude the recognition of taxonomic varieties within *C. sheeri* (= *C. robustispina*). Baker (2005) found that there are distinct geographical gaps between the distribution of this subspecies and the other subspecies, which occur in eastern Arizona, New Mexico, and Texas, and that the subspecies are morphologically coherent within their respective taxa (Baker 2004). His geographical and morphological work supports the idea that the sub-specific groups within *C. robustispina* are indeed discrete, and merit separate taxonomic status as subspecies (U.S. Fish and Wildlife Service 2007).

We have determined that Pima Pineapple cactus that are too isolated from each other may not be effectively pollinated. For example, the major pollinator of Pima Pineapple cactus is thought to be *Diadasia rinconis*, a ground-nesting, solitary, native bee. McDonald (2005) found that Pima Pineapple cactus plants need to be within approximately 600 m (1,969 ft) of each other in order to facilitate effective pollination. Based on this information and other information related to similar cacti and pollinators, we have determined that Pima Pineapple cactus plants that are located at distances greater than 900 meters from one another become isolated with regard to meeting their life history requirements. The species is an obligate outcrosser (not self-pollinating), so it is important for plants to be within a certain distance to exchange pollen with each other. Also, the study found that pollination was more effective when other species of native cacti are near areas that support Pima Pineapple cactus. The native bees pollinate a variety of cacti species and the sole presence of Pima Pineapple cactus may not be enough to attract pollinators.

The Pima Pineapple cactus occurs south of Tucson, in Pima and Santa Cruz counties, Arizona, as well as in adjacent northern Sonora, Mexico. In Arizona, it is distributed at very low densities throughout both the Altar and Santa Cruz valleys, and in low-lying areas connecting the two valleys. This cactus generally grows on slopes of less than 10 percent and along the tops (upland areas) of alluvial bajadas. The plant is found at elevations between 2,360 feet (ft) and 4,700 ft (Phillips *et al.* 1981, Benson 1982, Ecosphere Environmental Services Inc. 1992), in vegetation characterized as either or a combination of Arizona upland of the Sonoran desertscrub community and semi-desert grasslands (Brown 1982, Johnson 2004). Paredes-Aguilar *et al.* (2000) reports the subspecies from oak woodlands in Sonora. Several attempts have been made to delineate habitat within the range of Pima Pineapple cactus (McPherson 2002, RECON Environmental Inc. 2006, U.S. Fish and Wildlife Service unpublished analysis) with limited success. As such, we are still unable to determine exact ecological characters to help us predict locations of Pima Pineapple cactus or precisely delineate Pima Pineapple cactus habitat (U.S. Fish and Wildlife Service 2007), except perhaps in localized areas (U.S. Fish and Wildlife Service 2005).

As a consequence of its general habitat requirements, considerable habitat for this species appears to exist in Pima and Santa Cruz counties, much of which is unoccupied. Pima Pineapple cactus occurs at low densities, widely scattered, sometimes in clumps, across the valley bottoms and bajadas. The species can be difficult to detect, especially in dense grass cover. For this reason, systematic surveys are expensive and have not been conducted extensively throughout the range of the Pima Pineapple cactus. As a result, location information has been gathered opportunistically, either through small systematic surveys, usually associated with specific development projects, or larger surveys that are typically only conducted in areas that seem highly suited for the species. Furthermore, our knowledge of the distribution and status of this species is gathered primarily through the section 7 process; and we only see projects that require a Federal permit or have Federal funding. There are many projects that occur within the range of Pima Pineapple cactus that do not undergo section 7 consultation, and we have no information regarding the status or loss of plants or habitat associated with those projects. For these reasons, it is difficult to address abundance and population trends for this species.

The AGFD maintains the Heritage Data Management System (HDMS), a database identifying elements of concern in Arizona and consolidating information about their distribution and status throughout the state. This database has 5,553 Pima Pineapple cactus records, 5,449 Pima Pineapple cactus of which have coordinates. Some of the records are quite old, and we have not confirmed whether the plants are still alive. We also cannot determine which plants may be the result of multiple surveys in a given area. Of the known individuals (5,553), approximately 1,340 Pima Pineapple cactus plants are documented in the database as extirpated as of 2003. There have been additional losses since 2003, but that information is still being compiled in the database. The database is dynamic, based on periodic entry of new information, as time and staffing allows. As such, the numbers used from one biological opinion to the next may vary and should be viewed as a snapshot in time at any given moment. We have not tracked loss of habitat because a limited number of biological assessments actually quantify habitat for Pima Pineapple cactus.

We do know the number and fate of Pima Pineapple cactus that have been detected during surveys for projects that have undergone section 7 consultation. Through 2010, section 7 consultations on development projects (e.g., residential and commercial development, mining, infrastructure improvement) considered 2,680 Pima Pineapple cactus plants found on approximately 15,192 acres within the range of the Pima Pineapple cactus. Of the total number of plants, 1,985 Pima Pineapple cactus (74 percent) were destroyed, removed, or transplanted as a result of development, mining, and infrastructure projects. In terms of Pima Pineapple cactus habitat, some of the 15,192 acres likely did not provide Pima Pineapple cactus habitat, but that amount is difficult to quantify because Pima Pineapple cactus habitat was not consistently delineated in every consultation. Of the 15,192 acres, however, we are aware that 14,545 acres (96 percent) have been either permanently or temporarily impacted. Some of these acres may still provide natural open space, but we have not been informed of any measures (e.g., conservation easements) that have been completed to ensure these areas will remain open. Through section 7 consultation on non-development-related projects (e.g., fire management plans, grazing, buffelgrass control), we are aware of an additional 781 plants within an unknown number of acres; we do not know the number of acres because these types of projects are often surveyed for Pima Pineapple cactus inconsistently, if at all. Across the entire Pima Pineapple cactus range, it is difficult to quantify the total number of Pima Pineapple cactus lost and the rate and amount of habitat loss for three reasons: 1) we review only a small portion of projects within the range of Pima Pineapple cactus (only those that have Federal involvement and are subject to section 7 consultation), 2) development that takes place without any jurisdictional oversight is not tracked within Pima and Santa Cruz counties, and 3) many areas within the range of the Pima Pineapple cactus have not been surveyed; therefore, we do not know how many plants exist or how much habitat is presently available.

Some additional information related to the survival of Pima Pineapple cactus comes from six demographic plots that were established in 2002 in the Altar Valley. The results from the first year (2002-2003) indicate that the populations were stable; out of a total of over 300 Pima Pineapple cactus measured, only 10 died, and two Pima Pineapple cactus seedlings were found (Routson *et al.* 2004). The plots were not monitored in 2004, but were visited again starting in May 2005. In the two years between September 2003 and September 2005, 35 individuals, or 13.4 percent, of the original population had died and no new seedlings were found (Baker 2006). Baker (2006) suggests that recruitment likely occurs in punctuated events in response to quality and timing of precipitation, and possibly temperature, but there is little evidence until such events occur. He goes on to say that further observations need to be made to determine the rate at which the population is declining, because, based on an overall rate of die-off of 13.4 percent every two years, few individuals will be alive at this site after 15 years. As this monitoring program continues, critical questions regarding the life cycle of this species will be answered.

Threats to Pima Pineapple cactus continue to include habitat loss and fragmentation, competition with non-native species, and inadequate regulatory mechanisms to protect this species. We believe residential and commercial development, and its infrastructure, is by far the greatest threat to Pima Pineapple cactus and its habitat. However, we have only a limited ability to track the cumulative amount of development within the range of Pima Pineapple cactus. What is known with certainty is that development pressure continues in Pima and Santa Cruz counties.

Invasive grass species may be a threat to the habitat of Pima Pineapple cactus. Habitat in the southern portion of the Altar Valley is now dominated by Lehmann lovegrass (*Eragrostis lehmanniana*). According to Gori and Enquist (2003), Boer lovegrass (*Eragrostis chloromelas*) and Lehmann lovegrass are now common and dominant on 1,470,000 acres in southeastern Arizona. They believe that these two grass species will continue to invade native grasslands to the north and east, as well as south into Mexico. These grasses have a completely different fire regime than the native grasses, tending to form dense stands that promote higher intensity fires more frequently. Disturbance (like fire) tends to promote the spread of these non-natives (Ruyle *et al.* 1988, Anable *et al.* 1992). Roller and Halvorson (1997) hypothesized that fire-induced mortality of Pima Pineapple cactus increases with Lehmann lovegrass density. Buffelgrass (*Pennisetum ciliare*) has become locally dominant in vacant areas in the City of Tucson and along roadsides, notably in the rights-of-way along Interstate 10 and State Route 86. Some portions of Pima Pineapple cactus habitat along these major roadways are already being converted to dense stands of buffelgrass, which can lead to recurring grassland fires and the destruction of native desert vegetation (Buffelgrass Working Group 2007).

The effects of climate change (i.e., decreased precipitation and water resources) are a threat to the long-term survival and distribution of native plant species, including the Pima Pineapple cactus. For example, temperatures rose in the twentieth century and warming is predicted to continue over the twenty-first century. Although climate models are less certain about predicted trends in precipitation, the southwestern United States is expected to become warmer and drier. In addition, precipitation is expected to decrease in the southwestern United States, and many semi-arid regions will suffer a decrease in water resources from climate change as a result of less annual mean precipitation and reduced length of snow season and snow depth. Approximately half of the precipitation within the range of the Pima Pineapple cactus typically falls in the summer months; however, the impacts of climate change on summer precipitation are not well understood. Drought conditions in the southwestern United States have increased over time and may have contributed to loss of Pima Pineapple cactus populations through heat stress, drought stress, and related insect attack, as well as a reduction in germination and seedling success since the species was originally listed in 1993, and possibly historically. Climate change trends are likely to continue, and the impacts on species will likely be complicated by interactions with other factors (e.g., interactions with non-native species and other habitat-disturbing activities).

The Arizona Native Plant Law can delay vegetation clearing on private property for the salvage of specific plant species within a 30-day period. Although the Arizona Native Plant Law prohibits the taking of this species on State and private lands without a permit for educational or research purposes, it does not provide for protection of plants *in situ* through restrictions on development activities. Even if Pima Pineapple cactus are salvaged from a site, transplanted individuals only contribute to a population if they survive and are close enough (within 900 m [(2,970 ft]) to other Pima Pineapple cactus to be part of a breeding population from the perspective of pollinator travel distances and the likelihood of effective pollination. Transplanted Pima Pineapple cactus have variable survival rates, with moderate to low levels of survival documented. Past efforts to transplant individual Pima Pineapple cactus to other locations have had limited success. For example, on two separate projects in Green Valley, the mortality rate for transplanted Pima Pineapple cactus after two years was 24 percent and 66 percent, respectively (SWCA, Inc. 2001, WestLand 2004). One project southwest of Corona de Tucson involved transplanting Pima Pineapple cactus into areas containing *in situ* plants. Over the course of three years, 48 percent of the transplanted individuals and 24 percent of the *in situ* individuals died (WestLand 2008). There is also the unquantifiable loss of the existing Pima Pineapple cactus seed bank associated with the loss of suitable habitat. Furthermore, once individuals are transplanted from a site, Pima Pineapple cactus is considered to be extirpated from that site, as those individuals functioning in that habitat are moved elsewhere.

Pima County regulates the loss of native plant material associated with ground-disturbing activities through their Native Plant Protection Ordinance (NPPO) (Pima County 1998). The NPPO requires inventory of the site and protection and mitigation of certain plant species slated for destruction by the following method: the designation of a minimum of 30 percent of on-site, permanently protected open space with preservation in place or transplanting of certain native plant species from the site. There are various tables that determine the mitigation ratio for different native plant species (e.g. saguaros, ironwood trees, Pima Pineapple cactus) with the result that mitigation may occur at a 1:1 or 2:1 replacement ratio. Mitigation requirements are met through the development of preservation plans. The inadvertent consequence of this ordinance is that it has created a "market" for Pima Pineapple cactus. Any developer who cannot avoid this species or move it to another protected area must replace it. Most local nurseries do not grow Pima Pineapple cactus (and cannot grow them legally unless seed was collected before the listing). As a result, environmental consultants are collecting Pima Pineapple cactus seed from existing sites (which can be done with a permit from the Arizona Department of Agriculture and the permission of the private landowner), germinating seed, and placing Pima Pineapple cactus plants grown from seed back on these sites. There have been no long-term studies of transplant projects, thus the conservation benefit of these actions is unknown. Moreover, growing and planting Pima Pineapple cactus does not address the loss of Pima Pineapple cactus habitat that necessitated the action of transplanting cacti in the first place.

Other specific threats that have been previously documented (U.S. Fish and Wildlife Service 1993), such as overgrazing, illegal collection, prescribed fire, and mining, have not yet been analyzed to determine the extent of effects to this species. However, partial information exists. Overgrazing by livestock, illegal collection, and fire-related interactions involving exotic Lehmann lovegrass and buffelgrass may negatively affect Pima Pineapple cactus populations. Mining has resulted in the loss of hundreds, if not thousands, of acres of potential habitat throughout the range of the plant.

The protection of Pima Pineapple cactus habitat and individuals is complicated by the varying land ownership within the range of this species in Arizona. An estimated 10 percent of the potential habitat for Pima Pineapple cactus is held in Federal ownership. The remaining 90 percent is on Tribal, State, and private lands. Most of the federally-owned land is either at the edge of the plant's range or in scattered parcels. The largest contiguous parcel of federally-owned habitat is the Buenos Aires National Wildlife Refuge, located at the southwestern edge of the plant's range at higher elevations and with lower plant densities. No significant populations of Pima Pineapple cactus are known from Sonora or elsewhere in Mexico (Baker 2005).

There have been some notable conservation developments for this species. As of 2010, there are two conservation banks for Pima Pineapple cactus, one on a private ranch in the Altar Valley (Palo Alto Ranch Conservation Bank) and another owned by Pima County that includes areas in both the Altar Valley and south of Green Valley. In the Palo Alto Ranch Conservation Bank, 131.6 acres have been conserved to date. In Pima County's Bank, a total of 530 acres are under a conservation easement at this time (the County offsets its own projects within this bank). Additionally, three large blocks of land totaling another 1,078 acres have been set aside or are under conservation easements through previous section 7 consultations (see consultations 02-21-99-F-273, 02-21-01-F-101, and 02-21-03-F-0406). While not formal conservation banks, these areas, currently totaling 1,739.6 acres, are set aside and managed specifically for Pima Pineapple cactus as large blocks of land, and likely contribute to recovery of the taxon for this reason; therefore, we consider these acres conserved. Another 647 acres of land have been set aside as natural open space within the developments reviewed through section 7 consultation between

1995 and 2010. However, these are often small areas within residential backyards (not in a common area) that are difficult to manage and usually isolated within the larger development, and often include areas that do not provide Pima Pineapple cactus habitat (e.g., washes). Some conservation may occur onsite because of these open space designations, but long-term data on conservation within developed areas are lacking; the value of these areas to Pima Pineapple cactus recovery over the long-term is likely not great.

In summary, Pima Pineapple cactus conservation efforts are currently hampered by a lack of information on the species. Specifically, we have not been able to determine exact ecological characters to help us predict locations of Pima Pineapple cactus or precisely delineate its habitat, and considerable area within the Pima Pineapple cactus range has not been surveyed. Further, there are still significant gaps in our knowledge of the life history of Pima Pineapple cactus; for instance, we have yet to observe a good year for seed germination. From researcher observations and motion sensing cameras, we have learned that ants, Harris' antelope squirrels, and jackrabbits act as seed dispersal agents. Demographic plots have been only recently established, and information is just now beginning to be reported with regard to describing population dynamics for Pima Pineapple cactus in the Altar Valley.

Development and associated loss of habitat remain important and continuing threats to this taxon. However, the expanding threat of non-native grasses and resulting altered fire regimes are a serious concern for the long-term viability of the species, as is ongoing drought. The full impact of drought and climate change on Pima Pineapple cactus has yet to be studied, but it is likely that, if recruitment occurs in punctuated events based on precipitation and temperature (Baker 2006), Pima Pineapple cactus will be negatively affected by these forces. Already we have seen a nearly 25% loss of individuals across six study sites in the Altar Valley between 2010 and 2011; these deaths were attributed largely to drought and associated predation by native insects and rodents (Baker 2011). Conservation efforts that focus on habitat acquisition and protection, like those proposed by Pima County and the City of Tucson, are important steps in securing the long-term viability of this taxon. Regulatory mechanisms, such as the native plant protection ordinances, provide conservation direction for Pima Pineapple cactus habitat protection within subdivisions, and may serve to reduce Pima Pineapple cactus habitat fragmentation within areas of projected urban growth.

Environmental Baseline - Pima Pineapple Cactus

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.

Description of the Action Area

For the Rosemont Mine project, we define the action area for Pima Pineapple cactus as the area that will be affected for the utility corridor (TEP line and the water pipeline). Pima Pineapple cactus are not known or expected to occur within the footprint of the mine and associated structures and facilities occurring at higher elevation within the Santa Rita Mountains. Therefore, the action area for Pima Pineapple cactus includes only the lower elevation portions of the proposed utility corridor up to 4,000 feet elevation (see Figures PPC-1 and PPC-2). Within the action area, approximately 33.2 acres of anticipated disturbance will occur within Pima Pineapple cactus habitat along the proposed utility corridor, in addition to any disturbance that may occur on the Helvetia Ranch North conservation lands associated with the development of water features as a conservation measure for other species covered under this BO such as the Chiricahua leopard frog, jaguar, or ocelot (see Conservation Measures D, G, H, and I of the Second Supplemental BA).

The development and identification of alternative routes for the transmission line was based on electrical system requirements and an environmental and public planning process conducted by TEP from the summer of 2008 through the spring of 2010. Environmental studies included a review of land use issues, as well as studies of visual, biological, and cultural resources. Consideration was given to each route’s compatibility with established criteria for a Certificate of Environmental Compatibility (CEC) and consideration in the final route selection process by the Arizona Power Plant and Line Siting Committee and the Arizona Corporation Commission (ACC).

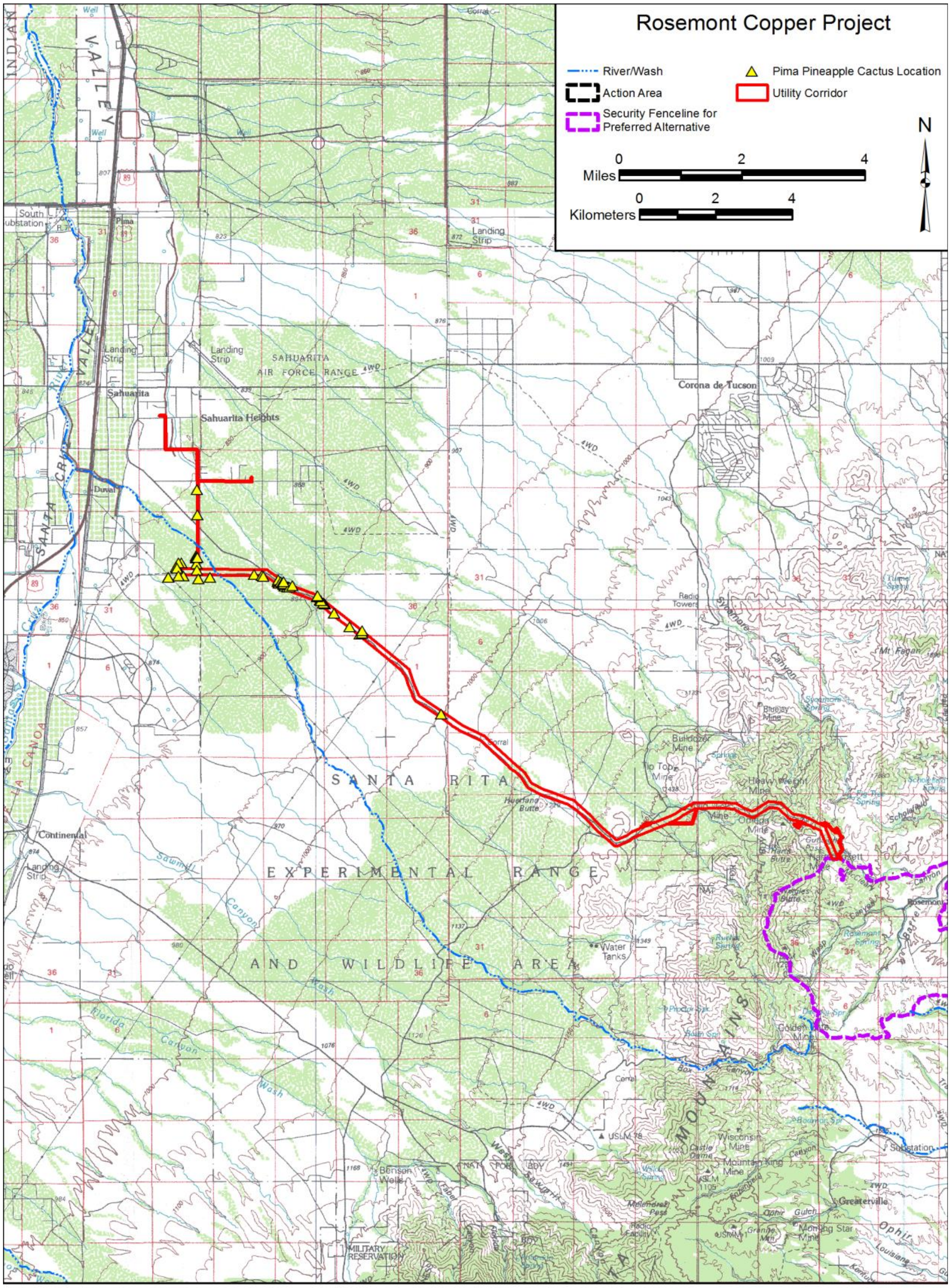

Figure 12. Pima Pineapple Cactus.

Figure PPC-1: Location of the Utility Corridor and Pima pineapple cacti for the Rosemont Mine project.

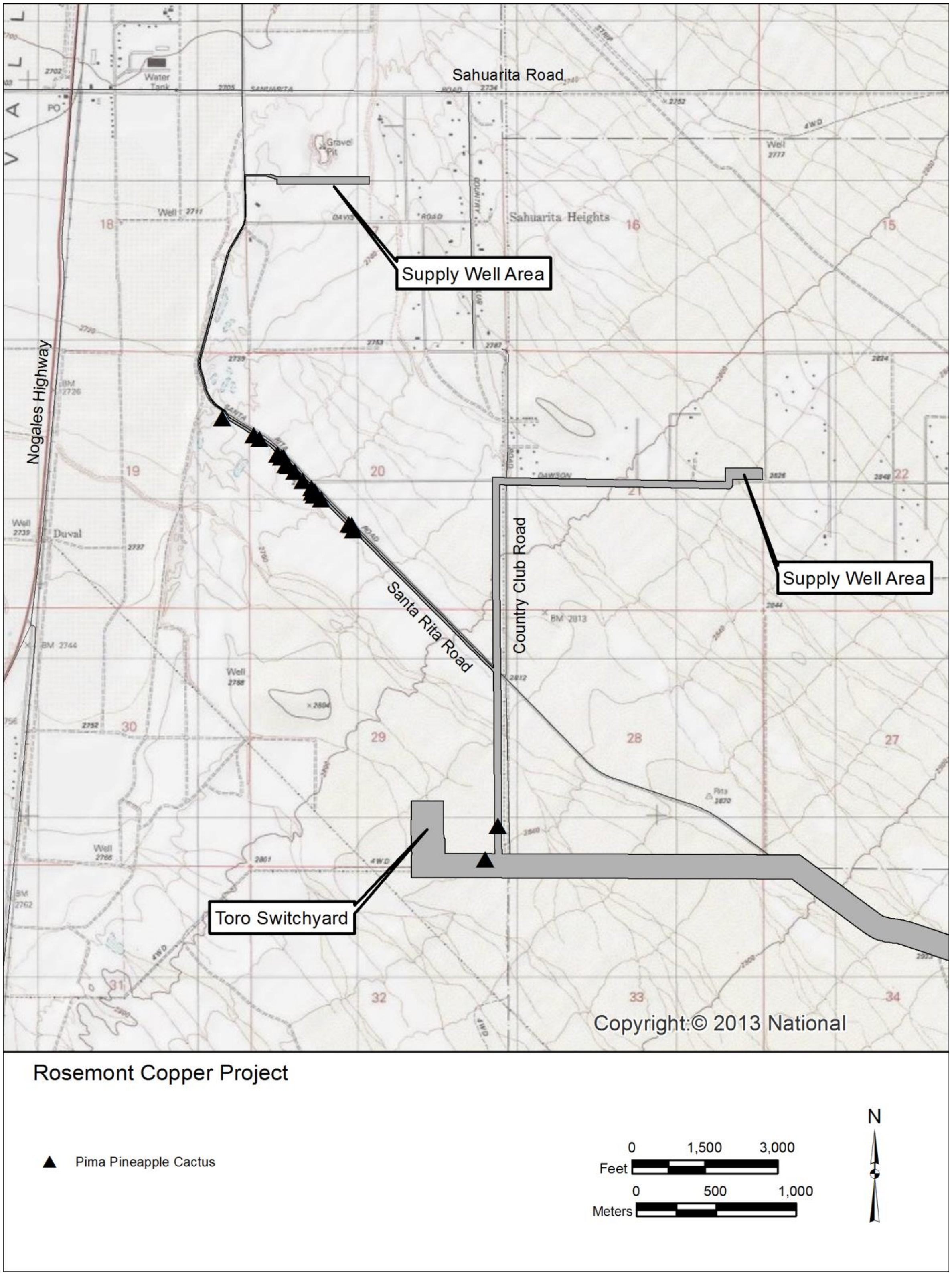

Figure PPC-2: Location of the far-western portion of the Utility Corridor and Pima pineapple cacti for the Rosemont Mine project.

Power would be provided from a link attached to existing transmission lines on the South Substation loop. All of the transmission lines alternatives include aboveground 138-kilovolt transmission lines and an associated 14-foot-wide unpaved maintenance road. This set of routing alternatives recommended to be carried forward will be presented to the Arizona Corporation Commission Line Siting Committee. TEP identified a preferred route and four alternatives for consideration; however, only the preferred route is considered this BO. The TEP preferred route runs west of the Santa Rita Mountains ridgeline. The preferred route generally parallels the existing South Santa Rita Road before entering private property held by Rosemont (see Figure PPC-1). The alignment then enters the Rosemont claim block and crosses the ridgeline at Lopez Pass. The ACC has selected the preferred route and a CEC was issued on June 12, 2012.

With regard to the proposed water pipeline, the proposed Rosemont Mine project will use approximately 5,000 acre-feet per year of fresh water, for a total use over the mine life of approximately 100,000 acre-feet. The water will be pumped from four to six wells located on land owned or leased by Rosemont near the community of Sahuarita in the Santa Cruz Valley at a maximum rate of 5,000 gallons per minute (total pumpage), and the pipeline will require booster stations to maintain water flow in the line. The water pipeline alignment will follow the TEP Preferred Alternative Transmission Line (see Figures I-1, PPC-1, and J-3).

The pipeline will be constructed with a minimum soil cover of 36 inches within ASLD easements and up to 24 inches on Rosemont’s property, where available and practical, depending on slope, topography, and the availability of material. At wash crossings, the pipeline will be constructed below the calculated scour depth of the wash, and grade control structures will be provided at the largest washes to provide additional protection. Construction of the pipeline will include an unpaved permanent maintenance road and up to five reservoirs and pump stations. The reservoirs and pump stations will be built outside potential jurisdictional WUS.

The action area occurs is northwest of the Santa Rita Mountains extending to the Town of Sahuarita. Topography consists of sloping terrain bisected by washes, with an estimated elevation range from approximately 2,750 to 4,000 feet. The biotic communities present are the Arizona Upland Subdivision of the Sonoran Desert and Semi-desert Grassland (Brown 1994). Typical vegetation within the project area includes creosote bush (*Larrea tridentata*), velvet mesquite (*Prosopis velutina*), catclaw acacia (*Acacia greggii*), barrel cactus (*Ferocactus wislizenii*), and saguaro (*Carnegiea gigantea*).

Land uses within the action area include the residential areas of the Town of Sahuarita, mining activities in the northwest corner of the Santa Rita Mountains, and livestock grazing lands. Much of the action area is included within the Santa Rita Experimental Range. This area of approximately 50,000 acres consists primarily of State Trust lands, and is controlled by the University of Arizona and used to conduct rangeland management research and monitoring.

Status of the Species within the Action Area

Recent Surveys

In 2008, species-specific surveys for Pima Pineapple cactus were conducted along a preliminary water pipeline corridor route (WestLand 2009a), which has since been dropped because it was decided that the water pipeline alignment should follow the TEP power line and utility maintenance road corridor. Hence, in 2009, a new preferred corridor route was selected, and additional surveys were conducted (WestLand 2009b, 2010b) (Figure PPC-1). The western portion of the route, near the Town of Sahuarita, was changed in September 2013 (Figure PPC-2) The preferred 2009 corridor route extends from just east of the town of Sahuarita to the east side of Lopez Pass in the Santa Rita Mountains.

The width of the area surveyed by WestLand ranged from 150 feet to approximately 650 feet (the width of proposed surface disturbance within the survey corridor is expected to be approximately 50 feet). Approximately 18.5 miles of the preferred corridor route were surveyed in 2009; the easternmost 3.2 miles was not surveyed because it was determined that the area has no potential for Pima Pineapple cactus occurrence because of the presence of steep slopes, sandy washes, and bedrock.

The survey followed guidelines provided by USFWS in the document titled Pima Pineapple cactus 3 Tier Survey Methods (Roller 1996). Surveyors walked parallel transects spaced approximately 15 feet apart in order to achieve 100% coverage of the survey area. The survey area was covered in a single pass. Coordinates for all Pima Pineapple cactus found during the survey were entered into a handheld Trimble global positioning system (GPS) unit. Pima Pineapple cactus were tagged with a unique number, and information was collected on the number of stems and general health of each plant.

Sixty-seven living Pima Pineapple cactus have been found within the preferred TEP and water pipeline corridor, including the western, rerouted portion of the waterline (see Figures PPC-1 and PPC-2) (WestLand 2009a, 2009b, 2010b). Given that the width of proposed surface disturbance within the survey corridor is 50 feet, it is likely that several of these cacti would be avoided during construction of the proposed action. The total impact area (i.e., potentially suitable Pima Pineapple cactus habitat along the selected alternative route) is estimated to be approximately 33.2 acres (17.2 acres permanently affected, 16.0 acres temporarily affected).

Effects of the Proposed Action - Pima Pineapple Cactus

The use of the proposed utility corridor to provide power and water for the Rosemont Mine project would result in direct effects to Pima Pineapple cactus owing to the placement of electrical and water transmission lines and associated access roads. Approximately 67 live Pima Pineapple cactus and 33.2 acres of Pima Pineapple cactus habitat would be affected. Areas of permanent disturbance would remove portions of the seed bank, and areas of temporary disturbance could alter the seed bank. Disturbance of soils would change water infiltration, compact soil, and change local site conditions. Recently disturbed areas have an increased potential to be invaded by noxious weeds (e.g., Lehmann lovegrass), which can negatively affect Pima Pineapple cactus. Pima Pineapple cactus can be found in areas of recent disturbance, as competition with other plants for nutrients and light are reduced. Although some areas of temporary disturbance may recover, it may take many years before full recovery is achieved. Vasek *et al.* (1975) found that desert vegetation is fragile and easily destroyed, but does have a long-term potential (probably measured in centuries) to recover from substantial disturbance such as that associated with the construction of a utility corridor.

Any individual Pima Pineapple cactus growing in the action area outside the mine footprint may experience indirect effects, such as fugitive dust. Effects from dust are likely to occur along the utility corridor as a result of traffic along the associated roadway. Existing traffic occurs in the area of the utility corridor, but the Rosemont mine project will result in a limited increase in traffic in the area of Santa Rita Road as a result of inspections and maintenance along the utility corridor. Physical effects of windborne fugitive dust on plants may include blockage and damage to stomata and shading and abrasion of the plant surface, which could result in reduced photosynthetic activity (Goodquarry 2011) and possibly reproductive success. These effects may also impact pollinators of Pima Pineapple cactus.

The proposed action will result in the direct removal of 67 Pima Pineapple cactus and permanent or temporary effects to approximately 33.2 acres of Pima Pineapple cactus habitat within the action area. Within the context of Pima Pineapple cactus individuals and surveyed area we have reviewed through section 7 consultation on development projects, this project adds 67 individuals and effects to 33.2 acres of Pima Pineapple cactus habitat to the known baselines. Within the range of the Pima Pineapple cactus in Arizona, this brings baseline numbers up to 2,764 Pima Pineapple cactus individuals, of which, 2,051 will have been destroyed, removed, or transplanted, and 15,275 acres surveyed, of which 14,612 will have been permanently or temporarily impacted by development projects. What this means in the context of the entire range of the Pima Pineapple cactus is difficult to determine for the reasons discussed above.

To offset the indirect effects to Pima Pineapple cactus and Pima Pineapple cactus habitat from invasive plant species, Rosemont has developed an *Invasive Species Management Plan*. This plan includes measures such as using weed-free seed and hay in reclamation and compliance actions, avoiding the use of invasive ornamental plants in landscaping and reclamation activities, and cleaning heavy equipment prior to use on the project to remove dirt, plant parts, and other materials that could carry invasive plant seeds. As part of the Invasive Species Management Plan, Rosemont will conduct monitoring of the project area once per year to determine the occurrence of invasive plant species. The goal of monitoring is to detect newly introduced invasive species and eliminate them before they infest the area and spread to other locations. The *Invasive Species Management Plan* is incorporated herein by reference.

To offset the direct impacts to Pima Pineapple cactus and its habitat, Rosemont proposes to record a restrictive covenant on parcels of land that support Pima Pineapple cactus. The lands are located within the Helvetia Ranch North Parcels (see Figure PPC-3). The proposed conservation lands are currently occupied by Pima Pineapple cactus and support appropriate

Mr. Jim Upchurch, Forest Supervisor

Pima Pineapple cactus habitat. Prior to initiation of construction on the utility corridor, the restrictive covenant will be recorded for the 940 acres that make up these ranch parcels.

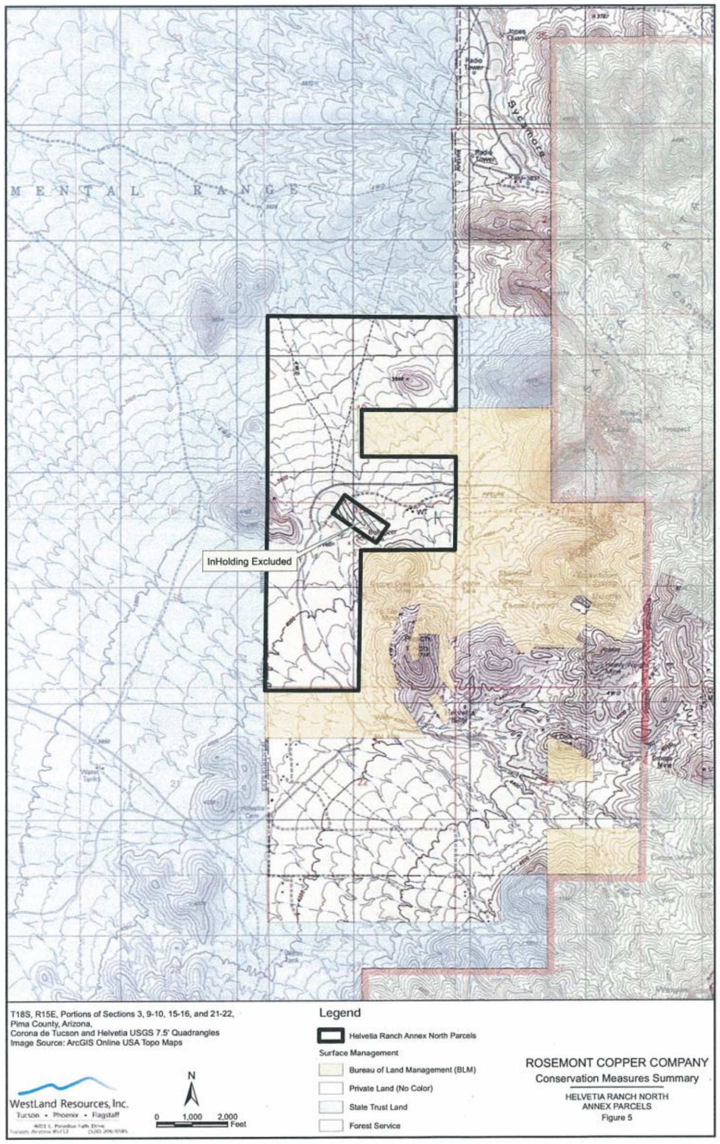

Figure PPC-3: Helvetia Ranch North Pima Pineapple Cactus Conservation Parcels

In summary, the proposed action will result in the direct loss of 67 Pima Pineapple cactus and effects to 33.2 acres of Pima Pineapple cactus habitat. This represents a loss of approximately 3.3 percent of the known individuals and 0.2 percent of the surveyed area we have reviewed through section 7 consultations (including this one). Rosemont proposes to offset this loss by setting aside 940 acres within the Helvetia Ranch parcels, 705 acres of which currently support Pima pineapple cactus or which contain soils and other habitat conditions suitable for the species. The project, while contributing to further fragmentation of Pima Pineapple cactus habitat, also contributes to the survival and recovery of Pima Pineapple cactus because it will establish protection from certain threats for Pima Pineapple cactus on the Helvetia Ranch parcels.

Cumulative Effects - Pima Pineapple Cactus

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. Federal land managers, the Coronado National Forest and Bureau of Land Management, manage approximately 45 percent of the lands affected by the Rosemont Mine project, and administer projects and permits on those lands. However, within the action area for the Pima Pineapple cactus, lands are primarily non-Federal, so there are many activities that could potentially affect Pima Pineapple cactus that are not Federal activities and thus not subject to additional Section 7 consultation under the ESA.

Activities that could result in cumulative effects to Pima Pineapple cactus include continued road maintenance, grazing activities, the spread of invasive species, and recreation in the action area, current and future development, other nearby mining projects, and unregulated activities on non-federal lands, such as trespass livestock and inappropriate use of OHVs. Adjacent open space, such as that found within the Santa Rita Experimental Range and other State Trust lands often provides recreational areas for nearby residents, and the use of these lands for recreation, off-road vehicle use, and illegal dumping of trash can ultimately lead to habitat degradation and possible loss of Pima Pineapple cactus. Additional cumulative effects on Pima Pineapple cactus include cross-border activities such as human traffic; deposition of trash; new trails from human traffic; increased fire risk from human traffic; and water depletion and contamination. From all of these activities, there is an increased risk of non-native invasive plant invasion, leading to both competition for limited resources and increased fire occurrence and intensity, all of which threaten Pima Pineapple cactus conservation and survival.

As discussed above, threats to Pima Pineapple cactus continue to include habitat loss and fragmentation both for the plant and its pollinators, competition with non-native species, and inadequate regulatory mechanisms to protect this species. We conclude that residential and commercial development, and its infrastructure, is a significant threat to Pima Pineapple cactus and its habitat, and that drought, nonnative plant invasion, and predation are also severe threats. The cumulative effects mentioned above all contribute to these ongoing threats to Pima

Pineapple cactus in the action area. The conservation of the Pima Pineapple cactus population in the southern portions of Tucson, extending into the Green Valley area, is tenuous given the extent of these threats and the likelihood that these threats will continue into the foreseeable future. Consideration of the conservation needs of Pima Pineapple cactus is included in the proposed habitat conservation plans being developed by the City of Tucson and Pima County, and implementation of these habitat conservation plans may help to reduce the extent of cumulative impact of non-Federal actions in the vicinity of the action area for Pima Pineapple cactus related to the Rosemont Mine project.

Conclusion - Pima Pineapple Cactus

After reviewing the current status of Pima Pineapple cactus, the environmental baseline for the action area, the effects of the proposed action, and the cumulative effects, it is our biological opinion that the Rosemont Mine project is not likely to jeopardize the continued existence of the Pima Pineapple cactus. No critical habitat has been designated for this species; therefore, none will be affected. Our rationale for this conclusion is as follows:

1. The loss of 67 Pima Pineapple cactus and effects to 33.2 acres of Pima Pineapple cactus habitat represents less than two percent of the Pima Pineapple cactus individuals (the majority of which were destroyed) and area surveyed for which we have conducted section 7 consultations. Additional Pima Pineapple cactus and habitat occur throughout the range of the taxon, but we do not have the information to determine the percentage of the overall range which these 67 Pima Pineapple cactus and 33.2 acres represent. However, based on the sites we have evaluated and for which we have information, the number of Pima Pineapple cactus and acres of Pima Pineapple cactus habitat impacted related to this project are relatively small and, additively, contribute a relatively small number of plants and acres to the effects we have evaluated.
2. Rosemont is proposing measures to reduce direct impacts to Pima Pineapple cactus during the construction of the utility corridor.
3. To offset effects from the Rosemont Mine project, Rosemont will protect approximately 700 acres of occupied Pima Pineapple cactus habitat on the Helvetia Ranch North parcels by recording a restrictive covenant on the parcels which will protect Pima Pineapple cactus from certain activities outlined as threats to Pima Pineapple cactus in our discussion above. This action will also address to some extent the ongoing cumulative effects to Pima Pineapple cactus habitat in the vicinity of the action area by removing the potential for future development of these lands in the future.
4. The relatively small magnitude of effects described under Conclusion 1 and the conservation measures described under Conclusion 3, above, indicate that the proposed action is unlikely to diminish the potential to achieve recovery of the Pima pineapple cactus.

INCIDENTAL TAKE STATEMENT - PIMA PINEAPPLE CACTUS

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 - Pima Pineapple Cactus

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.

1. We recommend that the FS participate in efforts to identify and conserve Pima Pineapple cactus throughout its range, including participation in forums that address the control of invasive, exotic plants (e.g. buffelgrass and Lehmann lovegrass).

2. We recommend that FS support research and monitoring proposals that will contribute to an increased understanding of important conservation efforts related to Pima Pineapple cactus such as the effectiveness of translocating Pima Pineapple cactus, appropriate management of conservation lands and conservation banks to promote recovery of Pima Pineapple cactus, and effects of climate change and fire on Pima Pineapple cactus.

3. We recommend the FS work with Rosemont to implement measures on the Helvetia Ranch North parcels, including appropriate monitoring of Pima Pineapple cactus and Pima Pineapple cactus habitat, so that the conservation approach on these parcels is consistent with other conservation lands, including Conservation Banks, established for the conservation of Pima Pineapple cactus. These measures should include the following in order to ensure the conservation of Pima Pineapple cactus in perpetuity:

    (a.) The conservation lands should be surveyed with 100% survey coverage using an approved Pima Pineapple cactus survey protocol. All Pima Pineapple cactus that are detected during the survey effort should be mapped, GPS coordinates recorded, and information regarding the condition and status of each cactus should be collected. This information should be provided to FWS.

    (b.) A management plan addressing actions needed for long-term conservation of the conservation lands, and all Pima Pineapple cactus within the conservation lands, should be developed and implemented in perpetuity. The management plan should address issues such as fencing and fence maintenance, invasive species management, fire management, approved and prohibited land uses, maintaining appropriate buffers from surrounding land uses, etc. The management plan should also address monitoring, which should include monitoring every three years to document the status of known cacti, as well as the presence of any new cacti. Annual reports on the status of the conservation lands should be submitted to the FWS.

(c.) Adequate funding should be provided to implement the management plan and required monitoring.

In order that we are 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.

Status of the Species – Chiricahua Leopard Frog

The Chiricahua leopard frog was listed as a threatened species without critical habitat in a Federal Register notice dated June 13, 2002. Included was a special rule to exempt operation and maintenance of livestock tanks on non-Federal lands from the section 9 take prohibitions of the Act. Final designation of critical habitat was made on March 20, 2012 (77 FR 16324) and included 39 sites in Arizona and New Mexico.

The frog 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 in duration (Platz and Mecham 1979, Davidson 1996). Snout-vent lengths of adults range from approximately 2.1 to 5.4 inches (Platz and Mecham 1979, Stebbins 2003). The Ramsey Canyon leopard frog (*Lithobates* "*subaquavocali*s"), found on the eastern slopes of the Huachuca Mountains, Cochise County, Arizona, has recently been subsumed into *Lithobates chiricahuensis* (Crother 2008) and recognized by the FWS as part of the listed entity (U.S. Fish and Wildlife Service [USFWS] 2009).

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). Reports of the species from the State of Aguascalientes (Diaz and Diaz 1997) are questionable. The distribution of the species in Mexico is unclear due to limited survey work and the presence of closely related taxa (especially *Lithobates lemosespinali*) in the southern part of the range of the Chiricahua leopard frog. Historically, the frog was an inhabitant of a wide variety of aquatic habitats, including cienegas, pools, livestock tanks, lakes, reservoirs, streams, and rivers at elevations of 3,281 to 8,890 feet. However, the species is now limited primarily to headwater streams, springs and cienegas, and cattle tanks into which nonnative predators (e.g. sportfishes, American bullfrogs, crayfish, and tiger salamanders) have not yet invaded or where their numbers are low (USFWS 2007). The large valley-bottom cienegas, rivers, and lakes where the species occurred historically are populated with nonnative predators at densities with which the species cannot coexist.

The primary threats to this species are predation by nonnative organisms and die offs caused by a fungal skin disease – chytridiomycosis (caused by the skin fungus, *Batrachochytrium dendrobatidis* (*Bd*)). 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 2007). 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). Witte *et al.* (2008) analyzed risk factors associated with disappearances of ranid frogs in Arizona and found that population loss was more common at higher elevations and in areas where other ranid population disappearances occurred. Disappearances were also more likely where introduced crayfish occur, but were less likely in areas close to a source population of frogs.

Based on 2009 data, 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. 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 southeastern Arizona, no recent records (1995 to the present) exist for the Pinaleño Mountains or Sulphur Springs Valley. Once thought to be extirpated from the Chiricahua Mountains, the species now occurs in Cave Canyon, in the vicinity of the Southwestern Research Station operated by the Smithsonian Institution. The species is now absent from all but one of the southeastern Arizona valley bottom cienega complexes. 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 refugia sites. At least 33 of the wild sites support breeding. In New Mexico, 15-23 breeding sites were known in 2008; the frogs occur at additional dispersal sites. The species has been extirpated from about 80 percent of its historical localities in Arizona and New Mexico. 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).

The chytridiomycete skin fungus, *Batrachochytrium dendrobatidis* (*Bd*), 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, Sredl and Caldwell 2000, Hale 2001, Bradley *et al.* 2002, USFWS 2007). In New Mexico, chytridiomycosis appears to be widespread in populations in west-central New Mexico, where it often leads to population extirpation. A threats assessment conducted for the species during the development of the recovery plan identified *Bd* as the most important threat to the frog in recovery units 7 and 8 in New Mexico. In recovery unit 6, which includes much of the mountainous region of west-central New Mexico, *Bd* and nonnative predators were together identified as the most important threats. Die-offs from disease typically occur during the cooler months from October-February (USFWS 2007).

The role of the *Bd* fungus in the population dynamics of the Chiricahua leopard frog is as yet undefined. Some populations are driven to extinction soon after the animals become symptomatic; however, other Chiricahua leopard frog populations can exist with the pathogen for years (USFWS 2007). For instance, the frog has coexisted with *Bd* in Sycamore Canyon, Santa Cruz County, Arizona since at least 1972. That is the earliest record for *Bd* in the western United States, which roughly corresponds to the first observed mass die-offs of ranid frogs in Arizona. 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.

Epizootiological data from Central America and Australia (high mortality rates, wave-like spread of declines, wide host range) suggest introduction of the disease into previously uninfected populations and the disease subsequently becoming enzootic in some areas. Alternatively, the fungus may be a widespread organism that has emerged as a pathogen because of either higher virulence or an increased host susceptibility caused by other factors such as environmental changes (Berger *et al.* 1998), including changes in climate or microclimate, contaminant loads, increased UV-B radiation, or other factors that cause stress (Pounds and Crump 1994; Carey *et al.* 1999, 2001; Daszak 2000). Morehouse *et al.* (2003) found low genetic variability among 35 *Bd* strains from North America, Africa, and Australia, suggesting that the first hypothesis – that it is a recently emerged pathogen that has dispersed widely – is the correct hypothesis.

The infection intensity or lethal threshold of *Bd* is perhaps more important to control than the prevalence of infection (the proportion of infected hosts). Efforts to limit multiple exposures to the pathogen can prevent the host population from reaching the lethal threshold of zoospores per frog. In a nine to13 year study by Vredenberg *et al.* (2010), a *Bd* infection took three years to spread until nearly all the 88 yellow-legged frog populations at a lake were infected. A lethal threshold of about 10,000 zoospores of the fungus per frog caused the collapse of these amphibian populations with Bd. Within a population, as the infection prevalence reached 100%, the infection intensity on individual frogs increased in parallel. Frog mass mortality began only when infection intensity reached a critical threshold and repeatedly led to extinction of populations. Our results indicate that the high growth rate and virulence of *Bd* allow the near-simultaneous infection and buildup of high infection intensities in all host individuals; subsequent host population crashes therefore occur before *Bd* is limited by density-dependent factors. Preventing infection intensities in host populations from reaching this threshold could provide an effective strategy to avoid the extinction of susceptible amphibian species in the wild. Because of a threshold of zoospores per frog must be reached before it results in mortality, there is a time lag between exposure to the pathogen and mortality. This time lag allows for the spread of the pathogen throughout the amphibian population before the population crashes. Unlike other pathogens that disappear as their hosts decline in numbers, this pathogen can cause the extirpation of its host population (Blaustein and Johnson 2010).

Because of this threshold, there is a time lag between exposure and mortality, so the pathogen can spread through much of the amphibian population before disease-driven reductions in host density negatively affect the transmission of *Bd*. Consequently, the pathogen can cause the loss and extinction of its host population, unlike the many other pathogens that disappear as their hosts decline in numbers (Blaustein and Johnson 2010).

Retrospective analysis revealed presence of chytridiomycosis in wild African clawed frogs (*Xenopus laevis*) dating to 1938 (Weldon *et al.* 2004). African clawed frogs were exported to many areas of the globe from Africa for use in human pregnancy testing beginning in the 1930s. Some of the test frogs escaped or were released and established populations in California, Arizona, and other areas. Although other explanations for the origin of the disease are viable, Weldon *et al.* (2004) suggest that Africa is where the disease originated and that international trade in African clawed frogs was the means of disease dissemination.

If the disease was introduced to the Southwest via escaped or released clawed frogs, it may have spread across the landscape by human introductions or natural movements of secondarily-infected American bullfrogs, tiger salamanders, or leopard frogs. If this is the case, its rapid establishment and spread could be attributable to humans. *Bd* does not have an airborne spore, so it must spread via other means. Amphibians in the international pet trade (Europe and USA), outdoor pond supplies (USA), zoo trade (Europe and USA), laboratory supply houses (USA), and species recently introduced (*Rhinella marinus* in Australia and American bullfrog in the USA and Uruguay) have been found infected with *Bd*, suggesting human-induced spread of the disease (Daszak 2000, Mazzoni *et al.* 2003).

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). Green and Dodd (2007) found *Bd* in bullfrogs at a fish hatchery in Georgia and suggested the disease could be moved with stocks of fish. Since that study, *Bd* was confirmed from a bullfrog captured at the Bubbling Ponds Hatchery in Arizona (V. Boyarski, pers. comm.). *Bd* could also be spread by tourists or fieldworkers 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. The AESO and AGFD are employing preventative measures to ensure the disease is not spread by aquatic sampling.

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, tiger salamanders (*Ambystoma mavortium mavortium*), crayfish (*Orconectes virilis* and possibly others), and several other species of fishes (Clarkson and Rorabaugh 1989; Sredl and Howland 1994; Fernandez and Bagnara 1995; Rosen *et al.* 1996, 1994; Snyder *et al.* 1996; Fernandez and Rosen 1996, 1998). For instance, in the Chiricahua region of southeastern Arizona, Rosen *et al.* (1996) 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.* (1996) suggested further study was needed to evaluate the effects of mosquitofish, trout, and catfish on frog presence.

The effect of mosquitofish on Chiricahua leopard frog populations could be influenced by factors such as abundant escape cover, high adult frog survivorship, and high reproductive output in terms of numbers of frog egg masses produced. Examination of studies with other ranid frog species illustrates the likely effects of trout on Chiricahua leopard frog. The relationship between trout and amphibian decline has best been documented with the Mountain yellow-legged frog (*Rana muscosa*) in high lakes of the Sierra Nevada, California. Several authors have concluded that predation by introduced trout and charr (*Salveninus* spp.) into these previously fishless lakes have eliminated many populations of this species (Bradford 1989, Bradford *et al.* 1993, Knapp and Mathews 2000, Vredenburg *et al.* 2005). One of the threats that lead to the listing of the southern California populations of the Mountain yellow-legged frog was predation by introduced trout. However, other factors, including chytridiomycosis and pesticides, are possible contributors to the decline of the species as well (Fellers *et al.* 2001, 2004; Vredenburg *et al.* 2005). Predation by trout has also been also implicated as a factor in decline or population loss in the Cascades frog (*Rana cascadae*, Fellers *et al.* 2007) and Columbia spotted frog (*Rana luteiventris*, Reaser and Pilliod 2005).

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 re-colonized 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.

Wildfires have affected Chiricahua leopard frog habitat. On May 29, 2011, Arizona's largest wildfire in recorded history started, known as the Wallow Fire. The Wallow Fire consumed 538, 049 acres of montane conifer forest on the Apache-Sitgreaves National Forest and likely adversely affected proposed critical habitat in Unit 27, Campbell Blue and Coleman Creeks, although as of October 2010, little information is available on the post-fire status of potential Chiricahua leopard frog habitat within the fire footprint. Since many tanks and springs that are important for recovery of the species in this area occur in meadows, sediment flows may not affect them as they would habitat within canyon bottoms.

Waters at the Beatty's Guest Ranch in the Huachuca Mountains, until recently, supported one of the most robust and dense populations of Chiricahua leopard frogs. On June 12, 2011, the Monument Fire started 4-miles east of Hereford, Arizona; ultimately consuming 30,526 acres 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. The remaining population at the Ranch represents a small fraction of its former number.

The Greaterville Fire started on May 2, 2011, and may have affected dispersal habitat along the eastern bajada of the Santa Rita Mountains (proposed critical habitat Units 7 and 8), but that fire was less severe, comparatively small-sized, and of shorter duration.

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 1870-1900, 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).

An understanding of the dispersal abilities of Chiricahua leopard frogs is the key to determining the likelihood that suitable habitats will be colonized from a nearby extant population of frogs. As a group, leopard frogs are surprisingly good at dispersal. In Michigan, young northern leopard frogs (*Lithobates pipiens*) commonly move up to 0.5 mile from their place of metamorphosis, and three young males established residency up to 8.4 miles from their place of metamorphosis (Dole 1971). Both adults and juveniles wander widely during wet weather (Dole 1971). In the Cypress Hills, southern Alberta, young-of-the year northern leopard frogs successfully dispersed to downstream ponds 3.4 miles from the source pond, upstream 0.6 mile, and overland 0.6 mile. At Cypress Hills, a young-of-the-year northern leopard frog moved 5 miles in one year (Seburn *et al.* 1997). The Rio Grande leopard frog (*Lithobates berlandieri*) in southwestern Arizona has been observed to disperse at least one mile from any known water source during the summer rainy season (Rorabaugh 2005). After the first rains in the Yucatan Peninsula, leopard frogs have been collected a few miles from water (Campbell 1998). In New Mexico, Jennings (1987) noted collections of Rio Grande leopard frogs from intermittent water sources and suggested these were frogs that had dispersed from permanent water during wet periods.

Dispersal of leopard frogs away from water in the arid Southwest may occur less commonly than in mesic environments in Alberta, Michigan, or the Yucatan Peninsula during the wet season. However, there is evidence of substantial movements even in Arizona. Movement may occur via locomotion of frogs or passive movement of tadpoles along stream courses. The maximum distance moved by a radio-telemetered Chiricahua leopard frog in New Mexico was 2.2 miles in one direction (R. Jennings, Western New Mexico University, C. Painter, NMDGF, pers. comm. 2004). In 1974, Frost and Bagnara (1977) noted passive or active movement of Chiricahua and Plains (*Lithobates blairi*) leopard frogs for 5 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 located 3.4 miles away. Rosen *et al.* (1996) 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 1.2-4.3 miles distant. In September 2009, 15-20 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 miles overland and approximately 4.1 miles along intermittent drainages.

Movements away from water do not appear to be random. 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). Based on these studies, the Chiricahua leopard frog recovery plan (USFWS 2007) 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.

A recovery plan has been completed (USFWS 2007), 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.

Management areas are also identified within recovery units where the potential for successful recovery actions is greatest.

Additional information about the Chiricahua leopard frog can be found in Platz and Mecham (1984, 1979), Sredl and Howland (1994), Jennings (1995), Rosen *et al.* (1996, 1994), Degenhardt *et al.* (1996), Sredl *et al.* (1997), Painter (2000), Sredl and Jennings (2005), and USFWS (2007).

Critical Habitat

The 2012 final rule includes 39 critical habitat units across the range of the species in Arizona and New Mexico. Based on the above needs and our current knowledge of the life history, biology, and ecology of the species, and the habitat requirements for sustaining the essential life-history functions of the species, we have determined the physical or biological features (the general habitat features upon which a species depends), as described by the primary constituent elements (or PCEs)(the more specific habitat parameters defining the physical and biological features), essential to the conservation of 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, bullfrogs, nonnative fish) 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 habitats that provide opportunities for foraging and basking that are immediately adjacent to or surrounding breeding aquatic and riparian habitat.

2. Dispersal and nonbreeding 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 nonwetted corridors, provide 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, provide 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 nonnative predatory fish, bullfrogs, or crayfish; highways that do not include frog fencing and culverts; and walls, major dams, or other structures that physically block movement.

The critical habitat units affected by the proposed action include:

Eastern Slope of the Santa Rita Mountains Unit

This unit includes 172 ac (70 ha) of lands in the Greaterville area of the Santa Rita Mountains that are managed by the Coronado National Forest, as well as 14 ac (6 ha) of private lands in this area. Included in this unit are two metal troughs in Louisiana Gulch, Greaterville Tank, Los Posos Gulch Tank, and the Granite Mountain Tank complex. The Granite Mountain Tank complex includes two impoundments and a well. We have determined this unit to be essential to the conservation of the species because it represents several known occupied areas that support or likely support breeding activity for the Chiricahua leopard frog in the Santa Rita Mountains. A number of other sites in this area have been found to support dispersing Chiricahua leopard frogs. Designated critical habitat also includes intervening drainages as follows: (1) From Los Posos Gulch upstream to a saddle, then downslope in an unnamed drainage to the confluence with another unnamed drainage, then upstream and south in that drainage to a saddle, and downslope through an unnamed drainage to its confluence with Ophir Gulch, then in Ophir Gulch to upper Granite Mountain Tank, to include an ephemeral tank near upper Granite Mountain Tank and a well; (2) from Greaterville Tank downstream in an unnamed drainage to Ophir Gulch; and (3) Louisiana Gulch from the metal tanks upstream to the headwaters of Louisiana Gulch then across a saddle and downslope through an unnamed drainage to its confluence with Ophir Gulch. Additionally, this unit has both PCEs 1 and 2.

Las Cienegas National Conservation Area Unit

This unit is in Pima County, Arizona, and includes 1,364 ac (552 ha) of Bureau of Land Management lands and 186 ac (75 ha) of Arizona State Land Department lands, including an approximate 4.33-mi (6.98-km) reach of Empire Gulch and 1.91 mi (3.08 km) of Cienega Creek, including the Cinco Ponds. This unit currently contains PCEs 1 and 2 to support life-history functions essential for the conservation of the species. This reach includes: (1) Empire Gulch from a pipeline road crossing above the breeding site downstream to Cienega Creek; and (2)

Cienega Creek from the Empire Gulch confluence upstream to the approximate end of the wetted reach and where the creek bends hard to the east, to include Cinco Ponds. This unit is currently managed an isolated metapopulation.

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 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.

Status of the Chiricahua Leopard Frog in the Action Area

Recovery Unit 2 (Santa Rita-Huachuca-Ajos Bavispe, Arizona and Mexico)

There are eight recovery units identified in the Chiricahua leopard frog recovery plan (USFWS 2007). The action area pertaining to the Chiricahua leopard frog under this consultation includes portions of Recovery Unit 2 (RU2), which incorporates several metapopulations (or management areas) and critical habitat units. Specifically, we consider the action area to include the Santa Rita, Empire Cienega, and Red Rock-Sonoita Creek Management Areas which include the Eastern Slope of the Santa Rita Mountains, and Las Cienegas National Conservation Area critical habitat units. These areas are discussed in greater detail below, following general discussion of RU2.

RU2 is generally located in portions of Cochise, Santa Cruz, and Pima counties, Arizona and adjacent portions of northern Sonora. This RU includes the upper reaches and headwaters of the San Pedro and Santa Cruz rivers, as well as the headwaters of the Rios Sonora, Magdalena, and Bavispe. Elevations vary from 9,466 feet on Miller Peak in the Huachuca Mountains to less than 4,000 feet at the western base of the Sierra de Pinitos and on Sonoita Creek downstream of Patagonia. Vegetation communities include semi-desert grasslands at the lower elevations, climbing through oak and pine-oak woodlands to stands of mixed conifer forests. The latter are restricted to the higher elevations of the Santa Rita and Huachuca Mountains in Arizona, and to the Sierra de los Ajos, Sierra Cananea, Sierra Azul, and the southern portions of the Sierra Pinitos in Sonora (Brown and Lowe 1980).

In RU2, Chiricahua leopard frogs are known historically from montane canyons below about 6,230 feet and in valleys above about 4,000 feet. Historically they inhabited canyons such as Scotia Canyon in the Huachuca Mountains and Big Casa Blanca Canyon in the Santa Rita Mountains; valley bottom cienegas, such as Sheehy Spring and the Empire Cienega in the upper Santa Cruz River drainage; as well as major rivers, such as the San Pedro and Santa Cruz. Platz and Mecham (1979) list only a single locality in Sonora from RU2: on the Rio Santa Cruz 4 miles south of the international boundary. However, the frog has been reported from the Ajos – Bavispe region (The Nature Conservancy undated), including Canon Evens in the Sierra los Ajos

(Hale pers. comm. 2004); leopard frogs (possibly Chiricahua leopard frogs) reportedly occur at the Los Fresnos Cienega and the Rancho Las Palmitas in the upper San Pedro River drainage (IMADES 2003); and likely also occur or occurred in other mountain ranges and valleys elsewhere in the Sonoran portion of RU2. Chiricahua leopard frogs are still well-represented in RU2, including populations on the eastern slope of the Santa Rita Mountains, Patagonia Mountains, Canelo Hills, Empire Cienega/Cienega Creek, Monkey Springs, Ajos-Bavispe area/upper San Pedro River basin, and San Rafael Valley.

The management areas (MAs) within RU2, affected by the proposed action include:

Santa Rita MA–Includes Box Canyon Wash-Upper Santa Cruz River hydrologic unit, Cienega Creek hydrologic unit, and Sonoita Creek hydrologic unit. The major threat in this MA is scarcity of water, particularly during long periods of drought. Also, fire in the watershed could result in scouring and sedimentation in the pools important as habitat for the frog. The breeding habitat at Louisiana Gulch, although limited to two 6.0-ft (1.8-m) diameter steel tanks, is dependable because it is fed by a well. The other tanks are filled by runoff and susceptible to drying during drought. Improvements have been made to important breeding habitat to improve their resiliency in holding water. West Tank, a tank formerly threatened by seasonal drying near Greaterville Tank, had piping installed in June 2011, which is fed by a nearby well and now supports a robust breeding population of Chiricahua leopard frogs. Greaterville Tank was dredged and lined in June 2012, which greatly improved its ability to maintain water during periods of short- to medium-term drought. Chytridiomycosis and nonnative predators are potential threats, but neither is considered a current threat in this MA.

Table CLF-1: Chiricahua leopard frog survey data for the Santa Rita Management Area from 2010-2012

Site Name	Descriptor	2010	2011	2012	Notes
Cave Creek	Sawmill Canyon Confluence	ND	D	D	Adults, Juveniles
Anaconda Spring	Temporal Gulch	NS	ND	ND	
Fish Canyon	Fish Well	ND	NS	NS	
Fish Canyon Tank	None	ND	NS	NS	
El Pilar Tank	Trib of Adobe Canyon	NS	ND	ND	
Big Casa Blanca Canyon	“Bathtubs” Area	ND	ND	ND	
Big Casa Blanca Canyon	“Long Pool/Ledge Pool” Area	ND	ND	ND	
Big Casa Blanca Canyon	“String of Pools” Area	ND	NS	ND	
Unnamed Tank	N of Fish Canyon	NS	ND	NS	
Unnamed Tank	SW of Fish Canyon	ND	NS	NS	
Unnamed Tank	Los Posos Gulch	ND	NS	ND	
Unnamed Tank	Little Fish Canyon	ND	ND	NS	
Unnamed Tank	S of Enzenberg Canyon	ND	D	D	Adults, Juveniles
Unnamed Tank	NE of California Gulch	ND	NS	NS	
Unnamed Tank	N of Thurber Ranch	ND	NS	ND	
Unnamed Tank	Ophir Gulch	D	D	ND	Adults, Juveniles

Table CLF-1: Chiricahua leopard frog survey data for the Santa Rita Management Area from 2010-2012

Site Name	Descriptor	2010	2011	2012	Notes
Unnamed Tank	California Gulch	D	D	D	Adults, Juveniles
Unmarked Tank	Armada Mine – Temporal Gulch	NS	NS	ND	
Unmarked Tank	1.2 mi from Crazy Lazy P Tank	NS	ND	D	Juveniles
Unmarked Tank	Just S of Hog Canyon on Mesa	NS	NS	ND	
Unnamed Tank	SE of Adobe Tank	ND	NS	NS	
Unnamed Tank	SE of Barrel Tank	ND	ND	ND	
Unnamed Tank	W of Trail Canyon	ND	ND	ND	
Unnamed Tank	S of Oak Tree Canyon	ND	NS	NS	
Unnamed Tank	Unnamed Trib of Empire Gulch	ND	NS	NS	
Unmarked Tank	Louisiana Gulch	ND	NS	NS	
Unnamed Tank	Los Posos Gulch	ND	NS	NS	
Unnamed Tank	Enzenberg Canyon	ND	NS	NS	
Unnamed Tank	Unnamed Trib of Gardner Canyon	ND	NS	NS	
Jones Canyon	Temporal Gulch	NS	NS	ND	
Adobe Canyon	End of FS 234	ND	ND	ND	
Bathtub Tank	Adobe Canyon	NS	NS	ND	
Temporal Gulch	From 4,450 to 6,450 ft elevation	NS	NS	ND	
Box Canyon	NW of Greaterville	ND	D	D	Adults, Juveniles
Highway Tank	State Hwy 83 and Oak Creek Canyon	ND	ND	ND	
Oak Tree Canyon Tank*	Oak Tree Canyon	ND	ND	ND	
Greaterville Tank*	NW of Greaterville	D	D	D	Adults, Juveniles
Granite Mountain Tank*	Ophir Gulch	D	D	D	Adults, Juveniles, Larvae
Upper Walker Tank	Walker Basin	NS	NS	ND	
Unnamed Drinkers	Corral in Louisiana Gulch	D	D	NS	Adults, Juveniles, Larvae
Unmarked Plastic Drinker/Spring	Ophir Gulch	ND	NS	NS	
Unmarked Drinker	Sucker Gulch	ND	NS	NS	
Unnamed Drinker	Sucker Gulch				
Unnamed Drinker	Ophir Gulch	ND	NS	NS	
Walker Canyon	Walker Basin	NS	NS	ND	
Louisiana Gulch	N of Sucker Gulch	NS	NS	D	Adults, Larvae
Bowman Tank*	Empire Gulch	ND	D	D	Adults, Juveniles
Bowman Spring	Mill Canyon	ND	NS	ND	
Lower Granite Mountain Tank*	Ophir Gulch	ND	ND	ND	
Unmarked Well	W of Greaterville along Ophir Gulch	D	D	D	Adults

Table CLF-1: Chiricahua leopard frog survey data for the Santa Rita Management Area from 2010-2012

Site Name	Descriptor	2010	2011	2012	Notes
Gardner Canyon	Cave Creek-Gardner Canyon Confluence	NS	D	D	Adults, Juveniles, Larvae, Egg Masses; Robust Breeding Population
Gardner Canyon	E of Tunnel Spring, W of Cave Creek Confluence	NS	D	ND	Adults, Juveniles, Egg Masses; Robust Breeding Population
West Tank*	California Gulch	D	D	D	Adults, Juveniles, Larvae; Robust Breeding Population
Fish Tank*	Hog Canyon	NS	D	D	Adults
Sweetwater Dam*	SW of Sweetwater Spring	ND	ND	ND	
Crazy Lazy P Tank*	NW of Douglas Ranch	ND	D	D	Adults, Juveniles
Mesa Tanks	Between Hog and Adobe Canyons	NS	NS	ND	
Milo Tank*	Nothern Trib of Hog Canyon	NS	ND	ND	
Upper Enzenberg Tank*	Enzenberg Canyon	D+	ND	ND	+ Ranid sp., Adult
Perfect Tank*	Unnamed Trib of Sawmill Canyon	ND	ND	NS	
Barrel Tank	E of Oak Tree Canyon	ND	ND	ND	
Cemetery Tank*	Ophir Gulch	ND	NS	NS	
Fish Dam*	Fish Canyon	ND	NS	NS	
Granite Mountain Drinker*	Sucker Gulch	ND	NS	NS	
Gunsite Tank*	W of McLeary Canyon	ND	ND	ND	
McLeary Tank*	McLeary Canyon	ND	ND	ND	
North Basin Tank	E of Barrel Canyon	ND	ND	ND	
Rosemont Crest Tank*	E of Gunsite Pass	ND	ND	ND	
Roadside Tank*	Gardner Canyon	ND	NS	NS	
South Upper Tank*	W of Wasp Canyon	ND	ND	ND	
Oak Tree Windmill*	Oak Canyon	ND	ND	ND	
Substation Tank*	Empire Gulch	ND	NS	NS	

Notes: "NS" means "not surveyed," "D" means species was "detected," and "ND" means the species was "not detected." "Unmarked" means the site was not marked on the corresponding USGS 7.5 minute quadrangle. "Unnamed" means the site was marked on the corresponding USGS 7.5 minute quadrangle but was not named. An asterisk denotes that the site was either unmarked or unnamed and was ascribed a name for identification purposes in the Arizona Game and Fish Department Ranid Frog Database. Survey data from sites on private lands are not included. Data provided by the Arizona Game and Fish Department, Nongame Branch, Ranid Frogs Project and WestLand Resources, Inc.

Empire Cienega MA–Includes the Cienega Creek hydrologic unit. Approximately 60 metamorphosed Chiricahua leopard frogs and 400 tadpoles were released to Las Cienegas Natural Conservation Area during the fall of 2011. Special management is required in this area to improve habitat, control disease, and remove nonnative species. A collaborative, three-year, multi-partner recovery program for the Chiricahua leopard frog and other native aquatic species known as the FROG Project was completed in 2012 at Las Cienegas which included habitat improvements, nonnative management, and headstarting Chiricahua leopard frogs. Significant progress was been made to eliminate bullfrogs from the area, but bullfrogs are still present regionally and represent a potential, on-going threat. Chiricahua leopard frogs suffer from chytridiomycosis in this area; however, the Chiricahua leopard frogs are persisting with the disease. Crayfish occur within a few miles and pose a significant threat if they reach Cienega Creek or Empire Gulch.

Table CLF-2: Chiricahua leopard frog survey data for the Empire Cienega Management Area from 2010-2012.

Site Name	Descriptor	2010	2011	2012	Notes
Mattie Canyon	Empire Cienega	ND	ND	NS	
Road Canyon Tank	Empire Cienega	ND	ND	D	Juveniles
Empire Spring	NE of Empire Ranch	NS	D	D	Adults, Larvae, Egg Masses
Gardner Canyon	E of Cottonwood Windmill	NS	NS	ND	
Cienega Creek	The Narrows	NS	ND	NS	
Cienega Creek	E of Empire Gulch	ND	ND	ND	Bullfrogs detected 2010-2012
Cienega Creek	SW of Cienega Ranch	NS	ND	NS	
Cienega Creek	Headwaters	ND	NS	NS	
Cinco Ponds*	E of Cienega Creek	NS	ND	ND	Bullfrogs detected 2011 and 2012
Empire Gulch	Cienega Creek	ND	NS	NS	
East Dam	S of Barrel Canyon	ND	NS	NS	
Adobe Tank	E of State Hwy 83	ND	NS	NS	
Clyne Pond*	Mud Spring Canyon	ND	ND	ND	Bullfrogs detected 2010
Clyne Spring*	Mud Spring Canyon	NS	ND	NS	
Boulder Tank	Hilton Wash	ND	NS	NS	
Oil Well Tank	Empire Cienega	ND	ND	NS	
Beck Tank*	W of Cienega Creek	ND	NS	NS	
Bellota Tank*	S of Los Posos Gulch	ND	NS	NS	
Big Pond*	N of Fortynine Wash	ND	NS	NS	
Blacktail Tank	W of Davidson Canyon	ND	NS	NS	
Cemetery Tank	W of Davidson Canyon	ND	NS	NS	
Cottonwood Tank*	Gardner Canyon	ND	NS	NS	
Dry Tank*	S of Smith Canyon	ND	NS	NS	
Fish Tank*	Davidson Canyon	ND	NS	NS	
Water Tank	E of Cienega Creek	ND	NS	NS	
Hummel Tank*	Cienega Creek	ND	NS	NS	
Landing Strip Tank*	N of Fortynine Wash	ND	NS	NS	
Johnson Reservoir*	W of Cienega Creek	ND	NS	NS	
East Johnson Reservoir*	Trib of Cienega Creek	ND	NS	NS	
Mulberry Tank	Mulberry Canyon	ND	NS	NS	

Enzenberg North Well	N of North Canyon	ND	NS	NS	
Rattlesnake Tank*	N of Cienega Creek	ND	NS	NS	
Reeves Tank*	E of Cienega Creek	ND	NS	NS	
Regge Tank*	S of Gardner Canyon	ND	NS	NS	
Unnamed Tank	SW of Blacktail Tank	ND	NS	NS	
Unnamed Tank	W of Davidson Canyon	ND	NS	NS	
Unnamed Tank	Unnamed trib of Cienega Creek	ND	NS	NS	
Smith Tank*	Smith Canyon	ND	NS	NS	
Twin Tanks	E of Davidson Canyon	ND	NS	NS	
Springwater Marsh*	Empire Gulch	ND	NS	NS	
Wind Tank	S of Hilton Wash	ND	NS	NS	
Unmarked Drinker	N of Smith Canyon	ND	NS	NS	
Unmarked Tank	Stoddard Ranch	ND	NS	NS	
Unmarked Tank	Cienega Creek	ND	NS	NS	
Maternity Wildlife Pond**	Las Cienegas NCA	-	-	-	Adults and juveniles, hosts individuals from other sites
Cottonwood Wildlife Pond**	Las Cienegas NCA	-	-	-	Frogs introduced in 2013
Cinco Pond No. 1**	Las Cienegas NCA	-	-	-	Frogs introduced in 2011
Road Canyon Tank**	Las Cienegas NCA	-	-	-	Frogs introduced in 2011
Empire Wildlife Pond**	Las Cienegas NCA	-	-	-	Frogs introduced in 2013
Cinco Canyon Wildlife Pond**	Las Cienegas NCA	-	-	-	Frogs introduced in 2013
Spring Water Wetland Pond**	Las Cienegas NCA	-	-	-	Frogs introduced in 2013
Cienega Creek at Cold Spring Wetland**	Las Cienegas NCA	-	-	-	Frogs introduced in 2012

Notes: "NS" means "not surveyed," "D" means species was "detected," and "ND" means the species was "not detected." "Unmarked" means the site was not marked on the corresponding USGS 7.5 minute quadrangle. "Unnamed" means the site was marked on the corresponding USGS 7.5 minute quadrangle but was not named. An asterisk (*) denotes that the site was either unmarked or unnamed and was ascribed a name for identification purposes in the AGFD Ranid Frog Database. Survey data from sites on private lands are not included. Data provided by the AGFD, Nongame Branch, Ranid Frogs Project. A double-asterisk (**) indicates data provided by the BLM during a review of the draft BO.

Red Rock-Sonoita Creek MA–Includes the Sonoita Creek hydrologic unit. Red Rock Canyon maintains a largely native biotic community with four species of native fish, Sonoran tiger salamanders, and northern Mexican gartersnakes but bullfrogs and nonnative, soft-rayed fish species are also known to occur within the Red Rock subbasin. Sonoita Creek maintains a persistent population of bullfrogs, crayfish and nonnative, spiny-rayed fish that likely trace their origin to downstream Patagonia Lake which is fed by Sonoita Creek. We are not currently aware of any occupied sites in this MA.

Table CLF-3: Chiricahua leopard frog survey data for the Red Rock-Sonoita Creek Management Area from 2010-2012.					
Site Name	**Descriptor**	**2010**	**2011**	**2012**	**Notes**
Unnamed Tank	Gringo Gulch	NS	ND	NS	Bullfrogs detected 2010
Dark Tank*	Dark Canyon	ND	NS	NS	
Notes: "NS" means "not surveyed," "D" means species was "detected," and "ND" means the species was "not detected." "Unnamed" means the site was marked on the corresponding USGS 7.5 minute quadrangle but was not named. An asterisk denotes that the site was either unmarked or unnamed and was ascribed a name for identification purposes in the AGFD Ranid Frog Database. Survey data from sites on private lands are not included. Data provided by the AGFD, Nongame Branch, Ranid Frogs Project.					

In total and within the Santa Rita (n=17) and Empire Cienega (n=2) MAs, we are aware of 19 sites where Chiricahua leopard frogs have been documented in one or more life stages. West Tank and Gardner Canyon are considered the strongest breeding populations but reproduction has been observed in several other locations from 2010-2013 (see Tables CLF-1, 2, and 3, above). Recent efforts to improve the water storage capacity and duration of Greaterville Tank are expected to create a third robust breeding population in that area.

Effects of the Proposed Action - Chiricahua Leopard Frog

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 action area as it relates to the Chiricahua leopard frog includes the project site, all aquatic sites subject to the effects of surface flow reductions and groundwater drawdowns, and remote aquatic sites at which conservation measures will be implemented.

The project description provided on pages 9-17 of the June, 2012, Biological Assessment for this project describes mining operations, ancillary operations, and reclamation and closure operations that will result in the direct disturbance of 5,421 acres of Federal, State, and private lands. This description will not be reiterated here, but independent facets of the proposed action that may affect the Chiricahua leopard frog or its critical habitat are identified and discussed below. We differentiate effects of the proposed action as those associated with the physical construction, operation, and closure of the mine and those associated with conservation measures included in the proposed action.

<u>Adverse Effects Associated with Mine Construction and Operation</u>

Adverse effects to Chiricahua leopard frogs are reasonably certain to occur over the life of the proposed action (up to 30 years), but are most likely to be heavily weighted towards the beginning phase of project implementation. Specifically, the majority of adverse effects are likely to result from the 18-month initial period of construction which will include the use of heavy earth-moving equipment to clear vegetation, build roads, construct infrastructure, manipulate area drainage patterns, build power lines and their access roads; seconded by sustained effects of harassment from lighting and noise associated with operations and discussed below. These activities will span all seasons of the calendar year and therefore overlap with periods recognized for Chiricahua leopard frog surface activity (March – October) and dispersal (July - September; monsoon). Individual frogs dispersing to or from known occupied sites nearby may be injured or killed by heavy equipment or their behavior may be modified by the effects of avoidance behaviors from construction activities in a manner that may result in decreased survivorship or fitness of individuals. Lower Stock Tank, the only tank within the active footprint of mine operations will be removed, but the tank will undergo pre-construction surveys which will greatly limit the number of individual frogs adversely affected by its removal.

As a result of on-going mine operations which include vehicle use, blasting, drilling, lighting, and the processing and management of ore and waste materials, Chiricahua leopard frogs that find their way into the active mining area or cross roads associated with mining activity and may be harassed, injured, or killed. Chiricahua leopard frogs that are nearby but not within the active mining area may be harassed by noise and light pollution associated with blasting, operation of heavy machinery and equipment, and the lighting needs associated with the proposed action. Frogs of many species (including those on the genus *Lithobates*) are known may be attracted to light sources (Longcore and Rich 2004) which may create an attractive nuisance at the active mining area, but most observations of this lighting-behavior phenomena are with light sources several times smaller than that considered for a massive project on a local landscape level. Longcore and Rich (2004) reported conclusions by Rand *et al.* (1997) and Buchanan (pers. comm.) that artificial night lighting may interfere with amphibian breeding activities such as mate selection, inhibit or interfere with movement to and from breeding sites by stimulating phototactic behavior, or may cease breeding behaviors entirely. Increased nocturnal lighting can also increase the predation risk of frogs as found by Rand *et al.* (1997). The rate of attenuation with distance from these types of lighting effects on frogs is uncertain but logic suggests that effects are attenuated with increasing distance from the lighting source. Loud noises associated with blasting and heavy equipment operation may also affect nearby Chiricahua leopard frogs by interfering with male calling ability and therefore breeding success, both independently and in chorus with other males, as suggested by research on the European treefrog (*Hyla arborea*) by Lengagne (2008). Finally, Chiricahua leopard frogs that disperse into the active mining area may be injured or killed by exposure to toxic chemicals associated with ore processing and wastewater storage in open ponds or pits.

As a result of groundwater drawdown after the life of the mine, the amount or volume of water within regional perennial pools could decrease, which could result in indirect effects on Chiricahua leopard frogs through long-term habitat alteration, which could cause die-back in aquatic and some riparian vegetation. Chiricahua leopard frogs have been documented within the action area in four locations that are fed by groundwater and where groundwater drawdown is possible after closure of the mine: Empire Gulch, Box Canyon–Dam Structure, Well in Ophir Gulch, and South Sycamore Canyon. We also note that reductions in discharge in Empire Gulch will result in reductions in flow in Cienega Creek below the confluence. The BLM also indicated that restored wetlands (Empire Wildlife, Cinco Canyon, and Spring Water Wetland ponds) which are scheduled to receive frogs may also be affectd by drawdowns.

Groundwater flow models were designed to simulate conditions prior to pit development, during pit dewatering, and for a 1,000-year post-closure period of groundwater level recovery and potential pit lake development (Montgomery and Associates 2010; Tetra Tech 2010c), and it was determined that groundwater drawdown could result in the dewatering of key breeding sites and other streams, seeps, and springs that support, or that may support, breeding frogs. These indirect impacts are anticipated to be negligible and immeasurable until at least 50 years after project closure in Empire Gulch and Cienega Creek. After mining activity ceases, however, there are indirect effects anticipated based on long-term projections of the hydrology models. Uncertainties in the variables used to build the models, however, could be manifested as greater reductions of groundwater and greater impact to surface water levels (e.g., lower water level, more extensive dry reaches) and riparian vegetation than modeled. The timing and amount of groundwater drawdown at the Box Canyon Dam Structure, Ophir Gulch Well, and South Sycamore Canyon have been modeled but not specifically reported. These impacts could be critical during periods of low flow (May and June) because even small flow reductions could cause some portions of Cienega Creek, or other aquatic areas, to stop flowing. These modeled decreases in groundwater (less than 1 foot) would occur over a long period of time but could cause changes in riparian vegetation extent or health; the reduction in stream flow could impact this frog species, which needs standing or flowing water. Indirect effects of groundwater drawdown on Chiricahua leopard frogs breeding and foraging within these areas could result in reduction of substrate for eggs, substrate for organisms fed on by tadpoles and adult frogs, escape cover for tadpoles and adults, and moist microhabitats for frogs, hence reducing the success of eggs, altering growth rates of tadpoles, reducing food for tadpoles and adults, and increasing the exposure of tadpoles and adults to vertebrate predation and desiccation (Southwest Endangered Species Act Team 2008). The term “possible” means there is definitely enough drawdown to impact a spring, but the water source of the spring is unknown. If the spring arises from the regional aquifer, then it would be impacted; however, if it is a localized spring that is not connected to the regional aquifer, then it may not be impacted at all.

Impacts to water quality and/or disruption of surface water flow resulting from the capture of runoff in the pit are only expected to occur along the Barrel Canyon drainage through Davidson Canyon to its confluence with Cienega Creek. The Chiricahua leopard frog is not known to currently occur in any of these reaches; however, lower Davidson Canyon Wash may provide suitable habitat for this species during high-water events. It is during these periods of connected surface flow that Chiricahua leopard frogs may disperse or be transported to downstream reaches of Cienega Creek and, from there, move upstream to temporary pools in Davidson Canyon Wash. If the placement of tailings in Barrel Canyon reduced the inundation time of these pools, the frogs will be affected.

The same types of effects described above can also affect Chiricahua Leopard Frog prey species as a result of the proposed project activities, hence altering their predator-prey relationships and resulting in additional effects to Chiricahua leopard frogs. Additionally, because the mine pit lake water quality could exceed wildlife standards (which do not actually apply to the water) for three contaminants that are known to bioaccumulate (i.e., cadmium, mercury, and selenium), effects on this species could occur from eating winged aquatic invertebrates originating in and, via flight, being exported from the mine pit lake to sites where they may be preyed upon by Chiricahua leopard frogs. The results of geochemical modeling for the mine pit lake indicate that various contaminant levels that would result from these mining processes may exceed aquifer or surface water quality standards for wildlife. Cadmium is highly toxic to wildlife, is carcinogenic and teratogenic, and can have sublethal and lethal effects at low environmental concentrations (EPA 2011). It affects respiratory functions, enzyme levels, muscle contractions, growth reduction, and reproduction. Cadmium is known to bioaccumulate in the food chain. A portion of mercury released into the environment is transformed by abiotic and biotic chemical reactions to organic derivatives, such as methylmercury, which bioaccumulates in individual organisms, biomagnifies in aquatic food chains, and is the most toxic form of mercury to which wildlife are exposed (EPA 1997). Risks from selenium are primarily associated with aquatic species. Selenium is a bioaccumulative pollutant, and aquatic life is exposed to selenium primarily through diet (EPA 2004). Risks stem from aquatic life eating food that is contaminated with selenium, rather than from direct exposure to selenium in the water.

Within the portions of the action area that include designated critical habitat for the Chiricahua leopard frog, it is possible that the proposed project could indirectly impact some of the PCEs of critical habitat for this species within those areas. Chiricahua leopard frogs are known to occur at seven locations within proposed critical habitat within the action area. There are two known Chiricahua leopard frog locations in designated critical habitat that are supported by groundwater: Ophir Gulch Well and Empire Gulch Springs. Groundwater drawdown at Empire Gulch is modeled to be measurable beginning 50 years after mine closure; the timing or amount of groundwater drawdown at Ophir Gulch Well has been modeled but not specifically reported. Other locations in Cienega Creek in designated critical habitat that are supported by groundwater are modeled to experience groundwater drawdown, and impacts are modeled to be negligible and immeasurable in Cienega Creek until at least 50 years after mine closure. Impacts to an interrupted perennial system, such as Cienega Creek, could be much greater during critical periods of low flow and during critical times of the year (May and June), and even small flow reductions could cause some portions of Cienega Creek, or other aquatic areas, to stop flowing. These modeled decreases in groundwater (less than 1 foot) would occur over a long period of time but could cause changes in riparian vegetation extent or health, and the reduction in stream flow could impact designated critical habitat for this aquatic frog species, which needs standing or flowing water.

Cover vegetation at the edge of stock tanks in designated critical habitat, especially the areas of designated critical habitat near the proposed project area, could be negatively impacted by windborne fugitive dust coating leaves, resulting in reduced photosynthetic activity. Physical effects of dust on plants may include blockage and damage to stomata, shading, abrasion of leaf surface or cuticle, and cumulative effects (e.g., drought stress on already stressed species) (Goodquarry 2011). Reduced emergent vegetation cover or substrates could result in reduced of substrate for eggs, substrate for organisms fed upon by tadpoles and adult frogs, escape cover for tadpoles and adults, and moist microhabitats for frogs, hence reducing the success of eggs, altering growth rates of tadpoles, reducing food for tadpoles and adults, and increasing the exposure of tadpoles and adults to vertebrate predation and desiccation (Southwest Endangered Species Act Team 2008). Comments submitted by the USFS (see USFS 2013d as cited in the Description of the Proposed Action), indicate that National Ambient Air Quality Standards (NAAQS) are not anticipated to be exceeded outside of the perimeter fence and thus, the aforementioned dust effects are unlikely to occur.

It is possible that the proposed mine and associated disturbances could also result in increases in populations of nonnative species and could create conditions suitable for the presence of *Bd*. *Bd* has been documented from Las Cienegas NCA (USFWS 2012b) but not confirmed from the Santa Rita Mountains; however, there is speculation that *Bd* may have been present in Tarahumara Frogs (*Lithobates tarahumarae*) in the Santa Rita Mountains in the past (Hale *et al.* 2005; Rorabaugh *et al.* 2005).

<u>Effects from Conservation Measures</u>

Numerous conservation measures are included in the proposed action; some that benefit the Chiricahua leopard frog directly and others, indirectly. Although most of these actions should be considered beneficial to the Chiricahua leopard frog in both the short- and long-term, brief but adverse effects are also associated with implementation of these activities. In some instances, conservation measures could pose more harm than good to the Chiricahua leopard frog and are therefore being replaced or modified by terms and conditions described below. Following, we discuss the effects associated with the proposed conservation measures.

Sonoita Creek Ranch – The general scope and purpose of proposed management on the Sonoita Creek Ranch is commensurate with ongoing recovery strategies outlined in the Chiricahua leopard frog Recovery Plan (FWS 2007); that is to say, management to benefit native aquatic species. We concur with the AGFD's recommendation in their letter dated February 14, 2013, that these two large ponds will be better managed for native vertebrates if they were reconstructed as a conglomeration of smaller bodies of water, after the removal of existing nonnative species. The construction of barrier fencing to restrict movement of bullfrogs was not included as part of this specific conservation measure. Without the construction of barrier fencing around these constructed water features, regional bullfrog populations are likely to infiltrate these ponds and render them useless for Chiricahua leopard frog conservation. Barrier fencing will allow these water features to act as self-sustaining source populations of Chiricahua leopard frogs by providing individuals, larvae, and egg masses for introductions elsewhere in the three affected frog management areas. It is likely that some level of larval Chiricahua leopard frog predation can be expected by interactions with Gila chub in ponds where both species are present. In general terms, conservation activities associated with introducing Chiricahua leopard frogs into these waters for conservation purposes will result in harassment of individuals and on rare occasion, injury or death of individuals from activities associated with capture, storage, transportation, and release of frogs in all life stages. These potential adverse effects are far outweighed by the benefits gained in recovery of the species. This conservation measure in its original form has been affectively modified by Term and Condition 4, below, to provide greater conservation value for Chiricahua leopard frogs.

Chiricahua Leopard Frog-Specific Measures – Anticipated effects to Chiricahua leopard frogs from general survey, capture, and relocation of frogs outlined in the Conservation Measures above may include harassment of individuals and on rare occasion, injury or death of individuals from activities associated with capture, storage, transportation, and release of frogs in all life stages. These potential adverse effects are far outweighed by the benefits gained in recovery of the species.

In addition to the known anticipated effects to Chiricahua leopard frogs from general survey, capture, and relocation of frogs discussed previously that we understand will precede any physical tank renovation work at a given site, we expect that a small percentage of adults and potentially numerous tadpoles may be injured or killed as a result of project implementation. These effects are in addition to harassment of frogs in any life stage present in selected sites from the capture, detainment, and potential relocation of resident frogs. It should be noted that improvements to a given tanks' ability to hold water for longer periods does not ultimately preserve the tanks suitability for occupation under medium- to long-term drought stress. Only installing an artificial water supply (such as a solar groundwater well) can warrant such a guarantee. For maximum conservation benefit, we supersede this conservation measure with Term and Condition 5, below, which: (1) requires that a guaranteed water supply shall be installed at each of the seven tanks being improved to secure against their drying during periods of prolonged drought conditions; and (2) adding that the location and selection of tanks for improvement should be a collaborative decision with the Chiricahua leopard frog local recovery group consisting of the Coronado National Forest, other entities, direct stakeholders, cooperating permitees, and FWS (local recovery group) as landscape and resource variables and regional threats are expected to change over the 25-year active life of the project and it may be necessary to focus such efforts at other sites within the affected management areas.

Anticipated effects to Chiricahua leopard frogs from general survey, capture, and relocation of frogs that are associated with the creation of additional water features to support Chiricahua leopard frogs may include harassment of individuals and on rare occasion, injury or death of individuals from activities associated with capture, storage, transportation, and release of frogs in all life stages to these new sites. Under the same premise as discussed immediately above, the location and selection of sites for creation should be a collaborative decision with the local recovery group for maximum conservation benefit.

Because effective nonnative species management is directly linked to surveys and monitoring, we expect resident Chiricahua leopard frogs in all life stages to be harmed or harassed as discussed previously where they occur in sites selected. We expect nonnative species management to occur in all three affected Chiricahua leopard frog Management Areas in Recovery Unit 2 (Santa Rita MA, Empire Cienega MA, and Redrock-Sonoita Creek MA) as appropriate.

Stormwater ponds were originally intended to be managed for Chiricahua leopard frogs as a conservation measure; however their management in such a manner is not consistent with the current recovery strategy for Chiricahua leopard frogs in Recovery Unit 2. The creation of stormwater ponds for the purpose of capturing precipitation runoff from the active mining area for subsequent evaporation is a necessary component of the projects stormwater permit. However, specifically managing these features for the purpose of creating and/or maintaining habitat for Chiricahua leopard frogs actually enhances the likelihood and magnitude for take of frogs by drawing them closer to active mining operations, thus becoming an attractive nuisance for regional metapopulations and at worst becoming a regional population sink. Therefore, Terms and Conditions 2 and 3 supersede the Conservation Measure that promotes the use of stormwater ponds by Chiricahua leopard frogs and instead requires that stormwater pond management focus on their primary objective of capturing runoff and evaporating water as quickly as possible. We also require that monitoring of these stormwater ponds occur during the summer monsoon when frogs are most-likely to make overland movements; any frogs found within the ponds will be relocated to sites under coordination with local recovery stakeholders.

Because we understand that the presence of water on the landscape is an attractive and necessary element to the Chiricahua leopard frogs' natural history, it is likely that over the life of the proposed action, an unknown number of dispersing adults could move into exposed process water where they would be likely to be injured or killed from toxic exposure. Process water ponds will, however, be enclosed, covered, or otherwise managed to protect wildlife, livestock, and public safety, thus minimizing, if not removing, this threat.

Cumulative Effects - Chiricahua Leopard Frog

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.

Exceptions include continued road maintenance, grazing activities, and recreation in the action area, current and future development, other nearby mining projects, and unregulated activities on non-federal lands, such as trespass livestock, inappropriate use of off-highway vehicles (OHVs), and illegal introduction of nonnative aquatic species (e.g., bullfrogs, crayfish, and salamanders), which can cumulatively adversely affect the Chiricahua leopard frog and its designated critical habitat. Additional cumulative effects on Chiricahua leopard frogs include ongoing activities in the watersheds in which the species occurs such as livestock grazing and associated activities outside federal allotments, irrigated agriculture, groundwater pumping, stream diversion, bank stabilization, channelization, recreation without a federal nexus, and cross-border activities that include the following: human traffic; deposition of trash; new trails from human traffic; soil compaction and erosion; increased fire risk from human traffic; and water depletion and contamination. These impacts are somewhat attenuated by the relatively minor amount of non-Federal lands in the action area.

Conclusion - Chiricahua Leopard Frog

After reviewing the current status of the Chiricahua leopard frog, the environmental baseline for the action area, the effects of the proposed Rosemont Mine Project, and the cumulative effects, it is our biological opinion that the action, as proposed, is not likely to jeopardize the continued existence of the Chiricahua leopard frog nor adversely modify its designated critical habitat. We make this finding for the following reasons:

1. The majority of the project activity likely associated with adverse effects from mine construction and operation is located on the northern-most edge of the recovery focus for the Santa Rita Management Area, and therefore, core metapopulation areas that have been the focus of recent recovery actions are spatially distant from the active mining area. This mitigates the likelihood for dispersing frogs to be present in the active mining area.
2. Conservation benefits from the suite of proposed conservation measures, if properly implemented, are expected to outweigh the adverse effects of mine construction and operation, through the creation and improvement of habitat and management of nonnative species, provided that predominate forces such as potential drought from regional climate change have been adequately forecasted over the life of the project (see the climate change analyses in the BA and in this document's Gila chub section). The most significant threats to Chiricahua leopard frogs in this area are drought (Santa Rita MA, Empire Cienega MA, and Redrock-Sonoita Creek MA), nonnative species (Redrock-Sonoita Creek MA), and Bd (Empire Cienega MA). Collectively, with the exception of the threat of *Bd*, the proposed conservation measures, with minor modifications, are likely to help secure the regional status of Chiricahua leopard frogs and enhance the achievement of recovery goals in this area.

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 - CHIRICAHUA LEOPARD FROG

Section 9 of the Act and Federal regulations pursuant to section 4(d) of the Act 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 further defined (50 CFR 17.3) 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. "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 of 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 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 the USFS 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. The USFS has a continuing duty to regulate the activity covered by this incidental take statement. If the USFS (1) fails to assume and implement the terms and conditions or (2) fails to require any 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, the USFS must report the progress of the action and its impact on the species to the FWS as specified in the incidental take statement. [50 CFR 402.14(i)(3)].

Amount or Extent of Take - Chiricahua Leopard Frog

We anticipate that take of Chiricahua leopard frogs in the form of harm and harassment will occur at up to 6 known sites where the species is currently or formerly known, as a result of groundwater drawdown as reported in the Biological Assessment: Lower Stock Tank, Empire Gulch, Box Canyon Dam, Ophir Gulch Well, South Sycamore Canyon, Cienega Creek. As described in the BA, climate change models predict that over time, the southwest is likely to become hotter and drier, punctuated with more extreme drought (declines in winter precipitation) and intense flooding (summer precipitation). The Chiricahua leopard frog sites listed above are likely to respond differently over time to the effects of climate change and groundwater withdrawal. Some of these occupied or formally occupied sites have more recharge potential based upon the number or mechanism of recharge inputs (a stream or drainage with several tributaries versus a stock tank fed by ephemeral flow within a single drainage) and are more likely to persist longer under the stress of climate change and declining groundwater levels. Regardless of how these effects materialize, it is most likely that measurable dewatering effects will be most apparent in the latter half of the life of the project; when the radius of influence of groundwater decline intercepts recharge of these sites and when climate change effects may be more noticeable. We therefore predict that the most vulnerable sites will be lost to Chiricahua leopard frogs as suitable perennial habitat: Lower Stock Tank, Box Canyon Dam, Ophir Gulch Well, and South Sycamore Canyon. The proposed project area is generally located in the northernmost periphery of the core metapopulation area along the eastern bajada of the Santa Rita Mountains.

We anticipate and authorize the take of up to and including 50 Chiricahua leopard frogs and 2 egg masses in the form of harm or harassment from adverse effects associated with the mine construction and continued operations at the active mine site and access roads, including frogs' occurrence in aquatic sites subject to groundwater drawdowns and stormwater detention ponds (see the Chiricahua leopard frog-specific Conservation Measures). This number is our conservative estimate of the total number of frogs that could be taken within the active mining footprint and associated road use – including stormwater ponds - over the life of the mine. Currently there is no occupied Chiricahua leopard frog habitat within the footprint of the proposed mine. Rosemont will survey for Chiricahua leopard frogs prior to construction which will reduce the potential for take.

We are unable to anticipate the amount of take associated with indirect effects of potential contamination of prey species (winged insects) in the region because the data required to ascertain that figure are unavailable and not reasonably collected. However, we do not consider this form of take to be significant because winged insects that are heavily impacted by contamination are not likely to move appreciable distances and comprise a meaningful proportion of the region's Chiricahua leopard frogs' diet.

We anticipate a proportion of Chiricahua leopard frogs will be taken through the implementation of conservation measures, most likely from activities associated with capture, detainment, disease treatments, transportation, and release of frogs in all life stages. It is impractical to quantify actual numbers of individuals taken under these mechanisms and we are not going to limit this form of take because potential, short-term adverse effects are far less significant than the conservation value gained in recovery of the species in the area and because the net number of individuals potentially harmed is far exceeded by the number of individuals which are benefited or created by the implementation of these activities.

In summary, and stated differently, the maximum allowable incidental take of the Chiricahua leopard frog is 50 individuals and two egg masses.

Effect of the Take - Chiricahua Leopard Frog

In this biological opinion, we determine that these levels of anticipated take are not likely to result in jeopardy to the species or result in adverse modification of its designated critical habitat for the reasons stated in the Conclusions section.

Reasonable and Prudent Measures - Chiricahua Leopard Frog

Reasonable and prudent measures and terms and conditions should minimize the effects of take, and provide monitoring and reporting requirements [50 CFR 402.14(i)(3)].

<u>Chiricahua Leopard Frog</u>

The following reasonable and prudent measures are necessary and appropriate to minimize take of Chiricahua leopard frogs:

1. Rosemont shall monitor the incidental take resulting from the proposed action and report the findings annually to our office. The report shall include the findings of the monitoring with regard to nonnative species (such as bullfrogs, crayfish, and warn water spiny-rayed fishes) and adaptive management actions.

2. Rosemont shall ensure that necessary precautions are taken to minimize the potential for Chiricahua leopard frogs to become attracted to water features near the active mining area.

3. Rosemont shall ensure that long-term, secure breeding populations of Chiricahua leopard frogs are created to act as source populations for use in future introductions of frogs into sites within the three affected Management Areas.

Terms and Conditions - Chiricahua Leopard Frog

In order to be exempt from the prohibitions of section 9 of the Act, the USFS shall ensure that Rosemont complies with the following terms and conditions, which implement the reasonable and prudent measures described above and outline required reporting/monitoring requirements. These terms and conditions are non-discretionary.

Chiricahua Leopard Frog

1. Rosemont shall monitor the action area to ascertain take of individuals and report to our office (written correspondence, e-mail, or phone call), information regarding:

    a. The observed occurrence or the discovery of harmful nonnatives such as American bullfrogs, crayfish, or warm-water, spiny-rayed fish species in any sites created inadvertently by or as a conservation measure for the proposed action to provide for collaborative emergency planning and corrective action (within three days of the observation).

    b. The results of any monitoring efforts conducted and a summary of any situations (and their corrective actions), that occurred during project implementation. Under an adaptive management framework, the report shall also make recommendations for modifying or refining potential, future conservation measures for implementation of similar projects which are likely to provide greater conservation benefit to Chiricahua leopard frogs.

2. Rosemont shall monitor suitable habitat on National Forest System and Rosemont-owned land within one mile of the active operations area, including (but not limited to) roads, the utility corridor, and on-site stormwater ponds, twice monthly from July 1 through September 30, while the mine is in operation. The one-mile monitoring criterion is based on the species' overland dispersal distance (see Status of the Species, above). If Chiricahua leopard frogs are detected on site or within a mile of the active operations area, they will be relocated to suitable habitat within the management area under close coordination with the local recovery group. This Term and Condition augments Conservation Measures 2 and G-3 (3.1-3.6) with respect to Chiricahua leopard frogs.

3. Rosemont shall explore alternatives to traditional stormwater pond construction, operation, etc. in order to minimize water holding duration to the maximum extent practicable without compromising the primary function of the ponds; this is to reduce the

creation and maintenance of habitat in the active operations area that could become an attractive nuisance for frogs. This Term and Condition replaces Conservation Measure G-7 for Chiricahua leopard frogs.

4. Rosemont shall create small waters on the Sonoita Creek Ranch property and manage them as potential source populations of Chiricahua leopard frogs for future releases in the affected management areas. This will include renovation to remove harmful nonnative predators such as bullfrogs, crayfish, nonnative spiny-rayed fish and the construction and maintenance of frog barrier fencing, as necessary, to prevent bullfrogs from recolonizing these waters. Fencing gauge shall be chosen that will not entrap other small terrestrial vertebrates such as snakes, lizards, etc., such as 0.25" mesh size or smaller. Barrier fencing will be located in a manner to allow adequate terrestrial space for foraging or terrestrial habitat enhancements. Should future, unrelated conservation activities render Sonoita Creek free of bullfrogs, the barrier fencing could be removed to allow natural immigration and emigration from the site. Management of Chiricahua leopard frogs at this site shall be coordinated through the local recovery group. This Term and Condition augments Conservation Measure 6 with respect to Chiricahua leopard frog recovery activities on the Sonoita Creek Ranch.

5. Rosemont shall coordinate with the local recovery group in the identification and location of the seven sites to be specifically dedicated for Chiricahua leopard frog conservation. These sites may or may not include particular sites referenced in the conservation measures of the Biological Assessment, may or may not be located on grazing allotments managed by Rosemont, but will be located on Coronado National Forest lands within the Santa Rita Management Area. To protect against the threat of prolonged drought, each of the seven tanks that will be improved for permeability and retention shall also have an artificial water source provided, such as a solar groundwater well, to ensure permanency of water at improved sites. Any water features that are created in addition to these seven sites that may affect the status of Chiricahua leopard frogs in the action area will be chosen in consultation with the local recovery group to facilitate avoiding incidental adverse effects or creating conservation opportunities. This Term and Condition augments or replaces several Conservation Measures proposed, including Conservation Measures 5 (5.1 – 5.3), G-4 (4.1-4.6), and G-5 (5.1-5.3).

These 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. The Coronado Nation Forest must immediately provide an explanation of the causes of the taking and review with our office the need for possible modification of the reasonable and prudent measures.

Conservation Recommendations - Chiricahua Leopard Frog

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.

1. We recommend that the Coronado National Forest implement Forest-specific actions within the Chiricahua Leopard Frog Recovery Plan (FWS 2007).
2. We recommend the Coronado National Forest work with FWS and the other entities to continue to control nonnative aquatic organisms on the Forest, particularly bullfrogs, nonnative fish, and crayfish. We therefore encourage the Coronado National Forest to consider installing drains at each of the seven tanks that will be improved or created for use by Chiricahua leopard frogs described in Term and Condition 5. Drains can significantly assist resource managers in the management of harmful nonnative species such as bullfrogs in the event they colonize any one or more of the improved or created tanks.
3. We recommend that the Coronado National Forest continue to identify factors that limit the recovery potential of Chiricahua leopard frogs on lands under their jurisdiction and work to correct them.

In order for us 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.

Effects to Aquatic Ecosystems

This section includes an analysis of the effects of the proposed action on fluvial aquatic ecosystems. The Gila chub and Gila topminnow occur in streams that are affected by the proposed action. The Huachuca water umbel is a semi-aquatic plant that occurs in and immediately adjacent to streams. The analyses contained herein will be incorporated via reference into the respective species' analyses. These analyses also, in part, inform the respective action area descriptions for the affected species.

The proposed action includes the excavation of an open pit to an elevation of approximately 3,050 feet, a level that will intersect regional groundwater and/or water-conducting subsurface fracture networks (USFS 2011). Subsurface water will therefore "daylight" and fill the excavated area. The need to dewater the pit during active mining operations and the post-mining existence of a lake from which water will evaporate mean that the pit will function as a well from which regional groundwater is removed from storage in the regional aquifer and, eventually, captured from discharges to springs, streams, and evapotranspiration (ET, the uptake of groundwater by vegetation) (Leake *et al.* 2008).

The effects of groundwater withdrawal on surface waters of interest may be evaluated with a model calibrated to local conditions. Groundwater models were prepared by Montgomery and Associates (2010) and Tetra Tech (2010), the results of which were incorporated into the Draft EIS. The BA and supplemental documents include analyses of effects to surface waters based on the outcomes of the Montgomery and Associates (2010) and Tetra Tech (2010) models, as well as an independent model prepared by Myers (2010). The validity of the Montgomery and Associates (2010) and Tetra Tech (2010) models was later evaluated by SRK Consulting at the request of the Forest Service (SRK 2012). The Myers (2010) model was not subjected to review by SRK.

Our review of DEIS comments submitted to the Coronado NF by the U.S. Geological Survey (USGS) (Port 2012), Pima County (Pima County 2012), and Sonoran Institute (Propst 2012), indicated that there were substantial uncertainties regarding the magnitude and timing of groundwater drawdowns, particularly as those drawdowns relate to potential reductions in discharges to springs and streams. These uncertainties were explored at length, culminating in an October 18, 2012, meeting between the Forest Service, consulting hydrologists, the USGS, the BLM, the USEPA, and the FWS. The technical discussions concluded with general consensus as to the validity of the models applied to evaluate the effects of the proposed action (FS 2012a).

Given the general agreement regarding the validity and utility of the Montgomery and Associates (2010) and Tetra Tech models, SWCA prepared a definitive impact analysis for seeps, springs, and riparian ecosystems for the Coronado NF and presented it to us on November 16, 2012 (SWCA 2012). The Coronado NF subsequently adopted the SWCA analysis in the second Supplemental BA (FS 2013a). These analyses are incorporated herein via reference.

We note that the models were based on the assumption that the local groundwater system exists as a porous media, rather than a system of individual fractures. The various hydrogeologic units were assigned different properties, such as hydraulic conductivity (the ease by which water can move through the material) and specific storage (which refers to the amount of water an aquifer can release from storage during changes in hydraulic head). There is a possibility that some portion of the regional groundwater is conducted through subterranean fractures and/or faults in the lithology in the project area, though we note that karst (limestone prone to formation of dissolution channels capable of relatively rapid groundwater movement) is unlikely to be present in or near the to-be-excavated area (USFS 2013b, SRK 2012). Knight (1996) described evidence of groundwater flow through fractures. If such a flow system is an appreciable component of the hydrogeology at and near the mine pit, or if mining results in loss of subterranean buoyant forces, new fractures could form. If such new fractures are localized, the flow of groundwater through them would still be encompassed by the existing flow models. If new fractures are of a scale that the groundwater flow system is fundamentally altered, the models' results may require reexamination.

Furthermore, it is not definitively known if or to what extent spring and stream baseflows are the result of discharges from: (1) the regional aquifer, which is affected by the proposed action; (2) a geologically-isolated groundwater system, isolated from the effects of the action; or (3) a combination of these two sources. Also note that our use of the term baseflow refers only to the water discharged from the regional or local aquifer to a spring, stream or waterbody, or to riparian vegetation (in the form of evapotranspiration). The regional aquifer is understood to consist of the interconnected fractures and hydrogeologic units that contain the groundwater encountered throughout the larger Rosemont area. Local aquifers may consist of alluvial sediments, areas of perched groundwater, or smaller areas of fractures that are not regionally connected but still may contain groundwater.

Lastly, we are aware of the cautionary narrative in Leake (2011), which stated that capture of groundwater destined for discharge to streams or riparian ET does not depend on rates and directions of groundwater flow. Leake (2011) further stated that: (1) capture can occur in stream reaches both up- and downgradient of pumping locations [see also Cosgrove and Johnson (2005)]; (2) capture is not limited to the fraction of base flow that originates in the pumped area, even in streams with base flow derived from groundwater discharge; (3) capture still occurs even if a groundwater divide exists between the pumping location and the river or stream; (4) non-pumping transient events, such as episodic recharge from connected streams, do not affect capture; and (5) the geochemical signature of surface water, if different from the groundwater signature, is not necessarily an indication that pumping from a particular location does not affect that surface water. These precepts, in part, form the basis for our precautionary approach regarding the reductions of mountain front recharge (see Gardner Canyon and Empire Gulch analyses, specifically).

The natural hydrologic system to which the models have been applied also exhibits a relatively large degree of variation under current conditions. This background variation is unaffected by the proposed action but does experience impacts from both natural, climatic variation and existing water withdrawals. The hydrologic summary compiled by SWCA and transmitted by the Forest Service (SWCA 2012), includes the following statements regarding fluctuations in depth to groundwater in the area of interest:

- In a well in lower Davidson Canyon, groundwater levels have been observed to fluctuate by more than 10 feet in a single year.
- Two stock wells along Empire Gulch have been monitored by the Arizona Department of Water Resources for three to four decades, and the results show that water levels have varied between 4 to 4.5 feet.
- Similar stock wells along Cienega Creek show variation between 3 and 4 feet.
- Two wells immediately adjacent to lower Cienega Creek were monitored between 2007 and 2009 by the Pima Association of Governments and exhibited a fluctuation in water level of up to 5 feet seasonally.
- Montgomery and Associates (2010) conducted a similar analysis on a much greater number of wells located throughout the basin (not just near streams) and found that the average short-term fluctuation in groundwater levels was 7.1 feet and that the long-term fluctuation in groundwater levels was 19.7 feet.

It is important to note that the estimated groundwater drawdowns resulting from implementation of the proposed action will be in addition to the natural and anthropogenic variation noted above, and would be additive to (not masked by) any negative baseline effects (or offset by positive effects) already extant (or reasonably certain to occur), as well as the effects of cumulative (future, non-Federal, and within the action area) actions. Please see the climate change discussion appearing in the BA, this BO's Gila chub Status of the Species section, and to the same species' Cumulative Effects analysis for additional information.

Despite the inherent uncertainties in the hydrologic system and the groundwater modeling data derived from analyses of that system, we are aware of no other existing model results or empirical data that would more accurately inform our analyses. The existing groundwater models therefore represent the best available information with which we can analyze the groundwater-related effects of the proposed action.

The action area is drained by ephemeral, intermittent, and perennial watercourses that flow primarily in a northeasterly direction from high-elevation ridges on the eastern flank of the Santa Rita Mountains through foothills toward larger drainages located at lower elevations on the basin floor. Ephemeral refers to streams or portions of a stream that flow briefly in direct response to precipitation, and whose channel is at all times above the groundwater reservoir. Intermittent refers to a stream where portions flow continuously only at certain times of the year, for example when it receives water from a spring, groundwater source, or from a surface source such as melting snow (i.e., seasonal). At low flow, an intermittent stream may exhibit dry reaches alternating with flowing reaches. Perennial refers to a stream or portion of a stream that flows year-round and is considered a permanent stream, and for which base flow is maintained by groundwater discharge to the streambed. Discharge to the streambed from groundwater would be due to the groundwater elevation adjacent to the stream typically being higher than the elevation of the streambed, though artesian conditions can also support perennial streams.

Four major drainages occur in the primary area of disturbance: Wasp, McCleary, Scholefield, and Barrel Canyons. Scholefield, Wasp, and McCleary Canyons drain to Barrel Canyon, which then joins Davidson Canyon approximately 4 miles east of the project area. Davidson Canyon wash flows northwesterly between the Empire and Santa Rita Mountains into Cienega Creek, which eventually enters Pantano Wash outside of the action area. The distance from the confluence of Barrel and Davidson Canyons to the outlet of Davidson Canyon at Cienega Creek is approximately 14 miles. Drainage from these systems eventually reaches the Santa Cruz River north of Tucson.

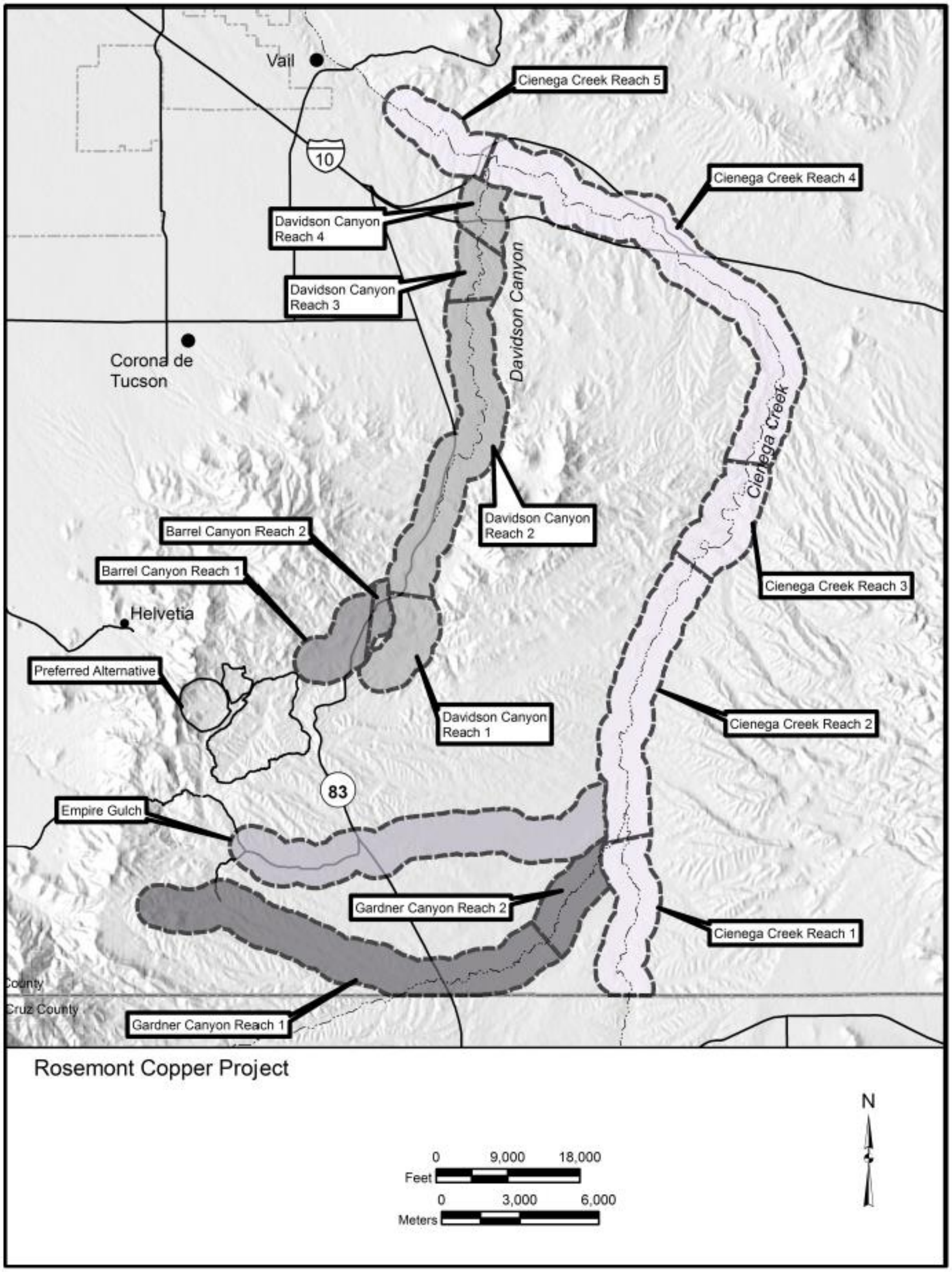

Figure A-1: Surface hydrology of the actions area (SWCA 2012)

Table A-1: Narrative descriptions of stream reaches adapted from SWCA (2012) and BLM (2013)		
Reach	**Location**	**Flow Regime**
Cienega Creek 1	From headwaters to confluence with Gardner Canyon	Perennial
Cienega Creek 2	From confluence of Gardner Canyon to the Narrows	Spatially intermittent; some perennial reaches; contains U.S. Geological Survey gage no. 09484550
Cienega Creek 3	The Narrows	Spatially intermittent; some perennial reaches
Cienega Creek 4	From the Narrows to confluence with Davidson Canyon	Spatially intermittent; some perennial reaches; contains U.S. Geological Survey gage no. 09484560
Cienega Creek 5	From confluence with Davidson Canyon to Pantano Dam	Spatially intermittent; some perennial reaches
Cinco Wetlands	Located in Cienega Creek floodplain east of Gardner Canyon	Perennial Interior Marshland
Spring Water Wetland	Cienega Creek floodplain downstream of Spring Water Canyon confluence	Perennial Interior Marshland
Multiple Unnamed Wetlands	Cienega Creek floodplain between Spring Water and Gardner canyons	Perennial and Seasonal Interior Marshland
Gardner Canyon 1	Upper Gardner Canyon	Ephemeral
Gardner Canyon 2	Lower Gardner Canyon	Ephemeral
Empire Gulch	From headwaters to confluence with Cienega Creek	Spatially intermittent; some perennial reaches
Cieneguita Wetland Complex	Floodplain in lower Empire Gulch	Perennial Interior Marshland
Cienega Ranch Wetland	Cienega Creek floodplain west of Empire Gulch	Perennial Interior Marshland
Cold Water Spring	Large spring located upstream of Mattie Canyon confluence	Perennial
Cold Water Wetland	Large wetland associated with Cold Water Spring	Perennial
Mattie Canyon	Tributary to Cienega Creek	Interrupted Perennial
Davidson Canyon 1	From headwaters to confluence with Barrel Canyon	Ephemeral
Davidson Canyon 2	From Barrel Canyon to Davidson Spring	Ephemeral
Davidson Canyon 3	From Davidson Spring to Reach 2 Spring	Ephemeral
Davidson Canyon 4	From Reach 2 Spring to confluence with Cienega Creek	Has been intermittent or perennial in the past; recently has been intermittent; contains U.S. Geological Survey gage no. 09484590
Barrel Canyon 1	From mine site to State Route 83	Ephemeral; contains U.S. Geological Survey gage no. 09484580
Barrel Canyon 2	From State Route 83 to confluence with Davidson Canyon	Ephemeral

Watershed Overview

The action area encompasses a large proportion of the greater Cienega Creek watershed. The Whetstone and Mustang Mountains form the eastern watershed boundary, the Canelo Hills form the southern boundary, and the eastern and northern Santa Rita and eastern face of the Empire mountains bound the western portion of the Cienega Creek watershed. Gardner Canyon and Empire Gulch are the largest tributaries to the upper reaches of Cienega Creek, and enter the stream south of the Empire Mountains. Mattie Canyon originates in the Whetstone Mountains and enters Cienega Creek downstream of the Empire Gulch confluence. Downstream from these three tributaries, Cienega Creek enters the narrows, a confined, bedrock-dominated reach in which alluvial and other sources of shallow groundwater are forced to the surface to contribute to discharges in the stream. Barrel Canyon and Davidson Canyon Wash arise in the Santa Rita Mountains and flow south along the western flanks of the Empire Mountains to join Cienega Creek well downstream of the narrows, south of Interstate 10.

The proposed mine will be situated within a portion of the watershed of Cienega Creek. Barrel Canyon watershed is the largest of the four major drainages that occur in the primary area of disturbance. Two sub-watersheds, Upper and Lower Barrel, total more than 2,300 acres and combine to make Barrel Canyon proper. Barrel Canyon is the largest of the watersheds affected by surface disturbance, extending almost 4 miles from its headwaters to its confluence with East Canyon; the average sandy-bottom channel width for washes in Barrel Canyon is estimated to be 51 feet. For comparison purposes, average wash widths in Wasp, McCleary, and Scholefield Canyons are approximately 38, 29, and 27 feet, respectively.

Somewhat smaller portions of additional watersheds occur within the perimeter fence. These watersheds include Oak Tree Canyon, Empire Gulch, and East Canyon. East, and Oak Tree Canyons are located east of the mine and drain east to join Cienega Creek. Empire Gulch is located southeast of the mine and also drains east to join Cienega Creek. Much of the land between the perimeter and security fences will remain undisturbed, though the primary access road, rerouted portion of the Arizona Trail, decommissioning of Forest Service Roads and secondary access road and utility ROW construction will result in effects to the Barrel canyon, East Canon, McCleary Canyon, and Wasp Canyon watersheds.

Groundwater and Surface Water Effects

The Montgomery and Associates (2010) and Tetra Tech (2010) models have variously predicted drawdowns greater than 100 feet in the immediate vicinity of the site; drawdowns of lesser magnitude are modeled to occur to the north along Davidson Canyon, to the east toward Cienega Creek, and to the south toward Empire Gulch. Specific drawdown estimates vary between models. The groundwater modeling by Montgomery and Associates (2010) and Tetra Tech (2010) involved creation of a number of scenarios, each scenario using different modeling parameters. Each individual parameter was varied within a reasonable range of values. This suite of modeling scenarios is known as the sensitivity analysis. Out of the suite of modeling scenarios, only one is considered the "best-fit", or baseline, modeling scenario. The range of predicted drawdown from the rest of the modeling scenarios, however, are still considered possible or reasonable, just not as likely to occur.

The ability for groundwater models to accurately predict the propagation of drawdown away from the pit is limited due to the asymptotic nature (mathematical leveling-off) of the response to groundwater withdrawals at large distances and times (SRK 2012). The difficulty in employing groundwater models to predict changes over large temporal and spatial scales (here, at up to 1,000 years and over 10 miles) is further increased if the groundwater system of interest exists within geologic formations of low permeability, as exists in the hard rock-dominated lithology at and near the mine site (SRK 2012, FS 2011). For these reasons, SRK (2012) estimated that the Montgomery and Associates (2010) and Tetra Tech (2010) models can reliably predict groundwater drawdowns of 5 feet or greater; changes of less magnitude have lower confidence (SRK 2012). It is unclear to us how modeled drawdowns of greater than five feet, but with increments of less than that amount, are inherently more reliable than incremental changes that do not meet the 5-foot threshold. We will therefore analyze the effects of all modeled drawdowns, and the effects that may result from those drawdowns, regardless of their magnitude.

Of the groundwater drawdowns predicted by Myers (2010), Montgomery and Associates (2010), and Tetra Tech (2010), the latter appear to be the most immediate and severe (see Table A-5). We feel that by emphasizing the results of the Tetra Tech (2010) model, our analyses will characterize the most conservative (i.e. maximum potential effect) levels of effects.

The values appearing in Table A-5 represent modeled drawdowns at location and time intervals of interest (SWCA 2012), but the models can also be employed to predict drawdowns at any location within the modeled domain and at any point in time (USGS 1997), such as at locations where monitoring wells have or will be placed. Also note that Table A-5 includes the results of sensitivity analyses performed during the development of the Montgomery and Associates (2010) and Tetra Tech (2010) groundwater models. In this BO, we have included the results of these sensitivity analyses to portray the range of values surrounding the predicted groundwater drawdowns that appear in Table A-5, and which, in part, form the basis of subsequent biological effects analyses.

The proposed action's effects to surface flows and groundwater occur in the southern and western portions of the greater Cienega Creek watershed. As stated previously, Gardner Canyon and Empire Gulch are tributaries to the upstream reaches of Cienega Creek. Barrel Canyon is a tributary to Davidson Canyon Wash which, in turn, is also a tributary to Cienega Creek. The effects to Barrel Canyon, Davidson Canyon Wash, Gardner Canyon, Empire Gulch and the upstream reaches of Cienega Creek represent incremental, additive effects to the lowermost reaches of Cienega Creek.

The stream-by-stream and reach-by-reach analyses that follow are arranged such that the uppermost portions of the watershed (Gardner Canyon, Empire Gulch, and upper Cienega Creek) appear first. The analyses then shift to Barrel Canyon and Davidson Canyon Wash, to which the former is the main, affected tributary. The individual analyses conclude with Lower Cienega Creek.

In addition to appearing in Table A-5, the Tetra Tech (2010) groundwater model-based analyses are employed in the stream- and reach-scale analyses, below as well as in the Effects to Riparian Ecosystems section, and in the respective effects analyses for Gila chub, Gila topminnow, Huachuca water umbel, and southwestern willow flycatcher. We again note that while the effects analyses contain reference to modeled, best-fit drawdown values, we have considered that those values are bracketed by the results of sensitivity analyses. Moreover, while it is possible, if not probable, that the actual, observed drawdowns will be less or greater than the modeled, best-fit values, our effects analyses conservatively consider only the possibility that the best-fit drawdown values will be exceeded, reaching the higher value noted in the sensitivity analysis. Subsequent tables and narratives will thus include only the higher values resulting from the sesnsitivity analyses. If a larger, sensitivity analysis-derived drawdown is not referenced, it means that the best-fit value is equal to the highest value that resulted from the analysis.

Gardner Canyon

Gardner Canyon is anticipated to experience regional aquifer drawdowns of < 0.1 foot from the cessation of mining until 50 years later (or up to 0.15 foot at 50 years) (see Gardner/Cienega Confluence data in Table A-5). At 150 years after mining, the effect to Gardner Canyon increases to 0.2 foot (or, based on sensitivity analysis, up to 0.35 foot) and reaches 0.5 foot at 1,000 years.

We are concerned with the effects to mountain front recharge by the mine pit, though the ultimate fate of all sources of recharge differs between the Montgomery and Associates (2010) and Tetra Tech (2010) models. Mountain front recharge is water that originates as precipitation and which enters the regional aquifer via infiltration in uplands and channels. Huth (1996, as cited in Knight 1997) found that approximately 70 percent of the annual recharge in Cienega Creek originates from the Santa Rita Mountains, with the majority of that subsurface flow travelling down the Gardner Canyon corridor.

The Coronado National Forest reviewed a preliminary, administrative draft version of this section (USFS 2013b), wherein comments regarding alterations in recharge were provided. Tetra Tech (2010) predicts an increase in recharge because of the draining down of water from the tailings, and because of the flow-through drains would result in infiltration instead of runoff. This draining down of imported water may be appreciable; the proposed action will import over 5,000 acre-feet of water for application within the site (USFS 2013). Montgomery and Associates (2010) predicted a slight decrease in recharge post-closure (USFS 2013c).

For the purposes of NEPA analysis, the Coronado National Forest has assumed that the water that gets captured by the pit either as rainfall or runoff is a loss to mountain front recharge (USFS 2013). All other water not captured by the pit may become mountain front recharge either by infiltrating into fractures within the mine site and/or infiltrating into alluvial channels. The review comments indicated that there will be an estimated loss of approximately 35 to 127 acre-feet of recharge (USFS 2013c), which we presume is apportioned among all streams with headwaters and recharge zones close to areas appreciably affected by the pit. Regardless, such reductions in recharge were explicitly modeled by Tetra Tech (2010) and Montgomery and Associates (2010).

Empire Gulch

The proposed action will affect the subsurface and, eventually, the surface hydrology of Empire Gulch at the Upper Empire Gulch Springs site (see Upper Empire Gulch Springs data in Table A-5). Tetra Tech (2010) modeled the effects at this site to range from 0.1 foot (or up to 0.2 foot) of groundwater drawdown upon cessation of mining to 0.2 foot (or up to 0.5 foot) at 20 years, 0.5 (up to 1.8 foot) foot at 50 years, 2.5 feet (up to 5.0 foot) at 150 years, and 6 feet at 1,000 years.

Empire Gulch is a spring-fed system (Bodner and Simms 2008) and is thus vulnerable to alterations in the groundwater conditions that sustain the spring discharges. The appreciable groundwater drawdowns discussed above will likely diminish surface flows in the stream.

Also, while Huth (1996; a pers. comm. cited in Knight 1997) stated that approximately 70 percent of the annual recharge in Cienega Creek originates from the Santa Rita Mountains and flows down the Gardner Canyon corridor, it is reasonable to presume some smaller fraction of the Santa Rita Mountain front recharge travels down the Empire Gulch flow path. This would correspond to some portion of the estimated, potential 35 to 127 acre-feet mountain front recharge captured by the drawdown associated with the pit.

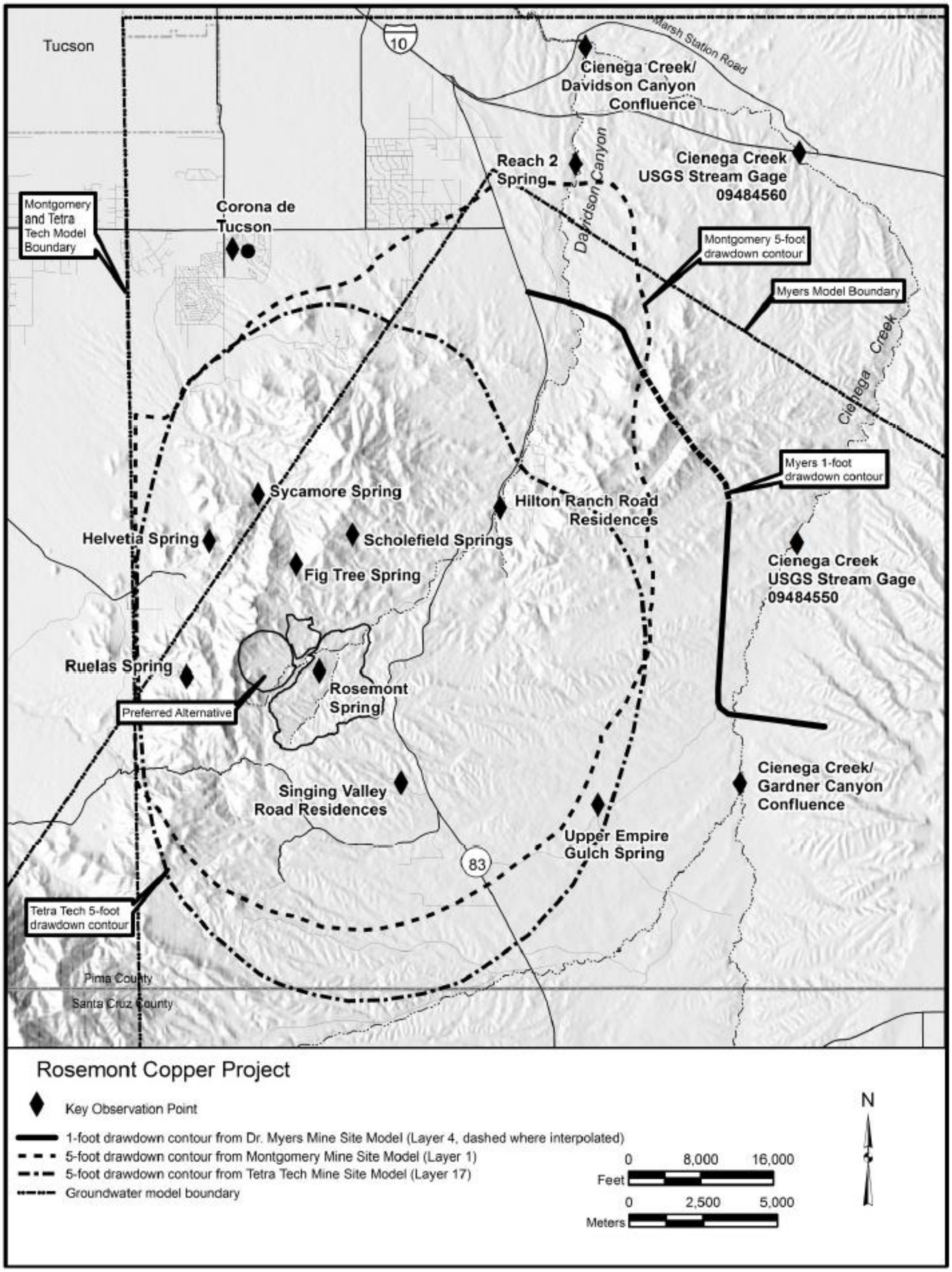

Figure A-2: Modeled groundwater drawdown contours

Upper Cienega Creek

Upper Cienega Creek is that portion of the stream in Reaches 1, 2, and 3 (the latter includes the narrows) (see Figure A-1). Gardner Canyon and Empire Gulch, along with Mattie Canyon are the major tributaries in this reach.

The USGS Cienega Creek stream gage (0948550) is situated near the narrows in the upstream portion of Reach 3 (see Figure A-1). Regional groundwater drawdowns at this site describe the effects to upper Cienega Creek. Tetra Tech (2010) modeled drawdowns of <0.1 foot from the end of mining and at 20, and 50 years later (or up to 0.15 foot at 50 years). Drawdowns reach 0.25 feet (or up to 0.35 foot) and 0.5 feet at 150 and 1,000 years, respectively .

Table 7 in Montgomery and Associates (2010) is a summary of various hydrologic and environmental effects resulting from the modeled drawdowns. Table A-2, below, excerpts the hydrologic effects analysis for upper Cienega Creek, including the narrows. The effects don't manifest until 1,000 years after the cessation of mining, but they become appreciable at that time.

Table A-2: Summary of Effects to Upper Cienega Creek, including the Narrows

Years after mining	Drawdown at perennial reach (feet)	Decrease in stream length (miles)	Decrease in baseflow (cfs)	Decrease in ET (afa)
0	0	0	0	0
20	0	0	0	0
150	0	0	0	0
1,000	0.01	0.16	0.02	51

Barrel Canyon

Barrel Canyon is proximal to the mine site. The primary effect of the proposed action on this stream is the reduced runoff that will result from the placement of mine tailings in its upper watershed and the retention of stormwater within the mine site, as opposed to the aquifer drawdowns that will occur deep beneath the stream bed (the ephemeral channel in this area does not receive discharge from the regional aquifer). SWCA (2012) included an estimate that ephemeral surface runoff in Barrel Canyon, under post-closure conditions, will be reduced approximately 17.2 percent. Greater effects – up to a 30 to 40 percent reduction in runoff- will occur during the first 10 years of mine construction (SWCA 2012), before concurrent reclamation activities that allow more water to move downstream are implemented.

The Coronado National Forest's review of the preliminary, administrative draft version of this section (USFS 2013) indicated that the placement of tailings in Barrel Canyon may have differing effects to mountain front recharge. As designed, the tailings lack flow-through drains, which would decreases the Tetra Tech (2010) model's potential for recharge within the mine site boundary. The Barrel alternative also lacks post-closure storage of water on site, which also decreases the potential for recharge within the mine site boundary. On the other hand, the Barrel alternative also moves more water downstream into ephemeral channels, within which mountain front recharge may be increased.

Davidson Canyon Wash

The uppermost reaches of Davidson Canyon Wash (Reaches 1 and 2) (see Figure A-1) are situated relatively close to the proposed mine pit and are situated in an area that will experience severe drawdowns (10 to 100 feet) in the regional aquifer; however, the primary water source in this area is precipitation runoff rather than regional aquifer discharge. These local sources of runoff will be unaffected and thus, the groundwater hydrology of Reaches 1 and 2 are not anticipated to be affected; Tetra Tech (2010) predicted drawdowns of <0.1 foot from the cessation of mining to 1,000 years.

Reaches 3 and 4 of Davidson Canyon Wash (see Figure A-1) may also be relatively unaffected by groundwater drawdowns. Tetra Tech predicted groundwater drawdowns in Davidson Canyon Wash at the downstream end of Reach 4 (see the Davidson/Cienega Confluence data in Table A-5) of <0.1 foot from 0 to 150 years after mining and 0.1 foot at 1,000 years (or up to 0.15 foot at 20 years, and 0.2 foot at both 50 and 150 years). These results assume a complete hydrologic connection between the regional aquifer and surface flows in the stream exists. However, when non-stormwater surface flows in Davidson Canyon Wash are present, they receive contributions from discharges at Reach 2 Spring and Escondido Spring (see Figure A-1). Tetra Tech (2010b) conducted an analysis, and based on geologic evidence, isotopic signatures in the springs, and the lack of consistent streamflow concluded that these springs likely derive their water from precipitation runoff-driven, ephemeral storm flows stored in the shallow alluvial stream sediments, which are then forced to the surface by bedrock constrictions in the stream channel. SRK conducted additional analyses (2012) and concluded that while some of the available evidence was anecdotal and less than certain, the available information also suggested that there is no connection between the Davidson Canyon springs and the regional aquifer. If surface flows in Davidson Canyon Wash are indeed derived from sources completely separate from the regional aquifer, then drawdowns caused by the proposed action could be of an even lower magnitude than those noted above.

Davidson Canyon Wash will, however, experience appreciable effects to its annual yield and peak flows. The stream's upper watershed will be subject to altered surface water runoff patterns due to the aforementioned placement of tailings and stormwater retention in the Davidson Canyon Wash tributary Barrel Canyon and retention of stormwater within the mine site. SWCA (2012), referencing Tetra Tech (2010) states that surface water runoff modeling on Barrel Canyon at Highway 83 indicated a post-closure runoff decrease (in acre-feet per annum) of approximately 17.2 percent under the proposed action. SWCA further extrapolates that this would equate to a 4.3 percent reduction of runoff (in acre-feet per annum) 12 miles downstream in the lower reaches of Davidson Canyon Wash. Modeled peak flow reductions (in cubic feet per second) are 22 percent at the Highway 83 Bridge, which extrapolates to 5.6 percent in Davidson Canyon Wash. Ephemeral channels (such as the upper and middle reaches of Davidson Canyon Wash (Reaches 1 and 2) can be characterized by stream flow losses (SWCA 2012), but the fate of surface waters that infiltrate into channel sediments varies. Some of the infiltrated runoff will be discharged to riparian vegetation via evapotranspiration, but some may remain in the sediment as subflow.

The lowermost reaches of Davidson Canyon Wash (Reaches 2, 3, and 4; see Figure A-1) will experience decreases in runoff volume. SWCA (2012) extrapolated the modeled 4.3 percent reduction in runoff to Cienega Creek reaches 3 and 4 and anticipated that it would have minimal effects to surface flows and riparian vegetation (as had been noted for reaches 1 and 2, above).

Lower Cienega Creek

Lower Cienega Creek extends from the narrows (Reach 3) to the Del Lago Diversion Dam, at which point the stream is referred to as Pantano Wash. Reach 4 is between the narrows and the Davidson Canyon Wash confluence while Reach 5 is downstream of the confluence (see Figure A-1). Tetra Tech (2010) modeled groundwater drawdowns of <0.1 foot at the USGS stream gage in Reach 5 (gage number 09484560) for all time steps from the cessation of mining to 1,000 years; this is to be expected at such a relatively large distance from the mine pit.

SWCA (2012), using data from the groundwater models and Pima County (Pima Association of Governments 2003b) has estimated that the anticipated reductions in Davidson Canyon Wash surface flow (and thus, subflow) are therefore anticipated, via extrapolation, to result in a 4.3 percent reduction in Cienega Creek subflow (SWCA 2012). This measurable reduction in subflow, in combination with other surface flow (both in yield and peak flow magnitude) reductions upstream (see Gardner Canyon, Empire Gulch, and Cienega Creek sections, above), the influence of climate change on baseline conditions over time, and the effects of cumulative actions, is likely to have detrimental effects to aquatic ecosystems in lowermost Cienega Creek.

As discussed above, Table 7 in Montgomery (2010) summarizes various hydrologic and environmental effects resulting from groundwater drawdowns. Table A-3, below, excerpts the Table 7 hydrologic effects analysis for Davidson Canyon Wash and lower Cienega Creek. Effects begin to appear 20 years after the conclusion of mining and become appreciable at 1,000 years. We note that Montgomery (2010) has predicted groundwater drawdowns of 0.31 foot at 20 years and 0.98 foot at 1,000 years, whereas Tetra Tech (2010) modeled drawdowns no greater than 0.1 foot at the same time steps.

Table A-3: Summary of Effects to Davidson Canyon Wash (based on Montgomery and Associates 2010)

Years after mining	Drawdown at perennial reach (feet)	Decrease in stream length (miles)	Decrease in baseflow (cfs)	Decrease in ET (afa)
0	0	0	0	0
20	0.01	0	0.01	0
150	0.31	0	0.02	8
1,000	0.98	0.29	0.04	22

Summary of Effects to Aquatic Ecosystems

The analyses, above, describe incremental changes to the groundwater and surface water systems that sustain a series of streams and their associated aquatic and riparian ecosystems. The effects of flow reductions will be in addition to any similar effects that result from changing baseline conditions (primarily ongoing drought and the future impacts of climate change) and the effects of future, non-Federal cumulative actions in the area (primarily, groundwater withdrawal not associated with the proposed action). Table A-4, below, summarizes the proposed action's effects to streams.

Table A-4: Summary of effects to streams (based on Tetra Tech 2010 and SWCA 2012)

Stream	Drawdown (feet) with upper bounds of sensitivity analyses in parentheses (Tetra Tech 2010)		Primary Effects
	150 years	1,000 years	
Gardner Canyon	0.2 (0.35)	0.5 (Same)	Modest drawdown, potential reduction in mountain front recahrge
Empire Gulch	2.5 (5.0)	6.0 (Same)	Appreciable drawdown, reduced flows and stream length, potential reduction in mountain front recharge
Upper Cienega Creek	0.25 (0.35)	0.5 (Same)	Modest drawdown, reduced flows and stream length, potential reduction in mountain front recharge
Barrel Canyon	Isolated from regional aquifer		Reduced runoff from placement of tailings in channel, potential reduction in mountain front recharge
Davidson Canyon Wash			Reduced flows due to tributary impacts in Barrel canyon, above
Lower Cienega Creek	<0.1 (Same)	<0.1 (Same)	Minimal drawdown

Table A-5: Modeled groundwater drawdowns at key locations (adapted from SWCA 2012). Results in parenthese for Montgomery and Associates (2010) and Tetra Tech (2010) represent the range of drawdowns from sensitivity analyses (not the magnitude of variation from the stated, best-fit value). The term "same" means that the modeled drawdown at that location was not sensitive to alterations in the model's input parameters.

End of active mining			
Location	**Montgomery (2010)**	**Tetra Tech (2010)**	**Myers (2010)**
Gardner/Cienega Confluence	<0.1 (Same)	<0.1 (Same)	0
Upper Empire Gulch Springs	<0.1 (Same)	0.1 (<0.1 - 0.2)	0
Cienega near stream gage 09484550 (perennial reach)	<0.1 (Same)	<0.1 (Same)	0
Davidson/Cienega Confluence	<0.1 (Same)	<0.1 (Same)	Outside of model domain
Cienega near stream gage 09484560 (intermittent reach)	<0.1 (Same)	<0.1 (Same)	0
20 years after mine closure			
Location	**Montgomery (2010)**	**Tetra Tech (2010)**	**Myers (2010)**
Gardner/Cienega Confluence	<0.1 (Same)	<0.1 (Same)	0
Upper Empire Gulch Springs	<0.1 (<0.1 - 0.1)	0.2 (<0.1 - 0.5)	0
Cienega near stream gage 09484550 (perennial reach)	<0.1 (Same)	<0.1 (Same)	0
Davidson/Cienega Confluence	<0.1 (Same)	<0.1 (<0.1 - 0.15)	Outside of model domain
Cienega near stream gage 09484560 (intermittent reach)	<0.1 (Same)	<0.1 (Same)	0
50 years after mine closure			
Location	**Montgomery (2010)**	**Tetra Tech (2010)**	**Myers (2010)**
Gardner/Cienega Confluence	<0.1 (<0.1 - 0.1)	<0.1 (<0.1 - 0.15)	0
Upper Empire Gulch Springs	<0.1 (<0.1 - 0.5)	0.5 (<0.1 - 1.8)	0.2

Cienega near stream gage 09484550 (perennial reach)	<0.1 (Same)	<0.1 (<0.1 - 0.15)	0
Davidson/Cienega Confluence	<0.1 (Same)	<0.1 (<0.1 - 0.2)	Outside of model domain
Cienega near stream gage 09484560 (intermittent reach)	<0.1 (Same)	<0.1 (Same)	0
150 years after mine closure			
Location	**Montgomery (2010)**	**Tetra Tech (2010)**	**Myers (2010)**
Gardner/Cienega Confluence	<0.1 (<0.1 – 0.4)	0.2 (<0.1 – 0.35)	0.1
Upper Empire Gulch Springs	0.3 (0.1 – 1.4)	2.5 (0.5 – 5.0)	0.3
Cienega near stream gage 09484550 (perennial reach)	<0.1 (Same)	0.25 (<0.1 – 0.35)	0
Davidson/Cienega Confluence	<0.1 (Same)	<0.1 (<0.1 – 0.2)	Outside of model domain
Cienega near stream gage 09484560 (intermittent reach)	<0.1 (Same)	<0.1 (Same)	0
1,000 years after mine closure			
Location	**Montgomery (2010)**	**Tetra Tech (2010)**	**Myers (2010)**
Gardner/Cienega Confluence	<0.1 (<0.1 – 0.8)	0.5 (0.3 – 0.5)	2.2
Upper Empire Gulch Springs	3.3 (2.3 – 5.0)	6 (4.4 – 6.0)	4.3
Cienega near stream gage 09484550 (perennial reach)	<0.1 (Same)	0.5 (0.4 – 0.5)	0.2
Davidson/Cienega Confluence	<0.1 (Same)	0.1 (Same)	Outside of model domain
Cienega near stream gage 09484560 (intermittent reach)	<0.1 (Same)	<0.1 (Same)	0.3

Status of the Species – Gila Chub

Gila chub (*Gila intermedia*) was listed as endangered with critical habitat on November 11, 2005 (70 FR 51985). The final rule cites collection records, historical habitat data, the 1996 AGFD Gila chub status review (Weedman *et al.* 1996), and USFWS information documenting currently occupied habitat to conclude that Gila chub has been eliminated from 85 to 90 percent of formerly occupied habitat. It was also estimated that 90 percent of the currently occupied habitat is degraded due to the presence of nonnative species and land management actions. Due to fragmented and often small population sizes, extant populations are susceptible to environmental conditions such as drought, flood events, and wildfire. Primary threats to Gila chub such as predation by and competition with nonnative organisms and secondary threats identified as habitat alteration, destruction, and fragmentation are all factors identified in the final rule that contribute to the consideration that Gila chub is likely to become extinct throughout all or a significant portion of its range (70 FR 66664).

<u>Background</u>

Gila chub is a member of the roundtail chub (*Gila robusta*) complex that also includes headwater chub (*G. nigra*). The roundtail chub complex has had a turbulent and controversial taxonomic history that includes an assortment of classification schemes. Much of the debate has centered on whether the complex represents a number of nominal species or subspecies of *Gila robusta*. A nomenclatorial synonymy for Gila chub can be found in Minckley (1973).

Gila chub has long been recognized as distinct. Miller (1945), following the arrangement of Jordan and Evermann (1896), supported full generic rank for the genus *Gila* (Baird and Girard) with a "*Gila robusta* complex" that included Gila chub. Miller (1946) considered Gila chub to be an "ecological subspecies" of *G. robusta* (i.e., *G. r. intermedia*) characteristic of the small tributaries they inhabit. Rinne (1969, 1976), using univariate analyses of morphological and meristic characters, argued for recognition of both *G. robusta* and *G. intermedia* as distinct species and against the ecological subspecies concept. This approach was supported by some (e.g. Minckley 1973), but it was not until further evidence was generated by DeMarais (1986, 1995) that the specific status for *G. intermedia* was generally accepted. DeMarais (1995) supported continued recognition of *G. intermedia* based on the following arguments: 1) phenotypic extremes between *G. intermedia* and *G. robusta* are widely divergent and each possesses many morphologically uniform populations; (2) the geographic distributions of both species is an overlapping mosaic, therefore not satisfying traditional geographic criteria; and (3) contiguous populations of *G. intermedia* and *G. robusta* show no evidence of genetic exchange, thus each species maintains its evolutionary independence.

Gila chub is a thick-bodied species, chunky in aspect, whereas roundtail chub is slender and elongate, and headwater chub is intermediate in meristic and morphometric characteristics (Rinne 1969, 1976, Minckley 1973, DeMarais 1986, Minckley and DeMarais 2000, Marsh and Minckley 2009). Females can reach 250 mm (10 in) in total length (TL), but males rarely exceed 150 mm (6 in)(Minckley 1969, 1973: Rinne and Minckley 1991, Schultz and Bonar 2006). Body coloration is typically dark overall, sometimes black or with diffuse, longitudinal stripes, with a lighter belly speckled with gray. The lateral scales often appear to be darkly outlined, lighter in center. Breeding males, and to a lesser extent females, develop red or orange on lower parts of the head and body and on bases of the pectoral, pelvic and anal fins.

While most reproductive activity by Gila chub occurs during late spring and summer, in some habitats it may extend from late winter through early autumn (Minckley 1973). Schultz and Bonar (2006) data from Bonita and Cienega creeks suggested that multiple spawning attempts per year per individual were likely, with a major spawn in late February to early March followed by a secondary spawn in autumn after monsoon rains. Reproductive activities in Monkey Spring (now extirpated) reportedly occurred for longer periods than in other populations, as breeding appeared to last virtually all season (Minckley 1969, 1973, 1985). Bestgen (1985) concluded that temperature was the most significant environmental factor triggering spawning.

Spawning probably occurs over submerged aquatic vegetation or root wads. Minckley (1973) observed a single female closely followed by several males over a bed of aquatic vegetation in a pond. Nelson (1993) suspected deep pools with vegetation in Cienega Creek were important sites for spawning but did not witness any associated behavior near submerged vegetation.

Gila chub is considered a habitat generalist (Schultz and Bonar 2006), and commonly inhabits pools in smaller steams, cienegas, and artificial impoundments throughout its range in the Gila River basin at elevations between 600 and 1,700 m (2,000 to 5,500 ft) (Miller 1946, Minckley 1973, Rinne 1975, Weedman et al. 1996). Common riparian plants associated with these populations include willows (*Salix* spp.), tamarisk (*Tamarix* spp.), cottonwoods (*Populus* spp.), seep-willow (*Baccharis glutinosa*), and ash (*Fraxinus* spp.). Typical aquatic vegetation includes watercress (*Nasturtium officinale*), horsetail (*Equisetum* spp.), rushes (*Juncus* spp.), and speedwell (*Veronica anagallis-aquatica*) (USFWS 1983, Weedman *et al.* 1996).

Gila chub is a highly secretive species, remaining near cover including undercut banks, boulders, root wads, fallen logs, and thick overhanging or aquatic vegetation in deeper waters, especially pools (Rinne and Minckley 1991; Nelson 1993, Weedman et al 1996). Recurrent flooding and a natural hydrograph are important in maintaining Gila chub habitats and in helping the species maintain a competitive edge over invading nonnative aquatic species (Propst *et al.* 1986, Minckley and Meffe 1987). They can survive in larger steam habitats, such as the San Carlos River, and artificial habitats, like the Buckeye Canal (Minckley *et al.* 1977, Minckley 1985, Rinne and Minckley 1991, Stout *et al.* 1970, Rinne 1976), and they interact with spring and small-stream fishes regularly (Meffe 1985).

Young Gila chub are active throughout the day and feed on small invertebrates, aquatic vegetation (especially filamentous algae) and organic debris (Bestgen 1985, Griffith and Tiersch 1989, Rinne and Minckley 1991). Adult chub are crepuscular feeders, consuming a variety of terrestrial and aquatic invertebrates, and fishes (Griffith and Tiersch 1989, Rinne and Minckley 1991). Benthic feeding may also occur, as suggested by presence of small gravel particles.

Gila chub evolved in a fish community with low species diversity and where few predators existed, and as a result developed few or no mechanisms to deal with predation (Carlson and Muth 1989). This species is known to be associated with speckled dace (*Rhinichthys osculus*), longfin dace (*Agosia chrysogaster*), desert sucker (*Pantosteus clarki*), Sonora sucker (*Catostomus insignis*), Gila topminnow (*Poeciliopsis occidentalis*), desert pupfish (*Cyprinodon macularius*), and Santa Cruz pupfish (*Cyprinodon arcuatus*). Before the widespread introduction of nonnative fishes, Gila chub was probably the most predatory fish within the habitats it occupied. In the presence of the nonnative green sunfish (*Lepomis cyanellus*) in lower Sabino Creek, Arizona, Gila chub failed to recruit young (Dudley and Matter 2000). Direct predation by green sunfish on young Gila chub was the acknowledged cause of this observation.

Many conservation and recovery efforts have been undertaken since species listing, largely by the Gila River Basin Native Fishes Conservation Program (Robinson 2010, 2011, 2012).

<u>Status and Distribution</u>

Historically, Gila chub was recorded from nearly 50 rivers, streams and spring-fed tributaries throughout the Gila River basin in southwestern New Mexico, central and southeastern Arizona, and northern Sonora, Mexico (Miller and Lowe 1967, Rinne and Minckley 1970, Minckley 1973, Rinne 1976, DeMarais 1986, Sublette *et al.* 1990, Varela-Romero *et al.* 1992, Weedman *et al.* 1996); and, occupancy of Gila chub throughout its range was more dense, and currently-occupied sites were likely more expansive in distribution (Hendrickson and Minckley 1985, Minckley 1985, Rinne and Minckley 1991). Gila chub now occupies an estimated 10 to 15 percent of its historical range (Weedman *et al.* 1996, 70 FR 66664) and these 25 localities are considered occupied, but all are small, isolated and face one or more threats (Weedman *et al.* 1996, 70 FR 66664). The biological status of several of these populations is uncertain, and the number of localities currently occupied may overestimate the number of remnant populations in that some might not persist if its core connected population was extirpated (eliminated).

Agua Fria River Subbasin

The Agua Fria subbasin is the system furthest downstream in the Gila River basin that currently supports or is historically known to have supported Gila chub. This subbasin sustains or recently sustained four remnant Gila chub populations. The Agua Fria River mainstem was historically occupied, but that population is considered extirpated. The four extant populations are Indian Creek, Little Sycamore Creek, Silver Creek (with replicates Larry and Lousy Canyon), and Sycamore Creek. In 1996, all remnant populations were considered threatened by Weedman *et al.* (1966), and two of the four were considered unstable.

In Silver Creek, a natural fish barrier (waterfall) has prevented invasion of green sunfish into the uppermost reaches, but the protected reach has only a few kilometers of perennial water, and the reach below is infested with nonnative green sunfish (Weedman *et al.* 1996). Natural barriers on Sycamore Creek have protected a portion of the population from warmwater nonnative fishes, but nonnative rainbow trout (*Oncorhynchus mykiss*) is present upstream, and Gila chub may be functionally extirpated below the lowermost barrier where a suite of warmwater nonnative fishes reside (Weedman *et al.* 1996). The Gila chub population in Little Sycamore Creek inhabits two short perennial reaches totaling only about 1 km in length, but nonnative fishes have not been recorded there. The Indian Creek population was not detected until 1995, and in 2005 a portion of the population was salvaged as a precaution following the Cave Creek Complex Fire and later successfully returned. Weedman *et al.* (1996) noted that cattle grazing and recreational uses within some of the streams may be additional potential threats to the populations. The replicated populations in Lousy and Larry canyons seem to be doing well, and there are no threats from nonnative fishes.

Verde River Subbasin

The Verde subbasin drainage includes the north-central Gila River basin between the Agua Fria and Salt subbasins. The Verde mainstem downstream from Sullivan Lake is mostly perennial to its confluence, and several large tributary systems contribute perennial flows, primarily from the eastern portion of the drainage. Gila chub populations are recently known from only four remnant sites within the Verde subbasin: Red Tank Draw, Spring Creek, Walker Creek, and Williamson Valley Wash. A population historically collected from Big Chino Wash is considered extirpated. There have been no replications of any Verde subbasin populations.

Williamson Valley Wash was tentatively considered extirpated by Weedman *et al.* (1996), but Bagley (2002) captured 50 individuals there in 2001. Spring Creek appears stable, and no nonnative fishes recently have been recorded from above a low (~0.5 m) diversion dam located near the mouth. Walker Creek appears stable and nonnative-free based on a number of surveys between 1978 and 2001.

Santa Cruz River Subbasin

Gila chub populations are known from three remnant sites (Cienega Creek, Sabino Canyon, and Sheehy Spring) in the Santa Cruz subbasin. The population in Cienega Creek and Mattie Canyon are the largest and most geographically widespread. The Gila chub proposed listing rule (67 FR 66664), final listing rule (70 FR 66664), and Rosemont BA (USFS 2012) state that Gila chub were captured in Empire Gulch in 1995 and 2001. That is an erroneous report unsupported by other sources (Ehret and Simms 2009, Simms 2013, Service files). The Sabino Creek population experienced bottlenecking associated with post-fire runoff in 2003, although the population was replicated into nearby Romero Canyon in 2005. Sheehy Spring is a small system that likely never supports more than ~500 adults. Gila chub also was known historically from Monkey Spring and the mainstem Santa Cruz River, but these populations are now extirpated.

Cienega Creek is protected against nonnative fishes by at least two natural barriers, and the Gila chub population appears stable. However, headcutting along lower Wood Canyon threatens to capture Cienega Creek, which would initiate headward erosion up Cienega Creek that likely would significantly diminish Gila chub habitat. Gila chub habitat in Sabino Creek seems to be recovering since the Aspen Fire in 2003, and the stream is protected against upstream invasions of nonnative fishes by a low-head dam and multiple road crossings. Sheehy Spring has been invaded by nonnative mosquitofish, which has displaced Gila topminnow, but the species does not appear to be significantly affecting Gila chub. Sheehy Spring, however, is a tiny drainage and is close to the mainstem Santa Cruz River, possibly enhancing its potential for upstream invasions. Green sunfish, largemouth bass, and black bullhead have been recorded in the Santa Cruz River downstream of Sheehy Spring in the last three years (Service files).

San Pedro River Subbasin

The San Pedro River Subbasin includes the entire San Pedro River watershed upstream from the confluence with Gila River. Gila chub populations are known from three remnant sites (Hot Springs Canyon, O'Donnell Canyon, and Redfield Canyon) in the San Pedro River Subbasin. Hot Springs Canyon and O'Donnell Canyon populations are protected behind constructed fish barriers, and a barrier on Redfield Canyon is expected to be constructed during 2013 or 2014. At least four and possibly as many as six, of the nine historically-known populations within the subbasin are considered extirpated.

Upper Gila River Subbasin

Upper Gila River Subbasin includes the entire Gila River watershed upstream of the Salt River confluence, exclusive of the Santa Cruz and San Pedro subbasins. Major subdrainages include the San Carlos, San Simon, San Francisco, and upper Gila rivers (including its three forks).

There are six remnant populations of Gila chub within this unit, and five historically-occupied streams are considered extirpated. The six populations are Blue River (San Carlos) Eagle, Bonita, Harden Cienega, and Dix creeks, Arizona; and, Turkey Creek, New Mexico. The Blue River (San Carlos) population is entirely on San Carlos Apache Tribal lands, and there is little information available regarding its status. There are constructed fish barriers on Bonita and Dix creeks, although nonnatives remain present in lower Bonita Creek. Harden Cienega appears free of nonnatives, although there is no barrier preventing their encroachment. The Eagle Creek population was significantly impacted by severe runoff following the 2011 Wallow Fire. The Turkey Creek population appears large and relatively stable, although rainbow trout inhabit the upper reaches and some warmwater nonnative species inhabit the lower reaches. Gila chub in Turkey Creek were affected by ash flows following the Miller Fire in 2011. Individuals were salvaged from the creek before the summer rains and were repatriated in 2012.

Critical Habitat

Critical habitat for Gila chub is designated for about 160.3 miles of stream reaches in Arizona and New Mexico that includes cienegas, headwaters, spring-fed streams, perennial streams, and spring-fed ponds. Critical habitat includes the area of bankfull width plus 300 feet on either side of the banks (70 FR 66664). The bankfull width is the width of the stream or river at bankfull discharge (i.e., the flow at which water begins to leave the channel and move into the floodplain) (Rosgen 1996). Critical habitat is organized into seven areas or river units:

Area 1 - Upper Gila River, Grant County, New Mexico, and Greenlee County, Arizona, includes Turkey Creek (New Mexico), Eagle Creek, Harden Cienega Creek, and Dix Creek;

Area - 2, Middle Gila River, Gila and Pinal Counties Arizona, consists of Mineral Creek;

Area - 3, Babocomari River, Santa Cruz County, Arizona includes O'Donnell Canyon and Turkey Creek (Arizona);

Area 4 - Lower San Pedro River, Cochise and Graham counties, Arizona, includes Bass Canyon, Hot Springs Canyon, and Redfield Canyon;

Area 5 - Lower Santa Cruz River, Pima County, Arizona, includes Cienega Creek, Mattie Canyon, Empire Gulch, and Sabino Canyon;

Area 6 - Upper Verde River, Yavapai County, Arizona, includes Walker Creek, Red Tank Draw, Spring Creek, and Williamson Valley Wash; and

Area 7 - Agua Fria River, Yavapai County, Arizona, includes Little Sycamore Creek, Sycamore Creek, Indian Creek, Silver Creek, Lousy Canyon, and Larry Creek (70 FR 66664).

There are seven primary constituent elements of critical habitat, which include those habitat features required for the physiological, behavioral, and ecological needs of the species:

1. Perennial pools, areas of higher velocity between pools, and areas of shallow water among plants or eddies all found in headwaters, springs, and cienegas, generally of smaller tributaries;
2. Water temperatures for spawning ranging from 63°F to 75 °F, and seasonally appropriate temperatures for all life stages (varying from about 50°F to 86 °F;
3. Water quality with reduced levels of contaminants, including excessive levels of sediments adverse to Gila chub health, and adequate levels of pH (e.g. ranging from 6.5 to 9.5), dissolved oxygen (i.e., ranging from 3.0 ppm to 10.0 ppm) and conductivity (i.e., 100 mmhos to 1,000 mmhos);
4. Prey base consisting of invertebrates (i.e., aquatic and terrestrial insects) and aquatic plants (i.e., diatoms and filamentous green algae);
5. Sufficient cover consisting of downed logs in the water channel, submerged aquatic vegetation, submerged large tree root wads, undercut banks with sufficient overhanging vegetation, large rocks and boulders with overhangs, a high degree of stream bank stability, and a healthy, intact riparian vegetation community;
6. Habitat devoid of non-native aquatic species detrimental to Gila chub or habitat in which detrimental nonnative species are kept at a level that allows Gila chub to continue to survive and reproduce; and
7. Streams that maintain a natural flow pattern including periodic flooding (70 FR 66664).

Consultation History

Our information indicates that, range wide, more than 32 consultations have been completed or are underway for actions affecting Gila chub. These opinions primarily include the effects of grazing, water developments, fire, species control efforts, recreation, sport fish stocking, native fish restoration efforts, and mining.

Environmental Baseline – Gila Chub

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.

Description of the Action Area

The action area for Gila chub encompasses all occupied or likely-to-be occupied reaches of stream within the Cienega Creek watershed, as these will be subject to the proposed action's effects to groundwater and surface flow hydrology. This area is described in detail in the Status of the Species and Critical Habitat within the Action Area section, below. The narrative that follows includes accounts of rangewide effects to Gila chub, its habitat, and its critical habitat as a means to describe similar factors affecting the species within the action area.

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).

With the arrival of Europeans, 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 almost extirpated. 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, Hendrickson and Minckley 1984, Sheridan 1986, Webb and Betancourt 1992, Hereford 1993, 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 Santa Cruz River (de La Torre 1970, Logan 2002) and Cienega Creek (Bodner and Simms 2008), became fragmented, and connectivity was substantially reduced. Populations of fish or other aquatic species eradicated 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 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 and has resulted in the existing, 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. As human activities are affected, additional flood control and channelization measures may occur, which exacerbate the problems in adjacent areas, and the channel will continue to become increasingly unstable. Some of these effects have been ameliorated in some areas, and several recovery projects are underway.

Nonnative species were imported by humans, starting with common carp (*Cyprinus carpio*) to Arizona in 1885 (Gilbert and Scofield 1898). Since that time, at least 50 species of nonnative fish have been introduced (ASU, Geographic Information Systems database of fish records, 2001) into the Gila River basin, and there are other records of incidental occurrences of another 10 to 15 species (Minckley and Marsh 2009). Many nonnative aquatic invertebrates, amphibians, reptiles, plants, and disease and parasite organisms (Sinderman 1993, Clarkson *et al.* 1997, Robinson *et al.* 1998, Bradley *et al.* 2002) have also been introduced. These species have been purposefully introduced for sport-fishing, bait, biocontrol, and ornamental fish use and releases through aquaculture, aquarium, and generalized "bait bucket" activities. They have also been accidentally introduced through interbasin water transfers (Davies *et al.* 1992, Meador

1992, 1996; Stefferud and Meador 1998, Claudi and Leach 2000), aquarium and pet releases (Welcomme 1988, Courtenay 1993, FAO 1998), and inclusion with other species being purposefully stocked (Marsh and Minckley 1982, Platz *et al.* 1990). Nonnative aquatic species have had major detrimental impacts on native aquatic fauna and were a major factor in the listing of topminnow and pupfish, as well as many other fishes native to the Gila basin (Desert Fishes Team 2003, 2006; USFWS 1984; 40 FR 29863, 50 FR 30188, 51 FR 10842, 51 FR 23769, 51 FR 39468, 52 FR 46400, 56 FR 13374). Introduction of nonnative pathogens, parasites (Wilson *et al.* 1996, Robinson *et al.* 1998, Weedman *et al.* 1996), plants, invertebrates, amphibians, and fish negatively affects the native fishes of the Southwest. Simms (1997) noted that stock tanks in the Cienega Creek watershed contained bullfrogs (*Lithobates catesbeiana*), goldfish (*Carassius auratus*), largemouth and smallmouth bass (*Micropterus salmoides* and *M. dolomieu*, respectively), and bluegill (*Lepomis macrochirus*). Fortunately, Cienega Creek appears to be free of nonnative fishes at present.

In summary, and given that Cienega Creek is within the Gila River basin as discussed above, the quality and quantity of suitable aquatic habitat for threatened and endangered fish in the action area has been affected through numerous past actions resulting in reduction of habitat, altered species composition, increased presence of nonindigenous aquatic species, decreased surface-water availability, changes in stream morphology, and other factors. A significant portion of the adverse impacts to the aquatic and riparian ecosystem come from the additive effect of small actions that individually may not threaten the system, but cumulatively result in continuing deterioration of the ecosystem.

Land ownership within the Cienega Creek watershed includes Forest Service, Bureau of Land Management, State Trust land, County land, and private land. Land use within and adjacent to where the proposed action will be implemented primarily consists of mining, livestock grazing, dispersed recreation (USFS 2012), and residential development (Hanson and Brott 2005). Barrel Canyon is the principal drainage system within the action area. Wasp, McCleary, and Scholefield Canyons discharge to Barrel Canyon, which discharges to Davidson Canyon and then to lower Cienega Creek in the northeastern part of the area. Empire Gulch and Gardner Canyon discharge into upper Cienega Creek in the southeastern portion of the action area.

Previous mineral exploration and production activities in the project area as well as within the watersheds in the larger action area have resulted in numerous landscape disturbances, such as mine prospects and adits, mine related access roads, and drilling sites. Additional anthropogenic disturbances have resulted from livestock grazing and all-terrain vehicle use. Within and near the action area, there are numerous wells in the Vail and Corona de Tucson areas that support residential and ranching uses (USFS 2012, PAG 2012b). Wells continue to be drilled in the lower Cienega-Davidson Canyon area, especially in the lower Cienega and Davidson Canyon areas (PAG 2012b). The drilling rate has also increased, with the number of wells drilled over the last 10-year period, greater than the previous 20 years (PAG 2012b). There has also been an upward trend in the amount of water pumped in the Cienega-Davidson area (Fonseca 2008), with about 804 acre-feet (af) withdrawn in 2010 (PAG 2012b). This area is within the Tucson Active Management Area, so groundwater restrictions and well reporting apply there. The number of wells in the Sonoita area has also increased in the last decade. In 2005 unpublished data, there are over 100 wells listed for the Sonoita area (Service files). We know of no data or reports demonstrating impacts to upper Cienega Creek from wells in the Sonoita-Elgin area.

Upper and lower Cienega Creek, lower Davidson Canyon, Empire Gulch, and Gardner Canyon are all areas with shallow groundwater (Pima Association of Governments 2012b). As can be seen in Table GC-1, these shallow groundwater areas also support perennial and intermittent stream reaches, and hydro-meso- and xeroriparian vegetation (Pima County 2000, Pima Association of Governments 2012a, 2012b). Any reduction of the water table that supports these shallow groundwater areas will likely reduce all the parameters (except maybe xeroriparian) in Table A (Fonseca 2008) (also see Table GC-1, below), with perennial stream miles of most concern for Gila chub. The number of days with no flow (Hynes 1970), and the extent of flow in May and June are the limiting factors for fish (Fonseca 2008).

Table GC-1: Shallow groundwater areas in the Rosemont action area. Derived from Pima County (2000)

Area	Shallow groundwater (acres)	Perennial stream (miles)	Intermittent stream (miles)	Hydro-meso riparian vegetation (acres)	Xeroriparian vegetation (acres)
Upper Cienega	2,911	7.7[1]	4.6	897	160
Lower Cienega	1,651	2.7	4.8	577	56
Gardner	1,210	0	0.5	-	-
Davidson	907	0.7	1.3	-	-
Empire	-	1.4	-	-	-
Mattie	-	1.3	0.4	-	-

[1] Average of 4.1 miles since 2001; 3.3 miles in fiscal year 2009-2010 (PAG 2012a)

In Knight's 1996 Thesis A Water Budget and Land Management Recommendations For Upper Cienega Creek Basin, he presents data from Bota (1996) on mountain front recharge (Table GC-2). Most of that mountain front recharge comes down Gardner Canyon. Gardner Canyon does drain much of the east side of the Santa Rita Mountains, and begins at the highest elevations. Undoubtedly, Gardner Canyon contributes a large part of the recharge for upper Cienega Creek.

Table GC-2: Mountain front recharge for the upper Cienega Creek basin, Arizona. Adapted from Knight 1996; data from Bota 1996.

Recharge Area	Recharge (ac ft/yr)	Percent of recharge
Santa Rita and Empire Mountains	5,564	41
Whetstone Mountains	4,936	36
Mustang Mountains	1,516	11
Canelo Hills	1,508	11
Total	13,524	99

Las Cienegas National Conservation Area (NCA) was created by Congress to "conserve, protect, and enhance" biological and other natural resources. The BLM manages Las Cienegas NCA with restrictions on multiple use activities that would impair ecological processes on watershed and riparian areas, as described in the current resource management plan (BLM 2002). Cienega Creek is subject to a number of human uses, including livestock grazing, recreation, urban and suburban development, groundwater pumping, and roads. Before BLM acquired the Las

Cienegas NCA, the area was primarily used for grazing, and there were extensive agricultural fields along the creek as well (Eddy and Cooley 1983). These fields were irrigated by a system of canals and dams and protected by a canal ("the Panama Canal") that the BLM is removing to restore more natural geomorphic and hydrological conditions conducive to native fish habitat (USFWS 1998, Simms 2001). The NCA presently receives heavy human visitation, and most of Cienega Creek is readily accessible. Upstream of the NCA, the Cienega Creek watershed is primarily used for livestock grazing. However, there is extensive proliferation of ranchette development in the area surrounding Sonoita that has increased the number of wells. Several wineries and vineyards occur along the groundwater divide between Cienega Creek and Babocomari River basins. The vineyards use mostly groundwater. The environmental baseline of the Las Cienegas NCA is thoroughly discussed in the USFWS 2012 Las Cienegas Aquatic Species BO (File number 22410-2002-F-0162-R001), and USFWS 2002 Las Cienegas NCA Resource Management Plan BO (File number 22410-2002-F-0162), and are incorporated by reference (FWS 2002, 2012).

The Cienega Creek Natural Preserve is established and managed by Pima County for the protection of its unique natural and cultural resources. Although accommodated, public recreation and education activities are limited so they will not degrade these resources. A permit is required by all visitors to the Preserve. Permits are issued by the Pima County Natural Resources, Parks and Recreation Department with the intent to limit the number of daily visitors to the Preserve and to notify visitors of the restrictive and prohibited activities (Pima County Flood Control District 2013).

The Pima County Draft Multiple Species Conservation Plan (Pima County 2012a) commits Pima County to pursue the following management actions and conservation commitments for the Gila chub (and Gila topminnow)(Pima County 2012b):

- Seek to prohibit Pima County Health Department from using *Gambusia* for mosquito control in watersheds tributary to reintroduction sites and in the Cienega Creek watershed upstream of Colossal Cave Road;
- Support protection of Cienega Creek water quality via ADEQ's Outstanding Waters program;
- Identify and address management of nonnative aquatic organisms through management plans and ranch infrastructure projects on County-controlled mitigation lands in the Cienega watershed;
- Implement the Pima County Floodplain Ordinance as described in Chapter 4 (Pima County 2012a) to minimize loss of habitat for these species;
- Implement monitoring as described in Appendix O (Pima County 2012b), including recording and entering incidental observations in the Covered Species Information Database; and
- Following significant upgrades to the County's two wastewater facilities, the Santa Cruz River downstream of the facilities may show favorable conditions for the reestablishment of Gila topminnow, longfin dace, desert sucker, and Sonora sucker. Pima County will work with the USFWS following upgrades in 2016 and subsequent water-quality testing to determine if fish monitoring is a reasonable and prudent activity at that location. If so,

> Pima County will commit to monitoring every 5 years using electrofishing and seining using the same methods as employed by Clarkson *et al.* (2011).

The Cienega Creek Natural Preserve is part of what is referred to as the Missing Link, or Cienega Corridor. An assessment of the area, required under the legislation establishing the Las Cienegas National Conservation Area, was completed by the Sonoran Institute (Hanson and Brott 2005).

Status of the Species and Critical Habitat within the Action Area

The action-area status of the Gila chub was recently described in our 2008 and 2012 BOs that addressed effects of Aquatic Species Conservation at the San Pedro Riparian and Las Cienegas National Conservation Areas, Arizona (File numbers 22410-2008-F-0103, 22410-2002-F-0162-R001). The action areas for those BOs overlap with the action area of the proposed action; that information is updated here. The status of Gila chub in the action area continues to be stable since the 2008 and 2012 BOs were completed (USFWS 2008, 2012).

The Santa Cruz River has five tributaries with extant populations of Gila chub: Sabino Canyon, Bear Canyon, Romero Canyon (Pima County), and Sheehy Spring (Santa Cruz County) have unstable-threatened populations, and Cienega Creek (Pima and Santa Cruz counties) has the only known stable-secure population of Gila chub in existence. Lower Cienega Creek has a small population north of Interstate 10 on Pima County's Cienega Creek Natural Preserve. On the Las Cienegas NCA, the chub is found throughout Cienega Creek and lower Mattie Canyon but is absent from Empire Gulch (Ehret and Simms n.d., Simms 2013). All three creeks on the Las Cienegas NCA have designated critical habitat, and all of the critical habitat in the Cienega Creek watershed is within the action area. Regional drought has impacted stream flows in both Empire Gulch and Cienega Creek, and resulted in a decrease in the amount of perennial aquatic habitat (Duncan and Garfin 2006, Bodner *et al.* 2007, Bodner and Simms 2008).

There is no suitable habitat, or known occurrences of this species, within the actual footprint of the action; however, there is suitable, occupied habitat within the action area. Surveys for this species have not been conducted within the action area for the purposes of the proposed action. We report here on survey information for the potentially affected area including Cienega Creek and its tributaries. Gila chub have been reported recently, from the Las Cienegas NCA, and from the Cienega Creek Natural Preserve, upstream of the confluence of Cienega Creek with Davidson Canyon (70 FR 66664b, Ehret and Simms n.d., Simms 2009,); both of these reaches of Cienega Creek are located within the action area. In 2002, two Gila chub were collected in the Cienega Creek Natural Preserve upstream of "railroad bridge" from a "deep pool" in the area covered by the Rincon Peak quadrangle map, on which coverage of Cienega Creek begins about 1 mile upstream of the Davidson Canyon confluence (Reinthal 2009). In 2005 and 2006, five reaches of Cienega Creek were sampled for fish during annual stream flow mapping by Pima Association of Governments. Gila chub were "observed" in Stream Reach 3, immediately upstream of the Davidson Canyon confluence (70 FR 66664b, 2006). Although Stream Reach 2, immediately downstream of the Davidson Canyon confluence, is described as "the best habitat for chub and topminnow" (70 FR 66664b), no Gila chub were reported in this reach in either

2005 or 2006 (70 FR 66664b, USFWS 2005). As part of an ongoing program established by the U.S. Bureau of Reclamation, Cienega Creek had fish monitoring conducted from 2007 through 2010 (Kesner and Marsh 2010; Marsh and Kesner 2011). Sampling was conducted at two locations in Cienega Creek: Station 1 (upstream of the confluence of Davidson Canyon) and Station 2 (Three Bridges). No Gila chub were taken at either station in 2007 or 2008 (Kesner and Marsh 2010). One Gila chub was collected at Station 1 in 2009 (Kesner and Marsh 2010), and five Gila chub were collected at Station 1 in 2010 (Marsh and Kesner 2011).

Extensive surveys in 2009 and 2011 suggest that Gila chub continue to be abundant in upper Cienega Creek (Doug Duncan, USFWS, pers. comm). Surveys in 2007 demonstrated that Gila chub are recolonizing Mattie Canyon following heavy flooding and extreme sedimentation resulting from collapse of a grade control structure in 2001. No chub have ever been observed in Empire Gulch since BLM acquired Las Cienegas NCA in 1988.

Additionally, Gila chub have been documented within upper Cienega Creek during various survey efforts from 1985 to 1995 (Weedman *et al.* 1996, Bodner *et al.* 2007, Schultz 2009). The BLM conducted chub sampling efforts in 2005, 2007, and 2008 within both reaches of upper Cienega Creek and within Mattie Canyon in 2007 and 2008, and Gila chub were captured and abundant during each effort (Ehret and Simms n.d. [2009]). BLM has conducted fish sampling almost every year in the Las Cienegas NCA since 1989 (Bodner *et al.* 2007). As part of an effort intended to create, enhance, and protect habitat for at-risk aquatic species within the Las Cienegas NCA, Caldwell *et al.* (2011) identified numerous pond sites for Gila chub reestablishment.

Native fish species in Cienega Creek on Las Cienegas NCA include Gila topminnow, longfin dace (*Agosia chrysogaster*), and Gila chub (Bagley *et al.* l991, Simms and Simms 1992). Cienega Creek is one of the last places in Arizona supporting an intact native fish fauna uncontaminated by nonindigenous fish (Bodner *et al.* 2007). The lack of a nonnative fish community raises the conservation status of Cienega Creek and contributes to its stable-secure status.

Status of Gila Chub Critical Habitat

The action area is within the 48.1 km (29.9 mi) Lower Santa Cruz/Cienega Creek Critical Habitat Unit (Unit 5) for Gila chub as described in the Final Rule (70 FR 66664). Cienega Creek and its tributaries Mattie Canyon and Empire Gulch contribute 77 percent of that, or 37 km (23 mi). The designated critical habitat in the action area represents 14 percent of all designated critical habitat.

Approximately 14.2 km (8.8 mi) of this area of critical habitat occurs in lower Cienega Creek between Interstate 10 and where Cienega Creek becomes Pantano Wash (though the area at Pantano Dam is not included). Another 13.6 km (8.4 mi) of critical habitat occurs within the Las Cienegas NCA in upper Cienega Creek, with an additional 5.2 km (3.2 mi) in Empire Gulch and 4.0 km (2.5 mi) in Mattie Canyon, on BLM and State Trust lands. All these sections of designated critical habitat contain one or more PCE: perennial pools, the necessary vegetation that provides cover, and adequate water quality. All of these sections are also within the action area of the proposed action. There are recent documented occurrences of Gila chub in both upper and lower segments of designated critical habitat within the action area and they are, therefore, considered occupied except for Empire Gulch. The populations within lower Cienega Creek are considered unstable, and those within upper Cienega Creek and Mattie Canyon are considered stable (Weedman *et al.* 1996, 70 FR 66664).

Factors affecting species environment and critical habitat within the action area

Primary threats to designated critical habitat and Gila chub include fire, nonnative species (both present and future), and water use in lower Cienega Creek; fire and nonnative species in upper Cienega Creek; fire, grazing, and nonnative species in Mattie Canyon; and fire and grazing in Empire Gulch (70 FR 66664). We describe activities that have occurred within and near the action area to qualify the environmental baseline and the state of critical habitat.

The seven PCEs of critical habitat include: (1) perennial pools; (2) appropriate water temperature; (3) good water quality; (4) adequate prey base; (5) sufficient cover; (6) no or minimal nonnative aquatic species; and (7) a natural hydrological cycle.

Water use

The over allocation of water resources in Arizona has already affected flows in many southern Arizona rivers (Hendrickson and Minckley 1983, Pool and Coes 1999, Logan 2002, Minckley and Marsh 2009). Groundwater pumping has eliminated habitat in the Santa Cruz River north of Tubac (Logan 2002), and threatens habitat in the San Pedro River. It is likely that some sites may not be viable in the future as a result of groundwater overdraft. The current drought has compounded the effects of pumping on vulnerable spring sources.

Haney *et al.* (2009) compared stream baseflow, current and projected populations, and different water use scenarios for 18 watersheds in Arizona. For the base population projection (least water use scenario; reduces water demand by 30 percent by 2050 and reduces population 25 percent below base projections), demand will equal base flows in the lower Cienega watershed by 2050, though we note that this projection included diversion and off-site use of water at Pantano Dam. The proposed action includes cessation of this diversion and recharge of the water through a Managed Underground Storage Facility. In all other scenarios, municipal water demand will exceed baseflow in lower Cienega Creek. The most aggressive scenario for amount of municipal water required increases population by 25 percent above base projections. We further note that the aforementioned recharge may offset some portion of the anticipated increases in groundwater pumping in the Vail and southeastern Tucson area.

In contrast to lower Cienega Creek, projected water demand is substantially less than base flow for the upper Cienega study watersheds for all four of the Haney *et al.* (2009) scenarios. Upper and lower Cienega Creek had the lowest water use (gal/person/day) of all 18 watersheds. Unfortunately, this also means water conservation would have less absolute impact on municipal water use.

Nonnative species

Most introductions of nonindigenous fishes and bullfrogs have been done illegally for many reasons (Aquatic Nuisance Species Task Force 1994, Rosen *et al.* 1995, USFWS 2008); the establishment of sport fish is an appreciable source of nonindigenous fishes (Rinne *et al.* 1998). Illegal introductions of nonindigenous fishes and other aquatic invasive species are routinely made by the public (e.g., red shiner, and guppies at Watson Wash). The release of nonindigenous fish, and likely bullfrogs, by the public has been a major factor in the spread of these species (Moyle 1976a, 1976b; Welcomme 1988). Nonindigenous fish are transported for bait and sporting purposes (Moyle 1976a, 1976b), for mosquito control (Meffe *et al.* 1983), and as aquarium fishes (Deacon *et al.* 1964, Moore *et al.* 1976, Shelton and Smitherman 1984). The population of Gila topminnow at Watson Wash was extirpated as a result of transfers of nonindigenous fish into topminnow habitat (Voeltz and Bettaso 2003). Refer to our May 15, 2008, BO on the Central Arizona Project for a discussion on the pathways and impacts of nonindigenous aquatic species to native fish, native frogs, and their habitats (file number 22410-2007-F-0081). We incorporate that BO by reference that discussion (USFWS 2008). Bullfrogs are present in Cienega Creek and its watershed.

Additionally, with increasing access and recreational use, the vulnerability of the stream and its native fish populations to nonindigenous species invasion is intensifying. The Cienega Creek basin has been closed to fishing by the Arizona Game and Fish Commission to reduce the potential for release of illegal fish and live bait. Finally, 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, Meador *et al.* 2003). In the Cienega Creek watershed, largemouth bass, green sunfish, and bullheads have been found in off-channel waters (clay pits, stock tanks, private ponds). Nonnative fish have not been found in Cienega Creek, Mattie Canyon, or Empire Gulch.

Livestock grazing

Historically, improper livestock grazing and logging likely contributed to habitat modifications noted by Miller (1950). The historical occurrence of intensive grazing and resulting effects on the land are indicated in published reports dating back to the early 1900s (Rixon 1905, Rich 1911, Duce 1918, Leopold 1921, Leopold 1924).

Livestock grazing has been shown to increase soil compaction, decrease water infiltration rates, increase runoff, change vegetative species composition, decrease riparian vegetation, increase stream sedimentation, increase stream water temperature, decrease fish populations and change channel form (Meehan and Platts 1978, Kauffman and Kruger 1984, Schulz and Leininger 1990, Platts 1991, Fleischner 1994, Ohmart 1996). Although direct impacts to the riparian zone and stream can be the most obvious sign of livestock grazing, upland watershed condition is also important because soil compaction, changes in percent vegetation cover, and vegetative type can influence the timing and amount of water and sediment delivered to stream channels (Platts 1991, Ohmart 1996, Belsky and Blumenthal 1997). As a consequence, impacted streams are more likely to experience flood events that negatively affect the aquatic and riparian habitats and are more likely to become intermittent or dry in the fall (groundwater recharge is less when water runs off quickly) (Platts 1991, Ohmart 1996).

Livestock grazing has been an ongoing disturbance in and around the footprint of the proposed mine for over 100 years; historically at much higher levels than at present. Rosemont holds term grazing USFS permits on four allotments: Rosemont, Thurber, Greaterville, and DeBaud. As part of its conservation measures, Rosemont and the USFS will develop modified allotment management plans for the grazing allotments to improve riparian areas and enhance water features. Livestock grazing within the perimeter fence will be assessed by Rosmeont and the USFS upon construction of mine facilities to determine whether grazing can continue during mine operations. If it is determined that grazing can continue within the inter-fence area, specific management prescriptions will be developed. Livestock grazing on the Las Cienegas NCA is managed by BLM to be compatible with the natural values of the area.

Fire

Since 2002, there have been several fires that have burned over 60,700 hectares (150,000 acres) in the Coronado National Forest that are near both occupied and designated CH for Gila chub. In May 2003, Gila chub were salvaged from Sabino Canyon during the Aspen Fire and were subsequently returned and now thrive in Sabino Creek. Gila chub continue to persist, post-fire in O'Donnel Creek. No fires appear to have impacted the Gila chub in Cienega Creek, though the 2005 Florida Fire burned in upper Gardner Canyon and its tributaries.

Direct fire-related fish mortalities are most likely during intense fires in small, headwater streams with low flows and high fuel-loads (less insulation and less water for dilution) (Gresswell 1999). In these situations, water temperatures can become elevated or changes in pH may cause immediate death (Cushing and Olson 1963). Spencer and Hauer (1991) documented 40-fold increases in ammonium concentrations during an intense fire in Montana. The inadvertent dropping of fire retardant in streams is another source of direct mortality of fish during fires.

Dr. Wayne Minshall (pers. comm., February 1995, Idaho State Univ.) has investigated the effects of fire on streams. Nutrients contributed from fires are phosphorous, which is associated with ash, and nitrogen/ammonia, which is associated with smoke. Ammonia is toxic to fish. In addition, incomplete combustion of materials creates charcoal and charcoal in the water can lead to deoxygenation. Minshall has done studies of effects of fire on water temperature (Minshall *et al.* 1989). They found small temperature changes in shallow ponds and small streams. They believed that the impact of fire on streams varied proportionally with the intensity and extent of burning of the watershed and the vegetation present.

Indirect effects of fire include ash and debris flows, increased water temperature, increased nutrient inputs, and sedimentation (Swanston 1991, Bozek and Young 1994, Gresswell 1999). Ash and debris flows can cause mortality months after fires occur when barren soils are eroded during precipitation (Bozek and Young 1994, Brown *et al.* 2001, Rinne 2004, Rhodes 2007). Fish can suffocate when their gills are coated with fine particulate matter, they can be physically injured by rocks and debris, or they can be displaced downstream below impassable barriers into habitat occupied by nonnative fish. Ash and debris flows or severe flash flooding can also decimate aquatic invertebrate populations that fish may depend on for food (Molles 1985, Rinne and Medina 1992, Rinne 1996, Lytle 2000). In larger streams, refugia are typically available where fish can withstand short-term adverse conditions; small headwater streams are usually more confined, concentrating the force of water and debris (Pearsons *et al.* 1992, Brown *et al.* 2001).

The floodplains of both upper and lower Cienega Creek are well vegetated. However, the mesic nature of riparian floodplains should reduce impacts from wildfires in these areas. Because the Gila chub in the action area are not in isolated, small streams, are miles downstream from fuel-loads that create ash and debris, the impact of ash and debris flows should be small.

Climate change

The June 2012 BA contained a detailed discussion of the likely effects of climate change; the analysis is incorporated herein via reference and is expanded upon in the following paragraphs. That southeastern Arizona and much of the American southwest have experienced serious drought recently is well known (Garfin *et al*. 2013). 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 decade-scale drought predictions. However, instrumental and paleoclimate records from the Southwest indicate that the region has a history of multi-year and multi-decade 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, decades-long droughts, and they will be hotter than historical droughts (Overpeck *et al.* 2012).

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, 2007; Overpeck *et al.* 2012). 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.

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).

Many of the predictions about the impacts of climate change are based on modeling, but many predictions have already occurred. 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. Because of drought, climate change, and human population growth, negative effects to aquatic habitat in the Gila basin will continue to occur. 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).

<u>Increased water temperature</u>

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). High water temperatures suppress appetite and growth, foster disease, can influence behavioral interactions with other fish (Schrank *et al.* 2003), reduce reproductive success (Bonar *et al.* 2005), or be lethal (McCullough 1999). The temperature preferences and tolerances of Gila chub are less than 98.6 °F (37.0 °C)(Carveth *et al.* 2006).

<u>Increased occurrence of extreme events</u>

Extreme events such as drought, fires, and floods are predicted to occur more frequently because of climate change (IPCC 2007, Overpeck *et al.* 2012). 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).

<u>Decreased streamflow</u>

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 Gila chub. 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, Stewart *et al.* 2005, Regonda *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 aquatic species. A smaller stream is affected more by air temperature than a larger one, exacerbating the effects of warm and cold air temperatures (Smith and Lavis 1975). In addition, fish isolated in pools may be subject to increased predation from terrestrial predators (ORPI 2008).

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 native fish assemblages. Variability in the hydrographs and greater flow volume has been shown to sustain native fishes (e.g., as seen for spikedace and loach minnow) over nonnatives between periodic flood events (Rinne and Miller 2006), although flooding has extirpated reintroduced Gila topminnow populations (Weedman 1999).

Drought

The Southwest U.S. is currently experiencing drought conditions (CLIMAS 2013). Almost 97 percent of Arizona was abnormally dry or drier (March 2013, CLIMAS 2013). The Cienega Creek basin is in moderate drought. Larger parts of New Mexico are in severe drought (89%)(CLIMAS 2013), including areas currently occupied by Gila chub. Although Gila chub evolved in the Southwest and have survived drought in the past, it is anticipated that a prolonged, intense drought would affect many populations, 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 fish and their habitat.

The regional drought has impacted stream flows in both Empire Gulch and Cienega Creek, reducing the amount of perennial aquatic habitat (Bodner *et al.* 2007, Bodner and Simms 2008). Primary constituent elements one and three of critical habitat (perennial pools, areas of higher velocity between pools, and areas of shallow water; and water quality with reduced levels of contaminants, and adequate levels of pH, dissolved oxygen, and conductivity) have been negatively impacted by drought in the area. The solubility of oxygen into water is less with higher ambient temperatures (Wetzel 1983).

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 native fish and other aquatic vertebrates and make management of extant sites more difficult.

Severe wildfires capable of extirpating or decimating fish populations are a 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, Swetnam 1990, Touchan *et al*. 1995, Swetnam and Baisan 1996, Belsky and Blumenthal 1997, 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).

Effects to Aquatic Species

The June 2012 BA characterizes climate change as a threat to rare plants and animals, and the extensive analysis contained in that document are incorporated herein via reference. Climate change affects the habitats where the species occur and alters physical and biological factors with which species evolved. The most obvious effects are on aquatic and riparian resources: under a hotter and drier climate, surface water is generally less available than it was historically. There are numerous references that describe a decline in aquatic resources due to an altered climate (Lenart 2007, California Department of Water Resources 2008, Bogan and Lytle 2010, MacDonald 2010, Reiman and Isaak 2010, Colorado River Basin Water Supply and Demand Study 2011,). The most at-risk group of threatened, endangered, and sensitive species on the Coronado National Forest are those associated with aquatic environments. Although there are many threats that affect aquatic organisms, climate change has been shown to be a causative agent in population declines.

Effects of the Action - Gila Chub

Groundwater pumping to support residential development (and other uses) in the Cienega Creek watershed was identified as a factor influencing Gila chub in the final rule (70 FR 66664). The proposed action represents an additional increment of groundwater impacts.

Despite the inherent uncertainties in the hydrologic system and the groundwater modeling data derived from analyses of that system, we are aware of no other model results or empirical data that would more accurately inform our analyses. The existing groundwater models therefore represent the best available information with which we can analyze the groundwater-related effects of the proposed action. Given the general agreement regarding the validity and utility of the Montgomery and Associates (2010), Tetra Tech (2010), and Myers (2012) models, SWCA prepared a definitive impact analysis for seeps, springs, and riparian ecosystems for the Coronado National Forest and presented it to us on November 16, 2012 (SWCA 2012). The Coronado National Forest subsequently adopted the SWCA analysis in the second Supplemental BA (USFS 2013a). These analyses were discussed in depth within the Effects to Aquatic Ecosystems section and are incorporated herein via reference. Also note that we relied primarily on the findings of Tetra Tech (2010); these are the largest in magnitude and therefore represent the most precautionary approach for the purposes of an effects analysis.

The aforementioned changes in groundwater elevations predicted by the models and, when applicable, the inferred and modeled losses of surface flows supported by surface or near-surface groundwater elevations, are measurable and reasonably certain to occur, but their precise impacts on aquatic ecosystems and riparian vegetation are difficult to quantify. The subsequent analyses will therefore be primarily qualitative in nature. In addition, as previously stated, the reliability of the models' estimated changes decreases over time.

Water withdrawals that reduce the surface and subsurface discharge of a stream are an adverse effect on fishes and other aquatic species. Any losses of surface water will decrease water depth and the wetted perimeter of aquatic habitat. A decrease in the wetted perimeter and depth of a stream is a loss of fish habitat. These losses would also reduce the amount of shallow waters, crucial habitat for small fishes such as Gila topminnow and young Gila chub. We also anticipate that reduced flow volumes resulting from groundwater withdrawal could result in increased summer water temperatures (Barlow and Leake 2012) and thus reductions in dissolved oxygen content (oxygen solubility is inversely related to water temperature). The proposed action will result in groundwater drawdowns and surface water reductions that will have varying magnitudes of effects to surface water quantity and quality and, as stated above, these effects are in addition to regional groundwater withdrawals.

Reduced water availability may also indirectly result in changes in riparian communities. We do not anticipate sudden mortality of vegetation, rather a gradual transition from more mesic to more xeric species assemblages in some areas. These changes to riparian vegetation can negatively affect bank stability, shading and cover, sediment transport, and water temperature. These impacts are discussed in greater detail within the Effects to Riparian Ecosystems section of this BO.

These modeled decreases in groundwater elevation would occur over a long time, but could cause changes in aquatic and riparian vegetation extent or health, and the reduction in stream flow could impact Gila chub and designated critical habitat (e.g., lower water level, more extensive dry reaches). As a result of groundwater drawdown, the amount or volume of water within perennial pools would decrease, and Gila chub in Cienega show a preference for pools. Reduced in-stream vegetative cover could result in reduced substrate for eggs, for prey, and escape cover for Gila chub, hence reducing the hatching rate of eggs, reducing food, and increasing the exposure of Gila chub to predation and desiccation. Changes in water volume and flow, and extent of flow could have similar effects, in addition to loss of habitat. Another indirect effect on Gila chub could also result from prey species being negatively impacted by groundwater drawdown, hence altering predator-prey relationships. If any changes to streamflow occur during normal low flows (May and June), impacts to fishes would be most significant. One day of no flow could potentially extirpate fish from a stream reach, though refugia would likely be present. More problematic would be extended no-flow, where refugia would be few or nonexistent. These effects may occur at upper and lower Cienega Creek, Mattie Canyon, and Empire Gulch. Lastly, these impacts would be amplified during exceptionally dry years that are expected to increasingly occur with continuing drought and climate change (Overpeck *et al.* 2012).

Regional impacts to groundwater quality and surface water runoff quality that could make it into perennial streams is not likely under the Aquifer Protection Permit. The cone of depression associated with the mine pit is predicted to capture water contaminants and prevent their movement to streams in the action area. Therefore, no impacts to Gila chub or designated critical habitat are expected to occur given the information in the various BAs. As stated in the Environmental Baseline section, above, Gila chub occur in Cienega Creek and 22.9 mi (37 km) miles of the mainstem and tributaries (Mattie Canyon and Empire Gulch) are designated as critical habitat.

The lack of information on the effects of with- and post-project water quality in the BA makes it difficult for us to analyze water quality issues as they relate to biological systems. Rosemont Copper (2012), however, summarizes baseline water quality and models the proposed action’s anticipated impacts. In brief, Rosemont Copper (2012) anticipates that surface runoff will meet Aquifer Water Quality Standards. Tetra Tech (2010) analyzed the potential for the project to exceed Surface Water Quality Standards and found that the proposed action was unlikely to cause an exceedance of these standards in downstream areas of Davidson Canyon wash and, therefore, lower Cienega Creek. We cannot ascertain if the water quality standards established by the Arizona Department of Environmental Quality are protective of Gila chub, as the specific levels have not been set yet (ADEQ 2012).

Gardner Canyon

Gardner Canyon is anticipated to experience regional aquifer drawdowns of < 0.1 foot from the cessation of mining until 50 years later (or up to 0.15 foot at 50 years) (see Gardner/Cienega Confluence data in Table A-5). At 150 years after mining, the effect to Gardner Canyon increases to 0.2 foot (or up to 0.35 foot) and reaches 0.5 foot at 1,000 years.

Impacts are expected to be negligible and immeasurable to groundwater at lower Gardner Canyon until at least 130 years after mine closure, at which time groundwater drawdown is modeled to be 0.8 ft (Tetra Tech 2010c). Groundwater drawdown would likely reduce spring and surface flow. The greatest effect to Gila chub from impacts to Gardner Canyon would be reduced surface or subsurface flows propagating downstream to both upper and then lower Cienega Creek (see discussion below).

Empire Gulch

The proposed action will appreciably affect Empire Gulch. The Upper Empire Gulch Springs data in Table A-5 in the Effects to Aquatic Ecosystems section displays the drawdowns modeled by Tetra Tech (2010); effects at this site to range from 0.1 foot (or up to 0.2 foot) of groundwater drawdown upon cessation of mining to 0.2 foot (or up to 0.5 foot) at 20 years, 0.5 (up to 1.8 foot) foot at 50 years, 2.5 feet (up to 5.0 foot) at 150 years, and 6 feet at 1,000 years. The spring-fed hydrology (Bodner and Simms 2008) of Empire Gulch render it particularly vulnerable to diminishment of the groundwater that may sustain the springs.

The modeled groundwater drawdown, would reduce the amount or volume of water in Empire Gulch itself, including perennial pools. This would impact the PCEs of water quantity and vegetative cover present within critical habitat there. However, since Gila chub are not known to occur in Empire Gulch, impacts to individual chub are not likely. Also, as long as Chiricahua leopard frogs occur at the headspring, it is very unlikely that Gila chub would be intentionally released there, as chub can prey on frog tadpoles and eggs.

It is possible, given the long time of the proposed action that Gila chub could naturally move into Empire Gulch. In that event, indirect effects on Gila chub habitat could impact breeding and foraging within these areas. These impacts would be more likely to occur near the confluence with Cienega Creek, which is expected to have less groundwater drawdown than the Empire Gulch headspring, and is closer to source populations in Cienega Creek.

Upper Cienega Creek

Upper Cienega Creek is that portion of the stream in Reaches 1, 2, and 3 (the latter includes the narrows) (see Figure A-1 in the Effects to Aquatic Ecosystems section). Gardner Canyon and Empire Gulch, along with Mattie Canyon, are the major tributaries in this reach.

The USGS Cienega Creek stream gage (0948550) is situated near the narrows in the upstream portion of Reach 3 (see Figure A-1). Regional groundwater drawdowns at this site describe the effects to upper Cienega Creek. Tetra Tech (2010) modeled drawdowns of <0.1 foot from the end of mining and at 20, and 50 years later (or up to 0.15 foot at 50 years). Drawdowns reach 0.25 feet (or up to 0.35 foot) and 0.5 feet at 150 and 1,000 years, respectively. Table A-2 in the Effects to Aquatic Ecosystems section is based on SWCA (2012) and describes the hydrologic effects to upper Cienega Creek. The effects don't manifest until 1,000 years after the cessation of mining, but at that point a 0.16-mile decrease in wetted stream length, a 0.02 cubic foot per second loss of discharge, and 51 acre-feet per annum of lost riparian evapotranspiration are predicted. Indirect effects to Gila chub, such as groundwater drawdowns and changes in riparian community composition, are reasonably certain to occur within the action area in upper Cienega Creek.

Davidson Canyon Wash

Barrel Canyon is a tributary to Davidson Canyon Wash. Barrel Canyon, in which Gila chub do not occur, will be primarily affected by the reduced runoff that will result from the placement of mine tailings in its upper watershed, rather than by drawdowns in the aquifer beneath the stream. SWCA (2012) estimated that ephemeral surface runoff yield in Barrel Canyon will be reduced from between 17.2 to 45.8 percent; the former value is associated with the Barrel Alternative (the proposed action). SWCA (2012) further extrapolated that this 17.2 percent reduction would equate to a 4.3 percent reduction of runoff 12 miles downstream in the lower reaches (2, 3, and 4) of Davidson Canyon Wash. Peak flows will also be affected; by 22 percent at the Highway 83 Bridge and an extrapolated 5.6 percent in Davidson Canyon Wash.

As stated in the Effects to Aquatic Ecosystems section, the uppermost reaches of Davidson Canyon Wash (Reaches 1 and 2) (see Figure A-1) are anticipated to experience minimal groundwater drawdowns of <0.01 foot from the cessation of mining to 1,000 years (Tetra Tech 2012). Reaches 3 and 4 of Davidson Canyon Wash (see Figure A-1) may also be relatively unaffected by groundwater drawdowns. Tetra Tech predicted groundwater drawdowns in Davidson Canyon Wash at the downstream end of Reach 4 (see the Davidson/Cienega Confluence data in Table A-5) of <0.1 foot from 0 to 150 years after mining and 0.1 foot at 1,000 years (or up to 0.15 foot at 20 years, and 0.2 foot at both 50 and 150 years).

Lower Cienega Creek

Lower Cienega Creek includes Reaches 4 and 5 as described in SWCA (2012) (see Figure A-1 in the Effects to Aquatic Ecosystems section). Tetra Tech (2010) modeled groundwater drawdowns of <0.01 foot at the USGS stream gage in Reach 5 for all time steps from the cessation of mining to 1,000 years; this is to be expected at such a relatively large distance from the mine pit.

Lower Cienega Creek, however, will also experience the accumulation of effects of groundwater drawdown and surface flow diminishment throughout the affected portion of its watershed. The effects to Barrel Canyon, Davidson Canyon Wash, Gardner Canyon, Empire Gulch, and the uppermost reaches of Cienega Creek represent incremental, additive effects to the lower reaches of Cienega Creek.

The Pima Association of Governments (2003b) has estimated that Davidson Canyon Wash subflow contributes 8 to 24 percent of the baseflow in Lower Cienega Creek. Given SWCA's finding that Davidson Canyon Wash will experience a 4.3 percent reduction in surface flows from the placement of tailings in Barrel Canyon (a tributary) (see above), we anticipate a 0.3 to 1.0 percent reduction in lower Cienega Creek baseflows. Again, these anticipated reductions are to annual yields, and may not describe any reductions in the dry-season baseflows which are crucial to conserving Gila chub.

The minimal reduction in lower Cienega Creek subflow from the Barrel Canyon and Davidson Canyon Wash systems will occur in addition to surface flow reductions in other upstream areas (see Gardner Canyon, Empire Gulch, and Upper Cienega Creek sections, above as well as in the subsequent narrative), the influence of climate change on baseline conditions over time, and the effects of cumulative actions. The end result will be an incremental, detrimental effect on aquatic ecosystems in lowermost Cienega Creek.

Peak flow reductions will also result from the proposed action; these were discussed in the Effects to Aquatic Ecosystems section. We cannot ascertain the precise effect that reduced peak flows from Barrel Canyon (modeled to be 22 percent) and thence Davidson Canyon Wash (extrapolated to be 5.6 percent) will have on lower Cienega Creek (see Effects to Aquatic Ecosystems section). It is reasonable to assume the effects will be appreciably less than 5.6 percent, as flood flow hydrology will remain largely intact in the eastern portions of the Cienega Creek watershed (including Empire Gulch, Gardner Canyon, and Mattie Canyon).

We note, however, that peak flows are responsible for the movement of sediment. A small reduction in sediment transport has been modeled for Davidson Canyon and Cienega Creek below their confluence (SWCA 2012), but is not anticipated to have a large effect given the remaining, unaffected sediment supply present within channels and tributaries (Rosemont Copper Company 2012). There may nevertheless be interactions between the expected changes in both peak flow hydrology and available sediment supply (Simon et al. 2007), making it difficult to predict future changes in sediment-related channel geometry. We note that Rosemont Copper Company (2012) predicts a slight narrowing in channel top width. This seems reasonable, given that any reduction in the magnitude of peak flows will affect floods of all return intervals, including the approximately 1.5-year return interval events that constitute channel-forming flows (Rosgen 1994, Moody et al. 2003). It is not clear if the modeled change in sediment and the channel narrowing will affect Gila chub positively or negatively; effects will depend on multiple variables (e.g. timing, quantity, amount of flow in Barrel Canyon, Davidson Canyon Wash, and ultimately, the Gila chub habitat (and critical habitat) in Cienega Creek.

Gila chub have been recorded in Reach 5 of Cienega Creek (below the confluence with Davidson Canyon); there appears to be suitable habitat and it is designated critical habitat, and there is a nearby source population of Gila chub upstream. Therefore, it is reasonably certain that Gila chub will occur during the timeframe of the action. Thus, even though effects are expected to be minimal in this area, effects may begin during mine operation, and continue for 1,000 years. Any loss of flow, wetted perimeter, and pool depth is an effect on Gila chub.

The groundwater modeling results do not discuss the potential for groundwater drawdowns to occur at Mattie Canyon; the site is outside of the 5-foot drawdown perimeter discussed in SWCA (2012). However, since lower Mattie Canyon is close to the stream gage, drawdown at the gage may also occur in the groundwater system associated with the tributary. As stated, Tetra Tech (2010) predicted groundwater drawdowns at the Cienega Creek gauge of 0.25 foot (or up to 0.35 foot) 150 years after mine closure and 0.5 foot (or up to 0.5 foot) 1,000 years after mine closure. Reductions of groundwater at Mattie Canyon may be slightly less than at the gage because Mattie Canyon is slightly further from the mine pit, and east of Cienega Creek. However, a reduction in groundwater that reduces surface flow and subflow, will affect Gila chub and critical habitat in Mattie Canyon as is discussed above.

Analyses undertaken by Westland Resources (2012) but not included in the three iterations of the BA or in SWCA (2012) correlated extent of surface flow in lower Cienega Creek with depth-to-groundwater in adjacent wells. Their results, partially based on averages in June, show there would be small decreases (<2% of average) in length of streamflow. Also, the extent of streamflow and proportional reduction in extent of streamflow could be greater than two percent in drier times.

Effect of the Proposed Conservation Measures – Gila Chub

The proposed action contains many conservation measures. Rosemont has agreed to monitor changes in groundwater and surface water quantity and quality and to update both groundwater and surface water models based on data obtained from monitoring efforts. Tracking what occurs with surface and groundwater will be crucial for determining any effects of the mine on water, and subsequently to species dependent on that water. The BA contained no additional conservation measures if monitoring shows groundwater drawdown greater than what was modeled. If this were to occur, reinitiation of consultation would likely be necessary.

Because the effects of the action to Gila chub will be long-term and off-site, conservation measures can only be realized off-site. The two conservations measures discussed below are outside the footprint of the mine, though one is in the action area. Other than the monitoring mentioned above, two conservation measures should promote conservation and recovery of Gila chub. A full description of the conservation measures can be found in the proposed action section of this BO.

The Cienega Creek Watershed Conservation Fund will fund $200,000 a year for 10 years for development and implementation of measures intended to preserve and enhance aquatic and riparian ecosystems and the federally listed aquatic and riparian species that depend on them. Projects may include surveys for and the removal of non-native species in the watershed. Funds can be used for restoration activities and adaptive management. Rosemont will acquire and close one well near the diversion dam in lower Cienega Creek. Also, Rosemont will acquire over 1100 af of water rights, and transfer and sever and transfer them for conservation purposes.

About 825 acre feet (af) annually will be used for aquifer recharge below Pantano Dam, either through an approved ILF mitigation program or through a “managed underground storage facility (MUSF)” permitted through the Arizona Department of Water Resources. This will allow surface water flows currently diverted for golf course irrigation to be captured and discharged back to the streambed below the Pantano Dam within the Cienega Creek Natural Preserve. Flow will be captured at the existing in-channel grated diversion, and then released into the stream channel below the dam. Gila topminnow and longfin dace have been observed right above the dam, on the dam, and in the scour pool below the dam. It is certain that fish have been and will continue to go into the diversion, and suffer death or injury. Though Gila chub have not been found within several miles, the possibility exists given the time-frame of analysis and the mitigating effects of Cienega Creek Watershed Conservation Fund before groundwater drawdown impacts lower Cienega Creek. The City of Tucson and Pima County (2009) expect that up to 3000 linear feet of riparian and aquatic habitat would form. Whether or not that habitat is suitable for chub, given the reduced stream gradient below the dam, remains to be seen. There would at least be a pool below the dam. The actions taken under this conservation measure should enhance the resiliency and suitability of Cienega Creek for Gila chub, especially in the lower creek, at least in the short-term. Under the threat of continuing long-term drought and climate change, enhancing system resiliency is a key component for adapting to climate change and reducing its affects (Overpeck *et al.* 2012).

Also, Rosemont will purchase about 1,200 acres of land along Sonoita Creek (Sonoita Creek Ranch) with about 590 af of certificated surface water rights from Monkey Spring. This is near Patagonia, and outside of the action area. It is anticipated that the land will be transferred either to a Corps-approved ILF program sponsor or to a conservation entity for long-term management of the property. In addition, unless an ILF program is developed, Rosemont will fund $150,000 a year for 10 years for resource management. An additional $100,000 ($20,000 annually for five years) will be provided for management against nonnative species, generally in the two existing ponds on the property that are maintained with water from Monkey Spring. At a minimum Gila chub and Gila topminnow will be established in the ponds after nonnatives are removed from them. Because this parcel is outside of the action area, this action represents recovery in lieu of threat removal (FWS 1994). The environmental baseline and recovery status of Gila chub should be improved by actions taken at Sonoita Creek Ranch. Also, the source of Monkey Spring appears to be the regional aquifer, which should be somewhat buffered from local groundwater pumping and climate change. The Cienega Creek Watershed Fund and Sonoita Creek Ranch conservation measures are essential to offset expected effects to Gila chub and their habitat.

Summary of Effects – Gila Chub

- Groundwater levels have historically been variable, but in a downward trend;
- The environmental baseline shows increasing trends in water use in parts of the action area;

- The current extended drought and climate change are highly likely to negatively impact many system components from the upper parts of the watershed to where Cienega Creek becomes Pantano Wash through:
    - Changes in upland vegetation and fire regime;
    - Higher ambient and water temperatures;
    - Increased variability in stream hydrographs;
    - More frequent severe climatic events (such as storms, droughts, wildlfires, etc.);
- The proposed conservation measures will not preclude all anticipated effects to surface water from occurring;
- The proposed conservation measures at Sonoita Creek Ranch will allow conservation in lieu of threat removal;
- Impacts to groundwater, and thus surface water, are reasonably certain to occur in designated critical habitat and areas occupied by Gila chub, and thus will negatively affect Gila chub; and
- Impacts to wetted stream perimeter and water depth are anticipated to occur well after mine closure (50-150 or more years after closure).

Cumulative Effects – Gila Chub

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.

In 1991, the American Fisheries Society adopted a position Statement regarding cumulative effects of small modifications to fish habitat (Burns 1991). Though the American Fisheries Society use of the term "cumulative" differs from the definition in the ESA, the statement concludes that accumulation of, and interaction between, localized or small impacts, often from unrelated human actions, pose a serious threat to fishes.

Unregulated activities on Federal and non-Federal lands, such as trespass livestock, inappropriate use of OHVs, illegal introduction of nonindigenous aquatic species, and residential and commercial development on lands within watersheds containing threatened and endangered aquatic animals, are cumulative effects and can adversely affect the species through a variety of avenues.

Other activities, such as recreation, are increasing. Increasing recreational, residential, or commercial use of non-Federal lands near or within the contributing watersheds of the riparian areas would likely result in increased cumulative adverse effects to occupied, as well as potentially-occupied native aquatic animal habitat through increased water use, increased pollution, increased movement of nonindigenous species, and increased alteration of the stream banks through riparian vegetation suppression, bank trampling, changing flow regimes, and erosion. We note that recreation use on Federal lands is not a cumulative effect and that much of the stream frontage along Cienega Creek is in Federal (BLM) ownership. Recreational use of Pima County lands, while restricted, is also a cumulative effect. Lastly, the right-of-way vegetatation maintenance activities conducted by Tucson Electric Power, which result in nearly-complete removal of riparian vegetation in the affected area (Pima County Regional Flood Control District 2009), are also a cumulative effect.

Cumulative effects to native aquatic animals include ongoing activities in the watersheds in which the species occurs such as livestock grazing and associated activities outside of Federal allotments, irrigated agriculture, groundwater pumping, stream diversion, bank stabilization, channelization without a Federal nexus, and recreation. Some of these activities, such as irrigated agriculture, are declining and are not expected to contribute substantially to cumulative long-term adverse effects to native aquatic animals.

There are many conservation actions being considered by the AGFD for native fish and frogs in the Santa Cruz River basin. Two important conservation actions are the approved Safe Harbor Agreements for the Chiricahua leopard frog and the topminnow and pupfish. While these two agreements and any other conservation actions taken by AGFD are likely to be federally funded or approved, it is likely some of them will have no Federal nexus.

The U.S. Census predicts that Arizona will be the second fastest growing state in the country through 2030, adding an additional 5.6 million people (U.S. Census 2005). During the 2010 Census, Arizona maintained its standing as having the second fastest population growth rate by growing more than 20 percent between 2000 and 2010 (Pollard and Mather 2010). If these predictions hold true, already severe threats to Gila chub and its habitat will worsen, primarily due to increased human demand for surface and ground water and decreased supply. Water demands will increase as the population increases. Most of Arizona's developed areas' groundwater is pumped out faster than the aquifer can recharge (U.S. Environmental Protection Agency 2011). Groundwater pumping is likely to be the greatest impact cumulatively, since it is minimally regulated by the State.

Additionally, the majority of the lands in the Cienega Corridor are Arizona State Trust Lands, most of which are currently leased for cattle grazing. The Arizona State Constitution mandates that State Trust Lands produce the maximum economic benefit for the beneficiaries of the Trust, most of which are school districts. One of the primary ways in which the State Land Department raises funds is to auction its Trust Lands for commercial or residential development (Hanson and Brott 2005). Activities on residential and commercial inholdings within watersheds containing Gila chub can adversely affect the species through poor land management practices and water withdrawal. These effects have not been well quantified within the action area.

Conclusion – Gila Chub

After reviewing the current status of the Gila chub, the environmental baseline for the action area, the effects of the proposed action, and the cumulative effects, it is the FWS's biological opinion that the proposed action is not likely to jeopardize the continued existence of the Gila chub. Pursuant to 50 CFR 402.02, "jeopardize the continued existence of" means to engage in an action that reasonably would be expected, directly or indirectly, to reduce appreciably the likelihood of both survival and recovery of a listed species in the wild by reducing the reproduction, numbers, or distribution of that species. We present this conclusion for the following reasons:

1. No direct effects from operation of the mine are expected;
2. Rosemont will monitor groundwater drawdown and the USFS will compare observed drawdown to modeled drawdown. Groundwater drawdown greater than modeled may require reinitiation of section 7 consultation;
3. The Cienega Creek Watershed Conservation Fund will, for the short-term at least, protect and potentially increase habitat for Gila chub by funding actions management and restoration actions in the watershed, protecting water rights, and creating habitat;
4. The Cienega Creek Watershed Conservation Fund is likely to increase ecosystem resiliency in the face of the expected groundwater drawdown from Rosemont Mine, and impacts from climate change;
5. The severance and transfer downstream senior water rights to upstream reaches of Cienega Creek is proposed to occur by no later than January 1, 2016. If successfully executed, these *in situ* water rights may be employed to protect against future diversions of surface water by junior appropriators.
6. The Sonoita Creek Ranch will create new habitat for Gila chub from a reliable water source (Monkey Spring);
7. The Cienega Creek Watershed Fund and Sonoita Creek Ranch conservation measures are essential to offset expected effects to Gila chub and their habitat;
8. Indirect effects from groundwater drawdown are difficult to predict at the distances from the drawdown (Rosemont Mine), and over a long time (1,000 years);
9. Groundwater drawdown is not expected to be less than 0.25 ft at all of the modeled locations within and upstream of Gila chub habitat until 150 years after mine closure; and
10. Conservation and recovery actions have taken place since species listing, continue to occur, with more actions in planning. Therefore, we believe the status of the species is improving.
11. The magnitude of the proposed action's effects and the implementation of conservation measures (as described in Conclusions 2 - 6 above), mean that the recovery potential of Gila chub and the species critical habitat will not be diminished.

Based on the above analyses and summary, it is the FWS's biological opinion that the proposed action will not alter the ability of this CH to retain its PCEs and to function properly. As such, Gila chub designated Critical Habitat (CH) will remain functional to serve its intended conservation role for the species. Therefore, we conclude that the proposed action is not likely to destroy or adversely modify Gila chub designated CH nor affect its role in recovery of the species.

INCIDENTAL TAKE STATEMENT – GILA CHUB

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 included by the USFS as binding conditions of any grant or permit issued to the applicant, as appropriate, for the exemption in section 7(o)(2) to apply. The USFS has a continuing duty to regulate the activity that is covered by this Incidental Take Statement. If the USFS (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 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, the USFS, or the applicant 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 – Gila Chub

We anticipate that the proposed action will result in incidental take of Gila chub. Any reduction in stream discharge resulting from groundwater drawdowns attributable to the proposed action will reduce the extent and/or quality of aquatic habitat required by Gila chub; we are thus reasonably certain that take will occur.

Incidental take of Gila chub in Cienega Creek will be difficult to detect for the following reasons: population levels cannot be accurately described with existing information and techniques, dead animals are difficult to find, cause of death may be difficult to determine, and losses may be masked by seasonal fluctuations in numbers or other causes. The incidental take is expected to be in the form of harm through the loss of habitat from groundwater drawdown, and harm, harassment, and mortality from water diversion and management at Pantano Dam.

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 Gila chub taken because: (1) dead or impaired individuals are almost impossible to find (and are readily consumed by scavengers and predators) and losses may be masked by seasonal fluctuations in environmental conditions; (2) the status of the species will change over time through disease, natural population variation, natural habitat loss, or the active creation of habitat through management; and (3) the species is small-bodied, well camouflaged, and occurs under water of varying clarity.

Gila chub are subject to an existing monitoring program in the Cienega Creek watershed on the Las Cienegas NCA. The currently used sampling techniques, however, do not result in population estimates, only relative abundance as catch-per-unit-effort. The sampling techniques used on Las Cienegas NCA are only sensitive enough to be statistically significant if the population doubles or is halved (Bodner *et al*. 2007). Monitoring in reaches downstream from the NCA (Marsh and Kesner 2011) is similarly unsuited to determining population trends. Gila chub population estimates can theoretically be acquired, but are difficult, time consuming, stressful to the fish (to the point of harm), and expensive. In addition, the number of Gila chub in any population are normally extremely variable during a year due to an r-selected (high fecundity, short generation time, wide dispersal of offspring) reproductive strategy, common in highly variable environments such as desert streams.

It is reasonable to assume that the abundance of Gila chub is correlated with the extent of suitable aquatic habitat provided by surface flows in the affected streams (see Status of the Species and Critical Habitat within the Action Area section). Baseflows maintain stream discharge when surface runoff is low or nonexistent, and these baseflows result from groundwater discharge. The discharge of groundwater to springs and streams is related to the elevation and gradient that regional groundwater exhibits relative to those surface waters. Decreases in groundwater elevation affect this gradient and thus, reduce the discharge of groundwater to streams (see Effects to Aquatic Ecosystems section). Groundwater elevations, which can be readily measured, are therefore effective surrogate measures for the incidental take of Gila chub.

The Effects to Aquatic Ecosystems and Effects to Riparian Ecosystems sections of this BO as well as the analysis of effects for the Gila chub, above, discuss the relationship between the proposed action, changes in groundwater elevation, and the volume and length of surface flow in streams. Changes in groundwater elevation have been modeled (Montgomery and Associates 2012, Myers 2010, and Tetra Tech 2012), and are summarized in Table A-5 in the Effects to Aquatic Ecosystems section. This document's analyses were based primarily on the drawdowns modeled by Tetra Tech (2010), including the results of sensitivity analyses. Sensitivity analysis is explained in the Effects to Aquatic Ecosystems section above, and is summarized, below.

The changes in groundwater elevation will result in reduced wetted lengths and volumes in reaches of stream maintained by discharges from the regional aquifer; surface flow effects are summarized in Tables A-2, A-3, and A-4 in the Effects to Aquatic Ecosystems section. Westland (2012) determined that there could be some reductions in the wetted length of lower Cienega Creek from groundwater drawdowns over the long term. We also anticipate that reduced flow volumes could result in increased summer water temperatures (Barlow and Leake 2012) and thus reductions in dissolved oxygen content (oxygen solubility is inversely related to water temperature), thus further adversely affecting (Bodner *et al*. 2007) the already-reduced numbers of Gila chub that would remain.

Therefore, the take of Gila chub is expressed in terms of the drawdowns noted in the locations and time frames (0, 20, 50, 150, and 1,000 years) discussed in analysis of the effects to the species, above, which are: (1) the Gardner/Cienega Confluence, representing effects to Gardner

Canyon; (2) Empire Gulch Springs, representing effects to Empire Gulch; (3) USGS stream gage No. 09484550, representing effects to upper Cienega Creek; (4) the Davidson/Cienega Confluence, representing effects to Davidson Canyon Wash; and (5) USGS stream gage No. 09484560 , representing effects to lower Cienega Creek. Further, take is expressed as the upper limits of the sensitivity analyses as this potentially larger drawdown was considered in the Effects of the Action section for Gila chub. The groundwater modeling involved the creation of a number of scenarios, each scenario using different modeling parameters (e.g. varying amounts of recharge, differing transmissivities, etc.). Each individual parameter was varied within a reasonable range of values. This suite of modeling scenarios known as the sensitivity analysis (in other words, determining which variables have the greatest influence on the model results). Out of the suite of modeling scenarios, only one was considered the "best-fit", or baseline, modeling scenario. The range of predicted drawdown from the rest of the modeling scenarios, however, is still considered possible or reasonable, though not as likely to occur. Since the entire range of results was considered in the Effects of the Proposed Action section for this species, take is expressed as the largest of the predicted drawdowns. Table GC-3, below, displays the anticipated amount or extent of take.

Table GC-3: Anticipated amount or extent of take for the Gila chub, based on Tetra Tech (2010, as referenced in SWCA 2012) and Table A-5 in the Effects to Aquatic Ecosystems section.

Location	**Maximum anticipated post-mining groundwater drawdown (in feet) by year[1]**				
	0	**20**	**50**	**150**	**1,000**
Gardner/Cienega Confluence	<0.1	<0.1	0.15	0.35	0.5
Upper Empire Gulch Springs	0.1	0.5	1.8	5.0	6.0
Upper Cienega Creek near stream gage No. 09484550	<0.1	<0.1	0.15	0.35	0.5
Davidson/Cienega Confluence	<0.1	0.15	0.2	0.2	0.1
Lower Cienega Creek near stream gage No. 09484560	<0.1	<0.1	<0.1	<0.1	<0.1

[1] Drawdowns described as less than 0.1 foot would be exceeded if they met or exceeded 0.1 foot.

The sites and time frames which appear in Tables GC-3 (above) and A-5 (in the Effects to Aquatic Ecosystems section), and are referred to throughout this BO's effects analyses, represent groundwater model outputs at locations and times of interest to biological resources. It is recognized, however, that the sites currently lack observation wells; groundwater elevations cannot be monitored at these locations. Moreover, these sites are proximal to streams and will experience confounding influences from recharge by runoff, riparian ET, and drought, rendering the sites relatively unsuited for groundwater monitoring – and unsuited for determining cause and effect relationships for hydrologic changes - even if wells were emplaced. It is also recognized that the time intervals for the reported drawdowns (0, 20, 50, 150, and 1,000 years post-mining) are not meaningful for monitoring take; the intervals are too infrequent and become even less frequent over time. The groundwater model, however, can be run such that drawdowns at any location within its domain (such as where groundwater monitoring wells have been or will be placed; see Table GC-4, below) and at any desired time interval can be determined (USGS 1997). Given that the drawdowns at alternative sites displayed in Table GT-4 (appropriate locations for monitoring wells) would be derived from the same model that resulted in the anticipated levels of take at the sites described in Table GC-3, the alternative sites can serve as directly-comparable proxies for the key locations noted in Table GC-3.

We also note that fluctuations in groundwater elevation can vary daily and seasonally from environmental factors. These daily fluctuations have the potential to exceed the smaller magnitude groundwater drawdowns displayed in table GC-3 (particularly those ≤0.1 foot). During the initial implementation phase (site construction, early pit construction) there is an opportunity to monitor daily and seasonal groundwater fluctuations for 2 to 4 years - under background conditions - before the anticipated effects from the pit dewatering are realized. The results from this initial monitoring will help determine the degree of background (baseline) variation in the observed groundwater elevations prior to the realization of Rosemont's effects. The data will also assist in discerning the groundwater drawdown attributable to the pit from unrelated environmental factors.

The USFS (2013b) has provided a list of well sites, already subject to monitoring for various environmental compliance purposes (see Monitoring Measure FS-BR-24 in the October 25, 2013, draft of Appendix B, the definitive version of which will appear in the Final EIS) that are likely to be suitable for monitoring the surrogate measure of incidental take (groundwater drawdown). The wells are located east of the crest of the Santa Rita Mountains, between the mine pit and Cienega Creek and Davidson Canyon Wash. Monitoring of some or all of these wells as proxies (for groundwater drawdown at the key locations in Table GC-3) will allow take of Gila Chub to be monitored immediately and during the active life of the mine, rather than waiting decades or centuries that it is modeled to take measurable drawdown to reach the affected streams, Cienega Creek and Empire Gulch. This suite of potential alternative monitoring sites has been reproduced in Table GC-4, below.

Table GC-4: Potential groundwater monitoring wells for compliance with the surrogate measure of incidental take (groundwater drawdown) described in Table GC-3, above. Groundwater drawdowns at a suite of these sites – once modeled and analyzed for their degree of natural variation – will serve as proxies for the drawdowns in Table GC-3.

Well Name	Direction from Mine Pit	Approximate Distance from Mine Pit (miles)
Potential Gardner Canyon monitoring wells to serve as a proxy for the Gardner/Cienega Confluence		
HC-6	S	0.5
17bdb	SE	3
RP-5	SSE	1.2
18ddb	SSE	3.2
16cbb	SE	3.4
Rosemont Ranch	SE	3.8
Potential Empire Gulch monitoring wells to serve as a proxy for Empire Gulch Springs		
DH-1541	ESE	2.6
Oaktree Windmill	ESE	4.1
Potential Davidson Canyon Wash monitoring wells to serve as a proxy for the Davidson/Cienega Confluence		
C-1	NE	0.5
HC-5B	NNE	0.6
P-899	NE	1
HC-4B	NE	1.6
RP-2C	ENE	2.5
RP-6	NE	3.8
RP-7	NE	4.5

Potential Cienega Creek monitoring wells to serve as proxies for Upper and Lower Cienega Creek		
RP-3B	E	1.5
RP-9	E	3.4
RP-8	ENE	4.5

In summary, and stated differently, the maximum allowable incidental take of Gila chub is represented by the surrogate measure of groundwater drawdowns at the sites and time intervals stated in Table GC-3, above. The to-be-modeled groundwater drawdowns at a suite of potential sites appearing in Table GC-4, above, will serve as proxies for the incidental take at the sites in Table GC-3. The manner by which Rosemont and the USFS shall monitor compliance with the amount of incidental take is described further in the Terms and Conditions, below.

Effect of the Take – Gila Chub

In this BO, the FWS determined that this level of anticipated take is not likely to result in jeopardy to the Gila chub.

Reasonable and Prudent Measures – Gila Chub

The FWS believes the following reasonable and prudent measures are necessary and appropriate to minimize impacts of incidental take of Gila chub:

1. Rosemont shall monitor groundwater levels (as a surrogate for take of Gila chub) at least annually;

2. Rosemont shall apply the funds identified for the Cienega Creek Watershed Fund and Sonoita Creek Ranch conservation measures solely to the identified conservation projects.

Terms and Conditions – Gila Chub

In order to be exempt from the prohibitions of section 9 of the Act, Rosemont and the USFS must comply with the following terms and conditions, which implement the reasonable and prudent measures described above and outline required reporting/monitoring requirements. These terms and conditions are non-discretionary.

1.1 Rosemont and the USFS shall select a representative group of the observation wells found in Table GC-4, above (USFS 2013b) at which groundwater levels, a surrogate for take of Gila chub, shall be monitored. Once the wells have been selected, Rosemont shall re-run the Tetra Tech (2010) groundwater model to obtain groundwater drawdowns (including sensitivity analyses) at all of the well sites. The time intervals shall be each year through closure of the mine, and thereafter, every 5 years. Monitoring will continue postclosure for a duration determined to be necessary by FWS and USFS based on data gathered during implementation and input from the team described in Term and Condition 1.5, below.

1.2 At the time construction of the mine commences (and prior to pit excavation), Rosemont shall initiate monitoring of the selected groundwater wells and report the results annually to the USFS and FWS through closure of the mine. Monitoring will continue postclosure for a duration determined to be necessary by FWS and USFS based on data gathered during implementation and input from the team described in Term and Condition 1.5, below.

1.3 During the initial implementation phase (site construction and early pit construction), Rosemont shall monitor the wells daily (or via continuous data collection devices) to determine the magnitude of daily and seasonal groundwater fluctuations prior to the onset of the anticipated effects of pit dewatering. The results from initial monitoring will help determine if and to what degree observed groundwater elevations vary due to natural fluctuations (baseline conditions). The magnitude of the observed fluctuations shall accompany the model results from Term and Condition 1.1 which will then be reported to the USFS and FWS.

1.4 Rosemont and the USFS shall compare the results of the monitoring described in Term and Condition 1.2 to the groundwater model results described in Term and Condition 1.1, including the variation noted from implementation of Term and Condition 1.3, and report the finding to FWS annually.

1.5 If it is determined at any time via monitoring that the observed groundwater drawdowns exceed the upper bounds of the sensitivity analyses for the modeled groundwater drawdowns, including consideration of applicable daily and seasonal fluctuations, then it is possible that the take of Gila chub described in Table GC-3 has been exceeded. In this event, the USFS shall convene a team consisting of Forest Service staff, FWS, Rosemont Copper, USGS, the University of Arizona, and the Bureau of Land Management to seek consensus on whether the exceedance can be attributable to Rosemont's activities and thus be considered an exceedance of the take authorized by this Incidental Take Statement. If a team cannot be convened or consensus is not reached, the USFS or FWS shall make the determination of whether reinitiation of consultation is appropriate.

2. The funds identified for the Cienega Creek Watershed Fund and Sonoita Creek Ranch conservation measures may only be used for projects as described in the Conservation Measures subsection of the Description of the Proposed Action Section, above. Indirect (overhead) costs must be funded separately.

Conservation Recommendations – Gila Chub

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. The Biological Monitor (see Description of the Proposed Conservation Measures) should coordinate directly with Rosemont and Rosemont's consultants on behalf of the Forest Service, and also coordinate with the Bureau of Land Management. If a Forest Service employee is unable to perform that task, funding should be made available for a BLM employee or contractor of BLM's choosing to coordinate projects that affect resources on Public Lands.

2. We recommend that Rosemont and the eventual owner or manager of Pantano Dam consider changing how water is diverted there to reduce fish entrainment. An infiltration gallery would be ideal to reduce entrainment;

3. We recommend that Rosemont and the eventual owner or manager of Sonoita Creek Ranch consider changing how water is diverted at Monkey Spring to reduce fish entrainment. An infiltration gallery would be ideal to reduce entrainment;

4. We recommend that the USFS coordinate with the Cienega Watershed Partnership, AGFD, the F.R.O.G. Project, and our office in an effort to work with private landowners to remove any source populations of nonnative aquatic species from the area;

5. We recommend that the USFS continue to assist us and the AGFD in conserving and recovering the Gila chub;

6. We recommend that the USFS assist us with the completion and implementation of the Gila chub recovery plan;

7. We recommend that the USFS and Rosemont acquire instream flow water rights to ensure perennial flow in streams with Gila chub;

8. We recommend that the USFS continue to work with the FWS and AGFD to remove nonnative species and reestablish Gila chub throughout its historical range in Arizona;

9. We recommend that the USFS continue fish surveys on National Forest lands to determine the extent that other chub, such as the headwater chub (*G. nigra*), may occupy those streams.

10. We recommend that the USFS continue to work cooperatively with us and AGFD to establish populations of Gila chub wherever possible.

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.

Status of the Species – Gila Topminnow

Gila topminnow was listed as endangered in 1967 without critical habitat (32 FR 4001). Only Gila topminnow populations in the United States, and not in Mexico, are listed under the ESA. The reasons for decline of this fish include past dewatering of rivers, springs and marshlands, impoundment, channelization, diversion, regulation of flow, land management practices that promote erosion and arroyo formation, and the introduction of predacious and competing nonnative fishes (Miller 1961, Minckley 1985). Other listed fish suffer from the same impacts (Moyle and Williams 1990). Life history information can be found in the 1984 recovery plan (USFWS 1984), the draft revised Gila topminnow recovery plan (Weedman 1999), and references cited in the plans.

Gila topminnow are highly vulnerable to adverse effects from nonnative aquatic species (Johnson and Hubbs 1989). Predation and competition from nonnative fishes have been a major factor in their decline and continue to be a major threat to the remaining populations (Meffe *et al.* 1983, Meffe 1985, Brooks 1986, Marsh and Minckley 1990, Stefferud and Stefferud 1994, Weedman and Young 1997, Minckley and Marsh 2009). The native fish fauna of the Gila basin and of the Colorado basin overall, was naturally depauperate and contained few fish that were predatory on or competitive with Gila topminnow (Carlson and Muth 1989). In the riverine backwater and side-channel habitats that formed the bulk of Gila topminnow natural habitat, predation and competition from other fishes was essentially absent. Thus Gila topminnow did not evolve mechanisms for protection against predation or competition and is predator- and competitor-naive. Due to the introduction of many predatory and competitive nonnative fish, frogs, crayfish, and other species, Gila topminnow could no longer survive in many of their former habitats, or the small pieces of those habitats that had not been lost to human alteration. Both large (Bestgen and Propst 1989) and small (Meffe *et al.* 1983) nonnative fish cause problems for Gila topminnow as can nonnative crayfish (Fernandez and Rosen 1996) and bullfrogs.

It has long been known and thoroughly documented, that, western mosquitofish *Gambusia affinis* (mosquitofish) has major deleterious effects on individual Gila topminnow and their populations (Minckley *et al.* 1977, Meffe *et al.* 1983, Minckley *et al.* 1991, Minckley 1999, Voeltz and Bettaso 2003). These publications and others (Miller 1961, Meffe *et al.* 1982, Duncan 2013) have made it abundantly clear that mosquitofish negatively impact topminnow, and documented the likely mechanisms responsible (Schoenherr 1974, Meffe 1984, 1985).

The Sonoran topminnow (*Poeciliopsis occidentalis*) was listed in 1967. The species was later revised to include two subspecies, *P. o. occidentalis* and *P. o. sonoriensis* (Minckley 1969, 1973). *P. o. occidentalis* was known as the Gila topminnow, and *P. o. sonoriensis* was known as the Yaqui topminnow. *P. occidentalis*, including both subspecies, was collectively known as the Sonoran topminnow. Both subspecies are protected under the ESA. Minckley (1999) stated that the Yaqui topminnow and Gila topminnow are separate species named *P. sonoriensis* and *P. occidentalis*, respectively (Nelson *et al.* 2006). Other researchers make the same argument

(Quattro *et al.* 1996, Hedrick *et al.* 2001, Hedrick and Hurt 2012). The name change has not been made to 50 CFR 17.11.

Historically, the Gila topminnow was abundant in the Gila River drainage in Arizona and was one of the most common fishes of the Colorado River basin, particularly in the Santa Cruz system (Hubbs and Miller 1941). Gila topminnow also were recorded from the Gila River basin in New Mexico (Minckley and Marsh 2009). In the last 50 years, they were reduced to only 16 naturally occurring populations. Presently, only 8 of the 16 known natural Gila topminnow populations are considered extant (Table GT-1)(Weedman and Young 1997, Voeltz and Bettaso 2003, Duncan 2013). There have been at least 200 wild sites stocked with Gila topminnow, however, topminnow persist at only 33 of these localities (Table GT-2). Of these, two sites are outside topminnow historical range and one contains nonnative fish (Voeltz and Bettaso 2003). All of these sites except two are in New Mexico. Many of the reestablished sites are very small and may not contain viable populations, as defined in the draft revised recovery plan (Weedman 1999). In addition several of the 33 sites have been reestablished in the last few years, and their eventual disposition is unknown.

The *Sonoran Topminnow Recovery Plan* (USFWS 1984) established criteria for down- and de-listing. Criteria for down-listing were met for a short period. However, due to concerns regarding the status of several populations, down-listing was delayed.

A draft revised recovery plan for the Gila topminnow is available (Weedman 1999). The plan's short-term (i.e. survival-related) goal is to prevent extirpation of the species from its natural range in the US and reestablish it into suitable habitat within historical range. The plan's longer-term goal (i.e. the reclassification criteria) include quantitative measures of the species persistence at a specific number of sites over time.

The draft revised recovery plan states that, before considering the Gila topminnow for reclassification, survival of the species in the U.S. must be ensured according to the following criteria:

I. Remaining natural populations and occupied habitat in the U.S. should be secured. Natural populations, as previously identified from the fourteen localities in which extant Gila topminnow populations have been found, will be managed as eight metapopulations:

   A. Upper Santa Cruz (Sharp Spring and upper Santa Cruz River in U.S.)
   B. Middle Santa Cruz River (north of Nogales)
   C. Upper Sonoita Creek (Cottonwood Spring and upper Sonoita Creek)
   D. Redrock Canyon
   E. Monkey Spring
   F. Lower Sonoita Creek (Coal Mine and Fresno Canyons and Sonoita Creek below Patagonia Lake)
   G. Cienega Creek (population on BLM and State property and one on Cienega Creek Preserve)
   H. Bylas Spring Complex (Bylas and Middle springs and Salt Creek)

II. The surviving reestablished populations within historical range (Appendix C of the draft revised recovery plan) are also considered necessary for the survival of the species. They should receive the same protections as natural populations.
III. Refuge stocks should be maintained for each of the eight natural metapopulations (changes may be made to this requirement in the future as new genetic information is developed).
IV. Population monitoring plans as outlined below should be developed and implemented.

The draft revised recovery plan further states that the Gila topminnow will be considered for reclassification as threatened when:

I. Criteria detailed under Survival Criteria (above) have been met to ensure survival;
II. The eight natural metapopulations (Level 1 populations; levels are described in the draft revised recovery plan) are replicated, established, and viable within historical range as Level 2 and Level 3 populations as described in Task 2 (below). In addition, mixed populations are established as Level 2 and Level 3 populations as identified in Task 2. Each of the existing eight natural metapopulations will be replicated in at least four level 2 sites equaling at least 32 level 2 populations. In addition, at least 20 level 2 populations of mixed origin will be established. Level 2 populations will not be considered established until they have persisted a minimum of 10 years with little to no human intervention. A minimum of 60 level 3 populations are required. Level 3 populations count as soon as they are established;
III. Plans for monitoring populations and their habitats, and periodic assessment of genetic integrity, are developed and implemented, including regular reporting of results; and,
IV. The genetic protocol delineated in Task 4 (as described in the draft revised recovery plan outline) is implemented to allow exchange of genetic material among reestablished populations.

While the draft revised recovery plan has not yet been approved, the criteria listed above are nevertheless useful for evaluating the effects of a given proposed on the conservation (survival and recovery) of the species.

The status of the species is mixed. An active recovery program actively stocks Gila topminnow in Arizona and New Mexico, reestablishing topminnow in “new” sites (Robinson 2010, 2011, 2012). However, natural sites continue to slowly decline. Gila topminnow has gone from being one of the most common fishes of the Gila basin to one that exists at about 41 localities (8 natural and 33 stocked). Many of these localities are small and highly threatened. The theory of island biogeography can be applied to these isolated habitat remnants, as they function similarly (Meffe 1983, Laurenson and Hocutt 1985). Species on islands are more prone to extinctions than continental areas that are similar in size (MacArthur and Wilson 1967). Meffe (1983) considered extirpation of Gila topminnow populations almost as critical as recognized species extinctions. Moyle and Williams (1990) noted that fish in California that are in trouble tend to be endemic, restricted to a small area, part of fish communities with fewer than five species, and found in isolated springs or streams. Gila topminnow has most of these characteristics.

Table GT-1. Status of natural Gila topminnow populations in the US.

Site	Ownership	Extant?[1, 8]	Nonnatives?	Mosquitofish?	Habitat Size[2]	Threats[3]
Bylas Spring[5]	San Carlos	YES	NO[4]	NO[4]	S D	M/ N G
Cienega Creek	BLM/County	YES	NO	NO	L	H/ R N W U M
Coal Mine Spring	AGFD	YES	NO	NO	S	L/ G
Cocio Wash	BLM	NO 1982	DRY	DRY	S	H/ M
Cottonwood Spring	Private	YES	NO	NO	S	M/ N W
Fresno Canyon[7]	State Parks	YES	NO[9]	NO[4]	M	H/ N U
Middle Spring[5]	San Carlos	YES	NO[4]	NO[4]	S	H/ N G
Monkey Spring	Private	YES	NO	NO	S	L/ W U
Redrock Canyon	USFS	NO 2008[10]	YES	YES	M D	H/ W R G N
Salt Creek[5]	San Carlos	YES	NO[4]	NO[4]	S	M/ N G
San Pedro River	Private	NO 1976	YES	YES	-	H/ W N G R
Santa Cruz River San Rafael Tumacacori	Private, State Parks, TNC	 NO[6] NO 2003	 YES YES[4]	 YES YES	L D	H/ W N R G C U
Sharp Spring	State Parks	NO 2004	YES	YES	M	H/ N G
Sheehy Spring	TNC	NO 1987	YES	YES	S	H/ N G
Sonoita Creek	Private, TNC, State Parks	YES	YES	YES	L D	H/ W N G

[1] if no, last year recorded
[2] Size L = large M= medium S = small D = disjunct
[3] Immediacy H = high M = moderate L = low
Type W = water withdrawal C = contaminants R = recreation N = nonnatives
G = grazing M = mining U = urbanization
[4] none recently, they have been recorded
[5] renovated
[6] in Mexico 2006, US in 1993
[7] includes Sonoita Creek below Patagonia Lake
[8] Recent records are those less than 10 years old
[9] Fresno Canyon renovated in 2007 and is free of nonnatives- Sonoita Creek has many nonnatives
[10] Stefferud and Stefferud 2008
The Bylas Springs complex, Bylas Spring, Middle Spring, and Salt Creek count as one natural site.

Table GT-2. Reestablished wild populations of Gila topminnow that are likely extant. In Arizona unless noted otherwise (Voeltz and Bettaso 2007, FWS files).

Site Name	Year stocked (discovered)	Mixed/pure	Lineage(s)	Fish From:
AD Wash	1993	Pure	Sharp Spring	Dexter NFH
Ben Spring	2011	Pure	Cottonwood Springs	Bubbling Ponds
Bleak Spring	2005	Pure	Bylas	San Carlos
Bonita Creek (upper)	2010	Pure	Bylas Spring	Dudleyville pond
Buckhorn Spring	2011	Pure	Sharp Spring	
Burro Cienega, NM	2008	Pure	Bylas Spring	Dudleyville pond
Campaign Creek	1983 - **Failed**	Mixed	Monkey/Bylas/Cocio	BTA
	2001	Mixed	Sharp/Cienega	ASU ARC
Cement Spring	2005	Pure	Bylas	San Carlos
Chalky Spring	2009	Pure	Sharp Spring	
Charlebois Spring	1983	Mixed	Monkey/Bylas/Cocio	BTA
Cherry Spring (Muleshoe)	2007-2008	Pure	Bylas Spring	Dudleyville pond
Cieneguita Wetland	2013	Pure	Cienega Creek	
Cold Spring (#85)	1985	Pure	Monkey Springs	BTA
Cottonwood Spring (Goldfield Mountains)	2008	Mixed	Monkey Springs	Boyce Thompson Arboretum
Cottonwood Artesian	1982 - **Failed**	Mixed	Monkey/Bylas/Cocio	BTA
	2001	Pure	Bylas Springs	ASU ARC
Dutchman Grave Spring	1983- **Failed**	Mixed	Monkey/Bylas/Cocio	BTA
	2006	Mixed	Monkey/Bylas/Cocio	BTA
Empire Tank	2013	Pure	Cienega Creek	
Fossil Creek (#280)	2007-2010	Pure	Sharp Spring	
Headquarters Spring (Muleshoe)	2008	Pure	Bylas Spring	Dudleyville pond
Horse Thief Draw	2011	Pure	Cottonwood Springs	Bubbling Ponds
Howard Well	2008	Pure	Bylas Spring	Dudleyville pond
Larry Creek trib	2005	Pure	Coalmine Spring	Coalmine Spring
Lime Creek	Dispersal from Lime Cabin Spring (1996)	Mixed	Monkey/Bylas/Cocio (Lime Cabin Spring stocked in 1982)	BTA
Little Nogales Spring	2013	Pure	Cienega Creek	
Lousy Canyon	1999, 2006	Pure	Coalmine Spring	Coalmine Spring
Morgan City Wash	2009	Pure	Sharp Spring	
Mud Springs	1982	Mixed	Monkey/Bylas/Cocio	BTA
Murray Spring	2011	Pure	Cottonwood Springs	Bubbling Ponds
Nogales Spring	2013	Pure	Cienega Creek	
O'Donnell Creek	1974	Pure	Monkey	Monkey
Pasture 2 Tank	2013	Pure	Sharp Spring	Robbins Butte
Redrock Wildlife Area NM	2010	Pure	Bylas Spring	Dudleyville pond
Road Canyon Tank	2012	Pure	Cienega Creek	Robbins Butte
Rock Spring	2013	Pure	Santa Cruz (Peck)	Phoenix Zoo
Secret Spring (#331, Muleshoe)	2007	Pure	Bylas Spring	Dudleyville pond
Springwater Wetland	2013	Pure	Cienega Creek	
Swamp Spring (Muleshoe)	2007-2008	Pure	Bylas Spring	Dudleyville pond
Tule Creek	1981	Mixed	Monkey/Bylas/Cocio	BTA
Unnamed Drainage 68b	Dispersal from Mesquite Tank #2 (1985)	Mixed	Monkey/Bylas/Cocio (Mesquite Tank @ stocked in 1982)	BTA
Walnut Spring (Mesa Ranger District)	1982	Mixed	Monkey/Bylas/Cocio	BTA

Walnut Spring (Tonto Basin Ranger District)	2013	Pure	Redrock Canyon	ASU & Desert Harbor
Usery Park	2011	Pure	Cottonwood Springs	

Consultation History

Our information indicates that, range wide, over 100 formal consultations have been completed for actions affecting Gila topminnow. These opinions primarily include the effects of grazing, water developments, fire, species control efforts, recreation, land management planning, native fish restoration efforts, and mining.

Environmental Baseline – Gila Topminnow

The portion of the action area associated with Gila topminnow encompasses all occupied or likely-to-be occupied reaches of stream within the Cienega Creek watershed, as these will be subject to the proposed action's effects to groundwater and surface flow hydrology. This area is described in detail in the Status of the Species and Critical Habitat within the Action Area section, below. The narrative that follows includes accounts of rangewide effects to Gila topminnow and its habitat as a means to describe similar factors affecting the species within the action area.

The environmental baseline for the action area, and specifically for aquatic species, was thoroughly discussed in the Gila chub section of this BO. It is incorporated here by reference; specifics for the Gila topminnow will be discussed here.

Status of the Species within the Action Area

The action area for the Gila chub encompasses the occupied stream reaches in the Cienega Creek watershed. The action-area status of the Gila topminnow was described in our 2008 and 2012 BOs that addressed effects of Aquatic Species Conservation at the San Pedro Riparian and Las Cienegas National Conservation Areas, Arizona (File numbers 22410-2008-F-0103, 22410-2002-F-0162-R001). The action areas for those BOs overlap with the action area of the proposed action; that information is updated here. Other background information can be found in the Gila chub section of this BO. There is no designated critical habitat for Gila topminnow.

The natural population of Gila topminnow in Las Cienegas continues to be the only extant one on public lands and it is by far the largest of all remaining natural populations in the United States (Simms and Simms 1992, Bodner *et al.* 2007). The only other public land population, Redrock Canyon on the Coronado National Forest, was extirpated in 2008 (Duncan 2013). The first repatriation of Gila topminnow into the upper Cienega Creek watershed took place in October 2001 at Empire Gulch, followed with additional releases. However, reestablishment of Gila topminnow at Empire Gulch has failed (Simms 2010, Service files). This is likely due to high levels of aquatic vegetation and aquatic invertebrate predators of Gila topminnow in Empire Gulch (Bodner *et al.* 2007).

On May 7, 2012, AGFD stocked 974 Gila topminnow and 656 desert pupfish *Cyprinodon macularius* (lower Colorado River stock), were stocked into Road Canyon Tank in the Las Cienegas NCA. Gila topminnow were acquired from Cienega Creek, and hence were Cienega Creek lineage. The AGFD's Nongame Branch and BLM staff visited Road Canyon Tank on July 9, 2012 and reported seeing hundreds of topminnow and about 20 desert pupfish (Robinson 2013).

On May 8, 2012 AGFD and BLM staff stocked 833 Gila topminnow into one pool in Nogales Spring and 910 into two pools in Little Nogales Spring. Fish were collected from Cienega Creek (and hence were Cienega Creek lineage) earlier in the day. AGFD Nongame Branch and BLM staff visited the two springs on July 10, 2012. Between 50 to 100 Gila topminnow, of which about 37 were juveniles, were observed in Nogales Spring. In the upper stocking pool in Little Nogales Spring, about 100 Gila topminnow were observed, about half of which were juveniles. Adults and juveniles were also observed in the stream for several hundred meters below the upper stocking location. In the lower stocking pool over 100 Gila topminnow were observed (Robinson 2013).

BLM management actions that have improved riparian and aquatic habitat for other species on Cienega Creek, coupled with drought, have caused topminnow to become significantly rarer in the upper perennial reach (Bodner *et al.* 2007, Duncan 2013). The lower reach of upper Cienega Creek appears to have a stable Gila topminnow population (Bodner *et al.* 2007). There are also perennial sections of Cienega Creek north (downstream) of Interstate 10 that hold topminnow (Kesner and Marsh 2010).

Gila topminnow was first documented from Cienega Creek in the 1970's. In addition to Gila topminnow, Cienega Creek supports two other native fishes (Bagley *et al.* 1991, Simms and Simms 1991), the longfin dace and the endangered Gila chub. Cienega Creek is one of the last places in Arizona supporting an intact native fish fauna uncontaminated by nonindigenous fish and is one of the natural Gila topminnow populations not contaminated by mosquitofish (Weedman 1999, Voeltz and Bettaso 2007, Duncan 2013).

Cienega Creek and its Gila topminnow habitat are subject to a number of human uses, including livestock grazing, recreation, urban and suburban development, groundwater pumping, and roads. Before BLM acquired the area, it was primarily used for grazing, but there were also extensive agricultural fields along the creek (Eddy and Cooley 1983). These fields were irrigated by a system of canals and dams that locally destroyed Gila topminnow habitat and created severe erosion. The BLM is removing these developments and has reconstructed part of the creek to restore more natural geomorphic and hydrologic conditions (USFWS 1998a, Simms 2001).

The lower reach of upper Cienega Creek appears to have a stable Gila topminnow population, but because of how data were collected, even that is uncertain (Bodner *et al.* 2007). The Cienega Creek topminnow population is still considered a viable population, and it is still the largest by far in the U.S.

Gila Topminnow populations in upper Cienega Creek as a whole have declined by 15.6 percent per (Bodner *et al.* 2007). They found this trend to be highly significant, although it only explained 10 percent of the variation in fish abundance. Trends were vastly different between the upper and lower reaches. Topminnow populations in the lower reach were stable over this 16-year period. However, Gila topminnow numbers in the upper reach declined dramatically over the same time.

Gila topminnow was discovered on Pima County's Preserve in 2002, as was Gila chub. Longfin dace also occur there. Use of the Preserve is only recreation, which is limited to 20 people per day. Several clay pits, sand and gravel mines, and other mineral development occurs or is planned in the area. Some of the clay pits close to the preserve have been known to contain water and nonindigenous fish and bullfrogs. Fortunately, to date no nonindigenous fish have been found in Cienega Creek in the Preserve. There is a diversion at the downstream-most end of perennial flow. All base flow is diverted down a grate.

In 2004, AGFD personnel captured 30 Gila topminnow at the confluence of Davidson Canyon and Cienega Creek (Voeltz 2004). As part of an ongoing program established by the U.S. Bureau of Reclamation, Cienega Creek is one location where fish monitoring was conducted from 2007 through 2010 (Kesner and Marsh 2010, Marsh and Kesner 2011). Sampling was conducted at two locations in Cienega Creek: Station 1 (upstream of the confluence of Davidson Canyon) and Station 2 (downstream of the confluence with Davidson Canyon). They caught 26 Gila topminnow in 2007, 96 in 2008, 61 in 2009, and 255 in 2010. Gila topminnow were captured by the BLM within the lower and upper reaches of upper Cienega Creek in 2005, 2007, and 2008. Many topminnow were observed in Mattie Canyon in 2006, and one was captured within Mattie Canyon in 2007 (Bodner *et al.* 2007); however, none were observed in 2008 (Ehret and Simms 2009). As part of an effort intended to create, enhance, and protect habitat for at-risk species within the Las Cienegas NCA, Caldwell *et al.* (2011) identified numerous new suitable renovated pond sites for Gila Topminnow reestablishment within Upper and Lower Cienega Creek and within other portions of the Empire Valley.

Monkey Spring

Monkey Spring is located 1.2 mi (2 km) south of Cottonwood Spring and 100 feet east of Sonoita Creek. It originates on a sideslope above Monkey Canyon, a tributary of Sonoita Creek. Before diversion, the spring flowed through a marsh then over a travertine terrace that resulted in a waterfall of about 40 ft (12 m) into the canyon (Minckley 1973). In the late 1800's a dam was built across the terrace and the flow diverted into a ditch (see also Chamberlain 1904). The artificial pond later drained when attempts to deepen it resulted in breaking the seal on the bottom. The springhead and a short reach are excluded from livestock grazing. The spring continues to be diverted into a cement ditch, and then pipes, that take it to the Sonoita Creek floodplain for irrigation. Some flow periodically drains into the pond and provides transient Gila topminnow habitat.

Monkey Spring is privately owned and is not accessible to the public. The ranch on which it is located was once threatened with development but is being acquired as part of the proposed action. Although the to-be-acquired lands do not actually contain Monkey Spring proper, the water rights to the spring's outflow are appurtenant to the lands and will thus also be acquired and protected.

Gila topminnow was first documented in Monkey Spring in 1904 (Chamberlain). Monkey Spring is the most genetically differentiated of the Gila topminnow populations (Hedrick and Parker 1998, Hedrick *et al.* 2001, Parker *et al.* 1999) in the Gila basin. Historically, two other native fish occurred in Monkey Spring, the Santa Cruz pupfish (*Cyprinodon arcuatus*) and Gila chub (Minckley 1973). The pupfish went extinct, and Gila chub was extirpated after nonindigenous sport fish were introduced (Minckley 1973). Yaqui catfish, a native of the Rio Yaqui basin to the east and south, were introduced into a reservoir fed by Monkey Spring in 1899, but died out sometime after 1950 (Chamberlain 1904, Minckley 1973). At present, there are no nonindigenous fish in Monkey Spring (Voeltz and Bettaso 2003). Previous landowners introduced the nonindigenous fish in the past, but this is now less likely given that the site will enter conservation ownership and be actively managed for native species as part of the proposed action.

Factors affecting species environment within the action area

The action-area status of the Gila topminnow was described in our 2008 and 2012 BOs that addressed effects of Aquatic Species Conservation at the San Pedro Riparian and Las Cienegas National Conservation Areas, Arizona (File numbers 22410-2008-F-0103, 22410-2002-F-0162-R001). The action areas for those BOs overlap with the action area of the proposed action; that information is updated here. The factors affecting the Gila chub are the same ones affecting the Gila topminnow; so that section of this BO is incorporated here by reference. There is no designated critical habitat for Gila topminnow.

Effects of the Action - Gila Topminnow

The effects of the action to Gila topminnow will be very similar to those described for Gila chub. Therefore, that discussion in this BO is incorporated here by reference. Any effects that may affect the Gila topminnow differently than Gila chub, will be discussed below.

Climate change may be less problematic for Gila topminnow compared to Gila chub. Gila topminnow have about a 2^{o} C higher tolerance of water temperature than Gila chub (Carveth *et al.* 2006). Gila topminnow are also likely to respond better to reduced dissolved oxygen in the water; topminnow can survive with dissolved oxygen at 1ppm, while chub require at least 3ppm. Also, amount of stream flow is a factor in dissolved oxygen; generally the less the flow, the less the amount of dissolved oxygen.

As for how the modeled groundwater drawdowns will impact Gila topminnow, many of the impacts will be the same as for Gila chub. However, a reduction in the wetted perimeter will be more deleterious for topminnow than Gila chub, since Gila topminnow prefer and use shallow waters much more than chub. Therefore, habitat that is likely to be occupied by topminnow in the future (when drawdowns occur) will be lost or reduced by the proposed action. Losses of habitat resulting from the groundwater drawdown associated with the proposed action may impact Cienega Creek north of I-10 (The Preserve), Cienega Creek on Las Cienegas NCA, and Mattie Canyon. The modeled loss of surface water in the northern reaches of upper Cienega Creek is more of a concern than the southern reaches, because the best topminnow populations on the NCA occur there (Bodner *et al.* 2007). In addition, BLM's Cieneguita wetland project in the lower Empire Gulch drainage is slated to receive Gila topminnow (BLM 2007) in the next two years. Groundwater losses near the confluence of Empire Gulch and Cienega Creek could impact the Cieneguita wetlands.

Since attempts to establish Gila topminnow in Empire Gulch have failed, the modeled groundwater decline at the Empire Gulch Spring is not likely to impact Gila topminnow, at least certainly not in the near term. There are no discussions on releasing topminnow into any part of Empire Gulch. The problems with excess aquatic vegetation and shade in the spring run would need to change before Gila topminnow releases were entertained.

Since the effects of the action to Gila topminnow will be off-site, conservation measures can only be effectively realized off-site. The two conservations measures discussed below are outside the footprint of the mine, though one is in the action area. Other than the monitoring mentioned above, two conservation measures should promote conservation and recovery of Gila topminnow. A full description of the conservation measures can be found in the proposed action section of this BO.

The Cienega Creek Watershed Conservation Fund will provide $200,000 a year for 10 years for development and implementation of measures intended to preserve and enhance aquatic and riparian ecosystems and the federally listed aquatic and riparian species that depend on them. The funds can be used to support approved management efforts by Pima County and others to control invasive aquatic species that presently occur (bullfrogs), or may occur later. Funds can be used for restoration activities and adaptive management. Rosemont will acquire and close one well near the diversion dam in lower Cienega Creek. Also, Rosemont will acquire over 1100 af of water rights, and transfer them for conservation purposes, or sever them.

About 825 acre-feet per annum (afa), will be used for aquifer recharge below Pantano Dam, either through a Corps approved ILF mitigation program or through a "managed underground storage facility (MUSF)" permitted through the ADWR. This will allow surface water flows currently diverted for golf course irrigation to be captured and discharged back to the streambed below the Pantano Dam within the Cienega Creek Natural Preserve. Flow will be captured at the existing in-channel grated diversion, and then released into the stream channel below the dam. Gila topminnow and longfin dace have been observed right above the dam, on the dam, and in the scour pool below the dam. It is certain that fish have been and will continue to go into the diversion, and suffer death or injury. How much habitat will be suitable for topminnow remains to be seen, but it is highly likely suitable topminnow habitat will form below the dam. The actions taken under this conservation measure should enhance the resiliency and suitability of Cienega Creek for Gila topminnow, especially in the lower creek, at least in the short-term. Under the threat of continuing long-term drought and climate change, enhancing system resiliency is a key component for adapting to climate change and reducing its affects (Overpeck *et al.* 2012).

Also, Rosemont will purchase about 1,200 acres of land along Sonoita Creek (Sonoita Creek Ranch) with about 590 afa of certificated surface water rights from Monkey Spring. This is near Patagonia, and outside of the action area. It is anticipated that the land will be transferred either to a Corps-approved ILF program sponsor or to a conservation entity for management of the property. In addition, unless an ILF program is developed Rosemont will fund $150,000 a year for 10 years for resource management. An additional $100,000 ($20,000 annually for five years) will be provided for management against nonnative species, generally in the two existing ponds on the property that are maintained with water from Monkey Spring. An evolutionary significant unit of Gila topminnow occurs in Monkey Spring (Hedrick *et al.* 2001); acquisition of even part of the water rights will provide some protection to this natural topminnow population. Gila chub and Gila topminnow will be established in the ponds after nonnatives are removed from them. Because this parcel is outside of the action area, this action represents recovery in lieu of threat removal. The environmental baseline and recovery status of Gila topminnow should be improved by actions taken at Sonoita Creek Ranch. Also, the source of Monkey Spring appears to be the regional aquifer, which should be somewhat buffered from local groundwater pumping and climate change.

The environmental baseline and recovery status of Gila topminnow should be improved by actions taken at Sonoita Creek Ranch. The proposed action is implements tasks in the draft revised Gila topminnow recovery plan (Weedman 1999). This is a vitally important area for Gila topminnow conservation, because many natural topminnow populations are in the area, and reestablishment sites are limited there. The Cienega Creek Watershed Fund and Sonoita Creek Ranch conservation measures are essential to offset expected effects to Gila topminnow and their habitat.

Lastly, there exists a draft revised recovery plan for Gila topminnow (Weedman 1999; see Status of the Species section, above), which contains Survival and Reclassification Criteria. The proposed action will affect the habitat for and the population of Gila topminnow in Cienega Creek, the securing of which is described in Survival Criterion I(A), but we anticipate, as previously stated, that the Cienega Creek Watershed Fund will be effective in conserving Gila topminnow in this system. Survival Criteria II, III, and IV will not be affected.

Reclassification Criterion I is met when the Survival Criteria have been met. Given that the proposed action supports Survival Criterion I and does not affect Survival Criteria II, III, or IV, we anticipate that the ability to reclassify (downlist) Gila topminnow will not be precluded by the proposed action. Reclassification Criterion II refers to the replication, establishment, and survival of populations within the Gila topminnow's historical range. The acquisition and restoration of the Sonoita Creek Ranch will contribute to the implementation of this criterion, thus supporting reclassification from endangered to threatened, a meaningful increment towards recovery of the species. Reclassification Criterion III refers to monitoring of populations and periodic assessments of genetic integrity. The restoration of and likely reestablishment of Gila topminnow to the Sonoita Creek Ranch will be monitored; genetic assessments are beyond the scope of the proposed action and will most likely be pursued at the species-wide scale by AGFD, FWS, and academia. Reclassification Criterion IV requires that a genetic protocol that allows for the exchange of genetic material between populations; this too is beyond the scope of the proposed action and will most likely be pursued by wildlife agencies and researchers.

Summary of Effects – Gila Topminnow

- Groundwater levels have historically been variable;
- The environmental baseline shows increasing trends in water use in some areas of the action area;
- The current extended drought and climate change are highly likely to negatively impact many system components from the upper parts of the watershed to where Cienega Creek becomes Pantano Wash through:
  - Changes in upland vegetation and fire regime;
  - Higher ambient and water temperatures;
  - Increased variability in stream hydrographs;
  - More frequent severe climatic events (such as storms, droughts, wildlfires, etc.);
- The proposed conservation measures will not preclude all anticipated effects to surface waters from occurring;
- Acquisition of Sonoita Creek Ranch is a significant benefit to a critically important natural Gila topminnow population;
- Impacts to groundwater, and thus surface water, are reasonably certain to impact areas occupied by Gila topminnow, and thus will negatively impact Gila topminnow; and
- Impacts to wetted stream perimeter and water depth are anticipated to be long-term (50-150 or more years after closure).

Cumulative Effects – Gila Topminnow

The cumulative effects for the action area, and specifically for aquatic species, was thoroughly discussed in the Gila chub section of this BO. It is incorporated here by reference.

Conclusion – Gila Topminnow

After reviewing the current status of the Gila topminnow, the environmental baseline for the action area, the effects of the proposed action, and the cumulative effects, it is the FWS's biological opinion that the proposed action is not likely to jeopardize the continued existence of the Gila topminnow. Pursuant to 50 CFR 402.02, "jeopardize the continued existence of" means to engage in an action that reasonably would be expected, directly or indirectly, to reduce appreciably the likelihood of both survival and recovery of a listed species in the wild by reducing the reproduction, numbers, or distribution of that species. We present this conclusion for the following reasons:

1. No directs effects from operation of the mine are expected;
2. Rosemont will monitor groundwater drawdown and the USFS will compare observed drawdown to modeled drawdown. Groundwater drawdown greater than modeled may require reinitiation of section 7 consultation;

3. The Cienega Creek Watershed Conservation Fund will, for the short-term at least, protect and potentially increase habitat for Gila chub by funding actions management and restoration actions in the watershed, protecting water rights, and creating habitat;
4. The Cienega Creek Watershed Conservation Fund is likely to increase ecosystem resiliency in the face of the expected groundwater drawdown from Rosemont Mine, and impacts from climate change;
5. The Sonoita Creek Ranch will create new habitat for Gila topminnow that is created from a reliable water source (Monkey Spring);
6. The Sonoita Creek Ranch will provide additional protection to an evolutionarily significant unit of Gila topminnow, and proposes to implement actions in the draft revised Gila topminnow recovery plan;
7. The Cienega Creek Watershed Fund and Sonoita Creek Ranch conservation measures are essential to offset expected effects to Gila topminnow and their habitat;
8. Indirect effects from groundwater drawdown are difficult to predict at the distances from the drawdown (Rosemont Mine), and will not occur until well after mine closure.
9. Groundwater drawdown is not expected to be more than 0.1 ft in any of the modeled locations until 150 years after mine closure; and
10. Conservation and recovery actions have taken place since the species was listed, continue to occur, with more actions in planning. Therefore, we believe the status of the species is static or improving.
11. The magnitude of the proposed action's effects and the implementation of conservation measures, as described in Conclusions 2 - 6, above) mean that the recovery potential of Gila topminnow (per the draft revised recovery plan) will not be diminished.
12. Critical habitat has not been designated for the Gila topminnow; none will be affected.

INCIDENTAL TAKE STATEMENT – GILA TOPMINNOW

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 included by the USFS as binding conditions of any grant or permit issued to the applicant, as appropriate, for the exemption in section 7(o)(2) to apply. The USFS has a continuing duty to regulate the activity that is covered by this Incidental Take Statement. If the USFS (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 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, the USFS, or the applicant 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 – Gila Topminnow

We anticipate that the proposed action will result in incidental take of Gila topminnow. Any reduction in stream discharge resulting from groundwater drawdowns attributable to the proposed action will reduce the extent and/or quality of aquatic habitat required by Gila topminnow; we are thus reasonably certain that take will occur.

Incidental take of Gila topminnow in Cienega Creek will be difficult to detect for the following reasons: population levels cannot be accurately described with existing information and techniques, dead animals are difficult to find, cause of death may be difficult to determine, and losses may be masked by seasonal fluctuations in numbers or other causes. The incidental take is expected to be in the form of harm through the loss of habitat from groundwater drawdown, and harm, harassment, and mortality from water diversion and management at Pantano Dam.

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 Gila topminnow taken because: (1) dead or impaired individuals are almost impossible to find (and are readily consumed by scavengers and predators) and losses may be masked by seasonal fluctuations in environmental conditions; (2) the status of the species will change over time through disease, natural population variation, natural habitat loss, or the active creation of habitat through management; and (3) the species is small-bodied, well camouflaged, and occurs under water of varying clarity.

Gila topminnow are subject to an existing monitoring program in the Cienega Creek watershed on the Las Cienegas NCA. The currently used sampling techniques result in an index of fish abundance per sampling site, as catch-per-unit-effort per pool. The sampling techniques used on Las Cienegas NCA are only sensitive enough to be statistically significant if the population doubles or is halved (Bodner *et al*. 2007). Monitoring in reaches downstream from the NCA (Marsh and Kesner 2011) is even less suited to determining population trends. Gila topminnow population estimates can theoretically be acquired, but are difficult, time consuming, stressful to the fish (to the point of harm), and expensive. In addition, the number of Gila topminnow in any population are normally extremely variable during a year due to an r-selected (high fecundity, short generation time, wide dispersal of offspring) reproductive strategy, common in highly variable environments such as desert streams.

It is reasonable to assume that the abundance of Gila topminnow is correlated with the extent of suitable aquatic habitat provided by surface flows in the affected streams (see Status of the

Species within the Action Area section). Baseflows maintain stream discharge when surface runoff is low or nonexistent, and these baseflows result from groundwater discharge. The discharge of groundwater to springs and streams is related to the elevation and gradient that regional groundwater exhibits relative to those surface waters. Decreases in groundwater elevation affect this gradient and thus, reduce the discharge of groundwater to streams (see Effects to Aquatic Ecosystems section). Groundwater elevations, which can be readily measured, are therefore effective surrogate measures for the incidental take of Gila topminnow.

The Effects to Aquatic Ecosystems and Effects to Riparian Ecosystems sections of this BO as well as the analysis of effects for the Gila chub, above, discuss the relationship between the proposed action, changes in groundwater elevation, and the volume and length of surface flow in streams. Changes in groundwater elevation have been modeled (Montgomery and Associates 2012, Myers 2010, and Tetra Tech 2012), and are summarized in Table A-5 in the Effects to Aquatic Ecosystems section. This document's analyses were based primarily on the drawdowns modeled by Tetra Tech (2010), including the results of sensitivity analyses. Sensitivity analysis is explained in the Effects to Aquatic Ecosystems section above, and is summarized, below.

The changes in groundwater elevation will result in reduced wetted lengths and volumes in reaches of stream maintained by discharges from the regional aquifer; surface flow effects are summarized in Tables A-2, A-3, and A-4 in the Effects to Aquatic Ecosystems section. Westland (2012) determined that there could be some reductions in the wetted length of lower Cienega Creek from groundwater drawdowns over the long term. We also anticipate that reduced flow volumes could result in increased summer water temperatures (Barlow and Leake 2012) and thus reductions in dissolved oxygen content (oxygen solubility is inversely related to water temperature), thus further adversely affecting (Bodner *et al*. 2007) the already-reduced numbers of Gila topminnow that would remain.

Therefore, the take of Gila topminnow is expressed in terms of the drawdowns noted in the locations and time frames (0, 20, 50, 150, and 1,000 years) discussed in analysis of the effects to the species, above, which are: (1) the Gardner/Cienega Confluence, representing effects to Gardner Canyon; (2) Empire Gulch Springs, representing effects to Empire Gulch; (3) USGS stream gage No. 09484550, representing effects to upper Cienega Creek; (4) the Davidson/Cienega Confluence, representing effects to Davidson Canyon Wash; and (5) USGS stream gage No. 09484560 , representing effects to lower Cienega Creek. Further, take is expressed as the upper limits of the sensitivity analyses as this potentially larger drawdown was considered in the Effects of the Action section for Gila topminnow. The groundwater modeling involved the creation of a number of scenarios, each scenario using different modeling parameters (e.g. varying amounts of recharge, differing transmissivities, etc.). Each individual parameter was varied within a reasonable range of values. This suite of modeling scenarios known as the sensitivity analysis (in other words, determining which variables have the greatest influence on the model results). Out of the suite of modeling scenarios, only one was considered the "best-fit", or baseline, modeling scenario. The range of predicted drawdown from the rest of the modeling scenarios, however, is still considered possible or reasonable, though not as likely to occur. Since the entire range of results was considered in the Effects of the Proposed Action section for this species, take is expressed as the largest of the predicted drawdowns. Table GT-3, below, displays the anticipated amount or extent of take.

Table GT-3: Anticipated amount or extent of take for the Gila topminnow, based on Tetra Tech (2010, as referenced in SWCA 2012) and Table A-5 in the Effects to Aquatic Ecosystems section.

Location	**Maximum anticipated post-mining groundwater drawdown (in feet) by year**[1]				
	0	**20**	**50**	**150**	**1,000**
Gardner/Cienega Confluence	<0.1	<0.1	0.15	0.35	0.5
Upper Empire Gulch Springs	0.1	0.5	1.8	5.0	6.0
Upper Cienega Creek near stream gage No. 09484550	<0.1	<0.1	0.15	0.35	0.5
Davidson/Cienega Confluence	<0.1	0.15	0.2	0.2	0.1
Lower Cienega Creek near stream gage No. 09484560	<0.1	<0.1	<0.1	<0.1	<0.1

[1] Drawdowns described as less than 0.1 foot would be exceeded if they met or exceeded 0.1 foot.

The sites and time frames which appear in Tables GT-3 (above) and A-5 (in the Effects to Aquatic Ecosystems section), and are referred to throughout this BO's effects analyses, represent groundwater model outputs at locations and times of interest to biological resources. It is recognized, however, that the sites currently lack observation wells; groundwater elevations cannot be monitored at those locations. Moreover, these sites are proximal to streams and will experience confounding influences from recharge by runoff, riparian ET, and drought, rendering the sites relatively unsuited for groundwater monitoring – and unsuited for determining cause and effect relationships for hydrologic changes - even if wells were emplaced. It is also recognized that the time intervals for the reported drawdowns (0, 20, 50, 150, and 1,000 years post-mining) are not meaningful for monitoring take; the intervals are too infrequent and become even less frequent over time. The groundwater model, however, can be run such that drawdowns at any location within its domain (such as where groundwater monitoring wells have been or will be placed; see Table GT-4, below) and at any desired time interval can be determined (USGS 1997). Given that the drawdowns at the alternative sites displayed in Table GT-4 (appropriate locations for monitoring wells) would be derived from the same model that resulted in the anticipated levels of take at the sites described in Table GT-3, the alternative sites can serve as directly-comparable proxies for the key locations noted in Table GT-3.

We also note that fluctuations in groundwater elevation can vary daily and seasonally from environmental factors. These daily fluctuations have the potential to exceed the smaller magnitude groundwater drawdowns displayed in table GT-3 (particularly those ≤0.1 foot). During the initial implementation phase (site construction, early pit construction) there is an opportunity to monitor daily and seasonal groundwater fluctuations for 2 to 4 years - under background conditions - before the anticipated effects from the pit dewatering are realized. The results from this initial monitoring will help determine the degree of background (baseline) variation in the observed groundwater elevations prior to the realization of Rosemont's effects. The data will also assist in discerning the groundwater drawdown attributable to the pit from unrelated environmental factors.

The USFS (2013b) has provided a list of well sites, already subject to monitoring for various environmental compliance purposes (see Monitoring Measure FS-BR-24 in Appendix B) that are likely to be suitable for monitoring the surrogate measure of incidental take (groundwater drawdown). The wells are located east of the crest of the Santa Rita Mountains, between the mine pit and Cienega Creek and Davidson Canyon Wash. Monitoring of some or all of these wells as proxies (for groundwater drawdown at the key locations in Table GT-3) will allow take of Gila Topminnow to be monitored immediately and during the active life of the mine, rather than waiting decades or centuries that it is modeled to take measurable drawdown to reach the affected streams, Cienega Creek and Empire Gulch. This suite of potential alternative monitoring sites has been reproduced in Table GT-4, below.

Table GT-4: Potential groundwater monitoring wells for compliance with the surrogate measure of incidental take (groundwater drawdown) described in Table GC-3, above. Groundwater drawdowns at a suite of these sites – once modeled and analyzed for their degree of natural variation – will serve as proxies for the drawdowns in Table GC-3.

Well Name	Direction from Mine Pit	Approximate Distance from Mine Pit (miles)
Potential Gardner Canyon monitoring wells to serve as a proxy for the Gardner/Cienega Confluence		
HC-6	S	0.5
17bdb	SE	3
RP-5	SSE	1.2
18ddb	SSE	3.2
16cbb	SE	3.4
Rosemont Ranch	SE	3.8
Potential Empire Gulch monitoring wells to serve as a proxy for Empire Gulch Springs		
DH-1541	ESE	2.6
Oaktree Windmill	ESE	4.1
Potential Davidson Canyon Wash monitoring wells to serve as a proxy for the Davidson/Cienega Confluence		
C-1	NE	0.5
HC-5B	NNE	0.6
P-899	NE	1
HC-4B	NE	1.6
RP-2C	ENE	2.5
RP-6	NE	3.8
RP-7	NE	4.5
Potential Cienega Creek monitoring wells to serve as proxies for Upper and Lower Cienega Creek		
RP-3B	E	1.5
RP-9	E	3.4
RP-8	ENE	4.5

In summary, and stated differently, the maximum allowable incidental take of Gila topminnow is represented by the surrogate measure of groundwater drawdowns at the sites and time intervals stated in Table GT-3, above. The to-be-modeled groundwater drawdowns at a suite of potential sites appearing in Table GT-4, above, will serve as proxies for the incidental take at the sites in Table GT-3. The manner by which Rosemont and the USFS shall monitor compliance with the amount of incidental take is described further in the Terms and Conditions, below.

Effect of the Take – Gila Topminnow

In this BO, the FWS determined that this level of anticipated take is not likely to result in jeopardy to the Gila topminnow.

Reasonable and Prudent Measures – Gila Topminnow

The FWS believes the following reasonable and prudent measures are necessary and appropriate to minimize impacts of incidental take of Gila topminnow:

1. Rosemont shall monitor groundwater levels (as a surrogate for take of Gila topminnow) at least annually;

2. Rosemont shall apply the funds identified for the Cienega Creek Watershed Fund and Sonoita Creek Ranch conservation measures solely to the identified conservation projects.

Terms and Conditions – Gila Topminnow

In order to be exempt from the prohibitions of section 9 of the Act, Rosemont and the USFS must comply with the following terms and conditions, which implement the reasonable and prudent measures described above and outline required reporting/monitoring requirements. These terms and conditions are non-discretionary.

1.1 Rosemont and the USFS shall select a representative group of the observation wells found in Table GT-4, above (USFS 2013b) at which groundwater levels, a surrogate for take of Gila topminnow, shall be monitored. Once the wells have been selected, Rosemont shall re-run the Tetra Tech (2010) groundwater model to obtain groundwater drawdowns (including sensitivity analyses) at all of the well sites. The time intervals shall be each year through closure of the mine, and thereafter, every 5 years. Monitoring will continue postclosure for a duration determined to be necessary by FWS and USFS based on data gathered during implementation and input from the team described in Term and Condition 1.5, below.

1.2 At the time construction of the mine commences (and prior to pit excavation), Rosemont shall initiate monitoring of the selected groundwater wells and report the results annually to the USFS and FWS through closure of the mine. Monitoring will continue postclosure for a duration determined to be necessary by FWS and USFS based on data gathered during implementation and input from the team described in Term and Condition 1.5, below.

1.3 During the initial implementation phase (site construction and early pit construction), Rosemont shall monitor the wells daily (or via continuous data collection devices) to determine the magnitude of daily and seasonal groundwater fluctuations prior to the onset of the anticipated effects of pit dewatering. The results from initial monitoring will help determine if and to what degree observed groundwater elevations vary due to natural fluctuations (baseline conditions). The magnitude of the observed fluctuations shall accompany the model results from Term and Condition 1.1 which will then be reported to the USFS and FWS.

1.4 Rosemont and the USFS shall compare the results of the monitoring described in Term and Condition 1.2 to the groundwater model results described in Term and Condition 1.1, including the variation noted from implementation of Term and Condition 1.3, and report the finding to FWS annually.

1.5 If it is determined at any time via monitoring that the observed groundwater drawdowns exceed the upper bounds of the sensitivity analyses for the modeled groundwater drawdowns, including consideration of applicable daily and seasonal fluctuations, then it is possible that the take of Gila topminnow described in Table GT-3 has been exceeded. In this event, the USFS shall convene a team consisting of Forest Service staff, FWS, Rosemont Copper, USGS, the University of Arizona, and the Bureau of Land Management to seek consensus on whether the exceedance can be attributable to Rosemont's activities and thus be considered an exceedance of the take authorized by this Incidental Take Statement. If a team cannot be convened or consensus is not reached, the USFS or FWS shall make the determination of whether reinitiation of consultation is appropriate.

2. The funds identified for the Cienega Creek Watershed Fund and Sonoita Creek Ranch conservation measures may only be used for projects as described in the Conservation Measures subsection of the Description of the Proposed Action Section, above. Indirect (overhead) costs must be funded separately.

Conservation Recommendations – Gila Topminnow

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, to help implement recovery plans, or to develop information. The FWS recommends the following conservation activities:

1. We recommend that the USFS and Rosemont coordinate with the Cienega Watershed Partnership, AGFD, the F.R.O.G. Project, and our office in efforts to work with private landowners to remove populations of nonnative aquatic species from lands in the area;

2. We recommend that the USFS continue to assist us and the AGFD in conserving and recovering the Gila topminnow;

3. We recommend that the USFS assist us with the completion and implementation of the Gila topminnow revised recovery plan;

4. We recommend that Rosemont consider releasing Gila topminnow into water features on

the mine site, when the site is suitable, and the release of topminnow would not conflict with other conservation actions;

5. We recommend that Rosemont and the eventual owner or manager of Sonoita Creek Ranch consider changing how water is diverted at Monkey Spring to reduce fish entrainment. An infiltration gallery would be ideal to reduce entrainment;

6. We recommend that Rosemont consider acquiring the remaining water rights for Monkey Spring and the fee title property with Monkey Spring;

7. We recommend that Rosemont consider acquiring the water rights for Cottonwood Spring;

8. We recommend that the USFS acquire instream flow water rights to ensure perennial flow in streams with Gila topminnow;

9. We recommend that the USFS continue to work cooperatively with the FWS and AGFD to remove nonnative species and reestablish Gila topminnow whenever possible throughout its historical range in Arizona; and

10. We recommend that the USFS continue fish surveys on NFS lands to determine the extent that Gila topminnow occupy those streams.

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.

Status of the Species - Huachuca Water Umbel

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 inch in diameter and often 1 to 2 inches tall, but can reach up to 8 inches 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 inch 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; FWS 1997). 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; FWS 1999). No recovery plan has been developed, but a draft recovery plan is anticipated to be complete in 2013.

Distribution/Abundance

Umbel has been documented from sites in Santa Cruz, Cochise, and Pima counties, Arizona, and in adjacent Sonora, Mexico, west of the continental divide (Haas and Frye 1997, Saucedo-Monarque 1990, Warren *et al.* 1989, Warren *et al.* 1991, Warren and Reichenbacher 1991, Anderson 2006). The plant has been extirpated from six sites. 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 3,500 and 7,250 feet in elevation.

Habitat

The umbel grows in cienegas (marshy wetlands), and along streams, rivers, and springs in southeastern Arizona and northeastern Sonora, Mexico, typically in mid-elevation wetland communities often surrounded by relatively arid environments. 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 inches. 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 (Arizona Game and Fish Department 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 backwaters, side channels, and nearby springs. The upper Santa Cruz River and associated springs in the San Rafael Valley, where a population of umbel occurs, is an example of a site that meets these conditions. The types of microsites required by umbel were generally lost 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 recently recolonized small reaches of 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 present 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, refugial 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 (Arizona Game and Fish Department 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 1-2 weeks after falling from the parent plant (Johnson *et al.* 1992).

After a flood, umbel can rapidly expand its population and occupy disturbed habitat until interspecific competition exceeds its tolerance. This response was recorded at Sonoita Creek in August 1988, when a scouring flood removed about 95% of the umbel population (Gori *et al.* 1990). One year later, the umbel had recolonized the stream and was again codominant with watercress (*Rorippa nasturtium-aquaticum*, 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 populations appear to depend on the presence of “refugia” 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.

Density of umbel plants and size of populations fluctuate in response to both flood cycles and site characteristics. Some sites, such as Black Draw, have a few sparsely distributed clones, possibly due to the dense shade of the even-aged overstory of trees, dense non-native herbaceous layer beneath the canopy, and deeply entrenched channel. The Sonoita Creek population occupies 14.5 percent of a 5,385 square foot patch of habitat (Gori *et al.* 1990). Some populations are as small as 11 to 22 square feet. The Scotia Canyon population, by contrast, has dense mats of leaves. Scotia Canyon contains one of the larger umbel populations, occupying about 57% of the 4,756 foot perennial reach (Gori *et al.* 1990, Falk and Warren 1994).

While the extent of occupied habitat can be estimated, the number of individuals in each population 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.

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 near Batepito, Sonora, approximately 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 presumably lost at that time.

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

Limited numbers of populations and the small size of populations 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 a severe tropical storm or drought, could eliminate populations or cause extinction. Populations are in most cases isolated, as well, which makes the chance of natural recolonization after extirpation less likely. Small populations are also subject to demographic and genetic stochasticity, which increases the probability of population extirpation (Shafer 1990, Wilcox and Murphy 1985).

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 out to the beginning of upland vegetation. 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 Approximately 1.25 mile of Sonoita Creek southwest of Sonoita;
Unit 2 Approximately 2.7 miles of the Santa Cruz River on both sides of Forest Road 61, plus approximately 1.9 miles of an unnamed tributary to the east of the river;
Unit 3 Approximately 3.4 miles of Scotia Canyon upstream from near Forest Road 48;
Unit 4 approximately 0.7 mile of Sunnyside Canyon near Forest Road 117 in the Huachuca Mountains;
Unit 5 Approximately 3.8 miles of Garden Canyon near its confluence with Sawmill Canyon;
Unit 6 Approximately 1.0 mile of Rattlesnake Canyon and 0.6 mile of an unnamed canyon, both of which are tributaries to Lone Mountain Canyon; approximately 1.0 mile of Lone

Mountain Canyon; and approximately 1.0 mile of Bear Canyon; an approximate 0.6-mile reach of an unnamed tributary to Bear Canyon; and

Unit 7 Approximately 33.7 miles of the San Pedro River from the perennial flow reach north of Fairbank (Arizona Department of Water Resources 1991) to 0.13 mile 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:

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 population 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.

Environmental Baseline - Huachuca Water Umbel

The action area for the Huachuca water umbel includes the occupied portions of the Cienega Creek watershed, as described below. Prior to 2001, the sole Huachuca water umbel metapopulation known from the action area was in Empire Gulch in Las Cienegas National Conservation Area (NCA) [Engineering and Environmental Consultants (EEC) 2001, Pima County 2001]. Since that time, the species has been found in other locations within the action area: in a small patch along Cienega Creek in the county's reserve upstream from of the confluence of Cienega Creek and Davidson Canyon (EEC 2001, Pima County 2001); in Las Cienegas NCA, from the confluence of Cienega Creek with Gardner Canyon north to the northern boundary of the NCA; in middle reaches of Cienega Creek (AGFD 2011); and, via recent transplants, in the Cieneguita Wetland in lower Empire Gulch (BLM 2013). The Huachuca water umbel metapopulations within Las Cienegas NCA include (BLM 2011): (1) 19 patches recorded between the headwaters of Cienega Creek near the southern boundary of the NCA, north to the confluence of Cienega Creek with Gardner Canyon; (2) 61 patches recorded between the confluence of Cienega Creek with Mattie Canyon, north to Powerline Road; (3) 16 patches recorded within Cienega Creek between the Narrows Powerline Road, north to the Narrows; (4) one patch recorded within Lower Empire Gulch between Rattlesnake Tank and the confluence with Cienega Creek; and (5) three patches recorded within Mattie Canyon between the spring source and the confluence with Cienega Creek. Much of the extensive wetlands that border Empire Gulch and upper Cienega Creek (see the Aquatic Vegetation subsection in the Description of the Proposed Action section and Table A-1) are likely to be suitable sites for Huachuca water umbel, even if the species has not been specifically detected throughout the reaches. There is no critical habitat for Huachuca water umbel in the action area.

The Pima Association of Governments (PAG) monitors ecological conditions on Cienega Creek within the Pima County Cienega Creek Preserve and reports the data to the Pima County Regional Flood Control District (RFCD) (Mier 2012 pers. comm.). Recent drought conditions and anthropogenic alterations have affected the stream's hydrology. As of the summer of 2012, the length of wetted stream within the Preserve was 1.24 miles, the shortest in a period of record going back to 1975. This contrasts to the wet years of the early 1980s when up 9.5 miles of the creek within the Preserve exhibited perennial flow. PAG has found that stream discharge and groundwater levels are correlated to streamflow length, matching the rise and fall of the seasons and the downward trend with drought. Since September 2009, when the region lacked a monsoon season, the wells have remained at 5-7 feet below their pre-drought levels, with levels in June 2012 slightly below last June 2011 and 7 feet below pre-drought. Stream volume is at 14% of pre-drought flow (similar to flow length's comparison), with 0.12 cfs flowing.

Cienega Creek is thus susceptible to inter-annual changes in weather as well as longer-term changes in the regional climate. Anthropogenic impacts act to further reduce the stream's hydrologic resilience. For example, PAG stated that the Arizona Department of Transportation pumped water from the alluvium while constructing a new overpass at Marsh Station Road in 2010 and 2011, and this withdrawal appears to have been a factor contributing to approximately 10 feet of groundwater decline in the two wells nearest the pumping site. PAG also noted that there has been some recovery since that time.

We have completed one other formal consultation (and a reinitiation thereof) within the action area for a project affecting Huachuca water umbel: our February 21, 2012, *Reinitiated Biological Opinion on Aquatic Species Conservation at the San Pedro Riparian and Las Cienegas National Conservation Areas, Arizona* (File number 22410-2012-F-0162-R001), and its predecessor consultation, our December 31, 2008, *Biological Opinion on Aquatic Species Conservation at the San Pedro Riparian and Las Cienegas National Conservation Areas, Arizona* (File number 22410-2008-F-0103). These proposed actions included measures to restore Huachuca water umbel to sites within the San Pedro Riparian National Conservation Area (RNCA) and within Las Cienegas National Conservation Area (NCA); the latter is within the action area for the proposed action. To date, the species has only been reestablished within the San Pedro RNCA.

Effects of the Action - Huachuca Water Umbel

Huachuca water umbel is an aquatic to semi-aquatic plant that requires adjacency to open water and very moist substrates. As such, the effects to the species are in many respects similar to those of threatened and endangered fishes as well as to the woody riparian vegetation that serves as a nesting and foraging substrate for obligate riparian birds. The sections of this BO pertaining to the effects of the proposed action to Gila chub and southwestern willow flycatcher describe the process whereby stream flows would be diminished to the extent that aquatic habitat is reduced and riparian vegetation reduced in vigor and areal extent, respectively. These analyses are hereby incorporated into this section via reference.

Leenhouts *et al.* (2005) examined interactions between hydrologic processes and riparian vegetation within the San Pedro RNCA on the San Pedro River, a neighboring watershed situated east of the Cienega Creek system. The specific objectives of the study were to: (1) determine the water needs of riparian vegetation through the riparian 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.

Although Huachuca water umbel occurs in the San Pedro RNCA, this species was not specifically evaluated by Leenhouts *et al.* (2005). Huachuca water umbel would fall within the authors' Hydric Herbaceous Perennial functional group which includes smooth scouring rush (*Equisetum laevigatum*), hardstem bulrush (*Schoenoplectus acutus*), Torrey rush (*Juncus torreyi*), cattail (*Typha latifolia* and *T. domingensis*), watercress (*Rorippa nasturtium-aquaticum*), water speedwell (*Veronica anagallis-aquatica*), sand spikerush (*Eleocharis montevidensis*), and Baltic rush (*J. arcticus* var. *balticus*). Leenhouts *et al.* (2005) found that cover of hydric perennial herbs was most abundant in an approximately 1-meter wide strip along the channel margins; these species depend on shallow, inflowing ground water to sustain stream base flows and moisten surface soils. This group had high abundance only at sites with perennial or near-perennial streamflow, declining sharply in abundance as flows became intermittent as well as across floodplains of increasing elevation above the stream. While the Leenhouts *et al.* (2005) study was conducted on the San Pedro River, the physiologic needs of hydric perennial plants would indicate similar ecological responses within any stream in which they occur, including the nearby Cienega Creek system.

Leenhouts *et al.* (2005) also examined the spatial arrangement of plants in relation to streamflow permanence (as a surrogate for depth to groundwater) in order to assess the changes that could occur under conditions of declining groundwater levels. As streamflow became more intermittent and depth to the alluvial ground-water table increased, herbaceous species, such as bulrush and rushes, declined in abundance. In addition, streamside-zone species composition shifted towards more mesic herbaceous species, including the nonnative rhizomatous perennial Bermuda grass (*Cynodon dactylon*). This sod-forming species is relatively drought- and flood-tolerant and became the most common mesic riparian perennial as stream flow became intermittent (Stromberg *et al.* 2005).

Huachuca water umbel, with its shallow root system, is a poor competitor; population numbers tend to be lower in areas with a high density of native or nonnative plant species competition (Titus *et al.* 2002). As Huachuca water umbel is sensitive to interspecific competition, requiring both ample light penetration and little competition for nutrients (Zuhlke *et al.* 2002, Vernadero 2011, USFWS 2001), competition from Bermuda grass will hasten the decline of the listed species in sites where alluvial groundwater levels have declined but still occasionally remain within the range that would otherwise support a hydric herbaceous perennial plant community. Other researchers studying Huachuca water umber in the San Pedro RNCA have noted that Bermuda grass presence reduces the number of exploitable sites for Huachuca water umbel making it a threat to umbel dispersal (Vernadero 2011).

Effects to the Aquatic and Riparian Ecosystems - Huachuca Water Umbel

The section in this BO entitled Effects to Aquatic Ecosystems describes the hydrologic basis for effects to the streams in which Huachuca water umbel occurs. The subsequent analysis of effects to riparian vegetation, of which the species is a component, appears in the Effects to Riparian Ecosystems section. These prior analyses are incorporated herein via reference.

Based on these prior analyses, we are particularly concerned with the modeled drawdowns in Empire Gulch, in the vicinity of Empire Gulch's confluence with Cienega Creek, and at the Gardner Canyon/Cienega Creek confluence within Las Cienegas NCA, as well as within the lowermost reaches of Cienega Creek, such as in the Pima County Cienega Creek Preserve. The relevant aspects of these analyses are reiterated in the narrative that follows.

Gardner Canyon

Gardner Canyon is anticipated to experience regional aquifer drawdowns of < 0.1 foot from the cessation of mining until 50 years later (or up to 0.15 foot at 50 years) (see Gardner/Cienega Confluence data in Table A-5). At 150 years after mining, the effect to Gardner Canyon increases to 0.2 foot (or up to 0.35 foot) and reaches 0.5 foot at 1,000 years.

Empire Gulch

Tetra Tech (2010) modeled the effects at this site to range from 0.1 foot (or up to 0.2 foot) of groundwater drawdown upon cessation of mining to 0.2 foot (or up to 0.5 foot) at 20 years, 0.5 (up to 1.8 foot) foot at 50 years, 2.5 feet (up to 5.0 foot) at 150 years, and 6 feet at 1,000 years (see Table A-5).

Upper Cienega Creek

The USGS Cienega Creek stream gage (0948550) is situated near the narrows in the upstream portion of Reach 3 (see Figure A-1). Tetra Tech (2010) modeled drawdowns of <0.1 foot from the end of mining and at 20, and 50 years later (or up to 0.15 foot at 50 years). Drawdowns reach 0.25 feet (or up to 0.35 foot) and 0.5 feet at 150 and 1,000 years, respectively. Table A-2, also found in the Effects to Aquatic Ecosystems section, is based on SWCA (2012), and describes appreciable effects to upper Cienega Creek, including an 0.16-mile decrease in stream length, a decrease in baseflow of 0.02 cfs, and a decrease in riparian ET of 51 afa.

Lower Cienega Creek

Tetra Tech (2010) modeled groundwater drawdowns of <0.01 foot at the lowermost USGS stream gage in Cienega Creek at all intervals from the cessation of mining to 1,000 years; this is to be expected at such a large distance from the mine pit. The loss of runoff from the placement of tailings in Barrel Canyon has a relatively greater effect.

Given SWCA's finding that Davidson Canyon Wash will experience a 4.3 percent reduction in runoff (surface flows) from the placement of tailings in its watershed and the Pima Association of Governments' (2003b) estimate that the wash contributes 8 to 24 percent of the baseflow in Lower Cienega Creek, we anticipate that there will be a 0.3 to 1.0 percent reduction in the latter stream.

As discussed above, Table 7 in SWCA (2012) (also see Table A-5 in this document) summarizes various hydrologic and environmental effects resulting from groundwater drawdowns. Table A-3, in the Effects to Aquatic Ecosystems section, includes the SWCA (2012) findings wherein lower Cienega Creek will experience 0.31 foot of drawdown, no loss of stream length, a 0.02 cfs loss of discharge, and 8 afa in reduced riparian ET at 150 years after mining. By 1,000 years, SWCA (2012) predicted 0.98 foot of drawdown, a 0.29-mile reduction in stream length, a 0.04 cfs loss of discharge, and 221 afa in reduced riparian ET. The latter effects are appreciable.

Summary of Adverse Effects - Huachuca Water Umbel

We reiterate that the 5-foot threshold for reliably modeling changes in ground water elevation posited by SRK (2012) does not mean we cannot consider changes of less than that magnitude. Moreover, the results of the groundwater models have much greater utility in determining trends in groundwater elevation than in determining actual values and/or magnitudes of change. In this regard, the aquatic habitat of the Huachuca water umbel (occupied areas in Empire Gulch and Cienega Creek) is likely to experience a contraction in wetted length and a reduced wetted perimeter (which may also be expressed as a narrowing of top-width).

As discussed in the effects analysis for the southwestern willow flycatcher (see below), reduced surface flows characterize the most visible aspect of riparian effects, but don't describe their full extent. Moreover, the flycatcher analysis was concerned primarily with the sustenance and recruitment of woody riparian vegetation; the effects to a near-aquatic plant such as Huachuca water umbel would be more immediate and severe. Surface flows in alluvial reaches of Cienega Creek exist in locations where the thalweg (lowest elevation portion of the channel) of the stream intersects the alluvial water table. A longitudinal contraction in surface flows would be a component of a more-lengthy (and also longitudinal) reduction in shallow, subsurface flows, with alluvial groundwater in areas adjacent to dewatered reaches also dropping below critical depths for Huachuca water umbel. In areas where the depth to groundwater has exceeded the species' ability to access water, individual patches would senesce and eventually die unless they could: (1) reproduce asexually and access more moist microsites via the spread of rhizomes; and/or (2) colonize new, well-watered reaches via the spread of seeds generated in occupied sites upstream. A longitudinal contraction in surface flows would also be accompanied by a narrowing of the stream's top width, and such a narrowing of a stream can be expected to result in Huachuca water umbel rooting closer to the centerline of the channel, as the water-dependent plant grows towards the remaining, available water. Additionally, plants tolerant of drier conditions, potentially including nonnative species, could colonize the less-well watered lateral sites and indirectly or directly compete with Huachuca water umbel. This is problematic in that the proposed action will leave flood flows in reaches above Davidson Canyon Wash largely unaffected. Vegetation that establishes itself in a narrowed low-flow channel will be subject to scouring from peak flows. Flood scour could be further exacerbated if the larger herbaceous and woody vegetative communities suffer mortality sufficient to reduce the stability of the stream's banks, where Huachuca water umbel occurs. While Huachuca water umbel requires low to moderate severity floods to create niches for colonization, excessive flooding is intolerable to populations and may result in extinctions locally (Warren *et al.* 1991; Warren *et al.* 1989).

Effects of the Proposed Conservation Measures - Huachuca Water Umbel

The proposed action includes: (1) eight conservation measures specifically pertaining to aquatic species; (2) a Cienega Creek Watershed restoration and water right protection program; and (3) the restoration of wetlands within the Sonoita Creek Ranch (see the Aquatic Species: Gila Chub, Gila Topminnow, and Huachuca Water Umbel; Cienega Creek Watershed; and Sonoita Creek Ranch subsections in the Description of the Proposed Conservation Measures section, above).

Six of the eight aquatic species conservation measures' stated purpose is to implement various monitoring programs to: (1) verify groundwater model results (via monitoring wells in key locations); (2) to ensure the chemical integrity of the regional groundwater (via the Aquifer Protection Permit) and streams (via the Arizona Department of Environmental Quality's National Pollution Discharge Elimination System permit: NPDES); and (3) assess alterations in channel geomorphology that may result from altered peak flow hydrology and sediment dynamics. The benefit of well monitoring is to obtain empirical data related to changes in groundwater storage, which may then be used to verify or update the groundwater models. The primary benefit of the monitoring of water quality is to provide an early warning and recommendation for corrective actions prior to the onset of gross changes in chemistry or geomorphology that would be most likely to kill or displace Huachuca water umbel. Successful implementation of these measures will help ensure that water quality remains within applicable standards, but we note that the tolerance of Huachuca water umbel to metals, changes in acidity/basicity, and other factors is not known.

The Cienega Creek Watershed conservation measure contains two elements: (1) severance and transfer of water rights; and (2) establishment of the Cienega Creek Watershed Conservation Fund. The program commits to: (1) transfer 150 acre-feet of water rights to a suitable entity for *in situ* use to preserve and enhance the aquatic and riparian ecosystem use in the upper Cienega Creek watershed area and an additional 100 acre-feet to Pima County for similar uses within the Cienega Creek Preserve; (2) transfer 825 acre-feet per annum to aquifer recharge and riparian restorations downstream from Pantano Dam (at which point lower Cienega Creek becomes Pantano Wash); and (3) make annual payments of $200,000 for 10 years to a Conservation fund managed and controlled by a designated conservation partner.

The Cienega Creek Watershed program may eventually have appreciable value in conserving Huachuca water umbel if the effort results in the retention of water in occupied areas. The mitigative value of the water rights- related component of the conservation measure must be considered speculative at this time, as the action depends on the successful navigation of complex administrative and legal proceedings involving the Arizona Department of Water Resources and other State agencies, BLM, and, potentially, other permitted and certificated water rights holders. Recognizing this uncertainty, the Rosemont may require until January 1, 2016, to fully implement this proposed conservation measure.

The proposed establishment and funding of the Cienega Creek Watershed Conservation Fund is anticipated to be beneficial to Huachuca water umbel, but its exact mitigative value is prospective and cannot be ascertained in advance. We presume that actions beneficial to the aquatic environment in which Huachuca water umbel occur will be implemented, and while we cannot know if such actions will be implemented, we note that reestablishment of Huachuca water umbel is feasible (Environment and Natural Resource Division 2012). Similarly, the anticipated 3,000 linear feet of surface flow that will be made available below Pantano Dam may permit the establishment of a Huachuca water umbel metapopulation, though it is not clear if Cienega Creek Watershed Conservation Fund monies could be applied at this downstream site.

Rosemont has also acquired the right to purchase approximately 1,200 acres of land along Sonoita Creek with approximately 590 acre-feet of certificated surface water rights from Monkey Spring along Sonoita Creek. These lands and appurtenant water rights will be protected in perpetuity and made available to a suitable aganecy, land trust, or conservation organization. As is the case with Cienega Creek, above, the site, if deemed biologically appropriate, could provide a site for establishment of Huachuca water umbel. Given the current lack of specific plans to restore and maintain Huachuca water umbel at this site, we must also consider the mitigative value of this conservation measure to be somewhat speculative.

Effects to Recovery

There is no final recovery plan for the Huachuca water umbel, so it is difficult to determine at what point recovery of the species may be achieved. It is similarly difficult to determine at what point recovery would be precluded by the implementation of a proposed action. The Rosemont Copper Mine's effects will likely reduce the wetted perimeter and length of streams occupied by Huachuca water umbel, but the streams will not be completely dewatered (see . Effects of the Action - Huachuca Water Umbel and subsequent analyses, above). We must therefore compare these unquantifiable reductions in abundance to the overall status of the species as well as to the mitigative value of the proposed conservation measures.

The Cienega Creek system is one of several medium-scale watersheds in which Huachuca water umbel occurs (the others being situated within the larger San Pedro River watershed, the upper Santa Cruz River watershed, and in the Rio Yaqui watershed. These systems are all likely to experience diminished environmental conditions from regional climate change and increasing withdrawals of groundwater for human needs. At the most coarse scale, we feel that it is reasonable to assume that recovery of Huachuca water umbel would be precluded if the species were to be extirpated from one or more of these watersheds. Such extirpation would likely require long-term losses of surface water in habitats occupied by the species. Conversely, we feel that recovery of the species could be achieved if the surface flows in these watersheds were secured, if not increased in volume and length, in perpetuity. We caution that this is not a *de facto* recovery criterion; downlisting and delisting criteria, as applicable, will be fully developed during recovery planning. Neverthless, we feel that the diminished flows in the Cienega Creek system that are likely to result from the proposed action are not of sufficient scale (stream length and potential number of individuals) to preclude recovery. We also feel that the Cienega Creek Watershed Fund and the acquisition and restoration of the Sonoita Creek Ranch, should they achieve their stated goals and incorporate the species into their plans, will make incremental contributions to Huachuca water umbel recovery.

Cumulative Effects - Huachuca Water Umbel

The Cumulative Effects sections for the Gila chub and southwestern willow flycatcher are incorporated herein via reference. In brief, of the cumulative actions relevant to the proposed action, we are primarily concerned with the withdrawal of groundwater from wells in vicinity of Cienega Creek, Sonoita, and Elgin.

Conclusion - Huachuca Water Umbel

The magnitude of the proposed action's adverse effects is difficult to ascertain in light of natural variability and uncertainties regarding baseline conditions that may change independently from the effects of the proposed action change over time, but all three groundwater models indicate that the proposed action will result in a small – but measurable - downward trend in groundwater availability and surface discharges. We anticipate that an indeterminate number of individual Huachuca water umbel patches will fail to persist in Cienega Creek and Empire Gulch over time, and that Huachuca water umbel metapopulations will be reduced in extent at the scale of the stream reach. It is, however, unlikely that the proposed action will result in large reductions of perennial stream reaches in the action area and thus, Huachuca water umbel is unlikely to be extirpated from the Cienega Creek watershed. Lastly, the mitigative value of the proposed conservation measures is currently speculative, but could result in the restoration of Huachuca water umbel to new sites and long-term protection of stream flows.

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, it is our biological opinion that the proposed Rosemont Mine project is not likely to jeopardize the continued existence of the species. Our rationale for this conclusion is as follows:

1. Modeled declines groundwater elevation will result in decrease in stream length, wetted perimeter and baseflows in the Cienega Creek Watershed at time scales varying from 20 to 1,000 years. If groundwater model results and the associated deceases in stream length and baseflow are valid, these losses will be potentially severe in Empire Gulch, minimal in the upper and low reaches of the mainstem of Cienega Creek, and will reduce the vigor and extent of Huachuca water umbel in the affected areas.

2. These effects to Huachuca water umbel are not likely to jeopardize the species because it occurs elsewhere in the Santa Cruz, San Pedro, and Yaqui river watersheds in sites unaffected by the proposed action.
3. The relatively wide distribution of the Huachuca water umbel within distinct watersheds and the low likelihood that the proposed action will extirpate the species entirely from the Cienega Creek watershed mean that the proposed action is unlikely to preclude recovery.
4. Rosemont will monitor water quality and quantity as well as channel geometry within Davidson Canyon Wash (a tributary to Cienega Creek), any or all of which may help validate model results and provide advanced notice for unforeseen effects to the aquatic environment. Unforeseen effects to aquatic and riparian ecosystems may necessitate reinitiation of formal consultation.
5. Rosemont will sever and transfer downstream senior water rights to upstream reaches of Cienega Creek by no later than January 1, 2016. If successfully executed, these *in situ* water rights may be employed to protect against future diversions of surface water by junior appropriators. Rosemont will also fund a conservation program to implement to-be-determined projects within the Cienega Creek watershed. If the water rights cannot be successfully severed and transferred, reinitiation of formal consultation may be warranted.
6. Rosemont has also acquired the rights to purchase the Sonoita Creek Ranch and, upon transfer to a suitable entity, the site will undergo aquatic, wetland, and riparian restorations. These projects will be vetted by FWS and other appropriate entities, and may include the reestablishment of Huachuca water umbel**.**
7. Critical habitat has been designated for Huachuca water umbel, but none is present in the action area. Critical habitat will not be affected nor will that critical habitat's ability to function in the recovery of the species be impaired.

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, **di**g 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.

1. We recommend that the FS 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 agency expertise.
2. We recommend that the FS continue with its ongoing efforts to arrest erosion and restore ecosystems on streams on the Coronado National Forest within which Huachuca water umbel occurs.
3. We recommend that the FS participate in genetic studies, such as those underway by Fort Huachuca, in order 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.

Effects to Riparian Ecosystems

This section includes an analysis of the effects of the proposed action on riparian ecosystems. The southwestern willow flycatcher is an obligate riparian bird and the Huachuca water umbel is a semi-aquatic plant that occurs in streams and riparian areas; the analyses contained herein are incorporated via reference into the respective species' analyses.

Effects to the riparian ecosystems must be based on a classification system. Riparian vegetation may be classified in various ways. Brown (1982), National Wetlands Inventory (2013) methods are widely applied, but available maps are outdated and are of insufficiently fine resolution to be applicable to the action area. Three sources of riparian mapping are available for the area of analysis: Pima County, the Forest Service, and WestLand Resources Inc. (the latter conducted on behalf of Rosemont Copper). Each source represents different techniques, definitions, and geographic coverage. The Draft EIS used a combination of these mapping sources, primarily relying on mapping by WestLand Resources Inc. for the mine site and on Pima County mapping to define hydroriparian and mesoriparian areas elsewhere along major stream corridors.

The Coronado NF considered both public comments and input from cooperating agencies regarding riparian classification and has determined to employ the Pima County riparian mapping source in the eventual Final EIS. The Forest Service's own mapping coverage was considered too limited in geographic extent and largely ignored xeroriparian areas. The Pima County mapping was largely based on remote photographic analysis and generally encompassed a wider swath along washes than the mapping efforts conducted by WestLand Resources Inc., which were based in part on field surveys. However, the underlying purpose of the Pima County riparian mapping was to identify corridors of overall wildlife habitat, whereas the site-specific mapping by WestLand Resources Inc. focused on identifying the extent of specific vegetation species. Determining the presence of wider habitat corridors and their impact to biological resources was one of the primary purposes of analyzing impacts to riparian vegetation for NEPA purposes, and this largely informed the Coronado NF's decision to select the Pima County mapping. Use of the Pima County mapping offers three benefits: an appropriate focus on habitat corridors, consistency across the area of analysis, and extensive geographic coverage. It is for these reasons that we have adopted the same riparian classification method in this BO.

It is recognized that discrepancies have arisen between the Pima County and WestLand Resources, Inc. mapping efforts. WestLand Resources Inc. (2010) noted that Pima County mapping overestimated riparian resources 86% of the time in 43 riparian area widths measured in Barrel and Scholefield Canyons. These differences in acreage were determined by the Coronado NF to be acceptable for NEPA analysis, given the different criteria used by Pima County. However, in several reaches of Barrel and Davidson Canyons, discrepancies were also evident concerning the overall species types indicated by Pima County mapping and those observed in the field by WestLand Resources Inc. In these cases, acreages were not been changed, but the overall type of habitat was reinterpreted from that used by Pima County. For the purposes of the analyses contained in this BO, the areal extent of impacts to riparian vegetation represents the maximum anticipated effect of the proposed action.

There are a total of approximately 22,106 acres of riparian vegetation in the analysis area (Pima County 2012; USFS 2012d, as cited in the Description of the Proposed Action section). These vegetation communities are present in drainages within the analysis area and along downstream portions of Box, McCleary, Sycamore, Scholefield, Wasp, Barrel, Davidson, and Gardner Canyons; Empire Gulch; and Cienega Creek. In addition to the riparian vegetation listed below as occurring in riparian areas in the analysis area, Emory oak, Mexican blue oak, and Arizona white oak are common in Box, McCleary, Sycamore, Scholefield, Wasp, and Barrel Canyons. While many springs support some individuals of species considered to indicate hydroriparian habitat, only two springs had large mappable areas of hydroriparian vegetation: Scholefield No. 1 spring supports about 0.3 acre of wetland, and Fig Tree spring supports about 0.5 acre of riparian habitat, with a very limited wetland area. These water sources provide habitat for aquatic species within the analysis area. Pima County's riparian mapping source is used for this project, and the following riparian habitat types are mapped within the analysis area (Pima County 2013). Detailed descriptions of the respective communities are found in the Vegetative Communities subsection of the Description of the Proposed Action section.

Hydroriparian

Hydroriparian habitats are generally associated with perennial watercourses and/or springs. The following drainages and associated riparian habitat contain stretches that are mapped as hydroriparian: Cienega Creek, Gardner Canyon, Empire Gulch, Davidson Canyon, and Barrel Canyon. Approximately 7,325 acres of hydroriparian habitat are located within the action area.

Aquatic vegetation that is unique to the springs and seeps is also present within the analysis area. Vegetation at these springs and seeps includes obligate wetland plants. Within the analysis area, moist soil or surface water (both lentic and lotic systems) and associated aquatic vegetation are known to occur at the several springs (e.g., Deering, Upper Empire Gulch, Fig Tree, Mudhole, Oak, Ojo Blanco, Rosemont, Scholefield No. 1, Sycamore, and Water Develop) (WestLand Resources Inc. 2011j). Areas of aquatic habitats are too small to map; therefore, they do not appear on Figure I-4, below.

Xeroriparian

Xeroriparian habitats are generally associated with an ephemeral water supply. These communities typically contain plant species also found in upland habitats; however, these plants are typically larger and/or occur at higher densities than adjacent uplands. Approximately 14,781 acres of xeroriparian habitat are located within the action area. Xeroriparian habitat is further divided into four subclasses to reflect the amount of vegetation present. Pima County Regional Flood Control District’s Regulated Riparian Habitat Mitigation Standards and Implementation Guidelines (Pima County Department of Transportation and Flood Control District 2001; Pima County Regional Flood Control District 2011) define the xeroriparian subcategories as follows:

• Xeroriparian A: The most dense xeroriparian subcategory with a total vegetative volume greater than 0.856 m^3/m^2. Xeroriparian A habitat is present in stretches of Cienega Creek, Empire Gulch, and Davidson Canyon where vegetation consists of mesquite and netleaf hackberry. Approximately 145 acres of xeroriparian A habitat is located within the analysis area.

• Xeroriparian B: Moderately dense xeroriparian subcategory with a total vegetative volume less than or equal to 0.856 m^3/m^2 and greater than 0.675 m^3/m^2. Xeroriparian B habitat is present in stretches of Cienega Creek, Gardner Canyon, Empire Gulch, Davidson Canyon, and Barrel Canyon where vegetation consists of mesquite, scattered cottonwood, netleaf hackberry, burrobrush, juniper, and acacia. Approximately 7,116 acres of xeroriparian B habitat is located within the analysis area.

• Xeroriparian C: Less dense xeroriparian subcategory with a total vegetative volume less than or equal to 0.675 m^3/m^2 and greater than 0.500 m^3/m^2. Xeroriparian C habitat is present in stretches of Cienega Creek, Gardner Canyon, Empire Gulch, and Davidson Canyon where vegetation consists of mesquite, desert broom, burrobush, desert willow, hackberry, and juniper. Approximately 7,345 acres of xeroriparian C habitat is located within the analysis area.

• Xeroriparian D: Less to sparse plant density xeroriparian subcategory that provides hydrologic connectivity to other riparian habitat areas with a total vegetative volume less than or equal to 0.500 m^3/m^2. Xeroriparian D habitat is present in stretches of Cienega Creek and Davidson Canyon where vegetation consists of acacia and desert broom. Approximately 174 acres of xeroriparian D habitat is located within the analysis area.

Aquatic Vegetation

Aquatic vegetation is unique to the springs and seeps within the action area and includes obligate wetland plants (i.e., almost always occurs under natural conditions in wetlands). Within the action area, moist soil or surface water (both lentic and lotic systems) and associated aquatic vegetation are known to occur at the following springs (WestLand 2011a): Basin, Deering, Empire Gulch, Fig Tree, Mudhole, Oak, Ojo Blanco, Rosemont, Scholefield, Sycamore, and

Water Develop.

Information provided by the BLM during the review of the draft version of the BO notes that these aquatic vegetation communities, along with those present along cienega-like reaches of Cienega Creek and its tributaries should be classified as Interior (Sonoran) Marshland (Brown 1982). These Cienega communities (Minckley and Brown 1982, Hendrickson and Minckley 1984) are prevalent in the Las Cienegas NCA; the area contains over 30 jurisdictional wetlands, both perennial and seasonal. Most of these wetlands occur on the Cienega Creek floodplain between Cinco Canyon and Oak Tree Canyon. Named wetland complexes include Cieneguita Wetland, Spring Water Wetland, Cinco Ponds Wetland. Another series of wetlands occurs upstream of the Mattie Canyon confluence on Cienega Creek (Cold Spring Wetland). These wetlands cover tens of acres. An inventory of wetlands has been completed by the Arizona Botanical Garden with a report anticipated to be transmitted in September 2013.

Areas of aquatic habitats were considered too small to map by USFS; therefore, they do not appear on Figure I-4, below. The BLM, in comments on the content of the Draft BO, stated that Cienaga Cienega Creek exhibits approximately 7 miles of surface flow. In addition, Empire Gulch has approximately 0.5 mile, Empire Spring approximately 1,000 feet, and Mattie Canyon approximately 1 mile. The BLM also stated that large blocks of wetland also occur which could easily be delineated on a map. We note that aquatic habitat in the context of this section refers to vegetative communities, not solely wetted areas. While we agree that mapping cold be improved, it is likely that the aquatic vegetative community mapping was superseded by mapping of the dominant overstory (i.e. xerioriparian or hydroriparian) that may co-occur with the understory of Interior Marshland in many sites.

Again, more-detailed descriptions of the riparian communities appears in the Vegetative Communities subsection of the Description of the Proposed Action section, above. Table R-1, below, summarizes the acreages of riparian vegetation within the affected streams, using the reach-by-reach classification found in Figure A-1 in the Effects to Aquatic Ecosystems section.

Table R-1. Riparian affected environment adapted from SWCA (2012)

Reach Name	Acres	Pima County Class	Dominant Riparian Plants
Cienega Creek 1	695.13	Hydroriparian	Cottonwood and Goodding's willow**
Cienega Creek 1	364.69	Xeroriparian B	Large mesquites and scrub mesquites with scattered cottonwoods**
Cienega Creek 2	2,086.96	Hydroriparian	Mature cottonwood and Goodding's willow**
Cienega Creek 2	323.98	Xeroriparian B	Acacia, desert willow, ironwood, paloverde, mesquite, soapberry*
Cienega Creek 2	65.58	Xeroriparian C	Acacia, desert willow, ironwood, paloverde, mesquite, soapberry*
Cienega Creek 3	382.27	Hydroriparian	Mature cottonwood and Goodding's willow with young velvet ash**
Cienega Creek 3	35.88	Xeroriparian B	Mesquite and netleaf hackberry**
Cienega Creek 3	126.96	Xeroriparian C	Mesquite with desert broom and burrobrush**
Cienega Creek 3	0.78	Xeroriparian D	Acacia, desert willow, ironwood paloverde, mesquite, soapberry*
Cienega Creek 4	11.15	Xeroriparian A	Mature mesquite and netleaf hackberry**
Cienega Creek 4	179.52	Xeroriparian B	Mesquites with burrobrush**
Cienega Creek 4	656.81	Xeroriparian C	Less dense mesquites with burrobrush**
Cienega Creek 4	38.58	Xeroriparian D	Acacia, desert willow, ironwood, paloverde, mesquite, soapberry*
Cienega Creek 4	2138.93	Hydroriparian	Mature cottonwoods and ash with some Goodding's and seep willow**
Cienega Creek 5	4.86	Xeroriparian A	Mesquite**
Cienega Creek 5	21.75	Xeroriparian B	Mesquites with burrobrush**
Cienega Creek 5	168.15	Xeroriparian C	Less dense mesquites with desert broom and burrobrush**
Cienega Creek 5	49.91	Xeroriparian D	Acacia, desert willow, ironwood, paloverde, mesquite, soapberry*
Cienega Creek 5	463.95	Hydroriparian	Cottonwood and willow gallery forest**
Gardner Canyon 1	422.26	Xeroriparian B	Acacia, desert willow, ironwood, paloverde, mesquite, soapberry*

Gardner Canyon 1	381.08	Xeroriparian C	Acacia, desert willow, ironwood, paloverde, mesquite, soapberry*
Gardner Canyon 1	523.96	Hydroriparian	Cottonwood, willow, seepwillow, sycamore, hackberry*
Gardner Canyon 2	129.29	Xeroriparian B	Acacia, desert willow, ironwood, paloverde, mesquite, soapberry*
Gardner Canyon 2	121.51	Hydroriparian	Cottonwood, willow, seepwillow, sycamore, hackberry*
Empire Gulch	86.00	Xeroriparian A	Acacia, desert willow, ironwood, paloverde, mesquite, soapberry*
Empire Gulch	631.39	Xeroriparian B	Acacia, desert willow, ironwood, paloverde, mesquite, soapberry*
Empire Gulch	127.90	Xeroriparian C	Acacia, desert willow, ironwood, paloverde, mesquite, soapberry*
Empire Gulch	407.46	Hydroriparian	Large cottonwood willow gallery**
Davidson Canyon 1	84.03	Xeroriparian B	Acacia, desert willow, ironwood, paloverde, mesquite, soapberry*
Davidson Canyon 1	99.20	Hydroriparian***	Large ash trees**
Davidson Canyon 2	355.61	Xeroriparian B	Mesquites, hackberry**
Davidson Canyon 2	31.23	Xeroriparian C	Small mesquites, desert willow**
Davidson Canyon 2	33.95	Xeroriparian D	acacia, desert broom**
Davidson Canyon 2	570.38	Hydroriparian***	Seep willow, Arizona walnut, cottonwood**
Davidson Canyon 3	0.50	Xeroriparian B	Juniper**
Davidson Canyon 3	28.93	Xeroriparian C	Mesquite, hackberry**
Davidson Canyon 3	26.21	Xeroriparian D	Desert broom, acacia**
Davidson Canyon 3	71.05	Hydroriparian***	Willows, ash, tamarisk**
Davidson Canyon 4	5.71	Xeroriparian A	Large mesquite, hackberry**
Davidson Canyon 4	5.05	Xeroriparian B	Mesquite**
Davidson Canyon 4	50.42	Xeroriparian C	Small mesquite, juniper**
Davidson Canyon 4	3.27	Xeroriparian D	Desert broom, acacia**
Davidson Canyon 4	174.78	Hydroriparian	Willows, ash, tamarisk, and cottonwood**
Barrel Canyon 1	192.54	Hydroriparian***	Large mesquites, oak, juniper, desert willow, sumac**
Barrel Canyon 1	21.74	Xeroriparian B	Small mesquites, juniper, hackberry**
Barrel Canyon 2	12.39	Hydroriparian***	Seep willow**
Total Hydroriparian	**7,940.51**		
Total Xeroriparian A	**107.72**		
Total Xeroriparian B	**2,575.69**		
Total Xeroriparian C	**1,637.06**		
Total Xeroriparian D	**152.7**		
* From generic Pima County habitat type descriptions (Pima County Regional Flood Control District 2011). Note that BLM (2013) states that the habitat associations in Empire Gulch are not known to be present			
** From actual field observations (WestLand Resources Inc. 2010, 2012a).			
*** The Pima County habitat designation does not match field descriptions of species types; for purposes of analysis, these areas are onsidered xeroriparian/mesoriparian instead of hydroriparian			

General Effects to Riparian Ecosystems

The proposed action will affect riparian systems via the withdrawal of groundwater from the aquifer that sustains portions of springs and streams as well as by alterations in surface runoff patterns within the watershed of the streams. The hydrologic basis for these effects is discussed in detail within the Effects to Aquatic Ecosystems section, and is incorporated herein via reference.

The effect of increased depth to groundwater on riparian vegetation has been investigated by Stromberg *et al.* (1996), Scott *et al.* (1999), Horton *et al.* (2001b), and Merritt and Bateman 2012. Others have investigated riparian response to spatial variations in groundwater depth (i.e. as stream courses changed from perennial to intermittent along their course) (Leenhouts *et al.* 2005, Stromberg *et al.* 2005; Stromberg *et al.* 2007a and 2007b), or changes resulting from the operation of impoundments (Horton *et al.* 2001a, Shafroth *et al.* 2002). It is also important to note that riparian vegetation tends to develop in response to local conditions; communities that exist in sites with highly variable alluvial groundwater levels tend to have rooting depths capable of withstanding relatively larger variations in groundwater level than sites where groundwater elevations are more consistent (Shafroth *et al.* 2000). The streams in the action area exhibit high variability. The variation was described by SWCA (2012), and was summarized in the Effects to Aquatic Ecosystems section.

It is difficult to apply these prior investigations' quantitative results directly to the action area, but one key finding is that increasing depths to groundwater will eventually result in downgrades of a given sites' riparian community (i.e., hydroriparian communities would suffer decreased vigor and extent, eventually transitioning to a xeroriparian community). It is also possible that the groundwater declines resulting from the proposed action, while seemingly minor, will increase current or future levels of hydrologic variation to the point that present-day riparian communities cannot perpetuate themselves.

Maintenance of existing stands of cottonwood and/or willow forests requires the presence of relatively shallow groundwater. Lite and Stromberg (2005) found that cottonwood and Goodding's willow plants were able to compete successfully with non-native saltcedar plants when the maximum depth to groundwater was less than or equal to 8 feet. Leenhouts *et al.* (2005) found that cottonwoods and willow forests on the upper San Pedro River were dense and multiaged among sites where annual maximum ground-water depths averaged less than about 3 meters (9.8 feet) (and where streamflow permanence was greater than about 60 percent, and intra-annual ground-water fluctuation was less than about 1 meter). Others have found the ideal depth appears to be approximately 3 to 5 feet, depending on the species and soil conditions at the site (Parametrix 2008). Cottonwood and willow growth and survival suffer from water stress when groundwater declines below key depth thresholds, particularly if the declines are rapid; the proposed action's effects do not exhibit such immediacy. Seasonal declines of 1 meter 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 meter, with lesser declines (0.5 meter) reducing stem growth (Scott *et al.* 1999, 2000).

The aforementioned depths to groundwater were in reference to the needs of mature willows and cottonwoods. The recruitment of new individuals requires near-surface levels of groundwater during seed germination, followed by a relatively gradual decline in depth that allows roots to pursue the retreating alluvial groundwater. Leenhouts *et al.* (2005) state that manner in which cottonwoods and willows become established is linked to flood flow hydrology. Both species are relatively short-lived (about 100 to 150 years) and have vernally adapted reproduction strategies. Conditions for establishment are not consistently favorable at any given location year after year, so cohorts of these trees establish only during occasional favorable years. The timing of floodflows is critical, as both species produce seeds that are viable during the relatively brief period when high spring flows are usually declining and exposing base, damp sediments (Fenner *et al.* 1984). A typical pattern is for fall or winter floods to scour and redeposit flood-plain sediments, creating potential seed beds for these plants to establish without competition from an existing overstory; seed beds are then moistened by elevated (flood flows). Goodding's willow disperses seeds somewhat later in the season than does cottonwood (although the dispersal periods overlap) and, as the flood waters recede, establishes on sites that are lower and closer to the stream.

The rates of flood-water recession (i.e. the descending limb of the hydrograph) and subsequent decline in alluvial water table elevation influence seedling survival in Fremont cottonwood, Goodding's willow and other *Populus* and *Salix* species. During spring when flood waters are receding and seedlings are establishing on sediment bars, ground-water declines of greater than 1 to 3 centimeters per day can cause seedling death (Segelquist *et al.* 1993, Mahoney and Rood, 1998, Shafroth *et al.* 1998, Amlin and Rood 2002). Rood and Mahoney (1990) and Tyree *et al.* (1994) found that gradual decline of stream discharge after flooding allowed cottonwood seedlings' root systems to maintain contact with the ground water and avoid cavitation (gaps in the water flowing within xylem). In locations where the proposed action will appreciably reduce groundwater elevations beneath streams, we would expect the descending limb of spring hydrographs to steepen (declining less gradually), as discharge-driven channel recharge would first need to saturate a greater volume of alluvium relative to the more well-saturated alluvium present in an unaffected stream.

Sustained ground-water declines throughout the summer to depths greater than 1 or 2 meters below land surface (depending on soil texture, weather, and species) also can preclude establishment of the new cohort (Kalischuk *et al.* 2001, Amlin and Rood 2002). Willow seedlings are less tolerant of water-table decline than cottonwood seedlings (and more tolerant of inundation) and show greatest growth under no water-table decline (continually saturated soils; Horton and Clark, 2001, Amlin and Rood 2002).

Merritt and Bateman (2012) examined Cherry Creek, a central Arizona tributary of the upper Salt River, and modeled changes in riparian vegetation as a result of increasing the depth of groundwater from the surface. The relative frequency of riparian forest to shrubland decreased significantly as a function of increasing depth to groundwater, ranging from 58 percent (%) at base groundwater level to 5% at 6.6 feet (2 meters) below base level. A simulated groundwater decline of 6.6 feet (2 meters) below base level resulted in a nearly complete loss of riparian forest and conversion of the valley bottom to shrubland. Predicted loss of riparian forest averaged 4% per 4 inches (.33 feet) (10 centimeters) of groundwater decline.

We are aware of the difference in time scales between the aforementioned studies and the temporal progression of the modeled effects of the proposed action. Some of the referenced investigations were intra-annual and none were performed over the up-to-1,000-year terms of the modeling for the proposed action. Again, we refer to Shafroth *et al.* (2000), which would seem to indicate that riparian vegetation communities could adapt to a slow progression of groundwater elevation over a lengthy time period (as is often the case in the reach-specific sections, below), provided that maximum depths to groundwater were not exceeded.

Gardner Canyon

As indicated by the Gardner/Cienega Confluence data in Table A-5 in the Effects to Aquatic Ecosystems section, Tetra Tech's (2010) maximum modeled effect scenario predicts that Gardner Canyon is anticipated to experience regional aquifer drawdowns of < 0.1 foot from the cessation of mining until 50 years later (or up to 0.15 foot at 50 years). At 150 years after mining, the effect to Gardner Canyon increases to 0.2 foot (or up to 0.35 foot) and reaches 0.5

foot at 1,000 years. The groundwater drawdowns in the aquifer supplying Gardner Canyon are not likely to be solely capable of measurably reducing the extent or health of the approximately 645 acres of hydroriparian and 933 acres of xeroriparian (Classes B and C) vegetation in Reaches 1 and 2 of Gardner Canyon, but will be additive to other effects, primarily drought and long-term climate change.

Empire Gulch

The proposed action will measurably affect the hydrology of Empire Gulch at the Upper Empire Gulch Springs site (see Upper Empire Gulch Springs data in Table A-5). Effects are modeled to range from 0.1 foot (or up to 0.2 foot) of groundwater drawdown upon cessation of mining to 0.2 foot (or up to 0.5 foot) at 20 years, 0.5 (up to 1.8 foot) foot at 50 years, 2.5 feet (up to 5.0 foot) at 150 years, and 6 feet at 1,000 years (Tetra Tech 2010). As stated in the Effects to Aquatic Ecosystems section, the spring-fed nature of the stream within Empire Gulch is relatively more vulnerable to alterations in the groundwater conditions that sustain the spring discharges. The appreciable groundwater drawdowns discussed above will likely reduce the resilience of ground- and surface water-dependant vegetation in the near term (0 to 20 years). The appreciably increased depths to groundwater and diminished surface flows anticipated to occur in the 150 to 1,000-year timeframe will have more serious, deleterious effects.

The groundwater declines resulting from the proposed action are likely to diminish surface flows in Empire Gulch and cause mortality and/or a downward community transition of some portion of the stream's approximately 407 acres of hydroriparian vegetation. The lost hydroriparian vegetation may be replaced by xeric species, resulting in an increase in the 845 acres of Class A, B, and C xeroriparian vegetation present in Empire Gulch. There is also the potential that some portions of existing xeroriparian vegetation that are partially replying on alluvial groundwater will suffer educed vigor.

Lastly, the current depth to groundwater in Empire Gulch in areas maintained by spring discharge (but not immediately adjacent to the springs) is not known. If ongoing drought has already resulted in decreased groundwater elevations (as might be anticipated from reduced spring discharges), mortality thresholds for riparian plants could be exceeded appreciably sooner and/or the aerial extent of effects could be greater.

Upper Cienega Creek

Upper Cienega Creek in Reaches 1, 2, and 3, contains approximately 3,164 acres of hydroriparian vegetation. This riparian community will be affected by modeled drawdowns of <0.1 foot from the end of mining and at 20, and 50 years later (or up to 0.15 foot at 50 years). Drawdowns reach 0.25 feet (or up to 0.35 foot) and 0.5 feet at 150 and 1,000 years, respectively. Upper Cienega Creek's 917 acres of xeroriparian vegetation in Classes B, C, and D may increase in extent as it replaces lost hydroriparian vegetation, though some effects to xeroriparian plant species facultatively using alluvial groundwater might also occur.

Table A-2, which appears in the Upper Cienega Creek subsection of the Effects to Aquatic Ecosystems section, displays a decrease in riparian evapotranspiration (ET) of 51 acre feet per annum (AFA) at 1,000 years. The decreased riparian ET corresponds to a loss of riparian vegetation, though we cannot determine if the loss would be the result of mortality, conversion to more xeric types, or a combination of the two.

Barrel Canyon

As stated in the Effects to Aquatic Ecosystems section, the proposed action will affect Barrel Canyon primarily by the placement of tailings in the stream channel and its watershed, which will reduce surface runoff by approximately 17.2 percent over the long term. The largest effects will occur prior to the implementation of concurrent reclamation activities.

Barrel Canyon contains approximately 205 acres of hydroriparian and 22 acres of Class-B xeroriparian vegetation, though SWCA (2012) noted that the areas mapped as hydroriparian were more xeric and should likely be classified as xeroriparian.

Davidson Canyon Wash

Tetra Tech predicted groundwater drawdowns in Davidson Canyon Wash at the downstream end of Reach 4 (see the Davidson/Cienega Confluence data in Table A-5) of <0.1 foot from 0 to 150 years after mining and 0.1 foot at 1,000 years (or up to 0.15 foot at 20 years, and 0.2 foot at both 50 and 150 years).

The Effects to Aquatic Ecosystems section discusses the effects of changed runoff patterns in Davidson Canyon Wash. The stream's upper watershed will be subject to altered surface water runoff patterns due to the aforementioned placement of tailings and stormwater retention in Barrel Canyon and retention of stormwater within the mine site. SWCA (2012) extrapolated a 4.3 percent reduction in runoff in the lower reaches of Davidson Canyon Wash. The effect of this small, but measurable reduction in runoff on the recruitment, retention, and succession of riparian communities is difficult to predict, particularly because the 4.3 percent reduction is in average annual yield, which cannot describe discharge-based effects during crucial, low flow periods.

Lower Cienega Creek

Lower Cienega Creek (Reaches 4 and 5 in Figure A-1) supports approximately 2,603 acres of hydroriparian and 1,131 acres of Class A, B, C, and D xeroriparian vegetation. Tetra Tech (2010) modeled groundwater drawdowns of <0.1 foot at the USGS stream gage in Reach 5 (09484560) for all time steps from the cessation of mining to 1,000 years. Drawdowns of such low magnitude, absent other effects, are not anticipated to affect riparian vegetation.

Reach 5, which we again note is downstream of the Davidson Canyon Wash confluence, is nevertheless anticipated to experience the full suite of the proposed action's accumulated, adverse effects. While recognizing the potential for these effects, the fate of diminished surface flows is uncertain, as infiltration and/or riparian evapotranspirative losses vary spatially and temporally. The effects have nevertheless been modeled and represent the best available information.

The effects to riparian vegetation in lowermost Cienega Creek include all drawdown-driven surface flow alterations in upstream reaches (and in Empire Gulch in particular) as well as runoff reductions from the placement of tailings within the upper reaches of Barrel Canyon. Pima County's estimation that Davidson Canyon subflow contributes 8 to 24 percent of baseflow in Reach 5 of Cienega Creek and SWCA's (2012) interpolation that the subflow reduction could be approximately from 0.3 to 1.0 percent makes it reasonable to anticipate at least limited effects to riparian vegetation in the lowermost reaches of Cienega Creek (Reach 5). We refer to Table A-3 in the Lower Cienega Creek subsection of the Effects to Aquatic Ecosystems section, wherein Montgomery [(2010, cited in SWCA (2012)] predicted a 221 afa decrease in riparian ET in lower Cienega Creek 1,000 years after mining.

Westland (2012b) conducted an analysis of existing data pertaining to depth to groundwater and surface flows in a reach of lower Cienega Creek to determine the degree to which impoundment of surface runoff at the mine site and the modeled drawdowns might affect surface flows in lower Cienega Creek. The findings of Westland (2012b) are that there will be an estimated, immediate reduction of approximately 24 linear feet of wetted stream in lower Cienega Creek as a result of reduced runoff from areas impounded by the mine (and the stormwater capture within). After 100 years, an additional 88 feet of wetted stream, for a total of 112 feet, of lower Cienega Creek could be lost due to groundwater drawdown. Should regional drought conditions persist, these changes would be in addition to the ongoing reductions in stream flow extent measured by the Pima Association of Governments (2012).

We caution that reduction in the length of wetted channel does not necessarily characterize the potential full extent of riparian effects. Surface flows in alluvial reaches of Cienega Creek exist in locations where the thalweg (deepest part) of the stream intersects the alluvial water table. A longitudinal contraction in surface flows would necessarily be accompanied by a more-lengthy, longitudinal reduction in shallow, subsurface flows, with alluvial groundwater in some areas potentially dropping below critical depths for emergent, shallow-rooted plants, herbaceous shrubs, as well as broadleaf riparian trees.

The longitudinal contraction in surface flows would also be accompanied by a narrowing of the riparian strand and/or a transition to more xeric types (i.e. tamarisk, desert broom, etc.). The diminished lateral extent of shallow groundwater would also reduce the wetted perimeter of the stream. Stream top-width is a useful surrogate for wetted perimeter, and such a narrowing of a stream can be expected to result in vegetative recruitment encroaching closer to the centerline of the channel. This is problematic since the proposed action will leave flood flows in reaches above Davidson Canyon Wash largely unaffected. Vegetation that establishes itself in a narrowed low-flow channel is likely to be subject to scouring from the still-intact peak flows. Flood scour could be further exacerbated if vegetative communities suffer mortality sufficient to reduce streambank stability.

Status of the Species – Southwestern Willow Flycatcher

A complete description of the biology of the southwestern willow flycatcher (*Empidonax traillii extimus*) is contained in the *Southwestern Willow Flycatcher Recovery Plan* (FWS 2002); a summary of the information appears below.

Description

The southwestern willow flycatcher is a small grayish-green passerine bird (Family Tyrannidae) measuring approximately 5.75 inches. The song is a sneezy "fitz-bew" or a "fit-a-bew", the call is a repeated "whit." It is one of four currently recognized willow flycatcher subspecies (Phillips 1948, Unitt 1987, Browning 1993). It is a neotropical migrant that breeds in the southwestern U.S. and migrates to Mexico, Central America, and possibly northern South America during the non-breeding season (Phillips 1948, Stiles and Skutch 1989, Peterson 1990, Ridgely and Tudor 1994, Howell and Webb 1995). The historical breeding range of the southwestern willow flycatcher included southern California, Arizona, New Mexico, western Texas, southwestern Colorado, southern Utah, extreme southern Nevada, and extreme northwestern Mexico (Sonora and Baja) (Unitt 1987).

Listing and Critical Habitat

The southwestern willow flycatcher was listed as endangered, without critical habitat on February 27, 1995 (FWS 1995). Critical habitat was later designated on July 22, 1997 (FWS 1997a). A correction notice was published in the Federal Register on August 20, 1997 to clarify the lateral extent of the designation (FWS 1997b).

On May 11, 2001, the 10th circuit court of appeals set aside designated critical habitat in those states under the 10th circuit's jurisdiction (New Mexico). The FWS decided to set aside critical habitat designated for the southwestern willow flycatcher in all other states (California and Arizona) until it could re-assess the economic analysis.

On October 19, 2005, the FWS re-designated critical habitat for the southwestern willow flycatcher (FWS 2005). A total of 737 river miles across southern California, Arizona, New Mexico, southern Nevada, and southern Utah were included in the final designation. The lateral extent of critical habitat includes areas within the 100-year floodplain.

On August 15, 2011, the FWS proposed a revision to the critical habitat designation, identifying stream segments in each of the 29 Management Units where there are recovery goals (FWS 2011). These segments totaled 2,090 stream miles. Similar to the 2005 rule, the lateral extent of critical habitat includes only the riparian areas within the 100-year floodplain. About 790 stream miles were identified as areas we will consider for exclusion from the final designation under section 4(b) (2) of the ESA.

The 2005 critical habitat designation remained in place until the final rule was published on January 3, 2013 (78 FR 344). The final rule designated approximately 208,973 acres of streams and riparian areas within the 100-year floodplain or flood-prone areas along approximately 1,975 stream miles in California, Nevada, Utah, Colorado, Arizona, and New Mexico.

A final recovery plan for the southwestern willow flycatcher was signed by the FWS Southwestern Region Director and released to the public in March, 2003 (FWS 2002). The Plan describes the reasons for endangerment, current status of the flycatcher, addresses important recovery actions, includes detailed issue papers on management issues, and provides recovery goals. Recovery is based on reaching numerical and habitat related goals for each specific Management Unit established throughout the subspecies range and establishing long-term conservation plans (FWS 2002).

Habitat

The southwestern willow flycatcher breeds in dense riparian habitats from sea level in California to approximately 8,500 feet in Arizona and southwestern Colorado. Historical egg/nest collections and species' descriptions throughout its range describe the southwestern willow flycatcher's widespread use of willow (*Salix* spp.) for nesting (Phillips 1948, Phillips *et al.* 1964, Hubbard 1987, Unitt 1987). Currently, southwestern willow flycatchers primarily use Geyer willow (*S. geyeriana*), coyote willow (*S. exigua*), Goodding's willow (*S. gooddingii*), boxelder (*Acer negundo*), saltcedar (*Tamarix* sp.), Russian olive (*Elaeagnus angustifolio*), and live oak (*Quercus agrifolia*) for nesting. Other plant species less commonly used for nesting include: buttonbush (*Cephalanthus* sp.), black twinberry (*Lonicera involucrata*), cottonwood (*Populus* spp.), white alder (*Alnus rhombifolia*), blackberry (*Rubus ursinus*), and stinging nettle (*Urtica* spp.). Based on the diversity of plant species composition and complexity of habitat structure, four basic habitat types can be described for the southwestern willow flycatcher: monotypic willow, monotypic exotic, native broadleaf dominated, and mixed native/exotic (Sogge *et al.* 1997).

The flycatcher's habitat is dynamic and can change rapidly: nesting habitat can grow out of suitability; saltcedar habitat can develop from seeds to suitability in about four to five years; heavy runoff can remove/reduce habitat suitability in a day; or river channels, floodplain width, location, and vegetation density may change over time. The flycatcher's use of habitat in different successional stages may also be dynamic. For example, over-mature or young habitat not suitable for nest placement can be occupied and used for foraging and shelter by migrating, breeding, dispersing, or non-territorial southwestern willow flycatchers (McLeod *et al.* 2005, Cardinal and Paxton 2005). Flycatcher habitat can quickly change and vary in suitability, location, use, and occupancy over time (Finch and Stoleson 2000).

Tamarisk is an important component of the flycatcher's nesting and foraging habitat in the central part of the flycatcher's breeding range in Arizona, southern Nevada and Utah, and western New Mexico. In 2001 in Arizona, 323 of the 404 (80 percent) known flycatcher nests (in 346 territories) were built in a tamarisk tree (Smith *et al.* 2002). Tamarisk had been believed by some to be a habitat type of lesser quality for the southwestern willow flycatcher, however comparisons of reproductive performance (FWS 2002), prey populations (Durst 2004) and physiological conditions (Owen and Sogge 2002) of flycatchers breeding in native and exotic vegetation has revealed no difference (Sogge *et al.* 2005). The southwestern willow flycatcher is an insectivore, foraging in dense shrub and tree vegetation along rivers, streams, and other wetlands.

The introduced tamarisk leaf beetle was first detected affecting tamarisk within the range of the southwestern willow flycatcher in 2008 along the Virgin River in St. George, Utah. Initially, this insect was not believed to be able to move into or survive within the southwestern United States in the breeding range of the flycatcher. Along this Virgin River site in 2009, 13 of 15 flycatcher nests failed following vegetation defoliation (Paxton *et al.* 2010). As of 2012, the beetle has been found in southern Nevada/Utah and northern Arizona/New Mexico within the flycatcher's breeding range. Because tamarisk is a component of about 50 percent of all known flycatcher territories (Durst *et al.* 2008), continued spread of the beetle has the potential to significantly alter the distribution, abundance, and quality of flycatcher nesting habitat and impact breeding attempts.

Breeding biology

Arizona Distribution and Abundance

While numbers have significantly increased in Arizona (145 to 459 territories from 1996 to 2007) (English *et al.* 2006, Durst *et al.* 2008), overall distribution of flycatchers throughout the state has not changed much. Currently, population stability in Arizona is believed to be largely dependent on the presence of two large populations (Roosevelt Lake and San Pedro/Gila River confluence). Therefore, the result of catastrophic events or losses of significant populations either in size or location could greatly change the status and survival of the bird. Conversely, expansion into new habitats or discovery of other populations would improve the known stability and status of the flycatcher.

Fire

The evidence suggests that fire was not a primary disturbance factor in southwestern riparian areas near larger streams (FWS 2002). Yet, in recent time, fire size and frequency has increased on the lower Colorado, Gila, Bill Williams, and Rio Grande rivers. The increase has been attributed to increasing dry, fine fuels as a result of the cessation of flood flows and human caused ignition sources. The spread of the highly flammable plant, tamarisk, and drying of river areas due to river flow regulation, water diversion, lowering of groundwater tables, and other land practices is largely responsible for these fuels. A catastrophic fire in June of 1996, destroyed approximately a half mile of occupied tamarisk flycatcher nesting habitat on the San Pedro River in Pinal County. That fire resulted in the forced dispersal or loss of up to eight pairs of flycatchers (Paxton *et al.* 1996). Smaller fires have occurred along the upper most portion of the San Pedro River closer to the Mexico Border and another large fire occurred on the lower San Pedro River at the Nature Conservancy's San Pedro Preserve between Winkelman and Dudleyville in 2004. Recreationists cause over 95 percent of the fires on the lower Colorado River (FWS 2002).

Mortality and Survivorship

There are no extensive records for the actual causes of adult southwestern willow flycatcher mortality. Incidents associated with nest failures, human disturbance, and nestlings are typically the most often recorded due to the static location of nestlings, eggs, and nests. As a result, nestling predation and brood parasitism are the most commonly recorded causes of southwestern willow flycatcher mortality. Also, human destruction of nesting habitat through bulldozing, groundwater pumping, and aerial defoliants has been recorded in Arizona (T. McCarthey, AGFD, pers. comm.). Human collision with nests and spilling the eggs or young onto the ground have been documented near high use recreational areas (FWS 2002). A southwestern willow flycatcher from the Greer Town site along the Little Colorado River in eastern Arizona, was found dead after being hit by a vehicle along SR 373. This route is adjacent to the breeding site (T. McCarthey, AGFD, pers. comm.).

Past Consultations

Since listing in 1995, approximately 210 Federal agency actions have undergone (or are currently under) formal section 7 consultation throughout the flycatcher's range. This list of consultations can be found in the administrative record for this consultation. Since flycatcher critical habitat was finalized in 2005, at least 33 formal opinions have been completed in Arizona (within and outside designated critical habitat). While many opinions were issued for the previous critical habitat designation, the stream reaches and constituent elements have changed.

Activities continue to adversely affect the distribution and extent of all stages of flycatcher habitat throughout its range (development, urbanization, grazing, recreation, native and non-native habitat removal, dam operations, river crossings, ground and surface water extraction, etc.). Introduced tamarisk eating leaf beetles were not anticipated to persist within the range of the southwestern willow flycatcher. However, they were detected within the breeding habitat (and designated critical habitat) of the flycatcher in 2008 along the Virgin River near the Town of St. George, Utah. In 2009, beetles were also known to have been detected defoliating habitat within the range of flycatcher habitat in southern Nevada, and along the Colorado River in the Grand Canyon and near Shiprock in Arizona. Stochastic events also continue to change the distribution, quality, and extent of flycatcher habitat.

Conservation measures associated with some consultations and Habitat Conservation Plans have helped to acquire lands specifically for flycatchers on the San Pedro, Verde, and Gila rivers in Arizona and the Kern River in California. Additionally, along the lower Colorado River, the U.S. Bureau of Reclamation is currently attempting to establish riparian vegetation to expand and improve the distribution and abundance of nesting flycatchers. A variety of Tribal Management Plans in California, Arizona, and New Mexico have been established to guide conservation of the flycatchers. Additionally, during the development of the critical habitat rule, management plans were developed for some private lands along the Owens River in California and Gila River in New Mexico. These are a portion of the conservation actions that have been established across the subspecies' range.

Environmental Baseline – Southwestern Willow Flycatcher

The southwestern willow flycatcher is an obligate riparian bird and thus, the status of riparian ecosystems within the action area is crucial to the species' Environmental Baseline. The riparian vegetative communities present in the action area are described in Table R-1 within the Effects to Riparian Ecosystems section. Table SWF-1, below, displays the subset of sites from Table R-1 that constitute the southwestern willow flycatcher habitat (and critical habitat) affected by the proposed action. We again note that the determination to employ the Pima County riparian mapping may overestimate the exact acreage of the various classes of riparian vegetation.

Table SWF-1. Riparian affected environment within Southwestern Willow Flycatcher habitat and critical habitat adapted from SWCA (2012) and based on Pima County (2012) mapping

Reach Name	Acres	Pima County Class	Dominant Riparian Plants
Cienega Creek 1	695.13	Hydroriparian	Cottonwood and Goodding's willow**
Cienega Creek 1	364.69	Xeroriparian B	Large mesquites and scrub mesquites with scattered cottonwoods**
Cienega Creek 2	2,086.96	Hydroriparian	Mature cottonwood and Goodding's willow**
Cienega Creek 2	323.98	Xeroriparian B	Acacia, desert willow, ironwood, paloverde, mesquite, soapberry*
Cienega Creek 2	65.58	Xeroriparian C	Acacia, desert willow, ironwood, paloverde, mesquite, soapberry*
Cienega Creek 3	382.27	Hydroriparian	Mature cottonwood and Goodding's willow with young velvet ash**
Cienega Creek 3	35.88	Xeroriparian B	Mesquite and netleaf hackberry**
Cienega Creek 3	126.96	Xeroriparian C	Mesquite with desert broom and burrobrush**
Cienega Creek 3	0.78	Xeroriparian D	Acacia, desert willow, ironwood paloverde, mesquite, soapberry*
Empire Gulch	86.00	Xeroriparian A	Acacia, desert willow, ironwood, paloverde, mesquite, soapberry*
Empire Gulch	631.39	Xeroriparian B	Acacia, desert willow, ironwood, paloverde, mesquite, soapberry*
Empire Gulch	127.90	Xeroriparian C	Acacia, desert willow, ironwood, paloverde, mesquite, soapberry*
Empire Gulch	407.46	Hydroriparian	Large cottonwood willow gallery**
Total Hydroriparian in upper Cienega Creek and Empire Gulch			**3571.82**
Total Xeroriparian A in upper Cienega Creek and Empire Gulch			**86**
Total Xeroriparian B in upper Cienega Creek and Empire Gulch			**1355.94**
Total Xeroriparian C in upper Cienega Creek and Empire Gulch			**320.44**
Total Xeroriparian D in upper Cienega Creek and Empire Gulch			**0.78**
* From generic Pima County habitat type descriptions (CITE PIMA COUNTY RIPARIAN APPENDIX).			
** From actual field observations (WestLand Resources Inc. 2010d, 2012a, 2012b).			

Status of the Flycatcher in the Action Area

The action area includes the streams and associated riparian communities affected by the proposed action, as detailed within the Effects to Aquatic Ecosystems and Effects to Riparian Ecosystem section, above. Flycatcher surveys and detections have been limited within the action area. AGFD (Ellis *et al.* 2008) reported the results of flycatcher presence and absence surveys occurring between 1993 and 2006 along five reaches of Cienega Creek (in order from upstream to downstream, are Empire/ Cienega–Cienega Creek, Cienega Creek near Cross Hill, Cienega Narrows, Cienega Creek–Narrows to Coldwater, and Cienega Creek). Most recently, in 2011 the BLM (Radke 2011) conducted surveys along lower Empire Gulch and upper Cienega Creek and from 2010 to 2012, Pima County (Rodden 2010, 2011,2012) conducted flycatcher surveys along a mile portion of lower Cienega Creek.

Between 1993 and 2006, the reach of Cienega Creek in which territorial flycatchers were documented was the uppermost portion (Cienega Creek), where a pair and nest were located in

2001 (within the critical habitat segment). Two migrant flycatchers were documented in the same reach of Cienega Creek—one in 1999 and one in 2003. A willow flycatcher of an unknown subspecies (*Empidonax traillii ssp.*) was documented at the Empire Gulch Monitoring Avian Productivity and Survivorship (MAPS) station in July 2006 (Institute for Bird Populations 2006). Please note that the subsequent use of the term "willow flycatcher" refers to birds for which the subspecies cannot be definitively determined; these are individuals that are during migration. The term "flycatcher" is used throughout this document when a bird has been identified as a southwestern willow flycatcher based on observation of territorial behavior and breeding activity in the subspecies' known range.

A single flycatcher territory was detected along Cienega Creek in 2001 (Smith *et al.* 2002). An individual flycatcher was documented on Cienega Creek during formal surveys in August 2003 (Keith Hughes, BLM files, as cited in BLM 2013).

A flycatcher (or flycatchers) were documented with the "fitz-bew" call on a territory just west of net 10 of the Empire Gulch Monitoring Avian Productivity and Survivorship (MAPS) station on June 8 and 17, 2011; the detection was listed as "probable breeder-song" for these dates (BLM 2012, BLM 2013, Paxton 2012). An after-hatch-year flycatcher was caught in net 10 on June 17, 2011, and a hatch-year bird was caught on August 6, 2011, in net 7 of the same MAPS station (M. Radke, pers. obs., as cited in BLM 2013). Flycatchers were also listed as "likely breeder" for the 2011 year status for the Empire Gulch MAPS station (M. Radke, pers. obs., as cited in BLM 2013).

From 2010 to 2012, an approximately 1-mile length of the so-called Claypit Reach of Cienega Creek was surveyed by Pima County in order to evaluate a potential Partners for Fish and Wildlife project that would remove tamarisk. No flycatchers were detected the three seasons that this portion of lower Cienega Creek was surveyed (Rodden 2010, 2011, 2012).

Status of Flycatcher Critical Habitat in the Action Area

We revised the flycatcher critical habitat designation in 2013, including reaches of Cienega Creek and Empire Gulch within the Las Cienegas National Conservation Area in Pima County. Specifically, we designated a 17.9-km (11.1-mi) segment of Cienega Creek and two segments of Empire Gulch; an isolated 0.4-km (0.3-mi) upper segment of Empire Gulch and a second 1.3-km (0.8-mi) lower segment of Empire Gulch that connects to Cienega Creek. The Cienega Creek portion of the critical habitat is located within Reaches 1, 2, and 3 (see Figure A-1). Empire Gulch was not subdivided for groundwater modeling purposes, so groundwater decline-driven effects to the two portions of critical habitat in the stream cannot be described separately.

Cienega Creek was identified in the Recovery Plan as an area with substantial recovery value (FWS 2002, p. 91), while the adjacent Empire Gulch was not identified in the Plan, but was only recently reported as likely having a flycatcher territory. These stream segments fall within the Santa Cruz Management Unit and were designated (along with a portion of the Santa Cruz River) to follow and meet the geographic and territory and habitat-related goals described in the Plan (FWS 2002). The Santa Cruz Management Unit is, in turn, a component of the Gila Recovery Unit. These areas, as are all critical habitat segments, are anticipated to provide flycatcher habitat for metapopulation stability, gene connectivity through this portion of the flycatcher's range, protection against catastrophic population loss, and population growth and colonization potential. We also designated critical habitat to support the feeding and sheltering needs of migratory and dispersing flycatchers. Overall, these river segments and associated flycatcher habitat are anticipated to support the strategy, rationale, and science of flycatcher conservation.

The areas designated as flycatcher critical habitat are designed to provide sufficient riparian habitat for breeding, non-breeding, territorial, dispersing, and migrating flycatchers in order to reach the geographic distribution, abundance, and habitat-related recovery goals described in the Recovery Plan (FWS 2002, pp. 77–85).

In general, the physical or biological features (PBF) of critical habitat for nesting flycatchers are found in the riparian areas within the 100-year floodplain or flood-prone area. Flycatchers use riparian habitat for feeding, sheltering, and cover while breeding, migrating, and dispersing. It is important to recognize that flycatcher habitat is ephemeral in its presence, and its distribution is dynamic in nature because riparian vegetation is prone to periodic disturbance (such as flooding) (FWS 2002, p. 17). Even with the dynamic shifts in habitat conditions, one or more of the primary constituent elements (elements of the physical and biological factors) described below are found throughout each of the units that we designated as critical habitat.

Flycatcher habitat may become unsuitable for breeding through maturation or disturbance of the riparian vegetation, but it may remain suitable for use during migration or for foraging. This situation may be only temporary, and vegetation may cycle back into suitability as breeding habitat (FWS 2002, p. 17). Therefore, it is not practical to assume that any given breeding habitat area will remain suitable over the long term or persist in the same location (FWS 2002, p. 17). Thus, flycatcher habitat that is not currently suitable for nesting at a specific time, but is useful for foraging and migration, can still be important for flycatcher conservation. Feeding sites and migration stopover areas are important components for the flycatcher's survival, productivity, and health, and they can also be areas where new breeding habitat develops as nesting sites are lost or degraded (FWS 2002, p. 42). These successional cycles of habitat change are important for long-term persistence of flycatcher habitat.

Based on our current knowledge of the life history and ecology of the flycatcher and the relationship of its life-history functions to its habitat, it is important to recognize the interconnected nature of the physical or biological features that provide the primary constituent elements of critical habitat. Specifically, we consider the relationships between river function, hydrology, floodplains, aquifers, and plant growth, which form the environment essential to flycatcher conservation.

The hydrologic regime (stream flow pattern) and supply of (and interaction between) surface and subsurface water is a driving factor in the long-term maintenance, growth, recycling, and regeneration of flycatcher habitat (FWS 2002, p. 16). As streams reach the lowlands, their gradients typically flatten and surrounding terrain opens into broader floodplains (FWS 2002, p. 32). In these geographic settings, the stream-flow patterns (frequency, magnitude, duration, and timing) will provide the necessary stream-channel conditions (wide configuration, high sediment deposition, periodic inundation, recharged aquifers, lateral channel movement, and elevated groundwater tables throughout the floodplain) that result in the development of flycatcher habitat (Poff *et al.* 1997, pp. 770–772; FWS 2002, p. 16). Allowing the river to flow over the width of the floodplain, when overbank flooding occurs, is integral to allow deposition of fine moist soils, water, nutrients, and seeds that provide the essential material for plant germination and growth. An abundance and distribution of fine sediments extending farther laterally across the floodplain and deeper underneath the surface retains much more subsurface water, which in turn supplies water for the development of the vegetation that provides flycatcher habitat and micro-habitat conditions (FWS 2002, p. 16). The interconnected interaction between groundwater and surface water contributes to the quality of riparian vegetation community (structure and plant species) and will influence the germination, density, vigor, composition, and the ability of vegetation to regenerate and maintain itself (Arizona Department of Water Resources 1994, pp. 31–32).

Considering these issues and other information regarding the biology and ecology of the species, we have determined that the flycatcher requires the essential physical or biological features (PBF) described below.

*Space for Individual and Population Growth and for Normal Behavi*or

Streams of lower gradient and more open valleys with a wide or broad floodplain are an essential physical or biological feature of flycatcher habitat. In some instances, streams in relatively steep, confined areas can also support flycatcher breeding habitat (FWS 2002, p. D-13). These areas support the abundance of riparian vegetation used for flycatcher nesting, foraging, dispersal, and migration.

Streams of lower gradient and more open valleys with a wide and broad floodplain are the geological settings that are known to support flycatcher breeding habitat from near sea level to about 2,600 m (8,500 ft) in elevation in southern California, southern Nevada, southern Utah, southern Colorado, Arizona, and New Mexico (FWS 2002, p. 7). Sometimes, the low-gradient wider floodplain exists only at the habitat patch itself within a stream that is otherwise steeper in gradient (FWS 2002, p. D-12). Flycatchers can occupy and breed in very small, isolated habitat patches and may occur in fairly high densities within those small patches.

Many willow flycatchers are found along streams using riparian habitat during migration (Yong and Finch 1997, p. 253; FWS 2002, p. E-3). Migration stopover areas can be similar to breeding habitat or riparian habitats with less vegetation density and abundance compared to areas for nest placement (the vegetation structure is too short or sparse or the patch is too small) (FWS 2002, p. E-3). Such migration stopover areas, even though not used for breeding, are critically important resources affecting productivity and survival (FWS 2002, p. E-3). The variety of riparian habitat occupied by migrant flycatchers ranges from small patches with shorter and sparser vegetation to larger more complex breeding habitats.

Food, Water, Air, Light, Minerals, or Other Nutritional or Physiological Requirements

Food

The presence of a wide range of invertebrate prey, including flying and ground- and vegetation-dwelling species of terrestrial and aquatic origins is an essential physical or biological feature of flycatcher habitat.

The flycatcher is somewhat of an insect generalist (FWS 2002, p. 26), taking a wide range of invertebrate prey including flying, and ground- and vegetation-dwelling species of terrestrial and aquatic origins (Drost *et al.* 2003, pp. 96–102). From an analysis of the flycatcher diet along the South Fork of the Kern River, California (Drost *et al.* 2003, p. 98), flycatchers consumed a variety of prey from 12 different insect groups. Flycatchers have been identified targeting seasonal hatchings of aquatic insects along the Salt River arm of Roosevelt Lake, Arizona (Paxton *et al.* 2007, p. 75).

Flycatcher food availability may be largely influenced by the density and species of vegetation, proximity to and presence of water, saturated soil levels, and microclimate features such as temperature and humidity (FWS 2002, pp. 18, D-12). Flycatchers forage within and above the tree canopy, along the patch edge, in openings within the territory, over water, and from tall trees as well as herbaceous ground cover (Bent 1960, pp. 209–210; McCabe 1991, p. 124). Flycatchers employ a “sit and wait” foraging tactic, with foraging bouts interspersed with longer periods of perching (Prescott and Middleton 1988, p. 25).

Water

Flowing streams with a wide range of stream flow conditions that support expansive riparian vegetation is an essential physical feature of flycatcher habitat. The most common stream flow conditions are largely perennial (persistent) stream flow with a natural hydrologic regime (frequency, magnitude, duration, and timing). However, in the Southwest, hydrological conditions can vary, causing some flows to be intermittent, but the floodplain can retain surface moisture conditions favorable to expansive and flourishing riparian vegetation. These appropriate conditions can be supported by managed water sources and hydrological cycles that mimic key components of the natural hydrologic cycle. Flycatcher nesting habitat is largely associated with perennial (persistent) stream flow that can support the expanse of vegetation characteristics needed by breeding flycatchers, but there are exceptions. Flycatcher nesting habitat can persist on intermittent streams that retain local conditions favorable to riparian vegetation (FWS 2002, p. D-12).

In the Southwest, hydrological conditions at a flycatcher breeding site can vary remarkably within a season and between years (FWS 2002, p. D-12). At some locations, particularly during drier years, water or saturated soil is only present early in the breeding season (May and part of

June) (FWS 2002, p. D-12). At other sites, vegetation may be immersed in standing water during a wet year but be hundreds of meters from surface water in dry years (FWS 2002, p. D-12). Where a river channel has changed naturally, there may be a total absence of water or visibly saturated soil for several years. In such cases, the riparian vegetation and any flycatchers breeding within it may persist for several years (FWS 2002, p. D-12).

Sites for Germination or Seed Dispersal

Elevated subsurface groundwater tables and appropriate floodplain fine sediments are essential physical or biological features of flycatcher habitat. These features provide water and seedbeds for the germination, growth, and maintenance of expansive growth of riparian vegetation needed by the flycatcher.

Subsurface hydrologic conditions may in some places (particularly at the more arid locations of the Southwest) be equally important to surface water conditions in determining riparian vegetation patterns (Lichivar and Wakely 2004, p. 92). Where groundwater levels are elevated to the point that riparian forest plants can directly access those waters, it can be an area for breeding, non-breeding (unpaired), territorial, dispersing, foraging, and migrating flycatchers. Elevated groundwater helps create moist soil conditions believed to be important for nesting conditions and prey populations (FWS 2002, pp. 11, 18), as further discussed below.
Depth to groundwater plays an important part in the distribution of riparian vegetation (Arizona Department of Water Resources 1994, p. 31) and, consequently, flycatcher habitat. The greater the depth to groundwater below the land surface, the less abundant the riparian vegetation (Arizona Department of Water Resources 1994, p. 31). Localized, perched aquifers (a saturated area that sits above the main water table) can and do support some riparian habitat, but these systems are not extensive (Arizona Department of Water Resources 1994, p. 31).

The abundance and distribution of fine sediment deposited on floodplains is critical for the development, abundance, distribution, maintenance, and germination of the plants that grow into flycatcher habitat (FWS 2002, p. 16). Fine sediments provide seed beds to facilitate the growth of riparian vegetation for flycatcher habitat. In almost all cases, moist or saturated soil is present at or near breeding sites during wet and non-drought years (FWS 2002, p. 11). The saturated soil and adjacent surface water may be present early in the breeding season, but only damp soil is present by late June or early July (FWS 2002, p. D-3). Microclimate features (temperature and humidity) facilitated by moist or saturated soil, are believed to play an important role where flycatchers are detected and nest, their breeding success, and availability and abundance of food resources (FWS 2002, pp. 18, D-12).

Cover or Shelter

Riparian tree and shrub species that provide cover and shelter for nesting, breeding, foraging, dispersing, and migrating flycatchers are essential physical or biological features of flycatcher habitat.

Riparian vegetation provides the flycatcher cover and shelter while migrating and nesting. Placing nests in dense vegetation provides cover and shelter from predators or nest parasites that would seek out flycatcher adults, nestlings, or eggs. Similarly, using riparian vegetation for cover and shelter during migration provides food-rich stopover areas, a place to rest, and shelter or cover along migratory flights (FWS 2002, pp. D-14, F-16). Riparian vegetation used by migrating flycatchers can sometimes be less dense and abundant than areas used for nesting (FWS 2002, p. D-19). However, migration stopover areas, even though not used for breeding, may be critically important resources affecting local and regional flycatcher productivity and survival (FWS 2002, p. D-19).

Sites for Breeding, Reproduction, or Rearing (or Development) of Offspring

Reproduction and Rearing of Offspring

A variety of riparian tree and shrub species is an essential physical or biological feature of flycatcher habitat. Typically, dense, expansive riparian forests provide habitat to place nests. Riparian vegetation with these characteristics, with a mosaic of open spaces, typically surrounds locations to place nests or along river segments and provides vegetation for foraging, perching, dispersal, and migration, and habitat that can develop into nesting areas through time. Riparian habitat characteristics such as dominant plant species, size and shape of habitat patches, tree canopy structure, vegetation height, and vegetation density are important parameters of flycatcher breeding habitat, although they may vary widely at different sites (FWS 2002, p. D-1).

Flycatchers nest in thickets of trees and shrubs ranging in height from 2 m to 30 m (6 to 98 ft) (FWS 2002, p. D-3). Nest sites typically have dense foliage at least from the ground level up to approximately 4 m (13 ft) above ground, although dense foliage may exist only at the shrub level, or as a low, dense tree canopy (FWS 2002, p. D-3). Regardless of the plant species' composition or height, breeding sites usually consist of dense vegetation in the patch interior, or an aggregate of dense patches interspersed with openings creating a mosaic that is not uniformly dense (FWS 2002, p. 11).

Canopy density (the amount of cover provided by tree and shrub branches measured from the ground) at various nest sites ranged from 50 to 100 percent (FWS 2002, p. D-3). Flycatcher breeding habitat can be generally organized into three broad habitat types—those dominated by native vegetation (typically willow), by exotic (nonnative) vegetation (typically salt cedar), and those with mixed native and those dominated by exotic plants (typically salt cedar and willow). These broad habitat descriptors reflect the fact that flycatchers inhabit riparian habitats dominated by both native and nonnative plant species.

Flycatchers have been recorded nesting in patches as small as 0.1 ha (0.25 ac) along the Rio Grande, and as large as 70 ha (175 ac) in the upper Gila River, New Mexico (FWS 2002, p. 17). The mean reported size of flycatcher breeding patches was 8.6 ha (21.2 ac), with the majority of sites toward the smaller end, as evidenced by a median patch size of 1.8 ha (4.4 ac) (FWS 2002, p. 17).

With only some exceptions, flycatchers are generally not found nesting in confined floodplains (typically those bound within a narrow canyon) (Hatten and Paradzick 2003, p. 780) or where only a single narrow strip of riparian vegetation less than approximately 10 m (33 ft) wide develops (FWS 2002, p. D-11).

While riparian vegetation too mature, too immature, or of lesser quality in abundance and breadth may not be used for nesting, it can be used by breeding flycatchers for foraging (especially if it extends out from larger patches) or during migration for foraging, cover, and shelter (Sogge and Tibbitts 1994, p. 16; Sogge and Marshall 2000, p. 53).

Primary Constituent Elements for Flycatcher

Primary constituent elements are those specific elements of the physical or biological features that provide for a species' life-history processes and are essential to the conservation of the species.
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 specific to the flycatcher are:

(1) Primary Constituent Element 1— *Riparian vegetation.* Riparian habitat along a dynamic river or lakeside, in a natural or manmade successional environment (for nesting, foraging, migration, dispersal, and shelter) that is comprised of trees and shrubs (that can include Goodding's willow, coyote willow, Geyer's willow, arroyo willow, red willow, yewleaf willow, pacific willow, boxelder, tamarisk, Russian olive, buttonbush, cottonwood, stinging nettle, alder, velvet ash, poison hemlock, blackberry, seep willow, oak, rose, sycamore, false indigo, Pacific poison ivy, grape, Virginia creeper, Siberian elm, and walnut) and some combination of:

> (a) Dense riparian vegetation with thickets of trees and shrubs that can range in height from about 2 to 30 m (about 6 to 98 ft). Lower-stature thickets (2 to 4 m or 6 to 13 ft tall) are found at higher elevation riparian forests and tall-stature thickets are found at middle- and lower-elevation riparian forests;
> (b) Areas of dense riparian foliage at least from the ground level up to approximately 4 m (13 ft) above ground or dense foliage only at the shrub or tree level as a low, dense canopy;
> (c) Sites for nesting that contain a dense (about 50 percent to 100 percent) tree or shrub (or both) canopy (the amount of cover provided by tree and shrub branches measured from the ground);
> (d) Dense patches of riparian forests that are interspersed with small openings of open water or marsh or areas with shorter and sparser vegetation that creates a variety of habitat that is not uniformly dense. Patch size may be as small as 0.1 ha (0.25 ac) or as large as 70 ha (175 ac).

(2) Primary Constituent Element 2— *Insect prey populations.* A variety of insect prey populations found within or adjacent to riparian floodplains or moist environments, which can

include: flying ants, wasps, and bees (Hymenoptera); dragonflies (Odonata); flies (Diptera); true bugs (Hemiptera); beetles (Coleoptera); butterflies, moths, and caterpillars (Lepidoptera); and spittlebugs (Homoptera).

Effects to Southwestern Willow Flycatchers

The section in this BO entitled Effects to Aquatic Ecosystems describes the hydrologic basis for effects to streams. The subsequent analysis of effects to riparian vegetation appears in the Effects to Riparian Ecosystems section. These prior analyses are incorporated herein via reference.

<u>Direct Effects to Southwestern Willow Flycatchers</u>

There are no known flycatcher territories or areas anticipated to have or to develop flycatcher breeding habitat within the proposed footprint of the Rosemont Mine; the project area is predominately uplands and directly affected streams (i.e. Barrel Canyon) are ephemeral and lacking in suitable hydroriparian vegetation. As a result, we do not anticipate that any breeding flycatchers will be directly affected by the construction or operation of the mine.

Migratory flycatchers have been detected along nearby Cienega Creek and Empire Gulch and are known to occur in a wider variety of habitat types and locations than are territorial, breeding individuals. The Rosemont Mine site is situated between the Cienega Creek watershed and, to the south, the Sonoita Creek watershed. Given that flycatchers are a neo-tropical migrant and migrate between North American breeding locales and wintering sites in subtropical and tropical latitudes, it is probable that migratory or dispersing flycatchers will intermittently occur in the area of Rosemont Mine during construction or its operation. Because of the length of time the mine is expected to operate, it is reasonable to anticipate that migratory or dispersing flycatchers will transit the mine site. The mine site (in its pre-, during- and post-operation states) lacks the stopover habitat known to be preferred by migratory or dispersing flycatchers, so it is unlikely that the birds would be harmed or harassed to a greater degree than they would be when crossing other, unsuitable habitats.

<u>Indirect Effects to Southwestern Willow Flycatchers</u>

The Effects to Aquatic Ecosystems section discusses the proposed action's effect to regional groundwater and the volume and linear extent of surface flows in area streams. The relationship between flood flow hydrology, depth to groundwater, and the recruitment, maturation, and retention of the riparian forests in which flycatchers occur was analyzed in the section entitled Effects to Riparian Ecosystems. These prior narratives are incorporated herein via reference.

The drawdown of groundwater can negatively influence the ability for riparian plants to germinate, grow, and persist (Stromberg *et al.* 1996, Scott *et al.* 1999, Horton *et al.* 2001, and Merritt and Bateman 2012) (see Effects to Riparian Ecosystems section). Small reductions in stream flow or ground water levels can cause plants to undergo physiological stress and lose productivity, with possible adverse implications for southwestern willow flycatchers (FWS

2002). Even short-term loss of surface flows may reduce bio-productivity and habitat quality by stressing those insects with aquatic larval forms, a portion of the southwestern willow flycatcher's food base (FWS 2002). Nesting flycatchers do not rely on just the existence of riparian plants, but the persistence of this vegetation in abundant and dense quantities, requiring groundwater near the surface that creates conditions for abundant plant germination, growth, and persistence.

As discussed in the Effects to Aquatic Ecosystems section, the proposed action will appreciably, adversely affect the subsurface and, eventually, the surface hydrology of Empire Gulch at the Upper Empire Gulch Springs site (see Upper Empire Gulch Springs data in Table A-5). Tetra Tech (2010) modeled the effects at this site to range from 0.1 foot (or up to 0.2 foot) of groundwater drawdown upon cessation of mining to 0.2 foot (or up to 0.5 foot) at 20 years, 0.5 (up to 1.8 foot) foot at 50 years, 2.5 feet (up to 5.0 foot) at 150 years, and 6 feet at 1,000 years.

The modeled groundwater drawdowns at upper Cienega Creek (Reaches 1, 2, and 3) are of lesser magnitude than in Empire Gulch. The USGS Cienega Creek stream gage (0948550) is situated near the narrows in the upstream portion of Reach 3 (see Figure A-1). Tetra Tech (2010) modeled drawdowns of <0.1 foot from the end of mining and at 20, and 50 years later (or up to 0.15 foot at 50 years). Drawdowns reach 0.25 feet (or up to 0.35 foot) and 0.5 feet at 150 and 1,000 years, respectively.

We caution that the distance of these areas from the mine site, the present lack of definitive information regarding the regional aquifer, and the precision (or lack thereof) of the models used, mean there is no reasonable certainty regarding the exact magnitude of the drawdowns or of the exact manner in which groundwater declines will affect riparian ecosystems in either the near or long terms. Groundwater models are more useful in determining the magnitude of trends rather than absolute groundwater elevations. Regardless, the combined result of the effects to regional groundwater, changes in the baseflow hydrology of streams, decreases in stream length, and reduced riparian ET is a likely decrease in the quality of the flycatcher's Environmental Baseline along Empire Gulch and upper Cienega Creek.

Moreover, we have highlighted the aforementioned trends in increasing groundwater drawdown specifically because Merritt and Bateman (2012), modeling hydrology and riparian vegetation relationships on Cherry Creek in Central Arizona, found that a 0.33-foot drop in groundwater translated into a 4% loss of riparian forest in that location.

Brand *et al.* (2010) examined the upper San Pedro River and found that canopy nesting and insectivorous birds reached their highest densities and levels of nesting success in cottonwood stands along intermittent and perennial reaches. While southwestern willow flycatchers are insectivorous, the species is rare on the upper San Pedro River and was not specifically investigated.

Brand *et al.* (2011) conducted analyses intended to determine changes in riparian condition class as described in Leenhouts *et al.* (2005) under varying groundwater scenarios. Scenarios involving groundwater depletion were found to result in reduced abundance of cottonwood/willow vegetation and increased abundance of less phraetophytic species such as tamarisk. While southwestern willow flycatchers are known to occur in high densities in salt tamarisk in the southwestern U.S., the sites are generally associated with perennial river reaches maintained by releases from dams. We also note that Brand *et al.* (2010, 2011) found that densities of brown-headed cowbirds - a nest parasite of the southwestern willow flycatcher - increased in abundance under decreasing groundwater levels, increasing flow intermittency, and increasing density of tamarisk.

The streams studied by these investigators differ from Cienega Creek in myriad ways, but the findings all document that depletions of groundwater are likely to result in reductions in the quality and quantity of habitat for the southwestern willow flycatcher.

Approximately 3,572 acres of hydroriparian habitat were mapped within Empire Gulch and Reaches 1, 2, and 3 of Cienega Creek by Pima County; some or all of this acreage will be affected by the proposed action (see Table C-1). It is likely that the single 2001 Cienega Creek flycatcher territory and the presumed 2011 Empire Gulch territory were situated within areas mapped as hydroriparian habitat. The anticipated effects to these hydroriparian sites may reduce their suitability to serve as nesting substrates in the future. Conversely, the erratic occurrence of southwestern willow flycatchers in these sites means that we cannot be reasonably certain that birds will be incidentally taken if and when the anticipated effects occur.

It is likely that some fraction of the approximately 1,763 acres of Class A though D xeroriparian habitat mapped by Pima County in Empire Gulch and Reaches 1, 2, and 3 of Cienega Creek are important for flycatchers, providing either: (1) marginal nesting substrate (especially where cottonwoods are interspersed within a mesquite bosque) or foraging and dispersal habitat; or (2) a buffer between more hydric sites and the adjacent, xeric uplands, which decreases the edge/interior ratio of a given hydroriparian patch. Again, the sporadic use of Empire Gulch and upper Cienega Creek by flycatchers for breeding does not support a reasonable certainty that birds will be incidentally taken. Moreover, xeroriparian vegetation may increase in extent if and as hydroriparian communities diminish.

<u>Effect to Southwestern Willow Flycatcher Critical Habitat</u>

The analyses contained in the Effects to Aquatic Ecosystems and Effects to Riparian Ecosystems sections as well as the preceding analysis of adverse effects to the flycatcher inform the analysis of the effects to critical habitat, and are incorporated herein by reference.

To summarize the prior analyses, the proposed action will adversely affect critical habitat via small, future declines in groundwater elevation which, in turn, will decrease the wetted length of stream, and reduce the vigor and extent of riparian vegetation. These effects would be in addition to relatively larger effects of natural variation. Alternately, if natural conditions recover (i.e. drought ceases), the effects of the proposed action would slightly reduce the magnitude of the improvement. The former scenario, which is more likely given climate change, represents effects to the PCEs of critical habitat: (1) riparian vegetation; and (2) insect prey population.

Within Pima and Santa Cruz Counties, Arizona, we designated flycatcher critical habitat along Cienega Creek, Empire Gulch, and the Santa Cruz River; only the former two sites are within the action area. The Cienega Creek designation includes a 17.9-km (11.1-mi) segment of Cienega Creek above the Narrows within the Las Cienega NCA. There are two segments of critical habitat in Empire Gulch; an isolated 0.4-km (0.3-mi) upper segment of Empire Gulch and a second 1.3-km (0.8-mi) lower segment of Empire Gulch that connects to Cienega Creek. The "Gardner/Cienega Confluence", "Upper Empire Gulch Springs", and "Cienega near Stream Gage 09484550" groundwater drawdown modeling points in Table SWF-2 and the Upper Cienega and the Narrows impact summaries in Table SWF-3 are informative.

As stated in prior analyses, the effects to riparian and aquatic ecosystems are appreciable and, to the extent that the available models permit, have been quantified (see Tables A-2, A-3, A-5, and SWF-1). Table SWF-2, below, is an excerpt from Table A-5, and includes the 20 to 1,000-year modeled groundwater drawdowns for Empire Gulch and Cienega Creek within critical habitat. The data for the time of mine closure (0 years) are omitted because modeled drawdowns are 0.1 feet or less. Table SWF-2 shows that from the cessation of mining to 150 years, many groundwater drawdowns are <0.1 foot, though Tetra Tech (2010) consistently predicts larger drawdowns than either Montgomery (2010) or Myers (2010). The most extreme effects are at the 1,000-year timeframe, where Tetra Tech (2010) has modeled a 6-foot drawdown at Upper Empire Gulch Springs. Our prior analyses have characterized this relatively large drawdown as having a limited effect to individual southwestern willow flycatchers; the sporadic use of the reach for nesting means that even large effects are unlikely to harm birds. This represents, however, an appreciable adverse effect to critical habitat. The drawdown is likely to result in the loss of riparian vegetation for nesting and foraging and a reduction in wetted stream, which, in turn, will reduce the export of aquatic insects.

The Effects to Riparian Ecosystems sections describes the work of Merritt and Bateman (2012) at Cherry Creek in central Arizona, where it was found that a simulated groundwater decline of 6.6 feet (2 meters) below base level resulted in a nearly complete loss of riparian forest and conversion of the valley bottom to shrubland. We cannot directly compare Cherry Creek and Empire Gulch using the hydrology, geomorphology, or riparian mapping data that are available to us, nor do we know the current, drought-affected groundwater elevations in Empire Gulch, but the effects noted at the former site indicate that relatively small drawdowns can cause appreciable reductions in riparian vegetation. The 2.5-foot (or up to 5.0 feet) and 6-foot modeled decline that has been predicted at Upper Empire Gulch Springs at 150 and 1,000 years, respectively (Tetra Tech 2010) - given uncertainties regarding ongoing drought and climate change – could result in an appreciable loss of riparian vegetation (PCE 1) within some portion of the 0.4-km (0.3-mi) upper segment and 1.3-km (0.8- mi) lower segment of Empire Gulch, with lesser effects in the 17.9-km (11.1-mi) segment of mainstem Cienega Creek.

Table SWF-2. Modeled groundwater drawdowns within flycatcher critical habitat, including the limits of sensitivity analyses in parentheses.

Location	Montgomery (2010)	Tetra Tech (2010)	Myers (2010)
20 years after mine closure			
Gardner/Cienega Confluence	<0.1 (Same)	<0.1 (Same)	0
Upper Empire Gulch Springs	<0.1 (<0.1 - 0.1)	0.2 (<0.1 - 0.5)	0
Cienega near stream gage 09484550 (perennial reach)	<0.1 (Same)	<0.1 (Same)	0
50 years after mine closure			
Location	**Montgomery (2010)**	**Tetra Tech (2010)**	**Myers (2010)**
Gardner/Cienega Confluence	<0.1 (<0.1 - 0.1)	<0.1 (<0.1 - 0.15)	0
Upper Empire Gulch Springs	<0.1 (<0.1 - 0.5)	0.5 (<0.1 - 1.8)	0.2
Cienega near stream gage 09484560 (intermittent reach)	<0.1 (Same)	<0.1 (Same)	0
150 years after mine closure			
Location	**Montgomery (2010)**	**Tetra Tech (2010)**	**Myers (2010)**
Gardner/Cienega Confluence	<0.1 (<0.1 – 0.4)	0.2 (<0.1 – 0.35)	0.1
Upper Empire Gulch Springs	0.3 (0.1 – 1.4)	2.5 (0.5 – 5.0)	0.3
Cienega near stream gage 09484550 (perennial reach)	<0.1 (Same)	0.25 (<0.1 – 0.35)	0
1,000 years after mine closure			
Location	**Montgomery (2010)**	**Tetra Tech (2010)**	**Myers (2010)**
Gardner/Cienega Confluence	<0.1 (<0.1 – 0.8)	0.5 (0.3 – 0.5)	2.2
Upper Empire Gulch Springs	3.3 (2.3 – 5.0)	6 (4.4 – 6.0)	4.3
Cienega near stream gage 09484550 (perennial reach)	<0.1 (Same)	0.5 (0.4 – 0.5)	0.2

Table SWF-3, below, repeats the content of Table A-2, above; both are based on SWCA (2012). Table SWF-3 includes only the sites within critical habitat. There are anticipated to be no drawdowns, decreases in the wetted length of stream, decreases in baseflow, or decreases in riparian ET within the vicinity of flycatcher critical habitat at up to 150 years. At 1,000 years, drawdown is modeled to reach 0.01 foot, 0.16 mile (845 feet) of stream will be lost, baseflow will be diminished by 0.02 cfs, and riparian ET will decrease by 51afa. The loss of 845 feet of stream length and 51 afa of riparian ET will result in losses of riparian vegetation within and both up- and downstream from the affected reach.

The predictions found in Table SWF-3, which were performed by Montgomery (2010) and referenced in SWCA (2012) , are not as severe as those that might be expected to result from the worst-case, 1,000-year scenario associated with Tetra Tech's (2010) modeling, and they do provide spatial information regarding the affected stream length. If it is assumed that the 0.16 mile of lost stream length represents the maximum extent of impacts to PCE 1 (riparian vegetation), then that loss represents 1.3 percent of the 12.2 miles of critical habitat in the Cienega Creek watershed, 0.56 percent of the critical habitat in the 28.8-mile Santa Cruz Management Unit, and immeasurably small fractions of both the Gila Recovery Unit (of which the Santa Cruz Management Area is a subdivision) and the rangewide critical habitat designation. These small-scale effects are incapable of diminishing the Management Unit, Recovery Unit, or the critical habitat's respective abilities to contribute to the recovery of the species.

Table SWF-3. Summary of effects to streams within southwestern willow flycatcher critical habitat

	Upper Cienega Creek and the Narrows			
Years after mining	**Drawdown at perennial reach**	**Decrease in stream length (miles)**	**Decrease in baseflow (cfs)**	**Decrease in ET (afa)**
0	0	0	0	0
20	0	0	0	0
150	0	0	0	0
1,000	0.01	0.16	0.02	51

Cumulative Effects – Southwestern Willow Flycatcher

The primary cumulative effects to the riparian vegetation in which southwestern willow flycatchers occur and to the aquatic environment that supports an appreciable amount of the species prey are the stresses associated with decreases in water availability due to non-Federal actions. The aforementioned right-of-way vegetation maintenance activities conducted by Tucson Electric Power, which result in nearly-complete removal of riparian vegetation in the affected area of lower Cienega Creek (Pima County Regional Flood Control District 2009), are also a cumulative effect. This suite of cumulative effects were described in detail in the section containing descriptions of general effects to aquatic and riparian ecosystems and in the cumulative effects analysis for Gila chub; the findings in these prior analyses are incorporated herein via reference.

CONCLUSION

After reviewing the current status of the flycatcher and its critical habitat, the environmental baseline for the action area, the effects of the Rosemont Copper Mine, and the cumulative effects, it is the FWS's biological opinion that the Rosemont Mine, as proposed, is not likely to jeopardize the continued existence of the flycatcher, and is not likely to destroy or adversely modify designated flycatcher critical habitat. We present this conclusion for the flycatcher for the following reasons:

- We anticipate that the proposed action may result in immeasurably small losses of riparian vegetation in Empire Gulch and upper Cienega Creek from the conclusion of mining until 150 years later. We anticipate, however, that there will be appreciable losses of hydroriparian vegetation in Empire Gulch and lesser losses in upper Cienega Creek by 1,000 years after the conclusion of mining. Empire Gulch supported a likely southwestern willow flycatcher territory in 2011; upper Cienega Creek hosted a definitively-known territory in 2001. The low frequency of flycatcher breeding in the affected reaches makes it unlikely birds will be harmed or harassed by riparian vegetation losses resulting from implementation of the proposed action.

- The low number, infrequent detections, and lack of persistent flycatcher territories along Empire Gulch and upper Cienega Creek can be contrasted with the population numbers for the greater Gila Recovery Unit, which contained 659 territories as of 2008 (the last year for which comprehensive, area-wide surveys were conducted) (Durst *et al.* 2008, p. 12).
- Southwestern willow flycatcher critical habitat exists in Empire Gulch and along Cienega Creek; effects to the critical habitat parallel the effects to the species. The proposed action will likely result in a significant loss of riparian vegetation (PCE 1) within some portion of the 0.4-km (0.3-mi) upper segment and 1.3-km (0.8- mi) lower segment of Empire Gulch, with lesser effects in the 17.9-km (11.1-mi) segment of mainstem Cienega Creek.
- If the 0.16 mile of lost stream length at 1,000 years after mining calculated by Montgomery (2010) represents the maximum extent of impacts to PCE 1 (riparian vegetation), then it represents 1.3 percent of the 12.2 miles of critical habitat in the Cienega Creek watershed, 0.56 percent of the critical habitat in the 28.8-mile Santa Cruz Management Unit, and immeasurably small fractions of both the Gila Recovery Unit (of which the Santa Cruz Management Area is a subdivision) and the rangewide critical habitat designation. These small-scale, long-delayed effects are incapable of diminishing the recovery value of the Management Unit, Recovery Unit, or the total area designated as critical habitat. The proposed action therefore will not adversely modify or destroy southwestern willow flycatcher critical habitat.

The conclusions of this biological opinion are based on full implementation of the project as described in the Description of the Proposed Action and Description of the Proposed Conservation Measures sections of this document.

INCIDENTAL TAKE STATEMENT – SOUTHWESTERN WILLOW FLYCATCHER

Section 9 of the Act and Federal regulations pursuant to section 4(d) of the Act 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 further defined (50 CFR 17.3) 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. “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 of 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 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.

Amount or Extent of Take – Southwestern Willow Flycatcher

As demonstrated in the Environmental Baseline and Effects of the Proposed Action sections, above, southwestern willow flycatchers are unlikely to be harmed or harassed as a result of the proposed action. While available habitat within the project's action area may change due to reductions in groundwater elevations and surface water flows, these changes will occur on a relatively small scale over hundreds of years, and are not anticipated to disrupt the species' essential behavioral patterns. As discussed previously, habitat occupied by flycatchers is 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 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.

1. We recommend that the Forest Service and Rosemont Copper Company facilitate implementing more consistent flycatcher presence/absence surveys, including nest searching and monitoring along lower Empire Gulch, upper Cienega Creek, and the Santa Cruz Management Unit using the latest accepted protocols to better understand the status of the flycatcher within the overall action area and the Management Unit.

2. We recommend implementing long-term monitoring of groundwater resources in the Action Area, especially areas where the groundwater models were less than certain in their conclusions. We recommend employing a third party entity that has experience designing, collecting, and analyzing these types of data which can be held to high scientific scrutiny, such as the U.S. Geologic Survey. At a minimum, we recommend establishing baseline information to better understand how groundwater moves through the watershed, existing groundwater elevations, and other groundwater and surface water uses in the watershed, and subsequently tracking the Rosemont Copper Mine's use of water and its comparative impact to the watershed.

3. If impacts from Rosemont Mine are different from that those anticipated in this biological opinion, we recommend implementing measures to offset those impacts such as acquiring and retiring other water diversion or groundwater stressors.

Disposition of Dead or Injured Listed Species

Upon locating a dead, injured, or sick listed species initial notification must be made to the FWS's Law Enforcement Office (FWS OLE, Resident Agent In Charge, 4901 Paseo del Norte NE, Suite D, Albuquerque, New Mexico 87113; telephone: (505) 248-7889) 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 if possible, and any other pertinent information. The notification shall be sent to the Law Enforcement Office with a copy to this office. Care must be taken in handling sick or injured animals to ensure effective treatment and care, and in handling dead specimens to preserve the biological material in the best possible state.

REINITIATION NOTICE

This concludes formal and conference consultation on the actions outlined in your request. 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 retained (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 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 the listed species or critical habitat not considered in this opinion; or (4) a new species is listed or critical habitat designated that may be affected by the action. In instances where the amount or extent of incidental take is exceeded, any operations causing such take must cease pending reinitiation.

The Incidental Take Statements for the lesser long-nosed bat, jaguar, Chiricahua leopard frog, Gila chub, and Gila topminnow contain Reasonable and Prudent Measures and Terms and Conditions that implement those measures. We reiterate that such measures are non-discretionary, and must be included by the USFS as binding conditions of any grant or permit issued to the applicant, as appropriate, for the exemption in section 7(o)(2) to apply. The USFS has a continuing duty to regulate the activity that is covered by the respective Incidental Take Statements. If the USFS (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 Statements 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, the USFS, or the applicant 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)].

Regarding the proposed action’s effects to proposed jaguar critical habitat, you may request the FWS to confirm the conference opinion as a biological opinion issued through formal consultation if the jaguar critical habitat is designated. The request must be in writing. If the

FWS 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 FWS will confirm the conference opinion as the biological opinion on the project and no further section 7 consultation will be necessary.

In keeping with our trust responsibility to American Indian Tribes for an action proposed by an agency not in the Department of Interior, subject to section 7 consultation, that may affect Indian lands, tribal trust resources, or tribal rights, we encourage you to coordinate with the Tohono O'odham Nation and the Hopi, Pascua Yaqui, and Yavapai Apache tribes and the Bureau of Indian Affairs (BIA).

If you have questions or concerns about this consultation or the consultation process in general, feel free to contact Jean Calhoun (520) 670-6150 (x223) or Steve Spangle at (602) 242-0210 (x244). Please refer to consultation number 22410-2009-F-0389 in future correspondence concerning this project.

Sincerely,

/s/ Steven L. Spangle
Field Supervisor

cc (electronic):
Brenda Smith, Assistant Field Supervisor, Fish and Wildlife Service, Flagstaff, AZ
Jean Calhoun, Assistant Field Supervisor, Fish and Wildlife Service, Tucson, AZ
Marjorie Blaine, Senior Project Manager, U.S. Army Corps of Engineers, Tucson, AZ

Chief, Habitat Branch, Arizona Game and Fish Department, Phoenix, AZ
Raul Vega, Regional Supervisor, Arizona Game and Fish Department, Tucson, AZ

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Mexican Spotted Owl (see Appendix A)

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Appendix A: Concurrence for the Mexican Spotted Owl

Species Information

A complete description of the biology of the Mexican spotted owl appears in our November 2012 *Mexican Spotted Owl Recovery Plan, First Revision* (FWS 2012). The rangewide status of the species appears in our April 11, 2013, *Biological Opinion on the Aravaipa Ecosystem Management Plan* (File number 02EAAZ00-2012-F-0282).

Background for Determination of Effects:

The action area for this analysis is based on: (1) the area of the mine footprint; (2) areas outside the mine footprint that may be affected by noise, dust, light pollution, and other mining activities; (3) all areas for which mining activity may affect groundwater and surface water; and (4) other areas outside the footprint that are related to mining activity, such as road modifications, power lines, and pipelines (i.e., connected actions). The action area totals approximately 145,513 acres, including the footprints of the Barrel Alternative and utility corridor. The action area is located primarily in Pima County, but also encompasses a small portion of Santa Cruz County; 65,215 acres within the action area are on Forest Service and Bureau of Land Management (BLM) lands, and the remaining 80,298 acres within the action area on Arizona State Land Department State Trust land and private land. The larger action area was drawn to consider the impacts of noise, dust, light pollution, groundwater drawdown, and surface water reduction.

There are three Mexican spotted owl protected activity centers (PACs) adjacent to the larger action area (see Table MSO-1, below). The project area does not contain Mexican spotted owl nest/roost habitat as defined in the Recovery Plan for the Mexican spotted owl (FWS 2012). The Coronado National Forest compiled all known Mexican spotted owl locations from the Santa Rita Mountains, and there are no records of owls within the action area. The closest occupied area is the Ramanote Canyon PAC, which is located approximately 0.7 mile to the west-southwest. The larger action area includes approximately 430 acres of critical habitat unit BR-W-12.

Table MSO-1. Mexican spotted owl PACs near the action area for the Rosemont Project.

PAC Name (Number)	Distance from Project Area	Distance from Action Area
Ramanote Canyon (#0502019)	4.8 miles	0.7 mile
Sawmill Canyon (#0502013)	5.6 miles	1.3 miles
Florida Spring (#0503001)	6.4 miles	2.5 miles

Determination of Effects:

We concur with your determination that the proposed action may affect, but will not likely adversely affect, the Mexican spotted owl. We base our concurrence on the following:

- The proposed action will not directly affect the key habitat components of Mexican spotted owl nest/roost habitat. The project and action areas contain desert, semi-desert grasslands, and Madrean encinal woodlands, which are not habitats used by Mexican spotted owls for nesting and/or roosting (FWS 2012).
- The project area is located approximately 4.8 miles northeast of the nearest PAC and the action area is located approximately 0.7 mile northeast of the nearest PAC. Therefore, the project will not result in noise disturbance to Mexican spotted owls during the breeding season (March 1 through August 31).
- The aforementioned level of effects are insignificant and discountable and will not reduce the potential to achieve recovery of the Mexican spotted owl.
- There is no Mexican spotted owl critical habitat in the action area; therefore, none will be affected.

United States Department of the Interior

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In Reply Refer to:
AESO/SE
22410-2009-F-0389R1

April 28, 2016

Kerwin Dewberry, Forest Supervisor
Coronado National Forest
300 West Congress Street
Tucson, Arizona 85701

RE: Amended Final Reinitiated Biological and Conference Opinion for the Rosemont Copper Mine, Pima County, Arizona

Dear Mr. Dewberry:

Thank you for your May 25, 2015, letter, which transmitted your May 2015 *Third Supplement to the Biological Assessment for the Rosemont Copper Project* (SBA). Your letter and the SBA were received by us via electronic mail on the same date, and together they constitute a request to reinitiate formal interagency consultation and conference pursuant to section 7 of the Endangered Species Act of 1973 (16 U.S.C. 1531-1544), as amended (Act) on our October 30, 2013, *Final Biological and Conference Opinion for the Rosemont Copper Mine, Pima County, Arizona* (October 2013 BO).

Your May 25, 2015, letter and SBA include determinations that the proposed action may affect, and will likely adversely affect, the threatened Chiricahua leopard frog (*Lithobates chiricahuensis*) (with critical habitat), the threatened northern Mexican gartersnake (*Thamnophis eques megalops*) (with proposed critical habitat), the endangered desert pupfish (*Cyprinodon macularius*), the endangered Gila chub (*Gila intermedia*) (with critical habitat), the endangered Gila topminnow (*Poeciliopsis occidentalis occidentalis*), the endangered jaguar (*Panthera onca*) (with critical habitat), the endangered ocelot (*Felis pardalis*), the endangered lesser long-nosed bat (*Leptonycteris curasoae yerbabuenae*), the endangered southwestern willow flycatcher (*Empidonax traillii extimus*) (with critical habitat), the threatened western yellow-billed cuckoo (*Coccyzus americanus*) (with proposed critical habitat), the endangered Huachuca water umbel (*Lilaeopsis schaffneriana* var. *recurva*) (with critical habitat), and the endangered Pima pineapple cactus (*Coryphantha scheeri* var. *robustispina*). Your May 2015 SBA also includes the determinations that the proposed action: (1) may affect, but is not likely to adversely affect the threatened Mexican spotted owl (*Strix occidentalis lucida*) or its critical habitat; and (2) have no effect on the nonessential experimental population of the Mexican gray wolf (*Canis lupus baileyi*).

This final biological and conference opinion (BO) is based on information provided in: (1) your May 2015 SBA; (2) your May 2015 *Supplemental Information Report, Rosemont Copper Project* (SIR); (3) Rosemont Copper's September 26, 2014 *Habitat Mitigation and Monitoring Plan, Permit No. SPL-2008-00816-MB* (HMMP); (3) your December 2013, *Final Environmental Impact Statement* (FEIS) for the Rosemont Copper Project; (4) our October 30, 2013, Final BO; (5) your February 2013 *Supplement to the Biological Assessment – Proposed Rosemont Copper Mine - Santa Rita Mountains, Pima County, Arizona - Nogales Ranger District* (Second Supplemental BA); (6) your October 2012 *Supplement to the Biological Assessment, Proposed Rosemont Copper Mine, Santa Rita Mountains, Arizona, Coronado National Forest* (First Supplemental BA); (7) the results of discussions and exchanges of scientific information between our respective agencies, other Federal, State, and local agencies, the Rosemont Copper Company (Rosemont), and consultants; and (8) other published and unpublished sources of information. Literature cited in this biological opinion is not a complete bibliography of all literature available on the threatened and endangered species at issue, the effects of the action on those species and their critical habitats, or on other subjects considered in this opinion. A complete administrative record of this consultation is on file at this office.

The U.S. Fish and Wildlife Service (FWS) and the National Marine Fisheries Service (NMFS) published a Final Rule on February 11, 2016 (81 FR 7214), revising the definition for destruction or adverse modification of critical habitat in the Act's implementing regulations at 50 CFR 402.02. Specifically, we finalized the following regulatory definition: "Destruction or adverse modification means a direct or indirect alteration that appreciably diminishes the value of critical habitat for the conservation of a listed species. Such alterations may include, but are not limited to, those that alter the physical or biological features essential to the conservation of a species or that preclude or significantly delay development of such features." This revised definition will be applied to the applicable critical habitat analyses in this consultation and supersedes the November 30, 2015, Draft BO's reliance 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), which we used, at that time, to complete our analyses with respect to critical habitat.

Furthermore, FWS and NMFS published a Final Rule on May 11, 2015 (80 FR 26832- 26845), amending the incidental take statement provisions of the implementing regulations for section 7 of the Act (50 CFR 402.02 and 402.14) to: (1) to refine the basis for development of incidental take statements for programmatic actions; and (2) address the use of surrogates to express the amount or extent of anticipated incidental take. The subject action is site-specific, not programmatic; therefore, the former amendment is not applicable. The latter amendment, however, is directly relevant to this consultation. We note that our October 2013 BO on the subject action already incorporated surrogate measures of take for affected species, and this practice has been implemented in this biological opinion as well.

Lastly, in reaching our findings that there is a reasonable certainty that lesser long-nosed bat, Chiricahua leopard frog, northern Mexican gartersnake, Gila chub, Gila topminnow, desert pupfish, jaguar, ocelot, western yellow-billed cuckoo, and southwestern willow flycatcher, will be incidentally taken, we considered the following:

- Section 9 of the Act and our implementing regulations in the Code of Federal Regulations (CFR) at 50 CFR part 17 prohibit the ``take" of fish or wildlife species listed as endangered or threatened.

- Take of listed fish or wildlife is defined under the Act as ``to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or to attempt to engage in any such conduct".
- The term ``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).
- The term ``harm" is defined in the regulations as ``an act which actually kills or injures wildlife. Such act may include significant habitat modification or degradation where it actually kills or injures wildlife by significantly impairing essential behavioral patterns, including breeding, feeding, and sheltering" (50 CFR 17.3).

"Incidental take" refers to takings that result from, but are not the purpose of, carrying out an otherwise lawful activity conducted by the Federal agency or applicant" (50 CFR 402.02).

Consultation History

October 30, 2013: We transmitted the Final Biological and Conference Opinion for the Rosemont Copper Mine, Pima County, Arizona (File Number 22410-2009-F-0389) to you. The October 30, 2013, Final BO concluded that the then-proposed action would not jeopardize the Gila chub (*Gila intermedia*), Gila topminnow (*Poeciliopsis occidentalis occidentalis*), Huachuca water umbel (*Lilaeopsis schaffneriana* subsp. *recurva*), southwestern willow flycatcher (*Empidonax traillii extimus*), Chiricahua leopard frog (*Lithobates chiricahuensis*), lesser long-nosed bat (*Leptonycteris curasoae yerbabuenae*), jaguar (*Panthera onca*), ocelot (*Leopardus pardalis*), and Pima pineapple cactus (*Coryphantha scheeri* var. *robustispina*). We also concluded that the proposed action would not destroy or adversely modify the critical habitat for Gila chub, Huachuca water umbel, southwestern willow flycatcher, Chiricahua leopard frog or, in conference, the jaguar's proposed critical habitat. We further concurred with your determination that the proposed action was not likely to adversely affect the Mexican spotted owl (Strix occidentalis lucida) or its critical habitat. The then-proposed northern Mexican gartersnake (*Thamnophis eques megalops*) and yellow-billed cuckoo (*Coccyzus americanus*) were not included in conference.

December 13, 2013: You published your Final Environmental Impact Statement (FEIS) for the proposed action. The FEIS was accompanied by the *Draft Record of Decision and Finding of Nonsignificant Forest Plan Amendment for the Rosemont Copper Project* (ROD); the proposed action is not final unless and until the ROD is signed.

March 5, 2014: We published a Final Rule designating critical habitat for the jaguar (79 FR 12572).

March 5, 2014: We participated in a conference call with your staff and staff of the Environmental Protection Agency (EPA) regarding substantive differences in the hydrologic analyses found in the FEIS and the hydrology that formed the basis of many of the effects analyses in our October 30, 2013, BO.

March 21, 2014: We participated in a meeting with your staff as well as the EPA to discuss the differences in the hydrology disclosed in the FEIS and that used for the analysis in the October 13, 2103, BO. This meeting precipitated the eventual formation of a hydrology working group composed of members of your staff, Federal and County agencies, and consulting scientists.

May 16, 2014: We transmitted a letter to you with respect to the need to reinitiate formal consultation on the proposed action (File Number 22410-2009-F-0389). We stated that reinitiation was warranted due to: (1) substantive differences in the effects analysis in the October 30, 2013, Final BO and the impact analysis in the FEIS; (2) the listing of additional species not considered in the initial consultation; (3) adoption of conference; and (4) the detection of an ocelot within the action area.

May 28, 2014: We attended a meeting with your staff wherein we were informed that you would be preparing a Supplemental Information Report (SIR) in order to evaluate new information and changed conditions that had come to your attention. Meetings associated with the SIR and revised BA process occurred semi-regularly from this date until shortly before the Draft SIR was transmitted (see below).

July 8, 2014: We published a Final Rule listing the northern Mexican gartersnake as a threatened species (79 FR 38678).

October 3, 2014: We published a Final Rule listing the western yellow-billed cuckoo as a threatened species (79 FR 59992).

November 24, 2014: We received the September 26, 2014, HMMP from WestLand Resources, Inc. (WestLand), consultants for the Rosemont Copper Company.

March 1, 2015: We received your draft February 2015 *Supplemental Information Report - Rosemont Copper Project* (Draft SIR).

March 10, 2015: We transmitted an electronic mail to your staff indicating that consultation on the effects of the proposed action was not necessary for the non-essential, experimental population of Mexican grey wolf.

March 25, 2015: We transmitted our *Review of the Draft February 2015 Supplemental Information Report - Rosemont Copper Project* (Draft SIR Review) (File Number 22410-2009-F-0389).

May 22, 2015: We received the final version of your May 2015 SIR.

May 25, 2015: We received your request for reinitiation of formal consultation, accompanied by the May 2015 SBA.

May 28, 2015: We received correspondence from the U.S. Army Corps of Engineers (Corps) requesting that we consider the September 26, 2014, HMMP in this consultation.

June 22, 2105: We transmitted a letter (File Number 22410-2009-F-0389-R001) to you stating that we had reviewed the May 2015 SBA and determined that all information required of you to initiate formal consultation required by the regulations governing section 7(a)(2) interagency consultation at 50 CFR §402.14 had been provided. Our letter also provided notice that, pursuant to section 7(d) of the Act, you were not to make any irreversible or irretrievable commitment of resources which would have the effects of foreclosing the formulation or implementation of any reasonable and prudent alternative measures which would not violate section 7(a)(2) and would avoid jeopardizing the continued existence of endangered or threatened species or destroying or adversely modifying their critical habitats. We concluded by stating that we anticipated providing you with a draft BO by August 23, 2015, a final BO by October 7, 2015, and indicating that a request for an extension was likely.

August 18, 2015: We transmitted a written request for a 60-day extension, revising the Draft BO due date to October 22, 2015, and the Final BO due date to December 6, 2015.

September 11, 2015: We received your letter granting the 60-day extension we requested on August 18, 2015.

October 16, 2015: Based on agreements made during an October 14, 2015, meeting with you, Corps staff, and representatives of the Rosemont Copper Company and HudBay Minerals, we transmitted a written request for an additional 30-day extension, this time revising the Draft BO due date to November 30, 2015, and the Final BO due date to January 22, 2016.

November 30, 2015: We transmitted our Draft Reinitiated Biological and Conference Opinion for the Rosemont Copper Mine, Pima County, Arizona (File Number 22410-2009-F-0389R1) to you and the Corps.

December 4, 2015: We receive a telephone call from the FS noting jurisdictional issues related to the November 30, 2015, Draft BO.

December 14, 2015: We received a copy of correspondence between Rosemont and your agency detailing concerns and comments on the November 30, 2015, Revised Draft BO, including; (1) question with respect to the methodologies used to calculate effects to threatened and endangered species; and (2) issues regarding the FS jurisdiction with respect to the Reasonable and Prudent Measures.

December 21, 2015: We received a copy of correspondence between Rosemont and your agency containing specific comments on the November 30, 2015, Revised Draft BO.

December 21, 2015: We transmitted a letter that documented the progress and agreements made during the December 2015 meetings and establishing revised timelines for the transmittal of a Revised Draft BO (January 22, 2016) and a Final BO (February 26, 2016).

December 16, 2015 to January 29, 2016: Your biological resource staff coordinated review comments and revisions with FWS species lead biologists. In addition, potential conservation measures to offset take were discussed with Rosemont Copper Company and your staff. The proceedings of these efforts are contained in our administrative record.

January 8, 2016: We transmitted a preliminary version of the Revised Draft BO to you and the Corps.

January 22, 2016: We received an electronic mail from your staff transmitting the Rosemont's January 20, 2015, proposed Conservation Measures offered in lieu of certain aquatic and riparian species' Terms and Conditions appearing in the November 30, 2015, Draft BO.

February 1, 2016: We received your comments on the Reasonable and Prudent Measures, Terms and Conditions, and Conservation Recommendations for the threatened and endangered species analyzed in the January 22, 2016, Draft BO.

February 3, 2016: We met with your staff, SWCA, Rosemont, and WestLand to discuss the contents of the January 22, 2016, Draft BO.

February 5, 2016: We received your preliminary technical comments on the November 30, 2015, Draft BO for consideration in the Revised Draft BO.

February 6, 2016: We received an electronic mail message from Fennemore Craig, outside legal counsel to Rosemont, transmitting a December 21, 2015, review of the November 30, 2015, Draft BO.

February 9 and 11, 2016: Our respective staffs, SWCA, Rosemont, and WestLand participated in workshops to clarify the effects analyses in the January 22, 2016, Draft BO and to discuss the development of Conservation Measures.

February 10, 2016: We received an electronic mail message from SWCA, Inc. staff, transmitting suggested edits to the Sources of Uncertainty subsection of the Effects to Aquatic Ecosystems section.

February 11, 2016: We received a courtesy copy of a letter from Rosemont to the Coronado NF in which Rosemont's draft proposed Conservation Measures in lieu of aquatic and riparian species Terms and Conditions were described.

February 16, 2016: We received WestLand's letter containing detailed comments on the use of groundwater model predictions used in the November 30, 2015, Draft BO; comprehensive comments on the overall content of the BO; and information regarding yellow-billed cuckoo habitat along Davidson Canyon and Cienega Creek.

February 18, 2016: We received a detailed description of the Sonoita Creek Ranch conservation measure and detailed information regarding our jaguar effects analysis from WestLand. Due to internal FWS electronic mail difficulties, an additional copy was provided on February 18, 2016.

February 23, 2016: We transmitted an electronic mail message to you containing our input on the February 11, 2016, draft Conservation Measures.

February 24, 2016: We received a copy of a letter you transmitted to Rosemont. Your letter included suggested revisions to Rosemont's February 11, 2016, Conservation Measure letter.

February 24, 2016: We received a courtesy copy of a letter from Rosemont to the Coronado NF in which the final proposed Conservation Measures were described (Rosemont 2016a).

March 3, 2016: We transmitted a Revised Draft BO to you.

March 8, 2016: Our staffs discussed, via telephone and electronic mail, specific comments related to conservation measures and the treatment of climate change as a component of baseline conditions in the Revised Draft BO.

March 10, 2016: We received Rosemont's comprehensive comments on the March 3, 2016, Revised Draft BO via electronic mail.

March 15, 2016: We received your initial, technical comments on the March 3, 2016, Revised Draft BO.

March 17, 2016: We received written comments from the Corps via electronic mail.

March 18, 2016: We received, via electronic mail, a written commitment by Rosemont to pursue conservation measures at Sonoita Creek Ranch and other sites regardless of Corps' ultimate determination regarding its wetland mitigation value. The full implementation of such conservation measures was stated to be contingent on receipt of a Department of the Army (Clean Water Act section 404) Permit form the Corps and approval of a Final Mine Plan of Operations from your agency. The latter action is the ultimate result of your approval of the proposed action (Rosemont 2016b).

March 25, 2016: We received, via electronic mail, your substantive comments on the March 3, 2016, Revised Draft BO as well as your review of Rosemont's March 10, 2016, comprehensive comments.

April 22, 2016: We transmitted our Final BO to you via electronic mail.

April 27, 2016: We received your additional comments on our April 22, 2016 Final BO via electronic mail.

April 28, 2016: We transmitted this amended Final BO to you via electronic mail. The amended Final BO addressed your April 27, 2016, comments to the extent we determined was appropriate; incorporated additional text with respect to the status of the respective draft recovery plans for the Huachuca water umbel and Pima pineapple cactus; and included refinements to the reach-scale acreages of affected riparian habitat in the yellow-billed cuckoo and southwestern willow flycatcher analyses.

BIOLOGICAL OPINION

Description of the Proposed Action

The proposed action, known as the Barrel Alternative (including the proposed conservation measures), was described in detail in the October 30, 2013, BO, and is incorporated herein via reference, with the exception of the changes (to both the proposed action and conservation measures) described below.

The May 2015 SBA employs both the terms *project area* and *action area*. The term project area is defined as all areas in which any ground disturbance would take place as a result of the proposed project, the Barrel Alternative (i.e., the preferred alternative, chosen by the Coronado National Forest Supervisor), including the mine pit, waste rock piles, tailings, access roads, utility corridors, and onsite facilities (i.e., the mine “footprint”). The project area acreage, expected to result in direct impacts owing to project activities, is 5,431 acres.

The May 2015 SBA defined the action area as the project area *plus* a larger, surrounding area that may experience direct or indirect temporal and spatial impacts from the project. This corresponds well with the action area definition appearing in the *Endangered Species Consultation Handbook* (FWS and National Marine Fisheries Service 1998), which is: [all] areas to be affected directly or indirectly by the Federal action and not merely the immediate area involved in the action.

Temporally, the potential onsite and offsite impacts resulting from the proposed project encompass all the activities associated with mine construction, operation, reclamation, and postclosure, as well as conservation measures. The action area for this analysis is based on: (1) the area of the mine footprint; (2) areas outside the mine footprint that may be affected by noise, dust, light pollution, and other mining activities; (3) all areas for which mining activity may affect groundwater and surface water; and (4) other areas outside the footprint that are related to mining activity, such as road modifications, power lines, and pipelines (i.e., connected or interrelated/interdependent actions). Thus defined, the action area totals approximately 146,163 acres, including the project area. The action area is located primarily in Pima County but also encompasses a small portion of Santa Cruz County; 65,289 acres are on Forest Service and Bureau of Land Management (BLM) lands, and the remaining 80,874 acres within the action area are on Arizona State Land Department State Trust land and private land. The methodology for determining the action area was discussed in the January 2012 deliberative *Draft Biological Assessment, Rosemont Copper Project, Santa Rita Mountains, Nogales Ranger District*, and subsequently refined in the October 2012 SBA and February 2013 SBA.

The acreages of the project and action areas are based on those found in the FEIS where the action area for purposes of Section 7 consultation is equivalent to the biological analysis area delineated for purposes of the National Environmental Policy Act (NEPA) process, and these acreages have changed since they were last mentioned in the October 2012 SBA based on refinements to the number of acres disturbed in the project area for utility line corridors and Forest Service road creation and decommissioning. The project area is 64 acres larger in the FEIS than in the October 2012 SBA (an approximately 1 percent change); the action area is 37 acres larger in the FEIS than in the October 2012 SBA (an approximately 0.03 percent change). Table 1 shows the updated breakdown of impacts as described in the FEIS.

Table 1 (adapted from Table 1 in the May 2015 SBA): Directly affected acreage in the project area by disturbance element.

Disturbance Element	Direct Effect (acres disturbed)
Security fence disturbance area – all area within security fence	4,228
Primary access road corridor - 600 feet wide to allow for designed cut areas (outside security fence)	226
Utility line corridor –500 feet wide for transmission with others co-located – water line and utility maintenance road – 150-foot corridor where not within transmission line, except for the designated 30- to 40-foot easement or ROW (outside security fence)	899
Road disturbance– outside security fence New Roads – 100 feet wide; Decommissioned Roads – 14 feet wide	39 20
Arizona National Scenic Trail – 8 feet wide trail plus trailheads	19
Total Disturbance Area (acres)	5,431

For the purpose of section 7 consultation, the action area also includes lands proposed for acquisition (or already acquired) and areas in which conservation measures will be implemented (see Table 2, below).

The action area includes 4,827 acres in which land acquisition-based conservation measures (see below) will be implemented, including: Sonoita Creek Ranch (1,580 acres); and the Davidson Canyon (545 acres), Helvetia Ranch Annex North (939 acres) and Fullerton Ranch (1,763) parcels.

We have also anticipated that no less than 31 acres of hydroriparian habitat will be restored at a to-be-determined location (see Table YBCU-6 and its supporting narrative in the effects analyses for the yellow-billed cuckoo, below) in association with implementation of Revised Conservation Measure 3 – Western Yellow-Billed Cuckoo and Southwestern Willow Flycatcher Habitat Enhancement and Monitoring, Surveying, and Conservation Property Management. Once site selection for this riparian restoration is complete, the parcel(s) will be included in the action area.

The action area also includes National Forest System lands on the Sierra Vista Ranger District of the Coronado National Forest in which a portion of Revised Conservation Measure 2 – Harmful Nonnative Species Management and Removal will be implemented to benefit the Huachuca water umbel (see effects analysis, below). Based on the taxon's occurrences (which are larger than the actual area occupied by plants; again, see the effects analysis for details), we anticipate that 538 acres of land encompassing the Sunnyside (125 acres); Turkey Creek (45 acres); Bear/Lone Mountain (107 acres); Scotia (189 acres); O'Donnell (10 acres); Sycamore (8 acres); and Cave Creek (46 acres) Huachuca water umbel occurrences will be affected.

The action area also conceptually includes portions of the San Rafael Valley and the Huachuca and Patagonia mountains, necessitated by the eventual implementation of Revised Conservation Measure 2 – Harmful Nonnative Species Management and Removal to benefit the northern Mexican gartersnake, Chiricahua leopard frog, Gila chub, Gila topminnow, and desert pupfish (see the respective effects analyses, below). There are no definitive acreage values for the portion of Revised Conservation Measure 2 for these vertebrate species, but future unanticipated effects will be analyzed and evaluated within the framework of this Final Biological Opinion prior to implementation.

Table 2: Acreage affected directly and indirectly by the implementation of off-site Conservation Measures (i.e. not within the action area defined by adverse effects in Table 1, above).

Conservation Measure	Effect (acres)
Sonoita Creek Ranch	1,580
Davidson Canyon	545
Helvetia Ranch Annex North	939
Fullerton Ranch	1,763
Revised Conservation Measure 3 (Hydroriparian Habitat Enhancement)	≥ 31
Revised Conservation Measure 2 (Harmful Nonnative Species Management and Removal to benefit Huachuca water umbel)	538
Revised Conservation Measure 2 (Harmful Nonnative Species Management and Removal to benefit vertebrate species)	TBD
Total Disturbance Area	≥ 5,396

Summary of Other Sources of New Information

The May 2015 SBA is only the most recent document considered in this BO. The May 2015 SBA is additive to the SIR, June 2012 BA, October 2012 SBA, and February 2013 SBA (see the Consultation History in our October 30, 2013 BO).

Much of the information that has changed subsequent to our October 30, 2013, BO is related to changes in the on-the-ground and/or listing status for threatened and endangered species, including the yellow-billed cuckoo, northern Mexican gartersnake, Chiricahua leopard frog, Mexican gray wolf, jaguar, and ocelot. The new information appears in these species' respective Status of the Species and/or Environmental Baseline sections.

New documents—primarily from the Bureau of Land Management (BLM), Pima County, and FWS, but also including the final report for the Frog and Fish Restoration Outreach Group Conservation Project (FROG Project), occurrence records from University of Arizona wildlife cameras, and new species-specific surveys conducted in the action area—have changed the baseline for some of the species within the action area, adding new documented occurrences and in some cases providing new trend analyses. The new information also appears, as appropriate, in the respective Status of the Species and/or Environmental Baseline sections.

Lastly, we reiterate that the proposed conservation measures described in the October 30, 2013, Final BO remain part of the proposed action. They are incorporated here by reference, except as noted below or as modified by Reasonable and Prudent Measures and Terms and Conditions for species incidentally taken by implementation of the proposed action.

U.S. Army Corps of Engineers Habitat Mitigation and Monitoring Plan

The U.S. Army Corps of Engineers' (Corps) September 2014 Habitat Mitigation and Monitoring Plan (HMMP) contains the Rosemont Copper Company's proposed mitigation to offset impacts to Waters of the United States. The HMMP post-dates the October 30, 2013, BO, and was therefore not specifically analyzed. Our initial BO did, however, include analyses of various mitigation sites proposed in varying levels of detail by the Rosemont Copper Company.

Our analysis of HMMP implementation appears here as a separate section, but we recognize that its implementation is relevant to both the preceding Effects to Aquatic Ecosystems and Effects to Riparian Ecosystems sections, as well as to effects analyses individual threatened and endangered species.

The HMMP must be approved by the Corps as part of the proponent's pursuit of a Department of the Army Permit (also referred to as a Clean Water Act Section 404 Permit). We note, as stated in Rosemont's March 18, 2016, letter (see Consultation History, above) (Rosemont 2016b), that implementation of the conservation measures within the HMMP is contingent on both the issuance of a permit by the Corps as well as your approval of a Mine Plan of Operations. The March 18, 2016, letter concludes, in part, by stating "…we will record appropriate conservation easements to ensure the protection of resources and future conservation value of these properties, regardless of whether a particular parcel is accepted as mitigation by the Corps." We thus consider that implementation of all aspects of the HMMP relevant to threatened and endangered species is reasonably certain to occur.

We are also aware that the ecosystem restoration proposed for the Sonoita Creek Ranch may involve its own impacts to Waters of the United States thus likely to require additional Corps permitting prior to implementation. Given the likely presence of threatened and endangered species on the Sonoita Creek Ranch property, it may also require section 7 consultation.

Several components of the proposed Section 404 mitigation have changed since they were discussed in the previous BA and SBAs. These include additional acreage and a more-detailed restoration design at Sonoita Creek Ranch, and the incorporation of additional acreage on the Davidson Canyon parcels. The Fullerton Ranch parcel represents a new conservation measure in terms of section 7 consultation; it appeared in the May 2015 SBA and thus was not analyzed in the October 30, 2013 BO.

All descriptions of proposed mitigation stated in the June 2012 BA, February 2013 SBA, and October 30, 2013 BO are incorporated by reference, as are the contents of the February 24, 2016 and March 18, 2016 Rosemont letters (Rosemont 2016a and 2016b, respectively). The following subsections describe changes to those prior descriptions.

Lastly, it must be noted that HMMP-related actions are considered conservation measures for effects to threatened and endangered species as an adjunct their primary intended purpose as Clean Water Act mitigation measures. Further, their status as both proposed conservation measures and as a part of the Federal action undertaken by the Corps means that the parcels are part of the action area for this consultation.

Sonoita Creek Ranch

There are two substantive changes to this mitigation component as analyzed in the FEIS and October 30, 2013 BO; (1) the acreage to be enhanced has increased from 1,200 acres to 1,580 acres; and (2) a detailed restoration plan has been prepared (see below). We note in advance that the beneficial effects described in this section represent the intentions of the Proponent (Rosemont Copper), and are not to be considered effects analyses. The respective Effects of the Proposed Action sections for the species mentioned herein represent our definitive findings on proposed conservation measures' effects.

The Sonoita Creek Ranch Conservation Measures appearing below were received by us on February 24, 2016 (see Consultation History, above) (Rosemont 2016a) , after having been revised based on the input of the U.S. Army Corps of Engineers (Corps), with additional clarifying text provided by USFS and FWS.

1. Rosemont has acquired the right to purchase Sonoita Creek Ranch, which contains approximately 1,580 acres of land along Sonoita Creek with an estimated 590 acre-feet per annum (AFA) of certificated surface water rights from Monkey Spring along Sonoita Creek. The Sonoita Creek Ranch parcel is part of the intended Conservation Measures for the northern Mexican gartersnake, Chiricahua leopard frog, Gila chub, Gila topminnow, Huachuca water umbel, lesser long-nosed bat, jaguar, ocelot, and yellow-billed cuckoo. The Sonoita Creek Ranch lands will be restored by Rosemont to a more natural condition from the current agricultural state. These restoration activities have been designed to meet, in part, the requirement to mitigate for impacts to potential waters of the U.S., in conformance with the Corps' 2008 mitigation rule (73 FR 19594). Regardless of whether the Sonoita Creek Ranch restoration activities ultimately provide mitigation for impacts to potential waters of the U.S., Sonoita Creek Ranch will be managed for conservation purposes, as stated below.
2. In the event that the property is approved for potential waters of the U.S. mitigation, it is not anticipated that the wildlife conservation benefits described below will be affected. If modification of any conservation measure is ultimately determined to be required, Rosemont will propose a modification for review and comment by the Corps and USFS to modify the conservation measures in a manner that would not change the evaluation for each species and

which would result in the same benefits for each species but would not conflict with Section 404 mitigation requirements.

3. Rosemont will record a restrictive covenant (as stated in the HMMP) or conservation easement (started in Rosemont’s March 16, 2016 letter) on the Sonoita Creek Ranch property that precludes real estate development and similar land use activities and livestock grazing and other agricultural uses subject to the limitations described below. This restrictive covenant shall not restrict access to these lands for recreational or traditional cultural purposes provided that these uses are not incompatible with the conservation uses of the property as determined by the Corps, FWS, and Land Manager (if the latter is designated). Also note that a Restrictive Covenant won’t involve a Land Manager as a Conservation Easement does, but the Restrictive Covenant approach will allow Rosemont Copper to convey the property to a conservation agency with Corps approval. Prior to such conveyance, Rosemont would be the responsible party. In addition, it is in the Corps’ purview to determine and negotiate allowable uses; current Corps requirements preclude off road vehicles, horseback riding, biking, hunting or fishing.
4. Rosemont anticipates transferring ownership of Sonoita Creek Ranch, including the appurtenant water rights, to a suitable owner for conservation purposes consistent with the conservation and public benefits contemplated by these conservation measures. The transfer of ownership will follow Rosemont's demonstration to the Corps that the success criteria for mitigation of impacts to potential waters of the U.S. have been met.
5. Funding for long-term management will be accomplished through the establishment of both a wasting and non- wasting endowment(referred to as the Dedicated Accounts) subject to approval by the Corps . Rosemont will pay into that account adequate funds to cover the normal long-term management and maintenance activities. Establishment of the long-term wasting and non-wasting accounts shall be in accordance with 33 CFR 332.7 (d). Until the Dedicated Account is fully funded, Rosemont shall provide all funds necessary to conduct required annual management, maintenance, and monitoring activities. Prior to the time that the Dedicated Account is fully funded, the monies from the Dedicated Account will not be used for any management, maintenance, or monitoring activities. Fence replacement actions completed during the Dedicated Account establishment period will be funded by Rosemont with funds other than the funds used to establish the Dedicated Account. An alternative financial assurance mechanism to that described above may be utilized if approved in advance by Rosemont and the Corps. Please note that this funding is distinct from, and cannot be co-mingled with, the amounts described in Revised Conservation Measures 1, 2, and 3.
6. Restoration activities to be implemented at Sonoita Creek Ranch are as described below. Rosemont will fund the construction of the restoration project. Additional detailed information is located in the Rosemont Copper Project: Revised Habitat Mitigation and Monitoring Plan (September 26, 2014).

    a. Re-establish Sonoita Creek floodplain. Sonoita Creek has been altered over much of its length along State Route 82 between Sonoita and Patagonia to accommodate the highway, smaller access and private roads, and agricultural and ranching developments in the valley. Alterations include realigning, straightening and deepening the channel (or berming its banks) to prevent flows from impinging upon roads and fields. The altered reaches confine flows to a high-capacity channel that maximizes flow velocity and exacerbates both incision and bank instability through scour and degradation. In some places Sonoita Creek's realignment has left tributary inflows without a clear path to a confluence with Sonoita Creek.

As part of the site restoration efforts, Rosemont will construct a minimum of 3.8 miles of new ephemeral channel through historic agricultural fields in order to direct a portion of Sonoita Creek flows back into the Sonoita Creek historic floodplain. The construction of these channels will also allow for the rehabilitation of approximately 5.7 miles of the existing Sonoita Creek channel by directing high flows into the parallel, meandering constructed channels, reducing the volume and velocity of degrading high flows through the primary channel. Channel improvements are intended to result in a more stable channel, which would enhance multiple ephemeral channel functions, including energy dissipation, sediment transport, and habitat connectivity.

The agricultural fields will be retired, recontoured, and reseeded with a mix of native forbs, grasses, shrubs, and trees. In addition, approximately 8,400 xeroriparian trees (anticipated to be mostly *Prosopis velutina*) will be planted along the slopes and adjacent floodplain of the constructed channels to facilitate the development of a xeroriparian corridor within the entirety of the Sonoita Creek floodplain. The intended success of this restoration effort can be seen in previously abandoned agricultural fields in portions of the ranch property, where mature stands of native mesquite have developed over the last 40 years. Downstream of the agricultural fields, Sonoita Creek flows will be restored to a portion of the relatively rare mesquite-sacaton grasslands already established at, and south of, the mouth of Corral Canyon. In addition, the Sonoita Creek Ranch restoration project intends to preserve a cottonwood gallery near the south end of the property.

The total area of restored floodplain within Sonoita Creek Ranch is approximately 730 acres, and is intended to provide substantial, landscape-scale habitat benefits to a number of wildlife species. In particular, planting, reseeding, and reestablishment of flood flows throughout the floodplain are intended to provide habitat for the western yellow-billed cuckoo.

b. Enhancement of two ponds. Two ponds at the north end of the Sonoita Creek Ranch property function as part of an agricultural irrigation system, supplied with water from Monkey Springs. The northernmost pond, which is higher in elevation, fills first and overflows into the lower pond. Overflow water from the lower pond is controlled by an existing structure that diverts water into the irrigation canal serving the agriculture fields. Both ponds are also plumbed at their downstream ends to facilitate draining for pond maintenance. Flow data collected over the last eight months show an average monthly flow volume of 16.2 million gallons of spring water reporting to the pond system; this is as-stated by Rosemont, FWS does not possess these data.

   Rosemont will renovate the ponds with the intent to support recovery efforts for sensitive species, including, as appropriate, northern Mexican gartersnake, Chiricahua leopard frog, Gila chub, Gila topminnow, northern Mexican gartersnake, and Huachuca water umbel. The current configuration of the ponds, with relatively deep pools and open water, supports sport fish and invasive bullfrogs. The final configuration of the ponds is still being developed, but it is anticipated that the ponds will be modified to allow for a passive flow-through system to keep the surface water from stagnating, and that infiltration of the pond water will be reduced through application of a wildlife-friendly chemical sealant. In addition, harmful non-native fish and wildlife species will be eradicated from the pond system and portions of the ponds will be made shallower and planted with native aquatic species, including willow trees (*Salix* spp.).

c. Establishment of pond overflow system. Surface water discharges from the downstream pond will report to a constructed channel that will ultimately discharge to the constructed channels in the Sonoita Creek floodplain, as previously described. Vegetation development along this channel is likely to be more mesic or hydroriparian in nature, given the anticipated flow- through system described above. Where feasible, this vegetation development will be supplemented with plantings.

d. Boundary fencing. Wildlife-friendly fencing will be installed to discourage use by cattle and encourage use by threatened and endangered species, including jaguars and ocelots. Rosemont will construct wildlife fence along the west boundary of the property to enhance the utilization of the SR 82 crossing of Big Casa Blanca Canyon and Smith Canyon. The balance of fence repaired or replaced at Sonoita Creek Ranch will be wildlife-friendly four-strand wire fence built in accordance with Arizona Game and Fish Department standards.

7. Sonoita Creek Ranch is intended to be managed for conservation purposes to provide habitat and connectivity for the Jaguar and Ocelot between USFS administered lands in the Canelo Hills/Patagonia Mountains and the Santa Rita Mountains, in perpetuity. The southern portion of the ranch has been identified by the Arizona Wildlife Linkages Workgroup and the Arizona Missing Linkages Corridor design as a likely corridor between these two Coronado National Forest land blocks.

8. Management actions in Sonoita Creek Ranch are intended not to compromise the ability to manage for threatened and endangered species. This includes species that are not currently present, but could recolonize the area if habitat were improved.

Fullerton Ranch

Fullerton Ranch was included in the BA and October 2012 SBA as a voluntary mitigation measure, and is noted as having been withdrawn as a mitigation measure in the February 2013 SBA. It was thus not included in the October 30, 2013 BO. Fullerton Ranch was, however, proposed as a mitigation measure in the 2014 HMMP, was included as a proponent voluntary measure in the FEIS (see measure RC-BR-01 in appendix B of the FEIS), and was further refined by Rosemont’s February 24, 2016 letter (see Consultation History, above), and will therefore be included in this BO.

Although no Chiricahua leopard frogs were observed at Fullerton Ranch in 2012, aquatic features do occur (WestLand Resources Inc. 2013). Therefore, the enhancements to the Fullerton

Ranch property could benefit Chiricahua leopard frogs and northern Mexican gartersnakes by increasing habitat and metapopulation connectivity near the action area. Preserving the existing agaves and saguaros, as well as any additional planting, on Fullerton Ranch could benefit lesser long-nosed bats by preserving and creating foraging habitat. Further, any species using the ephemeral wash or riparian buffer habitat (including the western yellow-billed cuckoo) may benefit by having higher quality habitat available in the region. We again note that these are the *intended* outcomes; the effects analyses section for these species represent our definitive findings regarding the mitigative value of Fullerton ranch.

1. The 1,763-acre Fullerton Ranch is located approximately 28 miles west of the Project site, within the Altar Valley, which is ultimately tributary to the Brawley Wash and the Santa Cruz River. The parcel is adjacent to the Marley Ranch Conservation Area, an 114,400-acre ranch that is under contract for purchase by Pima County in phases as a conservation area. The site sits at the western terminus of an identified wildlife corridor between the Santa Rita Mountains (the location of the Rosemont Project) and the Sierrita Mountains.
2. The Altar/Brawley Wash has experienced significant degradation due to historic overgrazing in the valley and adjoining uplands coupled with significant flood events, which have resulted in intensive erosion within the Altar/Brawley Wash and its tributaries. Fullerton Ranch, in the headwaters of Altar Valley, has been intensively overgrazed, and restoration activities at the site offer an opportunity to improve the overall watershed function within the Altar Valley.
3. Rosemont will record a restrictive covenant and possibly, a subsequent conservation easement, on the Fullerton Ranch Parcels that precludes grazing, real estate development and similar land use activities.
4. These parcels will be utilized for mitigation of impacts to potential waters of the U.S. as considered under the CWA Section 404 permit for the Rosemont Project. Restoration activities at these parcels are intended to result in the rehabilitation of an estimated 50 acres of potential waters of the U.S. and an additional 263 acres of associated xeroriparian buffer habitat.
5. Restoration activities to be implemented at Fullerton Ranch are as described below. Rosemont will fund the completion of the 404-mitigatory activities (which may have adjunct conservation benefits), which includes funding[1] for long-term management, as described for the Sonoita Creek Ranch mitigation parcel (see above). Additional detailed information is located in the HMMP.

    a. Boundary fencing. Wildlife-friendly fencing will be installed to discourage use by cattle and encourage use by threatened and endangered species. The fence repaired or replaced will be wildlife-friendly four-strand wire fence built in accordance with AGFD standards. Substantial restoration benefits may be realized by excluding domestic livestock grazing from intensively overgrazed landscapes like the one at Fullerton Ranch, with identifiable improvements to stormwater infiltration, peak flow discharges, and sediment yield.
    b. Physical improvements. Proposed physical manipulations of the landscape include: maintenance of a concrete dam; removal and revegetation of unnecessary roads; maintenance and modification of existing roads; gully repair; and removal of corrals and other infrastructure.

Davidson Canyon Parcels

The primary change to this mitigation component as analyzed in the FEIS and October 30, 2013, BO is that the acreage to be protected decreased from 574 acres in the October 30, 2013, BO to 545 acres in the 2014 HMMP, although the management will remain the same (see Rosemont letter of February 24, 2016 in Consultation History). These parcels will still be included as available land for the establishment of water features that may benefit species such as Chiricahua leopard frog, jaguar, ocelot, and northern Mexican gartersnake. The portions of jaguar designated critical habitat that occur within the Davidson Canyon parcels will be preserved because Davidson Canyon will be managed for long-term habitat protection as described in the FEIS and October 30, 2013, BO. We caution that the aforementioned benefits are the intended results of the conservation measure. The respective species effects analyses represent our official determinations regarding the Davidson Canyon Parcels.

1. Rosemont owns six parcels of land on the eastern side of the Santa Rita Mountains, containing approximately 545 acres of land with semidesert grassland and riparian habitat. Four of these parcels are within 2.5 miles of the Rosemont Project, and the other two sites are approximately five miles away. All share habitat similar to those within the Rosemont Project area. Prior to acquisition by Rosemont, four of these parcels were owned by a real estate developer and have value for development. They also have been identified by Pima County as having significant conservation potential.
2. Of these parcels, only Davidson Canyon 3 will be utilized for mitigation of impacts to potential waters of the U.S. as considered under the CWA Section 404 permit for the Rosemont Project. Conservation of these parcels is intended to result in the preservation of an estimated 16 acres of potential waters of the U.S. and an additional 83 acres of associated xeroriparian buffer habitat. In addition, these parcels include three springs (Barrel Spring, Questa Spring, and an unnamed spring) and more developed riparian habitat downstream of Mulberry Spring, all of which will be preserved.
3. Wildlife-friendly fencing will be installed to discourage use by cattle and encourage use by threatened and endangered species. Fence that is repaired or replaced will be wildlife-friendly, four-strand wire fence built in accordance with AGFD standards.
4. Rosemont will record a restrictive covenant per the HMMP (and potentially, a subsequent conservation easement) on the Davidson Canyon Watershed Parcels that precludes grazing, real estate development and similar land use activities, as well as many recreational activities.
5. The Davidson Canyon Watershed Parcels (other than parcel 3, which lacks water features) will be included as available land for the establishment of water features beneficial to listed species and to provide general wildlife benefits.
6. Portions of the Davidson Canyon Watershed Parcels have been identified as culturally important by Native Americans. None of the conservation actions outlined for the Davidson Canyon Watershed Parcels will preclude reasonable access to these parcels by interested Native American groups.

Helvetia Ranch Annex North Parcels

There is no change to the Helvetia Ranch Annex North parcels as analyzed in the FEIS and

October 30, 2013 BO. Pima pineapple cactus will still benefit by having a Restrictive Covenant recorded to ensure long-term habitat protection, which may reduce the potential harm to Pima pineapple cactus or its habitat from grazing or real estate development. These parcels will still be included as available land for the establishment of water features that may benefit species such as Chiricahua leopard frog, jaguar, and ocelot (per Rosemont letter of February 24, 2016; see below). Note that water features are not a component of the HMMP. Again, our definitive effects analyses appear in the respective species' sections; the benefits stated below represent only the intended effects of the conservation measure

1. The Helvetia Ranch Annex North Parcels are comprised of approximately 939 acres located in the western foothills of the Santa Rita Mountains, immediately north of the proposed utility line and approximately 2.5 miles northwest of the proposed mine area. These parcels were secured from a real estate developer who was marketing them as an opportunity for a housing development, similar to other residential developments in the area (e.g. the Sycamore Canyon development). The Helvetia Parcels provide landscape-scale connectivity between the Santa Rita Experimental Range to the west and federal lands (BLM and the Coronado National Forest) to the east, and will provide conservation benefits for several federally listed species, including but not limited to the lesser long-nose bat and Pima pineapple cactus.
2. Rosemont will record a restrictive covenant or conservation easement on the Helvetia Ranch Annex North Parcels that precludes grazing, real estate development and similar land use activities as well as certain recreational activities.
3. These parcels will be utilized for mitigation of impacts to potential waters of the U.S. as considered under the CWA Section 404 permit for the Rosemont Project. Conservation of these parcels is intended to result in the rehabilitation of an estimated 39 acres of potential waters of the U.S. and enhancement of an additional 270 acres of associated xeroriparian buffer habitat.
4. Activities to be implemented at the Helvetia Ranch Annex North Parcels are as described below. Rosemont will fund[1] the completion of these conservation activities; funding for long-term management will be as described for the Sonoita Creek Ranch mitigation parcel (see Conservation Measure B.5). Additional detailed information is located in the Rosemont Copper Project: Revised Habitat Mitigation and Monitoring Plan (September 26, 2014).

    a. Boundary fencing. Wildlife-friendly fencing will be installed to discourage use by cattle and encourage use by threatened and endangered species. The fence repaired or replaced will be wildlife-friendly four-strand wire fence built in accordance with AGFD standards.
    b. Access road improvements. The wash crossings along the primary access road through the Helvetia Ranch Annex North Parcels are all at-grade crossings. Crushed limestone has been used to stabilize the roadways and this material has in some cases migrated downstream into the ephemeral channels. This material has the potential to create a natural crust, affecting the infiltration of stormwater and sediment transport. Rosemont will import aggregate base material that will be combined with the existing limestone material to create a more stable road bed as the limestone reacts with the fines in the AB

1 The activities described in the HMMP are proposed as mitigation actions and may or may not constitute conservation activities. Funding will need to be provided via an advance financial assurance and long term management wasting and non-wasting endowments.

to form larger cementitious particles. Lime-treated AB is common in construction for its stabilizing and strengthening properties. For maintenance, the road surface will be bladed and watered once or twice a year in order to mix the AB and lime material and continually stabilize the road.

c. Unnecessary road removal and revegetation. Rosemont will rip and reseed approximately 2.4 miles of infrequently used unpaved roadways within the Helvetia Ranch Annex North parcels. This effort is intended to improve stormwater runoff by reducing the degree of runoff concentration, thereby reducing onsite erosion and downstream sedimentation.

5. The Helvetia Ranch Annex North Parcels will be included as available land for the establishment of water features beneficial to listed species such as the Chiricahua Leopard Frog, jaguar, and ocelot and to provide general wildlife benefits; no specific proposals exist at this writing.
6. Preservation of the Helvetia Ranch Annex North Parcels is intended to serve as mitigation for impacts to Pima pineapple cactus.

Other Aquatic Resource Conservation Measures

In the May 2015 SBA, none of the aquatic resource conservation measures had changed substantially from what was analyzed in the FEIS and October 30, 2013 BO; the prior descriptions are incorporated herein by reference. The benefits of the Aquatic Resource Conservation Measures (i.e., Cienega Creek water rights transfer, Cienega Creek Watershed Conservation Fund, surface water features, and grazing management) will vary by species, and are described in the respective analyses.

Revised Conservation Measures

During the latter stages of our interagency consultation, we worked with your staff and Rosemont to develop Conservation Measures that would be implemented in lieu of certain Terms and Conditions associated with the effects analyses for the Gila chub, Gila topminnow, desert pupfish, Chiricahua leopard frog, northern Mexican gartersnake, western yellow-billed cuckoo, and southwestern willow flycatcher. The revised Conservation Measures would also implement one of the Conservation Recommendations for the Huachuca water umbel. It is anticipated that the USFS will act as the Conservation Partner to manage all of the conservation funds[2] described in the three Revised Conservation Measures.

The revised Conservation Measures were proposed by Rosemont in correspondence dated February 18 and 24, 2016, (see Consultation History), and are as follows:

Revised Conservation Measure 1 – Staff Funding

Rosemont will provide funding to the USFS for one full-time Biologist position at a pay grade

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2 Under Corps regulations, several types of funding are required for a mitigation site including the financial assurances for all of the costs associated with implementing the mitigation (including land costs if a Restrictive Covenant is recorded); in addition, long term management in the form of wasting and non-wasting endowments are required. While the USFS will serve as a Conservation Partner for implementing the three Revised Conservation Measures, it must be reiterated that the USFS cannot hold funds intended for HMMP-related measures.

level General Schedule (GS)-9 or higher. The full-time Biologist position would support the Rosemont Copper project on all biology related issues and would be responsible for oversight of implementation and monitoring of all Conservation Measures, as well as Terms and Conditions appearing in this BO. Furthermore, this position will incorporate and fulfill the roles previously identified for the Biological Monitor in the October 30, 2013 BO and FEIS. Funding for this position will continue until either such time as the Project is completed or until all conservation funds covered by the BO have been fully expended, whichever happens later. Please note that this conservation measure supplants the Biological Monitor position described in the Description of the Proposed Conservation Measures in the October 30, 2013, Final BO.

The conservation entities to be engaged in the distribution and use of the funds tied to the Conservation Measures consist of those land and resource management agencies with special expertise or knowledge regarding the action area and adjoining areas in southeastern Arizona, as well as the wildlife and other resources associated with these Conservation Measures.

Revised Conservation Measure 2 – Harmful Nonnative Species Management and Removal

To benefit threatened and endangered aquatic species, as well as other native Arizona aquatic species potentially impacted by the Rosemont Copper Project, a harmful nonnative aquatic species management and removal program will be developed and implemented. This program is intended to specifically address the threat of harmful nonnative aquatic vertebrate, invertebrate, and plant species invading the aquatic habitat within the action area on USFS lands preferentially in and around Cienega Creek and in the San Rafael-Santa Cruz River Watersheds in the Nogales and Sierra Vista Ranger Districts (but excluding the recreational sport fishery at Parker Canyon Lake). Acreage within these watersheds but outside USFS lands will be considered for inclusion within this program, subject to obtaining consent of the appropriate land owner/management agency and the agreement of FWS and USFS.

The Conservation Measures specified here will augment a program that the Coronado National Forest is currently undertaking that will assemble existing data on efforts to control targeted harmful nonnative species, collect additional data, purchase equipment for the removal of harmful nonnative species, mitigate effects to threatened and endangered species as well as other native aquatic species, and develop a plan for continued control efforts within the Sierra Vista Ranger District.

The purpose of this Conservation Measure is to provide funding for a program with the following goal:

> That subbasins within the Cienega Creek and neighboring San Rafael-Santa Cruz River Watersheds in the Nogales and Sierra Vista Ranger Districts, that are of value to the survival and continued recovery of the Gila chub, Gila topminnow, desert pupfish, Chiricahua leopard frog, northern Mexican gartersnake, Huachuca water umbel, and other native aquatic species, are secured and maintained as a whole or nearly whole native community.

Specific components of the harmful nonnative species management and removal program include:

1. Baseline surveys and the preparation of plans and priorities of the program.
2. Harmful nonnatives to be addressed in the program will include, but not be limited to, nonnative fish in the families Centrarchidae (sunfishes and black basses) and Ictaluridae (catfishes), American bullfrogs (*Lithobates catesbeianus*), any species of crayfish, other nonnative aquatic invertebrates, and nonnative plants invading aquatic habitat and adjoining riparian areas.
3. Baseline surveys will include all known suitable habitat that has legal access or for which legal access is given for Gila chub, Gila topminnow, desert pupfish, Chiricahua leopard frogs, and northern Mexican gartersnakes (and their native prey species [i.e., fish and amphibians]).
4. The plans shall include removal activities of harmful nonnative species using mechanical methods or any other methods, with associated revegetation or restoration where appropriate, which accomplish the repeated removal and control of harmful nonnative species as authorized by the USFS.
5. Data, plans and priorities that arise from this funding will be managed through the Conservation Partners program with USFS ultimately being responsible for program direction and administration.
6. Funding for this measure will be apportioned as follows:
    a. Ten (10) percent of the total funding will be provided to the USFS within 90 days of approval of the Final Mine Plan of Operations for use in planning and survey implementation.
    b. The remainder of the fund will be provided within 30 days of project commissioning, which is defined by the declaration of commercial production for the facility.
    c. The total amount of funding for these activities will be $3,000,000.

The USFS and Conservation Partners will be responsible for appropriate reporting and financial management of the $3,000,000 to ensure that the funds are spent in a way that meet the goals specified above.

Revised Conservation Measure 3 – Western Yellow-Billed Cuckoo and Southwestern Willow Flycatcher Habitat Enhancement and Monitoring, Surveying, and Conservation Property Management

Western yellow-billed cuckoos (cuckoo) have been detected along Cienega Creek and Empire Gulch, in areas proposed as critical habitat, and in small numbers in xeroriparian habitat in drainages at the Rosemont Project site. Additionally, small numbers of southwestern willow flycatchers (SWFL) have been detected along upper Cienega Creek and Empire Gulch, in areas that have been designated as critical habitat for the species.

Analysis of the Cienega Creek basin has shown a possibility that, under the range of potential groundwater impacts, habitat for the cuckoo and SWFL may be affected by the Project. Because of this, Rosemont is interested in providing funding for a habitat improvement, preservation, and replacement program to benefit these species. This program also will provide substantial benefits to other native Arizona species that utilize riparian habitat.

Habitat replacement, improvement and survey program

In addition to the elements of the program specified above, habitat replacement, improvement and surveys funded by this Conservation Measure will include these specific components:

1. Baseline surveys, preparation of plans, priorities, and implementation of the plans for a SWFL and cuckoo habitat replacement, improvement and survey program.
2. Specific projects will be identified in areas proximal to the Rosemont Project, preferably on USFS lands (FWS also intends that the sites are in areas not subject to drawdown effects). Rosemont will also work with conservation entities as necessary in other appropriate areas.
3. Baseline surveys[3] for southwestern willow flycatcher and western yellow-billed cuckoo in the action area will include all known suitable habitat that has legal access or for which legal access is given. Proposed habitat monitoring methods will be measurable, repeatable, and capable of detecting changes in extent, density, species composition, canopy height, canopy closure, vertical foliar density, soil moisture, temperature, and humidity of habitat.
4. The program shall include enhancement activities that may include, but not be limited to, the following: planting and maintaining trees native to the local environment, elevating groundwater levels, reducing stressors that affect vegetation establishment and growth, installing rock erosion control structures that slow stream flow, excluding or removing livestock from certain riparian areas, and providing riparian area fencing to prevent damage from humans and livestock.
5. Data, plans and priorities that arise from this funding will be managed through the Conservation Partners program with the USFS ultimately being responsible for direction and administration.
6. Funding for this measure will be apportioned as follows:
   a. Ten (10) percent of the total funding will be provided to the USFS within 90 days of approval of the Final Mine Plan of Operations for use in planning and survey implementation.
   b. The remainder of the fund will be provided within 30 days of project commissioning, which is defined by the declaration of commercial production for the facility.
   c. The total amount of funding for these activities will be $1,250,000.

The USFS and Conservation Partners will be responsible for appropriate reporting and financial management of the $1,250,000 to ensure that funds are spent in a way that meet the goals specified above.

EFFECTS OF THE PROPOSED ACTION

The following sections describe the effects of the proposed action, first to aquatic and riparian ecosystems in general, then to the respective threatened and endangered species and, as appropriate, their proposed or final critical habitats.

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3 Surveys must be conducted by individuals with the appropriate species-specific section 10(a)(1)(a) Recovery Permits employing protocols acceptable to FWS, i.e. Halterman *et al*. (2015) for yellow-billed cuckoos and Sogge *et al*. (2010) for southwestern willow flycatchers.

Effects to Aquatic Ecosystems

This section revises and supplants the analysis of the effects of the proposed action on fluvial aquatic ecosystems that appeared in our October 30, 2013 Final BO on the proposed action.

The Gila chub, Gila topminnow, Desert Pupfish, Chiricahua leopard frog, and northern Mexican gartersnake occur in streams and/or adjacent cienega complexes that are affected by the proposed action. The Huachuca water umbel is a semi-aquatic plant that occurs in and immediately adjacent to streams. The analyses contained within this section will be incorporated via reference into the respective species' analyses. These analyses also, in part, inform the respective action area descriptions for the affected species.

As discussed in our October 30, 2013 BO, the excavation of the open pit to an elevation of approximately 3,050 feet will result in the intersection of regional groundwater and/or water-conducting subsurface fracture networks (USFS 2012a). Subsurface water will therefore "daylight" and fill the excavated area. The need to dewater the pit during active mining operations and the post-mining existence of a lake from which water will evaporate mean that the pit will function as a well from which regional groundwater is removed from storage in the regional aquifer and, eventually, captured from discharges to springs, streams, and evapotranspiration (ET, the uptake of groundwater by vegetation) (Leake *et al.* 2008).

The impacts of groundwater withdrawal on surface waters of interest may be evaluated with a model calibrated to local conditions. Groundwater models were prepared by Montgomery and Associates (2010) and Tetra Tech (2010), the results of which were incorporated into the FEIS. The 2012 through 2013 BA and supplemental documents included analyses of impacts to surface waters based on the outcomes of the Montgomery and Associates (2010) and Tetra Tech (2010) models, as well as an independent model prepared by Myers (2010). The validity of the Montgomery and Associates (2010) and Tetra Tech (2010) models was later evaluated by SRK Consulting at the request of the Forest Service (SRK 2012). The Myers (2010) model was not subjected to review by SRK.

Our October 30, 2013 Final BO contained analyses of the three models' relative strengths and weaknesses as well as precautionary statements regarding hydrogeological uncertainties in the action area and porous-media groundwater models in general. These prior analyses and cautions are incorporated herein via reference. The SIR also confirmed the validity of the respective models' utility in evaluating impacts to the groundwater system in the action area.

Our October 30, 2013 Final BO also included a narrative explaining our utilization of largely-qualitative surface water impact analyses based primarily on the Tetra Tech (2010) groundwater drawdown model; this model's results were the largest in magnitude among the three separate models and therefore represented the most precautionary approach for the purposes of an effects analysis (i.e. resulted in the greatest groundwater drawdowns which, in turn affected aquatic and riparian habitat occupied by threatened and endangered species). Table A-4 in the October 30, 2013 Final BO displayed a summary of groundwater drawdowns and was based on the SWCA (2012) interpretation of the Tetra Tech (2010) results.

Despite our prior reliance on Tetra Tech (2010) drawdown results, the October 30, 2013 Final BO also included limited quantitative descriptions of groundwater-driven stream flow losses in upper Cienega Creek based on the findings of Montgomery (2010); Table A-2 described flow losses in upper Cienega Creek and Table A-3 described flow losses in Davidson Canyon Wash. These Montgomery-based analyses' limited geographic site-specificity (upper Cienega Creek and Davidson Canyon Wash) was in contrast to our primary reliance on a different groundwater model (Tetra Tech 2010). The geographic-area shortcomings of the Montgomery (2010) model made it desirable for us to employ an improved approach in this consultation (see Background on Revised Effects Analyses, below).

This prior, primary utilization of Tetra Tech (2010) and secondary utilization of Montgomery (2010) model results have thus been superseded by the rigorous and yet more-precautionary, revised analyses appearing in the SIR and May 2015 SBA. The more-current analyses, and their analytical advantages compared to prior results, are incorporated herein via reference from the SIR and May 2015 SBA. The revised analyses are also summarized in the subsequent section.

Background on Revised Effects Analyses

The FEIS, published after issuance of the October 30, 3013 Final BO, disclosed impacts to groundwater in a comprehensive manner. The FEIS selected the largest predicted drawdown value (the worst-case scenario), at each location and time-step, regardless of the model from which the scenario was derived. The FEIS also disclosed direct (1:1 ratio) linkages between these groundwater drawdowns caused by mining and losses of surface flow in streams (i.e. 0.2-foot drawdown at a stream would result in a 0.2-foot drop in water elevation). While these were reasonable approaches to employ in a disclosure document, they were nevertheless different from the approaches employed in the various BAs and in the Final BO. Moreover, the revised analyses in the FEIS indicated a strong potential to trigger Item 2 in the October 30, 2013 Final BO's Reinitiation Notice, which directs that consultation be reinitiated if "new information reveals effects of the agency action that may affect listed species or critical habitat in a manner or to an extent not considered in this opinion".

The new groundwater and discharge data presented in the FEIS, in part, resulted in the Coronado National Forest conducting a large-scale, May through November of 2014 reanalysis of groundwater and surface water impacts. These revised analyses were first applied to the analyses found in the FEIS. Forest Service regulatory guidance requires that all potentially new information received after publication of a FEIS must be assessed for "whether or not the new information or changed circumstances are within the scope and range of impacts considered in the original analysis" (Forest Service Handbook 1909.15) (U.S. Forest Service 2012b). This process was described by the Coronado National Forest in the Supplemental Information Report (SIR), a document intended to inform the retention or supplementation of a standing EIS.

The SIR included a refined analysis of impacts to the aquatic environment, informed by the new information obtained between May and November 2014. Full details of the methodology and results of the aquatic analysis, including potential impacts to stream flow, standing pools, and riparian vegetation, are contained in the SIR and are incorporated herein via reference.

By its status as a document disclosing impacts for NEPA purposes, the FEIS contained an analysis of hydrologic impacts that extended 1,000 years after closure of the mine. While the uncertainty involved in estimating impacts this far into the future is substantial and was disclosed in the FEIS, choosing this long time frame was necessary in order to fully examine the potential for the bedrock aquifer impacted by the mine to reach equilibrium with the mine pit. Like the FEIS, the SIR also disclosed potential impacts out to 1,000 years, as the primary purpose of the SIR is to assess whether new information or changed circumstances are within the scope and range of impacts considered in the FEIS.

The May 2015 SBA includes the same hydrological and aquatic and riparian species effects analyses as the SIR, but the May 2015 SBA does not employ the 1,000-year time frames. Federal regulations at 50 CFR 402.02 state that "Indirect effects are those that are caused by the proposed action and are later in time, but still are reasonably certain to occur". We and the Coronado NF have acknowledged the high level of uncertainty associated with effects to threatened and endangered species at up to 1,000 years after closure of the mine, but both agencies have also recognized that effects to aquatic and riparian ecosystems may not manifest themselves until decades after mine closure. Therefore, a reasonable post-closure time frame of 150 years for groundwater drawdown analysis was employed in the May 2015 SBA, with the Coronado National Forest stating the 150-year duration for effects analyses will encompass effects that are reasonably certain to occur. We concur with the Forest Service, primarily because the hydrologic effects of the mine extend far into the future and in large part worsen over time; evaluating 150 years of effects allows us to assess both the proposed action's near-term effects but also their long-term trend as it relates to recovery.

The results of the revised analyses contained in the SIR were reiterated in the May 2015 SBA, although they are adjusted to reflect the 150-year time frame instead of the 1,000 year time frame. The details of the methodologies used to derive the revised results were described in detail in the SIR and as stated above, are incorporated by reference into this BO. The May 2015 SBA contains a brief summary of the methodologies, and this is both incorporated via reference and further summarized below.

Methodology

The SIR and May 2015 SBA contain refined analyses of effects of mine drawdown on the aquatic and riparian environment along Cienega Creek and Empire Gulch, which consist of three parts: (1) analysis of impacts to stream flows (discharge of baseflows), (2) analysis of impacts to standing pools, and (3) analysis of impacts to riparian vegetation (discharge to evapotranspiration). The stream flow and pool analysis was further organized into five key features[4]:

- Documentation of current baseline trends5 associated with the ongoing drought, including

4 The SIR contains an additional aspect of the analysis: analysis of impacts from generic, incremental drawdown, regardless of modeling results. This aspect was not included in the May 2015 SBA, as it is largely duplicated by actual modeling results.

5 We employ a different interpretation of the hydrologic baseline condition than what appears in the SIR. Our approach is described throughout the Background on Revised Effects Analyses and is reiterated in the Background

climatic, aquatic, and vegetation trends.
- Analysis of effects resulting from aquifer drawdown from the mine only.
- Analysis of estimated effects from climate change.
- Analysis of effects resulting from both mine drawdown and climate change.
- Analysis of a range of effects that can be considered to encompass 95 percent of possible analysis outcomes (given the modeling assumptions explained below).

Sources of Uncertainty

As disclosed in the 2013 Final BO, FEIS, SIR, and May 2015 SBA, there are several sources of uncertainty associated with the hydrologic analysis. In both the FEIS and SIR analyses, the following strategies were implemented to address these sources of uncertainty (adapted from the May 2015 SBA: Table 2).

To address inherent uncertainty in groundwater models, due to long distances, long time frames, and prediction of stresses greater than currently observed:
- Use of three individual models, instead of a single model
- Disclosure of predictions using high and low ends of model sensitivity analyses (quantitative)
- Disclosure of predictions using 95th percentile results (quantitative)

To determine seasonal and drought-related changes in flow patterns:
- Use of real-world hydrographs for entire period of record, rather than relying on average or median flow

To determine spatial differences along riparian corridor:
- Use of multiple key reaches, with hydrologic framework assessed independently for each reach, and each analyzed separately

To incorporate climate change:
- Disclosure of predicted impact with mine drawdown alone, as well as impact predicted combining mine drawdown with climate change
- Ongoing riparian trends incorporated into baseline analysis

To translate groundwater drawdown to reductions in stream flow:
- Disclosure of predictions using 95 percent confidence intervals for regression slope, in addition to best-fit regression slope (quantitative)

Subsequent discussions occurring between May and November 2014 resulted in the incorporation of quantitative strategies, when possible, to help inform the analysis of uncertainty with respect to effects analyses. Concerns regarding the disclosure of uncertainty were revisited on February 3, 2016 (see Consultation History section, above); this section was subsequently revised in consultation with USFS (USFS 2016).

Impacts resulting from aquifer drawdown associated with the mine, whether alone or in

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for Analyses and Definition of Baseline sections which appear within aquatic and riparian species effects sections.

conjunction with climate change, fit within a wide range of potential model outcomes, including the low and high ends of the respective models' sensitivity analyses, as well as the best-fit model results for three independent groundwater models (Myers 2010, Montgomery and Associates 2010, and Tetra Tech 2010). Modeling with sensitivity analysis allows for the consideration of a reasonable variation in conditions affecting the behavior of groundwater in the aquifer.

When conducting modeling sensitivity analyses, ranges of values for different input parameters (i.e. the amount of water stored in the aquifer and factors that affect the movement of that water through the aquifer) are modeled in various combinations. Only reasonable values are selected for inclusion in the range of possible values. Thus, any of the sensitivity analyses can be considered to be reasonable outcomes of the modeling. A summary of all sensitivity analyses provided for the three groundwater models is shown in Table A-0, below.

Table A-0: Groundwater model runs developed to test sensitivity of various model components (Myers 2010, Montgomery and Associates 2010, and Tetra Tech 2010)

Model Component	**Parameter**	**Montgomery Sensitivity Analyses**	**Tetra Tech Sensitivity Analyses**
Backbone fault	K	- Increase Kx by factor of 10 - Decrease Ky and Kz by factor of 10	
Basin fill	Sy	- Increase by 50 percent - Decrease by 50 percent	- Increase by 50 percent - Decrease by 50 percent
Bedrock	SS	- Increase by factor of 10 - Decrease by factor of 10	
Bedrock	Sy	- Increase by factor of 2 - Decrease by factor of 2	- Increase by factor of 2 - Decrease by factor of 2
Davidson Canyon fault	K	- Decrease (unknown amount)	
Flat fault	K	- Increase by factor of 10 - Decrease by factor of 10	
Lower Cretaceous sedimentary formation (Ksd)	K	- Increase by factor of 10 - Decrease by factor of 10	
Upper Cretaceous and Early Tertiary intrusive formations (KTi)	K	- Increase by factor of 10 - Decrease by factor of 10	
Upper Cretaceous sedimentary and volcanic formations (Kv)	K	- Increase by factor of 10 - Decrease by factor of 10	
Precambrian igneous and metamorphic crystalline formations (pCb)	K	- Decrease by factor of 10	
Paleozoic sedimentary and metamorphic formations (Pz)	K	- Increase by factor of 10 - Decrease by factor of 10	
Quaternary alluvium (Qal)	K	- Increase by 30 percent - Decrease by 30 percent	
Lowest permeability Late Tertiary to Early Quaternary basin-fill deposits (QTg2)	K	- Increase by factor of 10 - Decrease by factor of 10	
Higher permeability Late Tertiary to Early Quaternary basin-fill deposits (QTg)	K	- Increase by 30 percent - Decrease by 30 percent	
All Units	SS		- Increase by factor of 10 - Decrease by factor of 10
Davidson Canyon Dike			- Remove Davidson Canyon dike from model

Table A-0: Groundwater model runs developed to test sensitivity of various model components (Myers 2010, Montgomery and Associates 2010, and Tetra Tech 2010)			
Model Component	**Parameter**	**Montgomery Sensitivity Analyses**	**Tetra Tech Sensitivity Analyses**
Pit evaporation			- Decrease by 20 percent
Boundary cells		- Replace boundary cells with constant flux cells that prevent any changes in inflow/outflow as the model runs	
K – hydraulic conductivity. This parameter can also be specific to a single flow direction (Kx, Ky, Kz) SS – Specific storage Sy – Specific Yield			

While all the sensitivity analyses shown in Table A-0 are considered reasonable, the sensitivity analyses are not all equally probable to occur because they all result from aquifer conditions that could exist, but not simultaneously. Model calibration typically results in only one modeling run that is considered to best fit the available real-world hydrologic data (i.e., groundwater levels). While the high and low bounds within and between the models may not be as probable to occur as the three models' respective best-fit model scenarios, using the high and low ends of the sensitivity analyses to predict impacts is appropriate, because this allows for disclosure (i.e. under NEPA) of the overall possible range of impacts. This wide range of analyses is also important to us for analyzing the effects of the mine over the long term (up to 150 years), over which time deviations from any one model from observed conditions would become most apparent. By analyzing the results of all models, we are able to analyze the full range of effects to threatened and endangered species that could occur.

For each key stream reach (see May 2015 SBA Figure 1 and below), for each time step, there are predictions of mine-driven groundwater drawdown from 37 to 38 individual modeling scenarios, including the Myers (2010) best-fit model (one scenario, only available for key reaches EG1, CC2, and CC5, and only for certain time steps), the Tetra Tech (2010) best-fit model (one scenario), the Montgomery (2010) best-fit model (one scenario), the Tetra Tech (2010) sensitivity analyses (8 scenarios), and the Montgomery (2010) sensitivity analyses (27 scenarios).

Given this wide array of model runs, it is also useful to condense the very large number of modeling scenarios and parameters into a single useful prediction that incorporates all sources of uncertainty. Often, the 95 percent confidence interval is used to consolidate all sources of uncertainty into a single statistic. In addition to the three modeling scenarios, a "95th percentile" analysis has been included for both mine-only and mine-plus-climate change scenarios in order to allow us to evaluate the effects of climate change relative to present-day, baseline conditions. The 95th percentile analysis incorporates uncertainty from two different parameters: model drawdown and drawdown/stream flow conversion. For model drawdown, the 95th percentile analysis represents a range of drawdown within which 95 percent of the 37 to 38 specific modeling scenarios reviewed in the SIR/SBA fall. This allows a more focused analysis of the results of all models; we are able to more defensibly analyze the full range of effects to threatened and endangered species that could occur.

The drawdown predicted by the models must be converted into reductions in stream flow in order for them to be useful in the analyses of effects to threatened and endangered aquatic and riparian species and their critical habitats. Analyses undertaken by WestLand Resources (2012) but not included in the three iterations of the BA, in SWCA (2012), or the FEIS, correlated extent of surface flow in lower Cienega Creek with depth-to- groundwater in adjacent wells. Their results, partially based on averages in June, show there would be small decreases (<2 percent of average) in length of streamflow. Also, the extent of streamflow and proportional reduction in extent of streamflow could be greater than two percent in drier times. Pima County performed a similar analysis, finding that a 0.1-foot decline in groundwater elevation would lead to a loss of 434 linear feet (3.4 percent) of stream flow in June (Powell *et al*. 2014). They also estimated a 0.25-foot decline would lead to a loss of 1,085 linear feet of stream flow in June. We did not use these studies in our analysis, as they did not emerge in their as-written state from the technical reviews conducted by the USGS (USGS 2014a, USGS 2014b), themselves a part of the SIR and SBA preparation process. The conversion ultimately employed in the SIR and May 2015 SBA (and therefore in this BO) uses an empirical relationship (linear regression) developed from paired field measurements of stream flow and groundwater level, with consideration given to the USGS (2014a and 2014b) reviews of Powell *et al*. (2014) and WestLand (2012) . This linear regression approach involves determining the correlation between observed groundwater levels in wells and flow in the adjacent stream. If sufficient relatedness exists, a slope-intercept equation can be used to convert any groundwater elevation of interest (specifically, a groundwater drawdown) into a corresponding stream flow. The second part of the 95th percentile analysis incorporates the possible range of outcomes associated with this linear regression.

Taking the variability in these two parameters into account (model drawdown and drawdown/stream flow conversion), the intent is to create a single range of stream flow effects that can be analyzed with the knowledge that 95 percent of all models that were chosen to run fall within this range.

The 95th percentile analysis was included in the SIR and May 2015 SBA specifically to address our stated need to understand the quantitative probability associated with stream flow effects resulting from the differing outcomes of the three groundwater models. In some cases, where the 95th percentile range is narrow and consistent (i.e., many locations along Cienega Creek), this is a useful approach that lends both certainty and accuracy to the analysis of drawdown-driven stream flow effects. In other cases, the 95th percentile range is extremely wide and does little to reduce the uncertainty in outcomes (e.g., Empire Gulch). In the latter situation, we will exhibit a precautionary approach by emphasizing the higher values (i.e., greater adverse effects of mining activities on threatened and endangered species and their critical habitats).

The upper end of the 95th percentile is not the situation that is most probable to occur. Statistically, the “best-fit models” are the model runs that are best calibrated to real-world observations and could be considered the most probable to occur. However, even though all three best-fit models are reasonable representations of the hydrology of the Rosemont area, their interpretations cannot all be correct. For instance, the Tetra Tech model incorporates a hypothesized dike in Davidson Canyon, which impedes drawdown in that direction and instead increases drawdown in the area of Empire Gulch and Upper Cienega Creek, while the Montgomery model does not include this hypothesized dike and therefore exhibits greater drawdown on Lower Cienega Creek. Selecting any one of the best-fit models as the sole description of hydrologic impacts risks picking a wrong interpretation and underestimating impacts to hydrology elsewhere.

While not the most probable model scenarios, the sensitivity analyses are still considered to be reasonable representations of reality because they accommodate all reasonably-possible variations in aquifer properties. An additional risk of selecting just a single best-fit model is that the evaluation of impacts to groundwater elevations (and then, to streams) could be less than that predicted for a wide range of other reasonable model results.

The selection of the upper end of the 95th percentile analysis reduces these risks. When this approach is taken, the effects described by the upper end of the 95th percentile represent a situation in which 97.5 percent of the other possible outcomes (given the same model assumptions) are less impactful than the effects analyzed in this BO[6]. This is a conservative and cautious approach. It does not represent the most probable outcome, but it does provide reasonable certainty that the real-world effects of mine drawdown experienced in these ecosystems are unlikely to be worse than those described in this consultation.

Our analyses of the effects of the proposed action will therefore rely primarily on the 95th percentile analyses from the May 2015 SBA, which reflect a reasonable certainty that the effects will occur. We will disclose, where necessary, of our use of higher-range 95th percentile predictions. Tables A-1 through A-8 illustrate the various hydrologic effects of the proposed action.

The FWS has been asked to provide a biological opinion that looks at the effects of the proposed action on threatened and endangered species and their critical habitats. In this case, this is difficult because the effects of mining activities may take place hundreds of years into the future. Predicting effects this far out is practically impossible. So, we have chosen the most cautious approach to predicting effects into the future in order to ensure our analysis adequately considers whether the effects of the action do or do not jeopardize affected species and/or destroy or adversely modify their critical habitats.

While the analysis contained in this section is quantitative, it reflects predicted impacts from relatively small amounts of groundwater drawdown, often fractions of a foot, that are occurring decades into the future. The conclusion of groundwater experts consulted by USFS is that such small amounts of drawdown are difficult for any groundwater model to accurately predict. It is important to understand that the detailed predictions contained in this section are meant to inform the decision and to show what could potentially happen if the model predictions were to occur as modeled; however, this does not change the overall uncertainty.

Lastly, the use of the terms “precaution” or “precautionary” in the preceding paragraphs and throughout this BO is related to our statutory requirement to ensure that the proposed action is not likely to result in jeopardy to threatened and endangered species and/or destruction or

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6 Statistically, the 95th percentile analysis contains all possible outcomes except those in the lower 2.5 percent and those in the upper 2.5 percent. When the upper end of the 95th percentile is selected as the value to use in the analysis, the only impacts that would be greater than the selected value are those that lie in the upper 2.5 percent. The remaining impacts – those that are analyzed in the BO – represent 97.5 percent of the possible outcomes.

adverse modification of critical habitat. To accomplish this, we must conduct our analyses to avoid concluding that the action had no effect (or minimal effects) on a listed species or its habitat when, in fact, there was an effect (or a large effect). This approach minimizes the likelihood of making a false negative conclusion with high consequences (i.e. falsely concluding jeopardy and/or destruction or adverse modification of critical habitat will not occur when in fact, they will).

Our analyses also must use the “best scientific and commercial data available,” and in cases where information is incomplete or not entirely definitive (as is the case with the 95th percentile approach), clearly articulate the rationale for reaching a conclusion (thus avoiding being found to have made an arbitrary or capricious conclusion). At times, this approach to the potential for error may lead to different conclusions than would a more traditional scientific approach to hypothesis testing, but it is in compliance with direction from the Act and the courts to provide the benefit of the doubt to the species.

Lastly, our use of a precautionary approach is warranted because of the irreversibility of the proposed actions possible effects at the higher end of the 95th percentile analyses.

Key Reaches

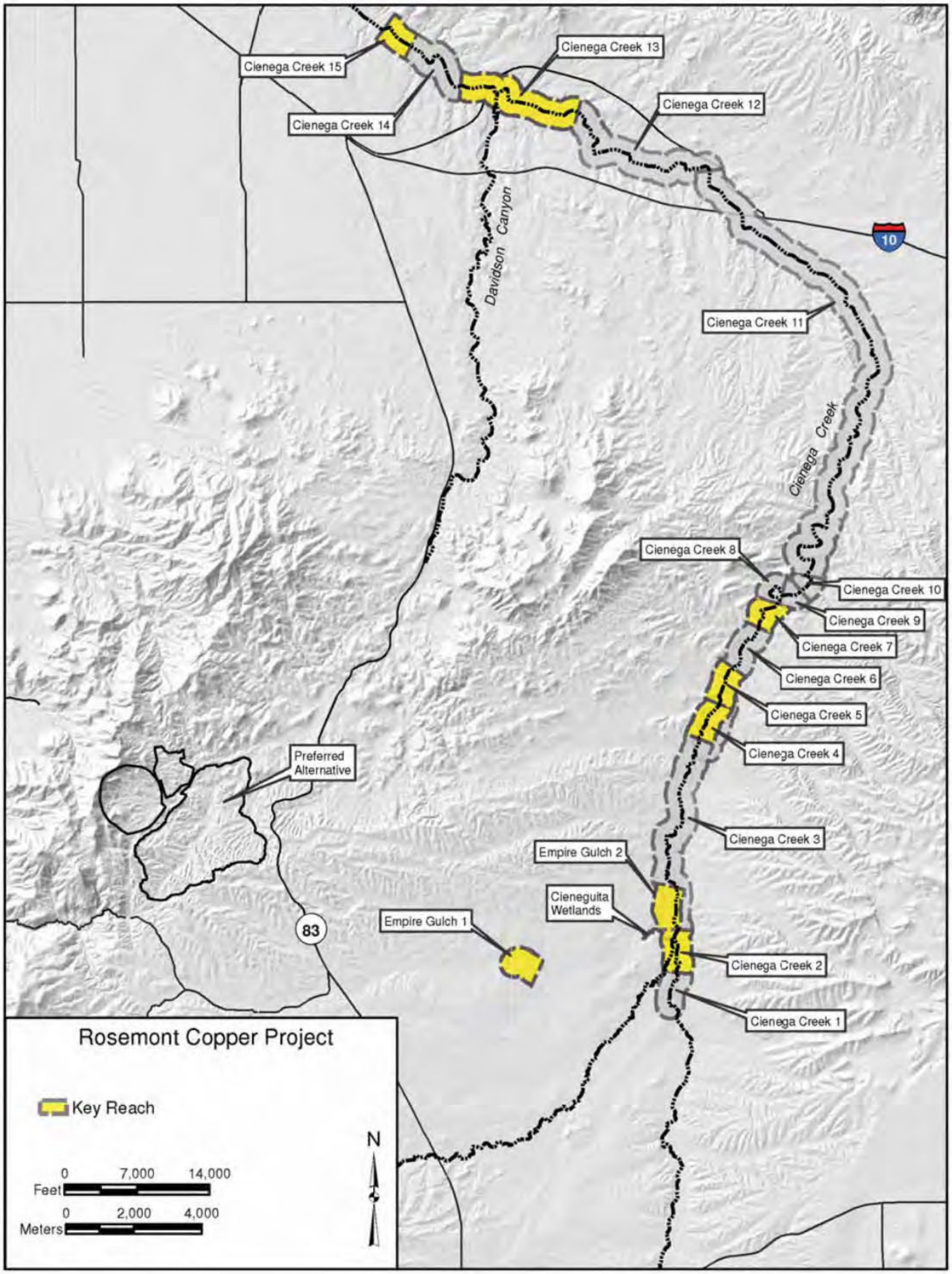
During discussions between May and November 2014, a combined group of agency specialists divided Cienega Creek and Empire Gulch into multiple reaches. Physical and biological characteristics of these reaches were then summarized, and reaches were selected that were considered key areas of biological importance to threatened and endangered species and their critical habitat. These key reaches tend to be areas with consistent presence of water, especially during the critical low-flow months of May/June. The refined aquatic analysis focuses on nine key reaches of Cienega Creek and Empire Gulch. These are shown in Figure A-1, below, and include the following:

- Cienega Creek Reach 2. Approximately 0.75 mile long, located on Upper Cienega Creek, within the Las Cienegas National Conservation Area (NCA), immediately upstream from Gardner Canyon.
- Cienega Creek Reach 4. Approximately 0.8 mile long, located on Upper Cienega Creek, within the Las Cienegas NCA, immediately upstream of Mattie Canyon.
- Cienega Creek Reach 5. Approximately 0.8 mile long, located on Upper Cienega Creek, within the Las Cienegas NCA, downstream of Mattie Canyon and containing the USGS Sonoita stream gage.
- Cienega Creek Reach 7. Approximately 0.6 mile long, located on Upper Cienega Creek, within the Las Cienegas NCA, at the beginning of the Narrows.
- Cienega Creek Reach 13. Approximately 2.5 miles long, located on Lower Cienega Creek, within the Pima County Cienega Creek Natural Preserve (CCNP), upstream and downstream of Davidson Canyon confluence.
- Cienega Creek Reach 15. Approximately 0.5 mile long, located on Lower Cienega Creek, within the Pima County CCNP, upstream of Pantano Dam.
- Empire Gulch Reach 1. Approximately 0.3 mile long, located within the Las Cienegas NCA immediately downstream from the Upper Empire Gulch Springs, near the Empire Ranch

Headquarters.

- Empire Gulch Reach 2. Approximately 1 mile long, located within the Las Cienegas NCA immediately upstream of the Cienega Creek confluence.
- Cieneguita Wetlands. Located on the Las Cienegas NCA, within the floodplain of Empire Gulch, near the confluence of Empire Gulch and Cienega Creek.

Figure A-1 (SBA Figure 1): Map of Key Reaches



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The hydrology of each key reach was individually assessed in the SIR and May 2015 SBA; key analysis assumptions are included in May 2015 SBA Table 3. While the refined aquatic analysis focuses on these nine reaches, it should not be assumed that impacts will not occur in the other non-key reaches. To the contrary, because these key reaches represent the most stable portions of Cienega Creek and Empire Gulch, any effects to these reaches, and the threatened and endangered species occurring in and near them, can be expected to occur elsewhere as well.

The May 2015 SBA's focus on key reaches, adopted in this consultation, does not imply that impacts will only occur at these locations, nor does it preclude impacts elsewhere in the system. There are four other areas where impacts could occur that are not explicitly addressed by the May 2015 SBA approach:

1. The key reaches were selected because they represent core areas of biological importance. Because these key reaches represent the most stable portions of Cienega Creek and Empire Gulch, any impacts observed to these reaches can be expected to occur elsewhere in the system as well, along reaches that are intermittent rather than perennial, and typically exhibit greater fluctuation in the presence of water. These other reaches often already experience drying during critical low flow months and during drought cycles, and accordingly there is less dependence on these areas by aquatic species. Nevertheless, if impacts are being experienced in key reaches, it can be assumed that the usual drying trends along other reaches would be more pronounced and severe than under current conditions.
2. For wetlands, only Cieneguita Wetlands was explicitly identified and analyzed as a key reach. There are numerous other wetlands in the Cienega Creek/Empire Gulch system, as identified in the FEIS: "The BLM has also conducted wetland inventories within the Las Cienegas NCA and has identified more than 30 perennial or seasonal wetlands. Most of these occur on the Cienega Creek flood plain immediately upstream and downstream of the confluence with Empire Gulch, including named wetland complexes such as Cieneguita Wetlands, Spring Water Wetlands, and Cinco Ponds Wetlands. Another complex, the Cold Spring Wetland, occurs upstream of the Mattie Canyon confluence on Cienega Creek" (FEIS: 496). For those on-channel wetlands adjacent to the flowing stream itself, the approach is similar to that used in the FEIS: "Impacts to these wetland complexes are not analyzed individually but are assumed to be part of the analysis of impacts to stream flow and riparian vegetation" (FEIS: 496). In other words, the analysis of stream flow and of standing pools contained in the May 2015 SBA is directly applicable to wetland areas alongside the stream channel itself; if the presence of water is impacted in the flowing stream or pools; it will be impacted in these on-channel wetlands as well.
3. Other off-channel wetlands were considered for analysis of mine-driven drawdown, but unlike the selection of key reaches, these wetlands did not appear to carry the same importance as the Cieneguita Wetlands (i.e. no threatened or endangered species or critical habitat), nor were any identified during the multi-agency collaboration to select key reaches. For instance, during field visits between May and November 2014 the Cinco Ponds Wetlands were visited but were largely dry. Nor were these wetlands a location for reintroduction of threatened or endangered species. Furthermore, Cieneguita Wetlands is closer to the mine than other identified wetlands and has a higher likelihood of being impacted (it sits within the floodplain of lower Empire Gulch), and supports threatened and endangered species.
4. Gardner Canyon was explicitly analyzed for impacts in the FEIS, but no key reaches were

identified in Gardner Canyon during the multi-agency collaboration, and therefore no key reaches are explicitly analyzed in the May 2015 SBA. A key assumption in the FEIS was that Gardner Canyon exhibited perennial stream flow. Based on field reconnaissance and discussions with BLM personnel, this does not appear to be the case. Gardner Canyon would be more correctly identified as an intermittent flow system. Therefore, Gardner Canyon should be considered along with other reaches, as described in No. 1 above. Nothing in the May 2015 SBA analysis should be construed to diminish the importance of any riparian and aquatic habitat that does exist within Gardner Canyon, or anywhere else in the system. The use of key reaches is a simplifying technique meant to focus analysis on critical locations, not a method meant to encompass all impacts to the system.

In summary, we feel the selection of key reaches serves as a reasonable benchmark by which to evaluate effects to threatened and endangered species because the reaches are distributed throughout the affected portions of Cienega Creek and Empire Gulch where those species and critical habitats exist.

Methodology for Prediction of Impacts to Stream Flow

Analysis of potential impacts to stream flow requires a hydrograph, based on stream flow measurements in the field, for each key reach. For the FEIS, only a single hydrograph was used. The refined analysis makes use of five different hydrographs, representing different flow conditions along Cienega Creek and Empire Gulch. For each key reach, the hydrograph is then modified in three ways if applicable:

1. Make changes to measured hydrograph in order to extrapolate to a different key reach. Cienega Creek Reach 4 is the only hydrograph extrapolated in this manner.
2. Make changes to hydrograph due to groundwater drawdown occurring in the key reach. This step requires a method of converting drawdown (in feet) to loss in stream flow (in cubic feet per second (cfs) or gallons per minute (gpm)); the exact nature of this conversion varies by key reach.
3. Change to hydrograph due to loss of upstream surface flow, if applicable.

The specific methods to be applied to each key reach are summarized in May 2015 SBA Table 3.

The method of converting groundwater drawdown into stream flow reductions is different in the FEIS from the refined analysis included in the SIR and in the May 2015 SBA. In the FEIS analysis, this translation was accomplished by directly assuming any drawdown of groundwater would appear identically in the stream channel (i.e., 1 foot of drawdown in the aquifer would equal 1 foot of lowering of the water surface of the flowing stream). The additional information obtained between May and November 2014 (see the discussion of groundwater well and stream flow regression analysis, above) allows a different approach to determining the relationship between groundwater levels and stream flow. Several data sets are now available for Empire Gulch and Cienega Creek that pair stream flow measurements (as measured in gpm or cfs) with groundwater levels (as measured in feet below land surface). SBA Table 4 describes the linear regression analyses for key reaches CC2, CC13, CC15, and EG1.

These data sets have been used to define a statistical relationship between groundwater level and stream flow. This empirical stream flow/groundwater level relationship replaces the assumed 1:1 stream depth/groundwater level relationship found in the FEIS. The relationships derived from these data sets are summarized in May 2015 SBA Table 4.

The SIR and May 2015 SBA employed a hydrograph-based approach. A hydrograph is a plotting of stream flow over a given interval of time. The hydrograph approach is useful because it allows analysis of impacts not just on average annual flows, but observed conditions in these aquatic systems, including seasonal low flows (May/June), drought conditions, and year-to-year variability.

Once drawdown caused by mining is applied to the natural hydrograph, a series of hydrologic metrics is calculated for each key reach, for each time step. These metrics include the following:

- Average annual days with zero stream flow
- Average annual days with extremely low stream flow[7]
- Flow status (i.e., perennial, intermittent, ephemeral[8])
- Flow reductions (in gpm)

The following time steps were analyzed: end of mining (which depends on the year in which mining begins, possibly as soon as 2016), and 10, 20, 50, 100, and 150 years after end of mining.

Methodology for Prediction of Mine-Related Impacts to Standing Pools

One refinement of the aquatic analysis is the inclusion of impacts to standing pools, in addition to stream flow. At least some pools are likely supported by groundwater, and during those times of the year when stream flow potentially could cease, it is useful to know whether standing water would remain in the channel or whether the amount of water in pools would be decreased due to groundwater withdrawals caused by mining activities. This is important because many of the species being analyzed in this BO rely on water in pools to serve as refugia during times when stream flow declines to the extent that pools are not connected by surface flows. During November and December 2014, field surveys were conducted of all key reaches, with the intent of collecting information on standing pools. During these surveys, all pools were identified, their locations mapped, and characteristics recorded. The locations of all pools identified during the field surveys are shown in May 2015 SBA Figures 12a through 12e. Measurements included total length, width at multiple locations, depth at multiple locations, and presence of inflow/outflow of surface water from the stream.

A three-dimensional approximation of each pool was created using the Surfer software package. Using this three-dimensional model, the depth, volume, and pool surface area were calculated for each of the incremental drawdown scenarios.

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7 An extremely low stream flow is any discharge that is less than the minimum streamflow observed in the past at a given site. A flow less than those observed in the past represents an adverse change from baseline conditions.
8 For this analysis, consistent with the FEIS and SIR, the following definitions are used: perennial (0 to 30 days with zero stream flow); intermittent (31 to 350 days with zero stream flow); ephemeral (more than 350 days with zero stream flow).

A summary of the baseline pool characteristics as measured or calculated in November and December 2014 is shown in May 2015 SBA Table 5. The pertinent measures of pool geometry do not depend on the presence of water, as the measurements are made of the substrate, banks, and inlet and outlet elevations. Conducting the surveys during the winter thus did not create a bias towards winter stream flows.

Climate Change Scenario

Analysis of both stream flow and standing pools includes scenarios for mine drawdown, as well as mine drawdown in combination with climate change. This analysis was performed by USFS done in an attempt to measure the effects to key reaches caused by climate change.

Climate change is expected to have three primary consequences related to stream flow hydrology and riparian ecosystems: decreased precipitation, change in precipitation patterns, and increased temperature. The USFS compared precipitation and temperature trends during the ongoing drought with predictions of climate change effects. The Climate Change Stress Estimate section of the SIR (pages 85 through 87) contains a detailed description of the USFS analysis, and is incorporated herein via reference. The USFS ultimately determined that precipitation over the past several years is within the same range predicted from climate change by the year 2100. Therefore, it was assumed those effects would likely already be evident in the baseline trends of stream flow, aquatic habitat extent (wet/dry mapping), and possibly riparian vegetation.

However, temperature trends during the ongoing drought have not been in the same range as those expected from climate change by the year 2100. An estimate of hydrologic changes due to continued increases in temperature was made. This estimate is described more fully in the SIR (pages 85 through 87). For the stream flow analysis, estimated stream flow reductions due to climate change would vary by reach, ranging from a reduction of 3.3 gpm in Cienega Creek Reach 2 to a reduction of 44 gpm in Cienega Creek Reach 13. For the standing pool analysis, estimated reductions in groundwater level would not vary by reach due to lack of detailed information for each reach, but an average reduction in groundwater level of 0.4 foot is estimated to result from future climate change.

ANALYSIS RESULTS

Stream Flow Analysis

Table 6 in the May 2015 SBA provides an index to the stream flow analysis results. The tables with the results of the stream flow analysis (tables D-1 through D-13) are provided in full in May 2015 SBA Appendix D and in Tables A-1 through A-8 in this BO. Graphical representations of the results are included in May 2015 SBA Appendix E.

Summary of Stream Flow Analysis Results

The following tabular summary of results is based on the 95th percentile analysis, which encompasses 95 percent of all models that were chosen to run, and provides a consistent and concise way of summarizing results. It should not be construed as ignoring those results that fall outside this range. For instance, the high end of the sensitivity analyses typically falls outside the 95^{th} percentile range; however, these results are still fully disclosed in tables D-1 through D-13 in Appendix D of the May 2015 SBA. Note that the following discussion refers only to those periods of time up to 150 years after closure of the mine.

The 95^{th} percentile summary of stream flow results appearing in Tables A-1 through A-4 discloses that, at certain locations and time intervals, there is a potential range of results; lower and higher. We primarily discuss the results of the higher-end of the 95^{th} percentile analyses of all models in order to evaluate a less-likely, although theoretically-possible, set of effects for the respective Key Reaches. We note that upper Empire Gulch exhibits widely divergent results for the potential effects; effects range from no measurable effect to complete dewatering at later time-steps. Precaution again dictates the analysis of the worst-case scenario for Empire Gulch.

In brief, the proposed action will result in diminished stream flows as well as increased frequency of extremely low and no-flow periods. Key Reach CC15 in Cienega Creek will transition from perennial to intermittent. In the extreme case of upper Empire Gulch EG1, dewatering may be so severe that the stream transitions from perennial to ephemeral flow. This prediction is tempered by the great uncertainty resulting from the use of modeling scenarios with highly divergent results at the latter site.

Regardless, any appreciable (i.e. measurable) loss of stream flow, regardless of its cause (mining or climate change) constitutes an adverse effect on threatened and endangered aquatic species and, as applicable, proposed and final critical habitat. Subsequent species-specific analyses will tier to the hydrological information found in this section, but also include analyses of the degree to which the modeled flow losses diverge from the present-day baseline conditions. Changes from the present-day baseline condition represent the incremental effects (of mining as well as climate change) over time.

Table A-1 (BA Table D-10): Results of stream flow analysis for 95th percentile range – predicted stream flow loss (gpm)							
Key Reach	Scenario	End of Mine	10 Years	20 Years	50 Years	100 Years	150 Years
CC2	Mine Only	0	0-4.8	0-4.8	0-4.8	0-4.8	0-6.9
CC2	Climate Change	4.3	4.3	4.3	4.3	4.3	4.3
CC2	Mine and Climate Change	4.3	4.3-9.1	4.3-9.1	4.3-9.1	4.3-9.1	4.3-11.2
CC4	Mine Only	0-0.1	0-8.5	0-8.5	0-9	0-10.3	0-13.2
CC4	Climate Change*	16.1	16.1	16.1	16.1	16.1	16.1
CC4	Mine and Climate Change	16.1-16.2	16.1-24.6	16.1-24.6	16.1-25.1	16.1-26.4	16.1-29.3
CC5	Mine Only	0-0.1	0-8.5	0-8.5	0-9	0-10.3	0-13.2
CC5	Climate Change*	59.1	59.1	59.1	59.1	59.1	59.1
CC5	Mine and Climate Change	59.1-59.2	59.1-67.6	59.1-67.6	59.1-68.1	59.1-69.4	59.1-72.3
CC7	Mine Only	0-0.1	0-8.5	0-8.5	0-9	0-10.3	0-13.2
CC7	Climate Change*	102.1	102.1	102.1	102.1	102.1	102.1
CC7	Mine and Climate Change	102.1-102.2	102.1-110.6	102.1-110.6	102.1-111.1	102.1-112.4	102.1-115.3
CC13	Mine Only	0-0.4	0-3.9	0-3.9	0-3.9	0-3.9	0-3.9
CC13	Climate Change	44	44	44	44	44	44
CC13	Mine and Climate Change	44-44.4	44-47.9	44-47.9	44-47.9	44-47.9	44-47.9
CC15	Mine Only	0-0.8	0-15.4	0-15.4	0-15.4	0-15.4	0-15.4
CC15	Climate Change*	56	56	56	56	56	56
CC15	Mine and Climate Change	56-56.8	56-71.4	56-71.4	56-71.4	56-71.4	56-71.4
EG1	Mine Only	0-2.3	0-4.2	0-6.5	0-28.4	0-33.4	0.3-49.1
EG1	Climate Change	3.3	3.3	3.3	3.3	3.3	3.3
EG1	Mine and Climate Change	3.3-5.6	3.3-7.5	3.3-9.8	3.3-31.7	3.3-36.7	3.6-52.4
EG2	Mine Only	0-0.1	0-0.3	0-0.3	0-0.6	0-1.4	0-2.2
EG2	Climate Change	3.3	3.3	3.3	3.3	3.3	3.3
EG2	Mine and Climate Change	3.3-3.4	3.3-3.6	3.3-3.6	3.3-3.9	3.3-4.7	3.3-5.5
* Includes climate change reductions from all applicable upstream reaches as well							

Table A-2 (SBA Table D-11): Results of stream flow analysis for 95th percentile range – number of days with zero flow per year							
Key Reach	Scenario	End of Mine	10 Years	20 Years	50 Years	100 Years	150 Years
CC2	Climate Change	0	0	0	0	0	0
CC2	Mine and Climate Change	0	0	0	0	0	0
CC4	Mine Only	0	0	0	0	0	0
CC4	Climate Change	0	0	0	0	0	0
CC4	Mine and Climate Change	0	0	0	0	0	0
CC5	Mine Only	0-2	2-3	2-3	2-3	2-3	2-3
CC5	Climate Change	5	5	5	5	5	5
CC5	Mine and Climate Change	5	5-8	5-8	5-8	5-8	5-9
CC7	Mine Only	0-2	2-3	2-3	2-3	2-3	2-3
CC7	Climate Change	23	23	23	23	23	23
CC7	Mine and Climate Change	23	23-28	23-28	23-28	23-31	23-31
CC13	Mine Only	0	0	0	0	0	0
CC13	Climate Change	23	23	23	23	23	23
CC13	Mine and Climate Change	23	23	23	23	23	23
CC15	Mine Only	0	0	0	0	0	0
CC15	Climate Change	37	37	37	37	37	37
CC15	Mine and Climate Change	37	37-50	37-50	37-50	37-50	37-50
EG1	Mine Only	0	0	0-6	0-307	0-339	0-365
EG1	Climate Change	0	0	0	0	0	0
EG1	Mine and Climate Change	0	0-6	0-26	0-333	0-339	0-365
EG2	Mine Only	0	0	0	0	0	0
EG2	Climate Change	0	0	0	0	0	0
EG2	Mine and Climate Change	0	0	0	0	0	0

Table A-3 (SBA Table D-12): Results of stream flow analysis for 95th percentile range – number of days with extremely low flow[1] per year							
Key Reach	Scenario	End of Mine	10 Years	20 Years	50 Years	100 Years	150 Years
CC2	Mine Only	0	0-6	0-6	0-6	0-6	0-6
CC2	Climate Change	6	6	6	6	6	6
CC2	Mine and Climate Change	6	6-11	6-11	6-11	6-11	6-11
CC4	Mine Only	0	0-6	0-6	0-6	0-6	0-6
CC4	Climate Change	6	6	6	6	6	6
CC4	Mine and Climate Change	6	6-11	6-11	6-11	6-11	6-11
CC5	Mine Only	3	3-3	3-3	3-3	3-4	3-4
CC5	Climate Change	23	23	23	23	23	23
CC5	Mine and Climate Change	23	23-28	23-28	23-28	23-31	23-31
CC7	Mine Only	3	3-3	3-3	3-3	3-4	3-4
CC7	Climate Change	60	60	60	60	60	60
CC7	Mine and Climate Change	60	60-68	60-68	60-68	60-68	60-73
CC13	Mine Only	0-8	0-8	0-8	0-8	0-8	0-8
CC13	Climate Change	46	46	46	46	46	46
CC13	Mine and Climate Change	46	46-61	46-61	46-61	46-61	46-61
CC15	Mine Only	0	0-9	0-9	0-9	0-9	0-9
CC15	Climate Change	57	57	57	57	57	57
CC15	Mine and Climate Change	57	57-72	57-72	57-72	57-72	57-72
EG1	Mine Only	0-19	0-26	0-58	0-339	0-359	6-365
EG1	Climate Change	26	26	26	26	26	26
EG1	Mine and Climate Change	26	26-64	26-102	26-339	26-365	26-365
EG2	Mine Only	0-6	0-6	0-6	0-6	0-6	0-19
EG2	Climate Change	26	26	26	26	26	26
EG2	Mine and Climate Change	26	26	26	26	26	26
Note: The magnitude of what constitutes extremely low flow varies by key reach and is defined as a modeled flow less than that observed during the critical summer low flow season. The defined low-flow discharges are as follows: EG1 (6 gpm); EG2 (6 gpm); CC2 (28 gpm); CC4 (56 gpm); CC5 (44 gpm); CC7 (44 gpm); CC13 (22 gpm); and CC15 (17 gpm).							

Table A-4 (Table D-13): Results of stream flow analysis for 95 percentile range – flow status							
Key Reach	Scenario	End of Mine	10	20	50	100	150
CC2	Mine Only	P	P	P	P	P	P
CC2	Climate Change	P	P	P	P	P	P
CC2	Mine and Climate Change	P	P	P	P	P	P
CC4	Mine Only	P	P	P	P	P	P
CC4	Climate Change	P	P	P	P	P	P
CC4	Mine and Climate Change	P	P	P	P	P	P
CC5	Mine Only	P	P	P	P	P	P
CC5	Climate Change	P	P	P	P	P	P
CC5	Mine and Climate Change	P	P	P	P	P	P
CC7	Mine Only	P	P	P	P	P	P
CC7	Climate Change	P	P	P	P	P	P
CC7	Mine and Climate Change	P	P	P	P	P-I	P-I
CC13	Mine Only	P	P	P	P	P	P
CC13	Climate Change	P	P	P	P	P	P
CC13	Mine and Climate Change	P	P	P	P	P	P
CC15	Mine Only	P	P	P	P	P	P
CC15	Climate Change	I	I	I	I	I	I
CC15	Mine and Climate Change	I	I	I	I	I	I
EG1	Mine Only	P	P	P	P-I	P-I	P-E
EG1	Climate Change	P	P	P	P	P	P
EG1	Mine and Climate Change	P	P	P	P-I	P-I	P-E
EG2	Mine Only	P	P	P	P	P	P
EG2	Climate Change	P	P	P	P	P	P
EG2	Mine and Climate Change	P	P	P	P	P	P
Notes: P = Perennial (<30 no-flow days per year); I = Intermittent (30–350 no-flow days per year); E = Ephemeral (>350 no-flow days per year) L = Low End of All Sensitivity Analyses; TT = Tetra Tech Base or Best-Fit Model; M = Montgomery Base or Best-Fit Model; MY = Myers Base or Best-Fit Model; H = High End of All Sensitivity Analyses - Indicates no data available for this model/time step							

STREAM FLOW STATUS

The analyses appearing below rely primarily on the 95th percentile analyses, as stated in the Sources of Uncertainty section, above. These results appear in their entirety in Tables A-1, A-2 and A-4 in this BO.

It is important to note that the present-day, no-mine condition serves as the baseline; the analyses in the Stream Flow Analysis section do not consider climate change-related flow losses to represent an ongoing and evolving representation of a climate change-influenced baseline against which mine-only effects are assessed. In other words, all effects, whether the result of anticipated climate change or mine drawdown, are described in terms of their divergence from pre-project conditions (though we note the present-day conditions have been influenced by climate change). The mine-only results represent the proposed action's effects to the discharge of groundwater to springs, fluvial systems, and other wetlands, and thus form the basis for our analyses of the manner and extent to which aquatic and riparian species are affected and, in the case of animals, incidentally taken. The mine plus climate change scenarios represent the future state of the hydrology to inform our conclusions regarding jeopardy for the affected species and/or the destruction or adverse modification of the affected proposed and final critical habitats as well as future consultations on other Federal actions.

The May 2015 SBA's stream flow loss analyses are expressed in gallons per minute (gpm). The narrative analyses appearing below, however, primarily emphasize increases in zero-flow and extremely-low flow days; these values effectively express the degree of alteration relative to today's baseflow hydrology, which has direct relevance to the habitat occupied by threatened and endangered aquatic species.

For this analysis, consistent with the FEIS and SIR, the following definitions are used: perennial (0 to 30 days with zero stream flow); intermittent (31 to 350 days with zero stream flow); ephemeral (more than 350 days with zero stream flow).

Upper Cienega Creek – Key Reaches CC2 and CC4

These reaches show no days with zero flow under current baseline conditions. Under the higher range of the 95th percentile analyses, the mine's effects by themselves are anticipated to result in stream flow losses in reach CC2 ranging from no change at the end of mining, up to 4.8 gpm at 10 to 100 years post-mining, and up to 6.9 gpm at 150 years. Reach CC4 experiences greater effects over the long term: for the higher range of the 95th percentile values, the mine may result in loss of only 0.1gpm at the end of mining but this loss increases to 8.5 gpm at 10 and 20 years, 9 gpm at 50 years, 10.3 gpm at 100 years, and 13.2 gpm at 150 years. These effects result in no increase in zero-flow days, and the stream remains perennial.

Climate change alone is anticipated to result in flow losses of 4.3 gpm and 16.1 gpm at all time-steps from 10 to 150 years at CC2 and CC4, respectively. These climate change-based flow losses by themselves are also not sufficient to cause any increase in zero-flow days, and the stream remains perennial.

The mine effects in combination with climate change shows potential stream flow losses in reach CC2 ranging from no change (the baseline 4.3 gpm) to from 9.1 to 11.2 gpm (at the end of mining to 150 years later, respectively) under the higher range of the 95th percentile analyses. Reach CC4 could experience greater effects from mining plus climate change. The higher end of the 95th percentile ranges from 24.6 gpm loss at 10 years to 29.3 gpm at 150 years. These combined effects still result in a perennial stream with no increase in zero-flow days.

Upper Cienega Creek – Key Reaches CC5 and CC7

The mine-only drawdown data for CC5 indicate an anticipated flow loss of 0.1 gpm at the end of mining, 8.5 gpm at 10 and 20 years post-mining, 9 gpm at 50 years, 10.3 gpm at 100 years, and 13.2 gpm at 150 years, all under the higher end of the 95th percentile analyses. Under the 95th percentile analysis, flow losses in CC5 are greater in magnitude and will reach 59.1 gpm from climate change alone at all time-steps. Under the higher end of the 95th percentile analyses, mining combined with climate change may increase flow losses to 59.2 gpm at 10 years and up to 72.3 gpm at 150 years.

At CC7, and also under the 95th percentile analysis, mining, by itself, may result in anticipated flow losses ranging from 0.1gpm at the end of mining to as high as 13.2 gpm at 150 years later. Key reach CC7 flow losses from climate change alone may be 102.2 gpm at all time-steps. Under the higher end of the 95th percentile analyses, mining plus climate change will increase flow losses to 102.2 gpm at the end of mining up to 115.3 gpm at 150 years. Mining is again an appreciable, though not dominant, factor in the CC7 flow losses.

Reaches CC5 and CC7 exhibit an average of 2 days with zero stream flow per year under present-day baseline conditions. Mine drawdown alone, assuming no influence from climate change, would change this to 2 or 3 days per year under the 95th percentile analyses. Future climate change absent the mine’s impacts would result in 5 additional days with zero stream flow per year in CC5, and 23 additional days with zero stream flow per year in CC7.

In combination, and under the 95th percentile analyses, mine drawdown plus climate change would result in 5 to 9 days with zero stream flow per year in CC5, and from 23 to 31 days with zero stream flow per year in CC7. Flow status in CC5 would remain perennial under the proposed mine-plus climate change scenarios; flow status in CC7 also largely remains perennial for most scenarios, but by 100 years after mine closure, the higher range of the 95th percentile analysis indicates a possible shift to intermittent flow for the mine-plus-climate change scenario.

Lower Cienega Creek – Key Reaches CC13 and CC15

Key reaches CC13 and CC15 are both located within the Pima County Cienega Creek Natural Preserve (CCNP), the ecological condition of which has been exhaustively investigated by Pima County. The techniques employed by Powell *et al.* (2014) to measure the effects of the proposed action on the extent of aquatic habitat were incorporated, in a modified form (specifically, the use of actual stream flow data, rather than its natural log, in regression analyses) to the preceding hydrological analyses. A prior investigation, Powell *et al.* (2013), investigated trends in various hydrologic parameters and determined that lower Cienega Creek flow was in a downward trend, meaning further flow losses will steepen the decline.

In brief, all water resources evaluated by Powell *et al.* (2013) within the Pima County CCNP displayed a decline over time. Streamflow and discharge were among the parameters that showed the greatest decline; between 1990 and 2011, the mean value of these two measures declined by 68 percent and 83 percent, respectively. Similarly, the geographic extent of surface water flow decreased from a high of 9.5 miles in the 1980s to a low of 1.1 miles in 2011, a decline of 88 percent during that time. The change was less pronounced, but still significant, from 1999-2011 during which time it declined by 63 percent. Changes in depth to groundwater varied among wells, but declines were as much as 44 percent at one site (Jungle Well) from 1994-2011.

This consultation employs the hydrologic methodologies stated in the SIR and May 2015 SBA. Of these, the higher-end 95th percentile analyses of the effects of mine drawdown alone, absent climate change, range from 0.4 gpm to 3.9 gpm at the end of mining at CC13 and from 0.8 gpm to 15.4 gpm at the same time intervals at CC15. The 95th percentile analyses indicate that reach CC 13 and CC 15 could experience flow losses of 44 and 56 gpm at each time step, respectively, solely from the effects of climate change. Adding the effects of the mine drawdown to climate change increases flow losses at CC13 and CC15 to 47.9 and 71.4 gpm at 150 years, respectively.

The May 2015 SBA's 95th percentile analyses for these reaches show that mine drawdown alone would result in no increase in zero stream flow at any time-step at either CC13 or CC15. Climate change by itself would result in 23 additional days exhibiting zero stream flow per year at every time step in CC13, and 37 additional days with zero stream flow at every time step in CC15. In combination, mine drawdown plus climate change would result in 23 days with zero stream flow per year in CC13 (no change from the climate change-only results), and from 37 to 50 days with zero stream flow per year in CC15 (up to 13 additional days relative to climate change alone). Reach CC13 would not change flow status from perennial. Climate change pushes reach CC15 from perennial to intermittent flow status, regardless of mine drawdown. Mine drawdown, however, may increase the intermittency.

The causes for the declining hydrology of lower Cienega Creek noted by Powell *et al.* (2013) are likely to include drought and potentially, upstream water uses such as private wells. Drought may be the result of a changing climate and thus, its effects have been explicitly incorporated into the May 2015 SBA's analyses. The effects of water uses associated with future upstream development have not been modeled or analyzed, and their expansion may result in some unspecified additional decline in stream discharge.

Upper Empire Gulch – Key Reach EG1

Reach EG1 may experience appreciable effects due to mine drawdown. The 95th percentile results, however, are characterized by large variations in outcomes and timing, unlike the relatively narrow results for reaches on Cienega Creek (CC1-CC15). The finite chance that the more-severe effects will occur requires us to evaluate them.

Under the higher range of the 95th percentile analyses, mine drawdown alone may cause flow losses from 2.3 gpm at the end of mining, ramping up steeply to 28.4 gpm at 50 years, and reaching as high as 49.1 gpm at 150 years. Climate change, as modeled, would result in steady EG1 flow losses of 3.3 gpm from the end of mining through all time steps to 150 years. The higher range of the 95th percentile analyses for mine drawdown plus climate change results in 5.6 gpm of flow loss at the end of mining, which reaches 52.4 gpm at 150 years.

Mine drawdown is the dominant factor in the high-range, 95th percentile analyses of flow loss, which are of a magnitude sufficient to cause dewatering of the stream. The number of days with zero flow caused by mine-driven drawdown in upper Empire Gulch is anticipated to appreciably increase. At 150 years after mine closure, the 95th percentile range for mine drawdown alone shows a range that is anywhere from no change in days with zero stream flow (perennial flow status), to 365 days with zero stream flow (ephemeral flow status; complete loss of baseflow and flowing only in response to runoff). Climate change by itself is not anticipated to cause any additional zero flow days, though the effects of mine drawdown plus climate change differ somewhat from mine effects alone. Under the higher end of the 95th percentile analyses, mining and climate change are anticipated to cause 6 days of zero flow as early as 10 years after mining, 26 days at 20 years, 333 days at 50 years, 339 days at 100 years, and year-round dewatering at 150 years.

Climate change by itself is not anticipated to cause any change in upper Empire Gulch's flow status; reach EG1 would remain perennial. At the higher range of the 95th percentile range, mine drawdown may cause this reach to shift from perennial to intermittent flow by 50 years after mine closure and to ephemeral flow by 100 years after mine closure. Mine drawdown with climate change yields the same results.

Lower Empire Gulch – Key Reach EG2

Discharges in lower Empire Gulch appear to be relatively less sensitive to mine drawdown relative to upper Empire Gulch (EG1, above). The higher end of the 95th percentile, mine-only modeling scenario predicts that lower Empire Gulch will experience flow losses ranging from 0.1 gpm at the end of mining to 2.2 gpm at 150 years later. Climate change is anticipated to result in 3.3 gpm losses at all time-steps. The higher end of the 95th percentile analyses for the mine combined with climate change predict flow losses ranging from 3.4 gpm to 5.5 gpm at the end of mining and 150 years, respectively. Climate change is the larger effect.

WATER QUALITY

For the purpose of this analysis, water quality refers primarily to dissolved oxygen levels, crucial for the persistence of aquatic life. Temperature exerts an influence on dissolved oxygen, and is therefore considered to be a predictive measure of dissolved oxygen. The BLM has monitored temperature and dissolved oxygen along with stream flow at their monitoring locations on Empire Gulch and Cienega Creek; trend analyses for these parameters are included in SIR Appendix C. While the USFS determined in the SIR that the relationships between temperature and dissolved oxygen were not strongly predictive, as shown in SIR Table 3 (page 52), there is a statistically significant relationship between reductions in stream flow, increases in temperature, and decreases in dissolved oxygen. Reduced stream flow will result in a reduced volume of water which, during flow-flow, high-air temperature season (typically May and June), will cause a concomitant decrease in dissolved oxygen.

The analysis of water quality is therefore expressed in terms of the days of extremely low flow. Please note that the use of the term “extremely” in the context of low flows is the result of its use in the SIR and May 2015 SBA and is intended only to differentiate near-zero flows from flows that are simply less than typically observed. The magnitude of what constitutes extremely low flow varies by key reach and is defined as a modeled flow less than that observed during the critical summer low flow season. The defined low-flow discharges are as follows: EG1 (6 gpm); EG2 (6 gpm); CC2 (28 gpm); CC4 (56 gpm); CC5 (44 gpm); CC7 (44 gpm); CC13 (22 gpm); and CC15 (17 gpm). The defined low-flow discharges vary among the key reaches and are as follows: EG1 (6 gpm); EG2 (6 gpm); CC2 (28 gpm); CC4 (56 gpm); CC5 (44 gpm); CC7 (44 gpm); CC13 (22 gpm); and CC15 (17 gpm) (Garrett pers. comm.) Again, our analysis will focus primarily on the 95th percentile analysis of the frequency of discharges below these values. Low-flow frequency is displayed in Table A-3, above.

Again, we primarily discuss the results of the higher-end of the 95th percentile analyses of all models in order to evaluate a less-likely, although theoretically-possible, set of effects for the respective Key Reaches. Our narrative analyses for upper Empire Gulch (Key Reach EG-1) will discuss both low-range and high-range results while still placing greater precautionary, analytical emphasis on the worst-case scenario.

Under present-day conditions, during periods of low seasonal stream flow (May/June), portions of the aquatic environment along Cienega Creek and Empire Gulch can experience high water temperatures and low concentrations of dissolved oxygen (DO). These same trends would be expected to continue under future climate change and be further exacerbated by mine drawdowns during days where stream flow is predicted to fall to levels lower than those experienced currently.

In brief, the proposed action would result in increasing numbers of extremely low-flow days at most sites. In particular, Key Reach EG1 in Empire Gulch may experience either little change from current conditions or total dewatering due to mine-driven aquifer drawdown; precaution dictates we give relatively greater weight to the more severe potential outcome.

Upper Cienega Creek – Key Reaches CC2 and CC4

Upper Cienega Creek (key reaches CC2 and CC4) experience no days with extremely low flows under present-day, baseline conditions. With respect to water quality impacts in both reach CC2 and CC4, climate change by itself would result in up to 6 days of extremely low flows per year at each time step. The 95th percentile analysis of mine drawdown predicts an anticipated outcome of up to 6 days of extremely low flows, at the conclusion of mining. In other words, upon closure, the mine results in no incremental increases in extremely low-flow days beyond those precipitated by climate change.

Beginning at 10 years post-closure, mine-related drawdowns plus climate change would result in extremely low flow days ranging up to 11 days per year (up to 5 additional days per annum relative to climate change alone). This indicates a relatively greater, though still minor, mine-related contribution to water quality effects over time. Climate change remains the greater effect.

Upper Cienega Creek – Key Reaches CC5 and CC7

With respect to water quality impacts under the 95th percentile analyses, these reaches currently exhibit an average of 3 days with extremely low stream flow per year under current conditions. The effects of mine drawdown for Key Reach CC5 will increase by only 1 day (to 4 days annually) by 100 years after mining. Climate change is anticipated to have a more drastic effect, and by itself will increase the occurrence of extremely low flow days to 23 days per year for all post-mine time steps at CC5. The 95th percentile, higher range mine-plus-climate change values range from 28 days at the 10-, 20-, and 50-year time steps to 31 days at the 10- and 150-year time steps. Climate change is the greater effect.

Within CC7, and at the higher-end of the 95th percentile analyses, mine drawdowns alone are anticipated to result in only a single extra day of extremely low flows by 100 years, as was noted for reach CC5, above. Climate change by itself will increase the number of extremely low flow days from 3 days a year under current conditions to 60 days at all post-mine time steps. The high-range, 95th percentile climate change-plus-mine modeling results increase from 68 days at 10 to 100 years to 73 days at 150 years. Thus, the suite of 95th percentile analyses indicates a moderate mine-only contribution of drawdown-related effects.

As is the case with CC2 and CC4, current low-flow conditions during May and June already result in high water temperatures and low DO within the aquatic environment along Cienega Creek. These adverse conditions are expected to increase in frequency during a changing climate and possibly to an even greater extent due to the effects of mine-related groundwater drawdowns.

Lower Cienega Creek – Key Reaches CC13 and CC15

Key reaches CC13 and CC15 do not experience extremely low flows under current conditions. Mining is anticipated to increase this to 8 days in CC13 and 9 days in CC15 by 10 years (and throughout the post-mining period to 150 years). Climate change is anticipated to increase the occurrence of extremely low-flow days at CC13 and CC 15 to 46 to 57 days at all time-steps, respectively. Mine drawdown and climate change combined would result in 61 days of extremely flow at CC13 and up to 72 days at CC15. Again, these represent the higher values from the 95th percentile analysis. Climate change is the greater effect.

As stated previously, these conditions will increase the incidence of poorer water quality that adversely affects aquatic life in the Pima County CCNP.

Upper Empire Gulch – Key Reach EG1

Upper Empire Gulch already experiences low flows and compromised water quality during May and June. Under the higher range values in the 95th percentile analyses for mine drawdown, upper Empire Gulch is anticipated to steadily increase from 19 days of extremely low flow per year at the end of mining, increasing steeply to 339 days at 50 years, 359 days at 100 years, and year-round at 150 years. Note that the 150-year low-flow analysis is subsumed within the 150-year zero-flow data discussed above; upper Empire Gulch is anticipated to be completely dewatered.

In these analyses, mine drawdown is the dominant factor in the anticipated effects. Climate change alone will only increase the incidence of extremely low-flow days to 26 per year from the end of mining to 150 years later. Modeled high-range, 95th percentile water quality effects for the mine plus climate change reach 64 days at 10 years, 102 days at 20 years, 339 at 50 years, and year-round at 100 and 150 years.

Again, it must be noted that the values discussed above actually include both extremely low stream flow and zero stream flow and need to be considered in conjunction with the days with zero stream flow metric. In the case of reach EG1, the 365 days of extremely low flow at the 100- and 150-year intervals are actually days with zero stream flow.

We are aware of the highly-divergent modeling results for this site (see contrast between low-range and high-range results in Table A-3, for example). Again, the wide range of these data make definitive conclusions uncertain, but precaution dictates we give greater weight to possibility that upper Empire Gulch will experience severe hydrologic effects.

Lower Empire Gulch – Key Reach EG2

Lower Empire Gulch does not experience extremely low flows under current conditions. Mining, under the 95th percentile analyses, is modeled to increase this to 6 days annually from the end of mining to 100 years, and up to 19 days at 150 years. Climate change will result in an additional 26 days of extremely low flows at lower Empire Gulch; mining plus climate change will not increase this number either under the 95th percentile analysis or the higher range of the sensitivity analysis. This indicates a relatively greater, though still minor, mine-related contribution to water quality effects over time. Climate change is the greater effect.

Under current conditions, during periods of low seasonal stream flow (May/June), portions of the aquatic environment along Cienega Creek and Empire Gulch can experience high water temperatures and low concentrations of dissolved oxygen. These same trends would be expected to continue and be exacerbated during days where stream flow is predicted to fall to levels lower than those experienced currently.

Standing Pool Analysis

Table 7 in the May 2015 SBA provides an index to the standing pool analysis results. The tables with the results of the standing pool analysis (tables D-14 through D-26) are provided in full in the SBA’s Appendix D, and also appear in this BO as Tables A-5 through A-8, below. Graphical representations of the results are included in the SBA’s Appendix F.

The 95th percentile summary of stream flow results appearing in Tables A-5 through A-8, like Tables A-1 through A-4, above, also disclose that, at certain locations and time intervals, there is a potential range of results; lower and higher. We primarily discuss the results of the higher-end of the 95th percentile analyses of all models in order to evaluate a less-likely, although theoretically-possible, set of effects for the respective Key Reaches. Our narrative analyses for upper Empire Gulch (Key Reach EG-1) will, however, discuss both low-range and high-range results. This is appropriate given the widely divergent values for the potential effects; effects range from no measurable effect to complete dewatering at later time-steps. Regardless of this disclosure, precaution still dictates the analysis of the worst-case scenario for Empire Gulch.

Table A-5 (SBA Table D-23): Results of refugia pool analysis for 95th percentile range – number of pools remaining under no-flow conditions

Key Reach	Scenario	End of Mine	10	20	50	100	150
CC2	Mine Only	22	22	22	22	22	22
CC2	Climate Change	19	19	19	19	19	19
CC2	Mine and Climate Change	19	19	19	19	19	19
CC4	Mine Only	16	16	16	16	16	16
CC4	Climate Change	15	15	15	15	15	15
CC4	Mine and Climate Change	15	15	15	15	15	15
CC5	Mine Only	19	19	19	19	19	19
CC5	Climate Change	19	19	19	19	19	19
CC5	Mine and Climate Change	19	19	19	19	19	19
CC7	Mine Only	15	15	15	15	15	15
CC7	Climate Change	15	15	15	15	15	15
CC7	Mine and Climate Change	15	15	15	15	15	15
CC13	Mine Only	8	8	8	8	8	8
CC13	Climate Change	7	7	7	7	7	7
CC13	Mine and Climate Change	7	7	7	7	7	7
CC15	Mine Only	4	4	4	4	4	4
CC15	Climate Change	3	3	3	3	3	3
CC15	Mine and Climate Change	3	3	3	3	3	3
EG1	Mine Only	5	5	5	2-5	2-5	0-5
EG1	Climate Change	5	5	5	5	5	5
EG1	Mine and Climate Change	5	5	5	2-5	1-5	0-5
EG2	Mine Only	11	11	11	11	11	11
EG2	Climate Change	10	10	10	10	10	10
EG2	Mine and Climate Change	10	10	10	10	10	10
CGW	Mine Only	3	3	3	3	3	3
CGW	Climate Change	3	3	3	3	3	3
CGW	Mine and Climate Change	3	3	3	3	3	3

Table A-6 (SBA Table D-24): Results of refugia pool analysis for 95 percentile range – median* depth of pools							
Key Reach	Scenario	End of Mine	10	20	50	100	150
CC2	Mine Only	1.1	1.1	1.1	1.1	1.1	1.1
CC2	Climate Change	1.9	1.9	1.9	1.9	1.9	1.9
CC2	Mine and Climate Change	1.9	1.9	1.9	1.9	1.9	1.9
CC4	Mine Only	2.5	2.4-2.5	2.4-2.5	2.4-2.5	2.4-2.5	2.4-2.5
CC4	Climate Change	2.4	2.4	2.4	2.4	2.4	2.4
CC4	Mine and Climate Change	2.4	2.4	2.4	2.4	2.4	2.4
CC5	Mine Only	2.9	2.9	2.9	2.9	2.9	2.9
CC5	Climate Change	2.5	2.5	2.5	2.5	2.5	2.5
CC5	Mine and Climate Change	2.5	2.5	2.5	2.5	2.5	2.5
CC7	Mine Only	2.9	2.9	2.9	2.9	2.9	2.8-2.9
CC7	Climate Change	2.5	2.5	2.5	2.5	2.5	2.5
CC7	Mine and Climate Change	2.5	2.5	2.5	2.5	2.5	2.4-2.5
CC13	Mine Only	0.8-0.9	0.8-0.9	0.8-0.9	0.8-0.9	0.8-0.9	0.8-0.9
CC13	Climate Change	0.5	0.5	0.5	0.5	0.5	0.5
CC13	Mine and Climate Change	0.5	0.5	0.5	0.5	0.5	0.5
CC15	Mine Only	1.4	1.4	1.4	1.4	1.4	1.4
CC15	Climate Change	1.7	1.7	1.7	1.7	1.7	1.7
CC15	Mine and Climate Change	1.7	1.7	1.7	1.7	1.7	1.7
EG1	Mine Only	1.0-1.2	0.9-1.2	0.7-1.2	0.8-1.2	0.4-1.2	N-1.2
EG1	Climate Change	0.8	0.8	0.8	0.8	0.8	0.8
EG1	Mine and Climate Change	0.6-0.8	0.5-0.8	0.3-0.8	0.4-0.8	0.2-0.8	N-0.8
EG2	Mine Only	1.9	1.9	1.9	1.9	1.8-1.9	1.7-1.9
EG2	Climate Change	1.6	1.6	1.6	1.6	1.6	1.6
EG2	Mine and Climate Change	1.5-1.6	1.5-1.6	1.5-1.6	1.5-1.6	1.5-1.6	1.4-1.6
CGW	Mine Only	3.6	3.6	3.6	3.5-3.6	3.4-3.6	3.2-3.6
CGW	Climate Change	3.2	3.2	3.2	3.2	3.2	3.2
CGW	Mine and Climate Change	3.2	3.2	3.2	3.1-3.2	3.0-3.2	2.8-3.2
N - Indicates that no pools are predicted to remain * The median is calculated only from those pools predicted to remain.							

Table A-7 (SBA Table D-25): Results of refugia pool analysis for 95 percentile range – median* percent remaining volume of pools

Key Reach	Scenario	End of Mine	10	20	50	100	150
CC2	Mine Only	99	88-99	88-99	88-99	88-99	84-99
CC2	Climate Change	52	52	52	52	52	52
CC2	Mine and Climate Change	52	50-52	50-52	50-52	50-52	50-52
CC4	Mine Only	100	97-100	97-100	97-100	97-100	96-100
CC4	Climate Change	62	62	62	62	62	62
CC4	Mine and Climate Change	62	61-62	61-62	61-62	60-62	60-62
CC5	Mine Only	99	97-99	97-99	97-99	97-99	97-99
CC5	Climate Change	67	67	67	67	67	67
CC5	Mine and Climate Change	67	66-67	66-67	66-67	66-67	66-67
CC7	Mine Only	100	98-100	98-100	97-100	95-100	93-100
CC7	Climate Change	67	67	67	67	67	67
CC7	Mine and Climate Change	67	66-67	66-67	65-67	64-67	63-67
CC13	Mine Only	99-100	88-100	88-100	88-100	88-100	88-100
CC13	Climate Change	18	18	18	18	18	18
CC13	Mine and Climate Change	18	17-18	17-18	17-18	17-18	17-18
CC15	Mine Only	100	89-100	89-100	89-100	89-100	89-100
CC15	Climate Change	53	53	53	53	53	53
CC15	Mine and Climate Change	51-53	51-53	51-53	51-53	51-53	51-53
EG1	Mine Only	64-100	40-100	30-100	4-100	0-100	N-90
EG1	Climate Change	33	33	33	33	33	33
EG1	Mine and Climate Change	24-33	17-33	11-33	0-33	0-33	N-31
EG2	Mine Only	99-100	97-100	97-100	94-100	87-100	81-100
EG2	Climate Change	59	59	59	59	59	59
EG2	Mine and Climate Change	58-59	57-59	57-59	56-59	53-59	49-59
CGW	Mine Only	98-100	92-100	90-100	75-100	52-100	38-100
CGW	Climate Change	38	38	38	38	38	38
CGW	Mine and Climate Change	37-38	36-38	36-38	33-38	28-38	21-38

N - Indicates that no pools are predicted to remain
* In this case, 100 percent indicates that the pool retains all of its original volume; lower percentages indicate the percentage left of the original volume. For instance, a statistic of 80 percent would mean that the pool retains 80 percent of its original volume, and has lost or shrunk by 20 percent. The median is calculated only from those pools predicted to remain.

Table A-8 (SBA Table D-26): Results of refugia pool analysis for 95 percentile range – median* percent remaining surface area of pools							
Key Reach	Scenario	End of Mine	10	20	50	100	150
CC2	Mine Only	99	92-99	92-99	92-99	92-99	89-99
CC2	Climate Change	57	57	57	57	57	57
CC2	Mine and Climate Change	57	55-57	55-57	55-57	55-57	55-57
CC4	Mine Only	100	98-100	98-100	98-100	98-100	97-100
CC4	Climate Change	68	68	68	68	68	68
CC4	Mine and Climate Change	68	67-68	67-68	67-68	67-68	67-68
CC5	Mine Only	99	98-99	98-99	98-99	98-99	98-99
CC5	Climate Change	75	75	75	75	75	75
CC5	Mine and Climate Change	75	74-75	74-75	74-75	74-75	74-75
CC7	Mine Only	100	98-100	98-100	98-100	96-100	94-100
CC7	Climate Change	71	71	71	71	71	71
CC7	Mine and Climate Change	71	69-71	70-71	69-71	68-71	67-71
CC13	Mine Only	99-100	91-100	91-100	91-100	91-100	91-100
CC13	Climate Change	29	29	29	29	29	29
CC13	Mine and Climate Change	29	28-29	28-29	28-29	28-29	28-29
CC15	Mine Only	100	92-100	92-100	92-100	92-100	92-100
CC15	Climate Change	63	63	63	63	63	63
CC15	Mine and Climate Change	63	61-63	61-63	61-63	61-63	61-63
EG1	Mine Only	78-100	61-100	47-100	7-100	2-100	N-93
EG1	Climate Change	52	52	52	52	52	52
EG1	Mine and Climate Change	38-52	26-52	14-52	2-52	2-52	N-48
EG2	Mine Only	100	98-100	98-100	97-100	93-100	89-100
EG2	Climate Change	73	73	73	73	73	73
EG2	Mine and Climate Change	73	72-73	72-73	70-73	67-73	64-73
CGW	Mine Only	99-100	94-100	93-100	81-100	64-100	52-100
CGW	Climate Change	51	51	51	51	51	51
CGW	Mine and Climate Change	51	50-51	49-51	45-51	38-51	29-51
N - Indicates that no pools are predicted to remain * In this case, 100 percent indicates that the pool retains all of its original volume; lower percentages indicate the percentage left of the original volume. For instance, a statistic of 80 percent would mean that the pool retains 80 percent of its original volume, and has lost or shrunk by 20 percent. The median is calculated only from those pools predicted to remain.							

Summary of Standing Pool Analysis Results

The following summary of results is based, like the stream flow and water quality analyses above, on the 95th percentile analyses provided in the May 2015 SBA.

It is again noted that the present-day, pre-proposed action condition serves as the baseline; the analyses in the Standing Pool Analysis do not consider future anticipated climate change-related losses to represent an ongoing and evolving representation of a climate-change influenced baseline because we view climate change as an effect (though not of the proposed action). In other words, all effects, whether the result of anticipated climate change or mine drawdown, are described in terms of their divergence from pre-project conditions. The percent losses described throughout the Pool Analysis subsections therefore refer to losses from a fixed, present-day baseline, not incremental losses between time steps or the increments between future climate change and drawdown-related losses. Again, we reiterate that all effects, whether the result of anticipated climate change or mine drawdown, are described in terms of their divergence from pre-project conditions. Furthermore, the mine plus climate change scenarios represent the future state of the hydrology to inform our conclusions regarding jeopardy for the affected species and/or the destruction or adverse modification of the affected proposed and final critical habitats as well as future consultations on other Federal actions.

It should also be noted that the tables summarizing results use summary statistics, such as the median depth, volume, or area for all pools in a key reach. To ensure that use of these statistics does not mask[9] the full range of results, results for individual pools are also included in Appendix G of the May 2015 SBA.

In brief, the proposed action will result in varying reductions in the numbers, depth, volume, and surface area of pools. The percentages of losses (and/or percentages retained) for volume and surface area represent the median value for all pools in the reach, and reflect the percentage loss (and/or percentage remaining) of the original volume or surface area. As is the case with the stream flow and water quality analyses, above, Key Reach EG1 in Empire Gulch may experience either little effect or a near-total loss of aquatic ecological function; we have exercised precaution and given greater weight to the latter, worse-case analysis.

Also note that for median depth, median percent remaining pool volume and median percent remaining pool area, the larger magnitude of effect is associated with the lower-range number in those 95th percentile analyses that report a range of values. Precaution also dictates that we give these greater adverse effects more analytical weight.

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9 As stated in the May 2015 SBA, selection of summary statistics exhibits shortcomings. In this case, the use of median values to summarize the results for an entire key reach can lead to some non-intuitive mathematical outcomes. This is because the median is only calculated using those pools still in existence, and does not incorporate pools that have dried up completely. For example, the median depth of pools in reach CC2 under current conditions is 1.1 feet, which is calculated using a total of 22 pools. Climate change stress causes three pools to disappear. Each of the individual remaining pools is modelled to drop 0.4 foot due to climate change, but when the median is calculated using the those remaining 19 pools, the median is 1.9 feet, which is deeper than under current conditions.

Pool Analysis

Upper Cienega Creek – Key Reaches CC2 and CC4

Upper Cienega Creek in reach CC2 currently possesses 22 pools with a median depth of 1.1 ft. (ranging from 0.3 to 7.8 ft.). Upper Cienega Creek in reach CC4 currently possesses 16 pools with a median depth of 2.5 ft. (ranging from 0.3 to 9.7 ft.).

Mine drawdown under the 95th percentile analyses, by itself, does not change the number of pools present in either CC2 or CC4. Climate change reduces the number of pools from 22 to 19 for reach CC2, and from 16 to 15 for reach CC4. Mining and climate change combined result in no additional effect to the number of pools.

The 95th percentile modeling results for mine drawdown, climate change, and both scenarios combined do not indicate any change in median percent remaining pool depth in CC2 and only 0.1 ft. of lost depth from mine drawdown in CC4.

Under the 95th percentile analyses for CC2, median remaining pool volume under the mine-only scenario may drop to 84 percent by 150 years. Climate change has greater effects to pool volume, leaving 52 percent remaining at all time-steps. The combination of mining and climate change may result in as little as 50 percent of pool volume remaining at 10 through 150 years.

Under the 95th percentile analyses for CC4, median remaining pool volume under the mine-only scenario may drop to 97 percent from 10 to 100 years following mining and 96 percent at 150 years. Climate change has greater effects to pool volume, leaving 62 percent remaining at all time-steps. The combination of mining and climate change may result in as little as 62 to 60 percent of pool volume remaining at 10 to 150 years, respectively.

The 95th percentile analyses of the percent remaining pool surface area again indicates that greater surface area losses in CC2 begin at the cessation of mining and increase over time. Mine drawdown may leave 89 percent area remaining at 150 years while climate change leaves as little as 57 percent at the same time step. Combined, as little as 55 percent of the initial pool area may remain 150 years after mining.

Upper Cienega Creek – Key Reaches CC5 and CC7

Upper Cienega Creek in reach CC5 currently possesses 19 pools with a median depth of 2.9 ft. (ranging from 1.7 to 8.3 ft.). Upper Cienega Creek in reach CC7 currently possesses 15 pools exhibiting a median depth of 2.9 ft. (ranging from 1.1 to 6.3 ft.).

The 95th percentile analyses indicate the number of pools in CC5 (19) or CC7 (15) will not be reduced by mine drawdown, climate change, or both effects combined. Median pool depth in CC5 will be similarly unaffected, but CC7 may lose 0.1 ft. of pool depth from mine drawdown at 150 years.

Mine drawdown may leave 97 percent of pool volume remaining in CC5 at 150 years while climate change may leave 67 percent remaining at the same time step. In CC7, mine drawdown by itself may leave 93 percent of pool volume remaining in CC5 at 150 years while climate change may leave 67 percent of pool volume remaining. Combined, mining and climate change are anticipated to result in 66 percent of the current CC5 pool volume and 63 percent of the current CC7 pool volume remaining at the 150-year time step.

Similarly, the 95th percentile results for median remaining pool surface area display greater effects from climate change than from mining alone. At 150 years, mine drawdown is anticipated to leave 98 percent of the pool surface area remaining in CC5 and 94 percent in CC7. Climate change will leave 75 percent in CC5 and 71 percent in CC7 at 150 years. Combined mining and climate change will result in 74 percent and 67 percent median pool surface area remaining at 150 years in reaches CC5 and CC7, respectively.

Lower Cienega Creek – Key Reaches CC13 and CC15

Lower Cienega Creek in reach CC13 currently possesses 8 pools with a median depth of 0.9 ft. (ranging from 0.4 to 3.1 ft.). Lower Cienega Creek in reach CC15 currently possesses 4 pools with a median depth of 1.4 ft. (ranging from 0.3 to 2.3 ft.).

Under the 95th percentile analysis, mine drawdown by itself does not change the number of pools present in key reaches CC13 and CC15. Climate change by itself reduces the number of pools from 8 to 7 for reach CC13, and from 4 to 3 for reach CC15. Mine drawdown and climate change, when combined, also do not substantially change the median pool depth (0.1-ft. change).

In CC13, the mine alone is anticipated to leave as little as 88 percent of pool volume remaining beginning as soon as 10 years after mining. Climate change has even greater effects, leaving as little as 18 percent of pool volume remaining 10 years post-mining. Together, the mine and a changing climate are anticipated to leave as little as 17 percent of pool volume remaining at 150 years. In CC15, mine drawdown will have similar effects (89 percent remaining). Climate change will affect CC15 to a lesser extent than CC13, though it will still leave just 53 percent pool volume remaining at all intervals from 10 to 150 years. Mining and climate change combined are anticipated to leave as little as 51 percent pool volume remaining in CC15 over time.

The 95th percentile, mine-only effect out to 150 years is the retention of 91 percent of median surface area in CC13. Climate change effects are of a greater magnitude in CC13; just 29 percent will remain by 150 years post-mining. Mining and climate change combined will leave as little as 28 percent of pool surface area remaining in key reach CC13 at 150 years out.

In key reach CC15, mining alone will leave at least 92 percent of median pool area intact throughout the modeled period (10 to 150 years). Climate change will leave 63 percent in place out to 150 years post-mining. Combining climate change and mining modestly decreases the median remaining pool area to 61 percent, beginning at 10 years and extending out to 150 years post-mining.

Upper Empire Gulch – Key Reach EG1

Upper Empire Gulch in Key Reach EG1 currently possesses 5 pools exhibiting a median depth of 1.2 ft. (ranging from 0.9 to 3.0 ft.).

Similar to the stream flow analysis, the 95th percentile range of pool results for reach EG1 encompasses a wide range of outcomes. Unlike the reaches on Cienega Creek, the range of possible outcomes for EG1 pools is quite large, as is the range of potential timing for impacts to occur.

At 150 years after mine closure, the 95th percentile range for mine drawdown alone shows an estimate that ranges from all pools remaining in the reach to no pools remaining. At the higher range of the 95th percentile range, pools begin to disappear by 50 years after mine closure. At the low end of the 95th percentile range, all pools remain even 150 years after mine closure. Climate change has very little effect on the number of pools, even in combination with mine drawdown. Mining plus climate change yields results similar to the effects of mining alone, although as few as one pool could remain by 100 years post mining (the mine alone could leave just two).

Mining alone may result in steady declines in the median depth of pools under the 95th percentile analysis, with depths potentially reaching zero (complete dewatering) at the higher end of the analysis range by 150 years. Climate change has a steady adverse effect on median pool depth (0.8 ft.) at all time-steps. Climate change combined with the mine’s drawdown results, again at the higher range, in steadily increasing losses of pool depth over time, culminating in dewatering by 150 years.

Pool volume exhibits appreciable losses under the higher end of the 95th percentile analyses. The mine by itself could leave as little as 64 percent of the volume intact by the end of mining, progressing steadily until pools are absent at 150 years. Climate change is anticipated to result in the loss of two-thirds (33 percent volume remaining) at all times steps. Climate change with the mine in place may have immediate and severe effects on pool volume; ranging from as little as 24 percent remaining at the end of mining to no remaining volume (dewatering) at 50 years.

The effects of the mine, by itself and at the higher end of the 95th percentile analyses, on the percent remaining pool surface area are similar in scope to the effects on volume described above, with steadily increasing losses occurring from the end of mining through 150 years. The effects reach a 53 percent loss at 20 years (47 percent remaining), only 7 percent remaining at 50 years, just 2 percent remaining at 100 years, and total loss of pools at 150 years. Climate change is anticipated to remove 48 percent of pool surface area by itself, so the effects of the mine plus climate change effects may be severe. At the higher end of the 95th percentile analyses, 38, 26, 14, 2, 2, and 0 percent of pool surface area remains at the end of mining, at 10, 20, 50, 100, and 150 years, respectively.

As with the analysis of effects to streamflow, above, aquatic species occurring in pools in upper Empire Gulch are anticipated to experience appreciable additive adverse effects from the proposed action beyond the effects of climate change, and may ultimately be extirpated from the site.

Lower Empire Gulch – Key Reach EG2

Lower Empire Gulch in Key Reach EG2 currently possesses 11 pools, the depths of which range from 0.2 to 4.9 ft. The median depth of these 11 pools is 1.9 ft.

Mine drawdown does not change the number of pools present in reach EG2; climate change reduces the number of pools from 11 to 10 (a 9 percent loss of numbers of pools, with 90 percent retained). Combined, mining and climate change retain the potential for the loss of only one pool.

Mine drawdown does changes the pool depth to a small degree (0.2 ft. at 150 years). Pool volume could be reduced by 19 percent (81 percent remaining) at 150 years from mining alone while climate change is anticipated to result in a 41 percent loss of pool volume (59 percent remaining) throughout the modeled time period. Mining and climate change together may leave as little as 58 percent volume remaining (42 percent lost) at the end of mining, increasing modestly to 49 percent (51 percent lost) at 150 years.

The 95th percentile analyses of the losses of median pool surface area in EG2 are similar in magnitude. The mine alone is anticipated to leave 89 percent of pool surface area intact (11 percent lost) at 150 years, with all other time-steps at a less than 10 percent loss (greater than 90 percent retained). Climate change is the predominant factor in surface area losses in EG2 pools, leaving 73 percent at all modeled intervals. Together, climate change and mine drawdown will leave 64 percent of pool surface area intact (and 36 percent lost) at 150 years.

Pools in lower Empire Gulch are anticipated to experience measurable adverse effects, although lower in magnitude relative to upstream reaches.

Cieneguita Wetlands – Key Reach CGW

The Cieneguita Wetlands (Key Reach CGW) is composed of 3 pools with depths ranging from 1.7 to 3.9 ft.; the median depth is 3.6 feet.

Similar to reach EG1, the 95th percentile range of results for the Cieneguita Wetlands encompasses a wide range of results. The number of pools does not change, either by mine drawdown alone or in combination with climate change.

Pool depth changes slightly due to mine drawdown by itself; 150 years after mine closure, median pool depth from reduces from 3.6 to 3.2 feet (11 percent loss of depth, 89 percent remaining). Pool volume does change substantially, albeit with large variations in some results. At the higher end of the 95th percentile analyses, the mine, by itself, reduces pool volume to 75 percent (25 percent lost) by 50 years, 52 percent (48 percent lost)by 100 years, and 38 percent (62 percent lost) by 150 years. Climate change by itself reduces pool volume to 38 percent of original volume (62 percent lost) at 150 years, and in combination with mine drawdown, pools are reduced to as little as 21 percent of original volume (79 percent of original volume lost).

Under the higher end of the 95th percentile analyses, mine drawdown alone is anticipated to decrease pool surface area modestly at the end of mining, and likewise at 10 and 20 years post-mining (99, 94, and 93 percent remaining pool surface area, respectively). Mine-only effects ramp up to 81 percent surface area remaining at 50 years, 65 percent at 100 years, and 52 percent at 150 years (19, 35, and 48 percent lost pool surface area, respectively). Climate change, under the same scenario, is predicted to leave 51 percent pool volume remaining (a 49-percent loss) in CGW throughout the modeled period (end of mining to 150 years). Effects are anticipated to be greatest when mine drawdown is considered in combination with climate change. The 100- and 150-year time step predictions are that as little as 38 and 29 percent of pool surface area, respectively, will be retained (meaning that 62 to 71 percent of pool volume will be lost at the 100- and 150-year time steps, respectively).

Summary of Effects to Aquatic Ecosystems

Climate change is anticipated to adversely affect aquatic ecosystems via increased temperatures, reduced precipitation, and altered patterns of precipitation. The proposed action contributes incremental effects that will, at varying levels, further diminish surface flows, the dimensions of pool habitat, and reduce water quality, resulting in significant degradation of the aquatic ecosystem on which the Gila chub, Gila topminnow, desert pupfish, Huachuca water umbel, Chiricahua leopard frog, and northern Mexican gartersnake depend.

Upper Empire Gulch (EG1) may suffer the most appreciable effects, with the potential to be subject to over 300 days of zero flow by 50 years post-mining. The number, depth, volume, and surface area of upper Empire Gulch’s pools may all be appreciably reduced, primarily due to mine effects, thus significantly degrading the aquatic habitat available in the reach.

The main stem of Cienega Creek (key reaches CC2, CC4, CC5, CC7, CC13, and CC15) will variously experience measurable losses of discharge, increases in the occurrence of zero flow and extremely low flows, and reductions in the number, depth, volume, and surface area of pools, with the magnitude varying by site. The manner and degree to which these changes effect the Gila chub, Gila topminnow, desert pupfish, Huachuca water umbel, Chiricahua leopard frog, northern Mexican gartersnake, and applicable proposed and final critical habitats are detailed in the respective species’ effects analyses below. Regardless of the ultimate determinations regarding the effects of the proposed action and its conservation measures on the affected species and critical habitats, the relatively minor mine drawdown-related effects (and the mine effects plus the relatively greater climate change effects) in the main stem of Cienega Creek still represent significant degradations of the aquatic ecosystem.

Background for Subsequent Analyses and Definition of Baseline

The hydrologic data appearing in the preceding section and upon which a portion of the riparian ecosystem, Gila chub, Gila topminnow, desert pupfish, Huachuca water umbel, Chiricahua leopard frog, northern Mexican gartersnake, yellow-billed cuckoo, and southwestern willow flycatcher-specific analyses employ hydrologic data based on a 95th percentile analysis of the Tetra Tech (2010), Montgomery (2010), and Myers (2010) groundwater model best-fit and sensitivity analyses, as applicable.

These 95th percentile analyses were developed for the SIR and were included in the May 2015 SBA to address FWS concerns with the use of multiple groundwater models with oftentimes divergent results. The 95th percentile analysis was described in detail in these prior documents, and was summarized in the Sources of Uncertainty subsection of the Effects of the Proposed Action section, above.

We are aware of the analytical strengths and weakness of this approach, but reiterate that our selection of the upper end of the 95th percentile values results in analyses in which 97.5 percent (which includes the 2.5 percent of the least well-represented values at the lower end of the distribution) of the *other* possible hydrologic outcomes exhibit lesser effects. The 95th percentile approach does not represent the most probable outcome (but it does provide reasonable certainty that the effects to this species are unlikely to be greater than those described below). Due to the uncertainty inherent in these modeling efforts, there are no results that can be definitively said to be the most likely to occur. Thus, we have selected the precautionary approach.

Secondly, the following species-specific analysis considers the present-day state of the hydrology to represent the baseline condition. All effects, whether the result of anticipated climate change alone, mine drawdown alone, and/or climate change and mine drawdown combined, are described in terms of their divergence from present, pre-project conditions. Climate change is *not* viewed as an ongoing and evolving baseline against which mine-only effects are incrementally assessed.

This statement will be reiterated in the respective effects analyses for the Gila chub, Gila topminnow, desert pupfish, Huachuca water umbel, Chiricahua leopard frog, northern Mexican gartersnake, yellow-billed cuckoo, and southwestern willow flycatcher to ensure our approach has been made clear.

Effects to Riparian Ecosystems

This section revises and supplants our October 30, 2013, BO’s analysis of the effects of the proposed action on riparian ecosystems. The southwestern willow flycatcher is an obligate riparian bird, the western yellow-billed cuckoo is strongly associated with riparian and adjoining upland areas, the northern Mexican gartersnake is strongly aquatic (although it does range well into upland areas when foraging), and the Huachuca water umbel is a semi-aquatic plant that occurs in streams and riparian areas; the analyses contained herein are incorporated via reference into the respective species’ analyses.

General Effects to Riparian Ecosystems

The proposed action will affect riparian systems to varying degrees via the withdrawal of groundwater from the aquifer that sustains portions of springs and streams as well as by alterations in surface runoff patterns within the watershed of the streams. The hydrologic basis for these effects is discussed in detail within the Effects to Aquatic Ecosystems section, and is incorporated herein via reference.

The effect of increased depth to groundwater on riparian vegetation has been investigated by Stromberg *et al.* (1996), Scott *et al.* (1999), Horton *et al.* (2001b), and Merritt and Bateman 2012. Others have investigated riparian response to spatial variations in groundwater depth (i.e. as stream courses changed from perennial to intermittent along their course) (Leenhouts *et al.* 2005, Stromberg *et al.* 2005; Stromberg *et al.* 2007a and 2007b), or changes resulting from the operation of impoundments (Horton *et al.* 2001a, Shafroth *et al.* 2002). It is also important to note that riparian vegetation tends to develop in response to local conditions; communities that exist in sites with highly variable alluvial groundwater levels tend to have rooting depths capable of withstanding relatively larger variations in groundwater level than sites where groundwater elevations are more consistent (Shafroth *et al.* 2000). The streams in the action area exhibit high variability. The variation was first described by SWCA (2012), was summarized in the Effects to Aquatic Ecosystems section on the October 30, 2013, Final BO, and later appeared in the FEIS (2: 294-295).

It is difficult to apply these prior investigations' quantitative results directly to the action area, but one key finding is that increasing depths to groundwater will eventually result in changes in the species composition of a given sites' riparian community (i.e., hydroriparian communities would suffer decreased vigor and extent, eventually transitioning to a xeroriparian community). It is also possible that the groundwater declines resulting from the proposed action, while seemingly minor, will increase current or future levels of hydrologic variation to the point that present-day riparian communities cannot perpetuate themselves.

Maintenance of existing stands of cottonwood and/or willow forests requires the presence of relatively shallow groundwater. Lite and Stromberg (2005) found that cottonwood and Goodding's willow plants were able to compete successfully with non-native saltcedar plants when the maximum depth to groundwater was less than or equal to 8 feet. Leenhouts *et al.* (2005) found that cottonwoods and willow forests on the upper San Pedro River were dense and multiaged among sites where annual maximum ground-water depths averaged less than about 3 meters (9.8 feet) (and where streamflow permanence was greater than about 60 percent, and intra-annual ground-water fluctuation was less than about 1 meter). Others have found the ideal depth appears to be approximately 3 to 5 feet, depending on the species and soil conditions at the site (Parametrix 2008). Cottonwood and willow growth and survival suffer from water stress when groundwater declines below key depth thresholds, particularly if the declines are rapid; the proposed action's effects do not exhibit such immediacy. Seasonal declines of 1 meter 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 meter, with lesser declines (0.5 meter) reducing stem growth (Scott *et al.* 1999, 2000).

The aforementioned depths to groundwater were in reference to the needs of mature willows and cottonwoods. The recruitment of new individuals requires near-surface levels of groundwater during seed germination, followed by a relatively gradual decline in depth that allows roots to pursue the retreating alluvial groundwater. Leenhouts *et al.* (2005) state that manner in which cottonwoods and willows become established is linked to flood flow hydrology. Both species are relatively short-lived (about 100 to 150 years) and have vernally adapted reproduction strategies. Conditions for establishment are not consistently favorable at any given location year after year, so cohorts of these trees establish only during occasional favorable years. The timing of floodflows is critical, as both species produce seeds that are viable during the relatively brief period when high spring flows are usually declining and exposing base, damp sediments (Fenner *et al.* 1984). A typical pattern is for fall or winter floods to scour and redeposit flood-plain sediments, creating potential seed beds for these plants to establish without competition from an existing overstory; seed beds are then moistened by elevated (flood flows). Goodding's willow disperses seeds somewhat later in the season than does cottonwood (although the dispersal periods overlap) and, as the flood waters recede, establishes on sites that are lower and closer to the stream.

The rates of flood-water recession (i.e. the descending limb of the hydrograph) and subsequent decline in alluvial water table elevation influence seedling survival in Fremont cottonwood, Goodding's willow and other Populus and Salix species. During spring when flood waters are receding and seedlings are establishing on sediment bars, ground-water declines of greater than 1 to 3 centimeters per day can cause seedling death (Segelquist *et al.* 1993, Mahoney and Rood, 1998, Shafroth *et al.* 1998, Amlin and Rood 2002). Rood and Mahoney (1990) and Tyree *et al.* (1994) found that gradual decline of stream discharge after flooding allowed cottonwood seedlings' root systems to maintain contact with the ground water and avoid cavitation (gaps in the water flowing within xylem). In locations where the proposed action will appreciably reduce groundwater elevations beneath streams, we would expect the descending limb of spring hydrographs to steepen (declining less gradually), as discharge-driven channel recharge would first need to saturate a greater volume of alluvium relative to the more well-saturated alluvium present in an unaffected stream.

Sustained ground-water declines throughout the summer to depths greater than 1 or 2 meters below land surface (depending on soil texture, weather, and species) also can preclude establishment of the new cohort (Kalischuk *et al.* 2001, Amlin and Rood 2002). Willow seedlings are less tolerant of water-table decline than cottonwood seedlings (and more tolerant of inundation) and show greatest growth under no water-table decline (continually saturated soils; Horton and Clark, 2001, Amlin and Rood 2002).

Merritt and Bateman (2012) examined Cherry Creek, a central Arizona tributary of the upper Salt River, and modeled changes in riparian vegetation as a result of increasing the depth of groundwater from the surface. The relative frequency of riparian forest to shrubland decreased significantly as a function of increasing depth to groundwater, ranging from 58 percent (percent) at base groundwater level to 5 percent at 6.6 feet (2 meters) below base level. A simulated groundwater decline of 6.6 feet (2 meters) below base level resulted in a nearly complete loss of riparian forest and conversion of the valley bottom to shrubland. Predicted loss of riparian forest averaged 4 percent per 4 inches (.33 feet) (10 centimeters) of groundwater decline.

We are aware of the difference in time scales between the aforementioned studies and the temporal progression of the modeled effects of the proposed action. Some of the referenced investigations were intra-annual and none were performed over the up-to-1,000-year terms of the modeling for the proposed action. Again, we refer to Shafroth *et al.* (2000), which would seem to indicate that riparian vegetation communities could adapt to a slow progression of groundwater elevation over a lengthy time period (as is often the case in the reach-specific sections, below), provided that maximum depths to groundwater were not exceeded.

The preceding narrative is, to an extent, based on hypothetical effects associated with modeled groundwater declines. This approach was employed in the October 30, 2013, Final BO, but subsequent improvements in the SIR and SBA's hydrologic impact analysis as well as the incorporation of additional riparian community data have resulted in a revised, more quantitative analysis, as described below.

Methodology for Prediction of Impacts to Riparian Vegetation

In the FEIS, impacts to riparian vegetation were based on an extensive review of available literature about the responses of riparian vegetation to hydrologic changes. The FEIS analysis focused primarily on the continued presence of the hydroriparian corridor along Cienega Creek and Empire Gulch. The October 30, 2013, Final BO had already indicated, and discussions between May and November 2014 confirmed that even small changes in vegetation health could trigger negative feedback loops with large consequences (i.e., loss of root mass, leading to channel erosion and downstream siltation of pools). The SIR ultimately included a refined analysis of the proposed action's effects to riparian ecosystems; the new analyses are discussed in detail in the SIR in the Refinements to Analysis of Impacts to Riparian Vegetation (page 64), and are incorporated herein by reference. Further, the SIR riparian analysis was quantified to the extent possible, with a focus on capturing changes from smaller increments of drawdown.

The SIR and SBA's analyses of effects to riparian vegetation also took into account current ongoing negative trends related to the aquatic ecosystem. As described in the Summary of Impacts to Riparian Vegetation section, these ongoing trends are, on the whole, a more useful predictor of future conditions than the few predictive measures available from reviewed literature.

Summary of Impacts to Riparian Vegetation

The October 30, 2013, BO contained a detailed discussion of riparian vegetation classes and their extent within the action area (incorporated herein via reference), but this was followed with a largely qualitative effects analysis based on modeled groundwater drawdowns. The revised hydrological analyses appearing in the SIR and May 2015 SBA differ from prior analyses in that quantitative stream flow and pool data have been calculated from the drawdown data.

We reiterate that current conditions represent the baseline, and that the analyses of effects to aquatic ecosystems and the species that occur in them (Gila chub, Gila topminnow, desert pupfish, northern Mexican gartersnake, Chiricahua leopard frog, and Huachuca water umbel) consider the hydrology-related effects of both mine drawdown and climate change as impacts to the present-day baseline. Unfortunately, it is still not possible to definitively quantify the full suite of effects to woody riparian vegetation, particularly with respect to the effects of climate change.

The analysis of effects to the hydroriparian habitat for yellow-billed cuckoo and southwestern willow flycatcher diverge from the aquatic ecosystem approach described in the preceding paragraph. While the hydrologic effects of climate change were modeled, we are unable to predict the full suite of effects of climate change on riparian ecosystems. While we do anticipate that reduced flows will adversely affect the extent and vigor of riparian vegetation, the hydrologic modeling contained in the SIR and May 2015 SBA do not address future temperatures, rainfall patterns, or other factors we anticipate will affect riparian vegetation. For this reason, the analyses of riparian-related effects to southwestern willow flycatcher are based largely on the mine-only drawdowns and their impact on hydroriparian vegetation. Climate change will be addressed in a largely qualitative manner. As stated in the May 2015 SBA, a reasonable assessment is to assume that negative trends in woody riparian habitat observed during the current drought are likely to continue into the future due to climate change.

Ongoing Trends in Riparian Vegetation

Trends in riparian vegetation at Cienega Creek result from changes in channel morphology, past and present management actions, the ongoing drought, and other activities within the basin. Cattle were excluded in the Pima County CCNP in 1988 and excluded from year-round residence on the Las Cienegas NCA in 1990. As a result, riparian areas have gone from bare, open areas to cottonwood (*Populus fremontii*)–willow (*Salix gooddingii*) gallery forests. Bodner and Simms (2008:figures 17–22) used repeated photo points to document the expansion of riparian forests within the Las Cienegas NCA, and used aerial photography to illustrate the widening of riparian forests from 1972 to 2002 (2008:figure 23), and Powell (2013:figure 3) shows the succession of vegetation within the Pima County CCNP from 1988 to 2003. Cienega Creek and its tributaries on Las Cienegas NCA support approximately 20 linear miles of riparian forest and marshland, which is often flanked by sacaton (*Sporobolus wrightii*) flats or mesquite bosque vegetation communities; additionally, many miles of xeroriparian and shrub communities occur (Bodner and Simms 2008). Within the Las Cienegas NCA, the Riparian Area Condition Evaluation (RACE) for Cienega Creek and its tributaries showed a marked increase in the percentage of linear miles of riparian habitat rated satisfactory – from 46 percent in 1989 to 93 percent in 2000 (Bodner and Simms 2008). For all areas of Las Cienegas NCA combined, comparing 1993 with 2006, there are more mature trees, saplings, and seedlings per acre; overall, ash and cottonwood density increased, though cottonwood to a lesser extent than ash, and willow density decreased; and different locations at Las Cienegas NCA have shifting age classes and species composition over time (Bureau of Land Management 2007). Additionally, some marshy areas are trending toward “woody swamp” vegetation community, likely because of reduced disturbance (Bodner and Simms 2008).

These apparent positive trends must be considered within the context of changed land management practices. Prior to the establishment of the CCNP in 1996, there were extensive cattle grazing activities on the site. Once cattle were removed from the system, vegetation height and volume increased significantly, but likely plateaued in the early 2000s (unpublished data). Vegetation often responds positively to removal of cattle (Krueper *et al*. 2003), but since 2005 there has only been a slight increase in the extent of cottonwood canopies in the Pima County CCNP (Powell 2013), though these analyses did not address the density of vegetation within the canopy.

Moreover, in contrast to long-term trends showing overall increase in riparian forest extent and health due to changes in land management, there are other, downward trends that are specific to the recent drought. Lower Cienega Creek continues to show the impacts of sustained drought on a shallow groundwater-dependent system (Pima Association of Governments 2015). Leenhouts *et al.* (2006) stated that stream flow permanence is also a useful predictor of riparian vegetation condition and type, meaning that surveys of the wetted length of a stream can help inform effects analyses for riparian ecosystems. Wet/dry surveys of Cienega Creek from June 2015 (the low-flow season, when hydrologic data are least likely to be influenced by rainfall runoff) showed only 0.88 miles of flow, just nine percent of the full 9.5 miles of flow extent observed in June of the mid-1980s (Pima Association of Governments 2015, Pima County 2015).

By most measures, the ongoing drought began in the late 1990s. During riparian monitoring from 1998 to 2005, BLM has shown a shifting in species composition, with ash (*Fraxinus velutina*) coming to dominate many reaches in place of cottonwoods or willow. Bodner and Simms (2008) speculate that this may be due to the system reaching a climax community, the effects of reduced disturbance (e.g., from cattle or fire), or the effects of drought or lowering of the water table. The vegetation surrounding Cienega Creek consists of mostly native plants, with some Bermuda grass (*Cynodon dactylon*), Johnsongrass (*Sorghum halepense*), and tamarisk (*Tamarix* spp.) occurring (Bodner and Simms 2008), and with tamarisk abundances increasing in recent years (Powell 2013).

Powell (2013) states that since 2005, there has only been a slight increase in the extent of cottonwood canopies at the Pima County CCNP, and the extent and vigor of the mesquite bosque vegetation community has apparently declined. The current drought is blamed for a thinning of cottonwood canopy at the Pima County CCNP (Powell 2013: Figure 40; Powell *et al.* 2014: Figure 12) and death of cottonwoods at the Pima County CCNP (Pima Association of Governments 2014). On Las Cienegas NCA downstream of the “Cienega Ranch” wetlands, Simms (2014) noted and photographed segments of Cienega Creek that currently have low and declining riparian function, likely due to drought and loss of groundwater. Simms (2014d: Appendix B) provided photographs of head cutting and bank erosion attributed to loss of riparian plants due to dry conditions. These areas show a loss of soil stability due to the loss of root systems, and they currently have a channel that is bordered by deer grass (*Muhlenbergia rigens*) in poor health and dead and dying willow trees, reportedly indicating that these areas are transforming as seepwillow (*Baccharis salicifolia*) comes in to replace cottonwood, willow, and ash (Simms 2014). Further, a head cut at the Pima County CCNP has resulted in the loss of cottonwood and mesquite (Powell 2013: Figure 34).

The drought has not only been likely to have caused the aforementioned thinning of cottonwood canopy and death of cottonwoods at the Pima County CCNP (Pima Association of Governments 2014), it has also likely to have caused the decline in the mesquite bosque vegetation community that borders the mesic/hydroriparian vegetation along the creek margins (Powell *et al*. 2014). Between 2005 and 2011, most of the vegetation away from the active channel at the Pima County CCNP was observed to have declined. Although mesquite occurs farther from the stream bed than cottonwood and willow trees where it can tolerate greater depth to groundwater, mortality is occurring where the water table has declined beyond the depth at which mesquite roots can reach.

In January 2015, in order to better quantify the anecdotal observations from other sources, the

Coronado NF requested that Rosemont Copper evaluate whether the ongoing drought has had noticeable effects on the extent and density of the riparian corridors along Cienega Creek and Empire Gulch using analysis of satellite imagery. WestLand Resources conducted an assessment of Landsat imagery between 1995 and 2014 using a technique known as Normalized Difference Vegetation Index (NDVI) (WestLand Resources Inc. 2015f). Using this technique, the color of pixels in the satellite image is correlated with vegetation density (the darker the pixel, the more vegetation is assumed to be present). This technique reflects the overall relative amount of vegetation present, and how that amount changes year to year. WestLand concluded that “a plot of NDVI values for each segment through time shows that there was no apparent trend in the data from 1995 through 2014” (WestLand Resources Inc. 2015).

The quantitative approach pursued in Westland (2015) exhibits an analytical flaw that renders it no more reliable than the field observation-based, less-quantitative observations of Powell (2013) and Pima Association of Governments (2014). Our basis for this lies in part with the fact that the WestLand (2015) results do not appear to correlate well with field-based observations of declining stream length (Pima Association of Governments 2015), declining occurrence of velvet mesquite (Powell 2013), a shift from cottonwood/willow to ash from 1988 to 2005 (Bodner & Simms 2008), and an increase in tamarisk (Powell 2013). More importantly, the WestLand (2015) study design could not have detected the habitat selected by yellow-billed cuckoos and the seasonal characteristics and phenology of riparian sites in which they breed.

The NDVI analysis methodology used by WestLand (2015) limited its imagery analysis to the months of May and June to minimize potential seasonal bias, presumably to minimize variation in greenness associated with the variable timing of the onset of monsoon season precipitation. A phenological analysis by Wallace *et al*. (2013) found, however, that yellow-billed cuckoo occupancy of a given habitat patch does exhibit a seasonal bias; occupancy is correlated with the greenness of that patch and sites with yellow-billed cuckoos present are dominated by landscapes that achieve a maximum greenness well into July (largest peak at day-of-year 217; July 25th). These results support a scenario in which cuckoos migrate northwards, following the greening of riparian corridors and surrounding landscapes in response to monsoon precipitation (typically initiating in July), but then select a nesting site based on optimizing the near-term foraging potential of the surrounding habitat. Therefore, by analyzing only May and June imagery, the WestLand (2015) findings did not incorporate the late-July greenness crucial to yellow-billed cuckoo occupancy described by Wallace *et al*. (2013).

Maximum greenness is highly likely to include both woody riparian vegetation, shrub, and ground cover. Hammond (2011) found that yellow-billed cuckoo habitat exhibits higher shrub area than sites without western yellow-billed cuckoos (Hammond 2011). Wallace *et al*. (2013) suggested that the condition and dynamics of so-called accessory vegetation in the understory and/or adjacent landscapes are important features of selected cuckoo nesting habitat. Later-season woody shrub and herbaceous species cover, which is likely to be more shallow-rooted and more vulnerable to drought, could not have been detected by Westland (2015). Drought effects, already ongoing, will be worsened by mine drawdown. An understanding of these effects as a result of field observations was crucial to our effects analyses for both the yellow-billed cuckoo and southwestern willow flycatcher.

In summary, riparian trends differ between investigations, finding variously that:

- There was an increase in linear stream miles in satisfactory condition from 1989 to 2000 (Bodner & Simms 2008)
- There was an increase in vegetation (more trees per acre) from 1993 to 2006 (Bodner & Simms 2008)
- Riparian forests widened between 1972 and 2002 (Bodner & Simms 2008)
- There was an extreme decline in wetted stream length during June from the mid-1980s to 2015 (Pima Association of Governments 2015)
- There was a slight increase in the extent of Fremont cottonwood trees between 2005 and 2013 (Powell 2013)
- There was a decline in the extent of velvet mesquite between 2005 and 2013 (Powell 2013)
- There was a shift in species from cottonwood/willow to ash from 1988 to 2005 (Bodner & Simms 2008)
- Powell (2013) noted an increase in tamarisk in recent years (no timeframe specified)
- Simms (2014) reports that portion of Cienega Creek are experiencing a current (no timeframe specified) decline in riparian function
- A head cut within the Pima County CCNP was noted by Powell (2013)
- Between 2005 and 2011, most vegetation away from the active channel had declined (Powell 2013)
- WestLand (2015) found no apparent trend in NDVI during May and June over the period of 1995 to 2014

Comparing the findings of these investigations, the apparent overall trends in the Cienega Creek system are:

- Through the mid-2000s, due to land management changes (grazing), vegetation and riparian health have demonstrably increased in the system;
- By the mid-2000s, a decline in riparian function has become apparent, likely due to ongoing drought conditions;
- A decline in the overall width and amount of riparian corridor has not been observed, but decline in wetted stream length has been documented and observations of declining riparian function and vegetation health have been made at various locations.

These trends are not contradictory, as they pertain to different time periods. Past changes in land management likely resulted in increases in riparian vegetation, which is likely to have resulted in increased occurrences of riparian obligate birds such as the yellow-billed cuckoo and southwestern willow flycatcher. Subsequent declines in riparian health are likely to have contributed to declines in habitat available for these species. And while we anticipate that climate change will continue to negatively affect riparian ecosystems in the Cienega Creek system over the long term, it does preclude interim expansions of riparian vegetation during the occasional periods of relatively higher precipitation as would be expected under a more-variable, future climate.

Lastly, the preceding analyses referred primarily to the recruitment, retention, and succession of woody, broadleaf riparian trees. These effects will be analyzed in this BO's respective effects analyses for the yellow-billed cuckoo and southwestern willow flycatcher. Shallow-rooted, aquatic, and/or emergent herbaceous plants – including Huachuca water umbel - are relatively more sensitive to small drawdowns. A more-specific analysis of these effects appears in the Huachuca water umbel section of this BO.

Effects of Mine Drawdown

While the literature reviewed during the preparation of the May 2015 SBA was not sufficient to analyze small incremental changes in vegetation due to small changes in groundwater, the analysis did provide some basis to evaluate the relative importance of stresses and impacts. In the 95th percentile analyses appearing in the Effects to Aquatic Ecosystems section (see Tables A-1 through A-3), the mine drawdown does not exceed 0.2 foot along Cienega Creek. This level of drawdown is half of what is estimated from climate change (0.4 foot), and the available literature reviewed during the preparation of the May 2015 SBA indicated such an increment was unlikely to lead to substantial shifts in woody vegetation health along Cienega Creek. Literature indicates that stream flow permanence is also a useful predictor of riparian vegetation condition and type (Leenhouts *et al.* 2006). As described in the May 2015 SBA's Summary of Stream Flow Analysis Results section, mine drawdown is not expected to change the flow status along most reaches of Cienega Creek to a point that would be expected to drastically alter the riparian corridor (i.e., a shift from perennial to intermittent flow). For Cienega Creek, the FEIS disclosed: "[It] would not be likely to result in widespread changes to riparian vegetation, even up to 1,000 years after mine closure. However, while total conversion from a hydroriparian to a xeroriparian corridor is unlikely, there is likely to be contraction of the hydroriparian area, with conversion occurring at the transitional margins of the habitat." This is similar to the effects described in the SIR riparian analysis. These effects are evaluated in the Effects of the Proposed Action – Huachuca Water Umbel (herbaceous), and Yellow-Billed Cuckoo Effects of the Proposed Action – Yellow-Billed Cuckoo (woody), below.

Upper Empire Gulch, on the other hand, is almost certain to experience major shifts in riparian vegetation due to mine drawdown, regardless of climate change stresses. Scenarios differ widely regarding when this transition might begin to occur. In order to implement a precautionary approach for subsequent effects analyses, we have elected to emphasize the higher end of the 95th percentile scenarios described in the Effects to Aquatic Ecosystems section (see narrative and Tables A-1 through A-3). In that regard, the higher-range values of the 95th percentile analyses predict a rapid onset of adverse effects (10 years post-mining) followed by a steady progression through drying conditions until total dewatering (zero flow) occurs at 150 years post-mining. We would anticipate these effects to result in losses of broadleaf woody riparian species and extirpation of aquatic and emergent vegetation.

Summary of Effects to Riparian Ecosystems

The drawdown-driven flow losses in Cienega Creek do not appear to be capable of precipitating large-scale mortality of woody riparian vegetation, but we do anticipate incremental losses of vigor, belt width, recruitment, and retention (see the analysis of effects to yellow-billed cuckoo, below). Flow losses in upper Empire Gulch may be more severe, and reach magnitudes capable of causing the woody riparian community to transition to a more xeric species composition. Herbaceous and emergent plants are likely to be extirpated as upper Empire Gulch becomes ephemeral.

We cautioned in our October 30, 3013, BO that reductions in the length of wetted channel do not necessarily characterize the potential full extent of riparian effects. Surface flows in alluvial reaches of Cienega Creek exist in locations where the thalweg (deepest part) of the stream intersects the alluvial water table and/or where springs discharge water from the regional aquifer. A longitudinal contraction in surface flows would necessarily be accompanied by a more-lengthy, longitudinal reduction in shallow, subsurface flows, with alluvial groundwater in some areas potentially dropping below critical depths for emergent, shallow-rooted plants, herbaceous shrubs, as well as the recruitment of broadleaf riparian trees.

A longitudinal contraction in surface flows could also be accompanied by a narrowing of the riparian strand, a movement of the strand towards the thalweg, and/or a transition to more xeric types (i.e. tamarisk, desert broom, etc.). These effects are analyzed in greater detail in the yellow-billed cuckoo effects analysis, below.

We are concerned with the potential for a lateral contraction in riparian vegetation. Drawdowns in the alluvial aquifer are expected to result in increasing relative depths to groundwater for riparian vegetation situated further from the thalweg and consequently, uphill. Our concern is with the hydroriparian trees that are situated landward relative to the stream and which may already be at their practical limit in terms of being rooted in the alluvial aquifer. These trees are at a greater risk of drawdown-related effects. Alternately, these trees may senesce and fail to be replaced.

The diminished lateral extent of shallow groundwater could also reduce the wetted perimeter of the stream. Stream top-width is a useful surrogate for wetted perimeter, and such a narrowing of a stream can be expected to result in vegetative recruitment encroaching closer to the centerline of the channel. This is problematic since the proposed action will leave flood flows in reaches of Cienega Creek above the confluence with Davidson Canyon Wash largely unaffected. Vegetation that establishes itself in a narrowed low-flow channel is likely to be subject to scouring from the still-intact peak flows. Flood scour could be further exacerbated if vegetative communities suffer mortality sufficient to reduce streambank stability. This hypothetical condition will further diminish the health of the already-narrowed riparian community.

Lastly, the effects of mine drawdown will be in addition to those modeled for climate change. We note that the climate change modeling conducted for the SIR and May 2015 SBA was a projection of hydrologic data associated with recent drought conditions, and not an actual modeling of future temperature and precipitations scenarios. Recruitment of Fremont cottonwood and Goodding's willow depends heavily on the formation of moist, mineral seedbeds by channel migration and on the timing of floods. The influence of climate change on pioneer riparian communities such as these will depend largely on how temperature and precipitation regimes change (Price *et al.* 2005, Friggens *et al.* 2013). If future climates are warmer and drier than at present (i.e., even more-severe drought), then we anticipate appreciable reductions in the representation of cottonwood/willow dominated communities along Cienega

Creek and Empire Gulch. And again, mine drawdown will precipitate an earlier onset and/or exacerbation of these effects.

GILA CHUB

Status of the Species – Gila Chub

Gila chub (*Gila intermedia*) was listed as endangered with critical habitat on November 11, 2005 (FWS 2005). Primary threats to Gila chub such as predation by and competition with nonnative organisms and secondary threats identified as habitat alteration, destruction, and fragmentation are all factors identified in the final rule that contribute to the consideration that Gila chub is endangered or likely to become extinct throughout all or a significant portion of its range (FWS 2005).

Gila chub generally spawn in late spring and summer; however, in some habitats, it may extend from late winter through early autumn (Minckley 1973). Schultz and Bonar (2006) data from Bonita and Cienega creeks suggested that multiple spawning attempts per year per individual were likely, with a major spawn in late February to early March followed by a secondary spawn in autumn after monsoon rains. Bestgen (1985) concluded that temperature was the most significant environmental factor triggering spawning.

Gila chub is considered a habitat generalist (Schultz and Bonar 2006), and commonly inhabits pools in smaller streams, cienegas, and artificial impoundments throughout its range in the Gila River basin at elevations between 609 and 1,676 meters (2,000 to 5,500 feet) (Miller 1946, Minckley 1973, Rinne 1975, Weedman *et al*. 1996).

Historically, Gila chub was recorded from nearly 50 rivers, streams and spring-fed tributaries throughout the Gila River basin in southwestern New Mexico, central and southeastern Arizona, and northern Sonora, Mexico (Miller and Lowe 1967, Minckley 1973). Gila chub now occupies an estimated 10 to 15 percent of its historical range, and is limited to about 25 small, isolated, and fragmented populations throughout the Gila River basin in Arizona and New Mexico (Weedman *et al*. 1996, FWS 2005a, FWS 2015).

Environmental Baseline – Gila Chub

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. Although groundwater levels have historically been variable in this area, there is an increasing trend in water use in parts of the action area, which is likely to initiate or contribute to a downward trend in groundwater levels. The current extended drought and climate change are highly likely to negatively impact many system components from the upper parts of the watershed to where Cienega Creek becomes Pantano Wash through: changes in upland vegetation and fire regime; higher ambient and water temperatures; increased variability in stream hydrographs; and more frequent severe climatic events (such as storms, droughts, wildfires, etc.).

We incorporate by reference the environmental baseline information from the 2013 Rosemont BO, the May 2015 SBA, and the SIR. The past effects of climate change are part of the species' present-day environmental baseline, but future climate change is not considered to represent an evolving baseline through time. The modeled adverse effects of climate change into the future are discussed in the effects of the action section to allow an easier comparison with the effects solely resulting from the mine.

The draft Gila chub recovery plan (FWS 2015) contains the following recovery criteria:
1. Maintain and protect all remnant populations in the wild (Cienega Creek).
2. Ensure representation, resiliency, and redundancy by expanding the size and number of populations within Gila chub historical range via replication of remnant populations within each RU. Cienega Creek is a recovery unit that has not been replicated yet.
3. Manage or eliminate threats of predation and competition with nonnative fishes and associated habitat-related modifications or loss.
4. Improve and develop new State regulations or agreements that conserve or improve quality Gila chub habitat.
5. Work with stakeholders to improve and conserve existing and newly established Gila chub populations and their habitats and ensure that appropriate management plans or agreements are in place.
6. Promote conservation of Gila chub in Mexico and on Tribal lands by forming partnerships and supporting research, outreach, and conservation management.
7. Monitor remnant, repatriated, and refuge populations to inform adaptive management strategies.

Description of the Action Area

The action area for Gila chub encompasses all occupied or likely-to-be occupied reaches of stream and other waters within the Cienega Creek watershed, as these will be subject to the proposed actions effects to groundwater and surface flow hydrology. Sonoita Creek Ranch is also in the action area (this parcel is one of the proposed mitigation measures in the HMMP), because the proposed action includes the release of Gila chub there. This area is described in detail in the Status of the Species and Critical Habitat within the Action Area section, below. The narrative that follows includes accounts of rangewide effects to Gila chub, its habitat, and its critical habitat as a means to describe similar factors affecting the species within the action area. We incorporate by reference the Environmental Baseline of the 2013 Rosemont BO, SBA3, and the SIR.

The quality and quantity of suitable aquatic habitat for threatened and endangered fish in the action area has been affected through numerous past actions resulting in reduction of habitat, altered species composition, increased presence of nonindigenous aquatic species, decreased surface-water availability, changes in stream morphology, and other factors. A significant portion of the adverse impacts to the aquatic and riparian ecosystem come from the additive effect of small actions that individually may not threaten the system, but cumulatively result in continuing deterioration of the ecosystem.

The Pima County Final Multiple Species Conservation Plan (Pima County 2015) commits Pima County to pursue the following management actions and conservation commitments for the Gila chub (and Gila topminnow)(Pima County 2015):

- Seek to prohibit Pima County Health Department from using *Gambusia* for mosquito control in watersheds tributary to reintroduction sites and in the Cienega Creek watershed upstream of Colossal Cave Road;
- Support protection of Cienega Creek water quality via ADEQs Outstanding Waters program;
- Identify and address management of nonnative aquatic organisms through management plans and ranch infrastructure projects on County-controlled mitigation lands in the Cienega watershed;
- Implement the Pima County Floodplain Ordinance as described in Chapter 4 (Pima County 2015) to minimize loss of habitat for these species;
- Implement monitoring as described in Appendix N (Pima County 2015), including recording and entering incidental observations in the Covered Species Information Database; and
- Following significant upgrades to the County‘s two wastewater facilities, the Santa Cruz River downstream of the facilities may show favorable conditions for the reestablishment of Gila topminnow, longfin dace, desert sucker, and Sonora sucker. Pima County will work with the FWS following upgrades in 2016 and subsequent water-quality testing to determine if fish monitoring is a reasonable and prudent activity at that location. If so, Pima County will commit to monitoring every 5 years using electrofishing and seining using the same methods as employed by Clarkson *et al.* (2011).

Status of the Species and Critical Habitat within the Action Area

The action-area status of the Gila chub was described in our 2013 Rosemont BO, and 2008 and 2012 BOs that addressed effects of Aquatic Species Conservation at the San Pedro Riparian and Las Cienegas NCAs, Arizona (File numbers 22410-2008-F-0103, 22410-2002-F-0162- R001). The action areas for those BOs overlap with the action area of the proposed action; that information is updated here. The status of Gila chub in the action area continues to be stable since those BOs were completed (FWS 2008, 2012, 2013). We incorporate by reference the status of the species in the action area from the 2013 Rosemont BO.

Sampling by AGFD in 2012 and 2015 found no Gila chub in the Pima County CCNP (Timmons and Upton 2013; Timmons, pers. comm., October 13, 2015). Gila chub were last seen in the Pima County CCNP in 2014 (Caldwell 2014). These locations are within the action area.

Recent surveys suggest that Gila chub continue to be abundant in upper Cienega Creek (Rosen *et al*. 2013; Simms 2014d, Simms and Ehret 2014). Surveys in 2007 and later demonstrate that Gila chub have recolonized Mattie Canyon following heavy flooding and extreme sedimentation resulting from collapse of a grade control structure in 2001. No chub have ever been observed in Empire Gulch since BLM acquired Las Cienegas NCA in 1988, and no other records exist that chub occur there.

Hatch (2015) analyzed fish counts conducted by the BLM from 2005 through 2012, and based on these counts estimated positive mean growth rates for this species in two populations in Cienega

Creek. Positive mean growth rates indicate that this specific population on Cienega Creek is tending to increase, not shrink.

However, because of the variability inherent in fish count data, the population data have substantial uncertainty, which can be analyzed by looking at the probability distribution of the data. By evaluating this probability distribution, it was determined that the lower bound of the 95 percent confidence intervals include growth rates that are negative. This means that even though mean growth rate is positive, the possibility still exists for long-term population decline due to environmental stresses. The probability that the extirpation threshold [which is defined in Hatch (2015) as a catch per unit of 1 fish over a 24-hour period] is reached was calculated for this species above Spring Water Canyon (CC1, CC2, and the southern portion of CC3) as 0.46, meaning that there is about a 46 percent chance that this specific population would be functionally extirpated in the future. It should be noted that extirpation is not the same as extinction; extirpation refers only to the local population analyzed by this study. Below Spring Water Canyon (northern portion of CC3 and CC4 through CC6) the probability is 0.8228, meaning there is about an 82 percent chance this species would become functionally extirpated.

These estimates are only probabilistic and cannot be interpreted as certainty; these estimates take into account this species' fitness in its environment but cannot fully account for random and unknown variability in the environment, future conditions that may be different from those experienced in the past, or density-dependent processes that may affect this species. It should be noted that the analysis only describes the sensitivity of this particular fish population to environmental change, but does not consider the cause of those stresses. The conclusion that this fish species is sensitive to environmental stresses—whether natural or manmade—and that local populations could face extirpation because of those stresses, is consistent with the status of Gila chub as endangered, with limited habitat, and reduced populations.

The unfinished Foster and Simms report (2005) attempted to estimate the chub population by upper and lower reaches of Cienega Creek on the Las Cienegas NCA. Though there were issues with the number of recaptures in the upper reach in this mark-recapture study, they did estimate numbers of Gila chub. The sampling was done in 2005, which was when the pools in the headwaters were often fishless due to low dissolved oxygen. Foster and Simms (2005) estimated the total abundance of catchable chub to be 4,810 in the lower reach, 1,481 chub in the upper reach, for a total of 6,291 chub in Cienega Creek on Las Cienegas NCA.

In the recently-released draft Gila chub recovery plan (FWS 2015), Cienega Creek is a management unit within the Santa Cruz recovery unit. They consider the Cienega Creek Gila chub population to be a priority 2 population for replication because it has not been replicated, has a high number of threats, and is a high priority population. BLM has already proposed establishing new Gila chub populations on Las Cienegas NCA (BLM 2012).

On Las Cienegas NCA, Gila chub may be released into 13 sites: Clyne Pond, Maternity Wildlife Pond, Oil Well Wildlife Pond, Bill's Wildlife Pond, Cieneguita Wetland Ponds, Gaucho Wildlife Pond, Cottonwood Wildlife Pond, Cinco Pond, Empire Wildlife Pond, Spring Water Wetland Pond, Nogales Spring, Little Nogales Spring, and Apache Spring Wildlife Pond. Of these 13 sites, Oil Well, Spring Water, Gaucho, Bill's, Cieneguita, Cottonwood, Maternity, and Empire are in the action area. Of sites in the action area, only Spring Water and Cieneguita are supported by groundwater. Thus, Cieneguita and Spring Water Wetlands are the only of these sites that may be affected by the proposed action.

Non-native species that are problematic for Gila chub, including crayfish, green sunfish *Lepomis cyanellus*, common carp *Cyprinus carpio*, bluegill *Lepomis macrochirus*, and largemouth bass *Micropterus salmoides* (Rosen *et al*. 2013; FWS files), have been found in the Cienega Creek watershed at one time or another. At present, green sunfish, western mosquitofish (*Gambusia affinis*), and crayfish are known to be present in the watershed.

Background for Analyses and Definition of Baseline

The hydrologic data upon which a portion of the following Gila chub-specific analyses are based were described in both the Effects of the Proposed Action section (below) and the Effects to Aquatic Ecosystems section (above).

The majority of the hydrologic data employed in this BO are based on a 95th percentile analysis of the Tetra Tech (2010), Montgomery (2010), and Myers (2010) groundwater model best-fit and sensitivity analyses, as applicable. The 95th percentile analyses were developed for the SIR and were included in the May 2015 SBA to address FWS concerns with the use of multiple groundwater models with oftentimes divergent results. The 95th percentile analysis was described in detail in these prior documents, and was summarized in the Sources of Uncertainty subsection of the Effects of the Proposed Action section, above.

We are aware of the analytical strengths and weakness of this approach, but reiterate that our selection of the upper end of the 95th percentile values results in analyses in which 97.5 percent (which includes the 2.5 percent of the least well-represented values at the lower end of the distribution) of the *other* possible hydrologic outcomes (given the modeling assumptions) exhibit lesser effects. The 95th percentile approach does not represent the most probable outcome (but it does provide reasonable certainty that the effects to this species are unlikely to be greater than those described below). Due to the uncertainty inherent in these modeling efforts, there are no results that can be definitively said to be the most likely to occur. Thus, we have selected the precautionary approach.

Secondly, the following Gila chub-specific analysis considers the present-day state of the hydrology to represent the baseline condition. All effects, whether the result of anticipated climate change alone, mine drawdown alone, and/or climate change and mine drawdown combined, are described in terms of their divergence from present, pre-project conditions. Climate change is *not* viewed as an ongoing and evolving baseline against which mine-only effects are incrementally assessed.

Effects of the Action - Gila Chub

Information from the 2013 Rosemont BO that has not changed will not be repeated here. No direct effects result from the mine. Indirect effects caused by groundwater draw down from the mine will negatively impact stream flow and pool metrics. Impacts from the mine only are small when compared to the effects of climate change. However, the impacts from the mine only, do cause impacts to aquatic habitats that negatively impact the Gila chub. We incorporate by reference the effects of the action from the 2013 Rosemont BO. Only changes will be discussed below.

The aforementioned changes in groundwater elevations, stream flow, and pool metrics, predicted by the models and, when applicable, the inferred and modeled losses of surface flows supported by surface or near-surface groundwater elevations, are measurable. However, their precise impacts on aquatic ecosystems and riparian vegetation are difficult to quantify with certainty. As in the SBA3 and SIR, our analysis focuses on the key reaches that were identified. Since many of the key reaches are the best watered, impacts to the key reaches are likely to be less than the other, less well watered reaches. “While the refined aquatic analysis focuses on these nine reaches, it should not be assumed that impacts will not occur in the other non-key reaches. On the contrary, because these key reaches represent the most stable portions of Cienega Creek and Empire Gulch, any impacts to these reaches can be expected to occur elsewhere as well (SBA, page 45).”

These modeled decreases in groundwater elevation due to the mine would occur over 150 years, and would cause changes in aquatic and riparian vegetation extent or health, and the reduction in stream flow would impact Gila chub and designated critical habitat (e.g., lower water level, reduced quality and quantity of habitat, more extensive dry reaches). As a result of groundwater drawdown, the amount or volume of water within perennial pools would decrease, and Gila chub in Cienega Creek (and in general) show a preference for pools (Minckley 1973, Rinne 1976, Weedman *et al*. 1996, Schultz and Bonar 2006).

Discharges to groundwater are not expected to exceed water quality standards; if they occur, the cone of depression associated with the mine pit is predicted to capture water contaminants and prevent their movement to streams in the action area. In addition, the ADEQ has issued their 401 water quality certification for the project and has determined that the project is not expected to violate surface water quality standards. Therefore, no impacts to Gila chub or designated critical habitat due to potential water contaminants are anticipated given the information in the various BAs. As stated in the Environmental Baseline section, above, Gila chub occur in Cienega Creek and 22.9 mi (37 km) of the mainstem and tributaries (Mattie Canyon and Empire Gulch) are designated as critical habitat.

Three different indirect effects are associated with mine: reductions in stream flow, reductions in pool metrics, and reduced water quality. The impacts from the mine only (an effect of the proposed action), climate change only (also an effect, though not of the proposed action), and the mine plus climate change (the total effect to Gila chub) are presented in this section, to facilitate their comparison.

Furthermore, we note that the total effect of mine plus climate change is relevant to our findings regarding jeopardy to a species and destruction and adverse modification of critical habitat whereas the effect of mine drawdown alone informs the amount or extent of take we anticipate will occur.

Stream Flow Effects

To reiterate, we do not consider climate change to be part of an evolving environmental baseline over time; future climate change is analyzed as an effect on present-day conditions (the definitive baseline for our analyses) to which the effects of the mine are compared and added. Thus, the impacts from climate change and the mine together are included as part of our jeopardy analysis.

To determine the current baseline flow for the key reaches in June, we used the information in Table GC-1, which is based on SBA Table 3, for measured flow, and not modeled flow. For each data set, we attempted to identify and remove flow values that were likely associated with runoff from storm events. This was done in order to focus on only the baseflow in June, which represents the critical hydrologic metric for then aquatic ecosystem.

The mean June flow of 60 gpm for CC2 was calculated from the seven monthly measurements taken by the BLM. The mean monthly flow for CC4 is twice that of CC2 (USFS 2015). Reach CC5 has the upper Cienega Creek gauge (09484550). We subtracted the flow of 26 June 2008 of 5,386 gpm from the gauge, because it was an outlier that increased the mean by 14 gpm (13%). We used 371 measurements instead of 372. The mean monthly June flow of 159 gpm for CC13 was derived from measurements taken by PAG, with the high years of 2004 to 2007 removed from the calculation (Table GC-1). The mean monthly June flow at CC13 for all years is 426 gpm. The mean monthly June flow at CC13 for 2004 to 2007 is 881 gpm (554% of calculated mean of 159). We calculated the mean monthly June flow using the PAG measurements from 2001 to 2003 and 2008 to 2014 (159 gpm). By contrast, the mean monthly March flow for all 14 years was 88 gpm. We believe that our calculated mean monthly June flow for CC13 of 159 gpm is reasonable. The mean monthly June flow for CC15 is calculated from the gauge at the del Lago Diversion (09484600). There were 402 daily flows (mean 375 gpm, 260% of calculated mean); we subtracted nine flood flows with more than 1,000 gpm that were outliers to arrive at our mean flow of 144 gpm (n=393). Also note that these analyses review decreases in June streamflow even though June did not always have the lowest monthly flow, and increases in zero-flow and extremely-low flow days; these values effectively express the degree of alteration to baseflow hydrology at the most critical time of the year for wholly aquatic species. For this analysis, consistent with the FEIS and SIR, the following definitions are used for temporal flow: perennial (0 to 30 days with zero stream flow); intermittent (31 to 350 days with zero stream flow); ephemeral (more than 350 days with zero stream flow). Removal of outliers is common practice in the use of descriptive statistics.

Table GC-1. Determining recent baseline June flow (gpm) by key reach for Cienega Creek and Empire Gulch, Arizona. See Figure A-1 for a map of key reaches.

REACH	INFORMATION SOURCE	# measurements	Flow (gpm)
CC2	BLM 2006-2014, June measurements in Appendix F	7	60
CC4	From CC2, doubled	7	120
CC5	Gauge 2001-2014, all June[3] measurements Subtract outlier 6/26/2008 5386 gpm[4]	Every June day 6/1/2001 to 6/12/2014	121 107[4]
CC7	“		121

CC13	PAG 2001-2014[1]	10	159
CC15	Gauge[2]	Every June day 1/1/2001 to 6/12/2014[2], minus 9 flows >1,000 gpm	144
EG1	BLM: 6/21/2007-6/23/2014	7	12
EG2	From EG1		12
See SIR Appendix F spreadsheet, all June measurements, as modified by DKD [1] Mean for June 2001-2014 is 426 gpm. Mean for June 2004-2007 is 881. Used mean for 2001-2003 and 2008-2014 = 159. The mean for all 14 years for March is 88. [2] Mean for June is 375. Subtracting the 3 flows >10,000 yields a mean of 182. Subtracting the 9 flows >1,000 yields a mean of 144. [3] Of the 12 complete years recorded, June was the month with the least flow 6 times. [4] Outlier, removed. Mean flow is then 107 instead of 121pgm.			

Standing Pool Analysis

Table 7 in the SBA provides an index to the standing pool analysis results. The tables with the results of the standing pool analysis (tables D-14 through D-26) are provided in full in SBA Appendix D. Graphical representations of the results are included in SBA Appendix F. Table GC-2, below, summarized the key data used in the standing pool analyses in this BO. To determine percent change, we totaled all values for that reach (e.g. the total volume of all pools in reach CC2 currently is 19,886 ft^3). While we use percentages to describe losses, the analysis of effects focused on actual amounts of water (pool depth, volume, area) lost, and impacts to individual pools.

The following summary of results is based on the 95th percentile high analysis, which provides a consistent, conservative, and concise way of summarizing results. Note that the following discussion refers only up to 150 years after closure of the mine. It should be noted that the SBA tables summarizing results use summary statistics, such as median depth, volume, or area for all pools in a key reach. Summary statistics obfuscate what is happening to individual pools. Loss or a large reduction in any of the parameters to a pool, are likely to make that pool uninhabitable for fish, at least periodically. To address this, we calculated total values for each key reach for mine only and mine plus climate change. To ensure that use of these statistics does not mask[10] the full range of results, results for individual pools are also included in Appendix G of the SBA. We also analyzed the results by looking at the percent loss of water quantity variable (flow, and pool volume, depth, area) by quartiles. By aggregating individual pools by the amount of water quantity loss, we get a clearer picture of impacts from the mine only, and the mine combined with climate change.

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10 As stated in the SBA, selection of summary statistics exhibits shortcomings. In this case, the use of median values to summarize the results for an entire key reach can lead to some non-intuitive mathematical outcomes. This is because the median is only calculated using those pools still in existence, and does not incorporate pools that have dried completely. For example, the median depth of pools in reach CC2 under current conditions is 1.1 feet, which is calculated using a total of 22 pools. Climate change stress causes three pools to disappear. Each of the individual pools has dropped 0.4 foot due to climate change, but when the median is calculated using the remaining 19 pools, the median is 1.9 feet, which is deeper than current conditions.

In brief, the proposed action will result in varying reductions in the numbers, depth, volume, and surface area of pools. Climate change will cause even greater reductions in pool metrics.

Quartile analysis

Using percent quartiles to look at losses to stream flow, and pool volume, depth, and surface area by reach presents a clearer picture of the magnitude of impacts to these water quantity variables (Table GC-2). Here, we look at the effects to Cienega Creek only, using the current baseline, compared to 150 years post-closure. Empire Gulch is not currently used by chub, though lower Empire Gulch (reach EG2) could be. Cieneguita Wetlands has three ponds; looking at those ponds separately is an adequate analysis.

In looking at the impacts from the mine only, no losses to June flow or pool depth are greater than 24 percent (76 percent depth remaining). However, three of the 83 pools in Cienega Creek that were measured lose more than 24 percent of their surface area from mine impacts (less than 76 percent remaining). Impacts to pool volume include one pool going dry at 150 years post closure; a very small pool in reach CC2. All seven pools losing at least 25 percent of their volume (with up to 75 percent remaining) from impacts from the mine are in reach CC2, and small.

The combined effects of the mine and climate change 150 years post mine closure are much greater than impacts from the mine only. Eight of the 13 pools that lose all volume are all small, with none having more than 17ft^3 of volume, and all being less than one-foot-deep. The other five pools that appear to dry, are all small; four of them are in reach CC13. Conversely, of the nine pools in Cienega Creek with at least 1,000ft^3 of volume, all but two maintain at least two thirds of their volume 150 years post closure (one-third of their volume remaining). All of these large pools are projected to be at least 5 feet deep then.

The combined impacts of the mine and climate change 150 years after mine closure cause four of the six key reaches in Cienega Creek to lose at least 24 percent (and retain up to 76 percent) of their June flow. Three of those four key reaches lose at least half their June flow, with one reach (CC7) being projected to have zero flow. CC7 appears vulnerable due to the large loss of stream flow projected from climate change (SBA Table D6, SIR Table 22).

Table GC-2. Percent loss of water quantity variables by quartile. Cienega Creek, Arizona, using current baseline compared to 150 years post-closure. Flow is number of reaches (n=6), other variables show number of pools (n=83). CC = climate change.

Quartile loss	Flow		POOL volume		POOL depth		POOL area	
	Mine only	Mine + CC	Mine only	Mine + CC	Mine only	Mine + CC	Mine only	Mine + CC
>24%	0	4	7	71	0	27	3	63
>49%	0	3	1	30	0	17	0	27
>74%	0	1	1	22	0	8	0	18
100	0	1	1	13	0	6	0	6

Water quality

The greatest concern regarding water quality is with dissolved oxygen. Contaminants from the mine site are only a concern for fishes in Cienega Creek below the confluence with Davidson Canyon, and only if water quality permits are not followed. Water temperature is also a concern.

Fishes require oxygen dissolved in water to survive and thrive. Dissolved oxygen tends to be lower in summer and with higher water temperatures, and lower with reduced (or zero) flow and mixing (Mason *et al*. 2007). Higher water temperatures also facilitate decay of detritus, which also requires and uses dissolved oxygen. Groundwater inflow to streams tends to be low in dissolved oxygen, though may have enough dissolved oxygen for low-oxygen tolerant fishes to survive general anoxic conditions. Pools during low flow periods, especially without flow between pools, only rely on photosynthesis and gaseous surface exchange for oxygen. Since fish consume more oxygen with higher water temperatures, June with its lowest flows of the year and highest temperatures is especially problematic for fish survival in Cienega Creek. Low dissolved oxygen has a host of negative impacts to fishes, including but not limited to: decreased food consumption, decreased fry survival, and decreased swimming speed and increased movement, which can make fish more susceptible to predators (Stewart *et al*. 1967, Dahlberg *et al*. 1968, Dowling and Wiley 1986).

Measurements of stream flow and dissolved oxygen made by BLM at reach CC2 display a positive correlation between those variables (SIR Figure C18). The significance is <0.001, but the r^2 is 0.19, meaning that stream flow is not the only variable controlling dissolved oxygen. Dissolved oxygen decreased with reductions in stream flow by about 0.28 parts per million (ppm) for every 10-gpm reduction in this reach. Dissolved oxygen in reach EG1 exhibited no correlation with stream flow (SIR Figure C16).

Some dissolved oxygen measurements made by BLM were already below the tolerance threshold for Gila chub, and even Gila topminnow (0 ppm at CC2). Oxygen concentrations are not uniform throughout a water body, and fish can detect oxygen levels, enabling them to move towards waters with higher concentrations of dissolved oxygen. Fishless pools that were likely caused by low levels of dissolved oxygen have already been observed in Cienega Creek (Bodner *et al*. 2007). Drier times of the year are of most concern, when there is little actual flow (flowing water has more dissolved oxygen), and water in the stream is restricted to pools. Lower amounts of dissolved oxygen are certain to occur with lower streamflow caused by the mine, and lower streamflow and higher temperatures caused by climate change.

Since we have few measurements of dissolved oxygen in Cienega Creek to analyze, our analysis of water quality is expressed in terms of the days of extremely low flow predicted by modeling. While days of zero flow are certainly more problematic, days of extremely low flow will likely present similar challenges to fishes, so we focus on them here. Again, our analysis is based on the higher range of the 95th percentile analyses, though the full range of 95th percentile values appear in various tables.

In brief, the proposed action will result in increasing numbers of extremely low-flow days at most sites, and climate change plus the mine increases low and zero flow days even more

(Tables D3, D5, D11, D12). Key Reach EG1 in Empire Gulch may experience either little change from present-day baseline conditions effect or total dewatering; precaution dictates we give relatively greater weight to the more adverse potential outcome.

Upper Cienega Creek

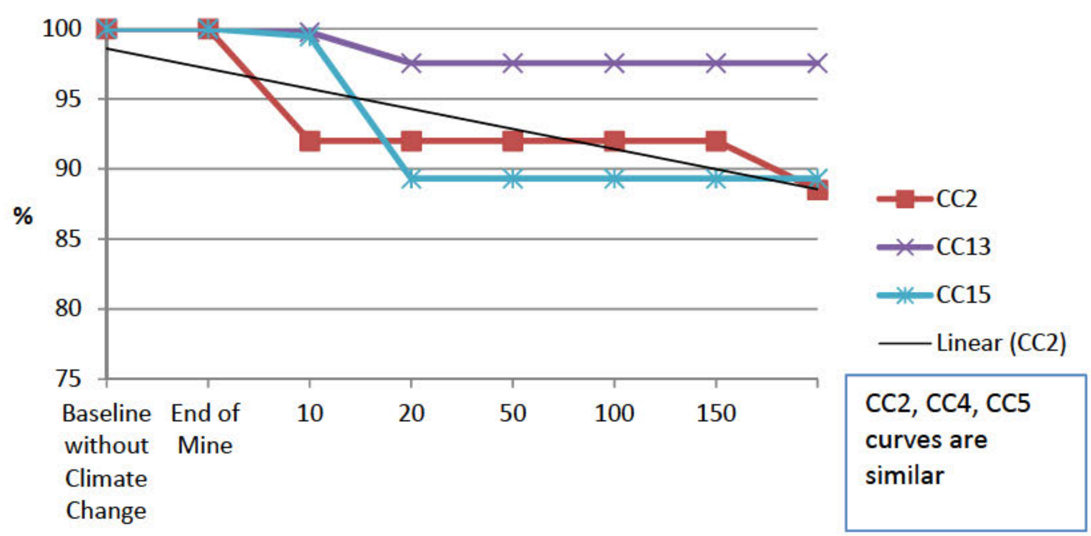
Upper Cienega Creek is that portion of the stream in Reaches 1 to 7 (see Figure A-1 in the Effects to Aquatic Ecosystems section). Gardner Canyon and Empire Gulch, along with Mattie Canyon, are the major tributaries in this reach. The USGS Cienega Creek stream gage (0948550) is situated near the narrows between Reach 7 and 8 (see Figure A-1). Indirect effects from the mine to Gila chub, such as groundwater drawdowns and changes in riparian community composition, are likely to occur within the action area in upper Cienega Creek.

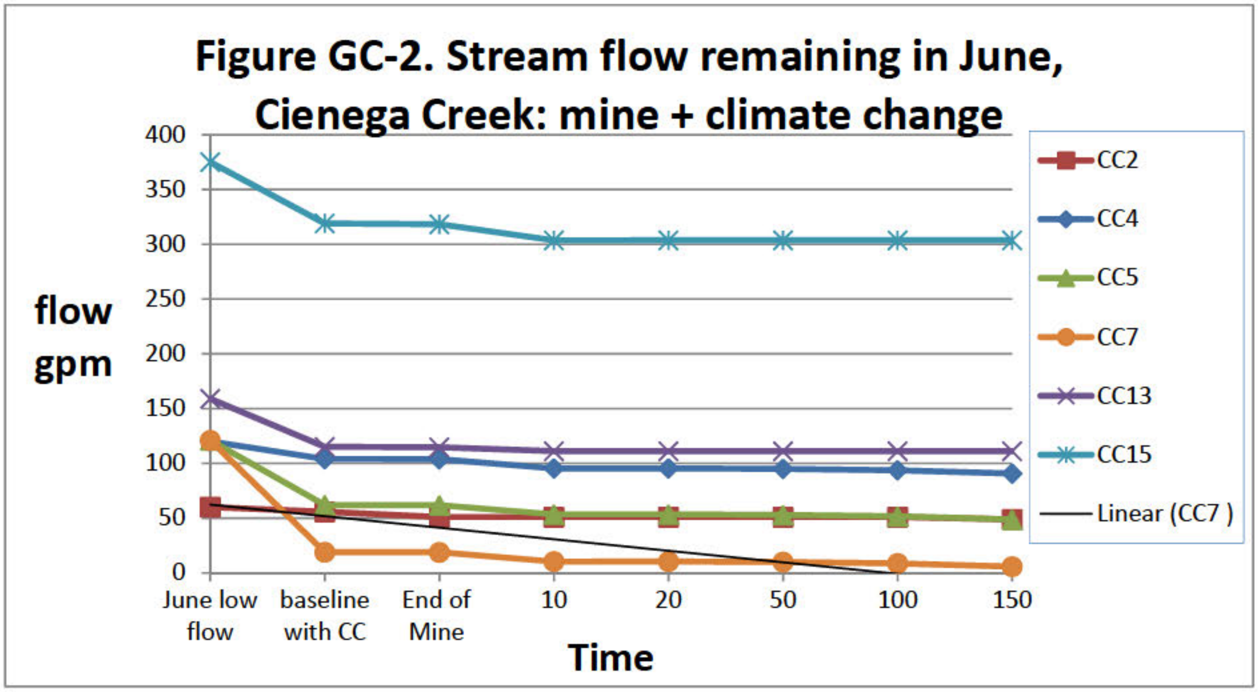
<u>Upper Cienega Creek – Key Reaches CC2 and CC4</u>

For mine impacts only, these reaches remain perennial, with stream flow losses ranging from no change to from 9.1 to 13.2 gpm (at the end of mining to 150 years later, respectively; SBA Table D10) under the higher range of the 95th percentile analyses. These two reaches maintain 89 percent of their June flow (losing 11 percent), respectively, at 150 years (Figure GC-1).

For impacts of the mine combined with expected climate change impacts to stream flow in these reaches, the loss in reach CC2 is 11.2 gpm and in reach CC4 is 29.3 gpm at 150 years (Figure GC-2). When looking at flow loss as a percentage of baseline at 150 years after mine closure, the June flow of CC2 is 81 percent (a 19-percent loss) of the current baseline (Figure GC-4). June flow of CC4 is 76 percent of current baseline (a 24-percent loss).

Figure GC-1. Percent stream flow remaining in June, Cienega Creek: mine only





With respect to water quality impacts, climate change by itself would result in 0 to 6 days of extremely low flows per year (Figure GC-3), 150 years after the conclusion of mining. Mine-related drawdowns plus climate change would result in 6 days of extremely low flows at the end of mining and at 10 to 150 years following closure, the extremely low flow days would range from 6 to 11 per year (from 0 to 5 additional days per annum). A review of 95th percentile, mine-only data in SBA Table D-10 indicates that climate change drives the frequency of extremely low-flow days early in the post-mine period (10 to 50 years), while the mine's relative contribution to the effects increases at 100 to 150 years. No zero flow days occur at these reaches under any scenario.

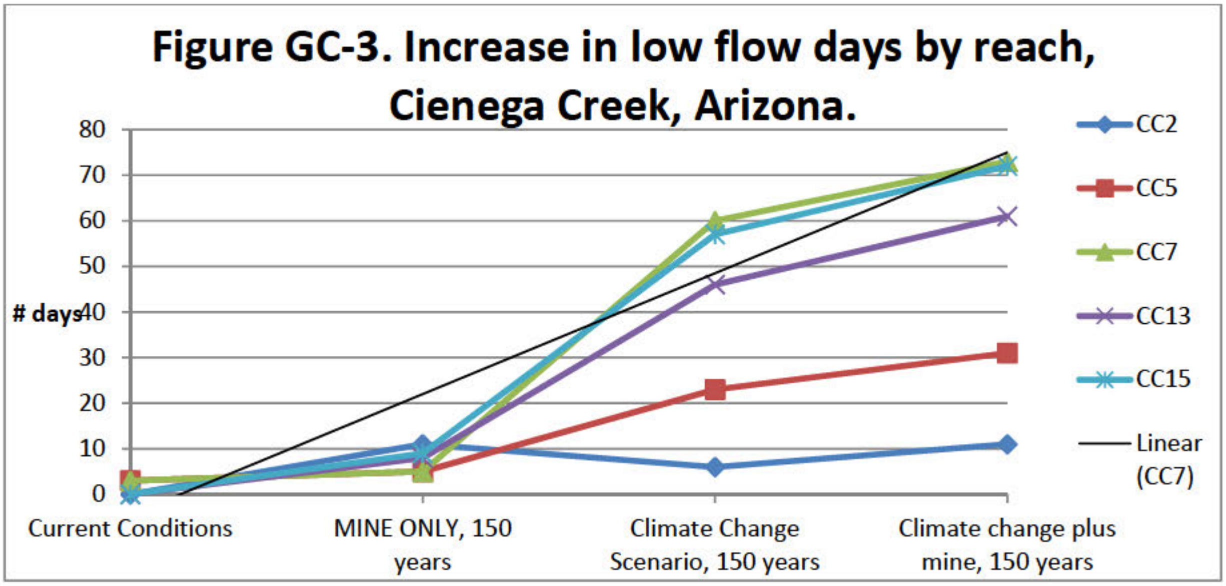


Figure GC-3. Increase in low flow days by reach, Cienega Creek, Arizona.

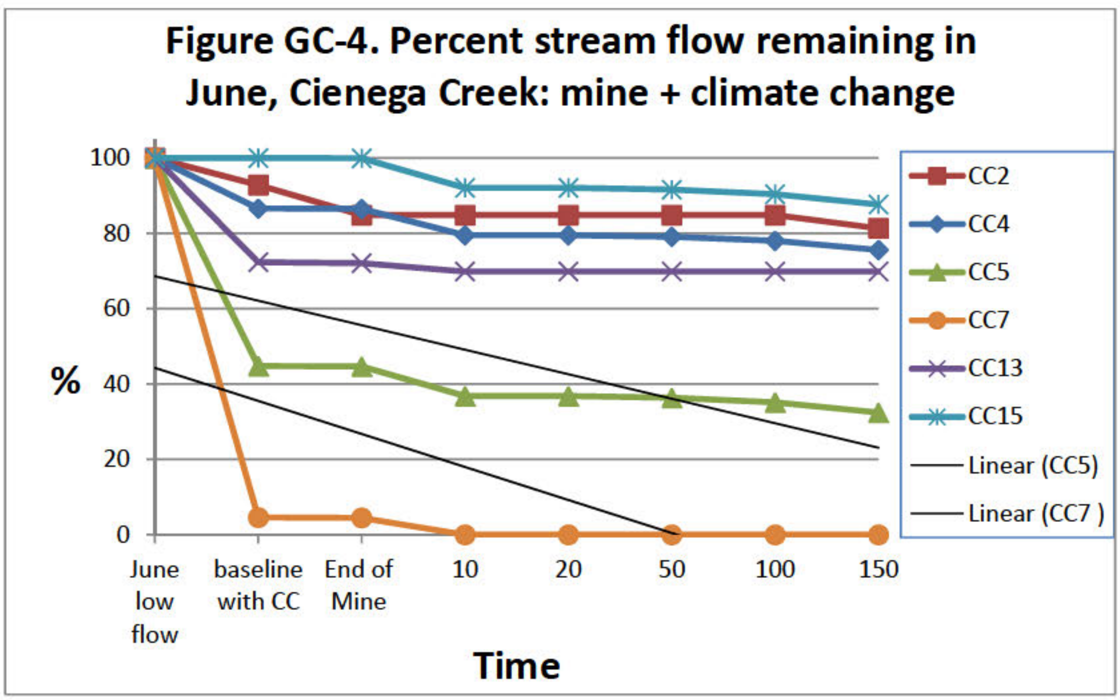
Under present-day baseline conditions, during periods of low seasonal stream flow (May/June), portions of the aquatic environment along Cienega Creek and Empire Gulch can experience high water temperatures and low concentrations of dissolved oxygen (DO). These same trends would be expected to continue and be exacerbated during days where stream flow is predicted to fall to levels lower than those experienced currently.

Mine drawdown under the high 95th percentile analyses does not change the number of pools present in these reaches; climate change reduces the number of pools from 22 to 19 for reach CC2, and from 16 to 15 for reach CC4. Mine drawdown by itself also does not substantially change the pool depth, pool volume, or surface area: pool depth does not change from current conditions; volume reduces to 98 percent (a 2-percent loss) of original volume and area for reach CC2 and 98 percent (also a 2-percent loss) of original volume for reach CC4 (Table GC-4). Pool area is reduced 3 percent in reach CC4from mine drawdown (retaining 97 percent of surface area). These effects to pools are modest due to the impacts of the mine after 150 years post-closure, but measurable, and will be considered in the analysis of effects to aquatic species. When climate change impacts are added to effects from the mine, pool volume is substantially impacted, reducing pool volume by 45 percent of original in reach CC2 and 32 percent in reach CC4 (55 percent volume remaining.

Table GC-3. Summary of water quantity effects by reach from mine closure to 150 years. Stream flow and pool geometry are described in terms of percent losses. Percent flow loss is derived from one value for each reach, as explained in the SBA and SIR. Pool numbers are described in terms of absolute losses of pools in Key Reaches. CC = climate change.

Reach	Flow		Pool volume		Pool depth		Pool area		# Pools	
	Mine only	Mine + CC	Mine only	Mine + CC	Mine only	Mine + CC	Mine only	Mine + CC	Mine only	Mine + CC
CC2	11	19	2	45[1]	0	14	2	12	22	19
CC4	11	24	2	32	0	14	3	31	16	15

CC5	12	68	1	29	0	13	1	27	19	19
CC7	12	100	5	29	3	15	5	27	15	15
CC13	2	30	8	69	0	34	8	63	8	7
CC15	11	50	5	45	0	28	4	35	4	3
Cienega Creek only	10	48	3	34	1	34	3	25	84	78
EG1	100	100	100	100	100	100	100	100	5	0
EG2	18	46	12	34	8	23	12	29	11	10
CGW	N/A		67	81	13	26	58	76	3	3
Pool volume, depth, and surface area percentages were calculated by summing all actual individual pool measurements in a reach, and then comparing it to the predicted value at 150 years post-closure for the mine, and the mine plus climate change. [1] For example, the measured volume of all pools in reach CC2 is 19,886 ft^3 and the calculated for the effects of the mine and climate change 150 years post-closure is 10,905 ft^3, which is a 45% reduction in pool volume for reach CC2.										



<u>Upper Cienega Creek – Key Reaches CC5 and CC7</u>

These reaches currently exhibit an average of two days with zero stream flow per year under present-day baseline conditions; mine drawdown would change this to 2 or 3 days per year under the 95th percentile analyses. Climate change absent the mine's impacts would result in 5 days with zero stream flow per year in CC5, and 23 days with zero stream flow per year in CC7. In combination, mine drawdown plus climate change would result in 5 to 11 days with zero stream flow per year in CC5, and from 23 to 31 days with zero stream flow per year in CC7. Flow status would remain perennial under the proposed mine-plus climate change scenarios; flow status in

CC7 also largely remains perennial for most scenarios, but by 10 years after mine closure, the higher range of the 95th percentile analysis indicates a possible shift to intermittent flow for the mine-plus-climate change scenario.

Losses to the June flow from mine impacts only at 150 years post-closure for both reaches is 13.2 gpm. The percent of flow remaining at 150 years is also the same for both reaches, at 88 percent (a 12-percent loss).

When the predicted stream flow losses from climate change are added to losses from the mine, a more problematic picture emerges. In reach CC5, 72 gpm are lost at 150 years, leaving 32 percent of the baseline June flow (a 68-percent flow loss). Reach CC7 does not fare well in the climate change only scenario, losing 102 gpm at 150 years. Combined with predicted loss at 150 years from the mine, CC7 loses 115 gpm of June flow. Since the June baseline flow is 107 gpm, the stream would be intermittent with isolated pools (Figure GC-4).

Mine drawdown, with or without climate change, does not change the number of pools present in these reaches (19 in CC5 and 15 in CC7; Table GC3). Mine drawdown alone also does not substantially change the percentage of pool depth, pool volume, or surface area lost (0-5%) (95 to 100 percent retained) (Table GC-3; SBA Tables D-24, 25, and 26, respectively). Pool volume, at 150 years, reduces to 99 percent (a 1 percent loss) of original volume for reach CC5 and 95 percent of original volume for reach CC7.

Under the 95th percentile analyses, climate change plus the mine reduces pool depth by 13 and 15 percent respectively, and pool surface area is reduced 27 percent. Climate change plus the mine reduces pool volumes by 29 percent of original volume in both reaches (with 61 percent retained).

The groundwater modeling results do not discuss the potential for groundwater drawdowns at Mattie Canyon; the site is outside of the 5-foot drawdown perimeter discussed in the FEIS (2: 294-295). However, since lower Mattie Canyon is close to the stream gage, drawdown at the gage may also occur in the groundwater system associated with the tributary. Reductions of groundwater at Mattie Canyon may be slightly less than at the gage because Mattie Canyon is slightly further from the mine pit, and east of Cienega Creek. However, a reduction in groundwater that reduces surface flow and subflow, will affect Gila chub and critical habitat in Mattie Canyon as is discussed above.

Lower Cienega Creek

Lower Cienega Creek will experience the accumulation of effects of groundwater drawdown and surface flow diminishment throughout the affected portion of its watershed. The effects to Barrel Canyon and Davidson Canyon Wash represent incremental, additive effects to the water yielded to lower reaches of Cienega Creek, though we are aware that the SIR and May 2015 SBA did not consider surface flow connection between upstream reaches and CC13 and CC15.

The Pima Association of Governments (2003b) has estimated that Davidson Canyon Wash subflow contributes 8 to 24 percent of the baseflow in Lower Cienega Creek. Given SWCA's finding that Davidson Canyon Wash will experience a 4.3 percent reduction (SIR: 31) in surface flows from the placement of tailings in Barrel Canyon (a tributary)(see above), we anticipate a 0.3 to 1.0 percent reduction in lower Cienega Creek baseflows. Again, these anticipated reductions are to annual yields, and may not describe any reductions in the dry-season baseflows which are crucial to conserving Gila chub.

The reduction in lower Cienega Creek subflow from the Barrel Canyon and Davidson Canyon Wash systems will occur in addition to surface flow reductions in other upstream areas of Cienega Creek and the influence of climate change over time. The end result will be an incremental, detrimental effect on aquatic ecosystems in lowermost Cienega Creek.

Peak flow reductions will also result from the proposed action; these were discussed in the Effects to Aquatic Ecosystems section. We cannot ascertain the precise effect that reduced peak flows from Barrel Canyon [modeled to be 22 percent (FEIS V1:126, Table 12)] and thence Davidson Canyon Wash (extrapolated to be 5.6 percent) will have on lower Cienega Creek (see Effects to Aquatic Ecosystems section). It is reasonable to assume the effects will be appreciably less than 5.6 percent, because flood flow hydrology will remain largely intact in the eastern portions of the Cienega Creek watershed (including Empire Gulch, Gardner Canyon, and Mattie Canyon). “Flood flow hydrology” includes peak flows, and declining and ascending limbs. There are also instantaneous peak flows.

We note, however, that peak flows are responsible for the movement of sediment. A small reduction in sediment transport has been modeled for Davidson Canyon and Cienega Creek below their confluence, but is not anticipated to have a large effect on sediment supply given the remaining, unaffected sediment supply present within channels and tributaries (Patterson and Annandale 2012, Rosemont Copper Company 2012, FEIS p. 464-467). There may nevertheless be interactions between the expected changes in both peak flow hydrology and available sediment supply (Simon *et al.* 2007), making it difficult to predict future changes in sediment-related channel geometry. We note that Rosemont Copper Company (2012) predicts a slight narrowing in channel top width. This seems reasonable, given that any reduction in the magnitude of peak flows will affect floods of all return intervals, including the approximately 1.5-year return interval events that constitute channel-forming flows (Rosgen 1994, Moody *et al*. 2003). It is not clear if the modeled change in sediment and the channel narrowing will affect Gila chub positively or negatively; effects will depend on multiple variables (e.g. timing, quantity, amount of flow in Barrel Canyon, Davidson Canyon Wash, and ultimately, the Gila chub habitat (and critical habitat) in Cienega Creek.

Gila chub have been recorded in Reach 13 and 15 of Cienega Creek (below the confluence with Davidson Canyon); there appears to be marginally suitable habitat (Timmons, AGFD, pers. comm., October 13, 2015) and it is designated critical habitat, and has an upstream source population of Gila chub. Therefore, it is reasonably certain that Gila chub will occur in the action area during the timeframe of the action. Effects in this area begin during mine operation, and continue well after mine closure. Any loss of flow, wetted perimeter, and pool depth is an effect on Gila chub.

Analyses undertaken by Westland Resources (2012) but not included in the three iterations of the BA, in SWCA (2012), or the FEIS, correlated extent of surface flow in lower Cienega Creek with depth-to- groundwater in adjacent wells. Their results, partially based on averages in June, show there would be small decreases (<2% of average) in length of streamflow. Also, the extent of streamflow and proportional reduction in extent of streamflow could be greater than two percent in drier times. Pima County performed a similar analysis, finding that a 0.1-foot decline in groundwater elevation would lead to a loss of 434 linear feet (3.4%) of stream flow in June (Powell *et al*. 2014). They also estimated a 0.25-foot decline would lead to a loss of 1,085 linear feet of stream flow in June. We did not use these studies in our analysis, as they did not emerge intact from the rigorous SIR and SBA preparation process, nor the technical reviews conducted by the USGS (USGS 2014a, USGS 2014b). We instead employed the results of the regression analyses contained in the SIR and May 2015 SBA.

<u>Lower Cienega Creek – Key Reaches CC13 and CC15</u>

The 95th percentile analyses for these reaches show that climate change by itself would result in 23 additional days with zero stream flow per year at every time step in CC13, and 37 additional days with zero stream flow at every time step in CC15. In combination, mine drawdown plus climate change would result in 23 days with zero stream flow per year in CC13 (no change from climate change-only results), and from 37 to 50 days with zero stream flow per year in CC15 (zero to 13 additional days). Reach CC13 would not change flow status from perennial; however, climate change pushes reach CC15 from perennial to intermittent flow status, regardless of mine drawdown. At 150 years post closure, effects of the mine cause 8 low-flow days in CC13, and 9 low-flow days in CC15.

Losses to the June flow from only mine impacts at 150 years post-closure is 3.9 gpm for CC13 and 15.4 gpm for CC15. The percent of flow remaining at 150 years is 98 percent for CC13 and 89 percent for reach CC15 (2 and 11 percent flow losses, respectively).

In reach CC13, 47.9 gpm are lost from the mine and climate change at 150 years, and CC15 loses 72.6 gpm. When looking at flow loss as a percentage of baseline, at 150 years after mine closure, the June flow of CC13 is 70 percent and CC15 is 50 percent of the current baseline (30 percent and 50 percent of flow retained, respectively) (Figure GC-4).

Under the 95th percentile analysis, mine drawdown does not change the number of pools present in these reaches (SBA Table D-23); climate change by itself reduces the number of pools from 8 to 7 for reach CC13, and from 4 to 3 for reach CC15. Mine drawdown also does not substantially change the pool depth, pool volume, or surface area (Table GC3; SBA Tables D-24, D-25, and D-26, respectively): pool depth does not change from current conditions (Table D-24); volume reduces to 92 percent (8 percent loss) of original volume for reach CC13 and 95 percent (5 percent loss) of original volume for reach CC15 (Table D-25).

Climate change plus the mine reduces pool volumes to 31 percent of original volume for CC13 and 55 percent of original volume for CC15 (reductions of 69 and 45 percent, respectively). Pool depth is reduced by 34 and 28 percent (66 and 72 percent retained), respectively, and pool surface area is reduced by 63 and 35 percent (37 and 65 percent retained) respectively.

Key reaches CC13 and CC15 do not experience extremely low flows under present-day baseline conditions; climate change is anticipated to increase this to 46 to 57 days at all time-steps, respectively (Figure GC-3). The influence of the mine will, at the high-range 95th percentile value, increase this to up to 61 and 72 days at 150 years post-closure, respectively. A review of the 95th percentile, mine-only data from Table D-10 in the SBA indicates these effects are primarily driven by climate change, not drawdown. Again, mine drawdown effects are of less magnitude than climate change, but increase over time. Once again, these conditions will increase the incidence of water quality that adversely affects aquatic life. All of the decrease in water quantity described above will reduce the amount of habitat that is available for Gila chub.

Empire Gulch

The modeled groundwater drawdown would reduce the amount or volume of water in Empire Gulch itself, including perennial pools. This would impact the PCEs of water quantity and vegetative cover present within critical habitat there by reducing those two metrics. However, since Gila chub are not known to occur in Empire Gulch, nor are there records of their occurrence, impacts to individual chub are not likely. Also, as long as Chiricahua leopard frogs occur at the headspring, it is very unlikely that Gila chub would be intentionally released there, as chub can prey on frog tadpoles and eggs.

It is possible, given the long period of effects of the proposed action that Gila chub could naturally move into lower Empire Gulch. In that event, indirect effects on Gila chub habitat could impact breeding and foraging within these areas. These impacts would be more likely to occur near the confluence with Cienega Creek, which is expected to have less groundwater drawdown than the Empire Gulch headspring, and is closer to source populations in Cienega Creek.

<u>Upper Empire Gulch – Key Reach EG1</u>

Similar to the stream flow analysis, the 95th percentile range of results for reach EG1 encompasses a wide range of outcomes. Unlike the reaches on Cienega Creek, the range of possible outcomes is quite large, as is the potential timing for impacts to occur. At 150 years after mine closure, the 95th percentile range for mine drawdown alone shows a range that is anywhere from no pools remaining, to all pools remaining in the reach. At the higher range of the 95th percentile range, some pools begin to disappear by 20 years after mine closure. To illustrate the variability in predictions, at the low end of the 95th percentile range, all pools remain even 150 years after mine closure. Climate change has very little effect on the number of pools, even in combination with mine drawdown. We assume that all pools in EG1 will be lost from groundwater drawdown from operation of the mine, consistent with our use of the higher range of the 95th percentile range. As with the analysis of effects to streamflow, above, aquatic species occurring in pools in upper Empire Gulch are anticipated to experience appreciable adverse effects through reductions in water volume, though none are expected for the Gila chub.

Climate change alone will increase the incidence of extremely low-flow days to 26 per year from the end of mining to 150 years later (Figure GC-3). Modeled water quality effects, similar to stream flows, exhibit wide variation at this site. The low-range values are also 26 days throughout the modeled time period but the high-range values diverge to 64 days at 10 years, 102 days at 20 years, 339 at 50 years, and year-round at 100 and 150 years. Here, the precautionary analysis of the higher range of the 95th percentile analyses displays similarly adverse numbers at longer intervals (339 at 50 years, and year-round at 100 and 150 years).

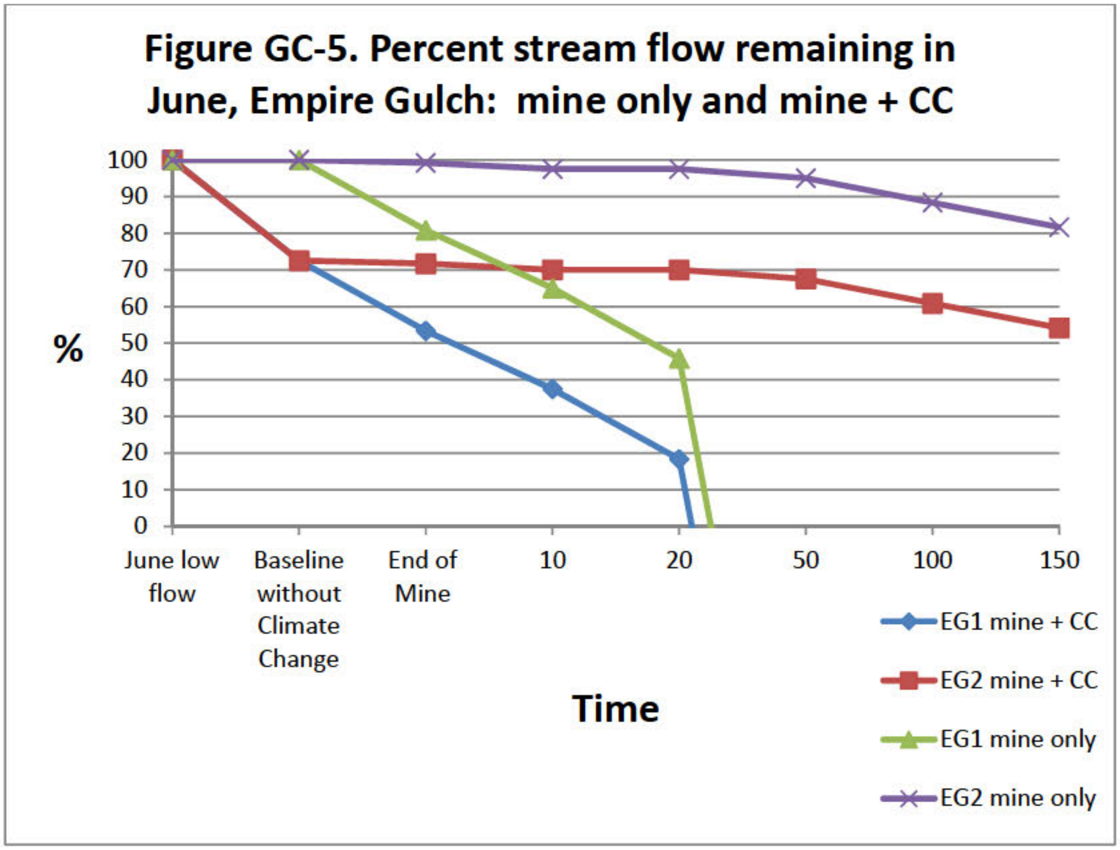
A review of 95th high percentile, mine-only data in SBA Table D-12 indicates the proposed action is the largest contributor to the large effects. Again, the wide range of these data make conclusions uncertain, but precaution dictates we give greater weight to the possibility that upper Empire Gulch will dry.

Empire Gulch already experiences low flows and compromised water quality during May and June. Climate change alone will exacerbate this trend, but the drawdown resulting from the mine will have appreciable adverse effects ranging up to complete dewatering.

Lower Empire Gulch – Key Reach EG2

Even though Gila chub have not been recorded anywhere in Empire Gulch, it is possible chub could occur there in the future by moving upstream from Cienega Creek. Discharges in lower Empire Gulch appear to be insensitive to mine drawdown, with no days of zero flow noted under any modeling scenario (95th percentile or the higher range of the 95th percentile analyses). This equates with no change from the baseline, and flow status would remain perennial.

Losses to the June flow from only the mine at 150 years post-closure is 2.2 gpm for EG2. The percent of flow remaining at 150 years is predicted to be 82 percent (18 percent of flow lost) (Figure GC-5). Reach EG2 loses 5.5 gpm from effects from the mine and climate change combined at 150 years, leaving 54 percent (46 percent lost) of the baseline June flow (12 gpm).



Mine drawdown does not change the number of pools present in reach EG2; climate change reduces the number of pools from 11 to 10 (91 percent of poll numbers retained, 9 percent lost). Median pool depth reduces from 2.6 feet (SIR Table 30) to 1.6 feet (SIR Table 40) (61 percent remaining, 39 percent lost) based on changes from present-day conditions. Median pool depth may change from 1.9 ft at the end of mining to 1.7 ft at 150 years (an 11 percent loss with 89 percent depth retained). Climate change is anticipated to have no effect to pool depth in EG-2. Mine drawdown plus climate change may change pool depth from 1.6 feet at the end of mining to 1.4 at 150 years (88 percent depth remaining, 12 percent lost). Overall, mine drawdown-related pool volume will be 88 percent of original (present-day) pool volume after 150 years (12 percent of volume lost). From the end of mining, pool volume in EG-2 may experience losses of up to 1 percent (99 percent remaining) to as much as a 19 percent loss (81 percent remaining) by 150 years post-closure. Climate change is expected to have greater effects, causing 41 percent losses of pool volume (59 percent remaining) at all time-steps. Combined, mine drawdown and climate change may leave 58 percent of pool volume intact (41 percent lost) at the end of mining, ranging up to as little as 49 percent (51 percent lost) by 150 years. Climate change in combination with mine drawdown reduced pool to 54 percent of original (present day) pool volume after 150 years (46 percent lost). Pools in lower Empire Gulch are anticipated to experience measurable adverse effects, though lower in magnitude relative to upstream reaches. Mine drawdown-driven pool surface area losses in EG2 range from no effect at the end of mining to as much as an 11 percent loss (89 percent remaining) at 150 years. Climate change effects are more pronounced, with 27 percent losses (and 73 percent remaining) at all time-steps. Mining and climate change combined may result in the same 27 percent losses (and 73 percent remaining) of pool surface area at the end of mining, but may increase to as much as a 36 percent loss of area (64 percent remaining) by 150 years later.

Under current conditions, during periods of low seasonal stream flow (May/June), portions of the aquatic environment along Cienega Creek and Empire Gulch can experience high water temperatures and low concentrations of dissolved oxygen (Simms and Ehret 2014). These same trends would be expected to continue and be exacerbated during days where stream flow is predicted to fall to levels lower than those experienced currently. Higher water temperatures and more occurrences of low dissolved oxygen will reduce the suitability of the area for Gila chub.

Cieneguita Wetlands – Key Reach CGW

Similar to reach EG1, the 95th percentile range of results for the Cieneguita Wetlands encompasses a wide range of results for mine only. The number of pools does not change, but rather, pool depth changes; after 150 years after mine closure, median pool depth reduces from 3.1 to 2.3 feet. Pool volumes change significantly, with the three Cieneguita pools losing 67 percent of their volume due to impacts from the mine after 150 years (33 percent remaining).

Climate change in combination with mine drawdown reduces pool volume to 19 percent of original volume (81 percent loss from original volume). Pool depth loses 26 percent (and retains 74 percent), and pool surface area declines by 76 percent (retaining 24 percent).

Summary

Area groundwater levels have historically been variable, and the environmental baseline shows trends of increasing water use in parts of the action area, which are likely to initiate or contribute to a downward trend in groundwater levels. The current extended drought and climate change are highly likely to negatively impact many system components from the upper parts of the watershed to where Cienega Creek becomes Pantano Wash through: changes in upland vegetation and fire regime, higher ambient and water temperatures, increased variability in stream hydrographs, and more frequent severe climatic events (such as storms, droughts, wildfires, etc.). Modeling has confirmed that impacts to groundwater from the mine, and thus to surface water (stream flow, pool area, pool volume, pool depth), are reasonably certain to occur in designated critical habitat and areas occupied by Gila chub, and thus will negatively affect Gila chub. Reductions in stream flow and in pool volume, depth, and surface area due to the mine will reduce the amount of habitat that is available to Gila chub.

Effect of the Proposed Conservation Measures – Gila Chub

The proposed action contains many conservation measures. Rosemont has agreed to monitor changes in groundwater and surface water quantity and to update groundwater models based on data obtained from monitoring efforts. Tracking what occurs with surface and groundwater will be crucial for determining any effects of the mine on water, and subsequently to species dependent on that water. The BA contained no additional conservation measures if monitoring shows groundwater drawdown greater than what was modeled. If this were to occur, reinitiation of consultation would likely be necessary. Groundwater is our surrogate measure of take for all three of the fish species.

The most current version of the conservation measures is provided in the Description of the Proposed Conservation Measures section of this BO. Because the effects of the action to Gila chub will be long-term and off-site, effective conservation measures can only be realized off-site. The conservation measures discussed below are outside the footprint of the mine, although one is in the action area. Other than the monitoring mentioned above, the conservation measures should promote conservation and recovery of Gila chub. A full description of the conservation measures can be found in the proposed action section of the 2013 Rosemont BO and in this BO.

The Cienega Creek Conservation package includes the acquisition of water rights and funding for conservation projects. Flow at Pantano Dam is currently captured at an existing in-channel grate-covered diversion. Flow will continue to be captured in this manner, then released into the stream channel at a hydrologically-appropriate location below the dam. Gila topminnow and longfin dace have been observed right above the dam, on the dam (dead), and in the scour pool below the dam. It is certain that fish have been and will continue to go into the diversion, and suffer death or injury. Although Gila chub have not been found within several miles of the dam, the possibility exists they could occur below the dam, given the time-frame of analysis and the mitigating effects of Cienega Creek Watershed Conservation Fund. The City of Tucson and Pima County (2009) expect that up to 3,000 linear feet of riparian and aquatic habitat would form below the dam. Whether or not that habitat is suitable for chub, given the reduced stream gradient below the dam, remains to be seen. There would at least be a perennial pool below the dam. The actions taken under this conservation measure should enhance the resiliency and suitability of Cienega Creek for Gila chub, especially in the lower creek, at least in the short-term through protection of water rights and creation of new habitat. Under the threat of continuing long-term drought and climate change, enhancing system resiliency is a key component for adapting to climate change and reducing its affects (Overpeck *et al.* 2012). Additional Cienega Creek water rights will also be transferred to an appropriate entity, which may help protect instream flow.

The Sonoita Creek Ranch conservation measure includes maintenance of the two ponds and conveyance channels. The water comes from Monkey Spring, with about 590 AFA of the spring's total 785 AFA of certificated surface water rights appurtenant to Sonoita Creek Ranch (the remainder is appropriated by another water right holder).

Sonoita Creek Ranch is near Patagonia; by virtue of its inclusion as a conservation measure, it is in the action area. Management of the property for conservation purposes, including maintaining the ponds and channels and removing nonnative aquatic species from that system, will be funded by Rosemont.

Sonoita Creek Ranch includes two ponds that are, and will continue to be, maintained with water discharged from Monkey Spring. The water conveyance structures bringing water to the ponds, between the ponds, and out of the ponds may also provide habitat for native fish. Based on conversations with Rosemont, the reestablishment of Gila chub and Gila topminnow is reasonably certain to occur after nonnatives are removed from them (in coordination with appropriate agencies). Because this parcel is outside of the main action area, this action represents recovery in lieu of threat removal (FWS 1994). The status of Gila chub should be improved by actions taken at Sonoita Creek Ranch by the creation of additional populations in the ponds. Establishment of new chub populations would partially implement recovery task 2.2 of the Draft Gila Chub Recovery Plan (FWS 2015). Rosemont has measured flow into the ponds over the last eight months, and it averages 16.2 gallons/month (Rosemont 2016). That flow equates to about 596 AFA. Also, the source of Monkey Spring appears to be the regional aquifer, which should be somewhat buffered from local groundwater pumping and climate change. However, flow from Monkey Spring could decrease over time, reducing the amount of water available for the ponds, but it is likely the ponds can be adequately maintained with less flow.

The harmful nonnative species management and removal conservation measure should benefit existing populations of Gila chub in Cienega Creek and in the San Rafael Valley, and any populations that may be established in those watersheds. This conservation measure, while not removing the indirect effects of the mine on groundwater, allows for recovery of listed species in lieu of threat removal and protects one of the PCEs of critical habitat. In addition, actions implemented on National Forest System lands preferentially receive funding under this conservation measure, although other partners and landowners and managers can take part in management actions against nonnative aquatic species. Because nonnative aquatic species are one of the greatest threats to native fish conservation (Meffe *et al*. 1983, Meffe 1985, Brooks 1986, Marsh and Minckley 1990, Stefferud and Stefferud 1994, Weedman and Young 1997; FWS 2002, 2008; Minckley and Marsh 2009), removing them from the landscape and potential fish habitat provides a benefit to native fishes. Cienega Creek currently has no nonnative fishes; if certain nonnative fishes were to become established in the creek, it could be catastrophic for the native aquatic vertebrates there (including Gila chub). Removing nonnative aquatic fish from the nearby watershed minimizes the chance that nonnative fish could find their way into Cienega Creek, or to occupied habitats in the San Rafael Valley. Removal of nonnative aquatic fish in the San Rafael Valley could open up habitats for the release of Gila chub.

The Cienega Creek Watershed Conservation Fund, harmful nonnative species management and removal, and Sonoita Creek Ranch conservation measures are essential to partially offset expected effects to Gila chub and their habitat.

Summary of Effects – Gila Chub

- Although groundwater levels have historically been variable in this area, the environmental baseline and cumulative effects show trends of increasing water use in parts of the action area, which are likely to initiate or contribute to a downward trend in groundwater levels;
- The current extended drought and climate change are highly likely to negatively impact many system components from the upper parts of the watershed to where Cienega Creek becomes Pantano Wash through:
    - Changes in upland vegetation and fire regime;
    - Higher ambient and water temperatures;
    - Increased variability in stream hydrographs;

- More frequent severe climatic events (such as storms, droughts, wildfires, etc.);
- Impacts to groundwater due to the mine, and thus to surface water (stream flow, pool area, pool volume, pool depth), are reasonably certain to occur (based on the modeling utilized in this analysis) in designated critical habitat and areas occupied by Gila chub, and thus will negatively affect Gila chub;
- The proposed conservation measures will not preclude anticipated effects to surface water from occurring nor entirely mitigate those effects;
- Within 50 to 150 years post-closure, substantial decreases to wetted stream perimeter and water depth are anticipated to occur;
- Cienega Creek is one of 22 extant populations of Gila chub range-wide (FWS 2015) and Cienega Creek is relatively stable, with no nonnative fishes present;
- The effects of the proposed action do not represent movement beyond a tipping point that would preclude the recovery of the species, nor will the proposed action result in the destruction or adverse modification of the species' critical habitat; and
- While the proposed conservation measures will not preclude the anticipated indirect effects due to the mine to surface waters and Gila chub from occurring, the Cienega Creek Watershed Conservation Fund, the Harmful Nonnative Species Management and Removal program, the Cienega Creek water rights transfer, and the acquisition and enhancement of Sonoita Creek Ranch conservation measures will allow partial conservation in lieu of threat removal, thus minimizing the adverse effects of the proposed action.

Cumulative Effects – Gila Chub

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.

In 1991, the American Fisheries Society adopted a position Statement regarding cumulative effects of small modifications to fish habitat (Burns 1991). Though the American Fisheries Society use of the term cumulative differs from the definition in the ESA, the statement concludes that accumulation of, and interaction between, localized or small impacts, often from unrelated human actions, pose a serious threat to fishes.

Unregulated activities on Federal and non-Federal lands, such as trespass livestock, inappropriate use of OHVs, illegal introduction of nonindigenous aquatic species, and residential and commercial development on lands within watersheds containing threatened and endangered aquatic animals, are cumulative effects and can adversely affect the species through a variety of avenues.
Other activities, such as recreation, are increasing. Increasing recreational, residential, or commercial use of non-Federal lands near or within the contributing watersheds of the riparian areas would likely result in increased cumulative adverse effects to occupied, as well as potentially-occupied native aquatic animal habitat through increased water use, increased pollution, increased movement of nonindigenous species, and increased alteration of the stream banks through riparian vegetation suppression, bank trampling, changing flow regimes, and erosion. We note that recreation use on Federal lands is not a cumulative effect and that much of

the stream frontage along Cienega Creek is in Federal (BLM) ownership. Recreational use of Pima County lands, while restricted, is also a cumulative effect. Lastly, the right-of-way vegetation maintenance activities conducted by Tucson Electric Power, which result in nearly complete removal of riparian vegetation in the affected area (Pima County Regional Flood Control District 2009), are also a cumulative effect.

Cumulative effects to native aquatic animals include ongoing activities in the watersheds in which the species occurs such as livestock grazing and associated activities outside of Federal allotments, irrigated agriculture, groundwater pumping, stream diversion, bank stabilization, channelization without a Federal nexus, and recreation. Some of these activities, such as irrigated agriculture, are declining and are not expected to contribute substantially to cumulative long-term adverse effects to native aquatic animals.

There are many conservation actions being considered by the AGFD for native fish and frogs in the Santa Cruz River basin. Two important conservation actions are the approved Safe Harbor Agreements for the Chiricahua leopard frog and the topminnow and pupfish. While these two agreements and any other conservation actions taken by AGFD are likely to be federally funded or approved, it is likely some of them will have no Federal nexus.

The U.S. Census predicts that Arizona will be the second fastest growing state in the country through 2030, adding an additional 5.6 million people (U.S. Census 2005). During the 2010 Census, Arizona maintained its standing as having the second fastest population growth rate by growing more than 20 percent between 2000 and 2010 (Pollard and Mather 2010). If these predictions hold true, already severe threats to Gila chub and its habitat will worsen, primarily due to increased human demand for surface and ground water and decreased supply. Water demands will increase as the population increases, in line with current trends. In most of Arizona‘s developed areas, groundwater is pumped out faster than the aquifer can recharge (U.S. Environmental Protection Agency 2011). Groundwater pumping is likely to be the greatest impact cumulatively, since it is minimally regulated by the State.

Additionally, the majority of the lands in the Cienega Corridor are Arizona State Trust Lands, most of which are currently leased for cattle grazing. The Arizona State Constitution mandates that State Trust Lands produce the maximum economic benefit for the beneficiaries of the Trust, most of which are school districts. One of the primary ways in which the State Land Department raises funds is to auction its Trust Lands for commercial or residential development (Hanson and Brott 2005). Activities on residential and commercial inholdings within watersheds containing Gila chub can adversely affect the species through poor land management practices and water withdrawal. These effects have not been well quantified within the action area.

Conclusion – Gila Chub

As discussed in full in the Sources of Uncertainty section, above, we have chosen to base our effects analysis on the upper end of the 95th percentile analysis. Given the long time frames involved, long distances involved, and small amounts of drawdown in the aquifer, there is a high degree of uncertainty associated with groundwater predictions. The scenario represented by the upper end of the 95th percentile analysis is not the scenario most probable to occur. Rather, by selecting it we are analyzing a conservative position that ensures almost all of potential and reasonable outcomes disclosed by the models would be encompassed by this BO analysis. This conservative approach ensures that under almost all potential outcomes that can be reasonably predicted, the conclusion of non-jeopardy and no destruction or adverse modification, below, would remain valid.

After reviewing the current status of the Gila chub, the environmental baseline for the action area, the effects of the proposed action, and the cumulative effects, it is the FWS's biological opinion that the proposed action is not likely to jeopardize the continued existence of the Gila chub nor destroy or adversely modify designated critical habitat. We present this conclusion for the following reasons:

1. No direct effects from operation of the mine are expected;
2. Rosemont will monitor groundwater drawdown and the USFS (and Corps, as appropriate) will compare observed drawdown to modeled drawdown. Groundwater drawdown greater than modeled will be evaluated and may require reinitiation of section 7 consultation;
3. The Cienega Creek Watershed Conservation Fund projects will, for the short-term at least, protect and potentially increase habitat for Gila chub by funding management and restoration actions in the watershed, protecting water rights, creating some habitat for Gila chub, and minimally protecting critical habitat in the Lower Santa Cruz/Cienega Creek Critical Habitat Unit (Unit 5;
4. Projects funded through the Cienega Creek Watershed Conservation Fund are likely to increase ecosystem resiliency in the face of the expected groundwater drawdown from Rosemont Mine, and impacts from climate change, thereby reducing and delaying impacts to Gila chub habitat;
5. The severance and transfer of downstream senior water rights to upstream reaches of Cienega Creek is proposed to occur. If successfully executed, these *in situ* water rights may be employed to protect against future diversions of surface water by junior appropriators;
6. The two ponds at Sonoita Creek Ranch will provide new habitat for Gila chub from a reliable water source (Monkey Spring);
7. The Cienega Creek Watershed Conservation Fund and pond component of the Sonoita Creek Ranch conservation measures are anticipated to partially offset expected effects to Gila chub and their habitat;
8. Indirect effects to Gila chub from groundwater drawdown are difficult to predict at the distances from the drawdown (Rosemont Mine), and are not anticipated to occur until after mine closure;
9. Groundwater drawdown is expected to be less than 0.25 ft at all of the modeled locations within and upstream of Gila chub habitat until 150 years after mine closure; and
10. Conservation and recovery actions have taken place successfully since species listing, and continue to occur, with more actions in planning. Therefore, we believe the status of the species is improving (Crowder and Robinson 2015, Robinson and Crowder 2015, FWS 2015);
11. The anticipated relatively small magnitude of the proposed action's effects to Gila chub and the implementation of conservation measures (as described in Conclusions 2 - 6 above), lead to the conclusion that the recovery potential of Gila chub and the species critical habitat will not be greatly diminished;

12. The harmful nonnative species management and removal conservation measure will help ameliorate the threats of nonnative aquatic species in the Cienega Creek watershed and San Rafael Valley by removing problematic aquatic nonnative species. It may also make available additional habitat to create additional populations Gila chub in sites where problematic aquatic nonnative species are removed;
13. Cienega Creek is one of 22 extant populations of Gila chub range-wide (FWS 2015);
14. The effects of the proposed action are not a tipping point that would preclude the recovery of the species, as delineated below.

The draft Recovery Plan (FWS 2015) has criteria that are useful for determining jeopardy, though they are subject to revision following the public participation and peer review processes. Before considering Gila chub for down- or de-listing, all available remnant populations within each recovery unit are maintained in a protected stream (including Cienega Creek), and trends of recruitment and population size indices are considered stable or positive over the most recent rolling 10-year period. In addition, the draft recovery plan defines a stable (viable) population as one containing at least 5000 reproductive adults. Cienega Creek may not currently support 5,000 reproductive adults (Foster and Simms 2005) but if Cienega Creek was precluded from supporting that number of breeding fish, it would seriously hamper recovery of Gila chub.

Since the impacts of the proposed action affect only one natural Gila chub population and the action area is small compared to the range of the species, and Gila chub are expected to still be present in Cienega Creek 150 years after mine closure, it is unlikely that a tipping point away from recovery would be reached. While the action area does include an important population of the species, the effects of the action are not anticipated to be large enough to cause the loss of the population, and it is similarly unlikely that a tipping point away from recovery would be reached. We believe that Gila chub will still be present in Cienega Creek 150 years after closure of the mine since adequate water will be present. We believe this even with the higher temperatures and lower dissolved oxygen levels that will be present then.

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.

Based on the above analyses and summary, it is the FWS‘s biological opinion that the proposed action will not alter the ability of this critical habitat to retain its PCEs and to function properly. As such, Gila chub designated CH will remain functional to serve its intended conservation role for the species. Therefore, we conclude that the proposed action is not likely to either destroy or adversely modify Gila chub designated CH nor affect its role in recovery of the species.

INCIDENTAL TAKE STATEMENT – GILA CHUB

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 included by the USFS as binding conditions of any grant or permit issued to the applicant, as appropriate, for the exemption in section 7(o)(2) to apply. The USFS has a continuing duty to regulate the activity that is covered by this Incidental Take Statement. If the USFS (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 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, the USFS, or the applicant 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 – Gila Chub

We anticipate that the proposed action will result in incidental take of Gila chub as enumerated in Table GC-4. Any reduction in stream discharge resulting from groundwater drawdowns attributable to the proposed action will reduce the extent and/or quality of aquatic habitat required by Gila chub, thus harming the species. We are therefore reasonably certain that take will occur.

Incidental take of Gila chub in Cienega Creek will be difficult to detect for the reasons listed below. Thus we will use a surrogate measure of take, the justification for which also appears below. The incidental take is expected will be monitored and defined in the form of harm through the loss of habitat from groundwater drawdown, and harm and kill from water diversion and management at Pantano Dam.

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 Gila chub taken because: (1) dead or impaired individuals are almost impossible to find (and are readily consumed by scavengers and predators) and losses may be masked by seasonal fluctuations in environmental conditions; (2) the status of the species will change over time through disease, natural population variation, natural habitat loss, or the active creation of habitat through management; and (3) the species is small-bodied, well camouflaged, and occurs under water of varying clarity.

Gila chub are subject to an existing monitoring program in the Cienega Creek watershed on the Las Cienegas NCA. The currently used sampling techniques, however, do not result in population estimates, only relative abundance as catch-per-unit-effort. The sampling techniques used on Las Cienegas NCA are only sensitive enough to be statistically significant if the population doubles or is halved (Bodner *et al*. 2007). Monitoring in reaches downstream from the Las Cienegas NCA (Marsh and Kesner 2011) is similarly unsuited to determining population trends. Gila chub population estimates can theoretically be acquired, but are difficult, time consuming, stressful to the fish (to the point of harm), and expensive. In addition, the number of Gila chub in any population are normally extremely variable during a year due to an r-selected (high fecundity, short generation time, wide dispersal of offspring) reproductive strategy, common in highly variable environments such as desert streams.

It is reasonable to assume that the abundance of Gila chub is correlated with the extent of suitable aquatic habitat provided by surface flows in the affected streams (see Status of the Species and Critical Habitat within the Action Area section). Baseflows maintain stream discharge when surface runoff is low or nonexistent, and these baseflows result from groundwater discharge. The discharge of groundwater to springs and streams is related to the elevation and gradient that regional groundwater exhibits relative to those surface waters. Decreases in groundwater elevation affect this gradient and thus, reduce the discharge of groundwater to streams (see Effects to Aquatic Ecosystems section). Reduced discharge equates with reduced habitat availability which could harm the species. Groundwater elevations, which can be readily measured, are therefore effective surrogate measures for the incidental take of Gila chub.

The Effects to Aquatic Ecosystems section of this BO as well as the analysis of effects for the Gila chub, above, discuss the specific relationship between the proposed action, changes in groundwater elevation, the volume and length of surface flow in streams, and various aspects of pool numbers and geometry. These changes are expressed in terms of both quartile and 95th percentile analyses of available groundwater drawdown, discharge, and pool data.

The changes in groundwater elevation will result in reduced wetted lengths and volumes in reaches of stream maintained by discharges from the regional aquifer; surface flow effects (including effects to pools) are summarized in Tables A-2 through A-8 in the Effects to Aquatic Ecosystems section, above. WestLand (2012) determined that there could be some reductions in the wetted length of lower Cienega Creek from groundwater drawdowns over the long term. We did not analyze the results from WestLand’s study.

We note that the 95th percentile approach included predictions of drawdown from 37 to 38 individual modeling scenarios, including the Myers (2010) best-fit model (one scenario, only available for key reaches EG1, CC2, and CC5, and only for certain time steps), the Tetra Tech (2010) best-fit model (one scenario), the Montgomery best-fit model (one scenario), the Tetra Tech sensitivity analyses (8 scenarios), and the Montgomery (2010) sensitivity analyses (27 scenarios). Please see the Sources of Uncertainty section, above, for additional detail.

As stated in the Sources of Uncertainty Section of this Final BO, we have determined that the 95th percentile approach is appropriate for the evaluation of the effects of mine drawdown and climate change on aquatic and riparian species. We also stated that selecting any one of the best-fit models as the sole description of hydrologic impacts risks picking a wrong interpretation and underestimating impacts to hydrology elsewhere.

There is, however, a practical limitation with respect to using the 95th percentile approach for measuring (and complying with) incidental take. Incidental take occurs in the future, and it is not practicable to implement an ongoing 95th percentile analysis of all three groundwater models (and sensitivity analyses) moving forward. The primary issue is that the 95th percentile approach is intended to encompass reasonable sources of uncertainty in order to incorporate reasonable precaution into our effects analyses. It is not intended to and cannot be a tool for future compliance monitoring.

The use of a single groundwater model is justified for future compliance monitoring, because one model needs to be selected to set clear and enforceable thresholds. We have selected the Tetra Tech (2010) model because it represents the upper end of the range of drawdown that could be observed in the nearest (to the pit) and most critically sensitive (to threatened and endangered riparian and aquatic species) areas, specifically Empire Gulch and Upper Cienega Creek. Of equal importance is the practical matter that only the Tetra Tech (2010) model remains in an active state (in the possession of NEIBRO Hydrogeology). The Montgomery (2010) and Myers (2010) models are no longer active to the best of our knowledge, and the latter lacks the spatial coverage to be useful in the measurement of incidental take.

The exact model scenario that most closely approximates the upper end of the 95th percentile analysis will differ geographically. As discussed in the "Sources of Uncertainty" section, the Tetra Tech model incorporates a hypothesized dike in Davidson Canyon, which impedes drawdown in that direction and instead increases drawdown in the area of Empire Gulch and Upper Cienega Creek. In these critically sensitive areas, the high end of the Tetra Tech sensitivity analyses very closely approximates the upper-end values relied upon for the analyses in the BO. As such, it is reasonable to express incidental take as the drawdowns observed under the high end of the Tetra Tech model sensitivity analyses.

Table GC-4, below, displays the anticipated amount or extent of take (again, in terms of Tetra Tech 2010) in the locations and time frames (0, 20, 50, and 150 years) discussed in the analysis of the effects to the species, above; these locations are: (1) Empire Gulch Springs, representing effects to Empire Gulch; (2) USGS stream gage No. 09484550, representing effects to upper Cienega Creek; (3) the Davidson/Cienega Confluence, representing effects to Davidson Canyon Wash; and (4) USGS stream gage No. 09484560, representing effects to lower Cienega Creek.

Table GC-4: Anticipated amount or extent of take for the Gila chub, based on Tetra Tech (2010, as referenced in SWCA 2012) and Table A-5 in the October 30, 2013, BO's Effects to Aquatic Ecosystems section, for mine only.

Location	**Maximum anticipated post-mining groundwater drawdown (in feet) by year**[1]			
	0	20	50	150

Upper Empire Gulch Springs	0.1	0.5	1.8	5.0
Upper Cienega Creek near stream gage No. 09484550	<0.1	<0.1	0.15	0.35
Davidson/Cienega Confluence	<0.1	0.15	0.2	0.2
Lower Cienega Creek near stream gage No. 09484560	<0.1	<0.1	<0.1	<0.1
[1] Drawdowns described as less than 0.1 foot would be exceeded if they met or exceeded 0.1 foot.				

The sites and time frames, which appear in Table GC-4 (above), are a subset of the values contained in Table A-5 in the Effects to Aquatic Ecosystems section of the October 30, 2013 BO. These data are referred to throughout this BO's effects analyses, and represent groundwater model outputs at locations and times of interest to biological resources. It is recognized, however, that the sites currently lack observation wells; groundwater elevations cannot be monitored at these locations. Moreover, these sites are proximal to streams and will experience confounding influences from recharge by runoff, riparian ET, and drought, rendering the sites relatively unsuited for groundwater monitoring – and unsuited for determining cause and effect relationships for hydrologic changes - even if wells were emplaced. It is also recognized that the time intervals for the reported drawdowns (0, 20, 50, 150 years post-mining) are not meaningful for monitoring take; the intervals are too infrequent and become even less frequent over time. The selected groundwater model, however, can be run such that drawdowns at any location within its domain (such as where groundwater monitoring wells have been or will be placed; see Table GC-5, below) and at any desired time interval can be determined (USGS 1997). Given that the drawdowns at alternative sites displayed in Table GC-5 (appropriate locations for monitoring wells) would be derived from the same model that resulted in the anticipated levels of take at the sites described in Table GC-4, the alternative sites can serve as directly-comparable proxies for the key locations noted in Table GC-4.

We also note that fluctuations in groundwater elevation can vary daily and seasonally from environmental factors. These daily fluctuations have the potential to exceed the smaller magnitude groundwater drawdowns displayed in Table GC-4 (particularly those $\leq$0.1 foot). During the initial implementation phase (site construction, early pit construction) there is an opportunity to monitor daily and seasonal groundwater fluctuations for 2 to 4 years - under background conditions - before the anticipated effects from the pit dewatering are realized. The results from this initial monitoring will help determine the degree of background (baseline) variation in the observed groundwater elevations before the realization of Rosemont's effects. The data will also assist in discerning the groundwater drawdown attributable to the pit from unrelated environmental factors.

The USFS (2013b) has provided a list of well sites, already subject to monitoring for various environmental compliance purposes (see Monitoring Measure FS-BR-27 in the FEIS) that are likely to be suitable for monitoring the surrogate measure of incidental take (groundwater drawdown). The wells are located east of the crest of the Santa Rita Mountains, between the mine pit and Cienega Creek and Davidson Canyon Wash. Monitoring of some or all of these wells as proxies (for groundwater drawdown at the key locations in Table GC-4) will allow take of Gila Chub to be monitored immediately and during the active life of the mine, rather than waiting for the decades or centuries that it is modeled to take measurable drawdown to reach the affected streams, Cienega Creek and Empire Gulch. This suite of potential alternative monitoring sites has been reproduced in Table GC-5, below.

Table GC-5: Potential groundwater monitoring wells for compliance with the surrogate measure of incidental take (groundwater drawdown) described in Table GC-4, above. Groundwater drawdowns at a suite of these sites – once modeled and analyzed for their degree of natural variation – will serve as proxies for the drawdowns in Table GC-4.

Well Name	Direction from Mine Pit	Approximate Distance from Mine Pit (miles)
Gardner Canyon monitoring wells that could potentially be a proxy for the Gardner/Cienega Confluence		
HC-6	S	0.5
17bdb	SE	3
RP-5	SSE	1.2
18ddb	SSE	3.2
16cbb	SE	3.4
Rosemont Ranch	SE	3.8
Empire Gulch monitoring wells that could potentially serve as a proxy for Empire Gulch springs		
DH-1541	ESE	2.6
Oaktree Windmill	ESE	4.1
Davidson Canyon Wash monitoring wells that could potentially serve as a proxy for the Davidson/Cienega Confluence		
C-1	NE	0.5
HC-5B	NNE	0.6
P-899	NE	1
HC-4B	NE	1.6
RP-2C	ENE	2.5
RP-6	NE	3.8
RP-7	NE	4.5
Cienega Creek monitoring wells that could potentially serve as proxies for Upper and Lower Cienega Creek		
RP-3B	E	1.5
RP-9	E	3.4
RP-8	ENE	4.5

In summary, and stated differently, the maximum allowable incidental take of Gila chub is represented by the surrogate measure of groundwater drawdowns at the sites and time intervals stated in Table GC-4, above. The to-be-modeled groundwater drawdowns at a suite of potential sites specified in Table GC-5, above, will serve as proxies for the incidental take at the sites in Table GC-4. The manner by which Rosemont and the USFS shall monitor compliance with the amount of incidental take is described further in the Terms and Conditions, below.

Effect of the Take – Gila Chub

In this BO, the FWS determined that the level of take anticipated to result from the action is not likely to result in jeopardy to the Gila chub, nor lead to destruction or adverse modification of designated critical habitat.

Reasonable and Prudent Measures – Gila Chub

The FWS believes the following reasonable and prudent measures are necessary and appropriate to minimize impacts of incidental take of Gila chub:

1. The USFS and Corps shall ensure that Rosemont monitor groundwater levels (as a surrogate for take of Gila chub) at least annually (see also FEIS mitigation measure FS-BR-27);
2. The USFS and Corps shall ensure that Rosemont creates and funds the Cienega Creek Watershed Conservation Fund according to stipulations contained in FEIS mitigation measure FS-BR-16 and this BO.
3. The USFS and Corps shall ensure that Rosemont manages the Sonoita Creek Ranch as specified, and includes the creation of a Gila chub population in at least one of the ponds.
4. The USFS and Corps shall ensure that the program to manage against nonnative aquatic species is conducted as stated.

Terms and Conditions – Gila Chub

In order to be exempt from the prohibitions of section 9 of the Act, Rosemont, the USFS, and Corps must comply with the following terms and conditions, which implement the reasonable and prudent measures described above and outline required reporting/monitoring requirements. These terms and conditions are non-discretionary.

Terms and Conditions 1.1 through 1.5 implement Reasonable and Prudent Measure 1. Term and Condition 2 pertains to the implementation of Reasonable and Prudent Measures 2, 3, and 4.

1.1 Consistent with FEIS mitigation measure FS-BR-27, Rosemont, the USFS, and the Corps shall select a representative group of the observation wells found in Table GC-5, above (USFS 2013b) at which groundwater levels, a surrogate for take of Gila chub, shall be monitored. Once the wells have been selected, the USFS shall ensure that Rosemont re-run the Tetra Tech (2010) groundwater model to obtain groundwater drawdowns (including sensitivity analyses) at all of the well sites. The wells selected and the modeling results should be reviewed by an independent third party, with the U.S. Geological Survey being the preferred party. The time intervals shall be once a year through closure of the mine, and thereafter, every 5 years. Monitoring will continue postclosure for a duration determined to be necessary by FWS, USFS, and the Corps based on data gathered during implementation and input from the team described in Term and Condition 1.5, below.

1.2 At the time construction of the mine commences (and before pit excavation), the USFS and Corps shall ensure that Rosemont initiate monitoring of the selected groundwater wells and report the results annually to the USFS, Corps, and FWS through closure of the mine (FEIS mitigation measure FS-BR-27, and FS-BR-16). Monitoring will continue postclosure for a duration determined to be necessary by FWS and USFS based on data gathered during implementation and input from the team described in Term and Condition 1.5, below.

1.3 During the initial implementation phase (site construction and early pit construction), The USFS and Corps shall ensure that Rosemont monitor the wells daily (or via continuous data collection devices) to determine the magnitude of daily and seasonal groundwater fluctuations before the onset of the anticipated effects of pit dewatering (FS-BR-27). The results from initial monitoring will help the USFS to determine if and to what degree observed groundwater elevations vary due to natural fluctuations (present-day baseline conditions). The magnitude of the observed fluctuations shall accompany the model results from Term and Condition 1.1, which will then be reported to the USFS, Corps, and FWS.

1.4 Rosemont, the USFS, and Corps shall compare the results of the monitoring described in Term and Condition 1.2 to the groundwater model results described in Term and Condition 1.1, including the variation noted from implementation of Term and Condition 1.3, and report the finding to FWS annually.

1.5 If it is determined at any time via monitoring that the observed groundwater drawdowns exceed the upper bounds of the sensitivity analyses for the modeled groundwater drawdowns, including consideration of applicable daily and seasonal fluctuations, then it is possible that the take of Gila chub described in Table GC-4 has been exceeded. In this event, the USFS and Corps shall consult with Forest Service staff, FWS, Rosemont Copper, and/or the USGS, the University of Arizona, Bureau of Land Management, and/or other appropriate sources of expertise to seek consensus on whether the specific metrics identified in the take statement have been exceeded and whether the exceedance can be attributable to Rosemont's activities and thus be considered an exceedance of the take authorized by this Incidental Take Statement. The USFS and Corps may convene any of these individuals as a team, in consultation with FWS, which may advise USFS and the Corps. The USFS, Corps, and/or FWS have ultimate responsibility to make the determination of whether reinitiation of consultation is appropriate.

2. The funds identified for the non-HMMP Cienega Creek Watershed Conservation Fund, Sonoita Creek Ranch, and Harmful Nonnative Species Control conservation measures may only be used for projects as described in the Conservation Measures subsection of the Description of the Proposed Action Section, above, unless more appropriate actions are later identified and approved by the USFS, Corps, and FWS. Indirect (overhead) costs must be funded separately.

These reasonable and prudent measures, with their implementing terms and conditions, are designed to minimize the effects of the 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. The Coronado National Forest and/or Corps must immediately provide an explanation of the causes.

Conservation Recommendations – Gila Chub

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. The USFS full-time Biologist position (Revised Conservation Measure 1 – Staff Funding Biological Monitor) should coordinate directly with Rosemont and Rosemont's consultants on behalf of the Forest Service, and also coordinate with other land managers as deemed necessary.

2. We recommend that Rosemont and the eventual owner or manager of Pantano Dam consider changing how water is diverted there to reduce fish entrainment. An infiltration gallery would be ideal to reduce entrainment;

3. We recommend that Rosemont and the eventual owner or manager of Sonoita Creek Ranch consider changing how water is diverted at Monkey Spring to reduce fish entrainment. An infiltration gallery would be ideal to reduce entrainment;

4. We recommend that the USFS, while implementing the harmful nonnative species management and removal conservation measure, coordinate with the Cienega Watershed Partnership, AGFD, the F.R.O.G. Project, and our office in an effort to work with private landowners to continue to remove any source populations of nonnative aquatic species from the area;

5. We recommend that the USFS continue to assist us and the AGFD in conserving and recovering the Gila chub;

6. We recommend that the USFS continue to assist us with the completion and implementation of the Gila chub recovery plan;

7. We recommend that the USFS and Rosemont acquire instream flow water rights to ensure perennial flow in streams with Gila chub;

8. We recommend that the USFS continue to work with the FWS and AGFD to remove nonnative species and reestablish Gila chub throughout its historical range in Arizona;

9. We recommend that the USFS conduct fish surveys on National Forest lands to determine the extent that other chub, such as the headwater chub (*G. nigra*), may occupy those streams.

10. We recommend that the USFS continue to work cooperatively with us and AGFD to establish populations of Gila chub wherever possible.

11. We recommend that the USFS and Corps ensure that Rosemont researches techniques for reducing the use and loss of groundwater from the proposed action in the project area, considering any and all current and future techniques that may be technologically and economically feasible.

In order for the FWS to be kept informed of actions minimizing or avoiding adverse effects or benefiting listed species or their habitats, the FWS requests notification of the implementation of any conservation recommendations.

GILA TOPMINNOW

Status of the Species – Gila topminnow

Gila topminnow was listed as endangered in 1967 without critical habitat (32 FR 4001). Only Gila topminnow populations in the United States, and not in Mexico, are listed under the ESA. The reasons for decline of this fish include past dewatering of rivers, springs and marshlands, impoundment, channelization, diversion, regulation of flow, land management practices that promote erosion and arroyo formation, and the introduction of predacious and competing nonnative fishes (Miller 1961, Minckley 1985). Other listed fish suffer from the same impacts (Moyle and Williams 1990). Life history information can be found in the 1984 recovery plan (FWS 1984), the draft revised Gila topminnow recovery plan (Weedman 1999), and references cited in the plans.

Gila topminnow are highly vulnerable to adverse effects from nonnative aquatic species (Johnson and Hubbs 1989). Predation and competition from nonnative fishes have been a major factor in their decline and continue to be a major threat to the remaining populations (Meffe *et al.* 1983, Brooks 1986, Stefferud and Stefferud 1994, Minckley and Marsh 2009). The native fish fauna of the Gila basin and of the Colorado basin overall, was naturally depauperate and contained few fish that were predatory on or competitive with Gila topminnow (Carlson and Muth 1989). In the riverine backwater and side-channel habitats that formed the bulk of Gila topminnow natural habitat, predation and competition from other fishes was essentially absent. Thus Gila topminnow did not evolve mechanisms for protection against predation or competition and is predator- and competitor-naive. Due to the introduction of many predatory and competitive nonnative fish, frogs, crayfish, and other species, Gila topminnow could no longer survive in many of their former habitats, or the small pieces of those habitats that had not been lost to human alteration. Both large (Bestgen and Propst 1989) and small (Meffe *et al.* 1983) nonnative fish cause problems for Gila topminnow as can nonnative crayfish (Fernandez and Rosen 1996) and bullfrogs.

Environmental Baseline – Gila topminnow

The action area for Gila topminnow encompasses all occupied or likely-to-be occupied reaches of stream and other waters within the Cienega Creek watershed, as these will be subject to the proposed action's effects to groundwater and surface flow hydrology. Sonoita Creek Ranch is also in the action area, because the proposed action includes the likely release of Gila topminnow there. This area is described in detail in the Status of the Species within the Action Area section, below. The narrative that follows includes accounts of rangewide effects to Gila topminnow and its habitat as a means to describe similar factors affecting the species within the action area.

The environmental baseline for the action area, and specifically for aquatic species, was thoroughly discussed in the Gila chub section of this BO. It is incorporated here by reference; specifics for the Gila topminnow will be discussed here and are hereby incorporated from the 2013 Rosemont BO. Although groundwater levels have historically been variable in this area, there is a trend of increasing water use in parts of the action area, which is likely to initiate or contribute to a downward trend in groundwater levels. The current extended drought and climate change are highly likely to negatively impact many system components from the upper parts of the watershed to where Cienega Creek becomes Pantano Wash through: changes in upland vegetation and fire regime; higher ambient and water temperatures; increased variability in stream hydrographs; and more frequent severe climatic events (such as storms, droughts, wildfires, etc.).

Table GT-1. Reestablished wild populations of Gila topminnow that are likely extant, 2013 to 2015. In Arizona unless noted otherwise (Voeltz and Bettaso 2007, Crowder and Robinson 2015, Robinson and Crowder 2015, FWS files).

Site Name	Year stocked (discovered)	Mixed/pure	Lineage(s)	Fish From:
Cottonwood Artesian	1982 - **Failed** 2001	Mixed Pure	Monkey/Bylas/Cocio Bylas Springs	BTA ASU ARC
Lime Creek	Dispersal from Lime Cabin Spring (1996)	Mixed	Monkey/Bylas/Cocio (Lime Cabin Spring stocked in 1982)	BTA
Bass Canyon	2014	Pure	Bylas	Dudleyville pond
Bonita Creek (upper)	2010/2014	Pure	Bylas Spring	Dudleyville pond
Buckhorn Spring	2011	Pure	Sharp Spring	
Burro Cienega, NM	2008	Pure	Bylas Spring	Dudleyville pond
Chalky Spring	2009	Pure	Sharp Spring	
Cherry Spring Canyon (Muleshoe)	2007-2008	Pure	Bylas Spring	Dudleyville pond
Cieneguita Wetland 1 & 3	2013	Pure	Cienega Creek	
Cold Spring (#85)	1985	Pure	Monkey Springs	BTA
Cottonwood Spring (Goldfield Mountains)	2008	Mixed	Monkey Springs	Boyce Thompson Arboretum
Cottonwood Tank	2013	Pure	Cienega	Cienega
Empire Tank	2013	Pure	Cienega Creek	
Fossil Creek (#280)	2007-2010	Pure	Sharp Spring	
Gaucho Tank	2013	Pure	Cienega	Cienega
Headquarters Spring (Muleshoe)	2008	Pure	Bylas Spring	Dudleyville pond
Hot Springs Canyon	2013	Pure	Bylas	Dudleyville
Howard Well	2008	Pure	Bylas Spring	Dudleyville pond
Larry Creek trib	2005	Pure	Coalmine Spring	Coalmine Spring
Lousy Canyon	1999, 2006	Pure	Coalmine Spring	Coalmine Spring
Morgan City Wash	2009	Pure	Sharp Spring	
Mud Springs	1982	Mixed	Monkey/Bylas/Cocio	BTA
Murray Spring	2011	Pure	Cottonwood Springs	Bubbling Ponds
O'Donnell Creek	1974	Pure	Monkey	Monkey
Pasture 2 Tank	2013	Pure	Sharp Spring	Robbins Butte
Redfield Canyon	2012	Pure	Bylas	Dudleyville Ponds
Redrock Wildlife Area NM	2010	Pure	Bylas Spring	Dudleyville pond
Road Canyon Tank	2012	Pure	Cienega Creek	Robbins Butte
Rock Spring	2013	Pure	Santa Cruz (Peck)	Phoenix Zoo
San Rafael	2013	Pure	Sharp Spring	Robbins Butte
Secret Spring (#331, Muleshoe)	2007	Pure	Bylas Spring	Dudleyville pond
Sheepshead Canyon	2014	Pure	Santa Cruz	Phoenix Zoo
Springwater Wetland	2013	Pure	Cienega Creek	
Swamp Springs Canyon (Muleshoe)	2007-2008	Pure	Bylas Spring	Dudleyville pond
Tule Creek	1981	Mixed	Monkey/Bylas/Cocio	BTA
Unnamed Drainage 68b	Dispersal from Mesquite Tank #2 (1985)	Mixed	Monkey/Bylas/Cocio (Mesquite Tank @ stocked in 1982)	BTA

Usery Park	2011	Pure	Cottonwood Springs	
Walnut Spring (Mesa Ranger District)	1982	Mixed	Monkey/Bylas/Cocio	BTA
Walnut Spring (Tonto Basin Ranger District)	2013	Pure	Redrock Canyon	ASU & Desert Harbor
Wildcat Canyon	2013	Pure	Bylas	Dudleyville pond

Status of the Species within the Action Area

The action area for the Gila topminnow encompasses the occupied stream reaches in the Cienega Creek watershed. The action-area status of the Gila topminnow was described in our 2008 and 2012 BOs that addressed effects of Aquatic Species Conservation at the San Pedro Riparian and Las Cienegas NCAs, Arizona (File numbers 22410-2008-F-0103, 22410-2002-F-0162-R001) and in the 2013 Rosemont BO. The action areas for those earlier BOs overlap with the action area of the proposed action; that information is updated here. Other background information can be found in the Gila chub section of this BO. There is no designated critical habitat for Gila topminnow. Since the 2013 BO, Cottonwood Tank, Gaucho Tank, and Cieneguita Wetlands have had topminnow reestablished there (Crowder and Robinson 2015, Robinson and Crowder 2015).

The natural population of Gila topminnow in Las Cienegas NCA continues to be the only extant one on public lands and it is by far the largest of all remaining natural populations in the United States (Simms and Simms 1992, Bodner *et al.* 2007). The only other public land population, Redrock Canyon on the Coronado National Forest, was extirpated in 2008 (Duncan 2013). The first repatriation of Gila topminnow into the upper Cienega Creek watershed took place in October 2001 at Empire Gulch, followed with additional releases. However, reestablishment of Gila topminnow at Empire Gulch has failed (Simms 2010, Service files). This is likely due to high levels of aquatic vegetation and aquatic invertebrate predators of Gila topminnow in Empire Gulch (Bodner *et al.* 2007).

The lower reaches (CC5 & CC7) of upper Cienega Creek appear to have a stable, although small, Gila topminnow population, but because of how data were collected, even that is uncertain (Bodner *et al.* 2007). The Cienega Creek topminnow population is considered a viable population under recovery plan guidelines (Weedman 1999), and it is still the largest by far in the U.S.

Sampling by AGFD in 2012 and 2015 found Gila topminnow in the Pima County CCNP at two sampling sites (Timmons and Upton 2013; Timmons, AGFD, pers. comm., October 13, 2015). Recent surveys suggest that Gila topminnow continue to be abundant in upper Cienega Creek (Rosen *et al*. 2013, Simms 2014d, Simms and Ehret 2014).

Hatch (2015) analyzed fish counts conducted by the BLM from 2005 through 2012, and based on these counts estimated positive mean growth rates for this species in two populations (upper and lower) in Cienega Creek. By evaluating this probability distribution, Hatch determined that the lower bound of the 95 percent confidence intervals include growth rates that are negative for the population found below Spring Water Canyon. This means that even though overall mean growth rate is positive for this population, there is still the possibility of long-term population decline due to environmental stresses. The probability that the extirpation threshold (which Hatch defines as a catch per unit of 1 fish over a 24-hour period) is reached above Spring Water

Canyon was 0.000006, meaning that there is far less than 0.01 percent chance that this specific population of this species would be functionally extirpated in the future. It should be noted that extirpation is not the same as extinction; extirpation refers only to the local populations analyzed by this study. Below Spring Water Canyon the probability is 0.9609, meaning there is an about 96 percent chance that this species would be functionally extirpated at some point in the future.

As part of an effort intended to create, enhance, and protect habitat for at-risk species within the Las Cienegas NCA, Caldwell *et al.* (2011) and BLM (2012) identified numerous new suitable renovated pond sites for Gila topminnow reestablishment within Upper and Lower Cienega Creek and within other portions of the Empire Valley. Since the 2013 BO, Cottonwood Tank, Cieneguita Wetland, and Gaucho Tank have had Gila topminnow reestablished. There are six other sites where topminnow may be released on Las Cienegas NCA (BLM 2012).

Factors affecting species environment within the action area

The action-area status of the Gila topminnow was described in our 2008 and 2012 BOs that addressed effects of Aquatic Species Conservation at the San Pedro Riparian and Las Cienegas NCAs, Arizona (File numbers 22410-2008-F-0103, 22410-2002-F-0162- R001). The action areas for those BOs overlap with the action area of the proposed action; that information is updated here. The factors affecting the Gila chub are the same ones affecting the Gila topminnow; so that section of this BO is incorporated here by reference, as is the Gila topminnow section of the 2013 Rosemont BO. There is no designated critical habitat for Gila topminnow.

Background for Analyses and Definition of Baseline

The hydrologic data upon which a portion of the following Gila topminnow-specific analyses are based were described in both the Effects of the Proposed Action section (below) and Effects to Aquatic Ecosystems sections (above).

The hydrologic data are based on a 95th percentile analysis of the Tetra Tech (2010), Montgomery (2010), and Myers (2010) groundwater model best-fit and sensitivity analyses, as applicable. The 95th percentile analyses were developed for the SIR and were included in the May 2015 SBA to address FWS concerns with the use of multiple groundwater models with oftentimes divergent results. The 95th percentile analysis was described in detail in these prior documents, and was summarized in the Sources of Uncertainty subsection of the Effects of the Proposed Action section, above.

We are aware of the analytical strengths and weakness of this approach, but reiterate that our selection of the upper end of the 95th percentile values results in analyses in which 97.5 percent (which includes the 2.5 percent of the least well-represented values at the lower end of the distribution) of the *other* possible hydrologic outcomes exhibit lesser effects. The 95th percentile approach does not represent the most probable outcome (but it does provide reasonable certainty that the effects to this species are unlikely to be greater than those described below). Due to the uncertainty inherent in these modeling efforts, there are no results that can be definitively said to be the most likely to occur. Thus, we have selected the precautionary approach.

Secondly, the following species-specific analysis considers the present-day state of the hydrology to represent the baseline condition. All effects, whether the result of anticipated climate change alone, mine drawdown alone, and/or climate change and mine drawdown combined, are described in terms of their divergence from present, pre-project conditions. Climate change is *not* viewed as an ongoing and evolving baseline against which mine-only effects are incrementally assessed.

Effects of the Action - Gila topminnow

The effects of the action to Gila topminnow will be very similar to those described for Gila chub. Therefore, that discussion in this BO is incorporated here by reference. Effects that differ from those described for the Gila chub will be discussed below. Information from the 2013 Rosemont BO that has not changed will not be repeated here. There are no direct effects from the mine. Indirect effects caused by groundwater draw down from the mine will negatively impact stream flow and pool metrics. Impacts from the mine only are small when compared to the effects of climate change. However, the impacts from the mine only do cause negative impacts to aquatic habitats that negatively impact the Gila topminnow.

Climate change may be less problematic for Gila topminnow compared to Gila chub, because Gila topminnow have about a 2^{o} C higher tolerance of water temperature than Gila chub (Carveth *et al.* 2006). Also, Gila topminnow are more tolerant of reduced dissolved oxygen in the water; topminnow can survive with dissolved oxygen at 1ppm, while chub require at least 3ppm (Meffe *et al*. 1982, FWS 2015). Amount of stream flow is a factor in dissolved oxygen; generally the less the flow, the less the amount of dissolved oxygen.

As for how the modeled groundwater drawdowns will impact Gila topminnow, many of the impacts will be the same as for Gila chub. However, a reduction in the wetted perimeter and pool surface area will be more deleterious for topminnow than Gila chub, since all life stages of Gila topminnow prefer and use shallow waters much more than chub (Schoenherr 1974). Therefore, habitat that is likely to be occupied by topminnow in the future (when drawdowns occur) will be lost or reduced by the proposed action. Losses of habitat resulting from the groundwater drawdown associated with the proposed action may impact Cienega Creek north of I-10 (Pima County CCNP), Cienega Creek on Las Cienegas NCA, Cieneguita Wetlands, and Mattie Canyon. The modeled loss of surface water in the northern reaches of upper Cienega Creek (CC5 & 7) is more of a concern than in the southern reaches, because the most robust topminnow populations on the Las Cienegas NCA occur there (Bodner *et al.* 2007).

Impacts from only the mine reduce pool surface area (mean and total) by less than 10 percent for all reaches of Cienega Creek. Though the loss by percent is small for all Cienega Creek reaches, 1,068 square feet (3%) of surface area is lost from the pools during June, 150 years post closure. Cieneguita Wetlands lose 50 percent of their surface area. Only key reach CC2 has any individual pools that lose more than 24 percent of their surface area. However, all three of these CC2 pools are very small (8, 12, and 31 ft^2, SBA Addendum Table G3).

Effects to pool surface area in June are much greater when the impacts of climate change are added to the impacts of the mine, 150 years post closure. All Cienega Creek key reaches combined lose approximately 17,000 ft^2 of pool surface area, or 29 percent (dropping from approximately 59,000 to 42,000 ft^2). The key reaches in lower Cienega Creek lose the most surface area, 63 and 35 percent for CC13 and CC15 respectively. The two key reaches in upper Cienega Creek (CC2 & CC4) that have had robust Gila topminnow populations (Bodner *et al.* 2007) each lose 27 percent of their surface area after 150 years due to the effects of climate change and the mine. CC5 loses 3,162 ft^2 surface area after 150 years due to the effects of climate change and the mine (dropping from 11,597 to 8,435ft^3).

In looking at quartile losses for pool area, 63 of 83 pools lose more than 24 percent (retaining 76 percent) after 150 years due to the combined effects of climate change and the mine. The two upper key reaches of Cienega Creek have 13 of 16 and 11 of 19 pools that lose at least 25 percent of their surface area (retaining 75 percent). In addition, 12 of 16 and 6 of 19 pools lose at least 50 percent of their surface area (and retain up to 50 percent) after 150 years due to the effects of climate change and the mine.

Since attempts to establish Gila topminnow in Empire Gulch have failed, the modeled groundwater decline at key reach EG1 is not likely to impact Gila topminnow, at least certainly not in the near term. There are no discussions on releasing topminnow into any part of Empire Gulch. The issues in EG1 with excess aquatic vegetation and shade in the spring run would need to change before Gila topminnow releases were entertained. Gila topminnow could potentially get into EG2 on their own from Cienega Creek.

About 825 AFA of surface water from Cienega Creek will be used for aquifer recharge below Pantano Dam, in support of an In-lieu-fee (ILF) mitigation program. Gila topminnow and longfin dace have been observed right above the dam, on the dam (dead), and in the scour pool below the dam. It is certain that fish have been and will continue to go into the diversion as long as it operates, and suffer death or injury. How much habitat will be suitable for topminnow remains to be seen, but it is highly likely suitable topminnow habitat will form below the dam. Other water rights will be transferred to a suitable entity (HMMP 2014). Lastly, the $2,000,000 Cienega Creek Watershed Conservation Fund will provide $200,000 a year for 10 years for development and implementation of measures intended to preserve and enhance aquatic and riparian ecosystems and the federally-listed aquatic and riparian species that depend on them. The actions anticipated to be taken under this conservation measure should enhance the resiliency and suitability of Cienega Creek for Gila topminnow, especially in the lower creek, at least in the short-term. Under the threat of continuing long-term drought and climate change, enhancing system resiliency is a key component for adapting to climate change and reducing its affects (Overpeck *et al.* 2012).

Also, Rosemont will purchase about 1,580 acres of land along Sonoita Creek (Sonoita Creek Ranch) with about 590 AFA of certificated surface water rights from Monkey Spring. This is near Patagonia, and outside of the project area. Funding for restoration and management of the property will include management against nonnative species, generally in the two existing ponds on the property that are maintained with water from Monkey Spring. An evolutionarily significant unit (ESU) of Gila topminnow occurs in Monkey Spring (Hedrick *et al.* 2001); acquisition of even part of the water rights will provide some protection to this natural topminnow population, a key task in the draft revised recovery plan (Weedman 1999). Gila chub and Gila topminnow will likely be established in the ponds after nonnatives are removed from them. Because this parcel is outside of the project area, this action represents recovery in lieu of threat removal and a minimization of the action's effects.

The environmental baseline and recovery status of Gila topminnow should be improved by actions taken at Sonoita Creek Ranch. The proposed action implements tasks in the draft revised Gila Topminnow Recovery Plan (Weedman 1999) by partially protecting the water rights from Monkey Spring. This is a vitally important area for Gila topminnow conservation, because many natural topminnow populations are in the area, and reestablishment sites are limited there, especially Monkey Spring. Also, the groundwater source of Monkey Spring appears to be the regional aquifer, which should be somewhat buffered from local groundwater pumping and climate change. The ponds on Sonoita Creek Ranch would be the best location to replicate the Monkey Springs topminnow ESU. We consider the Sonoita Creek Ranch and Cienega Creek Watershed Fund (see analysis of the latter's beneficial effects in the Gila chub analysis, above) conservation measures to be essential to partially offset expected effects to Gila topminnow and their habitat.

Lastly, the draft revised recovery plan for Gila topminnow (Weedman 1999; see Status of the Species section, above), contains Survival and Reclassification Criteria. The proposed action will affect the habitat for and the population of Gila topminnow in Cienega Creek, the securing of which is described in Survival Criterion I(A), but we anticipate, as previously stated, that the Cienega Creek Watershed Fund should help conserve aquatic habitats and Gila topminnow in this system. Survival Criteria II, III, and IV will not be affected.

Reclassification Criterion I is met when the Survival Criteria have been met. Given that the proposed action supports Survival Criterion I and does not affect Survival Criteria II, III, or IV, we anticipate that the ability to reclassify (downlist) Gila topminnow will not be precluded by the proposed action. Reclassification Criterion II refers to the replication, establishment, and survival of populations within the Gila topminnow's historical range. The acquisition and restoration of the Sonoita Creek Ranch will contribute to the implementation of this criterion, thus supporting reclassification from endangered to threatened, a meaningful increment toward recovery of the species. Reclassification Criterion III refers to monitoring of populations and periodic assessments of genetic integrity. The restoration of and likely reestablishment of Gila topminnow to the Sonoita Creek Ranch will be monitored; genetic assessments are beyond the scope of the proposed action and will most likely be pursued at the species-wide scale by, FWS, other Federal and State agencies, and academia. Reclassification Criterion IV requires a genetic protocol that allows for the exchange of genetic material between populations; this too is beyond the scope of the proposed action and will most likely be pursued by wildlife agencies and researchers.

The harmful nonnative species management and removal conservation measure should benefit existing populations of Gila topminnow in Cienega Creek and in the San Rafael Valley, and any populations that may be established in those watersheds. This conservation measure, while not removing the indirect effects of the mine on groundwater, allows for recovery of listed species in lieu of threat removal. In addition, Forest System lands preferentially receive funding under this conservation measure, though other partners and landowners and managers can take part in management actions against nonnative aquatic species. Because nonnative aquatic species are one of the greatest threats to native fish conservation (Meffe *et al*. 1983, Meffe 1985, Brooks 1986, Marsh and Minckley 1990, Stefferud and Stefferud 1994, Weedman and Young 1997; FWS 2002, 2008; Minckley and Marsh 2009), removing them from the landscape and potential fish habitat provides a benefit to native fishes. Cienega Creek currently has no nonnative fishes; if certain nonnative fishes were to become established in the creek, it could be catastrophic for the native aquatic vertebrates there (including Gila topminnow). Removing nonnative aquatic fish from the nearby watershed minimizes the chance that nonnative fish could find their way into Cienega Creek, or to occupied habitats in the San Rafael Valley. Removal of nonnative aquatic fish in the San Rafael Valley could open up habitats for the release of Gila topminnow.

Summary of Effects – Gila Topminnow

- Although groundwater levels have historically been variable, the environmental baseline shows trends of increasing water use in some parts of the action area, which is likely to decrease groundwater levels in the near future;
- The current extended drought and climate change are highly likely to negatively impact many system components from the upper parts of the watershed to where Cienega Creek becomes Pantano Wash through:
    - Changes in upland vegetation and fire regime;
    - Higher ambient and water temperatures;
    - Increased variability in stream hydrographs;
    - More frequent severe climatic events (such as storms, droughts, wildfires, etc.);
- Impacts to groundwater from the action, and thus to surface water (stream flow, pool area, pool volume, pool depth), are reasonably certain to effect areas occupied by Gila topminnow, and thus will negatively impact Gila topminnow;
- Within 50 to 150 years post-closure, substantial decreases to wetted stream perimeter and pool area are anticipated to occur.
- Cienega Creek is one of six extant natural populations of Gila topminnow range-wide in the U.S. and is relatively stable, with no nonnative fishes present; there are at least 40 reestablished populations, and numerous refuge populations;
- The effects of the proposed action do not reach a tipping point that would preclude the recovery of the species, as topminnow are expected to persist within the action area, occur in locations outside of the action area, and are subject to ongoing recovery actions; and
- While the proposed conservation measures will not preclude all anticipated effects due to the mine to surface waters and Gila topminnow from occurring, the Cienega Creek water rights transfer, the Cienega Creek Watershed Fund, the Harmful Nonnative Species Management and Removal program, and acquisition of Sonoita Creek Ranch are anticipated to partially minimize the adverse effects of the mine. The acquisition of Sonoita Creek Ranch provides significant benefits to a critically important natural Gila topminnow population, because it is likely to greatly expand the amount of habitat available to the topminnow of Monkey Springs.

Cumulative Effects – Gila Topminnow

The cumulative effects for the action area, and specifically for aquatic species, were discussed in the Gila chub section of this BO. These effects are incorporated here by reference.

Conclusion – Gila Topminnow

As discussed in full in the Sources of Uncertainty section, above, we have chosen to base our effects analysis on the upper end of the 95th percentile analysis. Given the long time frames involved, long distances involved, and small amounts of drawdown in the aquifer, there is a high degree of uncertainty associated with groundwater predictions. The scenario represented by the upper end of the 95th percentile analysis is not the scenario most probable to occur. Rather, by selecting it we are analyzing a conservative position that ensures almost all of potential and reasonable outcomes disclosed by the models would be encompassed by this BO analysis. This conservative approach ensures that under almost all potential outcomes that can be reasonably predicted, the conclusion of non-jeopardy, below, would remain valid.

After reviewing the current status of the Gila topminnow, the environmental baseline for the action area, the effects of the proposed action, and the cumulative effects, it is the FWS's biological opinion that the proposed action is not likely to jeopardize the continued existence of the Gila topminnow. We present this conclusion for the following reasons:

1. No direct effects to Gila topminnow habitat from operation of the mine are expected;
2. Rosemont will monitor groundwater drawdown and the USFS will compare observed drawdown to modeled drawdown. Groundwater drawdown greater than modeled will be evaluated and may require reinitiation of section 7 consultation;
3. The Cienega Creek Watershed Conservation Fund projects will, for the short-term at least, protect and potentially increase habitat for Gila topminnow by funding management actions and restoration actions in the watershed, protecting water rights, and creating habitat;
4. The Cienega Creek Watershed Conservation Fund projects are likely to increase ecosystem resiliency in the face of the expected groundwater drawdown from Rosemont Mine, and impacts from climate change;
5. Cienega Creek is one of six extant natural populations of Gila topminnow range-wide and Cienega Creek is relatively stable, with no nonnative fishes present; there at least 40 reestablished populations, and numerous refuge populations;
6. The effects of the proposed action are not a tipping point that would preclude the recovery of the species because we believe there will be enough water in Cienega Creek to maintain a viable population, as defined in the *Draft Revised Gila Topminnow Recovery Plan*;
7. The Sonoita Creek Ranch ponds should provide new habitat for Gila topminnow from a reliable water source (Monkey Spring) for an Evolutionarily Significant Unit of Gila topminnow;
8. The conservation measures proposed at Sonoita Creek Ranch will also protect most of the water rights to Monkey Spring, and will implement actions in the *Draft Revised Gila Topminnow Recovery Plan*;
9. The Cienega Creek Watershed Fund and Sonoita Creek Ranch conservation measures are considered to be essential to partially offset expected effects to Gila topminnow and its habitat;

10. Indirect effects from groundwater drawdown are difficult to predict at the distances from the drawdown (Rosemont Mine), and are not anticipated to occur until after mine closure;
11. Groundwater drawdown from the mine is not expected to be more than 0.1 foot in any of the modeled locations until 150 years after mine closure;
12. Numerous conservation and recovery actions have been implemented over the last 10 years, and will continue to be implemented, with more actions in planning, in particular at Las Cienegas NCA. We believe that these recovery actions are improving the status of the species;
13. The anticipated relatively small magnitude of the proposed action's effects to Gila topminnow and the implementation of conservation measures (as described above) lead us to the conclusion that the recovery potential of Gila topminnow (per the draft revised recovery plan) will not be diminished; and
14. Critical habitat has not been designated for the Gila topminnow; therefore, none will be affected.

The draft revised Recovery Plan (Weedman 1999) has two criteria that are useful for determining jeopardy. Before considering Gila topminnow for down- or de-listing, survival of the species in the U.S. must be ensured by securing remaining Level 1 (natural, including Cienega Creek) populations and the habitat they occupy in the U.S. In addition, the draft revised recovery plan defines a stable (viable) population as one containing at least 500 overwintering adults, possessing an adequate representation of all age-classes and cohorts, and having evidence of reliable annual recruitment. Therefore, the complete loss of Gila topminnow in Cienega Creek, or even the reduction of the population to less than 500 overwintering adults, would be a serious blow to the recovery of Gila topminnow.

Since the impacts of the proposed action affect only one natural Gila topminnow population and the action area is small compared to the range of the species, 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 important population of the species, the effects of the action are not anticipated to be large enough to cause the loss of the population, and it is similarly unlikely that a tipping point away from recovery would be reached. We believe that Gila topminnow will still be present in Cienega Creek 150 years after closure of the mine since adequate water is anticipated to be present to support at least 500 overwintering Gila topminnow. We believe this despite the higher temperatures and lower dissolved oxygen levels that will be present then.

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.

INCIDENTAL TAKE STATEMENT – GILA TOPMINNOW

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 included by the USFS as binding conditions of any grant or permit issued to the applicant, as appropriate, for the exemption in section 7(o)(2) to apply. The USFS has a continuing duty to regulate the activity that is covered by this Incidental Take Statement. If the USFS (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 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. To monitor the impact of incidental take, the USFS, or the applicant 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 – Gila Topminnow

We anticipate that the proposed action will result in incidental take of Gila topminnow, as enumerated by the surrogate measure described in Table GC-4. Any reduction in stream discharge and pool surface area resulting from groundwater drawdowns attributable to the proposed action will reduce the extent and quality of aquatic habitat required by Gila topminnow, thus harming the species. We are therefore reasonably certain that take will occur.

Incidental take of Gila topminnow in Cienega Creek will be difficult to detect for the reasons below. Thus we will use a surrogate measure of take. The incidental take is expected to be in the form of harm through the loss of habitat from groundwater drawdown, and harm, harassment, and mortality from water diversion and management at Pantano Dam.

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 Gila topminnow taken because: (1) dead or impaired individuals are almost impossible to find (and are readily consumed by scavengers and predators) and losses may be masked by seasonal fluctuations in environmental conditions; (2) the status of the species will change over time through disease, natural population variation, natural habitat loss, or the active creation of habitat through management; and (3) the species is small-bodied, well camouflaged, and occurs under water of varying clarity.

Gila topminnow are subject to an existing monitoring program in the Cienega Creek watershed on the Las Cienegas NCA. The currently used sampling techniques result in an index of fish abundance per sampling site, as catch-per-unit-effort per pool. The sampling techniques used on Las Cienegas NCA are only sensitive enough to be statistically significant if the population doubles or is halved (Bodner *et al*. 2007). Monitoring in reaches downstream from the Las Cienegas NCA (Marsh and Kesner 2011, Timmons and Upton 2012) is even less suited to determining population trends. Gila topminnow population estimates can theoretically be acquired, but are difficult, time consuming, stressful to the fish (to the point of harm), and expensive. In addition, the number of Gila topminnow in any population is normally extremely variable during a year due to an r-selected (high fecundity, short generation time, wide dispersal of offspring) reproductive strategy, common in highly variable environments such as desert streams.

It is reasonable to assume that the abundance of Gila topminnow is correlated with the extent of suitable aquatic habitat provided by surface flows and pool surface area in the affected streams (see Status of the Species within the Action Area section). Baseflows maintain stream discharge when surface runoff is low or nonexistent, and these baseflows result from groundwater discharge. The discharge of groundwater to springs and streams is related to the elevation and gradient that regional groundwater exhibits relative to those surface waters. Decreases in groundwater elevation affect this gradient and thus, reduce the discharge of groundwater to streams (see Effects to Aquatic Ecosystems section). Groundwater elevations, which can be readily measured, are therefore effective surrogate measures for the incidental take of Gila topminnow.

The Effects to Aquatic Ecosystems section of this BO as well as the analysis of effects for the Gila chub, above, discuss the relationship between the proposed action, changes in groundwater elevation, the volume and length of surface flow in streams, and various aspects of pool numbers and geometry. These changes are expressed in terms of both quartile and 95th percentile analyses of available groundwater drawdown, discharge, and pool data.

The changes in groundwater elevation will result in reduced wetted lengths and volumes in reaches of stream maintained by discharges from the regional aquifer; surface flow effects (including effects to pools) are summarized in Tables A-2 through A-8 in the Effects to Aquatic Ecosystems section, above. WestLand (2012) determined that there could be some reductions in the wetted length of lower Cienega Creek from groundwater drawdowns over the long term. We did not analyze the results from WestLand's study. We also anticipate that reduced flow volumes could result in increased summer water temperatures (Barlow and Leake 2012) and thus reductions in dissolved oxygen content (oxygen solubility is inversely related to water temperature), thus further adversely affecting (Bodner *et al*. 2007) the already-reduced numbers of Gila topminnow that would remain. The number of days with extremely low flows per year (see Table A-3, above) are a useful proxy for water quality effects.

Therefore, the take of Gila topminnow is expressed in terms of drawdown, in the magnitudes specified in the Gila chub section (including Table GC-4); this table is incorporated here by reference.

Effect of the Take – Gila Topminnow

In this BO, the FWS determined that this level of anticipated take is not likely to result in jeopardy to the Gila topminnow for the reasons stated in the Conclusion section.

Reasonable and Prudent Measures – Gila Topminnow

The FWS believes the reasonable and prudent measures and terms and conditions in the Gila chub section of this BO are also necessary and appropriate to minimize impacts of incidental take of Gila topminnow; the prior measures are hereby incorporated by reference.

Conservation Recommendations – Gila Topminnow

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, to help implement recovery plans, or to develop information. The FWS recommends the following conservation activities:

1. We recommend that the USFS and the Corps coordinate with the Cienega Watershed Partnership, the F.R.O.G. Project, other wildlife agencies, and our office in efforts to work with private landowners to remove populations of nonnative aquatic species from lands in the area;
2. We recommend that the USFS and the Corps continue to assist us and other wildlife agencies in conserving and recovering the Gila topminnow;
3. We recommend that the USFS continue to assist us with the completion and implementation of the Gila topminnow revised recovery plan;
4. We recommend that Rosemont consider releasing Gila topminnow into water features on the mine site, when the site is suitable, and when the release of topminnow would not conflict with other conservation actions;
5. We recommend that Rosemont and the eventual owner or manager of Sonoita Creek Ranch consider changing how water is diverted at Monkey Spring to reduce fish entrainment. An infiltration gallery would be ideal to reduce entrainment;
6. We recommend that Rosemont consider acquiring the remaining water rights for Monkey Spring and the fee title property with Monkey Spring;
7. We recommend that Rosemont consider acquiring the water rights for Cottonwood Spring;
8. We recommend that the USFS acquire instream flow water rights to ensure perennial flow in streams with Gila topminnow;
9. We recommend that the USFS continue to work cooperatively with the FWS and other wildlife agencies to remove nonnative species and reestablish Gila topminnow whenever possible throughout its historical range in Arizona; and
10. We recommend that the USFS conduct fish surveys on NFS lands to determine the extent that Gila topminnow occupy those streams.

In order 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.

DESERT PUPFISH

Status of the Species

The desert pupfish was listed as an endangered species with critical habitat in 1986 (51 FR 10842). Historical collections occurred in Baja California and Sonora, Mexico and in the United States in California and Arizona. Historical distribution of desert pupfish in Arizona included the Gila, San Pedro, Salt, and Santa Cruz rivers, and likely the Hassayampa, Verde, and Agua Fria rivers, although collections are lacking for the latter three. The desert pupfish was also found in the Lower Colorado River, Rio Sonoyta basin, Salton Sink basin, and Laguna Salada basin (Eigenmann and Eigenmann 1888, Garman 1895, Gilbert and Scofield 1898, Evermann 1916, Miller 1943, Minckley 1980, Black 1980, Turner 1983, Miller and Fuiman 1987). Additional life history information can be found in the recovery plan (FWS 1993) and five-year review (FWS 2010 and other references cited there).

In Arizona, the desert pupfish genus *Cyprinodon* was historically comprised of two recognized subspecies, (*C. m. macularius)* and (*C. m. eremus*), and an undescribed taxon, the Monkey Spring pupfish (FWS 2010). They are still recognized as subspecies under the Act. The desert pupfish subspecies are now recognized as separate species, the desert pupfish (*Cyprinodon macularius*) and the Rio Sonoyta (Quitobaquito) pupfish (*C. eremus*)(Echelle *et al*. 2000), and the undescribed Monkey Spring form has since been described and renamed the Santa Cruz pupfish (*C. arcuatus*)(Minckley *et al*. 2002). The desert pupfish and Rio Sonoyta pupfish were listed as endangered (sub)species with critical habitat in 1986 (FWS 1986a). Critical habitat was designated in Arizona at Quitobaquito Springs on Organ Pipe Cactus National Monument in Pima County and in California along parts of San Felipe Creek, Carrizo Wash, and Fish Creek Wash. The Mexican government has also listed the species as endangered.

Work on the genetics and taxonomy of *C. macularius* has led to the division of the taxon into three species. This has effectively reduced the historical range of *C. macularius.* However, because *C. arcuatus* is likely extinct and is also considered ecologically similar to *C. macularius*, the range of *C. arcuatus* in the Santa Cruz River basin will be stocked with *C. macularius*.

More recent work (Echelle *et al*. 2007, Koike *et al*. 2008) provided further evidence that *C. macularius* and *C. eremus* are separate species. Results from microsatellites assays attribute 23 percent of microsatellite diversity to differences between the two species (Echelle *et al*. 2007). There was a small, but statistically significant part of the microsatellite diversity attributed to variation among the Salton Sea populations and the Colorado River delta populations. For *C. eremus*, there were differences in microsatellites between the two populations, but they were not significant (Echelle *et al*. 2007). They found no genetic evidence of separate evolutionarily significant units for either species. However, they recommended the recognition of two management units for *C. eremus* (Quitobaquito and Rio Sonoyta) and five for *C. macularius*, three in the Colorado River delta (Laguna Salada, Cerro Prieto, and Cienega de Santa Clara/El Doctor) and two in the Salton Sea (San Felipe Creek/San Sebastian Marsh and Salton Sea). They state that the loss of any one of the management units would be a significant step toward extinction of the species (Echelle *et al*. 2007).

The desert pupfish is a small fish, less than three inches long, and a member of the Cyprinodontidae family (Minckley 1973). The body is thickened and laterally compressed; coloration is a silvery background with narrow dark vertical bars on the sides. The protruding mouth is equipped with tricuspid teeth and the desert pupfish has an opportunistic, omnivorous diet, consisting of invertebrates, plants, algae, and detritus (Cox 1966 and 1972; Naiman 1979). Males are larger than females and become bright blue with orange-tipped fins during the breeding season and exhibit aggressive, territorial behavior (FWS 1993). Spawning occurs from spring through autumn, but reproduction may occur year-round depending on conditions (Constanz 1981). The desert pupfish appears to go through cycles of expansion and contraction in response to natural weather patterns (FWS 1986, 1993; Weedman and Young 1997). In very wet years, populations can rapidly expand into new habitats (Hendrickson and Varela-Romero 1989). Historically, this scenario would have led to panmixia among populations over a very large geographic area (FWS 1993).

The desert pupfish has a tolerance for high temperatures, high salinities, and low dissolved oxygen concentrations that exceed the levels known for many other freshwater fishes (Lowe *et al*. 1967, FWS 1993). Habitats have included clear, shallow waters with soft substrates associated with cienegas, springs, streams, margins of larger lakes and rivers, shoreline pools, and irrigation drains and ditches below 1,585 meters (5,200 feet) in elevation (Minckley 1973, Hendrickson and Varela-Romero 1989). Historical collections occurred in Baja California and Sonora, Mexico, and in the United States in California and Arizona.

Naturally occurring populations of desert pupfish (*C. m. macularius* or *C. macularius*) are now restricted in the United States to two streams tributary to, in shoreline pools and irrigation drains of the Salton Sea, and in the Sea itself, in California (Lau and Boehm 1991, Keeney 2013). This species is found in Mexico at scattered localities along the Colorado River Delta and in the Laguna Salada basin (Hendrickson and Varela-Romero 1989, Minckley 2000). The Quitobaquito pupfish (*C. m. eremus* or *C. eremus*), considered to be a separate species, persists in only two natural populations: one near the United States – Mexico border at Quitobaquito Springs in Organ Pipe Cactus National Monument in Arizona, in the U.S., and the other at Rio Sonoyta in Sonora, Mexico. Collectively, there are 11 extant populations of desert pupfish known in the wild in the United States and Mexico (California = 5, Arizona = 1, and Mexico = 5; Tier 1 populations in the Recovery Plan) (Table DP-1). Although many reestablishments have been attempted, approximately 25 transplanted populations of the desert pupfish exist in the wild at present, though this number fluctuates due to the establishment (and failure) of populations (Moyle 2002)(Tier 2 populations in the Recovery Plan)(FWS 1993, Voeltz and Bettaso 2003, FWS files)(Table DP-2). There is a total of 47 captive or refuge desert pupfish populations (that do not qualify as Tier 3), comprised of 34 in Arizona, 8 in California, and 5 in Sonora, Mexico. The range-wide status of desert pupfish is poor but stable, although increasing in Arizona due to an active recovery program (Duncan and Clarkson 2013, Crowder and Robinson 2015, Robinson and Crowder 2015). The fate of the species depends heavily upon future developments in water management of the Salton Sea and Santa de Clara Cienega in Mexico.

Table DP-1. Extant natural populations of desert pupfish in the United States and Mexico, by state, by subspecies.

Arizona	Baja California	California	Sonora

Cyprinodon m. macularius			
-	Cerro Prieto	San Felipe Creek	Cienega de Santa Clara
	Laguna Salada	Salt Creek	El Doctor
		Salton Sea	
		Hot Mineral Spa Wash	
		Salton Sea irrigation drains	
Cyprinodon m. eremus			
Quitobaquito pond and springs			Rio Sonoyta

]

Table DP-2. Reestablished wild populations of desert pupfish that are likely extant. In Arizona unless noted otherwise (AGFD, CDFW, Service files). The wild source for all releases is Cienega de Santa Clara/El Doctor.

Site Name	Years stocked	Last survey date pupfish found	Last survey date (if no pupfish found)
Antelope Hill – Las Cienegas NCA	2013	2016	
Bald Wildlife Pond – Las Cienegas NCA	2013	2016	
Bonita Creek	2008, 2010, 2011	2015	2011
Cherry Spring Canyon	2007, 2008	2010	2014
Cieneguita Wetland Ponds	2013 2005	2015	
Cinco Canyon Wildlife Pond	2013	2014	
Cold Springs	1983	2014	
Cottonwood Wildlife Pond – Las Cienegas NCA	2013	2015	
Empire Wildlife Pond - Las Cienegas NCA	2013	2015	
Gaucho Wildlife Pond – Las Cienegas NCA	2013	2015	
Headquarters Spring	2008-2010	2015	
Howard Well	2008,2009	2015	

Kei Sundt Pond	2010	2015	
Little Joe Spring – San Pedro Riparian National Conservation Area	2013	2015	
Larry/Charlie Tank	1976	2013	
Morgan/KT Ranch Pond	2012	2015	
Morgan City Wash	2009, 2010	2015	
Mud Springs	2007-2009, 2011	2015	
Murray Spring	2011, 2013	2014	
Nabhan-Monti Pond	2012	2015	
Road Canyon Wildlife Pond	2012	2014	
Secret Springs	2007, 2008, 2010	2012	2013
Swamp Springs Canyon (Muleshoe)	2007-2009	2008	2014
Tule Creek	2007, 2009	2009	2011
Walnut Spring	2008		2015

Arizona

No natural populations of *C. m. macularius* remain in Arizona, although numerous captive and wild, reestablished populations currently exist (Table DP-2; AGFD & FWS, unpublished data). These populations have been established on private, municipal, county, state, and Federal lands. Desert pupfish have been established at Mud Springs on the Tonto National Forest, and there are plans to stock them at several additional sites on that Forest. Desert pupfish have also been successfully established at several wild sites on the Muleshoe Cooperative Management Area, at Las Cienegas NCA, and at the San Pedro Riparian National Conservation Area. Additional sites in both NCA areas will also receive desert pupfish. Additional captive sites persist in southern Arizona, with a number of refuge and wild ponds having recently been created under a Safe Harbor Agreement (Table DP-3; AGFD 2015).

Table DP-3. Known extant refuge or captive populations of desert pupfish (*Cyprinodon m. macularius*) and Rio Sonoyta pupfish (*C. m. eremus*) (the latter indicated in **bold text**) in the U.S. and Mexico.

Arizona	California	Mexico
Apache Elementary School	Anza Borrego State Park	CEDES, Hermosillo
Aquatic Research & Conservation Center	Borrego Springs High School – 2 ponds	**Reserva Pinacate, Schuk Toak**

Arizona Historical Society	Oasis Springs Ecological Reserve – 2 ponds/streams	**Reserva Pinacate, HQ**
Arizona-Sonora Desert Museum	Dos Palmas Reserve – 4 ponds	**COBACH, Sonoyta**
Arizona-Sonora Desert Museum	Living Desert Museum – 4 ponds	**CEDO, Puerto Penasco**
ASU Desert Arboretum	Salton Sea State Recreation Area	
Audubon Society Appleton-Whittell Research Ranch	Coachella Valley Preserve – McCallum Pond	
Bill Williams NWR	University-California Riverside, Palm Desert Campus	
Black Canyon City		
Boyce-Thompson Arboretum		
Cabeza Prieta NWR		
Cibola NWR		
Deer Valley High School		
Desert Botanical Garden		
Flowing Wells Jr. HS		
Hermosa Montessori		
Hernbrode Pond		
Imperial NWR		
International Wildlife Museum		
Keiser Pond[3]		
Libby Elementary School		
Lulu Walker Elementary School		
McDowell Mountain Regional Park – 2 ponds		
MCC Red Mountain Campus		
Onofryton Pond		
Organ Pipe Cactus National Monument – La Cienega		
Palo Verde HS		
Phoenix Zoo – 2 ponds		
Rio Salado Audubon		
Robbins Butte Wildlife Management Area – 2 ponds		
Scottsdale Community College		
Southwestern Native Aquatic Resources & Recovery Center		
Spur Cross Solar Oasis		
TNC Lower San Pedro Preserve		

California
Five natural populations persist in California and no reestablished wild populations exist in California or Mexico. There are a total of 15 refuge populations in California (Table DP-3) (Keeney 2010, 2013, 2015). A total of six of the ponds have problems with nonnative species,

mainly mosquitofish. In addition, desert pupfish are likely extirpated at two more ponds, one of which is being restored (McCallum Pond, Coachella Valley Preserve) (Keeney 2010a).

Desert pupfish numbers in the Salton Sea are relatively low, but they are patchily distributed throughout (Parmenter *et al*. 2002; Keeney 2010b, 2013, 2015). While populations in irrigation drains entering the Sea can be abundant (Keeney 2010a, 2013, 2015), fish populations there are still dominated by nonnative fish (Martin and Saiki 2005; Keeney 2010a, 2013, 2015). The desert pupfish population in Salt Creek is stable to increasing, and currently has few nonnative species. San Felipe Creek also has a stable to increasing population, and no nonnative fish have been found in recent surveys (Keeney 2010a, 2013, 2015).

Desert pupfish do occur in other areas of the Salton Sink when conditions are suitable, and currently do occur in a wash near Hot Mineral Spa. This population is basically a fifth natural population (Tier 1) of *C. m. macularius* in California. As part of the research surrounding Salton Sea restoration, a shallow water habitat was constructed near the Alamo River (USBR 2005). The project was designed to exclude fish (USBR 2005); however, desert pupfish got into the ponds and flourished (Roberts 2010). The pilot project is over, the site was decommissioned, and pupfish were salvaged. Over 1,000,000 desert pupfish were moved to existing and new refuges, and to irrigation drains and other habitats around the Salton Sea (Keeney 2010b).

Mexico
In Mexico, five natural populations persist; no reestablished populations persist there. One natural population of *C. m. eremus* persists in Sonora, Mexico, in the Rio Sonoyta. Four refuge populations have been established in the last few years (Table DP-3; Duncan and Tibbitts 2008).

Additionally, *C. m. eremus* was stocked into the Quitovac Spring and ponds at Ejido Quitovac in 2007. Quitovac is within the Rio Guadelupe drainage, rather than the Rio Sonoyta drainage, and thus is outside of known historical range. The Rio Guadelupe is the next drainage to the east of the Rio Sonoyta, and very rarely, if ever, flows to the Sea of Cortez. The springs at Quitovac are faunistically similar to the Rio Sonoyta, in that they contain the Rio Sonoyta mud turtle (*Kinosternon sonoriensis sonoytae*), which only occurs in the Rio Sonoyta and Rio Guadelupe drainages (Rosen 2003). The northern divide in the headwaters between the two watersheds is very subtle.

Many natural and reestablished desert pupfish populations are imperiled by one or more threats. Threats to the species relating to destruction or curtailment of habitat include loss and degradation of suitable habitat through ground water pumping or water diversion; contamination from agricultural return flows, as well as other contaminants, and physical changes to water properties involving suitable water quality (71 FR 20714, FWS 1986, 2010; Moyle 2002, Martin and Saiki 2005, Echelle *et al*. 2007, Minckley and Marsh 2009). On Federal lands, Endangered Species Act Section 7 consultations have addressed effects of grazing, roads and bridges, agency planning, fire, flooding, recreation, pest control programs, irrigation drain maintenance, water transfers, and water development as potential threats to desert pupfish habitat. Although effects from these threats continue to be moderated for the desert pupfish, biologically, impacts from these threats individually and collectively can create fragmented populations in poorer quality habitat that are small and restricted in range, which can further endanger the desert pupfish.

The threats identified at the time of listing and in the recovery plan continue unabated. New nonnative aquatic species continue to establish within the desert pupfish's range, and previously existing nonnative species increase in numbers and distribution (Minckley and Marsh 2009). Human demands for water are unending, with the Salton Sea, Cienega de Santa Clara, and the Rio Sonoyta suffering water level declines and the associated threats to the desert pupfish from water depletion, such as habitat loss, fragmentation, and degradation of habitat quality still ongoing. Water availability for the desert pupfish will continue to suffer with predicted trends for warmer, drier, and more extreme hydrological conditions associated with climate change.

Groundwater extraction was considered a threat in the listing (51 FR 10842), recovery plan (FWS 1993), and in the five-year review (FWS 2010). It is still considered a threat; especially at Quitobaquito, Rio Sonoyta (Brown 1991), and El Doctor (P. Reinthal, University of Arizona, pers. comm.). Water extraction removes and degrades habitat, leaving higher concentrations of salts, toxic contaminants, and sediment in the remaining volumes of water and lower amounts of dissolved oxygen, and thus interacts with other compounding threats. Water reductions could lead to less shallow-water habitat preferred by the desert pupfish. Slight increases in salinity could benefit desert pupfish, by reducing populations of problematic nonnative fishes. However, if salinity keeps increasing, wetland areas may become unsuitable even for pupfish. The proposed changes to the configuration of the Salton Sea will reduce pupfish habitat, but there will still be habitat for numerous populations to persist. Any change to the water budget at Cienega de Santa Clara could be detrimental to the desert pupfish there. Groundwater withdrawal in the Rio Sonoyta drainage has exceeded recharge for decades. In addition, the pumping capacity is about twice of what is withdrawn in an average year (Brown 1991, Pearson and Conner 2000).

Watershed condition has been and continues to be a concern over most of the Southwest. Recreational pursuits that have the potential to increase soil erosion (i.e. off-highway vehicles (OHVs)) are a concern for desert pupfish because of their impacts to watershed health, rather than any direct effects. Overgrazing and historically extensive logging combined with climatic events (drought followed by rain events), have led to increased erosion and deeper channelization (Miller 1961, Bahre 1991), which do not provide the more shallow, clear, and vegetatively complex wetlands preferred by the desert pupfish (Hanes 1996).

Extensive logging is no longer a threat to desert pupfish or their habitats. Improper grazing at a watershed level probably does not impact desert pupfish populations anymore, except at the Rio Sonoyta. Grazing of occupied sites still occurs in Mexico and the United States. However, grazing in the United States is better managed and much less of a concern for its impacts to desert pupfish habitat. Urbanization and other human activities can and continue to impact watershed health and functioning.

Environmental contaminants, such as heavy metals, accumulating in water sources were given as threats at the time of listing, particularly in the form of mercury. At this time, selenium seems to be the element of most concern for fishes in the Salton Sea (Saiki 1990, California Regional Water Quality Control Board 1991, McClurg 1994, Saiki *et al*. 2008). In addition to conditions of elevated salinity, contaminants are still present in irrigation drains entering the Salton Sea.

These include problematic levels of heavy metals and organochlorines entering the Salton Sea, and effects to dissolved oxygen in the Salton Sea (Saiki 1990, Matsui *et al*. 1992). Salinity in the Salton Sea is expected to continue increasing (Saiki 1990, Matsui *et al*. 1992) to the point the Sea will be inhospitable for all fish (California Regional Water Quality Control Board 1991, McClurg 1994), unless planned restoration actions occur.

Livestock grazing was not mentioned as a threat in the final rule (51 FR 10842), although habitat modification from grazing was mentioned in the recovery plan (FWS 1993). The small size and high physical tolerance of the desert pupfish allow it to exist in small amounts of water spanning a wide variety of extreme habitat and water quality conditions (FWS 1993). Due to the scarcity of water in the desert pupfish's desert habitat and the tendency for cattle to congregate in watered areas, cattle are attracted to desert pupfish habitats that can lead to local impacts quickly. Low water conditions combined with congregations of cattle activity (grazing, watering, hoof action) can lead to additional reductions in water, physiological effects of reduced water quality, bank trampling, fragmentation of contiguous water, isolation/stranding and trampling of fish and eggs (Roberts and White 1992), and loss of habitat through de-watering. Long-term or seasonal drought can also exacerbate these conditions. Round-up of trespass cattle within these small enclosed areas could cause cattle congregations to increase their hoof action and cause movement into fish habitat. Cattle can cause disturbance, a decline in water quality, and mortality of fish and desert pupfish eggs, particularly at the perimeter of ponds, springs, wells, and shallow wetland areas, by reducing the distribution and abundance of water and isolating fish and eggs into inhospitable areas (Kauffman and Krueger 1984, Fleischner 1994, and Belsky *et al*. 1999). Carefully controlled grazing around some of the small pond habitats as a tool to manage problematic aquatic vegetation could actually be beneficial to the desert pupfish (Kodric-Brown and Brown 2008). Although impacts from livestock grazing have been problematic in some areas, as a result of consultations many of the impacts have been alleviated through fencing and grazing rotations.

Desert pupfish are susceptible to parasites and predation and competition from nonnative fish and other species. Desert pupfish are known to suffer infestations of anchor worm (*Lernea* spp.) (51 FR 10842) (Robinson 2009). Miller and Fuiman (1987) noted a nematode parasite present in desert pupfish collected from Quitobaquito Springs in Organ Pipe Cactus National Monument and hypothesized, after Cox (1966) that the parasites resembled a nematode known from birds and that waterfowl or shorebirds were a possible vector for introduction to the desert pupfish. It is therefore conceivable that many desert pupfish populations are at risk of infestation by this parasite. However, the specific effects to individual desert pupfish or populations are unknown. *Lernea* can kill its host, although largely through secondary infections.

Predation and competition from nonnative fish have been identified as main causes of the decline of the species (51 FR 10842; FWS 1993, 2010). Nonnative fish are still a major threat to the desert pupfish at this time. Martin and Saiki (2009) found the remains of *C. m. macularius* in the gastrointestinal contents of one longjaw mudsucker. In addition they found unidentifiable fish remains in the gastrointestinal contents of sailfin molly, porthole livebearer, longjaw mudsucker, redbelly tilapia, Mozambique tilapia, and western mosquitofish. In an earlier study (2005) they found the abundance of *C. m. macularius* to be inversely related to the abundance of nonnative fish.

It has long been assumed that western mosquitofish have a negative impact on desert pupfish (Deacon and Minckley 1974, FWS 1993), through similar mechanisms by which they affect other small fishes, such as competition for food and the predacious habits of mosquito fish upon young fish, as well as fin damage under crowded conditions (Meffe *et al*. 1983, Meffe 1985). Martin and Saiki (2009) found unidentifiable fish remains in western mosquitofish. They also believed there was significant dietary overlap between desert pupfish and western mosquitofish. To the contrary however, Martin and Saiki (2005) also found the abundance of desert pupfish was positively correlated with the presence of western mosquitofish. We surmise that this result stems from the high tolerance of both species to poor water quality and from competition with the many other nonnative fish individuals present in shared habitats. Because nonnative aquatic species are present in many occupied or potential desert pupfish habitats and nonnative aquatic species are exceedingly difficult to get rid of once established, nonnative aquatic species continue to be a major threat to the conservation of the desert pupfish.

Since the 19th century, desert pupfish habitat has been impacted by streambank erosion, the construction of water impoundments that dewatered downstream habitat, excessive groundwater pumping, the application of pesticides to nearby agricultural areas, and the introduction of nonnative aquatic species as both predators and potential competitors (Matsui 1981, Hendrickson and Minckley 1984, Minckley 1985, Schoenherr 1988). The bullfrog is an opportunistic omnivore with a diet that includes fish (Frost 1935, Cohen and Howard 1958, Brooks 1964, McCoy 1967, Clarkson and deVos 1986). Introduced salt cedar (*Tamarisk* spp.) growing adjacent to desert pupfish habitat might cause a lack of water at critical times (Bolster 1990, R. Bransfield, FWS, pers. comm. 1999); however, recent scientific information contradicts the long-held belief that tamarisk consumes more water than native trees (Glenn and Nagler 2005). These threats still occur today and continue to be impacted by increasing human development and demand for water, as well as interactions with predicted trends for warmer, drier, and more extreme hydrological conditions associated with climate change.

The recovery plan treats the two subspecies recognized then differently. Insoluble threats and limited habitat are stated as rendering delisting infeasible for either subspecies in the foreseeable future. There are downlisting criteria, but no delisting criteria for the subspecies desert pupfish (*C. m. macularius*). Downlisting or delisting of the single population of Quitobaquito pupfish (*C. m. eremus*), located in southern Arizona on the border, is not expected according to the recovery plan; therefore *C. m. eremus* is not discussed further in this section. A Desert Fishes Team report (2006) analyzes and rates recovery plan implementation for *C. m. macularius* in the Gila River basin.

Recovery criterion 1 has not been met. Currently, naturally-occurring populations are relatively secure only at San Felipe Creek, California. Table DP-1 shows the currently known natural populations of desert pupfish. Recovery criterion 1 addresses threat factor A, the present or threatened destruction, modification, or curtailment of the desert pupfish’s range, and seeks to minimize the impact of disease and predation (factor C) and other natural or manmade factors (factor E) on the population as a whole.

The number of natural and reestablished populations contained in the Task 2 specifications (FWS 1993: Tables DP-1 and DP-2) has not been met in Arizona, California, Baja California, or Sonora (Varela-Romero *et al*. 2002, Voeltz and Bettaso 2003, Duncan and Tibbits 2008, FWS files). Most of the reestablished populations are in human constructed environments (Table DP-2). The United States refuge populations of Quitobaquito pupfish are all outside of the Rio Sonoyta drainage, and ostensibly outside of historical range. The Desert Fishes Team report (2006) rated the implementation of this task as "low," though multiple reestablishments have occurred since the report (Table DP-2).

Based on their work on the natural populations and contrary to the recovery plan, Loftis (2007) and Echelle *et al*. (2007) recommended several management units. For *C. m. eremus* they recommended that the Rio Sonoyta and Quitobaquito populations be managed separately (Echelle at al. 2000). They recommended five management units for *C. m. macularius*: Laguna Salada, Cerro Prieto, Cienega de Santa Clara/El Doctor, San Felipe Creek, and the rest of the Salton Sea system (Echelle *et al*. 2007, Loftis *et al*. 2009). The recovery plan has three management units for California: San Felipe Creek, Salt Creek, and the Salton Sea (including the irrigation drains).

As stated in Section 1.3.4, above, the AGFD has conducted periodic and comprehensive status reviews of the desert pupfish in Arizona (Simons 1987, Bagley *et al*. 1991, Brown and Abarca 1992, Weedman and Young 1997, Voeltz and Bettaso 2003). The methodology used to assess the status of the desert pupfish in Arizona has been refined by these authors and currently exists as a *de facto* population monitoring protocol in Arizona. Quitobaquito is monitored regularly by Organ Pipe Cactus National Monument staff, following an established protocol (Douglas *et al*. 2001, Tibbitts 2009). The Rio Sonoyta is sampled annually; the Cienega de Santa Clara and El Doctor in Mexico are regularly surveyed by CEDES (State of Sonora resource agency) and CONANP (Mexican national parks agency). The California Department of Fish and Wildlife monitors all populations in California monthly or bi-monthly, following an established protocol (Black 1980). These monitoring protocols only partially meet the requirements of recovery criterion 4 and task 5 from the recovery plan. Genetic monitoring and population monitoring and maintenance were ranked as "moderate" implementation by the Desert Fishes Team (2006).

Environmental Baseline – Desert Pupfish

The portion of the action area associated with desert pupfish encompasses all occupied or likely-to-be occupied waters within the Cienega Creek watershed, as these will be subject to the proposed action's effects to groundwater and surface flow hydrology. Sonoita Creek Ranch may also be included if desert pupfish are released there. This area is described in detail in the Status of the Species and Critical Habitat within the Action Area section, below. The narrative that follows includes accounts of rangewide effects to desert pupfish and its habitat as a means to describe similar factors affecting the species within the action area.

The environmental baseline for the action area, and specifically for aquatic species, was thoroughly discussed in the Gila chub section of this BO. It is incorporated here by reference; specifics for the desert pupfish will be discussed here and are also in the 2013 Rosemont BO.

Status of the Species within the Action Area

The action area for the desert pupfish encompasses the occupied waters in the Cienega Creek watershed. The action-area status of the desert pupfish was described in our 2008 and 2012 BOs that addressed effects of Aquatic Species Conservation at the San Pedro Riparian and Las Cienegas NCAs, Arizona (File numbers 22410-2008-F-0103, 22410-2002-F-0162-R001). The action areas for those BOs overlap with the action area of the proposed action; that information is updated here. Other background information can be found in the Gila chub section of this BO. The only designated critical habitat for desert pupfish in Arizona is at Quitobaquito Springs and Pond. Since the 2013 BO, Cottonwood Wildlife Pond, Gaucho Wildlife Pond, and Cieneguita Wetland Ponds have had pupfish reestablished (Crowder and Robinson 2015, Robinson and Crowder 2015).

Factors affecting species environment within the action area

The factors affecting the Gila chub are the same ones affecting the desert pupfish at Cieneguita Wetlands; so that section of this BO is incorporated here by reference. There is no designated critical habitat for desert pupfish.

On Las Cienegas NCA, pupfish have been released to eight sites: Cieneguita Wetland Ponds, Gaucho Wildlife Pond, Bald Hill Wildlife Pond, Cottonwood Wildlife Pond, Road Canyon Wildlife Pond, Antelope Wildlife Pond, Cinco Canyon Wildlife Pond, and Empire Wildlife Pond. Also, desert pupfish may be released to five more sites: Clyne Pond, Maternity Wildlife Pond, Oil Well Wildlife Pond, Bill’s Wildlife Pond, and Apache Spring Wildlife Pond. Of these 13 sites, only Cieneguita, Cottonwood, Maternity, and Empire are in the Cienega Creek watershed within the action area. All sites but Cieneguita are supported by pumped well water. Thus, Cieneguita Wetland is the only site that may be affected by the proposed action.

Background for Analyses and Definition of Baseline

The hydrologic data upon which a portion of the following desert pupfish-specific analyses are based were described in both the Effects of the Proposed Action section (below) and Effects to Aquatic Ecosystems sections (above).

The hydrologic data are based on a 95th percentile analysis of the Tetra Tech (2010), Montgomery (2010), and Myers (2010) groundwater model best-fit and sensitivity analyses, as applicable. The 95th percentile analyses were developed for the SIR and were included in the May 2015 SBA to address FWS concerns with the use of multiple groundwater models with oftentimes divergent results. The 95th percentile analysis was described in detail in these prior documents, and was summarized in the Sources of Uncertainty subsection of the Effects of the Proposed Action section, above.

We are aware of the analytical strengths and weakness of this approach, but reiterate that our selection of the upper end of the 95th percentile values results in analyses in which 97.5 percent (which includes the 2.5 percent of the least well-represented values at the lower end of the distribution) of the *other* possible hydrologic outcomes exhibit lesser effects. The 95th percentile approach does not represent the most probable outcome (but it does provide reasonable certainty that the effects to this species are unlikely to be greater than those described below). Due to the uncertainty inherent in these modeling efforts, there are no results that can be definitively said to be the most likely to occur. Thus, we have selected the precautionary approach.

Secondly, the following species-specific analysis considers the present-day state of the hydrology to represent the baseline condition. All effects, whether the result of anticipated climate change alone, mine drawdown alone, and/or climate change and mine drawdown combined, are described in terms of their divergence from present, pre-project conditions. Climate change is *not* viewed as an ongoing and evolving baseline against which mine-only effects are incrementally assessed.

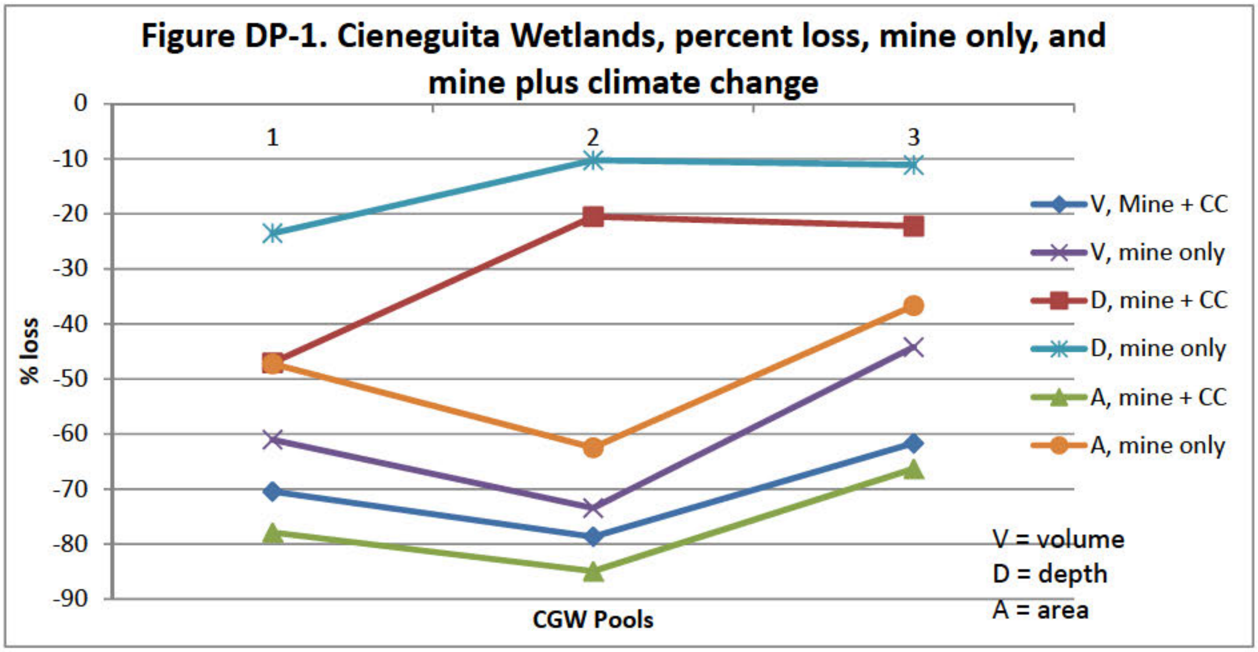
Effects of the Action - Desert Pupfish

The effects of the action to desert pupfish will be very similar to those described for Gila chub for Cieneguita Wetland. Therefore, that discussion in this BO is incorporated here by reference. Effects that may affect the desert pupfish differently than Gila chub will be discussed below. Information from the 2013 Rosemont BO that has not changed will not be repeated here. There are no direct effects from the mine. Indirect effects caused by groundwater drawdown from the mine will negatively impact stream flow and pool metrics. Impacts from the mine only are small when compared to the effects of climate change. However, the impacts from the mine only do cause negative impacts to aquatic habitats; this results in negative impacts to the desert pupfish.

Climate change may be less problematic for desert pupfish compared to Gila chub, because desert pupfish have about a 3^{o} C higher tolerance of water temperature than Gila chub (Carveth *et al.* 2006). Also, desert pupfish are also more tolerant of reduced dissolved oxygen in the water; pupfish can survive with dissolved oxygen at <1ppm, while chub require at least 3ppm (Lowe *et al*. 1967, FWS 2015). Amount of stream flow is a factor in dissolved oxygen; generally the less the flow, the less dissolved oxygen there is. But since desert pupfish only occur in wetlands and constructed ponds, water flow is not a factor.

As for how the modeled groundwater drawdowns will impact desert pupfish, Cieneguita Wetland Wildlife Ponds are the only concern. Cieneguita Wetlands only has three ponds; looking at those ponds separately is an adequate analysis of effects. The 95th percentile range of results for the Cieneguita Wetlands encompasses a wide range of results for mine only. The number of pools does not change, but pool depth does change; by 150 years after mine closure, median pool depth decreases from 3.6 to 3.2 feet. Pool volumes change significantly, with the three Cieneguita pools losing 67 percent of their volume due to impacts from the mine after 150 years. Cieneguita Wetland pools lose 50 percent of their surface area during this time (Figure DP-1).

Climate change in combination with mine drawdown 150 years post-closure reduces pool volume to 19 percent of original volume. Pool depth loses 26 percent, and pool surface area declines by 76 percent due to mine plus climate change by 150 years post-mine (Figure DP-1). The loss of depth, surface area, and volume at the three pools at the Cieneguita Wetlands will significantly reduce the amount of habitat for desert pupfish. In particular, the loss of 67 percent of pool volume at Cieneguita from impacts from the mine only is of great concern, because even if fish can still survive in the wetlands, population size and viability will be greatly decreased.



The Cienega Creek Watershed Conservation Fund and acquisition of water rights for Cienega Creek may be beneficial for desert pupfish conservation, but that will depend on the specifics of how the funds and water rights are used. Control of invasive aquatic species could be beneficial, depending on the species, their location, and where pupfish are. Restoration activities could benefit pupfish. It is unknown if these actions would mitigate for impacts to desert pupfish without greater detail. The purchase of conservation land and conservation activities along Sonoita Creek could benefit desert pupfish if they are included in the conservation planning.

Lastly, there is a recovery plan for desert pupfish (FWS 1993), which contains Survival and Reclassification Criteria. Because the desert pupfish populations in the action area are reestablished populations, the survival criteria in the plan will not be affected. The proposed action will affect the habitats for and the populations of desert pupfish at Las Cienegas NCA.

Given that the proposed action does not affect Survival Criteria I, II, III, or IV in the desert pupfish recovery plan, we anticipate that the ability to reclassify (downlist) desert pupfish will not be precluded by the proposed action. Reclassification Criterion II refers to the replication, establishment, and survival of populations within the desert pupfish's historical range. The existing and planned reestablishment of desert pupfish to Las Cienegas NCA will further the conservation and recovery of the species, and will not be precluded by the proposed action.

Lastly, the conservation measure directing the management and removal of harmful nonnative species may also benefit desert pupfish, as sites currently occupied by predatory and/or competitive nonnative aquatic species may be made suitable to reestablishment (or establishment) of desert pupfish.

Summary of Effects – Desert Pupfish

- Although groundwater levels have historically been variable in this area, the environmental baseline (see the Effects to Aquatic Ecosystems section, above, and Powell *et al.* 2013) shows a trend of increasing water use in parts of the action area, which is likely to initiate or contribute to a downward trend in groundwater levels in the near future;
- The effects from the mine lead to the loss of 67 percent of the total pool volume at Cieneguita Wetlands, and will lead to incidental take;
- The current extended drought and climate change are highly likely to negatively impact many system components from the upper parts of the watershed through:
    - Higher ambient and water temperatures;
    - Changes in upland vegetation and fire regime;
    - Increased variability in stream hydrographs;
    - More frequent severe climatic events (such as storms, droughts, wildfires, etc.);
- The proposed conservation measures will minimize the action's adverse effects, but will not preclude the occurrence of (or mitigate for) all anticipated effects to surface waters and desert pupfish;
- Las Cienegas NCA has eight reestablished populations of desert pupfish; there are at least 25 reestablished populations, and numerous refuge populations in Arizona;
- The effects of the proposed action do not reach a tipping point that would preclude the recovery of the species, as it may persist within the action area, occurs in locations outside of the action area, and is subject to ongoing recovery actions; and
- Impacts to groundwater, and thus surface water, are reasonably certain to affect areas occupied by desert pupfish, and thus will negatively impact desert pupfish.

Cumulative Effects – Desert Pupfish

The cumulative effects for the action area, and specifically for aquatic species, were thoroughly discussed in the Gila chub section of this BO. That section is incorporated here by reference.

Conclusion – Desert Pupfish

As discussed in full in the Sources of Uncertainty section, above, we have chosen to base our effects analysis on the upper end of the 95th percentile analysis. Given the long time frames involved, long distances involved, and small amounts of drawdown in the aquifer, there is a high degree of uncertainty associated with groundwater predictions. The scenario represented by the upper end of the 95th percentile analysis is not the scenario most probable to occur. Rather, by selecting it we are analyzing a conservative position that ensures almost all of potential and reasonable outcomes disclosed by the models would be encompassed by this BO analysis. This conservative approach ensures that under almost all potential outcomes that can be reasonably predicted, the conclusion of non-jeopardy (destruction and adverse modification of critical habitat does not apply), below, would remain valid.

After reviewing the current status of the desert pupfish, the environmental baseline for the action area, the effects of the proposed action, and the cumulative effects, it is the FWS's biological opinion that the proposed action is not likely to jeopardize the continued existence of the desert pupfish. Pursuant to 50 CFR 402.02, jeopardize the continued existence of means to engage in an action that reasonably would be expected, directly or indirectly, to reduce appreciably the likelihood of both survival and recovery of a listed species in the wild by reducing the reproduction, numbers, or distribution of that species. We present this conclusion for the following reasons:

1. No direct effects from operation of the mine are expected;
2. Rosemont will monitor groundwater drawdown and the USFS will compare observed drawdown to modeled drawdown. Groundwater drawdown greater than modeled may require reinitiation of section 7 consultation;
3. The Cienega Creek Watershed Conservation Fund may, for the short-term at least, protect and potentially increase habitat for desert pupfish by funding management and restoration actions in the watershed, protecting water rights, and creating habitat;
4. Groundwater drawdown is not expected to be more than 0.1 ft in any of the modeled locations until 150 years after mine closure;
5. Las Cienegas NCA has eight reestablished populations of desert pupfish of which only one population may be impacted by the mine (Cieneguita Wetlands); there at least 25 reestablished populations, and numerous refuge populations in Arizona, in addition to sites in California and Mexico;
6. The effects of the proposed action do not reach a tipping point that would preclude the recovery of the species, as it may persist within the action area, occurs in locations outside of the action area, and is subject to ongoing recovery actions;
7. Numerous conservation and recovery actions have occurred during the last 10 years, and continue to occur, with more actions in planning, in particular at Las Cienegas NCA. Therefore, we believe the status of the species is static or improving within the action area and rangewide;
8. The limited extent of the proposed action's effects on this species' habitat and the implementation of conservation measures, mean that the recovery potential of desert pupfish (per the recovery plan) will not be diminished;
9. Indirect effects are only experienced by desert pupfish and pupfish habitat at the three Cieneguita Wetlands pools;
10. Incidental take of desert pupfish will only occur at the three Cieneguita Wetlands pools, representing a small portion of the species' total occupied range; and
11. Critical habitat for the desert pupfish does not occur in the action area; therefore, none will be affected.

The Recovery Plan (FWS 1993) has two criteria that are useful for determining jeopardy. Before considering desert pupfish for down- or de-listing, survival of the species in the U.S. must be ensured by securing remaining Level 1 (natural) populations and the habitat they occupy in the U.S. In addition, the recovery plan defines a stable (viable) population as one containing at least 500 overwintering adults, possessing an adequate representation of all age-classes and cohorts, and having evidence of reliable annual recruitment.

Since the impacts of the proposed action do not affect any natural desert pupfish populations and the action area is small (one site) compared to the range of the species, it is 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. We believe that desert pupfish will still be present on Las Cienegas NCA 150 years after closure of the mine since adequate waters will be present at multiple sites to support at least 500 overwintering desert pupfish in the metapopulation. We believe this even with the higher temperatures and lower dissolved oxygen levels that are likely to be present then. Dissolved oxygen should only be an issue at Cieneguita Wetlands, and not the other sites where pupfish have been, or may be, released.

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 effects of the proposed action are not anticipated to reach any tipping point that would preclude the conservation and recovery of the desert pupfish.

Lastly, we note that the Cienega Creek Watershed Conservation Fund is designed to increase ecosystem resiliency in the face of both the expected groundwater drawdown from Rosemont Mine and impacts from climate change, although the fund's benefit to desert pupfish cannot yet be determined. Similarly, the Sonoita Creek Ranch conservation measure is intended to create new habitat for desert pupfish, habitat that would be sourced by a reliable water source (Monkey Spring), but we cannot definitively credit this conservation measure unless and until desert pupfish are successfully established at the site.

INCIDENTAL TAKE STATEMENT – DESERT PUPFISH

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 included by the USFS as binding conditions of any grant or permit issued to the applicant, as appropriate, for the exemption in section 7(o)(2) to apply. The USFS has a continuing duty to regulate the activity that is covered by this Incidental Take Statement. If the USFS (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 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, the USFS, or the applicant 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 – Desert Pupfish

We anticipate that the proposed action will result in incidental take of desert pupfish. Any reduction in pool size at Cieneguita Wetlands resulting from groundwater drawdowns attributable to the proposed action will reduce the extent and quality of aquatic habitat required by desert pupfish, thus harming the species. We are therefore reasonably certain that take will occur.

Incidental take of desert pupfish at Cieneguita Wetlands will be difficult to detect for the following reasons: population levels cannot be accurately described with existing information and techniques, dead animals are difficult to find, cause of death may be difficult to determine, and losses may be masked by seasonal fluctuations in numbers or other causes. The incidental take is expected to be in the form of harm through the loss of habitat from groundwater drawdown.

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 desert pupfish taken because: (1) dead or impaired individuals are almost impossible to find (and are readily consumed by scavengers and predators) and losses may be masked by seasonal fluctuations in environmental conditions; (2) the status of the species will change over time through disease, natural population variation, natural habitat loss, or the active creation of habitat through management; and (3) the species is small-bodied, well camouflaged, and occurs under water of varying clarity with differing amounts of aquatic vegetation and algae. Therefore, the take of desert pupfish is expressed in terms of groundwater drawdown, in the magnitudes specified in the Gila chub section (including Table GC-4); this table is incorporated here by reference.

Desert pupfish are subject to an existing monitoring program in the Cienega Creek watershed on the Las Cienegas NCA. The currently used sampling techniques result in an index of fish abundance per sampling site, as catch-per-unit-effort (Crowder and Robinson 2015, Love-Chezem *et al*. 2015, Robinson and Crowder 2015). Desert pupfish population estimates can theoretically be acquired, but are difficult, time consuming, stressful to the fish (to the point of harm), and expensive. In addition, the number of desert pupfish in any population is normally extremely variable during the year due to an r-selected (high fecundity, short generation time, wide dispersal of offspring) reproductive strategy, common in highly variable environments such as desert aquatic ecosystems.

It is reasonable to assume that the abundance of desert pupfish is correlated with the extent of suitable aquatic habitat provided the Cieneguita Wetland pools. The discharge of groundwater to wetlands is related to the elevation and gradient that regional groundwater exhibits relative to those surface waters. Decreases in groundwater elevation affect this gradient and thus, reduce the discharge of groundwater to wetlands (see Effects to Aquatic Ecosystems section). Groundwater elevations, which can be readily measured, are therefore effective surrogate measures for the incidental take of desert pupfish.

The Effects to Aquatic Ecosystems section of this BO as well as the analysis of effects for the Gila chub, above, discuss the relationship between the proposed action, changes in groundwater elevation, the volume and length of surface flow in streams, and various aspects of pool numbers and geometry. These changes are expressed in terms of both quartile and 95th percentile analyses of available groundwater drawdown, discharge, and pool data.

The changes in groundwater elevation will result in reduced wetted lengths and volumes in reaches of stream maintained by discharges from the regional aquifer; surface flow effects (including effects to pools) are summarized in Tables A-2 through A-8 in the Effects to Aquatic Ecosystems section, above. WestLand (2012) determined that there could be some reductions in the wetted length of lower Cienega Creek from groundwater drawdowns over the long term. We did not analyze the results from WestLand's study. We also anticipate that reduced flow volumes could result in increased summer water temperatures (Barlow and Leake 2012) and thus reductions in dissolved oxygen content (oxygen solubility is inversely related to water temperature), thus further adversely affecting (Bodner *et al*. 2007) the already-reduced numbers of desert pupfish that would remain. The number of days with extremely low flows per year (see Table A-3, above) are a useful proxy for water quality effects.

Effect of the Take – Desert Pupfish

In this BO, the FWS determined that this level of anticipated take is not likely to result in jeopardy to the desert pupfish, based on the conclusions presented above.

Reasonable and Prudent Measures – Desert Pupfish

The FWS believes the reasonable and prudent measures and terms and conditions in the Gila chub section of this BO are also necessary and appropriate to minimize impacts of incidental take of desert pupfish, and these are hereby incorporated by reference.

Conservation Recommendations – Desert Pupfish

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, to help implement recovery plans, or to develop information. The FWS recommends the following conservation activities:

1. We recommend that the USFS, the Corps, and Rosemont coordinate with the Cienega Watershed Partnership, the F.R.O.G. Project, other wildlife agencies, and our office in efforts to work with private landowners to remove populations of nonnative aquatic species from lands in the area;

2. We recommend that the USFS continue to assist us and other wildlife agencies in conserving and recovering the desert pupfish;
3. We recommend that the USFS and Corps assist us with the implementation of the desert pupfish recovery plan;
4. We recommend that Rosemont consider releasing desert pupfish into water features on the mine site, when the site is suitable (i.e. exhibits no deleterious levels of contaminants), and when the release of pupfish would not conflict with other conservation actions;
5. Waters at Sonoita Creek Ranch should be considered for the release of desert pupfish;
6. We recommend that Rosemont consider acquiring the remaining water rights for Monkey Spring and the fee title property with Monkey Spring;
7. We recommend that the USFS continue to work cooperatively with the FWS and other wildlife agencies to remove nonnative species and reestablish desert pupfish wherever possible throughout its historical range in Arizona; and
8. We recommend that the USFS survey streams on NFS lands to determine which may support desert pupfish.

In order 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.

CHIRICAHUA LEOPARD FROG

Status of the Species – Chiricahua Leopard Frog

The status of the species information contained in the October 30, 2013 BO remains current and is incorporated herein via reference, except for new, preliminary data on dispersal distance and behavior (Hall 2016) and additional information regarding overall population status and recovery planning for the species presented below.

Evidence indicates that since the time of listing, the Chiricahua leopard frog has probably made at least modest population gains in Arizona, but is apparently declining in New Mexico. Overall in the U.S., the status of the Chiricahua leopard frog is either static or, more likely, improving, with much of the increase attributable to an aggressive recovery program that is showing considerable results on the ground through the reestablishment of populations (mainly in Arizona), captive rearing programs, non-native species eradication programs, and enhancement and development of habitat (FWS 2011). Population status and trends in Mexico are unknown.

The Recovery Plan for the Chiricahua leopard frog identifies eight recovery units (RUs) in Arizona, New Mexico, and Mexico (FWS 2007). An RU is a population unit that has been documented as necessary to both the survival and recovery of the species. The RUs are natural units in which frog metapopulation dynamics function or could function as the species recovers. A metapopulation is a set of local populations that interact via individuals moving among local populations. Within RUs, it is important to implement recovery actions over large landscapes with the greatest potential for successful recovery. These areas are referred to as management areas (MAs), and are identified within each RU. Hydrologic units and mountain ranges are used as MA boundaries. MAs have been delineated to include all habitats of known extant Chiricahua leopard frog populations as well as other sites with the highest potential for recovery, including sites where habitat restoration or creation, and establishment or re-establishment of Chiricahua leopard frog populations will likely occur or has already occurred. We included all known extant populations within MA boundaries because of the high value of those populations for recovery. Metapopulations consisting of at least four local populations that exhibit local recruitment, three of which are continually in existence, as well as isolated robust populations will be established within MAs (FWS 2007, USWFS 2012). Metapopulations and isolated robust populations are referred to as “recovery sites” in the Recovery Plan (FWS 2007).

For the Chiricahua leopard frog to be recovered, conservation must occur in each RU (FWS 2007). Successful conservation is not necessary in every MA and recovery does not depend upon an even distribution of recovery efforts across an RU. Rather, we anticipate that recovery efforts will be focused in those MAs and portions of RUs in which opportunities are best. Recovery criteria, as identified in the Recovery Plan (FWS 2007), to delist the Chiricahua leopard frog includes 1) at least two metapopulations located in different drainages, plus at least one isolated and robust population in each RU; 2) protection of these populations and metapopulations; 3) connectivity and dispersal habitat protection; and, 4) reduction or elimination of threats and long-term protection (FWS 2007). As noted in the FWS’s 1998 Consultation Handbook, RUs are population units that have been documented as necessary to both the survival and recovery of the species. Avoiding loss of populations or other serious adverse effects in a RU will ensure continued contribution of that RU to the recovery of the species. To date, recovery criterion 1 has been accomplished only in RU1 although we are close to achieving it in RU2. No other recovery criteria have been achieved in any recovery unit. However, ongoing recovery actions have helped stabilize or improve the status of the species in other recovery units in Arizona and New Mexico.

Existing populations and suitable habitat in MAs will be protected through management (FWS 2007). As identified in the Recovery Plan, management will include maintaining or improving watershed conditions both upstream and downstream of Chiricahua leopard frog habitats to reduce physical threats to aquatic sites and allow for Chiricahua leopard frog dispersal, reducing or eliminating nonnative species, preventing and managing disease, and other actions. Suitable or potentially suitable unoccupied habitat with high potential for supporting Chiricahua leopard frog populations or metapopulations will be protected, and restored or created as needed, within MAs (FWS 2007). These habitats should include aquatic breeding habitats and uplands or ephemeral aquatic sites needed for movement among local populations in a metapopulation. Activities to achieve this include habitat management, removal of nonnative species (e.g. American bullfrogs, nonnative fishes, and crayfish), enhancing water quality conditions, and reducing sedimentation. Populations of Chiricahua leopard frogs will be established or reestablished in these MAs. Landscape level removal of nonnative species in conjunction with captive propagation-headstarting-release of Chiricahua leopard frogs has achieved recovery criterion 1 in RU1 and has made tremendous headway in reaching recovery criterion 1 in RU2 as well as recovery criterion 4 in RU1 and RU2.

Critical Habitat

The status of critical habitat information contained in the October 30, 2013 BO remains current and is incorporated herein via reference.

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.

The environmental baseline for the action area, and specifically for aquatic species, was thoroughly discussed in the Gila chub section of this BO. It is incorporated here by reference; specifics for the Chiricahua leopard frog are discussed here and in the 2013 BO.

Description of the Action Area

The action area remains as described in the October 30, 2013 BO except as described in the Description of the Proposed Action section (see Table 1) and in the following text:

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. In addition to the areas described in the October 30, 2013 BO, the action area for the Chiricahua leopard frog also encompasses all occupied or likely-to-be occupied aquatic sites including streams and wetlands within the Cienega Creek watershed, as these will be subject to the proposed action's effects to groundwater and surface flow hydrology. In addition, the action area includes a mitigation property identified in the HMMP known as Sonoita Creek Ranch, because the proposed action includes release of Chiricahua leopard frogs there as well as the to-be-determined sites in which the vertebrate species-focused Harmful Nonnative Species Management and Removal program will be implemented.

The proposed project falls within the three management areas (MAs) within the Santa Rita-Huachuca-Ajos/Bavispe Recovery Unit (RU2) for Chiricahua leopard frog. RU 2 was designed to encompass metapopulation(s) of frogs centered around the headwaters of the San Pedro and Santa Cruz rivers and adjacent mountain ranges in Arizona and Sonora. The RU was also designed so that land management and recovery efforts could be coordinated via relatively few land managers. In Arizona, management of frogs and their habitats is focused on the Sierra Vista and Nogales Ranger Districts of the Coronado National Forest and adjacent private and BLM lands including Las Cienegas NCA. The three MAs in RU2 that fall within the action area are described in detail in the Status of the Species and Critical Habitat within the Action Area sections, below.

Status of the Species within the Action Area

The status of the species and critical habitat within the action area information contained in the October 30, 2013 BO is updated here. The status of Chiricahua leopard frog in the action area has declined since the October 30, 2013 BO was completed. Updated information on metapopulations of the species is summarized below by each MA in the action area.

Santa Rita MA

The Santa Rita MA supports one functioning metapopulation in the Greaterville area within the action area and another potential developing metapopulation in and around Gardner Canyon just south of the action area. The Greaterville area metapopulation includes 5 sites where breeding has been documented between 2010 and 2015: Greaterville Tank and Granite Mountain Tank in Ophir Gulch, drinkers and another site in Louisiana Gulch, and West Tank in California Gulch. However, frogs have been extirpated from West tank since 2013. Frogs have also been detected at several other dispersal sites in this area including the following: Granite Tank and an unmarked well west of Greaterville Tank in Ophir Gulch, East Tank in California Gulch, Upper Enzenberg and Redtail Tank in Enzenberg Canyon, Box Canyon, and Bowman Tank in upper Empire Gulch. None of these aforementioned sites are within the perimeter fence of the proposed action. Of the 14 stock ponds and springs found in the mine within the perimeter fence, two have had detections of Chiricahua leopard frogs: Lower Stock Tank and Barrel Tank. Chiricahua leopard frogs were found in Lower Stock Tank in 2008 but have not been found since then although this tank and at least three other adjacent tanks appear to be perennial. Since completion of the 2013 BO, Chiricahua leopard frogs were found at two new sites in the action area: one juvenile frog was detected in Barrel Tank east of Oak Tree Canyon within the area of the mine footprint, and two sub-adult to adult sized frogs were found in Deering Spring just outside the mine footprint but within the perimeter fence. These frogs were found during the monsoon season and were likely recent dispersers from nearby breeding sites. It is unknown if these two sites hold water long enough to support breeding.

The major threat in this MA continues to be scarcity of water, although disease now rivals water scarcity as a leading threat to the species in this MA since completion of the 2013 BO. The first detection of chytridiomycosis (Bd) in Chiricahua leopard frogs in this MA was confirmed in frogs from West Tank and Greaterville Tank in the winter of 2014. Much of the population at Greaterville Tank died during the winter of 2014 and all specimens sampled tested positive for Bd (please refer to status of species in 2013 BO for explanation of this disease). November 2015 surveys detected 11 adult frogs in Greaterville Tank (C. Akins, pers. comm. 2015). At the same time, West Tank experienced a large die-off that was initially detected in February 2014 (E. Wallace, Pers. Comm. 2014). A few tadpoles and a number of juveniles were seen post die-off, but no adult frog life stages were detected there in most recent November 2015 surveys conducted by AGFD (C. Akins, pers. comm. 2015). Cave Creek confluence with Gardner Canyon in this MA also experienced a die-off with frogs testing positive for Bd, although this site is just south of the action area. Negative trends associated with Bd continue, based on recent surveys (April 5-6, 2016) of eight sites within the Santa Rita MA, several of which had been reliable source populations with large numbers of frogs (Akins 2016). Specifically, a total of two Chiricahua leopard frog tadpoles (at a single site) were observed and no metamorphosed frogs were detected (Akins 2016).

We would like to note that Bd has been confirmed in another species of ranid frog, the Tarahumara frog (*Lithobates tarahumarae*), in Big Casa Blanca Canyon prior to the current die-offs we are seeing in Chiricahua leopard frogs. Although Big Casa Blanca Canyon is in this MA, Chiricahua leopard frogs have not been verified here, although Hale and Jarchow (1988) documented leopard frogs (either Chiricahua leopard frogs or lowland leopard frogs, but species not confirmed) in lower Big Casa Blanca Canyon in the late 1970s and possibly the early 1980s. In addition, the habitat that Tarahumara frogs primarily occupy is in an extremely rugged portion of the canyon with deep plunge pools and tinajas, and is likely to have little if any overlap with Chiricahua leopard frog habitat.

Empire Cienega MA

Due in large part to a ten-year effort intended to create, enhance, and protect habitat for at-risk species and remove the threat of harmful nonnative species from within the Las Cienegas NCA, the Empire Cienega MA is now capable of supporting a functioning metapopulation of frogs within the action area, but for the effect of Bd (see below). The Las Cienegas NCA metapopulation has included 10 sites where breeding has occurred since at least 2012: Empire Spring in Empire Cienega, Headwaters Reach of Cienega Creek, Cold Spring Reach of Cienega Creek just upstream of the confluence with Mattie Canyon, and 7 wildlife ponds including Cinco Well, Cottonwood, Empire Well, Gaucho, Maternity Well, Spring Water Wetlands, and Road Canyon Tank.

Empire Spring, located about 4 miles upstream of Cienega Creek in Empire Gulch, is the most consistent source population for Chiricahua leopard frogs in this metapopulation. The Empire Spring population has persisted since at least the 1990s when records began in the area, and has increased in recent years from about 7 observed individuals to 100s of frogs detected in 2015 (Hall *et al*. 2015). Frogs were also documented at Cieneguita Wetlands throughout 2015, although breeding was not observed at this site.

Frogs have been known to disperse to numerous sites during the monsoon season, including 12 sites in 2015, three of which were new detection sites for the species (Rattlesnake Tank, Karen's Tank, and Clyne Pond; Hall *et al*. 2015). As of April 2016, approximately 20 surveys have occurred in the Las Cienegas NCA (Hall 2016b). Hall (2016b) found that metamorphosed frogs at all surveyed lentic sites experienced 100 percent mortality over the 2015-2016 winter; tadpoles remain extant at these sites, but two lentic sites where Bd is absent, Hilton Tank and Cline Pond, still maintain metamorphosed frogs. There are three lotic sites where metamorphosed Chiricahua leopard frogs survived the 2015-2016 winter: Empire Spring, and both the Headwaters and Cold Spring reaches of Cienega Creek; these sites all tested positive for the presence of Bd (Hall 2016b). Currently unoccupied sites where releases may occur include Cinco Ponds, Frog Tank and eight other stock tanks within the action area; these are considered included as part of the baseline in this consultation.

As part of the larger conservation effort on Las Cienegas NCA, nonnative aquatic species removal followed by captive propagation-headstarting-release of Chiricahua leopard frogs took place from 2010-2012, resulting in recent recovery successes. Partners continue to monitor Chiricahua leopard frog populations, disease (Bd), and bullfrog presence (Rosen *et al.* 2013, Hall *et al.* 2015). The most significant threat in this area is Bd. Nearly all harmful nonnative species have been removed from the Las Cienegas NCA, but bullfrogs and crayfish are still present regionally and represent a potential, on-going threat on the larger landscape scale that includes other surrounding Chiricahua leopard frog MAs.

Chiricahua leopard frogs experience periodic die-offs from Bd in this MA. The most recent die-off was initially detected in the winter of 2014 and appears to continue presently since temperatures have dropped in 2015 (Hall *et al* 2015). The current die-off was documented at 7 of 10 sites sampled on Las Cienegas NCA in 2014 (Hall *et al*. 2015). These 7 sites are all wildlife ponds including Cinco Well, Cottonwood, Empire Well, Gaucho, Maternity Well, Spring Water Wetlands, and Road Canyon. Notably, die-offs were not detected at Empire Spring in Empire Gulch, nor in the Headwaters and Cold Spring reaches of Cienega Creek, although frogs sampled at Empire Spring carried zoospore loads of Bd considered to be below disease-level (Hall *et al*. 2015). In spring 2015, surveys revealed that only tadpoles survived the winter in Cottonwood, Gaucho, and Road Canyon sites; Spring Water Wetlands and Maternity Well had no life stages present; and only a small number of adult frogs survived at Cinco Well and Empire Well sites, but adult survival appeared to be high at Empire Spring, Headwaters Reach, and Cold Spring Reach. In October and November 2015, dead and moribund frogs showing signs of Bd were again collected at all 5 remaining wildlife pond sites that experienced a die-off during the winter of 2014. The three lotic sites were also surveyed in November 2015 and no dead or moribund frogs were detected, but samples were collected to test for Bd (D. Hall, pers. comm. 2015). Both Cienega Creek and Empire Gulch are fed by springs which may provide a more thermally stable environment; this stable temperature environment is thought to prevent die-offs from the disease, although the mechanism is not clearly understood (Forrest and Schlaepfer 2011, Rowley and Alford 2013).

Potential, Bd-influenced population trends from 2015-2016 in both the Santa Rita and Empire MAs suggest a particular dynamic may be occurring. In simplified terms, sites that have supported Chiricahua leopard frogs in all age classes over successive years now may be behaving as “annual” sites where metamorphosed frogs succumb to Bd during their first winter, leaving only tadpoles present the following spring. These tadpoles may, in turn, metamorphose and even disperse to other sites where they might reproduce themselves, only to die from Bd in their first winter – again, leaving only tadpoles behind. We are uncertain what this trend, should it continue, may mean for these sites or these MAs as a whole, but are concerned that reproduction, and therefore recruitment, at affected sites may be significantly hampered at the least, or at worst, cease altogether. If this population dynamic persists, it would require active management through annual captive propagation-headstarting-release programs to keep metapopulations viable in these MAs.

Red Rock-Sonoita Creek MA
Red Rock-Sonoita Creek MA is discussed here because Sonoita Creek Ranch, identified as a mitigation property in the HMMP, is part of the proposed action and falls within this MA. Sonoita Creek Ranch is adjacent to an ephemeral section of Sonoita Creek. Red-Rock Sonoita Creek MA does not support a functioning metapopulation of Chiricahua leopard frogs. In October 2014, Chiricahua leopard frogs were discovered in a wildlife drinker and within an associated underground storage tank in Alamo Canyon within this MA. In 2015, Chiricahua leopard frogs were detected at a stock tank 0.9 stream-miles southeast of this wildlife drinker (D. Hall, pers. comm. 2015). Prior to these recent detections, Chiricahua leopard frogs were detected in Monkey Spring as late as 2000; this spring is located 5.5 stream-miles upstream in an ephemeral channel from the recent detections in the wildlife drinker in Alamo Canyon. Sonoita Creek is the only stream within the MA that has perennial water. However, the perennial portion of Sonoita Creek does not support Chiricahua leopard frogs because bullfrogs, crayfish, and nonnative, spiny-rayed fish are present along the creek. Bullfrogs and nonnative, soft-rayed fish species are also known to occur within other perennial spring sites and stock tanks within the MA, including the ponds on the Sonoita Creek Ranch mitigation property (FWS 2007). The Chiricahua leopard frog Recovery Plan identifies this MA as having potential for a metapopulation or isolated robust population, although we are not actively recovering the species in this MA to date due to the prevalence of nonnative predators occupying the majority of the sites that hold water perennially (FWS 2007, FWS 2011).

Huachuca Mountains MA
Huachuca Mountains MA is included in the action area because the northwest corner of the MA is part of Revised Conservation Measure 2 – Harmful Nonnative Species Management and Removal; this conservation measure is new and was not analyzed in the October 30, 2013 BO. We are limiting the discussion of the status to the portion of the MA that falls within the action area, which includes perennial waters at Peterson Ranch Pond in Scotia Canyon and Parker Canyon, and fewer than ten stock tanks. Chiricahua leopard frogs are currently only extant at Peterson Ranch Pond within Scotia Canyon in this portion of the MA. Frogs were first translocated from a Safe Harbor site in Miller Canyon to Peterson Ranch Pond in 2009. The

population grew quickly and peaked at over 200 individuals in 2013. However, by March 2014, the only adult frog observed at the pond was found dead. Although the frog was too decomposed to analyze, the most likely explanation for this rapid population decline is a large outbreak of chytridiomycosis caused by Bd. Since then, CLFs have persisted in relatively low numbers, despite the probable presence of Bd and the occasional presence of bullfrogs. Three augmentations to the Peterson Ranch Pond population took place in 2015 (H. McCall, personal communication, 2016).

Patagonia Mountains-San Rafael Valley MA
Patagonia Mountains-San Rafael Valley MA is included in the action area because it is part of a conservation measure that has been added to the proposed action since completion of the October 30, 2013 BO. Patagonia Mountains-San Rafael Valley MA currently does not support a functioning metapopulation or isolated robust population of Chiricahua leopard frogs. This MA includes perennial lotic waters in the upper Santa Cruz River, Sheehy Spring, and Sharp Spring, as well as roughly 80 springs and stock tanks spread across the landscape. The Santa Cruz River and many of the stock tanks support bullfrog and nonnative fish populations. Chiricahua leopard frogs were last seen in the upper Santa Cruz River portion of the MA in 1980. In 2008, Chiricahua leopard frogs were translocated from the Huachuca Mountains MA to a Safe Harbor site in the Patagonia Mountains-San Rafael Valley MA. The Safe Harbor site consists of a well-fed pond that has a hardware cloth fence around it designed to keep bullfrogs from entering the pond. In addition to Chiricahua leopard frogs, northern Mexican gartersnakes and Sonoran tiger salamanders have been detected in this pond. The fence has since been breached by bullfrogs, and the last observation of Chiricahua leopard frogs in this pond was in October 2012, when over 200 adults were detected. By April 2013, no Chiricahua leopard frogs were detected, and from September 2013 to April 2015, only bullfrogs have been detected (H. McCall, pers. comm. 2016).

Status of Critical Habitat within the Action Area

Information regarding the primary constituent elements (PCEs) for Chiricahua leopard frog designated critical habitat and the status of critical habitat within the action area contained in the October 30, 2013 BO remains current and is incorporated herein via reference. Key information is also summarized here along with updated information on the current condition and conservation role of individual critical habitat units in the action area, as well as special management required.

The action area includes two of 39 designated critical habitat units for Chiricahua leopard frog as described in the Final Rule (77 FR 16324), the Las Cienegas NCA Unit, the Eastern Slope of the Santa Rita Mountains Unit, and the Scotia Canyon Unit. These critical habitat units fall entirely within the action area and all occur within Recovery Unit 2 for the Chiricahua leopard frog.

The Las Cienegas NCA Unit consists of 1,554 acres (627 ha) that includes 4.3 mile (7 km) reach of Empire Gulch and 1.9 mile (3 km) reach of Cienega Creek. Lateral extent of critical habitat in this unit also includes approximately 25 acres (11 ha) wetlands known as Cinco Ponds, Empire, Springwater, Cieneguita, Rattlesnake, and Oak Tree. Special management is required in this unit to control disease, remove nonnative species, and improve habitat.

The Eastern Slope of the Santa Rita Mountains Unit consists of 186 acres (76 ha) that includes two steel tanks in Louisiana Gulch, Greaterville Tank, Los Posos Gulch Tank, Granite Mountain Tank complex, and dispersal habitat in intervening ephemeral drainages between these four lentic sites. Special management is required in this unit to address limited surface water and control disease.

The Scotia Canyon Unit includes 70 ac (29 ha) in Scotia Canyon, Huachuca Mountain, Cochise County, Arizona, and is entirely on Federal lands in the Coronado National Forest. Special management is required in this unit to remove nonnative predators and disease, protect from catastrophic wildlife impacts, and improve aquatic habitat.

The Las Cienegas NCA Unit is the largest of six critical habitat units in RU2 and the third largest critical habitat unit of all 39 units designated for the species. Even though the Las Cienegas NCA Unit is large compared to other units, we give it no more value than other critical habitat units in the designation beyond its size, and therefore its capacity to support larger populations of frogs. The critical habitat designation was based on functionality, or whether or not each unit has the PCEs to support a metapopulation in and of itself (must have PCE1 and PCE2 and at least four spatially disjunct breeding sites), contribute to a future metapopulation (must have PCE1 and PCE2, but fewer than 4 spatially disjunct breeding sites) or isolated robust population of frogs (PCE1 only) that would then contribute to recovery of the species as described above in the Status of the Species section. In the critical habitat designation, Las Cienegas NCA CH Unit is identified as an isolated population that could contribute to a metapopulation and has both PCE1 and PCE2, and the Eastern Slope of the Santa Ritas Unit is identified as a metapopulation and also has PCE1 and PCE2. There are 4 other critical habitat units in RU2: Florida Canyon Unit and Carr Barn Pond Unit with PCE1 to support an isolated population, Scotia Canyon Unit with PCE1 and PCE2 to support an isolated population with potential for connectivity to a nearby metapopulation, and Ramsey and Brown Canyons Unit with PCE1 and PCE2 to support a metapopulation.

Background for Analyses and Definition of Baseline

The hydrologic data upon which a portion of the following Chiricahua leopard frog-specific analyses are based were described in both the Effects of the Proposed Action section (below) and Effects to Aquatic Ecosystems sections (above).

The hydrologic data are based on a 95th percentile analysis of the Tetra Tech (2010), Montgomery (2010), and Myers (2010) groundwater model best-fit and sensitivity analyses, as applicable. The 95th percentile analyses were developed for the SIR and were included in the May 2015 SBA to address FWS concerns with the use of multiple groundwater models with oftentimes divergent results. The 95th percentile analysis was described in detail in these prior documents, and was summarized in the Sources of Uncertainty subsection of the Effects of the Proposed Action section, above.

We are aware of the analytical strengths and weakness of this approach, but reiterate that our selection of the upper end of the 95th percentile values results in analyses in which 97.5 percent (which includes the 2.5 percent of the least well-represented values at the lower end of the distribution) of the *other* possible hydrologic outcomes exhibit lesser effects. The 95th percentile approach does not represent the most probable outcome (but it does provide reasonable certainty that the effects to this species are unlikely to be greater than those described below). Due to the uncertainty inherent in these modeling efforts, there are no results that can be definitively said to be the most likely to occur. Thus, we have selected the precautionary approach.

Secondly, the following species-specific analysis considers the present-day state of the hydrology to represent the baseline condition. All effects, whether the result of anticipated climate change alone, mine drawdown alone, and/or climate change and mine drawdown combined, are described in terms of their divergence from present-day, pre-project conditions. Climate change is *not* viewed as an ongoing and evolving baseline against which mine-only effects are incrementally assessed.

Effects of the Action - Chiricahua Leopard Frog

"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 or interdependent with that action (50 CFR §402.02). Indirect effects are caused by the action, occur later in time, and are reasonably certain to occur. "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 (50 CFR §402.02).

Direct and indirect adverse effects to Chiricahua leopard frogs from the proposed action are anticipated during construction and operation of the mine as well as after mine operations cease, and are anticipated to continue far into the future. The proposed action may result in injury, death, or disturbance to Chiricahua leopard frogs as well as permanent removal and degradation of their habitats. Conservation measures included in the project description may help offset adverse effects to Chiricahua leopard frogs to some extent.

<u>Effects of Mine Construction and Operation</u>

Effects of Mine Construction and Operation unrelated to groundwater drawdown discussed in the October 30, 2013 BO remain current and are incorporated herein via reference, except for updated information on potential loss of habitat within the security fence as described below.

Complete loss of current and potential habitat for Chiricahua leopard frog will occur within the security fence of the mine. This includes at least four perennial sites centered around Lower Stock Tank (occupied in 2008) and Rosemont Springs, as well as at least three ephemeral tanks including Barrel Tank, North Basin Tank, unnamed tank and ephemeral drainages connecting these sites and other sites outside of the security fence.

<u>Effects of Groundwater Drawdown associated with the Mine</u>

Effects of Groundwater Drawdown associated with the Mine discussed in the October 30, 2013 BO are replaced with the following narrative:

Three different indirect effects from the mine to the Chiricahua leopard frog are associated with groundwater drawdown within the Cienega Creek HUC10 basin: reductions in stream flow, reductions in pool metrics, and reduced water quality. Climate change will further increase these effects relative to the present day baseline conditionThe “Effects to Aquatic Ecosystems” section of this BO describes the hydrologic basis for effects to streams and associated pools in which Chiricahua leopard frogs occur in the Santa Rita MA and Empire Cienega MA, as well as the species critical habitat in the East Slope of the Santa Rita Mountains Unit and Las Cienegas NCA Unit. In addition, the “Effects of the Action – Gila Chub” and “Effects of the Action – Gila Topminnow” sections further detail impacts of groundwater drawdown in key reaches in Cienega Creek and Empire Gulch, and are incorporated by reference. Impacts from the effects of climate change, mine drawdown, and both effects combined, are included as part of our jeopardy and adverse modification analyses.

Chiricahua leopard frogs have been documented in stream and wetland reaches defined in the May 2015 SBA including Empire Gulch reaches 1 and 2, Cieneguita Wetland, and Cienega Creek reaches 1 to 7 (see Figure A-1 in the Effects to Aquatic Ecosystems section and Environmental Baseline for species). Although our analysis will focus on Key Reaches identified in the May 2015 SBA (EG1, EG2, CC2, CC4, CC5, and CC7), we will interpolate to occupied habitats outsides of Key Reaches to the extent possible, including CC1, CC3, CC6, and all habitats that make up the entire Greaterville metapopulation in the Santa Rita MA that also fall within the Cienega Creek HUC10 basin. Although we are not aware of any methodology to correlate Chiricahua leopard frog abundance with stream flow, indirect effects to Chiricahua leopard frog from modeled groundwater drawdown related to stream flow and pool metrics, as well as changes in riparian community composition occur within the action area in all occupied reaches. Impacts from the mine only are small when compared to the effects of climate change. However, the impacts from the mine only do cause negative effects to aquatic habitats; this habitat degradation negatively impacts the Chiricahua leopard frog. Some of these impacts are similar to those described for Gila chub and Gila topminnow, which are incorporated herein with specific applicability to the frog discussed below.

Upper Empire Gulch – Key Reach EG1

Although the 95th percentile stream flow analysis of reach EG1 varies greatly, based on the modeling analyses, we assume that streamflow in EG1 ceases at 100 years post mine closure and pools begin to disappear 50 years after mine closure with all pools eventually lost from groundwater drawdown solely due to operation of the mine. Climate change has very little effect on streamflow and the number of pools, even in combination with mine drawdown. The robust breeding site for Chiricahua leopard frogs at Empire Spring within EG1 will become much more important throughout the life of this project prior to its ultimate disappearance, as climate change is anticipated to reduce availability of water to lentic sites that are part of the Las Cienegas NCA metapopulation. As flow decreases and habitat shrinks, fewer and fewer frogs will be able to use EG1, a reach that appears to be protected from die-offs during outbreaks of Bd. As pools begin to decrease in size, reduction in the wetted perimeter and pool surface area will result in take because all life stages of the frog use the wetted perimeter extensively and tadpoles metamorphose faster in warmer water in the shallows. In addition, smaller pool area and lower volume within pools will affect water chemistry by increasing water temperatures which lower dissolved oxygen levels; both will also adversely affect tadpoles. As flow and pools decrease, effects include reduction of substrate for eggs, substrate for organisms fed on by tadpoles and adult frogs, escape cover for tadpoles and adults, and moist microhabitats for frogs. These effects will reduce the success of eggs, alter growth rates of tadpoles, reduce food for tadpoles and adults, and increase the exposure of tadpoles and adults to vertebrate predation and desiccation (Southwest Endangered Species Act Team 2008).

Degradation and ultimate disappearance of surface water as modeled in the upper portion of Empire Gulch, would permanently remove the longest standing and most prolific site occupied by the Chiricahua leopard frog in the Las Cienegas NCA metapopulation and likely within RU2 for the frog.

Lower Empire Gulch – Key Reach EG2
The percent of June flow remaining at 150 years is predicted to be 82 percent from mine drawdown alone and 54 percent of baseline June flow (12 gpm) from mine and climate change combined (Figure GC-3). An 18 percent decrease in flow from mine drawdown only will decrease habitat available to all life stages of frogs. Loss of pool surface area due to mine drawdown alone predicts that as much as 11 percent loss of surface area at 150 years, with all other time steps at a less than 10 percent loss. Climate change is the predominate factor in surface area losses in EG2 pools, leaving 51 percent of the area at all modeled intervals. Together, climate change and the mine will leave 51 percent of pool surface area intact at end of mining and continue to decrease until only 29 percent of pool surface area remains at 150 years. Therefore frog habitat in pools in lower Empire Gulch will decrease significantly, and experience other effects similar to those described for upper Empire Gulch, although somewhat lower in magnitude. Mine-only data indicate that drawdown may have no contribution (0 days) or up to 19 days of extremely low flows, which would also contribute to adverse effects to tadpoles due to low concentrations of dissolved oxygen.

There are no days of zero flow in lower Empire Gulch under any of the 95th percentile analyses. This equates with no change from the baseline, and flow status would remain perennial. Climate change will result in an additional 26 days of extremely low flows in lower Empire Gulch; mining plus climate change will not increase this number under the 95th percentile analysis. However, mine-only analysis indicates that drawdown may contribute zero or up to 19 of the 26 days of extremely low flow. An additional 26 days of extremely low flow in lower Empire Gulch contributes to the overall adverse effects to the frog.

Upper Cienega Creek – Key Reaches CC2,CC4, CC5 & CC7
Modeled loss of June streamflow from mine-only drawdown is 11 or 12 percent in each of these four key reaches of upper Cienega Creek. The combined impacts of the mine and climate change 150 years after mine closure are much worse with streamflow loss from current June flow at 19 percent decrease in CC2, 24 percent in CC4, 68 percent in CC5, and 100 percent in CC7. This will result in a significant decrease of habitat available to all stages of frogs and reduce connectivity between breeding populations in upper Cienega Creek. However, habitat within

pools will remain within these four reaches in all scenarios. Mine drawdown, with or without climate change, does not change the number of pools present in these reaches, and mine drawdown alone also does not substantially change the pool depth, pool volume, or surface area (1-5%). Climate change plus the mine exacerbates decreases in pool metrics with a reduction in pool depth of 13 to15 percent, reduction of pool area of 12 to 27 percent, and reduction of pool volume by 29 to 45 percent across these four reaches.

There are no zero flow days in CC2 or CC4 under any scenario. Reaches CC5 and CC7 currently exhibit an average of two days with zero stream flow per year. Under the 95th percentile analyses, mine drawdown would change this to two or three days per year in both reaches, and climate change absent the mine's impacts would result in five additional days with zero stream flow per year in CC5, and 23 additional days with zero stream flow per year in CC7. In combination, mine drawdown plus climate change would result in 5 to 9 days with zero stream flow per year in CC5, and from 23 to 31 days with zero stream flow per year in CC7. A review of the 95th percentile mine-only data indicates that climate change drives the frequency of extremely low-flow days 10 to 50 years post mine closure, and the mine's relative contribution to the effects increases at 100 to 150 years. Low flow days increase significantly from current conditions (< 5 days) to the climate change scenario in 150 years (5 to 60 days), with the addition of mine impacts adding 5 to 10 more days of low flow.

As stated before, groundwater drawdown was not specifically modeled in non-key reaches in Cienega Creek that are currently occupied by Chiricahua leopard frogs, including CC1, CC3, and CC6. However, we anticipate effects from drawdown in these reaches to be similar to those described in key reaches.

Overall, streamflow loss, pool reduction, and decreased water quality in these four key reaches of upper Cienega Creek from mine-only drawdown are especially of concern, as these reaches include several stable breeding sites for the species, provide connectivity between these breeding populations, and along with EG1, appear to afford some protection from die-offs of Chiricahua leopard frogs related to Bd. Remaining habitat in Cienega Creek will be more important to the species 150 years post mine closure not only because EG1 will be lost, but also because at this point in time mine drawdown and climate change may have already significantly decreased three wetland habitats within the floodplain of Empire Gulch or Cienega Creek that support breeding populations of frogs and were not modeled in the key reach analysis but are within the 5-foot drawdown perimeter discussed in SWCA (2012) (Spring Water Wetlands in EG2, Cinco Ponds in CC2, and Rattlesnake north of CWG). Climate change may have also reduced or removed breeding sites in wildlife ponds within the action area that are solely supported by surface water, also increasing the importance of remaining populations and habitat within Cienega Creek.

Cieneguita Wetland – Key Reach CGW
Similar to EG1, the 95th percentile range of groundwater drawdown results from mine only encompasses a wide range for the three Cieneguita Wetlands. The number of pools does not change, although pool volumes change significantly, losing 67 percent of their volume and 50 percent of surface area due to impacts from the mine after 150 years. In addition median pool depth of Cieneguita wetlands is reduced from 3.6 to 3.2 feet (11 percent) 150 years after mine closure. Climate change in combination with mine drawdown reduces pool volume by 81

percent, pool surface area by 76 percent, and pool depth by 26 percent.

Other areas
The groundwater modeling results do not discuss the potential for groundwater drawdowns in the Greaterville metapopulation within the Santa Rita MA, although it is inside the 5-foot drawdown perimeter discussed in SWCA (2012). There are no perennial drainages in the portion of the Santa Rita MA that falls within this drawdown perimeter. However, three of the six current breeding sites for Chiricahua leopard frogs in the Greaterville metapopulation are perennial due to wells that could be affected by groundwater drawdown. These sites include the two steel tanks in Louisiana Gulch, Ophir Well, and West Tank. If depth to groundwater drops below the well depth in any of these wells, existing well would no longer be available to supply a perennial source of water to 50% of current breeding sites in this metapopulation.

The May 2015 SBA states that groundwater modeling indicates that in the first 150 years after mine closure, drawdown greater than 10 feet is unlikely to occur at the Empire Wildlife Pond and Maternity Wildlife Ponds (FEIS, pp. 341–345) (Montgomery and Associates Inc. 2010; Tetra Tech 2010). The exact depth of the well at those sites is not known; however, drawdown less than 10 feet was not considered in the FEIS to impact nearby wells (FEIS, p. 294). There also are not expected to be any changes in surface runoff (which also maintains water in the the sites) due to the mine in this watershed (FEIS, p. 398). We do not have groundwater drawdown data to determine if the tanks in Louisiana Gulch, Ophir Well, and West Tank would be similarly unaffected, if a 10-foot threshold is appropriate, nor can we determine if a deepening of the wells maintaining these sites would be effective in sustaining water supplies; no funding for such work has been proposed.

Lastly, we reiterate the analysis that appeared in our October 30, 2013 BO, regarding the potential effects of the pit lake to Chiricahua leopard frogs. The results of geochemical modeling for the mine pit lake indicate that various contaminant levels that would result from these mining processes may exceed aquifer or surface water quality standards for wildlife (which do not actually apply to the water) for three contaminants that are known to bioaccumulate (i.e., cadmium, mercury, and selenium). Cadmium is highly toxic to wildlife, is carcinogenic and teratogenic, and can have sublethal and lethal effects at low environmental concentrations (EPA 2011). It affects respiratory functions, enzyme levels, muscle contractions, growth reduction, and reproduction. Cadmium is known to bioaccumulate in the food chain. A portion of mercury released into the environment is transformed by abiotic and biotic chemical reactions to organic derivatives, such as methylmercury, which bioaccumulates in individual organisms, biomagnifies in aquatic food chains, and is the most toxic form of mercury to which wildlife are exposed (EPA 1997). Risks from selenium are primarily associated with aquatic species. Selenium is a bioaccumulative pollutant, and aquatic life is exposed to selenium primarily through diet (EPA 2004). Risks stem from aquatic life eating food that is contaminated with selenium, rather than from direct exposure to selenium in the water. Chiricahua leopard frogs could thus be directly exposed to contaminants should individuals disperse to and occupy the pit lake. We hypothesize that effects to this species could also occur from eating winged aquatic invertebrates originating in and, via flight, being exported from the mine pit lake to sites where they may be preyed upon by Chiricahua leopard frogs.

Effects of the Action on Critical Habitat

Adverse effects as a result of the mine are anticipated in two of 39 designated CH units for Chiricahua leopard frog. All effects of the action to critical habitat are associated with groundwater drawdown associated with the mine or the mine plus climate change. Reaches EG1, EG2, CGW, CC1, and CC2 make up the majority (71 percent) of the Las Cienegas NCA CH Unit. In addition, the Eastern Slope of the Santa Ritas CH Unit is entirely within the groundwater drawdown area associated with the mine, although it includes no stream reaches modeled in the May 2015 SBA or SIR.

Within the Las Cienegas NCA CH Unit, potential adverse effects to aquatic breeding habitat and immediately adjacent uplands (PCE1) include complete loss and of standing water in Empire Spring in reach EG1 with pools beginning to disappear 20 years after the beginning of mine operations, and partial loss of standing water in slow-moving water and reduction of pools in Empire Gulch at its confluence with Cienega Creek (EG2), Cieneguita Wetlands (CGW), and reaches modeled in Cienega Creek (CC1 and CC2). As discussed above in the Status of the Species in the Action Area section, Empire Spring in EG1 and the Headwaters Reach in CC2 may afford some protection from Bd (PCE1d), since frogs in this area carry low levels of chytrid zoospores but have not been found to succumb to the disease here to date (Hall *et al* 2015). Groundwater withdrawal may also cause a reduction in emergent and submergent vegetation and foraging and basking habitat immediately adjacent to surrounding breeding aquatic habitat (PCE1b). Within the Eastern Slope of the Santa Rita Mountains CH Unit, there is a potential reduction in standing water in aquatic breeding habitat (PCE1) in the steel tanks in Louisiana Gulch and Granite Mountain Well in Ophir Gulch because they are supplied by groundwater wells, which represent 50% of the breeding sites included in this critical habitat unit.

Mine-only groundwater withdrawal and the combined impacts of the mine and climate change may adversely affect all dispersal and nonbreeding habitat (PCE2) critical habitat within the Las Cienegas NCA and Eastern Slope of the Santa Rita Mountains CH Units. Dispersal and nonbreeding habitat is found within the portion of Empire Gulch between EG1 and CGW, lower Empire Gulch (EG2), and upper Cienega Creek reaches CC1 and CC2. This includes complete loss of value of dispersal habitat in Empire Gulch that connected breeding habitat at Empire Spring to breeding habitats in Cieneguita Wetlands, lower Empire Gulch, and upper Cienega Creek. In other words, there is no longer a need for connectivity because the breeding population at Empire Spring in EG1 is lost. In remaining critical habitat areas reduced by groundwater withdrawal (CGW, EG2, CC1, and CC2), there will be a reduction in low and mid-story vegetation cover for shelter, forage, and protection from predators. Intermittent and perennial aquatic habitat may be reduced in wetted corridors as well. In the Eastern Slope of the Santa Rita Mountains CH Unit, if PCE1 is lost due to groundwater withdrawal, this effectively reduces the need for connectivity to these sites, making PCE2 in Louisiana Gulch and Ophir Gulch obsolete.

Overall, mine-only groundwater withdrawal alone may permanently remove 49 percent of the Las Cienegas NCA CH Unit beginning 20 years after mine closure and mine impact combined with impacts of climate change may reduce the functionality of both PCE1 and PCE2 in the remaining 51 percent of this CH Unit within 150 years of mine closure. Mine-only groundwater withdrawal may also remove 50 percent of the Eastern Slope of the Santa Rita Mountains CH

Unit (climate change effects were not modeled here). In terms of RU2 for Chiricahua leopard frog, mine-only groundwater withdrawal may permanently remove 40-45 percent (759.5 to 852.5 acres) and reduce functionality of 41 percent (792 acres) of the 1,912.6 acres of critical habitat designated within RU2. Remaining critical habitat in RU2 unaffected by the proposed action includes 249 acres (13 percent) among five critical habitat units in this RU. A portion of the Eastern slope of the Santa Rita Mountains CH Unit as well as four other small critical habitat units will not be affected by the proposed action, but may be affected by climate change. In terms of all RUs for the frog, mine-only groundwater withdrawal permanently removes 6.8-7.7 percent of the total CH designation for the species, and mine-only plus climate change groundwater withdrawal reduces functionality of another 7.7 percent of the total CH designation for the species.

Effect of the Proposed Conservation Measures

Effects of the proposed conservation measures to Chiricahua leopard frogs contained in the October 30, 2013 BO remain applicable and are incorporated herein via reference, with the exception of updated information on Sonoita Creek Ranch and the addition of the Harmful Nonnative Species Management and Removal Conservation Measure. The latter conservation measure was identified in the February 11, 2016 letter from the Rosemont Copper Company to the Coronado National Forest, and has been described in detail in the Description of the Proposed Action section, above. The revised and new conservation measures are as follows:

Sonoita Creek Ranch – As described in the 2013 BO and HMMP, Rosemont will acquire Sonoita Creek Ranch. In the 2013 BO, we concurred with the AGFD's recommendation in their letter dated February 14, 2013, that these two large ponds will be better managed for native vertebrates if they were reconstructed as a conglomeration of smaller bodies of water, after the removal of existing nonnative species. However, regional bullfrog populations are likely to continuously infiltrate these ponds and render them useless for Chiricahua leopard frog conservation unless bullfrogs are removed from the Sonoita Creek watershed. While construction of barrier fencing to restrict movement of bullfrogs might allow these water features to act as an isolated source population of Chiricahua leopard frogs, fencing would have to be constantly managed; this has not been shown to be a long-term solution that contributes to recovery of the frog. Bullfrogs would likely breech the facility at some point due to the lack of any bullfrog eradication program in this area. In addition, as stated in the update of the environmental baseline, since the 2013 BO was completed we have discovered isolated populations of Chiricahua leopard frogs on the eastern edge of the Sonoita Creek MA that are serving as source populations for other sites within the MA. Adding an isolated population that is surrounded by bullfrogs does not contribute to recovery of the Chiricahua leopard frog. Therefore, we do not support introducing Chiricahua leopard frogs into Sonoita Creek Ranch waters for conservation purposes. Please note that Chiricahua leopard frog Term and Condition 4 from the October 30, 2013, Final BO is no longer binding.

Cienega Creek Watershed Conservation Fund-The Cienega Creek Watershed Conservation Fund will provide $200,000 a year for 10 years for development and implementation of measures intended to preserve and enhance aquatic and riparian ecosystems and the federally listed aquatic and riparian species that depend on them. For our analysis of effects to the Chiricahua leopard frog and based on recent history, continued commitments from recovery partners, and near- to mid-term planning efforts from the local recovery group, we assume that in most years, the Las Cienegas NCA will be maintained free of harmful nonnatives through a combination of BLM funding and supplementary funding through grant awards, other public and private partnerships, and as necessary, through the Cienega Creek Watershed Conservation Fund. Maintaining Las Cienegas NCA free from nonnative species will help minimize the effect of take from the proposed action; the proposed action is anticipated to result in the loss of occupied habitat that supports the Empire Cienega metapopulation of Chiricahua leopard frogs and its critical habitat within the Las Cienegas NCA CH Unit.

Harmful Nonnative Species Management and Removal- The addition of a conservation measure to fund nonnative species management removal in the San Rafael Valley-Santa Cruz River Hydrologic Unit 10 subbasin may also help minimize the effect of take from the proposed action. If implemented fully and successfully, this conservation measure would benefit the Chiricahua leopard frog in the Patagonia Mountains-San Rafael Valley MA and a small portion of the Huachuca Mountains MA. The USFS owns 68 percent of the San Rafael Valley-Santa Cruz River Hydrologic Unit 10 subbasin, with remaining lands owned by the State of Arizona (3 percent), and private land owners (29 percent). While addressing nonnatives on USFS lands is important, it will be critical to work with the two remaining landowners since the Santa Cruz River headwaters are located on their lands, acting as a major source population of harmful nonnative species throughout the remainder of the San Rafael Valley. Because there is currently only one site within this subbasin that is occupied by the Chiricahua leopard frog, successful implementation of this conservation measure would provide an opportunity to establish a metapopulation similar to the scope and function of the large Empire Gulch metapopulation on Las Cienegas NCA.

Summary of Effects – Chiricahua leopard frog

- Mine construction and operation are anticipated to directly kill and harm Chiricahua leopard frogs, to remove at least two lentic sites currently occupied by the frog within the fenced area, and to render the mine pit potentially both a source of contaminated prey and a sink for the species within its dispersal distance;
- Impacts from the mine to groundwater, and thus to surface water (streamflow, pool area, pool volume, pool depth), are expected in designated critical habitat and areas occupied by Chiricahua leopard frogs, and thus would negatively affect the frog;
- The proposed conservation measures will not preclude all anticipated effects to surface water from occurring nor entirely mitigate those effects;
- Within 50 to 150 years post-closure of the mine, substantial decreases to wetted stream perimeter and water depth are anticipated to occur;
- Mine-only groundwater drawdown in upper Empire Gulch may result in total loss of the most robust breeding population of Chiricahua leopard frogs in the MA at Empire Spring. This spring serves as a major source of frogs for dispersal to other sites within the Empire Cienega metapopulation, as well as potential connectivity to the Santa Rita metapopulation;
- Mine-only groundwater drawdown is anticipated to potentially result in complete loss of streamflow and pools in upper Empire Gulch, 18 percent loss in lower Empire Gulch, and 11 percent average loss in Cienega Creek reaches occupied by Chiricahua leopard frog. In

addition, pool metrics in Cieneguita Wetlands change significantly, losing 67 percent of their volume and 50 percent of surface area;

- There is more impact from the mine resulting in loss of present-day baseline streamflows than impact from climate change in areas of upper Cienega Creek occupied by the frog (CC2 and CC4). Together, the effects of both the mine and climate change to present-day conditions are relatively large. Downstream in CC7, climate change represents the greatest adverse effect to surface flow, with the effects of the mine being relatively less. Partial loss of breeding and dispersal habitat may occur in Empire Gulch reach EG2 located at the confluence of Empire Gulch and Cienega Creek, and Cienega Creek reaches CC2, CC4, CC5 and CC7 that currently support all life stages of frogs;
- Habitat in Cienega Creek will likely be more important to frogs by the time of 150 years post mine-closure because climate change will likely have already significantly decreased wetland habitats outside of the creek that are currently supporting breeding populations of Chiricahua leopard frogs;
- Loss of habitat in the Headwaters, Coldwater Spring and immediately downstream of Coldwater Spring reaches of upper Cienega Creek (CC2, CC4, CC5) may also decrease the ability of the frog to deal with Bd die-offs since these sites may not be able to support as many frogs due to further loss of habitat after the effects of climate change are considered;
- As a conservation measure (see the Description of the Proposed Action section in our October 30, 2013, BO and Item 5, page 48, of the second supplemental BA dated February 2013 for additional detail), the project proponent will secure water sources (via tank improvements, liner installations, and/or installation of solar wells) for up to 30 sites in the Santa Ritas MA, including all six current breeding sites that make up PCE1 of the Eastern Santa Rita CH Unit. This measure mitigates effects from drought (a serious threat in this MA) over time and therefore, may improve the baseline for this species in the area and its resiliency against extirpation. However, this conservation measure does not reduce or minimize the effect of groundwater withdrawal because groundwater withdrawal is not anticipated to influence water levels in stock tanks;
- Almost half of the Las Cienegas NCA CH Unit may be completely lost due to mine-driven drawdowns and the effects of climate change relative to the present-day baseline, and the remaining half diminished, although remaining portions in upper Cienega Creek, lower Empire Gulch, and Cieneguita Wetlands will still contain PCE1 and PCE2 and are likely to continue to contribute to the larger functioning Las Cienegas NCA metapopulation;
- A proposed conservation measure will create the “Cienega Creek Watershed Conservation Fund” which will supplement funding for nonnative species control on Las Cienegas NCA as well as other management and restoration actions in the watershed for a period of ten years; and,
- A proposed Harmful Nonnative Species Management and Removal conservation measure will decrease the threat of nonnative species in a majority of the currently unoccupied Patagonia Mountains-San Rafael Valley MA and a small portion of the currently occupied Huachuca Mountains MA.

Cumulative Effects - Chiricahua Leopard Frog

Cumulative effects described in the October 30, 2013BO remain current; this section is incorporated herein via reference.

Conclusion - Chiricahua Leopard Frog

As discussed in full in the Sources of Uncertainty section, above, we have chosen to base our effects analysis on the upper end of the 95th percentile analysis. Given the long time frames involved, long distances involved, and small amounts of drawdown in the aquifer, there is a high degree of uncertainty associated with groundwater predictions. The scenario represented by the upper end of the 95th percentile analysis is not the scenario most probable to occur. Rather, by selecting it we are analyzing a conservative position that ensures almost all of potential and reasonable outcomes disclosed by the models would be encompassed by this BO analysis. This conservative approach ensures that under almost all potential outcomes that can be reasonably predicted, the conclusions of non-jeopardy and no destruction or adverse modification, below, would remain valid.

After reviewing the current status of the Chiricahua leopard frog, the environmental baseline for the action area, the effects of the proposed Rosemont Mine Project, and the cumulative effects, it is FWS's biological opinion that the action, as proposed, is not likely to jeopardize the continued existence of the Chiricahua leopard frog nor destroy or adversely modify its designated critical habitat. Definitions of jeopardy and adverse modification are provided in the Gila chub section of this document. We present this conclusion for the following reasons:

1. The majority of the project activity likely associated with direct adverse effects from mine construction and operation is located on the northern-most edge of the recovery focus for the Santa Rita MA. The metapopulations that have been the focus of recent recovery actions in the Santa Rita MA are spatially distant from the active mining area, which decreases the likelihood for dispersing frogs to be present in the active mining area.
2. Conservation measures, in particular those which help secure metapopulation resiliency from the effects of drought (securing perennial water at numerous stock tanks in the Santa Rita MA) and from the effects of harmful nonnatives (Cienega Creek Conservation Fund), are expected to continue to provide meaningful conservation and recovery benefit into the long term. The Harmful Nonnative Species Management and Removal Program in the San Rafael Valley is expected to restore a Chiricahua leopard frog metapopulation at a subbasin level if its goals and objectives are met. We believe this measure may provide the same level of conservation and recovery benefit to the species as a whole as the Las Cienegas NCA does currently for the period of time the program remains funded, or approximately 13 years. The species-specific measures as identified and analyzed in the October 30, 2013, BO, which are intended to minimize the effect or likelihood of take associated with mine construction, provide additional benefit in varying degrees.
3. Although complete loss of Empire Spring 20 years after mine closure and significant loss of habitat in key reaches in Cienega Creek within 150 years after mine closure has been modeled, remaining habitat within Cienega Creek, although reduced, will likely continue to support a smaller and less-resilient Las Cienegas NCA metapopulation that will continue to contribute to recovery in RU2 and to the species as a whole.
4. Rosemont will monitor groundwater drawdown and the USFS will compare observed drawdown to modeled drawdown. Groundwater drawdown greater than modeled will be evaluated and may require reinitiation of section 7 consultation;
5. While three of the six current lentic breeding sites currently supported by groundwater wells

in the Greaterville metapopulation may be lost to groundwater withdrawal from the mine, a proposed conservation measure to secure water sources for up to 30 sites in the Santa Ritas MA (see Item 5, page 48, of the second supplemental BA dated February 2013) will ensure that all six breeding sites have a perennial water source supplied by new or improved groundwater wells at each site as needed. This includes the six sites that make up PCE1 of the Eastern Santa Rita CH Unit in the Eastern Santa Rita MA of RU2; these sites will allow conservation of Chiricahua leopard frog habitat in the Santa Ritas MA within RU2 as well as partial threat removal in the Eastern Santa Rita CH Unit. The Cienega Creek Watershed Conservation Fund will protect habitat for Chiricahua leopard frog by funding nonnative species control on Las Cienegas NCA as well as other management and restoration actions in the watershed for a period of 10 years (please note that this nonnative species control action is separate from and in addition to the Harmful Nonnative Species Management and Removal Program);

6. While the proposed Harmful Nonnative Species Management and Removal conservation measure will not preclude anticipated effects to Chiricahua leopard frog from groundwater withdrawal caused by the mine from occurring in the Empire and Santa Rita MAs and their corresponding critical habitat units in RU2, it will set the stage for establishing a new metapopulation of Chiricahua leopard frogs in another MA within this RU.
7. Successful conservation and recovery actions have taken place since species listing and subsequent designation of critical habitat, and continue to occur, with more actions in planning. Therefore, we believe the overall status of the species is improving.
8. Even though functionality of the Las Cienegas NCA CH Unit with respect to PCE 1d (which requires that "…. environmental, physiological, and genetic conditions are such that allow persistence of Chiricahua leopard frogs" [in the presence of Bd]) may be greatly reduced, other attributes of PCEs will only be partially affected or completely unaffected by the proposed action. Quantitatively speaking, the Las Cienegas NCA CH Unit represents 40 percent of designated critical habitat from RU2, and 6.8 percent of total CH designation for the species. While some aquatic habitat will be lost in this Unit, aquatic habitat will be gained in the adjacent Santa Rita MA through securing perennial water in lentic sites. The Las Cienegas NCA CH Unit will maintain much of its functionality and contribute to a smaller, less robust Las Cienegas NCA metapopulation which can contribute to recovery in RU2 and to the species as a whole.

The de-listing criteria in the Chiricahua leopard frog recovery plan (USFS 2007) are useful for determining jeopardy. Before considering Chiricahua leopard frog for de-listing, at least two metapopulations located in different drainages (defined here as USGS 10-digit Hydrologic Units) plus at least one isolated and robust population in each recovery unit must exhibit long-term persistence and stability for a period of 25 years (even though local populations may go extinct in metapopulations) as demonstrated by a scientifically acceptable population monitoring program. In addition, protection of these populations and metapopulations, connectivity and dispersal habitat protection, and reduction or elimination of threats and long-term protection must be achieved in each recovery unit.

Although the impacts of the proposed action may affect the long-term functionality of only one of the two current functioning Chiricahua leopard frog metapopulations in RU2 by indirectly increasing the effect of Bd on the metapopulation, the action area is small compared to the entire range of the species, and therefore large-scale physical alteration to the species' habitat is not occurring, thus not appreciably diminishing the likelihood of recovery nor the value of critical habitat in serving that role. While the action area does include a unique and important metapopulation of the species, one of the reasons the metapopulation is unique is because it occurs in a subbasin that has been managed in a manner that has functionally removed a primary threat to the species: harmful nonnative species. However, the conservation measure "Harmful Nonnative Species Management and Removal Program in the San Rafael Valley" is expected to create another unique metapopulation. This opportunity is poised to be important in moving the species toward recovery, especially if funding can be secured to keep the program going for the long-term. We believe that Chiricahua leopard frogs will still be present in the Las Cienegas NCA metapopulation 150 years after closure of the mine since adequate water should be present to support breeding populations within upper Cienegas Creek even though Empire Gulch is expected to be effectively lost. The adverse 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 conclusions and discussion above.

Based on the above analyses and summary, it is the FWS's biological opinion that the proposed action will not alter the ability of this critical habitat to retain its PCEs and to function properly. As such, Chiricahua leopard frog designated critical habitat is anticipated to remain functional to serve its intended conservation role for the species. Therefore, we conclude that the proposed action is not likely to destroy or adversely modify designated critical habitat nor significantly delay or preclude its role in recovery of the species.

INCIDENTAL TAKE STATEMENT - CHIRICAHUA LEOPARD FROG

The following Incidental Take Statement replaces the Incidental Take Statement for Chiricahua leopard frog in the October 30, 2013, BO.

Section 9 of the Act and Federal regulations pursuant to section 4(d) of the Act 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 further defined (50 CFR 17.3) 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. "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 of 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 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 the USFS 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. The USFS has a continuing duty to regulate the activity covered by this incidental take statement. If the USFS (1) fails to assume and implement the terms and conditions or (2) fails to require any 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, the USFS must report the progress of the action and its impact on the species to the FWS as specified in the incidental take statement. [50 CFR 402.14(i)(3)].

Amount or Extent of Take - Chiricahua Leopard Frog

We anticipate take of Chiricahua leopard frogs in the following forms: (1) complete loss of current and potential habitat for Chiricahua leopard frog within the security fence of the mine and outside of the security fence of the mine but within the action area (thus harming the species); (2) harm or harassment to frogs in four perennial sites centered around Lower Stock Tank and Rosemont Springs, as well as three ephemeral tanks including Barrel Tank, North Basin Tank, unnamed tank and ephemeral drainages connecting these sites and other sites outside of the security fence. We also anticipate take of 200 Chiricahua leopard frogs and 8 egg masses in the form of harm or harassment from adverse effects associated with the mine construction and continued operations at the active mine site and access roads, including impacts to occurrence of frogs in aquatic sites and stormwater detention ponds (see the Chiricahua leopard frog-specific Conservation Measures in the Oct 2013 BO). This number is our conservative estimate of the total number of frogs that could be taken within the active mining footprint and associated road use – including stormwater ponds - over the life of the mine. Currently there are two stock tanks within the security fence that have had dispersing Chiricahua leopard frogs detected in them. Rosemont will survey for Chiricahua leopard frogs prior to construction, and if frogs are found within the mine footprint they will be moved outside of the mine footprint, which will reduce the potential for take (see the Chiricahua leopard frog-specific Conservation Measures in the Oct 2013 BO).

We anticipate a proportion of Chiricahua leopard frogs will be taken through the implementation of conservation measures, most likely from activities associated with capture, detainment, disease treatments, transportation, and release of frogs in all life stages (see Oct 2013 BO). It is impractical to quantify actual numbers of individuals taken under these mechanisms and we are not going to limit this form of take because potential, short-term adverse effects are far less significant than the conservation value gained in recovery of the species in the area and because the net number of individuals potentially harmed is far exceeded by the number of individuals which are benefited or created by the implementation of these activities.

We also anticipate take of Chiricahua leopard frogs in the form of harm from adverse effects associated with groundwater drawdown from the proposed action, throughout the modeled analysis period and potentially beyond. Reduction in stream discharge and or pool surface area ranging from 11 percent to 100 percent of baseline measurements in Key Reaches in Empire Gulch and upper Cienega Creek, as well as a reduction in well discharge in wells in Louisiana Gulch and Ophir Gulch, as a result of groundwater drawdowns attributable to the proposed action will reduce the extent and quality of aquatic habitat required by Chiricahua leopard frog; we are thus reasonably certain that this take will occur.

Incidental take of Chiricahua leopard frogs in Empire Gulch, Cienega Creek, Cieneguita Wetlands, and breeding sites supplied by well water in Louisiana Gulch and Empire Gulch, is difficult to determine for the following reasons: population levels cannot be accurately described with existing information and techniques, dead animals are difficult to find, cause of death may be difficult to determine, and losses may be masked by seasonal fluctuations in numbers or other causes. This incidental take is expected to be in the form of harm through the loss of habitat from groundwater drawdown.

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. However, it is impossible to quantify the number of individual Chiricahua leopard frogs taken because: (1) dead or impaired individuals are almost impossible to find (and are readily consumed by scavengers and predators) and losses may be masked by seasonal fluctuations in environmental conditions; (2) the status of the species will change over time through disease, natural population variation, natural habitat loss, or the active creation of habitat through management; and (3) the species is small-bodied, well camouflaged, and occurs under water of varying clarity.

Therefore, the incidental take of Chiricahua leopard frogs due to indirect effects is expressed in terms of the groundwater drawdowns noted in the locations and time frames (0, 20, 50, 150 years) discussed in analysis of the effects to the Gila chub and used to support analyses for the other aquatic vertebrate species under consultation for this project. We believe this surrogate measure is appropriate for the Chiricahua leopard frog under this consultation because the most significant effects to this species (and other aquatic vertebrates under consultation) pertain to diminishment or loss of surface water as a result of groundwater withdrawal. We have based our analysis on how these effects were modeled over time. Groundwater monitoring is the appropriate means to evaluate, over time, what the actual effect on riparian and aquatic habitat will be, prior to it actually occurring.

These Incidental Take Statements are incorporated herein via reference.

Effect of the Take - Chiricahua Leopard Frog

In this biological opinion, we determine that these levels of anticipated take are not likely to result in jeopardy to the species nor result in destruction or adverse modification of its designated critical habitat for the reasons stated in the Conclusions section.

Reasonable and Prudent Measures - Chiricahua Leopard Frog

The FWS believes the following reasonable and prudent measures are necessary and appropriate to minimize impacts of incidental take of Chiricahua leopard frog:

1. The USFS and Corps shall ensure that Rosemont monitors the incidental take within the fenced area of the mine resulting from construction and operation of the mine.

2. The USFS and Corps shall ensure that Rosemont ensures that necessary precautions are taken to minimize the potential for Chiricahua leopard frogs to become attracted to water features near the active mining area (FEIS mitigation measure FS-BR-11).

3. A designated third party shall ensure that Rosemont applies the funds identified for the Cienega Creek Watershed Conservation Fund conservation measure solely to the identified conservation projects, including as a supplement, to maintain Las Cienegas NCA free of harmful nonnative aquatic species, unless more appropriate actions are later identified and approved by the USFS, Corps, and FWS (FEIS, Appendix B, p. B-43). If a third party is not so designated, the USFS and Corps shall ensure the funds are applied as stated. This is equivalent to Reasonable and Prudent Measure 2 for the Gila Chub.

4. The USFS and Corps shall ensure that Rosemont improves the resiliency of lentic aquatic habitat to secure breeding populations of Chiricahua leopard frogs at sites within the affected MAs (see also FS-BR-05 in the FEIS).

5. The USFS shall ensure that the proponent adheres to any Reasonable or Prudent Measures and Terms and Conditions, outlined for the northern Mexican gartersnake, which pertain to the harmful nonnative species removal program.

6. The FS shall ensure that Rosemont monitors groundwater levels (as a surrogate for take of Chiricahua leopard frog from effects of groundwater withdrawal) at least annually (FEIS mitigation measure FS-BR-27). This is equivalent to Reasonable and Prudent Measure 1 for the Gila Chub.

The USFS and Corps shall ensure that the proponent adheres to any Reasonable or Prudent Measures, outlined for the northern Mexican gartersnake, which pertain to the Harmful Nonnative Species Removal and Management Program (which provides equal benefit to the Chiricahua leopard frog, Gila topminnow, Gila chub, desert pupfish, and to a lesser extent, Huachuca Water Umbel).

Terms and Conditions - Chiricahua Leopard Frog

In order to be exempt from the prohibitions of section 9 of the Act, the USFS and Corps shall ensure that Rosemont complies with the following terms and conditions, which implement the Reasonable and Prudent Measures described above and outline required reporting/monitoring requirements. These terms and conditions are non-discretionary.

1. The USFS and Corps shall ensure that Rosemont monitors potential Chiricahua leopard frog breeding habitat on National Forest System and Rosemont-owned land within one mile of the active operations area, including (but not limited to) on-site stormwater ponds, twice monthly from July 1 through September 30, while the mine is in operation. The one-mile monitoring criterion is based on the species' overland dispersal distance (see Status of the Species, above). If Chiricahua leopard frogs are detected on site or within a mile of the active operations area, they will be relocated to suitable habitat within the Chiricahua leopard frog

recovery MA under close coordination with the FWS. This Term and Condition augments Conservation Measures 2 and G-3 (3.1-3.6) with respect to Chiricahua leopard frogs. See also FEIS Mitigation Measure BR-11. This Term and Condition implements Reasonable and Prudent Measure 1.

2. Consistent with FEIS mitigation measure FS-BR-11, the USFS and Corps shall ensure that Rosemont explores alternatives to traditional stormwater pond construction, operation, etc. in order to minimize water holding duration to the maximum extent practicable without compromising the primary function of the ponds; this is to reduce the creation and maintenance of habitat in the active operations area that could become an attractive nuisance for frogs. This Term and Condition replaces Conservation Measure G-7 for Chiricahua leopard frogs. See also FEIS Mitigation Measures BR-03 and BR-11. This Term and Condition implements Reasonable and Prudent Measure 2.

3. Refer to Term and Condition 2 for Gila chub for the implementation of Reasonable and Prudent Measure 3 for the Chiricahua leopard frog. In addition, the USFS and Corps shall ensure that Rosemont records a restrictive covenant for Sonoita Creek Ranch stating that it will not be managed as a recovery site for Chiricahua leopard frogs unless bullfrogs are eradicated within a 7-mile radius of the created wetlands. This Term and Condition augments the Conservation Measure pertaining to the acquisition and subsequent management of the Sonoita Creek Ranch. This Term and Condition supersedes Chiricahua leopard frog Term and Condition 4 from the October 30, 2013, Final BO.

4. The USFS and Corps shall ensure that Rosemont coordinates with the FWS in the identification and location of the seven lentic sites to be improved for Chiricahua leopard frog conservation (see the Water Source Enhancement and Mitigation subsection of the Description of the Proposed Action and Chiricahua Leopard Frog Term and Condition 5 in the October 30, 2013, Final BO). These sites may or may not include particular sites referenced in the conservation measures of the Biological Assessment, may or may not be located on grazing allotments managed by Rosemont, but will be located on Coronado National Forest lands within the Santa Rita Management Area. We encourage that sites within the Empire Management Unit also be considered to the extent acceptable to those responsible for compliance with these terms and conditions (see Conservation Recommendation 4 below). To protect against the threat of prolonged drought, each of the seven tanks that will be improved for permeability and retention shall also have an artificial water source provided, such as a solar groundwater well, to ensure permanency of water at improved sites. Any water features that are created in addition to these seven sites that may affect the status of Chiricahua leopard frogs in the action area will be chosen in coordination with the local recovery group (consisting of private, state, and Federal partners) to facilitate avoiding incidental adverse effects or to create conservation opportunities. This Term and Condition augments or replaces several Conservation Measures proposed, including Conservation Measures 4 and 5 (pages 47-48) from the February 2013, second supplemental BA. This Term and Condition implements Reasonable and Prudent Measure 4.

5. Reasonable and Prudent Measure 5 does not require an implementing Term and Condition.

6. Refer to the Terms and Conditions 1.1 through 1.5 for the Gila chub for the implementation of Reasonable and Prudent Measure 6 for the Chiricahua leopard frog. This Term and Condition implements Reasonable and Prudent Measure 6.

These Reasonable and Prudent Measures, with their implementing Terms and Conditions, are designed to minimize the effects of incidental take that might 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. The Coronado National Forest and/or Corps must immediately provide an explanation of the causes of the taking and review with our office the need for possible modification of the reasonable and prudent measures and/or reinitiation of consultation.

Conservation Recommendations - Chiricahua Leopard Frog

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.

1. We recommend that the Coronado National Forest implement Forest-specific recovery actions as described within the Chiricahua Leopard Frog Recovery Plan (FWS 2007).

2. We recommend the Coronado National Forest work with FWS (in coordination with other wildlife agencies) to continue to control nonnative aquatic organisms on the Forest, particularly bullfrogs, nonnative fish, and crayfish. We therefore encourage the Coronado National Forest to consider installing drains at each of the seven tanks that will be improved or created for use by Chiricahua leopard frogs described in Term and Condition 4. Drains can significantly assist resource managers in the management of harmful nonnative species such as bullfrogs in the event they colonize any one or more of the improved or created tanks.

3. We recommend that the Coronado National Forest continue to identify factors that limit the recovery potential of Chiricahua leopard frogs on lands under their jurisdiction and work to correct them.

4. We recommend the Coronado National Forest also consider implementation of Term and Condition 4 above in the Empire Management Unit where indirect effects of the action are the most significant although not under the management jurisdiction of the Forest Service itself.

In order for us 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.

NORTHERN MEXICAN GARTERSNAKE

Status of the Species

The Federal Register notice listing the northern Mexican gartersnake as threatened under the Act was published on July 8, 2014 (79 FR 38678). Please refer to this rule for more in-depth information on the ecology and threats to the species, including references. Critical habitat was proposed on July 10, 2013 (78 FR 41500) and has not yet been designated. We expect to publish a modified re-proposal for critical habitat and an accompanying Notice of Availability announcing the draft Environmental Assessment and draft Economic Analysis in 2016. Details on critical habitat are provided below. The final listing and proposed critical habitat rules are incorporated herein by reference.

The northern Mexican gartersnake, which reaches up to 44 inches total length, 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 because of its similarity of appearance to other native gartersnake species.

Throughout its rangewide distribution, the northern Mexican gartersnake occurs at elevations from 130 to 8,497 ft (Rossman *et al.* 1996) and is considered a “terrestrial-aquatic generalist” by Drummond and Marcías-García (1983). The northern Mexican gartersnake is often found in riparian habitat, but has also been found hiding under cover in grassland habitat up to a mile away from any surface water (Cogan 2015). The subspecies has historically been associated with three general habitat types: 1) source-area wetlands (e.g., Cienegas or stock tanks); 2) large-river riparian woodlands and forests; and 3) streamside gallery forests (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. 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 thought to heavily depend upon a native prey base (Rosen and Schwalbe 1988). Northern Mexican gartersnakes forage along vegetated stream banks, searching for prey in water and on land, using different strategies (Alfaro 2002). Primarily, its diet consists of amphibians and fishes, such as adult and larval (tadpoles) native leopard frogs, as well as juvenile and adult native fish (Rosen and Schwalbe 1988), but earthworms, leeches, lizards, and small mammals are also taken. In situations where native prey species are rare or absent, this snake’s diet may include nonnative species, including larval and juvenile bullfrogs, western mosquitofish (Holycross *et al.* 2006, Emmons and Nowak 2013), or other nonnative fishes. In northern Mexican gartersnake populations where the prey base is skewed heavily towards harmful nonnative species, recruitment of gartersnakes is often diminished or nearly absent.

Natural predators of the northern Mexican gartersnake include birds of prey, other snakes, wading birds, mergansers, belted kingfishers, raccoons, skunks, and coyotes (Rosen and

Schwalbe 1988, Brennan *et al.* 2009). Historically, large, highly predatory native fish species such as Colorado pikeminnow may have preyed upon northern Mexican gartersnakes where they co-occurred. Native chubs in their largest size class may also prey on neonatal gartersnakes, but this has not been confirmed in the literature or through field observation.

Sexual maturity in northern Mexican gartersnakes occurs at two years of age in males and at two to three 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 in July and August (Rosen and Schwalbe 1988, Nowak and Boyarski 2012).

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 wetlands such as Cienegas, ponds, or stock tanks (Rosen and Schwalbe 1988, Rosen *et al.* 2001; Holycross *et al.* 2006; see Figure NMGA-1). In New Mexico, the gartersnake had a limited distribution that consisted of scattered locations throughout the Upper Gila River watershed in Grant and western Hidalgo Counties (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, comprising approximately 85 percent of the total rangewide distribution of the subspecies (Rossman *et al.* 1996).

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 middle/upper Verde River. In New Mexico and elsewhere in Arizona, the northern Mexican gartersnake may occur in extremely low population densities within its historical distribution; limited survey effort is inconclusive to determine extirpation of this highly secretive species. 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 understood. Less is known 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.

We have concluded that in as many as 23 of 33 known localities in the United States (70 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. Only five populations of northern Mexican gartersnakes in the United States are considered likely viable where the species remains reliably detected. Harmful nonnative species are a significant concern in almost every northern Mexican gartersnake locality in the United States and the most significant reason for their decline. Harmful nonnative species can contribute to starvation of gartersnake populations through competitive mechanisms, and may reduce or eliminate recruitment of young gartersnakes through predation. Other threats include alteration of rivers and streams from dams, diversions, flood-control projects, and groundwater pumping that change flow regimes, reduce or eliminate habitat, and favor harmful nonnative species; and effects from climate change and drought (79 FR 38678).

Table NMGS-1: Current population status of the northern Mexican gartersnake in the United States						
Row	**Location**	**Last Record**	**Suitable Physical Habitat Present**	**Native Prey Species Present**	**Harmful Nonnative Species Present**	**Predicted Population Status**
1	Gila River (NM, AZ)	2013	Yes	Yes	Yes	Likely low density
2	Spring Canyon (NM)	1937	Yes	Possible	Likely	Likely extirpated
3	Mule Creek (NM)	1983	Yes	Yes	Yes	Likely low density
4	Mimbres River (NM)	Likely early 1900s	Yes	Yes	Yes	Likely extirpated
5	Lower Colorado River (AZ)	2015	Yes	Yes	Yes	Likely low density
6	Bill Williams River (AZ)	2012	Yes	Yes	Yes	Likely viable
7	Big Sandy River (AZ)	2015	Yes	Yes	Likely	Likely low density
8	Santa Maria River (AZ)	2015	Yes	Yes	Likely	Likely low density
9	Agua Fria River (AZ)	1986	Yes	Yes	Yes	Likely low density
10	Little Ash Creek (AZ)	1992	Yes	Yes	Yes	Likely low density
11	Lower Salt River (AZ)	1964	Yes	Yes	Yes	Likely extirpated
12	Black River (AZ)	1982	Yes	Yes	Yes	Likely low density
13	Big Bonito Creek (AZ)	1986	Yes	Yes	Yes	Likely low density
14	Tonto Creek (AZ)	2005	Yes	Yes	Yes	Likely viable
15	Upper /Middle Verde River (AZ)	2012	Yes	Yes	Yes	Likely viable
16	Oak Creek (AZ) (Page Springs and Bubbling Ponds State Fish Hatcheries)	2015	Yes	Yes	Yes	Likely viable
17	Spring Creek (AZ)	2014	Yes	Yes	Yes	Likely low density
18	Sycamore Creek (Yavapai/Coconino Co., AZ)	1954	Yes	Possible	Yes	Likely extirpated
19	Upper Santa Cruz River/San Rafael Valley (AZ)	2015	Yes	Yes	Yes	Likely viable
20	Redrock Canyon/Cott Drainage (AZ)	2008	Yes	Yes	Yes	Likely low density
21	Sonoita Creek (AZ)	2013	Yes	Possible	Yes	Likely low density
22	Scotia Canyon (AZ)	2009	Yes	Yes	No	Likely low density
23	Parker Canyon (AZ)	1986	Yes	Possible	Yes	Likely low density
24	Las Cienegas NCA and Cienega Creek Natural Preserve (AZ)	2015	Yes	Yes	No	Likely low density
25	Lower Santa Cruz River (AZ)	1956	Yes	Yes	Yes	Likely extirpated
26	Buenos Aires National Wildlife Refuge (AZ)	2000	Yes	Yes	Yes	Likely low density
27	Brown Canyon (AZ)	2014	Yes	Yes	No	Likely low density
28	Fort Huachuca (AZ)	1994	Yes	Yes	Yes	Likely low density
29	Bear Creek (AZ)	1987	Yes	Yes	Yes	Likely low density
30	San Pedro River (AZ)	1996	Yes	Yes	Yes	Likely low density
31	Babocomari River and Cienega (AZ)	1986	Yes	Possible	Yes	Likely low density
32	Canelo Hills-Sonoita Grasslands Area (AZ)	2015	Yes	Yes	Yes	Likely low density
33	San Bernardino National Wildlife Refuge (AZ)	1997	Yes	Yes	Yes	Likely low density

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 low density" means there is a post-1980 record for the species, it is not reliably found with minimal to moderate survey effort, and threats exist which suggest the population may be low density or could be extirpated, but there is insufficient evidence to support extirpation. "Likely viable" means that the species is reliably found with minimal to moderate survey effort, and that the population is generally considered to be somewhat resilient.

Critical Habitat

Critical habitat for the northern Mexican gartersnake has been proposed in 14 units in portions of Arizona and New Mexico totaling 421,423 acres. Within these areas, the primary constituent elements (PCEs) of the physical and biological features essential to northern Mexican gartersnake conservation are:

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 gartersnake or the maintenance of prey populations.
2. Adequate terrestrial space (600 ft 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.

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.

The action area for this project overlaps two proposed critical habitat units, the Cienega Creek Subbasin Unit and the Upper Santa Cruz River Subbasin Unit.

The Cienega Creek Subbasin Unit, which contains a combined 50,393 acres of proposed critical habitat within three subunits, the Cienega Creek Subunit, the Las Cienegas NCA Subunit, and the Cienega Creek Natural Preserve Subunit. This proposed unit is uniquely important for the northern Mexican gartersnake because it is the only unit in southern Arizona that provides an intact native prey base and is currently free of harmful nonnative species. Only one other area proposed for designation as critical habitat in Arizona or New Mexico boasts similar attributes, the Spring Creek Subunit, within the Verde River Subbasin Unit in central Arizona which is isolated from northern Mexican gartersnake populations in southern Arizona.

In the Las Cienegas NCA Subunit, we have also proposed to designate critical habitat for a total of 45,020 acres of springs, seeps, streams, stock tanks, and terrestrial space in between these features within the Las Cienegas NCA, including portions of Cienega Creek and upper Empire Gulch that occur within the boundary of the Las Cienegas NCA. Native fish and both Chiricahua and lowland leopard frog populations provide prey for northern Mexican gartersnakes, and ongoing bullfrog eradication has eliminated bullfrogs in the area, and reduces the threat of bullfrogs returning to this subunit. This subunit currently contains sufficient physical or biological features, including all PCEs, but will require special management to maintain or develop the physical or biological features, including preventing the invasion or reinvasion of bullfrogs from adjacent watersheds.

The Cienega Creek Natural Preserve Subunit includes the proposal to designate critical habitat for a total of 4,260 acres of springs, seeps, streams, stock tanks, and terrestrial space in between these features within the Cienega Creek Natural Preserve in Pima County, Arizona, including the reach of Cienega Creek that occurs within the Cienega Creek Natural Preserve. The Cienega Creek Natural Preserve is owned and managed by Pima County. Native fish and lowland leopard frog populations provide prey for northern Mexican gartersnakes, and ongoing bullfrog eradication in the area has eliminated them within this subunit. This subunit contains sufficient physical or biological features, including all PCEs but special management will be required to maintain or develop the physical or biological features, including preventing the invasion or reinvasion of bullfrogs. This subunit is being considered for exclusion from the final rule for critical habitat under section 4(b)(2) of the Act due to its conservation and management plan for native species.

Within the Cienega Creek Subunit, and between the Las Cienegas NCA and Cienega Creek Natural Preserve subunits, we have also proposed to designate 1,113 acres of critical habitat along 7.1 stream miles of Cienega Creek, from the northern boundary of the Las Cienegas NCA to the southern boundary of Cienega Creek Natural Preserve in Pima County, Arizona. The Cienega Creek Subunit occurs on lands managed by the Arizona State Land Department in addition to a small amount of private land. Native fish and both Chiricahua and lowland leopard frog populations provide prey for northern Mexican gartersnakes, and recent, ongoing bullfrog eradication in the area reduces the threat of bullfrogs within this subunit. This subunit contains sufficient physical or biological features, including all PCEs. However, special management may be required to maintain or develop the physical or biological features, including preventing the invasion or reinvasion of bullfrogs.

The Cienega Creek Subbasin Unit was proposed as critical habitat for the northern Mexican gartersnake because it was occupied at the time of listing and contained sufficient physical or biological features to support life-history functions essential for the conservation of the species. We expect the physical or biological features in this unit will require special management consideration due to ongoing and regional threat of bullfrogs from adjacent watersheds.

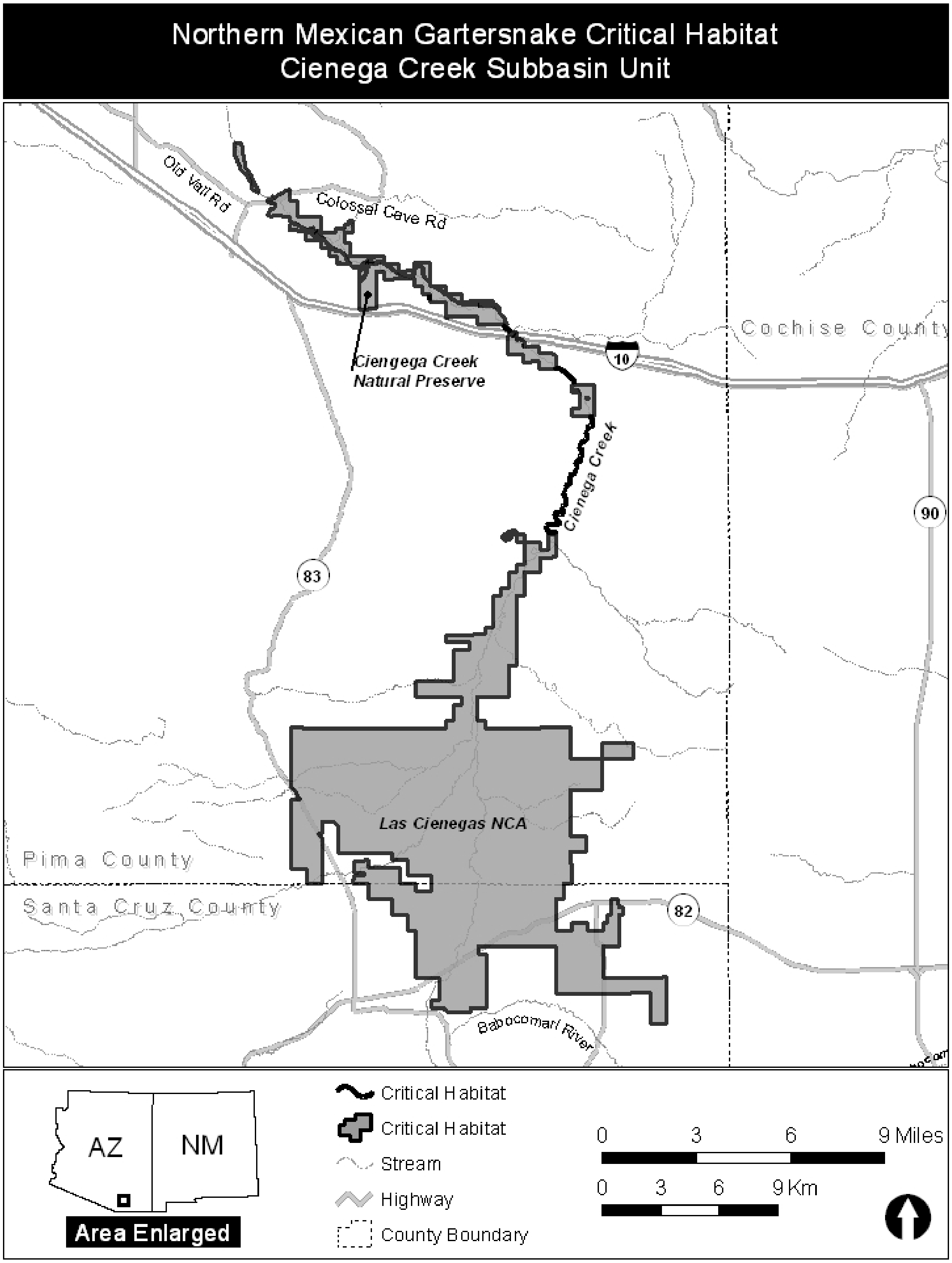


Figure NMGS-1: Map of Cienega Creek Subbasin Unit proposed for designation as critical habitat.

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 was 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.

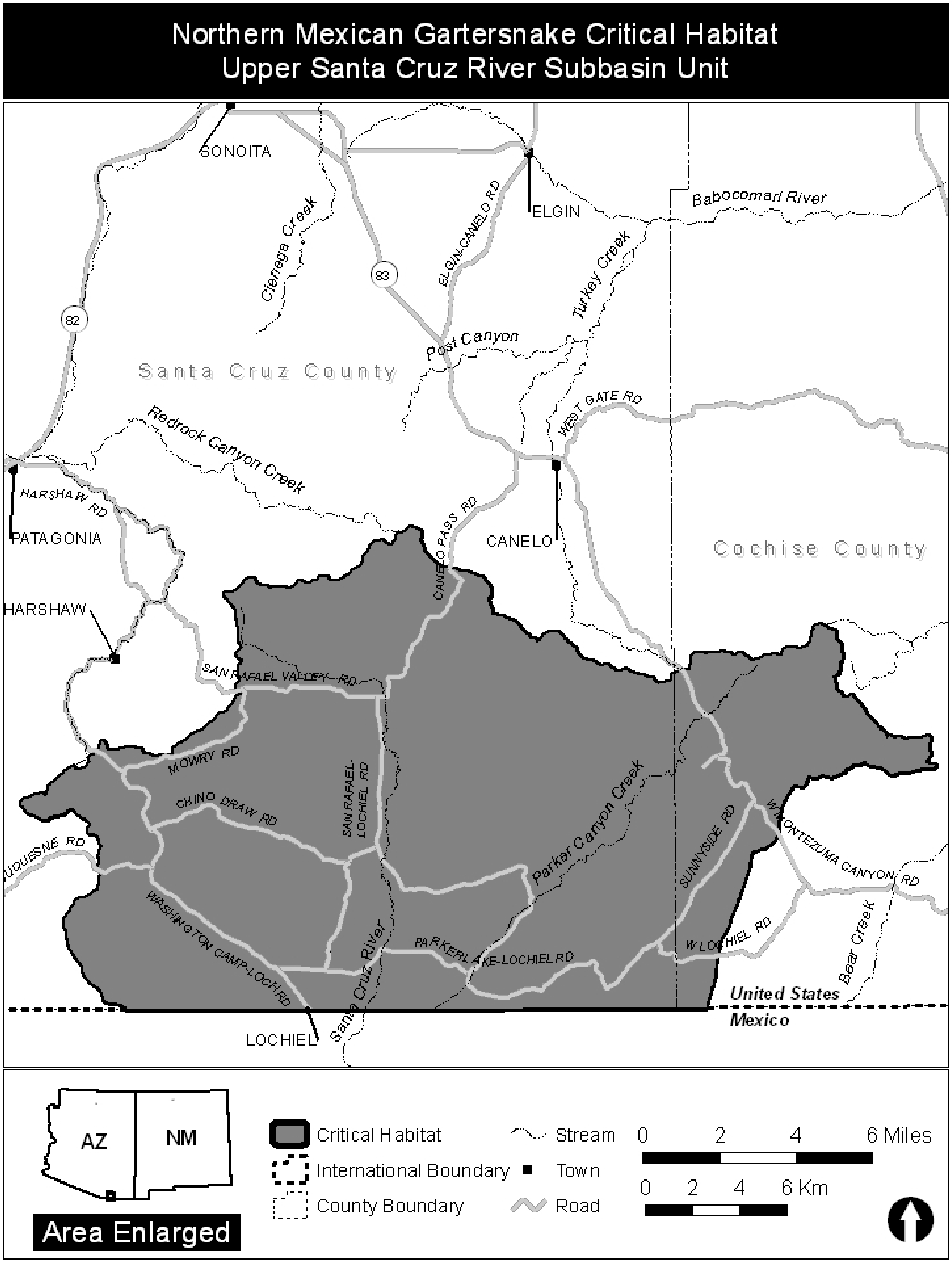


Figure NMGS-2: Map of Upper Santa Cruz River Subbasin Unit proposed for designation as critical habitat.

Status of the Species within the Action Area

Las Cienegas National Conservation Area and Cienega Creek Natural Preserve—Several records for the northern Mexican gartersnake in the Las Cienegas NCA and Cienega Creek Natural Preserve have been documented in the literature, predominantly from Cienega Creek, the first dating to 1986 (Rosen and Schwalbe 1988, Appendix I). Cienega Creek maintains perennial surface flow in two reaches; from its headwaters to just downstream of "the Narrows;" and from the confluence with Mescal Wash to just downstream of the Colossal Cave Road crossing in Vail, Arizona. The upper portion of the creek has historically been occupied by bullfrogs, but continues to support a native fish community, as well as both Chiricahua and lowland leopard frogs (Rosen *et al.* 2001, Appendix I). The lower perennial portion of Cienega Creek runs through Pima County's 3,979 acre Cienega Creek Natural Preserve for approximately 12 river miles. This reach supports a native fish community (Timmons *et al.* 2013, Table 1), including Gila chub and longfin dace as well as lowland leopard frogs (Caldwell 2014, entire), although there is a persistent threat of bullfrog invasion from a nearby house pond that continues to contribute immigrant bullfrogs to Cienega Creek. Despite this source, bullfrog numbers have remained somewhat low in recent years (Caldwell 2012, pers. comm.). In addition to Cienega Creek, the Las Cienegas NCA supports several tanks, springs, and wetlands that provide physically suitable northern Mexican gartersnake habitat and that may be used by northern Mexican gartersnakes sporadically as they emigrate from Cienega Creek and explore new foraging opportunities in the area. According to GIS analysis, Mattie Canyon, a tributary of Cienega Creek also supports suitable northern Mexican gartersnake habitat as a well as a native prey base.

In 2007 and 2008, more than 2,300 trap-hours were required per snake captured in this area (Caldwell 2008a, pers. comm.; 2008b, pers. comm.; Servoss *et al.* 2007, p. 1–12), compared with Rosen and Caldwell (2004, p. 21, Table 2) capture rates of 561 trap-hours per snake in this same area in 2002 and 2003; more than a four-fold increase in the effort needed to capture northern Mexican gartersnakes. In 2011, the capture rate was 3,167 trap-hours per capture (Hall 2012). These capture rate data point to increasing rarity over time which historically mirrored area declines in leopard frogs and may be exacerbated to some degree by continued bullfrog eradication efforts which may reduce the prey base for adult gartersnakes. As a recovery cooperator, the Arizona –Sonora Desert Museum (ASDM) has been successfully propagating northern Mexican gartersnakes in captivity since 2011 and releases of captive-bred snakes occurred in 2012, 2014, and 2015. Although no follow-up surveys have been conducted in areas where the releases occurred, one individual from the 2015 release was observed and captured several months later slightly downstream of its release point in Cienega Creek. Regardless, conservation and recovery efforts for native aquatic species in this area have reduced the influence of harmful nonnative species and provide a net-positive effect on the areas aquatic communities. Bullfrog surveys in 2015 confirm their absence from the Las Cienegas NCA (Hall *et al.* 2015); crayfish persist in Cline Pond/Spring in the extreme southeastern portion of the Las Cienegas NCA. Mosquitofish, while not present in Cienega Creek, are frequently used as mosquito control on private property and are known to currently occur in the adjacent Santa Rita Mountains and Elgin/Sonoita regions and pose a consistent threat to Cienega Creek. Recent records and recovery efforts confirm the northern Mexican gartersnake still exists in within Cienega Creek and surrounding lands, but existing information based on incidental observations without current surveys suggests the population exists as a low density population that appears to remain unstable.

Table NMGS-2 (Section 1 of 5): Santa Cruz River Subbasin: Las Cienegas NCA and Cienega Creek Natural Preserve (Arizona)			
Record Year	**Locality Descriptor**	**Reference**	**Notes**
1986	At Cienega Ranch; 35 mi SE Tucson	Rosen and Schwalbe 1988, Appendix I	Two adults
1994	R17E, T19S	Holycross *et al.* 2006; Appendix A	
1996	Cienega Creek at main perennial headwater	Rosen *et al.* 2001; Appendix I	Juvenile; dead
1997	Cienega Creek County Preserve; Nad 83 535113/354197	Caldwell 2012	
1999	UTM 536600, 3541200, S 1/2 Sec 28, T16S, R17E	Holycross *et al.* 2006; Appendix A	
2000	Cienega Creek at main perennial headwater	Rosen *et al.* 2001; Appendix I	Adult
2001	Cienega Creek County Preserve; Nad 83 535825/354952	Caldwell 2012	
2011	Las Cienegas NCA	Hall 2012	Five adults; two subadults
2012		FWS Files	40 captive-bred juveniles from ASDM released; cautery-marked
2014			36 captive-bred animals from ASDM released; Empire Wildlife Pond (5 subadults/ 6 juveniles), the Maternity Wildlife Pond (2 subadults/ 6 juveniles), and upper Cienega Creek (2 subadults/ 15 juveniles)
2014	Cienega Creek County Preserve	Caldwell 2014, pp. 1-2	One adult; one juvenile
2015	Las Cienegas NCA	Crawford 2015	19 captive-bred individuals from ASDM released; 12 near Cold Spring at the confluence with Mattie Canyon and 7 in the Cienega Creek headwaters area
Predicted Population Status: Likely low density			

Status of Prey Communities in the Las Cienegas NCA: Ranid Frogs

Numerous sites historically and currently support Chiricahua leopard frogs on the Las Cienegas NCA, including Cinco Well Wildlife Pond, Cottonwood Wildlife Pond, Empire Well Wildlife

Pond, Gaucho Wildlife Pond, Maternity Well Wildlife Pond, Road Canyon Wildlife Pond, Spring Water Wetlands, and Cienega Creek at Cold Spring, which produced a large cohort of young leopard frogs in 2015 (Hall *et al.* 2015). These sites represent areas where frogs were introduced, re-established by dispersal, or in a single locale, naturally persisted. Chiricahua leopard frogs were also confirmed in 2015 within two reaches of Cienega Creek (headwaters reach and Mattie Canyon reach) where they naturally dispersed into from other sites (Hall *et al.* 2015). Downstream of these reaches is the Narrows reach. Within this reach, a lowland leopard frog population persists and appears to be growing (Hall *et al.* 2015; Akins 2016b). Survey information as of April 2016, show lowland leopard frogs continue to advance upstream in Cienega Creek, having move approximately two stream miles from the Narrows reach into the Cold Spring reach and occur in slightly less than equal numbers as Chiricahua leopard frogs (Hall 2016b).

Historically, the stable source population for the Chiricahua leopard frog metapopulation in the Las Cienegas NCA is at Empire Spring within upper Empire Gulch, about 4 miles upstream of Cienega Creek. This is a historic population that has persisted since at least the 1990's, and has increased in recent years, numbering from below 10 individuals to over 100 currently (Hall *et al.* 2015). Water temperatures at this site are remarkably stable throughout the year, which is thought to be the key variable in this population's ability to persist in the presence of the *Bd* disease pathogen (Hall *et al.* 2015).

Chiricahua leopard frog reproduction was confirmed in 2015 at many of the aforementioned sites in the Las Cienegas NCA. This led to significant dispersal activity to and within Cienega Creek, and several other sites within or adjacent to the Las Cienegas NCA (Hall *et al.* 2015). Outside of Cienega Creek, sites that received dispersed frogs include Rattlesnake Tank, Karen's Tank, Clyne Pond, Cieneguita Wetlands (all 3 ponds), Bill's Tank, HQ Corral Pond, Cinco Well Wildlife Drinker, Lane Tank, Road Grate above Empire Spring, Bills Turnoff Small Tank, Oil Well Tank, and Borrow Pit (Gaucho) (Hall *et al.* 2015).

Frog populations in the Las Cienegas NCA are vulnerable to disease-related die-offs. The latest mass mortality event related to Bd occurred during the 2014-2015 winter (Hall *et al.* 2015); winter months are often when Bd outbreaks are most significant in native ranid frogs (Hyman and Collins 2015). Specifically, severe Chiricahua frog die-offs were observed in November and December of 2014 in all populations except for those at Empire Spring, Cold Spring, and Headwaters Reach, where temperatures are stabilized by spring flow (Hall *et al.* 2015). Of these three sites, only frogs Empire Spring experienced zero winter-disease mortality (Hall *et al.* 2015). Therefore, from a metapopulation persistence perspective, Empire Spring is critically important for Chiricahua leopard frogs in the Las Cienegas NCA as it is the only site that has been resistant to Bd die-offs in this area.

Status of Prey Communities in the Las Cienegas NCA: Native Fish

Four species of native fish are known from Cienega Creek: Gila chub, Gila topminnow, desert pupfish, and longfin dace (*Agosia chrysogaster*). Longfin dace will not be specifically addressed in this biological opinion although they are considered an important component to the northern Mexican gartersnake prey base within the action area, have similar ecology to the other native fish discussed, and will therefore be affected similarly by indirect effects of groundwater drawdown from the proposed action.

Of the five extant populations of Gila chub within the Santa Cruz watershed, only the Cienega Creek population is considered stable-secure. The other four populations are considered unstable-threatened. Within the Las Cienegas NCA, Gila chub are distributed and continue to be abundant throughout upper Cienega Creek (Rosen *et al.* 2013; Simms 2014d, Simms and Ehret 2014) and have made a steady comeback in lower Mattie Canyon after a failure of a grade-control structure resulted in heavy sedimentation and erosion. Where Gila chub occupy pool and backwater habitat, they provide an important source of prey for resident northern Mexican gartersnakes. Gila chub do not occur in upper Empire Gulch, nor in any stock tank or wildlife pond on the Las Cienegas NCA (Ehret and Simms n.d., Simms 2013).

The population of Gila topminnow in the Las Cienegas NCA demonstrably represents the largest natural population in the United States and the only extant one on Federal land (Simms and Simms 1992, Bodner *et al.* 2007) where the species continues to remain abundant within upper Cienega Creek (Rosen *et al.* 2013; Simms 2014d, Simms and Ehret 2014) and to a lesser extent, lower Cienega Creek (Bodner *et al.* 2007). Gila topminnow populations above and below the Spring Canyon confluence with Cienega Creek may face drastically different futures. Hatch (2015) found that above the Spring Canyon confluence, Gila topminnow have a 0.01 percent chance of extirpation at some point in the future, whereas downstream of the Spring Canyon confluence, Gila topminnow have a 96 percent chance of extirpation. Since 2013, several lentic sites have received Gila topminnow as part of an effort intended to create, enhance, and protect habitat for at-risk species within the Las Cienegas NCA, including Cottonwood Tank, Cieneguita Wetland, and Gaucho Tank. We have records documenting northern Mexican gartersnakes using these specific tanks, but there have not been any targeted surveys either.

Desert pupfish are extant in the Las Cienegas NCA, but only in lentic habitat; they are not extant in Cienega Creek. Several releases of desert pupfish have occurred on the Las Cienegas NCA in recent years, the first occurring at Road Canyon Wildlife Pond in 2012, with the release of 656 individuals. Subsequent to that event there were seven releases in 2013, including at Cinco Canyon Wildlife Pond (n=250), Cottonwood Wildlife Pond (n=269), Empire Wildlife Pond (n=299), Cieneguita Wetland Pond #3 (n=290) and #4 (n=240), Antelope Wildlife Pond (n=257), and Bald Hill Wildlife Pond (n=263). Future releases at Gaucho Wildlife Pond, Maternity Wildlife Pond, Oil Well Wildlife Pond, Bill's Wildlife Pond, Clyne Pond, and Apache Spring Wildlife Pond are pending. To date, none of these populations have become extirpated and some are thriving. Only the populations in Cieneguita Wetland Ponds #3 and #4 are anticipated to be affected by the proposed action.

Several factors have affected, or could affect, native fish habitat within the action area including water use, the risk of illegal releases of harmful nonnative species, livestock grazing, fire, and effects related to regional climate change. These factors are discussed in detail elsewhere in this biological opinion where addressed for native fish. For more detail on the status of native fish species within the action area and predicted effects to native fish populations as a result of the proposed action, we encourage further review of discussion under the species sub-headers, Gila Chub, Gila Topminnow, and Desert Pupfish.

Sonoita Creek—Three records of northern Mexican gartersnakes from 1954 to 2013 document the northern Mexican gartersnake in Sonoita Creek (Rosen and Schwalbe 1988, Appendix I; Holycross *et al.* 2006, Appendix A; Bookwalter 2014, pers. comm.). Turner (2007, pp. 1–5) found no northern Mexican gartersnakes in a 204 person-search-hour, 5,472 trap-hour survey effort in the Sonoita Creek State Natural Area. Crayfish, bullfrogs, and nonnative fish were observed by Turner (2007, p. 41) which likely emigrate from Patagonia Lake from which Sonoita Creek feeds. The length of time since the last records for northern Mexican gartersnakes as well as the persistent influence of harmful nonnative species supported by Patagonia Lake suggest the subspecies likely occurs at a very low density in Sonoita Creek.

<table>
<tr><th colspan="4">Table NMGS-2 (Section 2 of 5) Santa Cruz River Subbasin: Sonoita Creek (Arizona)</th></tr>
<tr><th>Record Year</th><th>Locality Descriptor</th><th>Reference</th><th>Notes</th></tr>
<tr><td>1954</td><td>Patagonia vicinity</td><td rowspan="2">Rosen and Schwalbe 1988, Appendix I; Holycross et al. 2006, Appendix A</td><td></td></tr>
<tr><td>1974</td><td>3 mi SW of Patagonia on AZ Route 82</td><td></td></tr>
<tr><td>2013</td><td>On trail where it's closest to creek; TNC's Patagonia-Sonoita Creek Preserve</td><td>Bookwalter 2014, pers. comm.</td><td>Sub-adult</td></tr>
<tr><td colspan="4">Predicted Population Status: Likely low density</td></tr>
</table>

Upper Santa Cruz River/San Rafael Valley Subbasin—Several recent and historical records document the northern Mexican gartersnake (neonates and adults) from tanks and springs within the San Rafael Valley, as well as the upper Santa Cruz River, confirming that the northern Mexican gartersnake is using various wetland habitats in the San Rafael Valley, and that reproduction is occurring. Recruitment rates within the population appear to be low and more study is required to confirm. In 2012, the capture rate was one snake every 378.75 trap hours (Lashway 2012, p. 5). Additionally, low recapture rates of marked individuals could be cause for concern. Green sunfish and mosquitofish dominated fish sampling results in 2014 (Timmons 2014). Native fish, bullfrogs, and nonnative fish inhabit several wetland areas in the San Rafael Valley, including the upper Santa Cruz River (Rosen *et al.* 2001, p. 17, Appendix I). Sonoran tiger salamanders (*Ambystoma mavortium stebbinsi*) also contribute to the prey base of northern Mexican gartersnakes in this area. Photo-documentation from the years 1999, 2001, and 2005 from several photo points along the upper Santa Cruz River depicted in Stingelin *et al.* (2006, Figure 3.1) reflect a trend of less water and more vegetation along the upper Santa Cruz River in recent years.

The foraging ecology of northern Mexican gartersnakes and past records suggest individuals move throughout the San Rafael Valley as they seek to explore regional wetland habitats for prey. The upper Santa Cruz River likely serves as a source for these individuals. We consider the upper Santa Cruz River, as well as tanks, springs, and wetlands with physically suitable northern

Mexican gartersnake habitat, within the greater San Rafael Valley to be occupied by the northern Mexican gartersnake based on historical and recent records, as well as our understanding of the subspecies' foraging ecology. This population is considered likely viable.

Table NMGS-2 (Section 3 of 5) Santa Cruz River Subbasin: Upper Santa Cruz River/San Rafael Valley Subbasin (Arizona)			
Record Year	**Locality Descriptor**	**Reference**	**Notes**
1986	Bog Hole Wildlife Management Area	Rosen and Schwalbe 1988, Appendix I	Nine specimens
1958	Sharp Spring		
1975			
1986		Rosen and Schwalbe 1988, Appendix I; Holycross *et al.* 2006, Appendix A	
1985	Upper 13 Reservoir	Rosen and Schwalbe 1988, Appendix I	
1979	Parker Canyon; 13 mi SE of Parker Canyon Lake	Holycross *et al.* 2006, Appendix A	5 specimens
1975	Lochiel vicinity	Rosen *et al.* 2001, p. 17, Appendix I; Holycross *et al.* 2006, Appendix A	4 specimens
1977	Lochiel vicinity		
1958	Sharp Spring		
1975			
1986			
2000			
2012	Pasture 9 Tank	C. Akins 2012, pers. comm.	Neonate
2012	Forest Service 799 Tank	T. Jones 2012d, pers. comm.	Two specimens; adult male, adult female
2007		T. Jones 2012b, pers. comm.	Adult female
2006	Upper Santa Cruz River	Stingelin *et al.* 2006, Table 1.3	
2008		Stingelin *et al.* 2009, p. 33)	55 specimens; 51 specimens were adults, one was a juvenile, and three were neonates
2010		Rorabaugh 2010, pers. comm.	Adult

2012		Lashway 2012, p. 5	24 specimens; one recapture from Stingelin *et al.* (2009, p. 33) 2008 effort; 1 neonate of 24 specimens
2015		Lashway 2015	29 snakes captured; 3 recaptures from 2008 survey and 2 recaptures from 2012 survey; 11 males and 18 females captured
2014		Timmons 2014	Captured in fish trap (alive or dead unreported)
2013	Private pond in Corral Canyon	Jones 2013, pers. comm.	
Predicted Population Status: Likely viable			

Scotia Canyon—There are numerous records of the northern Mexican gartersnake from the Peterson Ranch Pond site in Scotia Canyon in the Huachuca Mountains from 1981 to 2009 (Rosen and Schwalbe 1988, Appendix I; Holm and Lowe 1995, Appendix B; Rosen *et al.* 2001, pp. 15–16, Appendix I; Holycross *et al.* 2006, Appendix A; Frederick 2008b pers. comm.; J. Servoss 2009, pers. obs.). Data generated from comparative trapping and survey efforts from 1980-1982, 1993, and 2008 suggest a marked decline in this population over the last 30 years. 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 (Frederick 2008, pers. comm.; 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 reintroduced Chiricahua leopard frogs. With the reintroduction 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.

Santa Cruz River Subbasin (Section 4 of 5): Scotia Canyon (Arizona)			
Record Year	**Locality Descriptor**	**Reference**	**Notes**
1981	Peterson Ranch site	Rosen and Schwalbe 1988, Appendix I; Holm and Lowe 1995, Appendix B	Three specimens
1982		Holm and Lowe 1995, Appendix B	Six specimens
1987	Scotia Canyon	Holycross *et al.* 2006, Appendix A	
1993	Peterson Ranch site	Holm and Lowe 1995, Appendix B	39 specimens
2000		Rosen *et al.* 2001, Table 4	Three specimens
2008		Frederick 2008b	Adult

2009		J. Servoss 2009, pers. obs.	Adult
Predicted Population Status: Likely low density			

Parker Canyon—Historical records for the northern Mexican gartersnake in Parker Canyon were from Parker Canyon Lake in 1967 (Holycross *et al.* 2006, Appendix A) and 1986 (Rosen and Schwalbe 1988, Appendix I) and from Parker Canyon in 1968 and 1979 (Holycross *et al.* 2006, Appendix A). We are not aware of any dedicated northern Mexican gartersnake survey effort in Parker Canyon. The only survey known for Parker Canyon Lake was the Rosen and Schwalbe (1988) effort in 1986 that consisted of 3 person-search hours. Parker Canyon Lake is managed as a put-and-take fishery for rainbow trout and channel catfish and also supports a self-sustaining warm water fishery including harmful predatory species such as largemouth bass, bluegill, redear sunfish, green sunfish, black bullhead, and northern pike (FWS 2011b, p. 10-10, 10-15). These nonnative species may spill into the canyon proper below the dam or move up into pools above the lake where they contribute to the extant nonnative fish population. Parker Canyon below Parker Canyon Lake dam is best described as a spatially intermittent stream with several pools. There is approximately one river mi (1.6 km) of permanent water below the dam, and then the channel is ephemeral for approximately 4.5 river mi (7.2 km) to another perennial reach approximately 0.25 river mi (0.4 km) in length. It then, once again, becomes ephemeral until it joins the upper Santa Cruz River in the San Rafael Valley. The perennial reach below the Parker Canyon dam contains bullfrogs, crayfish, and nonnative, predatory fish species. Lower Parker Canyon also maintained longfin dace as of 2003 (Stefferud and Stefferud 2004, p. 433). Individual northern Mexican gartersnakes may migrate into Parker Canyon from populations that occur in Scotia Canyon or the San Rafael Valley which suggests the subspecies could be extant in Parker Canyon, likely as a low density population.

Santa Cruz River Subbasin (Section 5 of 5): Parker Canyon (Arizona)			
Record Year	**Locality Descriptor**	**Reference**	**Notes**
1968	Parker Canyon	Holycross *et al.* 2006, Appendix A	
1979	13 mi SE of Parker Canyon Lake		Five specimens
1967	Parker Canyon Lake		
1986	NE end of Parker Canyon Lake	Rosen and Schwalbe 1988, Appendix I	100 feet from lake shore under rock
Predicted Population Status: Likely low density			

Background for Analyses and Definition of Baseline

The hydrologic data upon which a portion of the following northern Mexican gartersnake-specific analyses are based were described in both the Effects of the Proposed Action section (below) and Effects to Aquatic Ecosystems sections (above).

The hydrologic data are based on a 95th percentile analysis of the Tetra Tech (2010), Montgomery (2010), and Myers (2010) groundwater model best-fit and sensitivity analyses, as applicable. The 95th percentile analyses were developed for the SIR and were included in the May 2015 SBA to address FWS concerns with the use of multiple groundwater models with oftentimes divergent results. The 95th percentile analysis was described in detail in these prior documents, and was summarized in the Sources of Uncertainty subsection of the Effects of the Proposed Action section, above.

We are aware of the analytical strengths and weakness of this approach, but reiterate that our selection of the upper end of the 95th percentile values results in analyses in which 97.5 percent (which includes the 2.5 percent of the least well-represented values at the lower end of the distribution) of the *other* possible hydrologic outcomes exhibit lesser effects. The 95th percentile approach does not represent the most probable outcome (but it does provide reasonable certainty that the effects to this species are unlikely to be greater than those described below). Due to the uncertainty inherent in these modeling efforts, there are no results that can be definitively said to be the most likely to occur. Thus, we have selected the precautionary approach.

Secondly, the following species-specific analysis considers the present-day state of the hydrology to represent the baseline condition. All effects, whether the result of anticipated climate change alone, mine drawdown alone, and/or climate change and mine drawdown combined, are described in terms of their divergence from present, pre-project conditions. Climate change is *not* viewed as an ongoing and evolving baseline against which mine-only effects are incrementally assessed.

Effects of the Action

The effects discussed below are attributed to the proposed action which are in addition to, and operate within, the background of regional climate change as part of the environmental baseline. The action area for northern Mexican gartersnakes includes the Las Cienegas NCA, Cienega Creek downstream of the Las Cienegas NCA and through Pima County‘s Cienega Creek Natural Preserve, and Sonoita Creek Ranch (acquisition property).

Effects to Northern Mexican Gartersnakes

Indirect, adverse effects to northern Mexican gartersnakes from the proposed action are anticipated to occur during mining operations and after they cease, and will continue for decades. With the exception of drinking, gartersnakes do not specifically require water in their life cycle; they do not need water to breathe (*i.e*. fish) or as a critical medium for a developmental life stage (*i.e*. larval amphibians). The primary cause of adverse effects from the proposed action is the long-term, permanent degradation to the gartersnakes’ prey community due to the adverse, indirect effects from a lowering groundwater table (and therefore truncated surface flows) associated with the Rosemont Mine, predominantly post-closure and in perpetuity. If a primary prey species becomes rare or extirpated, the resident northern Mexican gartersnake population may become less resilient over time as a result of population-level effects described below. The primary gartersnake prey species affected include ranid frogs (Chiricahua and lowland leopard frogs) and fish (Gila chub, desert pupfish, Gila topminnow, and longfin dace). These effects are anticipated to occur in both spatial and temporal contexts for the northern Mexican gartersnake within the proposed Cienega Creek Subbasin Unit proposed as critical habitat. Therefore, these effects will force resident northern Mexican gartersnakes to use other areas within the action area that continue to support an adequate prey population. As a net result and over time, there are expected to be fewer acres of otherwise suitable habitat for the gartersnake to forage.

Over time, after mine closure, and as groundwater discharge and thus, surface flow, begins to slowly but permanently disappear in upper Empire Gulch and become diminished in several reaches of Cienega Creek, pool (or backwater) habitat within these drainages will incrementally lose permanency, depth, area, and water volume during the driest periods of each year (see effects analysis presented for fish for details). For prey species at affected by groundwater drawdown, we expect fewer reproduction opportunities and lower overall reproduction success, resulting in lower overall recruitment into adult age classes, lower overall population sizes, and increased vulnerability for extirpation due to disease, drought, fire, or other stochastic events. Smaller pool area and lower volume within pools affect water chemistry by increasing water temperatures which lower dissolved oxygen levels. Lowered dissolved oxygen will affect Gila chub populations disproportionately compared to small-bodied Gila topminnow or desert pupfish as the latter are better equipped to persist under low dissolved oxygen conditions as a result of their evolutionary biology. Ranid frogs in their larval stages are also adversely affected by low dissolved oxygen levels.

Gila chub, larval and metamorphosed ranid frogs are more important than Gila topminnow as prey for northern Mexican gartersnakes because they achieve larger sizes and therefore provide more caloric energy per capture. Therefore, exaggerated effects to chub and ranid frog populations will have exaggerated effects to the northern Mexican gartersnake population. The primary resultant effect to northern Mexican gartersnakes is starvation. Starvation in northern Mexican gartersnakes leads to many physiological effects at the individual and population levels. These effects include reduced fitness, slower growth rates, lower fecundity, lower survivorship, and lower recruitment of gartersnakes into the reproductive size classes within the population. Ultimately, the physiological effects of starvation increase stress levels of affected gartersnakes making them more susceptible to disease and parasitism and weakening their ability to forage and reproduce successfully.

We expect significant losses of northern Mexican gartersnakes as an indirect effect from the anticipated degradation and ultimate disappearance of Empire Spring. Empire Spring is considered extremely important for the Chiricahua leopard frog metapopulation in the Las Cienegas NCA (see above discussion under *Status of Prey Communities in the Action Area: Ranid Frogs*) because its relatively stable year-round water temperatures buffer the debilitating effects of Bd, allowing for continued of survival adult leopard frogs at the spring to disperse and recolonize other habitats in the area via metapopulation dynamics. If lost, this vital site would be unable to act as a source population of frogs for the area which greatly increases the odds of extirpation of this metapopulation, most notably in years with significant Bd outbreaks and subsequent die-offs. Drummond and Marcias-Garcia (1983) found that within a varied prey community, northern Mexican gartersnakes primarily feed on ranid frogs. The loss or significant degradation of the resident Chiricahua leopard frog metapopulation in the area, as a result of the loss of a critical source population, would place significant nutritional strain on northern

Mexican gartersnakes and weaken the functionality of the habitat for recovery as a whole for northern Mexican gartersnakes, in perpetuity.

As stated above, area dimensions of affected pools are expected to shrink over time. As pool areas shrink, available space for reproduction of prey species and space required for development also shrinks which limits the abundance and biomass of prey species within each pool. Smaller pool sizes also increase prey population densities within each pool which increases predation success rates on gartersnakes and their prey from natural predators such as mammals, wading birds, etc. All of these effects are expected increase in both frequency and scope, over time, after mine closure.

Northern Mexican gartersnakes also use lentic habitats such as stock tanks, isolated springs, cienegas, etc. as habitat. Stock tanks are primarily fed by surface runoff in response to precipitation; others are fed by solar groundwater wells. Collectively, stock tanks within the Las Cienegas NCA are not expected to be affected by lowered groundwater levels which are expected to attenuate, to some degree, adverse effects to lotic habitat within the Las Cienegas NCA.

Effects to the Northern Mexican Gartersnake's Prey Species

The effects to northern Mexican gartersnakes' prey community are further detailed in the effects discussions which pertain to Gila chub, desert pupfish, Gila topminnow, and Chiricahua leopard frogs. Please review those discussions for additional details.

Proposed Conservation Measures

<u>Sonoita Creek Ranch</u> (Second Supplemental BA, Item B 1-9, pp. 41-42, February 2013)–The acquisition of Sonoita Creek Ranch and its subsequent management of the ponds for native aquatic species is expected to provide some level of beneficial effects to the low-density population of northern Mexican gartersnakes along Sonoita Creek. The level of benefit is contingent upon the number of individual gartersnakes, presumed extant in the Sonoita Creek system (based on the 2014 record), that eventually occur at the conservation property and whether management of the property provides suitable access to prey species and/or improves the prey community within the immediate region. In the event that bullfrogs inadvertently colonize and become established on the property, create a source population for subsequent dispersal, and immigrate to gartersnake-occupied habitat in the region, we expect adverse effects to the resident northern Mexican gartersnake community. This is because while larval or juvenile bullfrogs can provide a source of prey to resident gartersnakes, adult bullfrogs are a substantial predator of neonatal and juvenile gartersnakes, which negatively affects recruitment within the gartersnake population. Other conservation properties proposed for acquisition by the proponent have no effect on the northern Mexican gartersnake; i.e., the Davidson Canyon parcels are available for the establishment of water features, but no such actions have been specifically proposed.

<u>Water Rights Acquisition</u> (see May 2015 SBA, pp. 6-7 and measure FS-SSR-01 in Appendix B of the FEIS)– Rosemont Copper has acquired the rights to purchase 1,122

AFA of surface water rights on Cienega Creek currently held by and used on the Del Lago golf course. Portions of the water rights are specified to be transferred to an appropriate entity, as in-stream flow rights on upper Cienega Creek (150 AF), lower Cienega Creek (100 AF), and Davidson Canyon (46 AF). A large component (approximately 825 AF) of the water rights was envisioned in the FEIS and BO to be used below Pantano Dam, either as recharge or as part of an in-lieu fee project. The September 2014 HMMP does not specify where this remaining water would go, but does specify that it would be for a beneficial use within the Cienega Creek watershed, that it may be allocated to a restoration project at and downstream of the Pantano Dam, or that it may potentially be used in support of an in-lieu fee project.

With the exception of lower Davidson Canyon (no records of northern Mexican gartersnakes occur from there), these additional, potential surface flow protections may provide some additional benefit to the northern Mexican gartersnake as a function of benefits to its prey base in lower and upper Cienega Creek, respectively. Details regarding how, where, and whether these additional protections may manifest are unknown. Therefore, it is difficult to ascertain exactly how much, if any, direct or indirect benefit the gartersnake could experience. Regardless of location, these measures do nothing to minimize effects from the loss of Empire Spring and the subsequent effects to the Chiricahua leopard frog metapopulation as a result lowered population persistence in the face of disease outbreaks.

To facilitate the transfer, Rosemont will file an application to sever 250 AF of two of the water rights and transfer the place of diversion and beneficial use to the Cienega Creek watershed, at such location(s) as may be determined in coordination and consultation with wildlife agencies and Pima County. According to the second supplemental biological assessment from February 2013, "The balance of the surface water rights, approximately 825 ac-ft per annum, will be used for aquifer recharge below Pantano Dam. To accomplish this, a 'managed underground storage facility' (MUSF) will be permitted through the Arizona Department of Water Resources (ADWR). This will allow surface water flows currently diverted for golf course irrigation to be captured and discharged back to the stream bed below the Pantano Dam within the Cienega Creek Natural Preserve." The second supplemental biological assessment predicts this effort will result in the creation of approximately 3,000 linear feet of additional surface flow and riparian vegetation within lower Cienega Creek within Pima County's Cienega Creek Natural Preserve. Current estimates suggest that baseflow generated from this effort will equal approximately one cubic feet per second and that depending on where within the Pima County CCNP the water is redirected downstream of the Pantano Dam and piped to the surface, its presence as available surface water could be tenuous. Ultimately, potential benefits to the northern Mexican gartersnake from this effort will be directly related to whether or not this created, 3,000 foot reach could support additional lowland leopard frogs and or Gila chub which are presumed to be the gartersnakes' preferred prey in the lowermost reach of Cienega Creek, upstream of Pantano Dam. Provided the new reach can sustain these prey species and remain free of harmful nonnative predators, we expect northern Mexican gartersnakes to use the new reach as occupied habitat, and benefit from this measure.

Cienega Creek Conservation Fund (Second Supplemental BA, Item E. 1, pp. 42-43, February 2013)–The project proponent has committed to an annual payment of $200,000 into a conservation fund for a period of 10 years. The fund will be used for projects "designed to preserve and enhance aquatic and riparian ecosystems and protect and maintain habitat for federally listed aquatic and riparian species in the watershed." In particular, we expect this fund will restore and improve habitat as well as to supplement, as needed, on-going harmful nonnative species monitoring and removal in the Las Cienegas NCA which has been recently, and is currently, funded by the BLM. Given the ephemeral nature of Federal government funding year-to-year, it is possible that in some years, BLM may not be able to fund these efforts. In this event we expect this conservation fund will ensure these efforts do not lapse in any given year through the period of mine operations. To help ensure the conservation fund provides the maximum conservation benefit, we expect that not all of each annual dispersement ($200,000) will be spent in the same year, and encourage the majority of funds be saved over the long-term for when implementation of critical conservation activities such as harmful nonnative species monitoring and removal is at risk of not occurring in any given year. To the extent that the conservation fund ensures that habitat is restored and improved and that the Las Cienagas NCA remains harmful nonnative-free for the next several decades, we expect clear benefits to northern Mexican gartersnakes and their prey species.

Harmful Nonnative Species Management and Removal Program (see letter dated February 11, 2016, from Rosemont Copper Company to the Coronado National Forest)–The project proponent has committed to providing $3,000,000 for the establishment and implementation of a harmful nonnative species management and removal program. This program is described above in the Revised Conservation Measures subsection entitled Revised Conservation Measure 2 – Harmful Nonnative Species Management and Removal.

We consider the upper Santa Cruz watershed in the San Rafael Valley to be the first priority for implementation of this conservation measure, based on the potential benefit to the Huachuca water umbel and the aquatic vertebrate species under consultation (Gila chub, Gila topminnow, desert pupfish, Chiricahua leopard frog, and northern Mexican gartersnake) which all occur in the San Rafael Valley historically or currently. We estimate that the planning and implementation of nonnative plant control to benefit Huachuca water umbel in the San Rafael Valley may cost up to $200,000, which leaves approximately $2,800,000 for harmful nonnative species control in the San Rafael Valley to benefit the aquatic vertebrates under consultation.

For aquatic vertebrates, our best estimate of the costs for implementing this program in the San Rafael Valley is $259,000/year for the first five years (which includes $244,000/year for initial surveys and control efforts and $15,000/year for plan development and reporting) and $190,000/year for the remaining years until funding reaches zero (this includes $175,000/year for surveys and maintenance of preferred baseline conditions and $15,000 for annual report development). Figures for program implementation to benefit aquatic vertebrates include two full-time personnel and five seasonal personnel dedicated to this specific program's implementation. Collectively, these figures suggest the harmful nonnative management and removal program for vertebrate species could be implemented in the San Rafael Valley for approximately 13 years. There is no reasonable expectation that there will be enough funds available to commence a similar program for any other area or subbasin.

The harmful nonnative species community within the San Rafael Valley is influenced by several potential source populations, including the most significant contributors, spills from Parker

Canyon Lake and the intermittent hydrologic connection across the reach of the Santa Cruz River that is bisected by the International Boundary with Mexico. For these reasons, we do not anticipate or expect this program will reach a harmful nonnative species baseline of zero for any of the targeted species. Rather, we consider the program to act as a large-scale control program to maintain harmful nonnative populations near zero or at such a level as to allow native aquatic vertebrate populations the opportunity to achieve increased reproductive output, recruit successfully, and demonstrate positive population growth. We also recognize there are factors that contribute to population dynamics that are not linked to harmful nonnative species, such as disease, water quality, or water quantity, which are all outside of the purview of this program. For this reason, the only metric that will be used to demonstrate program success in minimizing the effect of take will be the catch rates of harmful nonnative species per unit effort. In our best professional judgment, we will consider this program as meeting its objective if during the final two years of implementation, averaged catch rates for each harmful nonnative species are at 10 percent or less of historical baseline capture rates for each type of habitat sampled and treated (lotic stream, stock tank, seep, spring, etc.).

A critical consideration of this programs' potential success in meeting objectives is whether other conservation partners who own land in the San Rafael Valley will allow access and otherwise cooperate, passively or actively, in program implementation. These other land owners include a private landowner who owns roughly a third of all land within the upper Santa Cruz River subbasin and who is actively pursuing finalization of a habitat conservation plan with us, and the State of Arizona who owns less than 5 percent of the land. The Coronado National Forest manages the remainder of lands in the programs' implementation area. We have no reason to suspect, based on recent coordination with these entities, that either of these non-Federal conservation partners will object to program implementation on their lands or prevent access to their lands.

There is no larger or more geographically pervasive factor negatively affecting to the status of the Gila chub, Gila topminnow, desert pupfish, Chiricahua leopard frog, or northern Mexican gartersnake, across their rangewide distributions, than harmful nonnative species. For this reason alone, it is our opinion that successful implementation of the Harmful Nonnative Species Management and Removal Program will have considerable conservation benefit to all native plant and animal species it aims to address. We expect, based on previous mid- and large-scale efforts to control and/or remove harmful nonnative species, without influence from disease, water quality, or water quantity on populations of consultation species, that populations of these native aquatic species will respond in a significant, demonstrably positive fashion.

It is important to note that northern Mexican gartersnakes, to some extent, depend on certain harmful nonnative species as prey, such as larval and juvenile bullfrogs, mosquitofish, and perhaps spiny-rayed fish in their smaller size classes. Therefore, to lessen the risk of starvation to the gartersnake population, it will be important to supplement the gartersnake's prey base with native prey species as this program is implemented. This will require close coordination with Chiricahua leopard frog headstarting facilities and safe harbor sites as well as with native fish hatcheries on timing their production of animals for release into the upper Santa Cruz River subbasin as well as identifying strategic release locations and times. We also expect that program implementation will result in incidental take of listed species in the upper Santa Cruz River subbasin. This take will be addressed in future consultation.

We expect significant conservation benefits from this programs' implementation, and will be exploring any and all possible funding mechanisms with public and private stakeholders and cooperators to continue program implementation after this funding source is depleted (or approximately 13 years from the beginning of implementation). However, based on a historical review of conservation funding and actions in the San Rafael Valley, we have no reasonable expectation that such funding (outside of that directly associated with this consultation) will be secured. It is highly unlikely that other landowners in the San Rafael Valley, such as the State of Arizona or the private landowner, will have or be willing to contribute the funds necessary to continue effective monitoring and control of harmful nonnative species. Historically, the Coronado has never been able to provide funds that could approach the level necessary to implement a broad-scale harmful nonnative species removal program, and we do not see that changing in the future. One or two years without implementation of monitoring and control activities could result in reinvasion of harmful nonnative species into the area. A vastly improved baseline in the status of the native species under consultation will temper this effect to some degree, but ultimately harmful nonnative species have an ecological and evolutionary advantage over native species and will slowly begin to dominate the riparian and aquatic community within the San Rafael Valley without sustained implementation of this program. Therefore, while this program stands to greatly benefit populations of several listed aquatic plants and vertebrates under consultation, these benefits are only temporary, while the adverse effects of mining to the aquatic ecosystem of the Las Cienegas NCA subbasin are anticipated to worsen over time and last for decades.

Effects to Northern Mexican Gartersnake Proposed Critical Habitat

The primary constituent elements specified for proposed northern Mexican gartersnake critical habitat are specifically linked to northern Mexican gartersnake ecology and therefore effects described above accurately illustrate how attributes of critical habitat are expected to be affected. As a result of mining activities and as detailed above, we expect the quantity of water within upper Empire Gulch and affected reaches along Cienega Creek to be reduced, which in turn is expected to reduce the size and challenge the permanency of the gartersnakes' primary prey community in affected areas within the Las Cienegas NCA. Effects to the aquatic environment affect PCE 1.a. and 1.d. Effects to the native prey community affect PCE 3.

Primary constituent elements are elements of physical or biological features that provide for a species' life-history processes and are essential to the conservation of the species. Primary constituent element 1 for proposed critical habitat for the northern Mexican gartersnake addresses the aquatic features within occupied habitat that are essential to the habitat adequately serving its role in supporting a resident northern Mexican gartersnake population. Specifically, primary constituent element 1.a. requires an adequate amount of pool and backwater habitat and a flow regime capable of adequately processing sediment within a system. Given that precipitation-induced flows are most likely to influence the movement of sediment within the Cienega Creek watershed where northern Mexican gartersnakes are extant, which are unaffected by any change in the groundwater level as a result of the proposed action, we do not expect any effects to sediment transport within the system. As stated previously in this biological opinion (see "*Effects to Northern Mexican Gartersnakes,*" other sections), we do expect effects from mine operations are reasonably certain to occur to base flows within affected reaches of Cienega Creek and to at least one important spring source, Empire Spring. We described how a reduction in base flow is expected to influence the dimensions, volume, permanency, and suitability of pool and backwater habitat to ranid frog and native fish populations.

Primary constituent element 1.d. requires that aquatic habitat maintain water quality characteristics that support a native amphibian prey base. Above in "*Effects to Northern Mexican Gartersnakes*", we described how decreasing water volume within affected pools is expected to affect the depth and area of pools which therefore affects the permanency of pools as well as water temperature and dissolved oxygen levels. Over time and as average water temperatures rise within affected pools, dissolved oxygen levels will lower, removing available oxygen and affecting the respiratory capacity of developing larval leopard frogs. Reducing the respiratory efficiency of larval frogs is expected to reduce the rate of successful metamorphosis into juvenile terrestrial frogs and later into reproductive adults. This effect results in a net, and compounding, reduction in reproductive output within the resident ranid frog population over time.

As referenced previously, and based on groundwater modeling results, we anticipate that the effects to Empire Spring from groundwater drawdown associated with mine operation will occur, may become measurable before mine closure, and result in total desiccation of the spring at some point post-closure of the mine, thus removing the spring as habitat for Chiricahua leopard frogs. Also stated previously and reiterated here, Empire Spring is arguably the most important site for the continued persistence of Chiricahua leopard frogs in the area, because of its naturally warmer water temperature which is vital for allowing frogs to persist while still infected by Bd. Recent monitoring efforts (Hall *et al*. 2015) confirm the Chiricahua leopard frog metapopulation within the Las Cienegas NCA is vulnerable to Bd outbreaks, as evidenced by extreme die-off events at multiple sites within the area. Empire Spring is therefore critical to ensuring there remains a source population of frogs which can disperse and recolonize extirpated sites within the metapopulation after significant disease outbreaks and die-offs occur.

Ultimately and collectively, these effects to the aquatic habitat within the Las Cienegas NCA are expected to manifest in continually reduced prey populations over time, which adversely affects primary constituent element 3 for the northern Mexican gartersnake, "A prey base consisting of viable populations of native amphibian and native fish species." While we expect that native fish populations will continue to persist in the Las Cienegas NCA despite adverse effects to pool habitat in affected reaches of Cienega Creek, the eventual potential complete loss of Empire Spring, as a perennial source population for dispersing individuals, makes the future of Chiricahua leopard frogs within this at-risk metapopulation tenuous into the future without active management such as annually stocking head-started frogs or artificially creating similar thermal refugia (if possible) where frogs can survive the winter in the presence of Bd. Remaining pools in unaffected reaches, pools which retain demonstrable habitat value in affected reaches, and the presence of natural and groundwater well-fed stock tanks and ponds are expected to attenuate the effects of groundwater drawdown into the future. However, there is no attenuating factor that ameliorates the important disease-buffering role of Empire Spring from its degradation, and ultimately, its potential total loss. This potential, irreversible, adverse effect to primary constituent element 3 presents a significant challenge for this proposed subunit in meeting its role in future recovery and conservation of the northern Mexican gartersnake.

Effects of Conservation Measures on Northern Mexican Gartersnake Proposed Critical Habitat

As stated previously, primary constituent elements that have been identified for the northern Mexican gartersnakes' proposed critical habitat are inextricably linked to the species ecology. Therefore, we only briefly discuss which primary constituent elements are expected to be affected by proposed conservation measures and refer the reader to the expanded discussion above on effects to the species itself from implementation of conservation measures.

<u>Cienega Creek Water Rights Acquisition</u> (see the September 26, 2014, HMMP and the Conservation Measures subsection of our October 30, 2013, BO for details)–The main objective of this conservation measure, which will be implemented in the Cienega Creek Subbasin Unit of proposed critical habitat, is to improve or secure streamflow into the future. Should the objective result in demonstrable gains in streamflow in Cienega Creek, we expect some level of benefit to PCE 1 (aquatic habitat) and potentially PCE 3 (native prey base).

<u>Cienega Creek Conservation Fund</u> (see the Conservation Measures subsection of our October 30, 2013, BO for details)–Specific activities funded by this conservation measure, which will also be implemented in the Cienega Creek Subbasin Unit, could vary widely but the principle objective is to improve riparian and aquatic habitat and help maintain a native community within the Las Cienegas NCA. Therefore, it is likely all PCEs for proposed critical habitat within this unit could benefit during the period of time for which conservation funds remain available. This period of time is uncertain.

<u>Harmful Nonnative Species Management and Removal Program</u> (see letter dated February 11, 2016, from Rosemont Copper Company to the Coronado National Forest; also described in the Revised Conservation Measures narrative, above)–The primary intent of this conservation measure is to remove harmful nonnative species from the upper Santa Cruz River Subbasin Unit of proposed critical habitat and improve the status of native aquatic species within the subbasin. This will significantly improve PCEs 3 (native prey base) and 4 (harmful nonnatives low or absent) for the period of time for which program funding remains available (or approximately 13 years from the start of implementation).

Cumulative Effects – Northern Mexican Gartersnake

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.

Examples of cumulative effects include continued road maintenance, grazing activities, and recreation in the action area, current and future development, other nearby mining projects, and unregulated activities on non-federal lands, such as trespass livestock, inappropriate use of off-highway vehicles (OHVs), and illegal introduction of harmful nonnative aquatic species, which can cumulatively adversely affect the northern Mexican gartersnake and its proposed critical habitat. Additional cumulative effects on northern Mexican gartersnakes include ongoing activities in the watersheds in which the species occurs such as livestock grazing in the presence of harmful nonnative species and associated activities outside federal allotments, irrigated agriculture, groundwater pumping, stream diversion, bank stabilization, channelization, recreation without a federal nexus, and cross-border activities that include the following: human traffic; deposition of trash; new trails from human traffic; soil compaction and erosion; increased fire risk from human traffic; and water depletion and contamination. These impacts are generally attenuated by the relatively minor amount of non-Federal lands in the action area.

Conclusions - Northern Mexican Gartersnake

As discussed in full in the Sources of Uncertainty section, above, we have chosen to base our effects analysis on the upper end of the 95th percentile analysis. Given the long time frames involved, long distances involved, and small amounts of drawdown in the aquifer, there is a high degree of uncertainty associated with groundwater predictions. The scenario represented by the upper end of the 95th percentile analysis is not the scenario most probable to occur. Rather, by selecting it we are analyzing a conservative position that ensures almost all of potential and reasonable outcomes disclosed by the models would be encompassed by this BO analysis. This conservative approach ensures that under almost all potential outcomes that can be reasonably predicted, the conclusions of non-jeopardy and no destruction or adverse modification, below, would remain valid.

After reviewing the current status of the northern Mexican gartersnake, the environmental baseline for the action area, the effects of the proposed Rosemont Mine Project to the northern Mexican gartersnake and its primary prey species, and the cumulative effects, it is our biological opinion that the action, as proposed, is not likely to jeopardize the continued existence of the northern Mexican gartersnake nor destroy or adversely modify its proposed critical habitat. We make this finding for the following reasons:

1. The affected northern Mexican gartersnake population and its proposed critical habitat, within and downstream of the Las Cienegas NCA, represent a relatively small proportion of the species' rangewide distribution in the United States and Mexico. We estimate that approximately 10-15 percent of occupied habitat for the northern Mexican gartersnake occurs in the United States (Arizona and New Mexico) with the remainder occurring in Mexico. The action area currently represents 2 of 14 extant populations in southern Arizona and likely less than 10 percent of its distribution in the United States; appreciably less than that rangewide (this subspecies has a range that extends significantly into Mexico). Lastly, the proposed Cienega Creek Subbasin Unit represents just 50,393 out of 421,423 total acres (12 percent) of proposed critical habitat, most of which within this subunit is comprised of terrestrial and lentic habitat which are unaffected by the proposed action.

2. Proposed critical habitat primary constituent elements 1.a., 1.d., and 3 noted above are expected to be adversely affected as a result of the proposed action; primary constituent element 3 is discussed further in item 4 below. We anticipate, based on modeling, that broad-scale, permanent degradation may occur to the prey base of the northern Mexican

gartersnake within the action area, at an unknown point in the foreseeable future and as a result of a lowered groundwater table. This would cause irreversible effects to northern Mexican gartersnake habitat in certain identified reaches in upper Cienega Creek, as well as all of upper Empire Gulch. Habitat is important to the maintenance and recovery of northern Mexican gartersnake populations because it serves two primary roles: 1) to support an adequate prey base; and, 2) provide protective cover in the presence of harmful nonnative species. The action area is largely if not completely devoid of harmful nonnative species and provided that status continues, we do not expect that habitat's role as protective cover will be meaningfully affected. We do have concern about some habitat supporting the local Chiricahua leopard frog population into the future, particularly the potential loss of Empire Spring. We suspect that Empire Spring serves a critical and unique role in keeping metamorphosed frogs, which are exposed to Bd, alive over the winter to act as a source population of dispersing frogs within the metapopulation the next year. Specifically, we suspect the springs' warmer water temperatures increase survivorship of infected frogs, as Bd-related mortality in Chiricahua leopard frogs correlates strongly with colder water temperatures (die-off most frequently occur over the winter months). However, lentic habitat areas fed by precipitation (or solar groundwater wells) within the action area are not expected to be affected by the proposed action, nor are various reaches along Cienega Creek where groundwater discharge is considered strong enough to sustain surface flow. Therefore, there will remain habitat for leopard frogs elsewhere within and downstream of the Las Cienegas NCA. These areas not sensitive to lowered groundwater levels can provide feeding, breeding, and sheltering habitat for northern Mexican gartersnakes and their prey communities (with exception to Bd die-offs), maintaining general ecologic function.

3. The Las Cienegas NCA's and Pima County's Cienega Creek Natural Preserve's most unique and important attribute contributing to the conservation and recovery of northern Mexican gartersnakes is that each of these areas provides a native prey base in the absence of harmful nonnative species. This combination sets this area aside from all other currently or historically occupied areas in southern Arizona (and throughout most of the species' range in the United States), making it an important component of future conservation and recovery of the species. We also expect that the Las Cienegas NCA and Pima County's Cienega Creek Natural Preserve will continue to be managed for native species into the foreseeable future. Funding levels and mechanisms are expected to fluctuate over time, and may even cease in some years, which is expected to affect on-the-ground implementation of conservation programs. At a minimum, however, we expect Chiricahua leopard frog recovery activities to continue in this area into the foreseeable future. Recovery activities are likely to include head-starting and release programs following Bd-related die-offs within the Chiricahua leopard frog metapopulation.

4. Of the primary prey species available to northern Mexican gartersnakes in the action area (primary constituent element 3 of proposed critical habitat), we anticipate that Chiricahua leopard frogs (its most important prey species in the area) may be most affected by the proposed action. This is due to the potential degradation and eventual loss of Empire Spring habitat for Chiricahua leopard frog, a vital population which appears to be

resistant to the effects of Bd (see above discussion under Item 2). Although not guaranteed to continue in perpetuity, active recovery efforts may re-establish Chiricahua leopard frog populations through headstart-and-release techniques, but without Empire Spring's thermal refuge, the ability of metamorphosed frogs to survive the winter in the presence of Bd could be perpetually at risk from persistent, seasonal die-offs associated with Bd. Although fish and Chiricahua leopard frog populations are expected to be less robust as a result of degraded and lost habitat, the northern Mexican gartersnake is a prey generalist to some degree; therefore, we anticipate that northern Mexican gartersnake will exploit such alternative sources of prey in the action area as have been documented in a number of ecology settings throughout its range. These additional sources of prey in the action area may include earthworms, leeches, lizards, small rodents, and toads which are not expected to be affected by the proposed action because they don't depend heavily (or at all in some cases) on habitat affected by the action. These alternative prey sources are expected to help sustain the resident gartersnake population at a low density, despite being adversely affected by losses to the Chiricahua leopard frog and Gila chub populations. The anticipated persistence of Gila chub, the implementation of on-going recovery actions to help maintain the Chiricahua leopard frog population, and an array of resident, alternative prey species (not affected by the action) within the Las Cienegas NCA are expected to temper the anticipated effects to the northern Mexican gartersnake prey base to some degree. We have observed lowland leopard frog populations expand and contract in the action area over time, and there remains the possibility that, if extant, they may replace Chiricahua leopard frogs in vacated habitat, serving an important role as prey items for northern Mexican gartersnakes. We also note that both leopard frog species are vulnerable to Bd, and therefore both species may be similarly affected by the presence of Bd on the landscape.

5. The suite of conservation measures, especially the funding of the anticipated 13-year implementation of the Harmful Nonnative Species Management and Removal Program in the upper Santa Cruz River subbasin, is expected to substantially improve the baseline status for the northern Mexican gartersnake and its native prey community on a subbasin-level. Considering that the effects of the proposed mining action last into the foreseeable future, the ultimate, long-term benefit of this conservation measure remains contingent upon whether funding can be secured to maintain the program after the proponents' funds are depleted. We remain concerned, based on the conservation history of that subbasin, that additional funding may not be secured, but during the 13-year implementation, the status of the gartersnake and numerous native aquatic species is expected to be bolstered significantly.

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 and Terms and Conditions specified below.

INCIDENTAL TAKE STATEMENT – Northern Mexican Gartersnake

Section 9 of the Act and Federal regulations pursuant to section 4(d) of the Act 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 further defined (50 CFR 17.3) 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. “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 of 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 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 the USFS 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. The USFS has a continuing duty to regulate the activity covered by this incidental take statement. If the USFS (1) fails to assume and implement the terms and conditions or (2) fails to require any 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, the USFS must report the progress of the action and its impact on the species to the FWS as specified in the incidental take statement. [50 CFR 402.14(i)(3)].

Amount or Extent of Take - Northern Mexican Gartersnake

We anticipate that take of northern Mexican gartersnakes in the form of harm is reasonably certain to occur in upper Empire Gulch and various pools and aquatic sites within affected reaches of Cienega Creek, as a result of permanent, adverse effects to primary prey communities in these areas, from groundwater drawdown due to the mine.

We anticipate take in the form of harm (death directly due to starvation or secondary effects of starvation, weight loss, reduced fitness, forced dispersal, etc.) to northern Mexican gartersnakes to result from adverse effects to the species’ prey base which we anticipate will result from modeled, mine-driven groundwater drawdown, throughout the modeled analysis period and potentially beyond. Reduced fecundity means that reproductive female gartersnakes will give birth to fewer offspring over time. The cumulative numbers of individual gartersnakes (and their subsequent offspring) that were never born as a result of reduced fecundity within this affected population is unknown and nearly impossible to accurately predict, even with advanced modeling. Therefore, these cumulative losses within the population are not included in the total anticipated number of taken individuals.

We also recognize the difficulty in monitoring the numbers of a cryptic, difficult-to-detect species such as the northern Mexican gartersnake. The analysis of the effects of the action emphasizes the reduction and potential loss of its prey base as the primary driver of adverse effects to the gartersnake. For this reason, we are adopting the contents of the respective Incidental Take Statements for the Gila chub, Gila topminnow, desert pupfish, and Chiricahua leopard frog, using groundwater drawdown (as informed by monitoring well data) as a surrogate measure of incidental take for the northern Mexican gartersnake. The use of monitored ground water levels is an appropriate surrogate for take of northern Mexican gartersnakes because monitoring will inform the potential response of habitat to changing groundwater levels, which in turn, inform the potential response of aquatic vertebrates that serve as important gartersnake prey species, and therefore indirectly monitor potential population stress to resident gartersnakes from effects to its prey community. Northern Mexican gartersnakes prey on other species, but this suite of aquatic species, albeit threatened and endangered, is the only one for which we have a detailed analysis of changes in abundance due to the proposed action.

These Incidental Take Statements are incorporated herein via reference.

Effect of the Take – Northern Mexican Gartersnake

In this biological opinion, we determine that these levels of anticipated take are not likely to result in jeopardy to the species nor result in adverse modification of its proposed critical habitat for the reasons stated in the Conclusions section.

Reasonable and Prudent Measures - Northern Mexican Gartersnake

Reasonable and prudent measures and terms and conditions should minimize the effects of take, and provide monitoring and reporting requirements [50 CFR 402.14(i)(3)]. The effects to the northern Mexican gartersnake from implementation of the proposed action occur specifically within the Las Cienegas NCA and downstream through Pima County's Cienega Creek Natural Preserve. Although within the action area, both of these areas are outside the management jurisdiction of the USFS. Therefore, the following reasonable and prudent measure and its accompanying term and condition require the Forest Service to minimize the effect of incidental take of northern Mexican gartersnakes outside the defined action area, as authorized under section 7 of the Act.

The following reasonable and prudent measure is necessary and appropriate to minimize the effect of take on northern Mexican gartersnakes:

As detailed above, we are reasonably certain the principle effect of the proposed action on the northern Mexican gartersnake is manifested through effects to its prey base; primarily to the Chiricahua leopard frog which is considered a primary prey species for this gartersnake population. The diminishment or loss of this prey species over time will increase the vulnerability of the gartersnake population to extirpation, as a function of depressed resiliency. The effect of take on the northern Mexican gartersnake is therefore minimized by securing the regional prey base for this species. The principle factor keeping regional prey communities at low densities is harmful nonnative species. Harmful nonnative species include, but are not limited to, nonnative fish in the families Centrarchidae and Ictaluridae, American bullfrogs (*Lithobates catesbeianus*), and any species of crayfish. Therefore, the project proponent has committed to temporary funding of a harmful nonnative species removal and management program, at a subbasin scale, within the San Rafael Valley. This will minimize the effect of take by helping ensure the long-term persistence of northern Mexican gartersnakes and their primary native prey species in the surrounding area. We consider the area identified for implementation to offer a reasonable likelihood of successfully minimizing the effect of incidental take of the gartersnakes, and provide the following terms and conditions to ensure a greater likelihood of program success.

Terms and Conditions - Northern Mexican Gartersnake

In order to be exempt from the prohibitions of section 9 of the Act, the USFS shall ensure that the proponent complies with the following terms and conditions, which implement the reasonable and prudent measure described above. This term and condition is non-discretionary.

1. The USFS and Corps shall ensure the harmful nonnative species program provides maximum conservation benefit and a higher likelihood of success:

    a. The program will have to demonstrate success by achieving a quantitative metric based on our best professional judgment: during the final two years of implementation, averaged catch rates for each harmful nonnative species are at 10 percent or less of historical baseline capture rates for each type of habitat sampled and treated (lotic stream, stock tank, seep, spring, etc.). If this metric is not met for any harmful nonnative species previously identified, an analysis evaluating the need to reinitiate formal consultation shall be conducted.

This reasonable and prudent measure, with its implementing terms and conditions, is designed to minimize the effect of 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. The Coronado National Forest and/or Corps must immediately provide an explanation of the causes of the taking and review with our office the need for possible modification of the reasonable and prudent measure and/or reinitiation of consultation.

Conservation Recommendation

As provided under section 7(a)(1) of the Act, we recommend that the Coronado National Forest and Corps seek local and regional, public and private, conservation collaborators, partnerships, and funding sources to secure and maintain viable populations of northern Mexican gartersnakes outside of, but adjacent to, Forest Service-managed land within the immediate region surrounding the action area. To best address effects of the proposed action where they occur, we urge the Coronado National Forest to implement this collaborative approach on the Las Cienegas NCA and Pima County’s Cienega Creek Natural Preserve.

HUACHUCA WATER UMBEL

Status of the Species - Huachuca Water Umbel

The rangewide status of the Huachuca water umbel remains largely unchanged from that which was described in our October 30, 2013, BO. We did, however, subsequently complete the August 21, 2014, Huachuca water umbel (*Lilaeopsis schaffneriana* ssp. *recurva*) 5-Year Review: Summary and Evaluation (five-year review) (FWS 2014c) and include status information from that review. The taxon's critical habitat remains as described in the July 12, 1999, Final Rule (64 FR 37441); none is present within the action area.

We also include updated genetics and cultivation information. We note that the 5-year review represents a more-current synthesis of available information and threats to the taxon.

Listing History
On January 6, 1997, we listed the Huachuca water umbel (*Lilaeopsis schaffneriana* ssp. *recurva*) as an endangered species (FWS 1997); on July 12, 1999, 83.2 kilometers (km) (51.7 miles (mi)) of streams or rivers in Cochise and Santa Cruz Counties, Arizona, were designated as critical habitat (FWS 1999a). A Five-Year Review of the taxon was finalized in August, 2014, and recommended no change to the classification of the taxon as endangered (FWS 2014c).

Recovery Planning
There is a Draft Recovery Plan for the Huachuca water umbel (FWS 2016), which is currently under public review (until May 9, 2016). The Draft Recovery Plan identifies Recovery Criteria by which the species may be downlisted (from endangered to threatened) or delisted (recovered and no longer in need of the Act's protections). These criteria, which are subject to revision following the public participation and peer review processes, are described below.

<u>Recovery Criteria</u>

To downlist:

1. A minimum cumulative extent of 2,000 m2 (0.5 acre / 0.2 hectare) of naturally occupied habitat exists in the San Pedro Watershed, 20 percent of which occurs in tributary streams, springs, or cienegas; and a minimum of 2,000 m2 (0.5 acre / 0.2 hectare) in the Santa Cruz Watershed, 90 percent of which occurs in tributary streams, springs, or cienegas, distributed among the areas of Cienega Creek (35 percent), Sonoita Creek (10 percent), the San Rafael Valley uplands and mainstem (10 percent), and the western Huachuca Mountains (35 percent); and a minimum of 125 m2 (0.03 acre / 0.01 hectare) exists in the Rio Yaqui Watershed; this level of occupancy is sustained or improved for a minimum of 10 years over a 15 year period.
2. At least three separate introduced occurrences with a minimum cumulative extent of 150 m^2 (0.037 acre / 0.015 hectare) of occupied habitat are placed in each of the three United States.
3. Threats to the taxon and its habitat have been managed and reduced, and management is in place for a minimum of 20 years to ensure the persistence of occurrences with

minimum cumulative extent (as reflected by the achievement and maintenance of downlisting criteria 1 and 2 in each of the three United States watersheds;

4. A living collection of as many plugs as resources allows, collected from genetically distinct regions (e.g. Fort Huachuca/SPRNCA north; San Rafael / Las Cienegas/Sonoita; San Pedro Riparian National Conservation Area, south/San Bernardino), from both the San Pedro and the Santa Cruz watersheds is maintained in at least one botanical garden in southern Arizona for recovery and educational purposes; and
5. Seeds of *L. schaffneriana* ssp. *recurva* are collected following Center For Plant Conservation guidelines, which include collecting from no more than 10 percent of the standing seed crop from 50 individual seed bearing plants per population (if the population size permits), and collecting from a variety of microsites and physical characteristics within the stand of plants. These seeds are stored at both the Agricultural Research Service National Center for Genetic Resources Preservation in Fort Collins, Colorado and stored according to protocols at a local facility such as the Desert Botanical Gardens in Phoenix, Arizona, for long-term conservation and recovery purposes.

To delist:

To delist *L. schaffneriana* ssp. *recurva*, the criteria for down-listing must be met and the level of occupancy in the downlisting criteria must be sustained or increasing for a minimum of 20 years over a 30-year period.

<u>Recovery Actions Needed</u>

The Draft Recovery Plan also includes a list of actions required in order to achieve recovery of the taxon; these are as follows:

1. Maintain or enhance groundwater hydrography, as measured by stream gages, by reducing water withdrawal and increasing water conservation and recharge;
2. Preserve existing *L. schaffneriana* ssp. *recurva* occurrences and their seedbanks through the protection of occupied habitat, unoccupied corridors, and habitat quality;
3. Remove stressors such as trampling and invasive non-native plant competition to *L. schaffneriana* ssp. *recurva* occurrences;
4. Conduct research and monitoring that will facilitate better understanding of: a) the distribution and genetics of the taxon in both the United States and Mexico, b) population and metapopulation dynamics and trends, c) life history, d) response to threats, and e) other relationships key to recovery of the species;
5. Establish introduced *L. schaffneriana* ssp. *recurva* occurrences to help ensure the long-term survival of the taxon in southern Arizona;
6. Develop collaborative partnerships with Federal and State land managers, private landowners, museums and botanical gardens, seed storage facilities, and others; and provide outreach to the public as needed to accomplish recovery;
7. Promote the achievement of conservation and recovery in Mexico, resulting in long-term protection of *L. schaffneriana* ssp. *recurva* and its habitat;
8. In coordination with stakeholders, revise this plan as needed as new information comes to light so that the recovery strategy and actions implement recovery in as efficient a

manner as possible.

Terminology
Because this taxon is clonal in nature and it is not practicable to identify individuals, the term occurrence is used herein to denote concentrations of this taxon within a distinct locality that are relatively distant from other concentrations. Occurrences are more likely to share underground root systems, and are often separated from one another by morphological or hydrological features. Within occurrences, clusters of stems separated by areas without stems are denoted herein as patches. An occurrence can consist of one to many patches; patches can have one or a few stems or form carpets of stems.

Biology
Huachuca water umbel is a semi-aquatic to fully aquatic herbaceous perennial plant of the carrot family (Apiaceae). Hollow linear leaves that taper to a point are produced singly or in clusters at the top of short rhizomes. The leaves vary greatly in length from 2.5 to 33 centimeters (cm) (0.98 to 12.99 inches (in)) depending on their habitat, with shorter leaves typically found in drier environments and longer when submerged in water (Coulter and Rose 1902; Affolter 1985; FWS 2014a). Three to ten 1.0 to 2.0 millimeters (mm) (0.04 to 0.08 in) wide flowers are borne on an umbel that is always shorter than the leaves. Fruits are spherical and dry, 1.6 to 2.3 mm (0.6 to 0.09 in) long by 1.2 to 2.0 mm (0.04 to 0.08 in) broad, with five distinct spongy ribs that make the seeds buoyant and easily dispersed by water (Affolter 1985).

Life History
Huachuca water umbel reproduces both asexually and sexually. Asexual reproduction, likely the primary form of reproduction in this taxon (Vernadero Group and the Desert Botanical Garden 2012), provides a means of rapid expansion of available habitat. Sexual reproduction may be important for maintaining genetic diversity, evolutionary potential, and persistence in the taxon. Recent work on sexual reproduction in captivity showed significantly higher fruit production in plants growing in flowing water, verses those in a terrestrial situation, indicating that the best habitat to increase genetic variation is flowing water (Morrow 2015).

Flowering has been observed episodically between March and October, peaking in July and occurring with abundance irregularly (Warren *et al.* 1991). Germination occurs one to two weeks after seeds disperse (Gori 1995). Plants may also dislodge during flooding or other disturbance events with clumps then possibly re-rooting in a different site along aquatic systems.

Natural seed banks are important for the persistence of rare species, and observations in the field suggest Huachuca water umbel seed may remain viable for five to ten years, an important survival strategy during times of drought (Titus and Titus 2008a; Titus and Titus 2008b; Titus and Titus 2008c). Another important survival strategy of the Huachuca water umbel are its rhizomes, which enable occurrences to rapidly expand or contract in size between years, seasons, or both, in response to local environmental conditions, including temperature and water availability (FWS 1997; Vernadero Group 2011).

Genetics and Variability
Historical numbers of unique individuals represented in clonal occurrences for the taxon is

unknown. Vernadero Group and Desert Botanical Garden (2012) found that occurrences currently exhibit relatively low variability, with occurrences having 6-17 distinct genetic types, and generally more within population variability than between population variability. Existing occurrences are generally not dominated by a single clone. Genetic diversity/number of individuals represented in such intermixed clones may be significant in population dynamics and conservation (Harper 1977). Vernadero Group and Desert Botanical Garden (2012) note that conservation efforts should emphasize preservation of existing genetic diversity in Huachuca water umbel occurrences and the promotion of factors that will contribute to the establishment of new clones and/or sexually-produced seedlings, maintain dispersal pathways, and reduce habitat fragmentation.

Habitat

Huachuca water umbel is restricted to cienegas, rivers, streams, and springs in permanently wet (or nearly so) muddy or silty substrates with some organic content (FWS 1999a). The taxon is generally found in shallow and slow-flowing waters that are relatively stable, or in active stream channels containing refugial sites where the plants can escape the effect of scouring floods (FWS 1997; FWS 1999a). In upper watersheds that generally do not experience scouring floods, Huachuca water umbel occurs in microsites where interspecific plant competition is low. At these sites, Huachuca water 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, Huachuca water umbel can occur in backwaters, side channels, and nearby springs.

Distribution/Abundance

Found between 855 and 2,170 meters (m) (2,805 and 7,120 feet [ft]) in elevation, the range of the taxon crosses the Sierra Madrean Region of southeastern Arizona and adjacent portions of Sonora, Mexico (Titus and Titus 2008c; Vernadero Group and the Desert Botanical Garden 2012). In the United States (U.S.), we are aware of 17 locations supporting extant occurrences of Huachuca water umbel, 8 locations where all Huachuca water umbel occurrences are considered extirpated, and 6 locations where no occurrences have been relocated in recent years. In the U.S., Huachuca water umbel occur on lands administered by the U. S. Army Fort Huachuca, the Forest Service, the Bureau of Land Management, the FWS, Arizona State Parks, Pima County, The Nature Conservancy, and private landowners. The majority of Huachuca water umbel occur along the San Pedro River, in the Huachuca Mountains, and along Cienega Creek in the San Pedro River and Santa Cruz River Watersheds. In Sonora, Mexico, we are aware of 21 locations supporting Huachuca water umbel occurrences, though most of these locations have not been revisited in recent years. In Mexico, most Huachuca water umbel occurs on private lands of the San Pedro River and its tributaries in the San Pedro River Watershed (Anderson 2006). Huachuca water umbel also occurs within the Santa Cruz, Rio Yaqui, Rio Sonora, and Rio Concepcion watersheds in Mexico.

Although we now are aware of many more occurrences of Huachuca water umbel than at the time of listing in both the U.S. and in Mexico, there are no occurrences that appear to be increasing in size and many are reported from single patches among competing vegetation or in aquatic habitat that is in danger of being lost to groundwater pumping or drought. Many other occurrences have not been relocated in many years and are believed extirpated due to changes in suitability of habitat.

Threats

Threats to the taxon identified through research and consultations that could potentially impact Huachuca water umbel include: aquatic habitat degradation; wildfire and resulting sedimentation; invasive, nonnative plant competition; livestock grazing; and recreation (Factor A) (the present or threatened destruction, modification, or curtailment of its habitat or range) and the effects of drought and climate change (Factor E) (other natural or manmade factors affecting its continued existence). See the Final Rule listing the species (62 FR 665-689) for additional information on the threat factors (A through E) evaluated during listing

<u>Aquatic habitat degradation</u> - Human activities such as groundwater overdrafts, surface water diversions, impoundments, channelization, improper livestock grazing, agriculture, mining, sand and gravel operations, road building, nonnative species introductions, urbanization, wood cutting, wildfires, and recreation all contribute to aquatic habitat loss and degradation within the historical range of Huachuca water umbel (Hendrickson and Minckley 1984; Bahre 1991; Hereford 1993).

<u>Wildfire and resulting sedimentation</u> - Fire would generally not burn the wetland habitat of Huachuca water umbel due to high humidity; however it has the potential to burn adjacent upland habitats, especially those invaded by nonnative grasses, causing indirect effects on Huachuca water umbel and its habitat throughout the range of the taxon (FWS 2009). Effects include increased runoff of floodwaters, deposition of debris and sediment originating in the burned area, and potential for scouring of individual Huachuca water umbel plants and habitat (FWS 2014b).

<u>Invasive, nonnative plants</u> - Invasive nonnative plants have increased their presence within aquatic habitat of southeastern Arizona, and this invasion and expansion of infestations are expected to continue in the future. Because Huachuca water umbel is sensitive to competition from both native and nonnative herbaceous plants, the continued increase in nonnative species will lead to a decrease in the presence of Huachuca water umbel throughout the range of the taxon.

<u>Livestock grazing</u> – Huachuca water umbel are affected by livestock grazing in the following ways: 1) trampling, 2) direct impacts from construction of range improvement projects, 3) changes in stream geomorphology that lead to erosion, sedimentation, and downcutting, 4) watershed degradation and resulting adverse effects to stream hydrology, and 5) consumption (FWS 1999b; Anderson 2006). Observations of Huachuca water umbel response to grazing indicate the taxon is capable of experiencing light to moderate grazing with negligible impact (Simms pers. comm. October 26, 2011; Anderson 2006; Edwards pers. comm. February 21, 2001; Rorabaugh 2013). More intensive grazing or that during dry periods when cattle spend a disproportionate amount of their time, if not controlled, in riparian areas, may result in harmful effects to Huachuca water umbel and other riparian obligates (Edwards pers. comm. February 21, 2001; FWS 2002; Krueper 1996; Malcom and Radke 2008; FWS 2014a).

<u>Recreation</u> - Riparian areas and cienegas offer important recreational opportunities for the

residents of southern Arizona and northern Sonora (FWS 1997). This visitation is expected to increase in the future with increases in human population, as well as drought conditions and the desire to be near water. Recreational activities, if poorly managed, can result in soil compaction, streambank destabilization, erosion and sedimentation, increases in the presence of invasive nonnative plant species, and trampling of Huachuca water umbel and other riparian plant species, thus reducing habitat quality.

Drought and climate change - Huachuca water umbel evolved in the Southwest and has persisted in many locations throughout its range through historical droughts such as those of the 1950s, yet, given the severity and persistence of the present multi-decade drought (Bowers 2005; Garfin *et al.* 2013; CLIMAS 2014), it is unknown how long Huachuca water umbel will maintain viability in de-watered habitat. It has been suggested that seed from this taxon may persist for five to ten years in such situations (Titus and Titus 2008a; Titus and Titus 2008b; Titus and Titus 2008c). Projections for the southwestern U.S. are that precipitation will be less in the future (Seager *et al.* 2007; Karl *et al* 2009) and that temperatures will rise (Overpeck *et al.* 2013; Karl *et al.* 2009). In addition, in a warmer environment, an enhanced hydrologic cycle is expected; rainfall events are to be less frequent, but more intense, and larger flood events more common (Karl *et al.* 2009). Such large floods can destroy Huachuca water umbel patches, and even entire occurrences, if no niches in backwaters are present to ensure recolonization.

The most direct threats from climate change to the Huachuca water umbel (related to loss of wetted habitat and increased stress) are increased fragmentation within and between hydrological units, decreased numbers of individuals impairing occurrence viability, and over time, incremental reduction of genetic variation important for genetic adaptation.

Small occurrence size - Habitat degradation over historical time has resulted in decreased number and size of Huachuca water umbel occurrences, potentially decreasing viability and genetic diversity of these occurrences. Occurrences are in many cases isolated, which makes the chance of natural recolonization after extirpation less likely. The clonal nature of the taxon, combined with small patch sizes, may result in less genetic diversity than in a non-clonal species, further aggravating vulnerability. The work of the Vernadero Group and the Desert Botanical Garden (2012) indicates that the taxon is more vulnerable to extinction as a result of stochastic events that are often exacerbated by habitat disturbance. For instance, the restriction of Huachuca water umbel to a relatively small area in southeastern Arizona and adjacent areas of Mexico increases the chance that a single environmental catastrophe, such as a severe tropical storm or drought, could eliminate many occurrences or cause extinction.

Critical Habitat

Seven Critical Habitat units have been designated for Huachuca water umbel; all are in Santa Cruz and Cochise counties, Arizona, and include stream courses and adjacent areas out to the beginning of upland vegetation. 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 Approximately 1.25 mile of Sonoita Creek southwest of Sonoita;
Unit 2 Approximately 2.7 miles of the Santa Cruz River on both sides of Forest Road 61, plus approximately 1.9 miles of an unnamed tributary to the east of the river;
Unit 3 Approximately 3.4 miles of Scotia Canyon upstream from near Forest Road 48;
Unit 4 approximately 0.7 mile of Sunnyside Canyon near Forest Road 117 in the Huachuca Mountains;
Unit 5 Approximately 3.8 miles of Garden Canyon near its confluence with Sawmill Canyon;
Unit 6 Approximately 1.0 mile of Rattlesnake Canyon and 0.6 mile of an unnamed canyon, both of which are tributaries to Lone Mountain Canyon; approximately 1.0 mile of Lone Mountain Canyon; and approximately 1.0 mile of Bear Canyon; an approximate 0.6-mile reach of an unnamed tributary to Bear Canyon; and
Unit 7 Approximately 33.7 miles of the San Pedro River from the perennial flow reach north of Fairbank (Arizona Department of Water Resources 1991) to 0.13 mile south of Hereford, San Pedro Riparian National Conservation Area.

The primary constituent elements of critical habitat for Huachuca water umbel include, but are not limited to, the habitat components that provide:

1. Sufficient perennial base flows to provide a permanently or nearly permanently wetted substrate for growth and reproduction of Huachuca water 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 Huachuca water umbel expansion;
3. A riparian plant community that is relatively stable over time and in which nonnative species do not exist or are at a density that has little or no adverse effect on resources available for Huachuca water 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 Huachuca water umbel is appreciably diminished. Such activities are also likely to jeopardize the continued existence of the taxon.

Environmental Baseline - Huachuca Water Umbel

The status of Huachuca water umbel in the action area is substantively the same as what appeared in the October 30, 2013, BO, minor refined information since that time has been included in the SBA of 2015. The May 2015 SBA based its analyses on named stream reaches (see Effects to Aquatic Ecosystems section, above). Huachuca water umbel has been documented in Cienega Creek Reaches 3, 5 through 8, although only CC5 and CC7 are Key Reaches subject to detailed analyses of effects to discharge and pools. We note that Huachuca water umbel has, in the past, been detected in lower Empire Gulch (EG2) (Warren, pers. comm. 1996) and that is has been reestablished by the BLM in the Cieneguita Wetlands (CGW, subject only to pool-related effects analyses).

We have also elected to incorporate information from the taxon's five-year review (see status of the species section above) so that the revised effects analysis found in the Effects to Aquatic Ecosystems section, above, can be compared to the most-current information regarding the presence of the taxon.

Cienega Creek and Empire Gulch

Cienega Creek and its tributary, Empire Gulch, support or have supported numerous occurrences and more than 100 patches of Huachuca water umbel (BLM 2012). There are multiple occurrences of Huachuca water umbel from Empire Gulch, Gardner Canyon, Mattie Canyon, and Narrows Powerlines Road areas in Cienega Creek within Las Cienegas NCA that have been detected as early as 1991, although these were not considered in the critical habitat designation of 1999 (Rebman 1991, entire; Warren. pers. comm. April 4, 1996; 64FR 37441, entire). In addition, there is one occurrence nearby the Narrows in Fresno Canyon on State Land. All of these occurrences are monitored regularly by personnel of the Bureau of Land Management and were last measured in full in 2011 when approximately 100 patches were detected over a 12.9 km (8 mi) section of creek (BLM 2011). In 2014, a partial survey was conducted with similar results, though the area was reported to be drier than in the past (M. Radke pers. comm. June 2014).

Huachuca water umbel occurring on Pima County lands along Cienega Creek within the Cienega Creek Natural Preserve are monitored periodically by County personnel. A single Huachuca water umbel occurrence was detected in lower Cienega Creek in 2001 when researchers noted a few leaves that did not persist beyond the season in which they were discovered (EEC 2001, p. 9). A survey in June 2006 revealed no Huachuca water umbel at this site and a deeply entrenched stream channel 7 to 9 ft below the former marsh (Titus and Titus pers. comm. June 20, 2006). A 2013 survey indicated no plants at this location and Huachuca water umbel is believed to be extirpated (Powell pers. comm. October 1, 2013).

Overall, the Cienega Creek subwatershed presently supports roughly 12 percent of the total known geographic range and extent of plant material of Huachuca water umbel and supports approximately 26 percent of the known range within the Santa Cruz River Watershed. The Cienega Creek subwatershed is centrally located in the range and has significant genetic variability that is important to the management of the taxon for sustainability, resilience and recovery.

Background for Analyses and Definition of Baseline

The hydrologic data upon which a portion of the following Huachuca water umbel-specific analyses are based were described in both the Effects of the Proposed Action section (below) and Effects to Aquatic Ecosystems sections (above).

The hydrologic data are based on a 95th percentile analysis of the Tetra Tech (2010), Montgomery (2010), and Myers (2010) groundwater model best-fit and sensitivity analyses, as applicable. The 95th percentile analyses were developed for the SIR and were included in the May 2015 SBA to address FWS concerns with the use of multiple groundwater models with oftentimes divergent results. The 95th percentile analysis was described in detail in these prior documents, and was summarized in the Sources of Uncertainty subsection of the Effects of the Proposed Action section, above.

We are aware of the analytical strengths and weakness of this approach, but reiterate that our selection of the upper end of the 95th percentile values results in analyses in which 97.5 percent (which includes the 2.5 percent of the least well-represented values at the lower end of the distribution) of the *other* possible hydrologic outcomes exhibit lesser effects. The 95th percentile approach does not represent the most probable outcome (but it does provide reasonable certainty that the effects to this species are unlikely to be greater than those described below). Due to the uncertainty inherent in these modeling efforts, there are no results that can be definitively said to be the most likely to occur. Thus, we have selected the precautionary approach.

Secondly, the following species-specific analysis considers the present-day state of the hydrology to represent the baseline condition. All effects, whether the result of anticipated climate change alone, mine drawdown alone, and/or climate change and mine drawdown combined, are described in terms of their divergence from present, pre-project conditions. Climate change is *not* viewed as an ongoing and evolving baseline against which mine-only effects are incrementally assessed.

Effects of the Proposed Action - Huachuca Water Umbel

Surface water in alluvial reaches of Cienega Creek, Empire Gulch, and Cieneguita Wetlands exists in locations where the thalweg (lowest elevation portion of the channel) of the stream intersects the alluvial water table. A longitudinal contraction in surface flows would be a component of a more-lengthy (and also longitudinal) reduction in shallow, subsurface flows, with alluvial groundwater in areas adjacent to dewatered reaches also dropping below critical depths for Huachuca water umbel. In areas where the depth to groundwater has exceeded the taxon's ability to access water, individual patches would senesce and eventually die unless they could: (1) gradually move to more moist microsites via the spread of rhizomes and/or (2) move entire patches via flood and colonize new, well-watered reaches.

The section in this BO entitled Effects to Aquatic Ecosystems describes the hydrologic basis for effects to the streams in which Huachuca water umbel occurs. A subsequent analysis of effects to riparian vegetation, of which the taxon is a component, appears in the Effects to Riparian Ecosystems section. These analyses are incorporated herein via reference.

Again, Huachuca water umbel has been documented in Cienega Creek Reaches 3, and 5 through 8, although only CC5 and CC7 are Key Reaches subject to the SIR and May 2015 SBA's detailed analyses of effects to discharge and pools (see the Effects to Aquatic Ecosystems section and the SIR for detailed explanations of Key Reaches and their selection criteria). Our subsequent analyses will, where necessary, interpolate effects modeled in unoccupied Key Reaches situated upstream of occupied, non-modeled reaches. This approach is corroborated by Table 3 in the May 2015 SBA, specifically the information in the column entitled Specific

Technique to Analyze Impact of Upstream Flow Losses.

We also note that Huachuca water umbel has, in the past, been detected in lower Empire Gulch (EG2) (Warren, pers. comm. 1996) and in the Pima County CCNP (within CC13). The taxon has also been reestablished by the BLM in the Cieneguita Wetlands (CGW, subject only to pool-related effects analyses in the SIR and May 2015 SBA).

Huachuca water umbel is a semi-aquatic to aquatic, emergent plant and as such, it tends to occur in shallow waters within cienegas and along the margins of perennial streams. The May 2015 SBA contained no data by which to evaluate changes in the wetted length of affected streams, nor are we aware of any methodology by which Huachuca water umbel presence or abundance can be correlated with stream discharge. Increases in the number of days with zero flow, particularly if they are capable of changing a stream from perennial to intermittent or ephemeral, are a useful surrogate for evaluating effects to Huachuca water umbel habitat. Similarly, the May 2015 SBA included no data regarding the lateral perimeter of pools. The percent of pool surface area remaining is a useful substitute for this metric, though we note that perimeter and area do not vary linearly. For these reasons, our analyses will focus on two discharge-related metrics (zero flow days) and flow status (perennial, intermittent, or ephemeral) and one pool-related metric (percent surface area remaining).

Again, the May 2015 SBA states that Huachuca water umbel occurs in CC3, CC5, CC6, CC7, and CC8. Of these, only CC5 and CC7 were subject to detailed discharge and pool analyses. We have elected to consider not only CC5 and CC7, but to also consider effects to reaches CC2 and CC4 given their upstream and midpoint locations relative to the other sites, respectively. We are also including CC13 (extirpated, but present in the past per EEC 2001, Titus and Titus pers. comm. 2006, and Powell pers. comm. 2013), EG2 (based on past occurrence per Warren, pers. comm. 1996) , and CGW (based on BLM establishment of the taxon). Note that CGW is subject only to pool-based analysis.

Detailed analyses of zero-flow days, flow status, and pool surface area are found in the Effects to Aquatic Ecosystems section and in Table A-2, A-4, and A-8, respectively, above. The analyses will be summarized briefly here, and the relevant tabular data are also summarized in Tables H-1, H-2, and H-3, below, for only those reaches that support Huachuca water umbel or are situated upstream of reaches that do.

Table H-1 (Excerpt from Table A-2 and SBA Table D-11): Results of stream flow analysis for 95th percentile range – number of days with zero flow per year for sites in the vicinity of or occupied by Huachuca water umbel.

Key Reach	Scenario	End of Mine	10 Years	20 Years	50 Years	100 Years	150 Years
CC2	Climate Change	0	0	0	0	0	0
CC2	Mine and Climate Change	0	0	0	0	0	0
CC4	Mine Only	0	0	0	0	0	0
CC4	Climate Change	0	0	0	0	0	0
CC4	Mine and Climate Change	0	0	0	0	0	0
CC5	Mine Only	0-2	2-3	2-3	2-3	2-3	2-3

CC5	Climate Change	5	5	5	5	5	5
CC5	Mine and Climate Change	5	5-8	5-8	5-8	5-8	5-9
CC7	Mine Only	0-2	2-3	2-3	2-3	2-3	2-3
CC7	Climate Change	23	23	23	23	23	23
CC7	Mine and Climate Change	23	23-28	23-28	23-28	23-31	23-31
CC13	Mine Only	0	0	0	0	0	0
CC13	Climate Change	23	23	23	23	23	23
CC13	Mine and Climate Change	23	23	23	23	23	23
EG2	Climate Change	0	0	0	0	0	0
EG2	Mine and Climate Change	0	0	0	0	0	0

Table H-2 (Excerpt from Table A-4 and Table D-13): Results of stream flow analysis for 95th percentile range – flow status for sites in the vicinity of or occupied by Huachuca water umbel.

Key Reach	Scenario	End of Mine	10	20	50	100	150
CC2	Mine Only	P	P	P	P	P	P
CC2	Climate Change	P	P	P	P	P	P
CC2	Mine and Climate Change	P	P	P	P	P	P
CC4	Mine Only	P	P	P	P	P	P
CC4	Climate Change	P	P	P	P	P	P
CC4	Mine and Climate Change	P	P	P	P	P	P
CC5	Mine Only	P	P	P	P	P	P
CC5	Climate Change	P	P	P	P	P	P
CC5	Mine and Climate Change	P	P	P	P	P	P
CC7	Mine Only	P	P	P	P	P	P
CC7	Climate Change	P	P	P	P	P	P
CC7	Mine and Climate Change	P	P	P	P	P-I	P-I
CC13	Mine Only	P	P	P	P	P	P
CC13	Climate Change	P	P	P	P	P	P
CC13	Mine and Climate Change	P	P	P	P	P	P
EG2	Mine Only	P	P	P	P	P	P
EG2	Climate Change	P	P	P	P	P	P
EG2	Mine and Climate	P	P	P	P	P	P

	Change						
Notes: P = Perennial (<30 no-flow days per year); I = Intermittent (30–350 no-flow days per year); E = Ephemeral (>350 no-flow days per year)							

Table H-3 (Excerpt from Table A-8 and SBA Table D-26): Results of refugia pool analysis for 95 percentile range – median* percent remaining surface area of pools in the vicinity of or occupied by Huachuca water umbel.

Key Reach	Scenario	End of Mine	10	20	50	100	150
CC2	Mine Only	99	92-99	92-99	92-99	92-99	89-99
CC2	Climate Change	57	57	57	57	57	57
CC2	Mine and Climate Change	57	55-57	55-57	55-57	55-57	55-57
CC4	Mine Only	100	98-100	98-100	98-100	98-100	97-100
CC4	Climate Change	68	68	68	68	68	68
CC4	Mine and Climate Change	68	67-68	67-68	67-68	67-68	67-68
CC5	Mine Only	99	98-99	98-99	98-99	98-99	98-99
CC5	Climate Change	75	75	75	75	75	75
CC5	Mine and Climate Change	75	74-75	74-75	74-75	74-75	74-75
CC7	Mine Only	100	98-100	98-100	98-100	96-100	94-100
CC7	Climate Change	71	71	71	71	71	71
CC7	Mine and Climate Change	71	69-71	70-71	69-71	68-71	67-71
CC13	Mine Only	99-100	91-100	91-100	91-100	91-100	91-100
CC13	Climate Change	29	29	29	29	29	29
CC13	Mine and Climate Change	29	28-29	28-29	28-29	28-29	28-29
CC15	Mine Only	100	92-100	92-100	92-100	92-100	92-100
CC15	Climate Change	63	63	63	63	63	63
CC15	Mine and Climate Change	63	61-63	61-63	61-63	61-63	61-63
EG1	Mine Only	78-100	61-100	47-100	7-100	2-100	N-93
EG1	Climate Change	52	52	52	52	52	52
EG1	Mine and Climate Change	38-52	26-52	14-52	2-52	2-52	N-48
EG2	Mine Only	100	98-100	98-100	97-100	93-100	89-100
EG2	Climate Change	73	73	73	73	73	73
EG2	Mine and Climate Change	73	72-73	72-73	70-73	67-73	64-73
CGW	Mine Only	99-100	94-100	93-100	81-100	64-100	52-100
CGW	Climate Change	51	51	51	51	51	51
CGW	Mine and Climate Change	51	50-51	49-51	45-51	38-51	29-51

N - Indicates that no pools are predicted to remain
* In this case, 100 percent indicates that the pool retains all of its original volume; lower percentages indicate the percentage left of the original volume. For instance, a statistic of 80 percent would mean that the pool retains 80 percent of its original volume, and has lost or shrunk by 20 percent. The median is calculated only from those pools predicted to remain.

Upper Cienega Creek – Key Reaches CC2 and CC3

Key Reach CC2 was subject to detailed hydrologic analyses but is not known to be occupied by Huachuca water umbel. Reach CC3, situated immediately downstream of and adjacent to CC2, is occupied by Huachuca water umbel, but was not subject to hydrologic analyses. The information found in Table 3 in the May 2015 SBA indicates that the hydrology of CC3 is affected by the effects modeled for CC2.

Reach CC2 shows no days with zero flow under current baseline conditions. The effects of the mine, climate change, and both effects combined result in no increase in zero-flow days, and Cienega Creek is anticipated to remain perennial in this reach.

The retention of perennial flow does not necessarily indicate the effects of flow diminishment on pools. The 95th percentile analyses of the percent remaining pool surface area again indicate surface area losses in CC2 begin at the cessation of mining and increase over time. Mine drawdown may leave 89 percent area remaining at 150 years while climate change leaves as little as 57 percent at the same time step. Combined, as little as 55 percent of the initial pool area may remain 150 years after mining. If it assumed that effects in reaches CC2 are similar to and/or propagate downstream to reach CC3, then these represent measurable adverse effects to Huachuca water umbel. Note that the Specific Technique to Analyze Impact of Upstream Flow Losses column in Table 3 in the May 2015 SBA assumes for analytical purposed that outflow from CC2 contributes to inflow to CC4. It is therefore also reasonable to assume that outflow from CC2 contributes to inflow to CC3, which is situated between CC2 and CC4.

Upper Cienega Creek – Key Reaches CC5 and CC7

Reaches CC5, CC6, and CC7 are occupied by Huachuca water umbel, but CC6 was not subject to hydrological analyses in the May 2015 SBA. Table 3 in the May 2015 SBA states that CC7 is influenced by flow from reach CC5, which is located upstream. It is therefore highly likely that effects to CC5 would propagate downstream through CC6 as well.

Reaches CC5 and CC7 exhibit an average of 2 days with zero stream flow per year under present-day baseline conditions. Mine drawdown alone, absent the modeled effects of climate change, could increase zero-flow days up to 3 days per year under the 95th percentile analyses. Climate change absent the mine's impacts could result in 5 additional days with zero stream flow per year in CC5, and 23 additional days with zero stream flow per year in CC7.

The 95th percentile analyses of mine drawdown plus climate change would result in up to 9 days with zero stream flow per year in CC5 and up to 31 days with zero stream flow per year in CC7. Flow status would remain perennial in CC5 under the proposed mine-plus climate change scenarios; flow status in CC7 also largely remains perennial for most scenarios, but by 100 and 150 years after mine closure, the higher range of the 95th percentile analysis indicates a possible shift to intermittent flow for the mine-plus-climate change scenario. Given the positioning of CC6 between reaches with somewhat divergent flow status, we assume that CC6 will remain perennial under the mine-plus-climate change scenario (as with its contributing reach, CC5), with a possible shift to intermittent status (evident in the reach to which it contributes, CC7) at 150 years, if not by 100 years. A transition to intermittent flow, defined as from 30 to 350 zero flow days per year, is an adverse effect to Huachuca water umbel. The effect is particularly notable in that it is likely the zero-flow days will occur during the summer growing season, when flows are already at their lowest.

The 95th percentile results for median remaining pool surface area indicate that, at 150 years, mine drawdown is anticipated to leave 98 percent of the pool area remaining in CC5 and 94 percent in CC7. Climate change will leave 75 percent in CC5 and 71 percent in CC7 at 150 years. Combined, mining and climate change are modeled to result in 74 percent and 67 percent median pool surface area remaining 150 years in reaches CC5 and CC7, respectively.

Climate change is the predominant factor in declining flows and loss of pool surface area in CC5 and CC7; the proposed action only intensifies the effects to a moderate degree (see previous key-reach analyses and Tables H-1 and H-3, above for the specific values). Again, Table 3 in the May 2015 SBA states that flow in CC7 is influenced by CC5; making it very likely that CC5 also influences CC6. Given that reach CC6 is likely to exhibit similar effects to reach CC 5 upstream and/or CC7 downstream, then the incremental effects of mine drawdown there are also similar; small and difficult to measure. With respect to assumption of flow contributions to CC6, we again refer to the Specific Technique to Analyze Impact of Upstream Flow Losses column in Table 3 in the May 2015 SBA assumes for analytical purposed that outflow from CC5 contributes to inflow to CC7. It is therefore also reasonable to assume that outflow from CC5 contributes to inflow to CC6, which is situated between CC5 and CC7.

Lower Cienega Creek – Key Reach CC13

Key Reach CC13 is located within the Pima County CCNP, and as stated previously, Huachuca water umbel has been detected here in the past. The May 2015 SBA's 95th percentile analyses for CC13 shows that mine drawdown alone would result in no increase in zero stream flow days at any time step from the end of mining to 150 years. Climate change by itself would result in 23 additional days exhibiting zero stream flow per year at every time step in CC13. In combination, mine drawdown plus climate change would result in 23 days with zero stream flow per year in CC13 (no change from climate change-only results). Reach CC13 would therefore remain perennial.

Under the 95th percentile analysis, the mine-only effect is the retention of 91 percent of median surface area in CC13 at 150 years. Climate change effects are of a greater magnitude in CC13; 29 percent of pool surface area will remain. Mining and climate change combined will leave as little as 28 percent of pool surface area remaining in key reach CC13.

Again, as is the case in CC5 and CC7, above, climate change is the primary driver of declining flows and loss of pool surface area in CC13 over time; the proposed action makes only an incremental contribution to losses from the present-day baseline condition. We cannot definitively ascertain the magnitude of this effect to the Huachuca water umbel.

Lower Empire Gulch – Key Reach EG2

Discharges in lower Empire Gulch, in which Huachuca water umbel has been detected, appear to be less affected by mine drawdown than upstream in EG1. Mine drawdown, climate change, or both scenarios combined are modeled to exhibit no days of zero flow noted under any of the 95th percentile modeling scenarios. This equates with no change from the baseline, and flow status would remain perennial.

The 95th percentile analyses of the losses of pool surface area due to mine drawdown alone predict that as little as 89 percent of pool surface area will remain intact at 150 years, with all other times steps at a less than 10 percent loss. Climate change is the predominate factor in surface area losses in EG2 pools, leaving 51 percent of the area at all modeled intervals.

Together, climate change and mine drawdown will leave 51 percent of pool surface area intact at the end of mining; this trend proceeds until reaching 29 percent at 150 years. Pools in lower Empire Gulch are anticipated to experience measurable adverse effects, although lower in magnitude relative to upstream reaches (EG1). These effects are driven by climate change, although mine drawdown does make a measurable, incremental contribution. The magnitude of this incremental effect in terms of Huachuca water umbel is difficult to definitively measure, but is anticipated to result in reduced vigor and extent of the taxon’s occurrences.

Cieneguita Wetlands

The Cieneguita Wetlands ponds, in which Huachuca water umbel have been established by the BLM, were not subject to a zero-flow day analysis, but were subject to pool-related analyses. As stated in the Effects to Aquatic Ecosystems section, above, mine drawdown alone is anticipated to modestly effect pool surface area up to 20 years post mining, but this effect will increase to 81 percent surface area remaining at 50 years, 65 percent at 100 years, and 52 percent at 150 years. Climate change is predicted to leave 51 percent pool volume remaining in CGW throughout the modeled period. The combined effects of mine drawdown and climate change are predicted to leave as little as 39 and 29 percent of pool surface area intact, at 100 and 150 years, respectively. This is a measurable adverse effect to Huachuca water umbel.

Other Effects

The detailed hydrologic modeling provides a method whereby the effects of the proposed action can be quantified. We, however, remain concerned with a certain adverse effect that is not readily quantified in this manner. As discussed in the effects analysis for the southwestern willow flycatcher in our October 30, 2013 BO, near-stream (alluvial) groundwater drawdown and reduced surface flows characterize the most visible aspect of riparian effects, but don’t necessarily describe their full extent. Moreover, the southwestern willow flycatcher analysis in the prior BO was concerned primarily with the sustenance and recruitment of woody riparian vegetation; the effects to a near-aquatic plant such as Huachuca water umbel would be more immediate and severe.

The May 2015 SBA quantified pool losses in terms of number (see Table A-5, above) and surface area (see Table A-9, above). These losses have the practical effect of reducing the wetted length of stream. A longitudinal contraction in surface flows would also be accompanied by a narrowing of the stream’s top width, and such a narrowing of a stream can be expected to result in Huachuca water umbel rooting closer to the centerline of the channel, as the water-dependent plant grows towards the remaining, available water.

This would be expected to be accompanied by reduced numbers of unique individuals and increased fragmentation and isolation. Such fragmentation and isolation increases the risk of genetic erosion that may reduce plant vigor necessary for successful longer-term genetic adaptation to changing conditions (Vernadero Group and Desert Botanical Garden 2012).

Additionally, plants tolerant of drier conditions, potentially including nonnative species, could colonize the less-well watered lateral sites and indirectly or directly compete with Huachuca water umbel. This is problematic in that the proposed action will leave flood flows in reaches above Davidson Canyon Wash largely unaffected, creating a relatively larger differential between low flows and peak flows. Vegetation that establishes itself at a lower elevation and closer to the thalweg (deepest, central line of a channel) in the pioneer zone of a narrowed low-flow channel will be subject to scouring from the unaffected peak flows, which act as channel-forming agents. Flood scour could be further exacerbated if the larger herbaceous and woody vegetative communities suffer mortality sufficient to reduce the stability of the stream's banks, where Huachuca water umbel occurs. While Huachuca water umbel requires low to moderate severity floods to create niches for colonization, excessive flooding is intolerable to occurrences and may result in extinctions locally (Warren *et al.* 1991; Warren *et al.* 1989).

Summary of Adverse Effects and Effects to Recovery - Huachuca Water Umbel

Huachuca water umbel plants occurring along Cienega Creek in reaches CC3, CC5, CC6, CC7, and CC8 are anticipated to experience a decreased extent of occurrence and reduced vigor of remaining occurrences over time. These effects are due primarily to the effects of climate change on stream flow and, by extension, pools. The relative effect of mine drawdown varies by reach; it is minimal in lower Empire Gulch and the mainstem of Cienega Creek, moderate in the Cieneguita Wetlands, and severe in upper Empire Gulch.

Reach CC3 was not specifically modeled, but in reach CC2, upstream, the mine would reduce pool surface area by 11 percent while climate change reduces it by 43 percent. The effects of the mine are additive to the effects of climate change and so the net, incremental effect of mine drawdown is to slightly reduce the ability for Huachuca water umbel to persist and associated expected reduction in genetic variability in reach CC2 over the long term.

In reaches CC5 and CC7, the only occupied reaches subject to detailed modeling, mine drawdown would result in 2 percent and 6 percent losses of pool surface area, respectively. Climate change would precipitate 25 percent and 29 percent losses of pool surface area in reaches CC5 and CC7, respectively. The effects of the mine are additive to the effects of climate change and so the net, incremental effect of mine drawdown is to slightly reduce the resilience of Huachuca water umbel in reaches CC5, CC7 and, by inference CC6, with an associated expected reduction in genetic variability in the face of climate change.

Huachuca water umbel occurring in or near lower Empire Gulch is also anticipated to experience reduced vigor and extent, but a larger proportion of the effects are the result of mine drawdown. In EG2, mine drawdown is anticipated to cause an 11 percent reduction in pool surface area while climate change will reduce pool area by 27 percent. Mine drawdown is therefore an appreciable contributor to the up-to 36 percent loss of pool surface area anticipated to occur as a result of mine operations and climate change. The net, incremental effect of the proposed action is significant degradation of aquatic habitat and an appreciable diminishment of Huachuca water umbel's ability to persist combined with a loss of genetic variability impairing adaptation potential, at recent levels of abundance or extent.

In the Cieneguita Wetlands, and at 150 years post-mining, climate change alone will reduce pool surface area by 49 percent from present-day, baseline conditions, leaving 51 percent remaining. The mine alone could result in as little as 52 percent of pool surface area remaining at 150 years (48 percent remaining). Combined, mining and climate change will leave as little as 31 percent of the present-day pool volume intact. Mine drawdown is therefore responsible for approximately one-third of the effects to Huachuca water umbel at this site, and will significantly degrade aquatic habitat and appreciably reduce the ability for the taxon to persist in the future.

We compared Huachuca water umbel occurrence data from the AGFD Heritage Data Management System (HDMS) (Schuetze, pers. comm. August 5, 2014) with the geographic extent of the key reaches (see the Effects to Aquatic Ecosystems section, above) and determined that 423 acres of Huachuca water umbel occurrences will be permanently adversely affected by the proposed action. The HDMS minimum polygon size for a Huachuca water umbel occurrence is 8 acres, which is why the affected area of occurrences exceeds the area actually occupied by patch-based occurrences of the taxon.

The adverse effects to the habitat for Huachuca water umbel described above also represent effects to the taxon’s recovery potential. The mine-driven drawdown’s effects to the taxon’s habitat reduce the potential for downlisting criterion 1 (minimum cumulative extent of naturally-occupied habitat, including within in the Santa Cruz Watershed) and criterion 3 (no less than 20 years of management and reduction of threats). Given that the potential to achieve downlisting criteria 1 and 2 is reduced, the potential to achieve the sole downlisting criterion (meeting the criteria for downlisting and sustaining or increasing the occupancy level in the downlisting criteria for a minimum of 20 years over a 30 year period) is also reduced.

Downlisting criterion 2 (placement of introduced occurrences), criterion 4 (maintenance of living plants from diverse locations in botanical gardens), criterion 5 (collection and storage of Huachuca water umbel seeds from diverse locations) are not anticipated to be adversely affected by mine-driven hydrologic changes.

An additional analysis of the proposed action’s effects to the recovery potential of Huachuca water umbel involves determining the manner and extent to which the necessary actions (see Actions Needed, above) can be implemented within the action area. The mine-driven groundwater drawdowns and reductions in surface flow will reduce the ability to implement needed action 1 (maintenance or enhancement of groundwater hydrography) and needed action 2 (preservation of existing Huachuca water umbel occurrences and habitat quality). The remaining actions needed are not anticipated to be affected.

Effects of the Proposed Conservation Measures - Huachuca Water Umbel

The proposed action described in the October 30, 2013 BO, included: (1) eight conservation measures specifically pertaining to aquatic species; (2) a Cienega Creek subwatershed restoration and water right protection program; and (3) the restoration of isolated ponds within the Sonoita Creek Ranch. The Sonoita Creek Ranch component of the conservation measures was more-definitively described in the September 2014 HMMP (see the U.S. Army Corps of Engineers

Habitat Mitigation and Monitoring Plan section in the Description of the Proposed Action, above). Additionally, a new conservation measure, entitled Revised Conservation Measure 2 – Harmful Nonnative Species Management and Removal (see Description of the Proposed Conservation Measures, above) was recently added.

We stated in the October 30, 2013 BO that the benefits of the various conservation measures associated with Huachuca water umbel were prospective, and of minimal incremental value for the taxon, and could not be definitively assigned any mitigative value. This remains our position for the initial eight conservation measures specifically pertaining to aquatic species and the Cienega Creek subwatershed restoration and water right protection program. As stated above, however, we have since published a Draft Recovery Plan for the Huachuca water umbel. We will therefore supplement our initial analysis of the initial eight conservation measures specifically pertaining to aquatic species and the Cienega Creek Watershed subwatershed restoration with analyses of the respective programs' contribution to recovery.

Five of the eight aquatic species conservation measures' stated purpose is to implement various monitoring programs to: (1) verify groundwater model results (via monitoring wells in key locations); (2) to ensure the chemical integrity of the regional groundwater (via the Aquifer Protection Permit; APP) and streams (via the Arizona Department of Environmental Quality's National Pollution Discharge Elimination System permit; NPDES); and (3) assess alterations in channel geomorphology that may result from altered peak flow hydrology and sediment dynamics. Of the remaining three conservation measures, one was an incorporation of the Sonoita Creek Ranch and Cienega Creek Watershed measures while the two other provided specific details regarding implementation of the latter.

The benefit of well monitoring is to obtain empirical data related to changes in groundwater storage, which may then be used to verify or update the groundwater models. The primary benefit of the monitoring of water quality is to provide an early warning and recommendation for corrective actions prior to the onset of gross changes in chemistry or geomorphology that would be most likely to kill or displace Huachuca water umbel. Successful implementation of these measures will help ensure that water quality remains within applicable standards, but we note that the tolerance of Huachuca water umbel to metals, changes in acidity/basicity, and other factors remains unknown.

We anticipate that these eight actions may make minimal contributions to downlisting criterion 1 (minimum cumulative extent of naturally-occupied habitat, including within in the Cienega Creek watershed) and criterion 3 (no less than 20 years of management and reduction of threats). We anticipate that the eight conservation actions will have no specific beneficial or adverse effects to any of the remaining three downlisting criteria or the sole delisting criterion. Given that there is a potential contribution to achieving downlisting criteria 1 and 2, the potential to achieve the sole downlisting criterion (meeting the criteria for downlisting and sustaining or increasing the occupancy level in the downlisting criteria for a minimum of 20 years over a 30 year period) is also minimally enhanced. We do note, however, that the adverse effects of mine drawdown may outweigh or reduce the magnitude of these conservation measures' benefits.

We also anticipate that implementation of the eight aquatic species conservation measures will make a small, incremental contribution to implement the ability to accomplish the Actions Needed (see above) in order to achieve recovery of Huachuca water umbel. Specifically, the water quality-related aspects of the measure may assist in implementing downlisting criterion 2 (preservation of the taxon's habitat quality via compliance with the APP and NPDES) and criterion (geomorphic studies could contribute to the understanding of relationships key to recovery of the species). We anticipate no beneficial or adverse effects to the remaining needed actions. Again, the adverse effects of mine drawdown may exceed and/or reduce the contributions made by these conservation measures.

The Cienega Creek Watershed conservation measure, analyzed in the October 30, 2013 BO, contains two elements: (1) severance and transfer of water rights; and (2) establishment of the Cienega Creek Watershed Conservation Fund. The program commits to: (1) transfer 150 acre-feet of water rights to a suitable entity for *in situ* use to preserve and enhance the aquatic and riparian ecosystem use in the upper Cienega Creek watershed area and an additional 100 acre-feet to Pima County for similar uses within the Cienega Creek Preserve; (2) transfer 825 acre-feet per annum to aquifer recharge and up to 3,000 linear feet of riparian restoration downstream from Pantano Dam (at which point lower Cienega Creek becomes Pantano Wash); and (3) make annual payments of $200,000 for 10 years to a Conservation fund managed and controlled by a designated conservation partner.

As stated in the October 30, 2013 BO, the Cienega Creek Watershed program may eventually have appreciable value in conserving Huachuca water umbel if the effort results in the retention of water in occupied areas. The mitigative value of the water rights- related component of the conservation measure was, and is, considered speculative.

The proposed establishment and funding of the Cienega Creek Watershed Conservation Fund is anticipated to make incremental contributions to achievement of downlisting criterion 1 (minimum cumulative extent of naturally-occupied habitat, including within in the Santa Cruz watershed), criterion 2 (placement of introduced occurrences) and criterion 3 (no less than 20 years of management and reduction of threats). Given that there is a small potential contribution to achieving downlisting criteria 1, 2, and 3, the potential to achieve the sole downlisting criterion (meeting the criteria for downlisting and sustaining or increasing the occupancy level in the downlisting criteria for a minimum of 20 years over a 30 year period) is also enhanced to a small degree.

The successful implementation of the proposed Cienega Creek Watershed Conservation Fund is also anticipated to make a small improvement in the ability to implement needed action 1 (maintenance or enhancement of groundwater hydrography), needed action 2 (preservation of unoccupied corridors and possibly, seedbanks) and needed action 5 (establishment of introduced Huachuca water umbel occurrences). The remaining actions needed are not anticipated to be affected.

We also anticipate mitigative value for the revised version of the Sonoita Creek Ranch project and the newly-proposed Harmful Nonnative Species Management and Removal program.

There have been two changes (relevant to the Huachuca water umbel) in the Sonoita Creek

Ranch conservation measure as analyzed in the FEIS and October 30, 2013 BO. First, the acreage to be enhanced increased from 1,200 acres to 1,580 acres. Within this acreage, approximately 6 surface acres of ponds containing wetlands will be restored. The second change is that Rosemont has stated that Huachuca water umbel will be included in the vegetation component of the restoration. We cannot definitively determine the length of pond banks or area of wetlands that will be suitable for Huachuca water umbel, but we anticipate that the site will eventually contain a patch or patches of the species and thus become a new occurrence (see Terminology section, above) of the species. While any Huachuca water umbel occupancy in the ponds at Sonoita Creek Ranch would be mapped in HDMS as an 8-acre occurrence, that acreage figure far exceeds the fractions of an acre along the 6-acre ponds' shallow periphery in which the taxon could be established and persist. There is no Huachuca water umbel critical habitat present on the site. Critical habitat is present at Cottonwood Spring, but this is located north (and upstream) from the conservation lands.

The successful implementation of the pond portion of the proposed Sonoita Creek Ranch conservation measure has the potential to contribute to achievement of downlisting criterion 1, should the taxon already be present there (minimum cumulative extent of naturally-occupied habitat, including within in the Santa Cruz watershed), criterion 2, should the taxon be absent but become established (placement of introduced occurrences), and criterion 3 (no less than 20 years of management and reduction of threats). Given that there is a potential contribution to achieving downlisting criteria 1 or 2, the potential to achieve the sole downlisting criterion (meeting the criteria for downlisting and sustaining or increasing the occupancy level in the downlisting criteria for a minimum of 20 years over a 30 year period) is also enhanced. Implementation of the Sonoita Creek Ranch conservation measure will result in no improvements to, nor diminish the ability to achieve downlisting criterion 4 (maintenance of living plants from diverse locations in botanical gardens) or criterion 5 (collection and storage of Huachuca water umbel seeds from diverse locations).

The successful implementation of the proposed Sonoita Creek Ranch conservation measure will improve the ability to implement needed action 1 (maintenance or enhancement of groundwater hydrography), needed action 2 (preservation of unoccupied corridors and possibly, seedbanks) and needed action 5 (establishment of introduced Huachuca water umbel occurrences). The remaining actions needed are not anticipated to be affected.

The Harmful Nonnative Species Management and Removal program has been subjected to a hypothetical analysis in order to determine its contribution to the conservation of Huachuca water umbel. Rosemont has proposed to provide $3,000,000 to implement nonnative species management, both plant and animal. We elected to apportion $200,000 to the control of nonnative plants, which, depending on the species, compete directly with Huachuca water umbel, alter stream hydrology, or increase fire risk within wetlands. Subsequent augmentation of Huachuca water umbel patches would also occur. Critical habitat is present within the area in which treatments will occur (within Scotia Canyon and Bear/Lone Mountain Canyons).

We first worked with USFS staff to generate cost estimates for herbicide application. It must be noted that herbicide application was selected for its potential to control larger infestations of invasive plants such as Johnsongrass (*Sorghum halepense*). We are aware that such herbicide applications could adversely affect extant Huachuca water umbel, as well as, threatened and endangered animal species. Herbicide application is but one potential restoration measure, and it was selected specifically because it would involve the greatest environmental compliance costs. Other potential uses of the $200,000 could exhibit lower costs per acre and thus, result in a larger areal extent of beneficial effects.

We examined Huachuca water umbel occurrences on the Sierra Vista Ranger District (RD) of the Coronado NF. These sites are well outside of the area affected by the proposed action's groundwater drawdowns and represent locations in which incremental improvements in the status of Huachuca water umbel (via reduction of competitive, nonnative plant species) are likely to be achieved . The following are the sites and occurrence acreage values calculated using HDMS data that resulted from this analysis: Sunnyside (125 acres); Turkey Creek (45 acres); Bear/Lone Mountain (107 acres); Scotia (189 acres); O'Donnell (10 acres); Sycamore (8 acres); and Cave Creek (46 acres). The total acreage among all of these Sierra Vista (RD) occurrences is 538 acres. As stated previously, AGFD HDMS data utilize an 8-acre minimum polygon size for a Huachuca water umbel occurrence; this is why the to-be-treated acreage exceeds the area occupied by patch-based occurrences of the taxon.

To determine the cost of survey and herbicide treatment, we consulted with the USFS. The Forest Service provided us a cost of $74/acre for survey and $200/acre for herbicide + application on 538 acres of occurrences ($274 x 538 = $147,412). We anticipate that planning and compliance costs, in general, could represent up to approximately one third of a project total (in this case, $48,647). The total cost of implementing such a nonnative plant removal program would be $196,058. While we employed herbicide application-based treatments for cost estimation purposes, we reiterate that herbicide treatment of nonnative plants is only one method by which to improve the status of Huachuca water umbel, and does not necessarily represent the only method that will ultimately be implemented. We also reiterate that herbicide treatment – and any other treatment for that matter – may require further consultation on effects to Huachuca water umbel and possibly, other threatened and endangered species.

As stated above in the Summary of Adverse Effects section, the proposed action will permanently, adversely affect up to 423 acres of Huachuca water umbel occurrences in the Cienega Creek watershed. The proposed action will beneficially, and to an extent temporarily, affect up to 538 acres of Huachuca water umbel occurrences in multiple watersheds. The 538 beneficially-affected acres of occurrences is associated with the Harmful Nonnative Species Management and Removal program, which we have envisioned as a single, relatively large-scale action (see cost estimate calculations, above). We anticipate that harmful nonnative species will become reestablished within some, if not all of the 538 acres at some point over the 150-year term of hydrologic modeling that forms the basis for the Huachuca water umbel effects analysis. The net effect, at up to 150 years post mining, is thus the adverse effects to up to 423 acres of occurrences. The effects of this net loss would be minimized if the Cienega Creek Watershed Conservation Fund and Sonoita Creek Ranch conservation measures result in the establishment of functionally permanent Huachuca water umbel occurrences, though we anticipate these will be relatively small in areal extent (i.e. small fractions of an acre).

The successful implementation of the Harmful Nonnative Species Management and Removal program has the potential to temporarily (the program is not perpetual) contribute to achievement of downlisting criterion 2 (placement of introduced occurrences). Given that the potential contribution to achieving downlisting criterion 2, the potential to achieve the sole downlisting criterion (meeting the criteria for downlisting and sustaining or increasing the occupancy level in the downlisting criteria for a minimum of 20 years over a 30 year period) will not be permanently precluded. The Harmful Nonnative Species Management and Removal program will result in no improvements to, nor diminish the ability to achieve downlisting criterion 1 (minimum cumulative extent of naturally-occupied habitat, including within in the Santa Cruz watershed), criterion 3 (no less than 20 years of management and reduction of threats), criterion 4 (maintenance of living plants from diverse locations in botanical gardens), or criterion 5 (collection and storage of Huachuca water umbel seeds from diverse locations).

The successful implementation of the proposed Harmful Nonnative Species Management and Removal program will improve the ability to implement needed recovery action 2 (preservation of existing Huachuca water umbel occurrences and habitat quality) and needed action 5 (establishment of introduced Huachuca water umbel occurrences) for as long as implementation is underway. The remaining actions needed are not anticipated to be affected.

Recovery Tipping Point

The tipping point at which recovery of Huachuca water umbel would be precluded requires that we determine the likelihood that the proposed action's 423 acres of permanent adverse effects will appreciably impede or preclude the achievement of the draft recovery criteria; and if so, are the impediments and/or preclusions of such a scale and/or magnitude that the taxon can no longer be recovered?

A tipping point and recovery analysis cannot be conducted for Huachuca water umbel critical habitat within the adversely-affected area in the Cienega Creek watershed, as none has been designated there. Critical habitat does exist in the area in which the Harmful Nonnative Species Management and Removal program will be implemented, but these effects, as stated above, are at least temporarily beneficial. Critical habitat also exists at Cottonwood Spring, located north and upstream of the Sonoita Creek Ranch; this portion of critical habitat will not be affected.

As previously stated, the 423 acres of adverse effects are the result of reductions in the wetted perimeter and length of streams occupied by patch-based occurrences of Huachuca water umbel. The 423-acre area is composed of individual Huachuca water umbel occurrences and surrounding stream and watersheds which were based, for analytical purposes, on the 8-acre AGFD HDMS minimum polygon size per occurrence. In other words, Huachuca water umbel patches do not occupy the entire 423-acre affected area, and there are not 423 acres of individual patches being affected.

We have also anticipated that the affected streams in the Cienega Creek mainstem and lower Empire Gulch are unlikely to be completely dewatered, even considering modeled climate change scenarios (see Effects to Aquatic Ecosystems section and the analysis of effects to the species, above). It is therefore likely that individual Huachuca water umbel occurrences will persist, albeit in unknown numbers and extent. For these reasons, we have determined that the area-based draft recovery criteria can still be met within the area affected by the proposed action. Specifically, we anticipate that draft recovery (downlisting) criterion 1, which requires that 0.5 acre of Huachuca water umbel occurrences persist in the Santa Cruz watershed, 35 percent (0.175 acre) of which are in Cienega Creek, can still be achieved, despite diminished flows. It must be noted, that while 0.175 acre of Huachuca water umbel occurrences appears small in terms of areal extent, it can nevertheless represent numerous patches of the taxon. For example, in 2011, throughout all of Cienega Creek, approximately 100 patches represented approximately 0.34 acres of occurrence (BLM 2011).

The retention of admittedly-reduced flows, and lack of complete dewatering in Cienega Creek and lower Empire Gulch, also will not preclude achievement of draft recovery (downlisting) criterion 2, which requires there exist at least three separate introduced occurrences with a minimum cumulative extent of 0.037 acre of occupied habitat in each of the three occupied watersheds in the United States (Yaqui, San Pedro, and Santa Cruz). In this case, Cienega Creek is but a portion of the larger Santa Cruz River watershed, and we anticipate sufficient opportunities will remain in other locations, if not in Cienega Creek itself. Furthermore, implementation of the Sonoita Creek Ranch and/or Cienega Creek Watershed Conservation Fund could also directly result in the establishment of introduced Huachuca water umbel occurrences.

The sole delisting criterion requires that all downlisting criteria be met and the level of occupancy in the downlisting criteria be sustained or increasing for a minimum of 20 years over a 30 year period. Given that the ability to achieve downlisting criteria 1 and 2 is likely to be retained, we have determined that the proposed action will not preclude the delisting of Huachuca water umbel.

To summarize the tipping point determination in general terms, the Cienega Creek system is one of three medium-scale watersheds in which Huachuca water umbel occurs (the others being the San Pedro and Yaqui river watersheds). These systems are all likely to experience diminished environmental conditions (relative to the present day) from regional climate change and increasing withdrawals of groundwater for human needs. At the most coarse scale, we feel that it is reasonable to state that recovery of Huachuca water umbel would be precluded if the taxon were to be extirpated from one or more of these watersheds; draft recovery criteria 1 and 2 specifically address this issue). Such extirpation would likely require long-term losses of surface water in habitats occupied by the taxon; the proposed action, alone or combined with climate change will not result in such losses. Conversely, we feel that recovery of the taxon could be achieved if the surface flows in these watersheds were secured, if not increased in volume and length, in perpetuity (see draft recovery criterion 3); the proposed action will make incremental contributions – both temporary and permanent - to this end. We have determined that the diminished flows in the Cienega Creek system that are likely to result from the proposed action, when considered in addition to the future effects of climate change, are not of sufficient scale (stream length and potential number of individuals within 423 acres of occurrences) to preclude recovery at the Cienega Creek watershed, Santa Cruz watershed, or rangewide scales.

The long-term (up to 150 years and beyond) adverse effects of the proposed action are permanent, but the affected area within the action area is small compared to the range of the Huachuca water umbel. The beneficial effects of the Sonoita Creek Ranch conservation measure are permanent, but very small in scale. The beneficial effects of the Harmful Nonnative Species Management and Removal conservation measures are similar in scale to the adverse effects and, while finite in duration, are anticipated to temporarily reduce the negative impact of the action, including within Huachuca water umbel critical habitat in the Scotia Canyon and Bear/Lone Mountain Canyon units. Lastly, while not given great analytical weight in our analysis and determinations, we do feel that the Cienega Creek Subwatershed Fund, should it achieve its stated goals and incorporate suggested conservation recommendations for the taxon into its plans, could make incremental contributions to Huachuca water umbel recovery that would be expected to help compensate for mine related contractions and losses.

Overall, it is the scale of the adverse effects that informs our conclusion that it is unlikely that the proposed action would cause large-scale physical alteration to the taxon's habitat, thus making it unlikely that a tipping point away from recovery would be reached. Quantitatively, the Cienega Creek subwatershed presently supports roughly 12 percent of the total known range of Huachuca water umbel. The proposed action will likely reduce this percentage but is unlikely to drive it below the 0.125 acre required to meet draft recovery criterion 1. The Harmful Nonnative Species Management and Removal program will temporarily enhance approximately 16 percent of the known occurrences of Huachuca water umbel. Establishment of Huachuca water umbel at Sonoita Creek Ranch would occur on some portion of the 6 acres of ponds and wetlands at the site, making an incremental contribution to the 0.037 acre of introduced occurrences in draft recovery criterion 2.

Alternately, given that climate change and the cumulative effects of groundwater use and invasive nonnative species are acting on the Huachuca water umbel at the rangewide scale, it is possible that the taxon's overall abundance will decline while the percentage represented in the Cienega Creek subwatershed will be only somewhat reduced based on climate change models. If declines elsewhere are significant, this will increase the significance of maintaining and managing the 423 acres of adversely affected Cienega Creek subwatershed occurrences in numbers, extent and genetic variability; particularly in light of its geographic center in the range. Further, rangewide declines may also reduce the extent of Huachuca water umbel within the small area at Sonoita Creek Ranch and the 538 acres of lands (and critical habitat units in the Scotia Canyon and Bear/Lone Mountain Canyon units) temporarily benefitting from the Harmful Nonnative Species Management and Removal program. This would reduce the value of the conservation measures in proportion to the adverse effects.

Regardless of which of the aforementioned scenarios occurs, the net adverse effects (Cienega Creek's permanent effects less the temporary effects of conservation measures) that occur in the action area do not reach the tipping point; the scale where recovery of the taxon would be delayed or precluded.

Cumulative Effects - Huachuca Water Umbel

The Cumulative Effects section for the Huachuca water umbel remains as described in the October 30, 2013 BO, and is incorporated herein via reference.

Conclusion - Huachuca Water Umbel

As discussed in full in the Sources of Uncertainty section, above, we have chosen to base our effects analysis on the upper end of the 95th percentile analysis. Given the long time frames involved, long distances involved, and small amounts of drawdown in the aquifer, there is a high degree of uncertainty associated with groundwater predictions. The scenario represented by the upper end of the 95th percentile analysis is not the scenario most probable to occur. Rather, by selecting it we are analyzing a conservative position that ensures almost all of potential and reasonable outcomes disclosed by the models would be encompassed by this BO analysis. This conservative approach ensures that under almost all potential outcomes that can be reasonably predicted, the conclusion of non-jeopardy, below, would remain valid.

The magnitude of the proposed action's adverse effects to streams and wetlands in which Huachuca water umbel occurs have been modeled, as have the effects of climate change. While it is unlikely that observed conditions will conform precisely to the 95th percentile results relied upon in this consultation, the data do represent the best available information regarding the future status of the physical habitat for the taxon. We therefore anticipate that an indeterminate number of individual Huachuca water umbel patches occurring along Cienega Creek in Key Reaches CC3, CC5, CC6, CC7, and CC8; in lower Empire Gulch (EG2); and in the Cieneguita Wetlands (CGW) will experience a decreased extent of occurrence and reduced vigor of remaining occurrences in Cienega Creek over time, and that Huachuca water umbel occurrences will be reduced to various extents at the reach scale.

It is, however, unlikely that the proposed action will result in large-scale reductions of perennial stream reaches in the Cienega Creek portion of the action area and thus, Huachuca water umbel is unlikely to be extirpated from the greater Cienega Creek subwatershed. Lastly, the mitigative value of two of the proposed conservation measures (Sonoita Creek Ranch ponds and the Harmful Nonnative Species Management and Removal program) are likely to result in the restoration of Huachuca water umbel to a new site and some enhancement of existing occurrences, respectively. The Cienega Creek subwatershed restoration and water right protection program could result in long-term protection of stream flows if the measure is fully implemented and successful. The Harmful Nonnative Species Management and Removal program is anticipated to result in enhanced conditions within Huachuca water umbel critical habitat units in the Scotia Canyon and Bear/Lone Mountain Canyon units.

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, it is our biological opinion that the construction and operation of the proposed Rosemont Mine project is not likely to jeopardize the continued existence of the taxon. Our rationale for this conclusion is as follows:

1. Modeled declines in groundwater elevation will result in decreases in stream discharge from the end of mining to at least 150 years later. These flow losses, in turn, precipitate degradation of the aquatic habitat in which Huachuca water umbel occurs. If the modeled increases in the frequency of zero-flow days and losses of pool surface area are valid, these losses will be potentially severe in the Cieneguita Wetlands and Empire Gulch, minimal in the upper and downstream reaches of the mainstem of Cienega Creek, and will reduce the vigor, extent, and genetic variation of individuals within 423 acres of

Huachuca water umbel occurrences in the affected areas.

2. These 423 acres of effects to Huachuca water umbel represent roughly12 percent of its known range. The effects are not likely to jeopardize the taxon because it occurs elsewhere in the Santa Cruz, San Pedro, and Yaqui river watersheds in sites unaffected by the proposed action.
3. Implementation of the Harmful Nonnative Species Management and Removal program could improve the status of Huachuca water umbel occurrences on 538 acres, potentially improving the species' status within approximately 16 percent of its known range.
4. A new Huachuca water umbel occurrence is likely to be established in the Sonoita Creek Ranch ponds, further minimizing the adverse effects of the proposed action.
5. The relatively wide distribution of the Huachuca water umbel within distinct watersheds and the low likelihood that the proposed action will extirpate the taxon entirely from the Cienega Creek subwatershed mean that the proposed action is unlikely to pass the tipping point (i.e. precipitate appreciable delays in or preclusion of implementation of the draft recovery criteria).
6. Rosemont will monitor water quality and quantity as well as channel geometry within Davidson Canyon Wash (a tributary to Cienega Creek), any or all of which may help validate model results and provide advanced notice for unforeseen effects to the aquatic environment. Unforeseen effects to aquatic and riparian ecosystems may necessitate reinitiation of formal consultation.
7. Rosemont will sever and transfer downstream senior water rights to upstream reaches of Cienega Creek via the Cienega Creek Watershed program. Once successfully executed, these *in situ* water rights may be employed to protect against future diversions of surface water by junior appropriators. Rosemont will also fund a conservation program to implement to-be-determined projects within the Cienega Creek subwatershed. If the water rights cannot be successfully severed and transferred, reinitiation of formal consultation may be warranted.
8. Critical habitat has been designated for Huachuca water umbel, but none is present in the action area. Critical habitat will not be affected nor will that critical habitat's ability to function in the recovery of the taxon be impaired.

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; maliciously damage or destroy any such species on any such area; or damage or destroy any such species on any other area in knowing violation of any law or 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.

The National Fish Wildlife and Plants Climate Adaptation Strategy (National Fish, Wildlife, and Plants Climate Adaptation Partnership 2012) emphasizes the importance of species specific management of populations for improved sustainability (Action 2.2.3 and 2.3.1) to address climate change impacts, including proactive measures to obtain and secure genetic diversity through seed banking and propagation (Actions 2.3.3 and 2.3.4). Employing these approaches and techniques can significantly improve the prospects for sustainability and adaptation for the hydrological units being impacted and for the species.

1. The FWS recommends that the USFS and Corps ensure that Rosemont survey for Huachuca water umbel in the existing ponds at the Sonoita Creek Ranch prior to initiating construction; the species already occurs and/or has occurred in the Sonoita Creek watershed (FWS 2014: 7).
2. The FWS recommends that the USFS and Corps ensure that Rosemont monitors Huachuca water umbel transplanted to the Sonoita Creek Ranch ponds for success, and supplement the transplants with additional plants until a self-sustaining occurrence has been established. Care should be given to ensure proper genetic matching of plant materials for all introduced or augmented occurrences.
3. The FWS recommends that the USFS and Corps ensure that Rosemont augment occurrences of Huachuca water umbel with the Huachuca Mountains on Forest Service land and /or work collaboratively with other land managers to introduce or augment occurrences of Huachuca water umbel in other suitable habitat. Transplants will be monitored by Rosemont for success, and supplemented with additional transplants until self-sustaining occurrences have been established. Care should be given to ensure proper genetic matching of plant materials for all introduced or augmented occurrences.
4. The FWS recommends that for reaches where the extent and numbers of individuals present are expected to be negatively impacted, that a program be developed to grow/cultivate representative samples of the water umbel to produce seed, get the resultant seed banked in long-term cryogenic storage—and explore the feasibility of cryogenic storage of rhizomes for future needs. Achieving this *ex-situ* resource will provide material to meet restoration needs to maintain occurrence viability and genetic variation in the watershed, optimizing sustainability and resilience for future adaptation.
5. The FWS recommends that the USFS continue to collect monitoring data regarding Huachuca water umbel occurrences on the Coronado National Forest.
6. The FWS recommends that the USFS and Corps provide comments when the draft recovery plan for the Huachuca water umbel is released, and that such comments include a synthesis of the monitoring data discussed under Recommendation 2, above.
7. The FWS recommends that the USFS continue with its ongoing efforts to arrest erosion and restore ecosystems on streams on the Coronado National Forest within which Huachuca water umbel occurs. We recommend specific attention to areas invaded by Johnsongrass (*Sorghum halepense*).
8. The FWS recommends that the USFS explore remedies to resolve cattle congregation in Huachuca water umbel habitat during critical, dry periods.
9. The FWS recommends that the USFS participate in genetic studies, such as those underway by Fort Huachuca, in order to determine population and metapopulation

dynamics of Huachuca water umbel throughout its range.

10. The FWS recommends that the USFS invasive nonnative plant management program include control for those species particularly impacting habitat quality for Huachuca water umbel noted to be problematic in the 5 year status assessment.

To be kept informed of actions minimizing or avoiding adverse effects or benefiting listed species or their habitats, the FWS requests notification of the implementation of any conservation recommendations.

WESTERN YELLOW-BILLED CUCKOO

Status of the Species

Description

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 medium-sized birds about 12 inches in length, and about 2 ounces 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).

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 Distinct Population Segment (DPS) and we refer to them as the western yellow-billed cuckoo. Only the Western DPS was listed as a threatened species (FWS 2014b). 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).

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 [American Ornithologists Union (AOU) 1957, 1983, 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 (FWS 2014a, 2014b). The largest remaining breeding areas are in southern and central California, Arizona, along the Rio Grande in New Mexico, and in northwestern Mexico (FWS 2014b).

Phillips *et al*. (1964) described the species a common resident in the (chiefly lower) Sonoran zones of southern, central, and western Arizona at the time of publication. The yellow-billed cuckoo now nests primarily in the central and southern parts of the state.

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). Wintering yellow-billed cuckoos generally use woody lowland vegetation near fresh water. However, wintering habitat of the western yellow-billed cuckoo is poorly known.

Habitat

Western populations of yellow-billed cuckoos are most commonly found in dense riparian woodlands, consisting 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). Occupied riparian habitat in Arizona may also contain box elder (*Acer negundo*), Arizona alder (*Alnus oblongifolia*), Arizona walnut (*Juglans major*), Arizona sycamore (*Platanus wrightii*), oak (*Quercu*s spp.), netleaf hackberry (*Celtis reticulata*), velvet ash (*Fraxinus velutina*), Mexican elderberry (*Sambuccus mexicanus*), tamarisk (*Tamarix* spp.; also called salt cedar), acacia (*Acacia* spp.), and seepwillow (*Baccharis glutinosa*)(Corman and Magill 2000, Corman and Wise-Gervais 2005, FWS unpubl. data). Tamarisk may be a component of breeding habitat, but there is usually a native riparian tree component within the occupied habitat (Gaines and Laymon 1984, Johnson *et al*. 2008, McNeil *et al*. 2013, Carstensen *et al*. 2015). Although cuckoos are most commonly found in gallery riparian forest, in Arizona they may also use narrow bands of riparian woodland [Arizona Game and Fish Department (AGFD) 2015, Cornell Lab of Ornithology 2016]. Adjacent habitat on terraces or in the upland (such as mesquite) can enhance the value of these narrow bands of riparian woodland.

In most of the range, western yellow-billed cuckoos primarily breeds in riparian habitat along low-gradient (surface slope less than 3 percent) rivers and streams, and in open riverine valleys that provide wide floodplain conditions (greater than 325 feet). However, in the southwest, cuckoos can also breed in higher gradient drainages, and narrower and drier reaches of riparian habitat.

Western yellow-billed cuckoos in Arizona will also use areas of mesquite and oak woodlands some distance from riparian gallery forests, including in the mountains of southeastern Arizona. Recent surveys found yellow-billed cuckoos with some regularity in these non-traditional habitats (Corman and Magill 2000; WestLand Resources, Inc. 2013a, 2013b, , 2015a, 2015b, 2015c; Tucson Audubon 2015a, 2015b).

Throughout the western yellow-billed cuckoo range, a large majority of nests are placed in willow trees, but cottonwood, mesquite, walnut, box elder, sycamore, hackberry, oak, alder, soapberry (*Sapindus saponaria*), acacia, and tamarisk are also used (Laymon 1980, Hughes 1999, Corman and Magill 2000, Corman and Wise-Gervais 2005, Holmes *et al*. 2008, Tucson Audubon 2015a, Tucson Audubon 2015b, FWS unpublished data).

Within the boundaries of the western distinct population segment (DPS) (see Figure 2 at 78 FR 61631), cuckoos occur from sea level to 7,000 feet (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 are also found nesting along more arid ephemeral and intermittent drainages with sycamore, mesquite, walnut, hackberry, alder, or mixed oak assemblages (Corman and Magill 2000; Corman and Wise-Gervais 2005;WestLand Resources, Inc. 2013a, 2013b, , 2015a, 2015b, 2015c; American Birding Association 2014; AGFD 2015; Tucson Audubon 2015a, 2015b; Cornell Lab of Ornithology 2016). 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), although their densities are lower in these habitats than they are in adjacent riparian areas.

Habitat for the western yellow-billed cuckoo in much of its range 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 riparian 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; FWS 2002). Hydrologic conditions at western yellow-billed cuckoo breeding sites can vary widely between years and during low rainfall years, water or saturated soil may not be present. Cuckoos may move from one area to another within and between years in response to hydrological conditions. They may also 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).

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 drainages where humidity is adequate for successful hatching and rearing of young (Hamilton and Hamilton 1965, Gaines and Laymon 1984, Rosenberg *et al*. 1991).

At the landscape level, the available information suggests the western yellow-billed cuckoo requires large tracts of willow-cottonwood or mesquite forest or Madrean evergreen 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. 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 40 hectares, and home ranges up to 202 hectares have been recorded (Laymon and Halterman 1987, Halterman 2009, Sechrist *et al*. 2009, McNeil *et al*. 2011, McNeil *et al*. 2012). Within riparian habitat, western yellow-billed cuckoos require relatively large (>20 hectares), patches of multilayered habitat for nesting, with optimal size generally greater than 80 hectares (Laymon and Halterman 1989). The multilayered canopy provides shade and traps moisture to create the relatively cooler and more humid streamside conditions which are believed to be important for nesting success. They are also known to nest in early to mid-successional native riparian habitat.

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 may be a mix of shrubs, ground cover, and scattered trees (Carstensen *et al*. 2015, Sechrist *et al*. 2009, FWS, unpublished data). Cuckoos often forage in open areas, woodlands, orchards and adjacent streams (Hughes 1999), which include stands of smaller mesquite trees and even tamarisk (Rosenberg *et al*. 1991). In Arizona, adjacent habitat is usually more arid than occupied nesting habitat. This adjacent habitat can be used for foraging where large insects are produced. Habitat types include Sonoran desertscrub, Mojave desertscrub, Chihuahuan desertscrub, chaparral, semidesert grassland, plains grassland, and Great Basin grasslands (Brown and Lowe 1982, Brown 1994, Brown *et al*. 2007).

Hydroriparian and Xeroriparian Cuckoo Habitat. Large expanses of gallery riparian woodland (hydroriparian) habitat supports greater densities of cuckoos than less dense reaches of scattered riparian trees (cottonwood, willow, walnut, ash, mesquite) or xeroriparian woodlands of mesquite, oak, acacia, hackberry, desert willow, and juniper (Halterman *et al*. 2015, McNeil *et al*. 2013, Sechrist *et al*. 2009). However, these less dense reaches of scattered riparian trees and xeroriparian woodlands are also important to yellow-billed cuckoos as nesting substrate, foraging habitat (WestLand Resources, Inc. 2013a and 2013b), and as a buffer between more hydric sites and the adjacent, xeric uplands, which decreases the edge/interior ratio of a given hydroriparian patch.

Migration habitat. Migration habitat needs are not well known, although they appear to include a relatively wide variety of conditions. Migrating yellow-billed cuckoos have been found in coastal scrub, second-growth forests and woodlands, hedgerows, forest edges, and in smaller riparian patches than those used for breeding.

Presence in Arizona

In a survey in 1999 that covered 265 mi (426 km) of river and creek bottoms (a subset of statewide cuckoo habitat), 172 yellow-billed cuckoo pairs and 81 single birds were located in Arizona (Corman and Magill 2000). Drainages with greater than 10 yellow-billed cuckoo detections 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 National Wildlife Refuge, Hooker Hot Springs, Big Sandy River, and many smaller drainages. Cuckoos have also been found during the breeding season in several drainages in the Santa Rita Mountains, Patagonia Mountains, Canelo Hills, Huachuca Mountains, and Pajarito/Atascosa Mountains (Powell 2000; Krebbs and Moss 2009; WestLand Resources, Inc. 2013a, 2013b, 2015a, 2015b, 2015c; Tucson Audubon 2015a, 2015b; Cornell Lab of Ornithology 2016). Many drainages throughout Arizona have not been thoroughly surveyed and it is likely that 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.

Presence in Southeastern Arizona Mountain Ranges

In addition to gallery riparian forest and mesquite woodlands, yellow-billed cuckoos are also using more xeroriparian drainages in the foothills and mountains of southeastern Arizona. This kind of habitat is more typical of habitat where cuckoos are found in Sonora, Mexico. Cuckoos have been detected during the breeding season in Florida Canyon, Madera Canyon, Gardner

Canyon, Chino Canyon, Montosa Canyon, Box Canyon, Walker Canyon, Wasp Canyon, McCleary Canyon, and Barrel Canyons; and in Salero Ranch in the Santa Rita Mountains (WestLand Resources, Inc. 2013a, 2013b, 2015a, 2015b, 2015c; ; Tucson Audubon 2015a, 2015b; Cornell Lab of Ornithology 2016); Carr, Ash, Garden, Ramsey, and Miller canyons in the Huachuca Mountains; Turkey Creek, O'Donnell Creek, Collins Canyon, Lyle Canyon, Merritt Canyon, and Korn Canyon in Canelo Hills; Babocomari River; Arivaca Lake and tributaries, Rock Corral Canyon, Pena Blanca Lake and Canyon, Scotia Canyon, Sycamore Canyon, and California Gulch in the Atascosa/Pajarito Mountains; Kitt Peak on Baboquivari Mountain; Sycamore Canyon, Corral Canyon, Hermosa Creek, Harshaw Canyon, Goldbaum Canyon, Willow Springs Canyon, and Paymaster Spring in the Patagonia Mountains; and a few locations in the Chiricahua Mountains (WestLand Resources, Inc. 2013a, 2013b, 2015a, 2015b, 2015c ; Arizona Game and Fish Department 2015,; Tucson Audubon 2015a, 2015b; Cornell Laboratory of Ornithology 2016). In addition, cuckoos were documented during surveys for the first time at two locations in 2015 in the Whetstone Mountains (Tucson Audubon 2015b). Yellow-billed cuckoos are likely breeding in these locations, with nesting confirmed in Montosa Canyon, Sycamore Canyon in the Atascosa/Pajarito Mountains, Pena Blanca Lake, and Kitt Peak (American Birding Association 2014;, Tucson Audubon 2015a, 2015b; Cornell Lab of Ornithology 2016).

Threats

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, FWS 2014a, 2014b). Habitat loss and degradation results from several interrelated factors, including alteration of flows in rivers and streams, mining, encroachment into suitable habitat from agricultural and other development activities on breeding and wintering grounds, 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, FWS 2014b). Pesticide use is widespread in agricultural areas in the western yellow-billed cuckoo breeding range in the United States and northern Mexico. Yellow-billed cuckoos have also been exposed to the effects of pesticides on their wintering grounds, as evidenced by DDT found in their eggs and eggshell thinning in the United States (Grocki and Johnston 1974, Laymon and Halterman 1987, Hughes 1999, Cantu-Soto *et al*. 2011). Because much of the species' habitat is in proximity to agriculture, the potential exists for direct and indirect effects to a large portion of the species in these areas through altered physiological functioning, prey availability, and, therefore, reproductive success, which ultimately results in lower population abundance and curtailment of the occupied range (Laymon 1980, Laymon 1998, Hughes 1999, Colyer 2001, Mineau and Whiteside 2013, Hopwood *et al*. 2013, Mineau and Palmer 2013, FWS 2014b).

The ongoing threats, including small isolated populations, cause the remaining populations to be increasingly susceptible to further declines and local extirpations through increased predation rates, barriers to dispersal by juvenile and adult yellow-billed cuckoos, chance weather events, fluctuating availability of prey populations, collisions with tall vertical structures during migration, defoliation of tamarisk by the introduced tamarisk leaf beetle (*Diorhabda* spp.), increased fire risk, and climate change events (Thompson 1961, McGill 1975, Wilcove *et al*.

1986). The warmer temperatures already occurring in the southwestern United States may alter the plant species composition of riparian forests over time. An altered climate may also disrupt and change food availability for the western yellow-billed cuckoo if the timing of peak insect emergence changes in relation to when the cuckoos arrive on their breeding grounds to feed on this critical food source.

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 threats 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.

Listing and Critical Habitat

The yellow-billed cuckoo was listed as a threatened species under the ESA on October 3, 2014 (79 FR 59992). Critical habitat for the yellow-billed cuckoo was proposed on August 15, 2014 (FWS 2014a). Proposed critical habitat encompasses 546,335 acres across the western United States.

Additional details on the status of this species and proposed critical habitat are found in our final rule to list the species as threatened (79 FR 59992) and our proposed rule to designate critical habitat (79 FR 48548). A revised proposed rule that may include additional proposed critical habitat is under development. The discussions of the status of this species in these documents are incorporated herein by reference.

<u>Past Consultations</u>
Because western yellow-billed cuckoos were only recently listed as threatened in 2014, no projects in the action area have undergone formal section 7 consultation for effects to the cuckoo. Ongoing grazing and travel management projects will undergo reinitiation of consultation.

<u>Environmental Baseline</u>

<u>Status of the Yellow-billed Cuckoo in the Action Area</u>
Although data are insufficient to determine population trends for this species within the action area, cuckoo survey and incidental detection data provide evidence of occupancy and likely breeding. Yellow-billed cuckoo numbers are difficult to determine without intensive surveying and monitoring. The yellow-billed cuckoo survey protocol is designed to document presence/absence during the breeding season, but is not designed to determine the number of breeding cuckoos (Halterman *et al*. 2011, 2015). Additional visits would be needed to determine cuckoo home ranges, occupancy throughout the breeding season, and to observe cuckoo nesting behavior. Because cuckoos have a very short nesting cycle, a pair may not remain in the area for the entire breeding season. However, we can infer breeding from behavioral cues observed. These include vocalizations between individuals, copulation, carrying food repeatedly to the

same location, and feeding fledglings. If cuckoos are detected on more than one of the four required surveys, breeding season occupancy is assumed (Halterman *et al*. 2015).

Within the Perimeter Fence (Project Area). Yellow-billed cuckoo protocol surveys (Halterman *et al*. 2011, 2015) were conducted during the breeding season in 2013, 2014, and 2015 in habitat within the Rosemont perimeter fence (project area) (WestLand Resources, Inc. 2015a, 2015b, 2015c). Surveys indicate likely breeding in upper and lower Barrel Canyon based on repeated cuckoo detections during the breeding season in two years as well as evidence of pairs (Table YBCU-1). Cuckoos are also using McCleary Canyon during the breeding season, based on detections during two surveys in 2015. Given that cuckoos have large home ranges, more than one canyon may occur within an individual's home range.

Vegetation associated with these detections was Emory oak (*Quercus emoryi*), Arizona white oak (*Q. arizonica*), velvet mesquite (*Prosopis velutina*), and desert willow (*Chilopsis linearis*), with an occasional Arizona sycamore (Platanus wrightii), Arizona walnut (*Juglans major*) and Goodding's willow (*Salix gooddingii*), and alligator juniper along sandy bottom drainages lacking perennial surface water. All transects were in habitat more typical of upland cuckoo habitat in southeastern Arizona and Sonora than the more typical mature cottonwood/willow/mesquite bosque/ash vegetation communities (Halterman *et al*. 2011; FWS 2013, 2014a, 2014b;WestLand Resources, Inc. 2015a, 2015b, 2015c).

In 2013, western yellow-billed cuckoos were detected along two transects at three separate locations (WestLand Resources Inc. 2015a). Two individuals were observed along lower Barrel Canyon transect, and one was observed along the Wasp Canyon transect.

In 2014, western yellow-billed cuckoos were observed along two transects at six separate locations. At two locations in Barrel Canyon, on the last survey, surveyors detected separate vocalizing pairs of cuckoos (WestLand Resources, Inc. 2015b). The presence of pairs is evidence of possible breeding (Halterman *et al*. 2015, FWS 2014a, 2014b).

In 2015, cuckoos were detected on all four surveys in lower Barrel Canyon, on two of four surveys in Upper Barrel Canyon, and on three of four surveys in McCleary Canyon (WestLand Resources, Inc. 2015c). Up to six cuckoos were detected during one survey in lower Barrel Canyon, with an exchange of vocalizations between two of the individuals that may indicate breeding. One cuckoo was detected on July 26, 2015 in Wasp Canyon, but this was the only detection for this canyon during the four surveys conducted between late June and August 2015.

Table YBCU-1. Yellow-billed cuckoo survey results from four canyons within the proposed Rosemont Copper Mine project area, 2013 - 2015, Santa Rita Mountains, Arizona (WestLand Resources, Inc. 2015a, 2015b, 2015c). Each canyon was surveyed four times annually during the breeding season according to the yellow-billed cuckoo survey protocol (Halterman *et al*. 2011, 2015).

Year	**No. of Surveys Cuckoos Present**	**Possible Evidence of Breeding**

Upper Barrel Canyon		
2013	0	
2014	2	vocalizations between a pair on 4th survey
2015	3	
Lower Barrel Canyon		
2013	1	
2014	2	vocalizations between a pair on 4th survey
2015	4	vocalizations between 2 cuckoos
McCleary Canyon		
2013	0	
2014	0	
2015	2	
Wasp Canyon		
2013	1	
2014	0	
2015	1	

Outside the Perimeter Fence. Other than at the confluence with Cienega Creek, cuckoo surveys in Davidson Canyon have not been conducted. One pair and two single cuckoos documented during a July 13 survey in Davidson Canyon, at the confluence of Cienega Creek in 1999 (Corman and Magill 2000) and a nest was found on July 25, 2008 (Kirkpatrick *et al*. 2010). Yellow-billed cuckoos have been incidentally observed in Las Cienegas NCA, along Cienega Creek Reaches 1 through 7, Empire Gulch Reach 1, and Mattie Canyon (Simms 2004, Bureau of Land Management 2013a), and observed through species-specific surveys from Cienega Creek Reaches 1 through 9 (Bureau of Land Management 2014a, USFS 2015a). In 2001, an estimated 23 mated pairs and 3 single birds occurred along surveyed portions of Cienega Creek; further, this species occurred more often in areas with vegetation more than 30 meters high and areas with greater cover in the 0.25- to 2-m range (BLM 2014). At least seven western yellow-billed cuckoos were documented in upper Cienega Creek (along the reach between Road 901A and the confluence with Gardner Canyon) on June 18, 2010 (M. Radke, pers. obs.). In addition, individuals were documented at Empire Gulch during the breeding season in 2010 and 2011, and one after-hatch-year individual was caught at the Empire Gulch Monitoring Avian Productivity and Survivorship station monitoring station in July 2011 (M. Radke, pers. obs.). A cuckoo was documented downstream of the Narrows on Cienega Creek while at an Arizona Bird Conservation Initiative riparian bird survey plot on August 8, 2011. Approximately 4.7 miles of the Pima County CCNP was surveyed on one day in 2013, with a total estimate of 11 separate cuckoos (Powell 2013a). The current drought is likely contributing to removing nesting habitat by causing cottonwood canopies to thin at the Pima County CCNP, though no data are available on the amount of nesting habitat removed or whether this loss is driving any population trends (Powell *et al*. 2014).

Yellow-billed cuckoos have been observed in Box Canyon during the breeding season in multiple years (Cornell Lab of Ornithology 2016, Tucson Audubon 2015b). Tucson Audubon detected cuckoos on 3 surveys in 2015, including the observation of a cuckoo carrying food (Tucson Audubon 2015b). Cuckoos were observed carrying food in 2013 and are often seen flying across Box Canyon Road (D. Sebesta, pers. comm. 2014). Other observations of cuckoos in Box Canyon have been reported by birders during the breeding season in more than one year (Cornell Lab of Ornithology 2016).

Yellow-billed cuckoos have been detected during the breeding season in Gardner Canyon, south of the proposed Rosemont mine, but this area has never been surveyed (AGFD 2015, Cornell Lab of Ornithology 2016). Gardner Canyon is an intermittent reach that was analyzed for impacts in the FEIS, but no key reaches were identified during the multi-agency collaboration, and therefore none were explicitly analyzed in the SBA (USFS 2015a). Yellow-billed cuckoos have been reported by birders during the breeding season 2 miles upstream from the confluence with Cienega Creek near artificial ponds and near the confluence of Sawmill Canyon, approximately 9 miles from the confluence with Cienega Creek (Cornell Lab of Ornithology 2016). Habitat within Gardner Canyon is patchy, but suitable habitat exists.

<u>Existing Habitat.</u> Within the action area, riparian deciduous woodland vegetation extends downstream through Empire Gulch, Cienega Creek, Davidson Canyon, Box Canyon, and Gardner Canyon (USFS 2012). The vegetation in this area is a mix of riparian woodlands and shrublands, with a variety of vegetation associations. The dominant vegetation varies, depending on a suite of site-specific characteristics, including elevation, substrate, stream gradient, and depth to groundwater.

Riparian habitat by nature is dynamic and changes in location, size, and age over time. The degree of habitat turnover is dependent on the flood regime, amount of surface flow, and whether vegetation is xeric (such as mesquite or hackberry) or hydric (such as willow or cottonwood). Xeroriparian habitat exists in drainages that generally receive less surface flow than hydroriparian habitat. Although xeroriparian habitat is less sensitive to reduction in surface flow than hydroriparian habitat, it can experience reduced vigor, regeneration, and survival of young trees. Over time, a sustained reduction in surface flow will result in a decline in cuckoo habitat.

<u>Davidson Canyon Habitat.</u> Riparian vegetation in Davidson Canyon is xeroriparian and mesoriparian, ranging from sparsely vegetated habitat with few trees to patches of dense mesquite, hackberry, and junipers. Some walnut, ash, and Goodding's willows occur as single trees rather than well-developed riparian vegetation in part of Davidson Canyon (WestLand Resources, Inc. 2016). A more detailed description from Westland Resources, Inc. (2011) is excerpted below and is shown in Figure YBCU-2.

> In the lower Barrel Canyon reach, the riparian zone is much wider upstream of the intersection with state route 83, than portions of the reach immediately downstream. Upstream of 83 the riparian vegetation is more extensive, but mesquite and upland associated vegetation are dominant. The vegetation in the downstream section is also dominated by mesquite and other upland vegetation, but is particularly sparse and heavily damaged by grazing. In the areas around the confluence of Davidson and Barrel Canyons, the riparian zone narrows, but the vegetation present is relatively tall (6-8m). The species composition is mostly upland associated species, but pockets of a few walnut and ash trees do occur, including a considerable pocket of several large, mature Arizona walnut. Following this section, the canyon within Reach 1 broadens and the mesquite vegetation, while still dominant, becomes sparser. The more mesic riparian species that are present

> occur as single individuals or in pockets of a few individuals. The species composition changes little throughout Reach 1, but vegetation characteristics do vary. Reach 2, the purported perennial section of Davidson Canyon, is associated with the further narrowing of the channel with bedrock slopes. Here the pockets of more mesic riparian wetland associated species are more frequent, but of limited extent due to channel morphology. Reach 3, [which occurs north and south of I-10] is associated with a widening of the channel to encompass dense mesquite thickets of moderate stature (5-9m) with an understory of mostly upland associated vegetation. Pockets of few to several individuals of more mesic riparian or wetland associated species, mostly Gooding's willow (*Salix gooddingii*), Arizona walnut (*Juglans major*) and velvet ash (*Fraxinus velutina*), are scattered throughout this segment of the canyon. In Reach 4, towards the confluence with Cienega Creek, Davidson Canyon is a relatively narrow, bedrock lined channel dominated by wetland-associated species, but upland species are still present.

Surface flow along Davidson Canyon does not originate from regional groundwater and based on groundwater use (TetraTech 2010a; ca 300 wells) does not appear to be permanently connected to the regional groundwater table (WestLand Resources, Inc. 2011). Surface flow is intermittent during wetter years and ephemeral during years of low precipitation. Geological evidence suggests that surface flow in Davidson Canyon is a result of bedrock constriction of narrow channels with limited alluvial depths, forcing upwelling of alluvial water to the surface (TetraTech 2010a). The water source in Davidson Canyon is seasonal precipitation (TetraTech 2010a). Data from a Pima County well downstream of Reach 2 indicate highly variable water depths, and an average water depth of more than 10 ft (TetraTech 2010a).

<u>Disturbance from Livestock and Human Activity in lower Barrel and Davidson Canyons.</u>
WestLand Resources, Inc. (2011) observed disturbance to riparian vegetation due to livestock or recreational activities (mainly Off-Highway-Vehicle use) at 100 percent of the 70 sampling points in a study on riparian vegetation in lower Barrel and Davidson canyons. These impacts are independent of the proposed action and are not included in our analyses of effects of the action, but they raise concern about the future condition of cuckoo habitat within Davdison Canyon if disturbance from livestock and recreational activities are not controlled.

Cienenga Creek Habitat. The following habitat description of habitat in Cienega Creek is from WestLand Resources, Inc. (2012b) and follows Table YBCU-2. Please note WestLand's reach numbering system differs from the Key Reach numbering system used throughout the aquatic and riparian-related analyses in this BO.

WESTLAND REACH 3 [River Mile (RM) 17-27.5] This reach encompasses most of the hydroriparian vegetation and spatially intermittent surface flow within the BLM Las Cienegas NCA (RM 17-27.5). Downstream of the confluence of Cienega Creek and Gardner Canyon, a gallery forest of mature cottonwood and Goodding's willow (*Salix gooddingii*) becomes prevalent, marking the beginning of the hydroriparian stretch of Cienega Creek within the BLM Las Cienegas NCA. Mid-canopy cover is also relatively extensive near the confluence with Gardner Canyon. The riparian zone is relatively narrow here [~30-50meters (m)]. These conditions appear to persist for approximately 2 miles downstream. Much of this stretch of the creek consists of very dense understory and large pools of standing water (RM 19). The gallery forest is bordered by dense 1-3m tall grasslands dominated by sacaton grass (*Sporobolus* spp.). Immediately downstream, the riparian vegetation is much less dense. A galley forest with mature cottonwood and Goodding's willow is present, but little to no understory exists. Surface water was not present downstream of RM 19 for approximately 3.5 miles until at around RM 22.5, where scour pools 0.5-1m deep occur, and become more prevalent and extensive further downstream. However, the mid and understory vegetation in this area remains sparse. These conditions transition into flowing surface water, often 0.5-1m deep at approximately RM 23. Understory vegetation becomes more prevalent at this point as well, but is still of relatively limited extent. The mid-canopy and understory vegetation becomes relatively denser downstream from RM 23, with young velvet ash (*Fraxinus velutina*) and cottonwood becoming prevalent. The gallery forest is interrupted by areas limited vegetation associated with exposed bedrock constraining the channel, creating large pools and waterfalls, such as the area near The Narrows (RM 25). Overall, the vegetation became denser, with more complex structure downstream. These conditions changed near the downstream (northern) extent of the BLM Las Cienegas NCA (RM 27.5). While gallery forest of cottonwood and willow still occur, the understory becomes much less extensive and surface water becomes restricted to remnant scour pools.

WESTLAND REACH 4 (RM 27.5-36) This is the reach of Cienega Creek between the BLM Las Cienegas NCA (RM 27.5) and approximately 0.25 miles upstream of I-10 (RM 36). This reach is largely xeroriparian in nature, consisting of mostly upland-associated species. The downstream extent of the BLM Preserve (RM 27.5) marks the transition between hydro/mesoriparian and xeroriparian vegetation. The vegetation characteristics likely reflect the changing hydrologic regime at this location from spatially intermittent to ephemeral. For approximately 9 miles downstream of the BLM Las Cienegas NCA, including Pima County's Empirita Ranch (RM 33), the riparian vegetation is largely xeroriparian, dominated by mesquite and limited amounts of netleaf hackberry (*Celtis reticulata*) with an understory of mostly desert broom (*Baccharis sarothroides*) and burrobush (*Hymenoclea monogyra*). The vegetation is likely supported by ephemeral surface flows and the alluvial channel is quite wide (>100m), particularly at Empirita Ranch. In places, the tall stature (~6-7m) of the mesquite and hackberry tree suggests that the vegetation is transitional between xeroriparian and mesoriparian. There are also a few Arizona walnuts (*Juglans major*) and ash along this reach, however, the tall mesquite, ash and walnut are widely scattered and mostly occur individually rather than as substantial pockets of vegetation. These conditions and riparian characteristics persist until the transition zone from xeroriparian to hydro/mesoriparian vegetation that occurs just south of I-10 (RM 36), near the upstream extent of the Pima County CCNP. Here, mature cottonwoods, ash and some young Goodding's willow occur along the channel, but mesquite continues to dominate the upper canopy and burrobush dominates the shrub layer.

WESTLAND REACH 5 (RM 36-46) This is the reach of Cienega Creek between the transition to hydro/mesoriparian vegetation near I-10 (RM 36) and the Pantano Dam (RM 46). Downstream of I-10, near the Pantano Jungle area (RM 38), cottonwood and willow gallery forest begins. The understory vegetation, however, is limited, and consists of a few young cottonwoods, Goodding's willows and seepwillows (*Baccharis salicifolia*). Cienega Creek throughout the Pima County Preserve is characterized by stretches of gallery forest with little understory interspersed with open areas of xeroriparian vegetation. These xeroriparian areas are dominated by mesquite with an understory of various grasses, desert broom and burrobush.

Similarly, surface flow along the stretch from Pantano Jungle (RM 38) to the USGS stream gauge at Pantano Wash (RM 46) is spatially intermittent, containing stretches of no surface flow. These conditions, characterized by hydro/mesoriparian gallery forest and perennial surface flow interspersed with areas of xeroriparian vegetation and no surface flow, persist until the Pantano dam (RM 46), just downstream of the confluence of Cienega Creek and Aqua Verde Creek (RM 45). Downstream of the dam, the sandy wash becomes increasingly wider and is dominated by xeroriparian vegetation, consisting of mostly mesquite, desert broom and burrobush that are likely supported by ephemeral flows.

<u>Response to Removal of Cattle Grazing on Empire Cienega and Cienega Creek</u>. Prior to the establishment of the Pima County CCNP there was extensive cattle grazing on the site, but once cattle were removed from the system, vegetation height and volume increased significantly and likely plateaued in the early 2000s (unpublished data). Vegetation often responds positively to removal of cattle (Krueper *et al*. 2003), but since 2005 there has only been a slight increase in the extent of cottonwood canopies in the Pima County CCNP, though this analysis does not address the density of vegetation within the canopy. The extent and vigor of mesquite trees has declined since 2005.

Removal of cattle grazing has resulted in increased vegetation in Empire Cienega and Upper Cienega Creek (M. Radke, pers. comm. January 27, 2016). Although effects of the drought are evident throughout Upper Cienega Creek, pockets of hydroriparian habitat continue to improve in suitability for both cuckoos and willow flycatchers.

Table YBCU-2. Summary of hydrologic regime and vegetation characteristics by reach of Cienega Creek, adapted from WestLand Resources, Inc. (2012b) and shown in Figure YBCU-2.

Reach	Reach surface water regime	River Miles	Vegetation Characteristics	Observations
Reach 3 Gardner Canyon to Apache Canyon	Spatially Intermittent	17.0-27.5 (10 miles)	Hydroriparian	Mostly cottonwood/willow gallery forest and perennial surface flow interrupted by a considerable section with no surface water (RM 19-22.5).
Reach 4 From the south end of BLM Las Cienegas NCA near Apache Canyon Preserve (RM 27.5) to approximately 0.25 miles upstream of I-10 (RM 36)	Ephemeral	27.5-36.0 (8.5 miles)	Xeroriparian; Transitional from Xeroriparian to Mesoriparian	Mostly xeroriparian vegetation, with limited pockets of mesoriparian vegetation, especially near the downstream end of the reach where the vegetation transitions to meso- and hydro-riparian vegetation.
Reach 5 Lower Cienega Creek 0.25 miles upstream of I-10 to del Lago Dam	Spatially Intermittent	36.0-46.0 (10 miles)	Hydroriparian; few stretches of Xeroriparian	Mostly cottonwood/willow gallery forest interrupted by stretches of mesquite-dominated xeroriparian vegetation. Surface flow is not continuous as there are several stretches of no surface flow.

Status of Yellow-billed Cuckoo Proposed Critical Habitat in the Action Area

Within Pima and Santa Cruz Counties, Arizona, critical habitat has been proposed along Cienega Creek and Empire Gulch, Florida Canyon, lower San Pedro River, Penitas Wash, Arivaca Wash and San Luis Wash, Santa Cruz River, and Sonoita Creek. Only Cienega Creek and Empire Gulch are within the action area. Proposed critical habitat is expected to be revised in 2016. Proposed critical habitat unit 33 (AZ–25, Upper Cienega Creek), is 2,106 hectare (5,204 ac) in extent and 23 km (14 mi) long and is comprised of 16 km (10 mi) of Cienega Creek and 7 km (4 mi) of Empire Gulch in Pima County (FWS 2014a) (Table YBCU 3). Proposed critical habitat unit 38 (AZ–30, Lower Cienega Creek), is 955 hectare (2,360 ac) in extent and is an 18-km (11-mi)-long segment of Cienega Creek in Pima County. The Upper Cienega Creek proposed critical habitat unit includes the Las Cienega NCA, including Empire Gulch, and the Lower Cienega Creek unit includes the Lower Cienega Creek Natural Preserve.

There are 7,284 acres of proposed critical habitat for the western yellow-billed cuckoo in the action area: 4,926.5 acres in unit 33 (AZ-25 Upper Cienega Creek) (68 percent of proposed critical habitat in the action area) and 2,357 acres in unit 38 (AZ-30 Lower Cienega Creek) (32 percent of proposed critical habitat in the action area) (FWS 2014a). The amount of proposed critical habitat in the action area is 1.3 percent of total proposed cuckoo critical habitat rangewide.

Within a 1,824,000 acre (2,850 square mile) area in southeastern Arizona, 7 proposed critical habitat units totaling 35,202 acres (55 square miles) exist along the upper and lower Cienega creeks, upper San Pedro River, Hooker Hot Springs, Santa Cruz River, Sonoita Creek, and Florida Wash in southeastern Pima, Santa Cruz, and western Cochise counties (Table YBCU-3). Distances from the Upper Cienega Creek and Lower Cienega Creek critical habitat units within the action area to units outside the action area are shown in Table YBCU-4. The distance from the eastern end of the Lower Cienega Creek unit to the Upper San Pedro River unit is 15 miles, the northeastern end of the Upper Cienega Creek unit to the Upper San Pedro River is 16 miles, the western end of Empire Gulch in the Upper Cienega Creek unit to the Florida Wash unit is 11 miles, the western end of Empire Gulch in the Upper Cienega Creek unit to the northern end of the Santa Cruz River unit is 24 miles, and the southern end of the Upper Cienega Creek unit to the Sonoita Creek Unit is 17 miles, and the eastern end of Lower Cienega Creek unit to the Hooker Hot Springs unit is 29 miles (Table YBCU-4).

Table YBCU-3. Seven proposed critical habitat units totaling 35,202 acres (55 square miles) within 1,824,000 acres (2,850 square miles) of southeastern Arizona in southeastern Pima, Santa Cruz, and western Cochise counties. The 1,824,000 acres includes the action area and nearest critical habitat units outside the action area.				
Unit	Unit Name	Acres	County	Proposed Critical Habitat within Action Area to Nearest Proposed Critical Habitat Unit (miles) Outside Action Area to
26	AZ-18 Upper San Pedro River	21,786	Cochise	15
27	AZ-19 Hooker Hot Springs	375	Cochise	29
32	AZ-24 Sonoita Creek	1,610	Santa Cruz	17
33	AZ-25 Upper Cienega Creek	5,204	Pima	NA
34	AZ-26 Santa Cruz River	3,689	Santa Cruz	24
38	AZ-30 Lower Cienega Creek	2,360	Pima	NA
45	AZ-37 Florida Wash	188	Pima	11
Total		35,212		

Table YBCU-4. Distance between proposed yellow-billed cuckoo critical habitat segments within the action area to nearest critical habitat segment outside the action area.		
From Critical Habitat Segment	To Critical Habitat Segment	Miles
AZ-25 Upper Cienega Creek	AZ-18 Upper San Pedro River	16
	AZ-37 Florida Wash	11
	AZ-26 Santa Cruz River	24
	AZ-24 Sonoita Creek	17
AZ-30 Lower Cienega Creek	AZ-18 Upper San Pedro River	15
	AZ-19 Hooker Hot Springs	29

Primary Constituent Elements for the Yellow-billed Cuckoo

The FWS has proposed to designate approximately 546,335 acres of critical habitat in Arizona, California, Colorado, Idaho, Nevada, New Mexico, Texas, Utah, and Wyoming (FWS 2014a). We note that the following PCEs in the proposed critical habitat rule are undergoing review and may be adjusted to better characterize Arizona habitat conditions in a future revised proposed rule:

(1) Riparian woodlands (willow-cottonwood, mesquite thornforest, or a combination of these) in contiguous or nearly contiguous patches of at least 200 acres in extent and at least 325 feet wide, with at least one nesting grove (often willow dominated with average canopy closure of more than 70 percent), and a cooler, more humid environment than surrounding areas;

(2) Adequate prey base, including a large insect fauna (e.g., cicadas, caterpillars, katydids,

grasshoppers, large beetles, and dragonflies) and treefrogs in breeding areas and postbreeding dispersal areas; and

(3) Dynamic riverine processes, especially including river system having hydrologic processes that promote regular habitat regeneration (sediment movement, seedling germination, plant vigor and growth), which leads to patches of old and new riparian vegetation.

Background for Analyses and Definition of Baseline

The hydrologic data upon which a portion of the following yellow-billed cuckoo-specific analyses are based were described in both the Effects of the Proposed Action section (below) and Effects to Aquatic Ecosystems sections (above).

The hydrologic data are based on a 95th percentile analysis of the Tetra Tech (2010b), Montgomery (2010), and Myers (2010) groundwater model best-fit and sensitivity analyses, as applicable. The 95th percentile analyses were developed for the SIR and were included in the May 2015 SBA to address FWS concerns with the use of multiple groundwater models with oftentimes divergent results. The 95th percentile analysis was described in detail in these prior documents, and was summarized in the Sources of Uncertainty subsection of the Effects of the Proposed Action section, above.

We are aware of the analytical strengths and weaknesses of this approach, but reiterate that our selection of the upper end of the 95th percentile values results in analyses in which 97.5 percent (which includes the 2.5 percent of the least well-represented values at the lower end of the distribution) of the *other* possible hydrologic outcomes (using the same sensitivity analyses and assumptions) exhibit lesser effects. The 95th percentile approach does not represent the most probable outcome (but it does provide reasonable certainty that the effects to this species are unlikely to be greater than those described below). Due to the uncertainty inherent in these modeling efforts, there are no results that can be definitively said to be the most likely to occur. Thus, we have selected the precautionary approach.

Secondly, the following species-specific analysis considers the present-day state of the hydrology to represent the baseline condition. All effects, whether the result of anticipated climate change alone, mine drawdown alone, and/or climate change and mine drawdown combined, are described in terms of their divergence from present, pre-project conditions. Climate change is *not* viewed as an ongoing and evolving baseline against which mine-only effects are incrementally assessed.

The analysis of effects to the meso- and hydroriparian habitat for yellow-billed cuckoos diverges from this approach. While the hydrologic effects of climate change were modeled, we are unable to predict the full suite of effects of climate change on riparian ecosystems. While we do anticipate that reduced flows will adversely affect the extent and vigor of riparian vegetation, the hydrologic modeling contained in the SIR and May 2015 SBA do not address future temperatures, rainfall patterns, or other factors we anticipate would affect riparian vegetation. For this reason, the analyses of riparian-related effects to yellow-billed cuckoos are based largely on the mine-only drawdowns and their impact on hydroriparian vegetation.

Effects of the Action - Yellow-billed Cuckoo

The section in this BO entitled Effects to Aquatic Ecosystems describes the hydrologic basis for effects to streams. The subsequent analysis of effects to riparian vegetation appears in the Effects to Riparian Ecosystems section. These prior analyses are incorporated herein via reference. In general, as a result of displacement by mine construction and mine-related groundwater drawdown, a decline in yellow-billed cuckoo numbers and habitat is expected to occur.

Direct Effects to Yellow-billed Cuckoos

Western yellow-billed cuckoos occur during the breeding season and likely breed within the perimeter fence where mine construction and operation will occur in Barrel, McCleary, and Wasp Canyons. The canyons within the perimeter fence and Davidson Canyon were included in the groundwater model, but the results did not appear in the 95th percentile analyses. Regardless, six miles of occupied yellow-billed cuckoo habitat in within the perimeter fence will be directly affected by mine construction and/or operations.

Direct impacts from the construction and operation of the mine and related facilities will harm cuckoos by removing suitable habitat and displacing breeding or foraging birds and or by disturbing cuckoos where suitable habitat is not displaced, but within the vicinity of mining activities. If there are resident birds present at the time of tree removal and site preparation, individuals could abandon their roosting and nesting sites. If present, nests and eggs would be lost, if ground disturbance occurred during the nesting season. Any individuals present in or adjacent to the project area could also experience impacts from decreased surface water flow in Barrel and Davidson Canyons, loss of prey availability, groundwater drawdown, noise, vibrations, and artificial night lighting (SWCA 2015). The effects could range from habitat use changes, activity pattern changes, increased stress responses, decreased foraging efficiency and success, reduced reproductive success, increased predation risk, intraspecific diminished communication, and hearing damage (NoiseQuest n.d. [2012]; Pater *et al*. 2009). These responses can vary, depending on the nature of the sound, including sound level, rate of onset, duration, number of events, spectral distribution of sound energy, and level of background noise (Pater *et al*. 2009). The magnitude of effects from noise, vibration, and light are uncertain, but these effects are expected to decrease as the distance from the mine increases.

Indirect Effects to Yellow-billed Cuckoos

The Effects to Aquatic Ecosystems, Effects to Riparian Ecosystems, and Effects of the Action - Gila Chub, in this BO apply to the analyses of yellow-billed cuckoos and are herein incorporated by reference. These sections discuss the proposed action's effect on regional groundwater and the volume and linear extent of surface flows in area streams; and the relationship between flood flow hydrology, depth to groundwater, and the recruitment, maturation, and retention of the riparian forests.

Light, Noise, and Vibration, Disturbance in McCleary Canyon
McCleary Canyon is immediately north of and adjacent to the proposed mine pit and perimeter

fence. Cuckoos remaining in McCleary Canyon will likely be adversely affected from artificial lighting, daily mine blasts, vibrations, and low frequency noise. Artificial lighting is anticipated to range from the equivalent of a quarter moon to full moon for much of the canyon. The extreme western portion of the canyon is anticipated to receive lighting brighter than a full moon (WestLand Resources, Inc. 2012a). The artificial lighting may disrupt or prevent cuckoos from successfully nesting in McCleary Canyon.

Blasting noise is expected to range from 70 to 90 dBA in McCleary Canyon, with no more than one blasting event per day (Tetra Tech 2009). The Occupational Safety and Health Administration noise standards are helpful in understanding the difference between different decibel levels. Noise from 70 to 90 dBA is described as noisy to very noisy (Tetra Tech 2009). Noise at 90 dBA is the equivalent of a leaf blower at five feet, jackhammer at 50 feet, or dog barking at five feet. Noise at 70 dBA is the equivalent of a leaf blower at 50 feet or 300 feet from busy six-lane freeway. Sudden blasts in the 70 to 90 dBA levels may flush birds from perches and nests, possibly causing abandonment.

In addition to noise, blasting generates low frequency airborne and ground vibrations that can induce vibrations in buildings or other structures. Peak airborne pressure levels occur at frequencies below the range of human hearing. Although not audible, these pressure waves can induce vibrations in buildings and other structures. The induced structural vibrations can rattle pictures, objects on wall-mounted shelves, or poorly fitted windows. Peak blast overpressure levels (air blast) at distances within one mile from the blast site may cause objects or windows to rattle. Modeling of blast-generated ground vibration levels indicates that locations less than 0.5 miles from the blast site may experience vibration intensities high enough to induce minor cosmetic damage to buildings (such as cracking paint or plaster) (Tetra Tech 2009). McCleary Canyon is within 0.5 miles of the blast site. Although the effects of blast vibrations on cuckoos or prey species are unknown, if buildings within 0.5 miles experience rattling or minor cosmetic damage, blast vibrations may flush cuckoos from tree perches and nests in McCleary Canyon (Tetra Tech 2009).

Highway 83 traffic and operational noise from haul trucks and other equipment working in the vicinity of McCleary Canyon is estimated to be 30 to 50 dBA (Tetra Tech 2009, 2010). The highway traffic and operational noise at 50 feet is less likely to disturb cuckoos than the higher decibel blast noise, being the equivalent of typical suburban daytime background conditions or an open field, summer night with numerous crickets.

Volume is just one measure of noise. Another measure is the frequency range of noise. Yellow-billed cuckoos vocalize within the same low frequency range of traffic noise (primarily ≤3 kHz) and may be affected by acoustic masking, whereby signals in the same frequency range as background noise are more difficult to detect (Klump 1996, Patricelli & Blickley 2006,Warren *et al*. 2006, Wood & Yezerinac 2006). Cuckoos were less likely to occur in noisy plots with traffic than in quiet plots in a Washington D.C. study, even when measures of vegetation were considered simultaneously (Goodwin and Shriver 2011). Results suggest that traffic noise influences the presence of bird species that vocalize in the frequency range generated by traffic noise. It is unknown whether the cuckoos may vacate areas along McCleary and Box canyons where they may be affected by acoustic masking from increased mine traffic noise.

Noise and Traffic Disturbance in Box Canyon

Increased vehicular traffic in the form of displaced recreation traffic is expected on Box Canyon Road during construction and mine operation (FEIS, Volume 3: 833-836), creating noise disturbance, and potential collisions with yellow-billed cuckoos flying across the road. The number of breeding cuckoos and offspring produced may decline. Approximately 3.5 miles of cuckoo habitat exists in the Box Canyon drainage.

Habitat Loss

Reduction in groundwater and related streamflow

As discussed in the Effects to Aquatic Ecosystems and Effects of the previous BO (FWS 2013) and this BO, the proposed action will adversely affect the subsurface and, eventually, the surface hydrology of Empire Gulch 1 and 2 (EG1, EG2 (Figure A-1). The modeled groundwater drawdowns at Cienega Creek and Davidson Canyon are of lesser magnitude than in Empire Gulch, but will likely result in reduced hydroriparian and xeroriparian habitat. Both lowered groundwater and reduction in streamflow affect hydroriparian and xeroriparian vegetation along drainages, although xeroriparian habitat can withstand greater water loss. The reduction in groundwater lowers the water table, while the reduction in streamflow reduces the length, width, and depth of wetted streambed. The net result is reduced plant regeneration, herbaceous and shrub growth, tree survival, foliar cover, woodland width, and prey abundance that coincides with the reduced length, width, and depth of wetted streambed and depth to groundwater.

In addition to reasons previously explained regarding model uncertainty, using the model to extrapolate effects on hydroriparian and xeroriparian habitat is all the more difficult because the model was not designed to predict changes in vegetation. The model does not account for varying vegetation depth to groundwater laterally from the streambed or the relationship between vegetation and stream flow depth, length, and lateral extent. Despite its limitations, we chose the loss of surface flow modeling as the basis for habitat loss because it can be measured across all affected drainages over time and is related to habitat health within and near the streambed.

We are assuming that there will be a 1:1 relationship between percent streamflow lost and percent habitat lost or degraded to the point of being incapable of supporting the occurrence of yellow-billed cuckoos. Based on a predicted average increase in depth to groundwater and associated loss of surface flow over the next 150 years (as presented in Table GC-3), we estimate a 10 percent loss of hydroriparian and xeroriparian breeding habitat, foraging habitat, and prey species in Empire Gulch and Cienega Creek (Table YBCU-5), with the exception of a 100 percent loss in EG1 and an 18 percent loss in EG2 (Table GC-3). Based on a predicted 4.3 percent reduction in surface flows from the placement of tailings in Barrel Canyon (a tributary) (SWCA 2012), we estimate a 4.3 percent loss of riparian and mesquite breeding habitat, foraging habitat, and prey species in Davidson Canyon.

We also anticipate that climate change will degrade habitat to the point of being incapable of supporting the occurrence of yellow-billed cuckoos. We reiterate that the modeled effect of climate change to streams is considered an effect relative to the present-day baseline, just as mine-driven drawdown’s effects to streams are. In Table GC-3, the estimated percent losses of the mine and climate change combined are 48 percent in Cienega Creek, 100 percent in EG-1, and 46 percent in EG-2. Subtracting the mine-driven drawdowns of 10 percent in Cienega Creek, 100 percent in EG-1, and 18 percent in EG-2, we anticipate climate change-only drawdowns of 38 percent in Cienega Creek, no measurable effect in EG-1 (which loses 100 percent of its flow to mine-driven drawdown)100 percent in EG-1, and 28 percent in EG-2.

The subsequent analyses, including the effects appearing in Table YBCU-5 will focus primarily on mine-driven drawdown, as this informs not only the effects solely attributable to the proposed action, but also the subsequent anticipated amount or extent of take for the species. Furthermore, the relationship between drawdowns and riparian vegetation is not as straightforward as the relationship between drawdowns and stream flow, permanence, and pool geometry. The modeled effects of climate change to stream flows are readily interpreted into effects to aquatic ecosystems and the species that occur in them (Gila chub, Gila topminnow, desert pupfish, Chiricahua leopard frog, northern Mexican gartersnake, and Huachuca water umbel). Stream flows and water availability are only one aspect of the ecology of riparian vegetation, which is also influenced by the increased air temperatures and altered flood-flow hydrology that may also accompany a changing climate (Lenart 2007). We will therefore include the anticipated effects of climate change on riparian vegetation in our effects analysis and conclusion, but we will not perform detailed calculations of mileage- and acreage-based losses of xero- and hydroriparian vegetation.

<u>Habitat Measurements: Linear Miles</u>. We measured straight-line distances between two points in the main channel. We did not measure meanders. Therefore, our measurements may differ from other measures. Cuckoo habitat is not uniformly distributed throughout the drainages within the action area, but exists as reaches or patches of suitable habitat interspersed with openings. We analyzed each drainage continuously from one end to the other rather than measuring each patch of cuckoo habitat separately. We chose this approach to encompass the changing vegetation over time and the ecosystem function of the drainages.

<u>Habitat Measurements: Area</u>. We used the area within cuckoo proposed critical habitat in estimates of cuckoo habitat acreage, but because we conducted our own measurements they may differ slightly from those in the critical habitat proposed rule (Table YBCU-5). Where critical habitat has not been proposed, we used the average width of riparian habitat: 0.1 mile for Cienega Creek, 0.09 mile for the Rosemont mine pit/infrastructure area, and 0.1 mile for Davidson Canyon. We measured only the habitat that grows along the drainage and did not include adjacent and less dense foraging habitat.

Riparian vegetation, whether woody species like mesquite, cottonwood, and willow or near-stream herbaceous vegetation, primarily obtains water from the shallow alluvial aquifer associated with Cienega Creek. This shallow alluvial aquifer likely is recharged by multiple sources of water, including a hydraulic connection with the regional aquifer and periodic recharge by storm flows (Garrett 2016).

The analysis assumes that drawdown in the regional aquifer caused by the mine would affect the shallow alluvial aquifer in multiple ways. Drawdown could lower the water table directly below riparian vegetation, increasing the depth that roots need to reach to obtain water, causing

reduction in streamflow, and causing pool levels to decline. Drawdown could also reduce the contribution of surface flow from upstream tributaries like Empire Gulch. These flow losses upstream would then propagate downstream through the alluvial system (Garrett 2016).
The riparian vegetation that lies away from the shallow alluvial aquifer along tributary drainage is more typically xeroriparian, subsisting on rainfall and the additional moisture concentrated along ephemeral stream channels. These areas are not likely to be impacted by drawdown in the regional aquifer. For this reason, for purposes of estimating impacts to habitat, impacts were not assumed to occur beyond the estimated boundary of the shallow alluvial aquifers along Cienega Creek and Empire Gulch, unless those areas are directly disturbed by the mine footprint (Garrett 2016).

Associated Effects of Loss of Surface Flow. Although we chose the loss of surface flow as the basis for habitat loss, additional associated effects that were not modeled contribute toward a reduction in suitable habitat and breeding cuckoos. We have no measures for these effects, but describe them qualitatively. They provide additional justification for our adverse effects determination. These associated effects include habitat fragmentation, increased loss of trees at outer periphery of habitat where depth to groundwater is the greatest, loss of trees where length of streamflow is reduced, increased headcutting where dead trees can no longer hold the stream bank intact, increased temperature, reduced humidity, reduced prey abundance, loss of nesting substrate, loss of cover, lack of regeneration and young trees to replace older trees, reduced length and width of riparian habitat reaches, reduced tree vigor, and reduced density of habitat. We provide the following summary of associated effects to yellow-billed cuckoos, based on the predicted percent loss of surface flow and associated increase in depth to groundwater over the next 150 years:

Narrowing of Habitat and Migration of Habitat Toward Center Channel. The inner perimeter of riparian habitat will gradually migrate toward the wetted stream channel center as the wetted channel width narrows. The periodic scouring floods in the narrowed low-flow channel will remove riparian seedlings and saplings, largely eliminating the youngest age class from developing into future riparian gallery forest. Where no replacement habitat is growing, suitable habitat will eventually die out.

Lack of Tree Regeneration and Survival. Riparian tree species and mesquite regeneration and seedling survival will decline as wetted streambed narrows and decreases in length and depth to groundwater increases. Where tree regeneration and survival are lacking in narrow reaches, suitable cuckoo habitat may cease to exist or may support fewer cuckoos when mature trees die.

Increasing Temperature and Evapotranspiration, Decreasing Humidity. Humidity, important for prey production and cuckoo nesting in southeastern Arizona, will decline and temperature and evapotranspiration will increase as habitat declines and fragmentation increases. These factors may reach a threshold in which cuckoos may no longer breed or may breed in reduced densities in some reaches.

Effects from Already Water-stressed Riparian System. Lower Cienega Creek continues to show the impacts of sustained drought on a shallow groundwater-dependent system (Pima Association of Governments 2015). Wet/dry surveys from June 2015 showed only 0.88 miles of flow, just nine percent of the full 9.5 miles of flow extent observed in June of the mid-1980s. Surface flow is at its lowest during June, when yellow-billed cuckoos are searching for and selecting breeding habitat.

The slow desiccation of some areas of the Pima County CCNP in the last years has significantly impacted the gallery riparian forest on which the cuckoo depends for nesting, even as other forest patches continue to gain canopy volume and height (Powell *et al*. 2014). A photo taken on May 30, 2014 (Figure 12) in the Powell *et al*. (2014) report shows evidence of the water-stressed system on canopy cover. The canopy of healthy trees should be fully leafed-out, but the Pima County CCNP trees in the photo lack foliage and the dry streambed is covered with dried leaves. Cuckoos may not nest in an area with such open canopy. Future loss of groundwater and stream flow will exacerbate this problem.

Lateral Effects. The outer perimeter of hydroriparian and xeroriparian habitat farther from the channel center and at the greatest depth to groundwater will degrade at a greater rate than habitat closer to the channel center and groundwater. Lateral narrowing of habitat will likely reduce the density of breeding cuckoos and the habitat may eventually reach a threshold which is too narrow for breeding.

The drought has not only caused the thinning of cottonwood canopy at the Pima County CCNP (Powell 2013b: figure 40; Powell *et al*. 2014:figure 12) and death of cottonwoods at the Pima County CCNP (Pima Association of Governments 2014), it has caused the decline in the mesquite bosque vegetation community that borders the mesic riparian vegetation along the creek margins (Figure 34 in Powell *et al*. 2014). Between 2005 and 2011, most of the vegetation away from the active channel at the Pima County CCNP declined.

Although the SIR (USFS 2015b) predicts only small changes as a result of groundwater drawdown, these small changes occur within and, in some areas, immediately adjacent to the stream bed. The groundwater drawdown estimated to be less than 0.2 feet in most of Cienega Creek does not include the depth to groundwater change with lateral distance from the channel center. Expected changes in vegetation with increasing groundwater depth, per the literature, are described in Table 42 of the SIR (USFS 2015b). To apply and quantify expected changes to vegetation in affected reaches in the action area would require modeling and analyses across cross-sections of the drainages. Because this lateral modeling and analyses was not conducted, the effects to hydroriparian and xeroriparian habitat can only be described qualitatively.

The depth to groundwater increases with lateral distance from the stream center. That is, depth to groundwater is naturally most shallow within the stream bed but increases incrementally moving from the stream bed to the stream bank and adjacent uplands. We can expect the herbaceous, shrub, and tree diversity and cover to decline with lateral distance from the channel center. This change can be expected to occur first on the perimeter of the riparian or mesquite habitat adjacent to the more arid upland. Evidence of this can be found in the mesquite bosque vegetation community that borders the mesic riparian vegetation along the creek margins of the Pima County CCNP, where the drought has reduced the extent and vigor of this species (Powell *et al*. 2014). Mesquite trees have similarly declined in a number of areas (Figure 34; Powel *et al*. 2014). Although mesquite has a much greater tolerance for increased depth to groundwater than riparian trees such as cottonwood and willow, it occurs away from the shallow groundwater aquifer of the Pima County CCNP, where well depths have declined (Figure 26, Powell *et al*. 2014). Mortality of mesquites is occurring, indicating the water table is likely to have declined beyond the considerable depth to which mesquite tap roots can reach. The current loss of cottonwoods and mesquite from the drought provides evidence that water stress from mine operation and drawdown is likely to cause further tree mortality.

Thinning Tree, Shrub, and Herbaceous Vegetation Density. Tree, shrub, and herbaceous vegetation density will decrease as stream flow and depth to groundwater decline. Vegetation thinning may reach a threshold at which vegetation is too open for breeding (Powell *et al*. 2014).

Loss of Habitat from Increased Erosion. Erosion along increasingly dry reaches will accelerate as roots from dead and dying trees fail to stabilize stream banks, further reducing suitable habitat. Erosion is likely to increase as less water flows through Empire Gulch, Cienega Creek, and Davidson Canyon, as is currently occurring with the drought. Headcutting has accelerated loss of riparian habitat in the Cienega Creek watershed. A major erosion head-cut in the streambed of lower Cienega Creek progressively erodes after major flood events when those floods are preceded by dry periods (Pima Association of Governments 2015). Erosion is also occurring in upper Cienega Creek. Head cutting in the Cienega Creek watershed demonstrates sediment fluctuation within the stream system. The head cut in lower Cienega Creek has changed from being a nick point with a steep drop in elevation within the three stream channels to a more gradual incline and a destabilized flood plain as it continues to move upstream (Pima Association of Governments 2015). The consequence of continued head cutting is an even greater loss of riparian habitat from bank collapse than from reduced flows alone.

Potential Loss of Permanent Cuckoo Recruitment. The number of cuckoos supported by riparian and mesquite habitat will permanently decline, along with the number of offspring produced. Where hydroriparian habitat converts to xeroriparian habitat and where general thinning or loss of habitat occurs, the density of cuckoos is expected to decline.

Decline in the Quantity and Quality of Yellow-billed Cuckoo Habitat and Prey Abundance. The combined result of the effects to regional groundwater, changes in the baseflow hydrology of streams, decreases in stream length, and increased temperature and riparian ET is a likely decline in the quantity and quality of yellow-billed cuckoo habitat along Empire Gulch, Cienega Creek, and Davidson Canyon. The reduced substrate for nest locations, prey species, and escape cover, in turn reduces reproductive success and increases the exposure to predation. Indirect effects to western yellow-billed cuckoo could also result from prey species experiencing the same indirect effects as the western yellow-billed cuckoo from groundwater drawdown, hence altering their predator-prey relationships. Aquatic, hydroriparian, and xeroriparian- dependent insect and amphibian prey abundance will decline as streamflow, width of wetted channel, pool volume, pool area, and habitat decrease. Reduced prey abundance will likely result in reduced density of breeding and foraging cuckoos. Changes to food sources could also result in changes in dispersal and hunting success (USFS 2015b).

Contaminants. Because the mine pit lake water quality could exceed wildlife standards for three contaminants that are known to bioaccumulate (i.e., cadmium, mercury, and selenium), indirect impacts to this species could occur from eating aquatic invertebrates originating from the mine pit lake.

Drainage-specific Effects:

Cienega Creek and Empire Gulch. Yellow-billed cuckoos in Cienega Creek and Empire Gulch are found in a portion of the riparian habitat that will be affected by mine drawdown and, to a small extent, reduced surface runoff resulting from the placement of tailings in Barrel Canyon. Cienega Creek is projected to experience an average of 10 percent loss of flow from mine-driven drawdown, a shift from perennial to intermittent flow in reaches CC7 and CC15, and an increase of depth to groundwater of up to 0.2 feet. Some hydroriparian habitat is likely to shift to xeroriparian habitat in Cienega Creek from mining. Lower Empire Gulch will experience an 18 percent loss of flow; this will also cause a shift from hydroriparian habitat to xeroriparian habitat. Upper Empire Gulch (EG1) will experience greater loss of cuckoo habitat due to the effects of the mine (100 percent), as it is expected to experience a greater increase in depth to groundwater and a shift to xeroriparian vegetation as the stream shifts away from perennial flow, beginning as early as 20 years post-mine closure.

We anticipate climate change-only drawdowns of 38 percent in upper and lower Cienega Creek, no additional effect in upper Empire Gulch (EG-1, which is anticipated to lose 100 percent of its flow to mine-driven drawdowns), and 28 percent in lower Empire Gulch (EG-2). The climate change-driven effects to hydroriparian vegetation in Cienega Creek and lower Empire Gulch will be relatively greater than mine-drawdowns alone. Upper Empire Gulch experiences no modeled climate change effects; its riparian habitat is affected solely by mine-related drawdowns.

Davidson Canyon. Patchy cuckoo habitat exists from the confluence of Barrel Canyon downstream to Cienega Creek. Davidson Canyon was not surveyed for yellow-billed cuckoos, but we assumed occupancy based on habitat similarity to occupied habitat and presence of cuckoos at the confluence of Davidson Canyon and Cienega Creek and within 2.5 miles of the confluence of Barrel and Davidson canyons (Corman and Magill 2000; WestLand Resources, Inc. 2015a, 2015b, 2015c; Cornell Lab of Ornithology 2016). The xeroriparian habitat in Davidson Canyon is similar to that of occupied cuckoo habitat within the perimeter fence at the proposed mine site, although it varies in plant species density and habitat width. The proposed action will adversely affect portions of the Davidson watershed and is predicted to reduce both storm-water runoff and regional groundwater levels (WestLand Resources, Inc. (2011). The pit lake will create a hydraulic sink that will divert regional ground water in the vicinity of the mine towards the pit and stormwater management practices proposed for the mine will retain surface water from precipitation events within the foot print of mine disturbance. Capture of runoff in the pit and placement of tailings is expected to reduce runoff (surface flows) 4.3 percent (see SIR and SWCA 2012), the wash contributes 8 to 24 percent of the baseflow in Lower Cienega Creek (Pima Association of Governments 2003), and the groundwater drawdown at Davidson Canyon/lower Cienega Creek Confluence is expected to be as much 0.35 feet by year 150 post-mine (Table GC-5 based on Tetra Tech (2010b), as referenced in SWCA 2012). Climate change modeling was not conducted for this site. The potential impacts of the mine-driven reduction in surface water discharges to Barrel and then Davidson Canyons and predicted groundwater decline are: (1) adverse effects on riparian vegetation in lower Barrel and Davidson Canyons;

and (2) a reduction in the length of reaches along lower Davidson Canyon that have perennial surface flow (WestLand Resources, Inc. 2011). We anticipate there will be some loss of cuckoo habitat in Davidson Canyon.

Conservation Measures Contribute toward Minimizing Adverse Effects of the Proposed Action

Sonoita Creek Ranch. Sonoita Creek Ranch, purchased by Rosemont, in two parcels is 5 miles in length and 1,580 acres (Table YBCU-7). No yellow-billed cuckoo surveys have been conducted on Sonoita Creek Ranch but some xeroriparian habitat appears to be suitable and cuckoos are regularly documented during the breeding season immediately south in similar habitat on Sonoita Creek and in the adjacent Patagonia Mountain drainages (WestLand Resources, Inc. 2013a, 2013b; Cornell Lab of Ornithology 2016). The property will be enhanced and managed to benefit cuckoos by retiring agriculture, fencing the perimeter to exclude grazing, enhancing floodplain channels, enhancing xeroriparian habitat, restoring natural drainage from the uplands. The approximately 5.7 miles of meandering channel will be enhanced and 3.8 miles of new ephemeral channel will be created. Approximately 730 acres of floodplain will be enhanced through native plant seeding and mesquite planting. Approximately 590 AF of certificated surface water rights from Monkey Spring will be available to flow through part of the property. Six acres of ponds and adjacent vegetation will be enhanced. Rosemont is funding the planning, implementation, management, and monitoring.

We are also aware of the concerns raised by Kondolf and Ashby (2015) regarding the purported hydrologic, hydraulic, and geomorphic design flaws for the Sonoita Creek restoration aspect of the Sonoita Creek Ranch conservation measure. Kondolf and Ashby's (2015) critique is primarily relevant to the ephemeral aquatic habitat in Sonoita Creek proper, though we anticipate that the authors ' concern over a lack of stream stability will mean that continual channel maintenance is required, else dynamic geomorphic process will result in continual erosional and deposition processes as the stream meanders. The xeroriparian vegetation enhancement proposed for the Sonoita Creek Ranch is likely to be concentrated away from the meander width of the active channel and will thus be less susceptible to being eroded away during high flow events.

Davidson Canyon Parcels. The Davidson and Barrel Canyon parcels, purchased by Rosemont, will be protected from development and damage (Table YBCU-7). No yellow-billed cuckoo surveys have been conducted in Davidson Canyon but some xeroriparian habitat appears to be suitable for the species. As mentioned above, the xeroriparian habitat in Davidson Canyon is similar to that of occupied cuckoo habitat within the perimeter fence at the proposed mine site, and, in the absence of cuckoo surveys, we assumed occupancy based on habitat similarity to occupied habitat and presence of breeding season cuckoos nearby (Corman and Magill 2000; WestLand Resources, Inc. 2015a, 2015b, 2015c; Cornell Lab of Ornithology 2016). Some xeroriparian habitat recovery is expected after fencing to exclude grazing and human recreation. The parcels include 1.8 miles of Davidson and Barrel canyons and 83 acres of xeroriparian habitat. Rosemont is funding management and monitoring for these parcels.

Western Yellow-Billed Cuckoo and Southwestern Willow Flycatcher Habitat Enhancement and Monitoring, Surveying, and Conservation Property Management (Revised Conservation Measure 3; $1.25 million Hydroriparian Conservation Fund). The hydroriparian habitat will be developed specifically for willow flycatchers in a location yet to be determined, but it will also benefit cuckoos (Table YBCU-7). At least 0.5 miles and 31 acres of hydroriparian habitat to be enhanced11 with the $1.25 million will provide minimize the effect of the incidental take resulting from the loss of 3.3 miles and 860.5 acres of xero- and hydroriparian habitat (see Table YBCU-5). The proposed conservation measure is expected to fund planning, compliance and permitting, site preparation, implementation, monitoring, maintenance, and reporting. The expected number of miles and acres to be enhanced may be greater than the minimum estimated; costs for different enhancements vary widely.

Implementation of the conservation measure to fund enhancement of hydroriparian habitat will help minimize adverse effects (Table YBCU-7). Subtracting the minimum miles and acres to be enhanced from the miles and acres of acres adversely affected by the proposed action, as many as 2.8 hydroriparian miles and 829.5 hydroriparian acres will not be offset by conservation measures.

<u>Calculation of the Mitigative Value of all Conservation Measures</u>. The tables below contain calculations of the proposed action's net effects to the yellow-billed cuckoo. We differentiate between the number of hydroriparian and xeroriparian habitat miles and acres because hydroriparian habitat supports a greater density of cuckoos than xeroriparian habitat. Therefore, hydroriparian habitat is of greater value per acre. As stated above, subtracting the anticipated (and estimated) miles and acres of habitat to be restored via the Hydroriparian Conservation Fund yields the number of miles and acres of habitat that will not be offset by conservation measures. Subtracting 6.8 linear miles along major drainages and 730 acres of xeroriparian habitat to be protected or enhanced via the Sonoita Creek Ranch and Davidson Canyon Parcels conservation measures from the 7.3 miles and 428.7 acres of xeroriparian habitat adversely affected yields 0.5 fewer xeroriparian miles enhanced or protected than adversely affected but 301.3 more xeroriparian acres enhanced than adversely affected. Additional channels enhanced and created within Sonoita Creek Ranch will compensate for 0.5 fewer xeroriparian miles enhanced than adversely affected. Therefore, these conservation measures fully minimize the effects of the action on cuckoos in xeroriparian habitat. However, the conservation measures minimize the effects of the action on cuckoos in only a small proportion of hydroriparian habitat adversely affected. If the miles and acreage anticipated to be enhanced at Sonoita Creek Ranch and/or under the Hydroriparian Conservation Fund are not met, the adverse effects to xero- and hydroriparian vegetation will be greater than analyzed in this BO, thus necessitating consideration of reinitiation by the USFS and Corps.

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11 Note that in the context of riparian vegetation, enhancement refers, at a minimum, to increases in the extent and/or vigor of riparian vegetation at a site where vegetation already exists in a reduced state. Should enhancement be implemented at a site devoid of riparian vegetation, it would amount to restoration of habitat. Protection of habitat refers to actions where existing riparian habitat is protected from threats, but no specific measures are implemented to increase the vigor and/or extent of the habitat.

Table YBCU-5. Expected adverse effects of the proposed Rosemont mine on yellow-billed cuckoos, without climate change. The anticipated percent of cuckoo breeding habitat affected is based on Table GC-3 overall percent loss of surface flow for Empire Cienega, Cienega Creek, and Davidson Canyon at 150 years. Percent flow loss is derived from one value for each reach, as displayed in Table GC-3. Acreages correspond to proposed critical habitat within a given reach or to the average width of riparian vegetation where critical habitat has not been proposed. Average width of riparian habitat where no critical habitat proposed: 0.1 mile for Cienega Creek, 0.09 mile for Rosemont mine area, 0.1 mile for Davidson Canyon. EG = Empire Gulch, CC = Cienega Creek

Reach	Within Critical Habitat?	Miles[12]	Acres[13]	Percent Habitat Affected without Climate Change[14]	Adversely Affected Miles	Adversely Affected Acres	Habitat along Drainage[15]
Upper Cienega Creek and Empire Gulch outside of EG1, EG2	Yes	15.2	4,554.0	10	1.5	455.4	Hydroriparian
EG1	Yes	0.7	124.8	100	0.7	124.8	Hydroriparian
EG2	Yes	0.9	247.7	18	0.2	44.5	Hydroriparian
Between Upper and Lower Cienega Creek	No	7.0	448.0	10	0.7	44.8	Xeroriparian
Lower Cienega Creek	Yes	9.4	2,357.8	10	0.9	235.8	Hydroriparian
Davidson Canyon	No	13.9	889.6	4.3	0.6	38.3	Xeroriparian
Mine pit/infrastructure area: Barrel, McCleary, and Wasp canyons[16]	No	6.0	345.6	100	6.0	345.6	Xeroriparian
Subtotal					3.3	860.5	Hydroriparian[17]
					7.3	428.7	Xeroriparian
Grand Total					**10.6**	**1,289.2**	Hydro- ,xeroriparian.

12 Our measures may differ from other measures. We measured straight-line distances between two points in the main channel. We did not measure meanders.
13 205.4 acres of proposed critical habitat were subtracted from the total number of acres on upper Cienega Creek, where habitat receives flow from eastern tributaries. Flow from eastern tributaries will not be affected by the proposed mine activities.
14 The percent loss is based on loss of surface flow, but represents loss of cuckoo breeding and foraging habitat, reduction in the number of breeding cuckoos, loss of prey species, and contamination of breeding cuckoos eating contaminated prey species near the mine site. SWCA (2012) estimated that Davidson Canyon Wash will experience a 4.3 percent reduction in surface flows from the placement of tailings in Barrel Canyon (a tributary). Also note that climate change has greater effects (38 percent in upper and lower Cienega Creek, 100 percent in upper Empire Gulch, and 28 percent in lower Empire Gulch).
15 Habitat classified is the primary habitat type, but small patches of other habitat types occur within these reaches.
16 Loss of foraging habitat was not included in number of miles and acres of cuckoo habitat affected.
17 An unknown portion of the 3.3 miles and 860.5 acres is expected to transition from hydroriparian to xeroriparian habitat as streamflow declines, with a reduced density of cuckoos.

Table YBCU-6. Expected minimization of the effects of the proposed Rosemont mine on western yellow-billed cuckoos, without climate change, with offsetting habitat enhancement provided by the $1.25 million of funding in the Western Yellow-Billed Cuckoo and Southwestern Willow Flycatcher Habitat Enhancement and Monitoring, Surveying, and Conservation Property Management (Revised Conservation Measure 3). The anticipated percent of yellow-billed cuckoo breeding habitat affected is based on Table GC-3 overall percent loss of surface flow for Empire Cienega and Cienega Creek at 150 years minus the number of miles and acres to be enhanced or protected from the $1.25million hydroriparian habitat fund and at Sonoita Creek Ranch and at Davidson Canyon. Percent flow loss is derived from one value for each reach, as displayed in Table GC-3. Acreages correspond to critical habitat within a given reach or to the width of riparian vegetation where critical habitat has not been proposed.

Adversely Affected Miles	Adversely Affected Acres	Habitat Type Affected[18]	Miles to be Enhanced or Protected[19]	Acres to be Enhanced or Protected	Adversely Affected Miles minus Miles to be Enhanced or Protected	Adversely Affected Acres minus Acres to be Enhanced or Protected	Conservation Measure
3.3	860.5[20]	Hydro-riparian	≥0.5 mile (≥ 250 ft wide)	≥31	3.3 - ≥0.5 = ≤2.8	860.5 - ≥ 31 = ≤829.5	$1.25 million hydroriparian habitat enhancement
7.3	428.7	Xero-riparian	6.8 linear miles along major drainages including 9.5 miles of channels	730 acres enhanced 83 acres protected, totaling 813 acres enhanced or protected	7.3 - 6.8 = 0.5 but additional channels enhanced and created minimize adverse effects to no residual xeroriparian adversely affected miles	428.7 – 730 = - 301.3 No remaining xeroriparian habitat adversely affected acres; 301.3 more acres created than adversely affected	Sonoita Creek Ranch Davidson Canyon Parcels

18 Habitat classified is the primary habitat type, but small patches of other habitat types occur within these reaches.
19 Our measures may differ from other measures. We measured straight-line distances between two points in the main channel. We did not measure meanders.
20 An unknown portion of the 3.3 miles and 860.5 acres is expected to gradually convert from hydroriparian to xeroriparian habitat as streamflow declines, with a reduced density of cuckoos. Therefore, the remaining habitat is expected to have value to cuckoos as xeroriparian habitat. The 3.3 miles and 860.5 acres also corresponds to the number of acres of critical habitat adversely affected by the proposed action.

Table YBCU-7 Yellow-billed cuckoo habitat conservation measure summary				
Reach	**To be Enhanced or Protected**	**Miles to be Enhanced or Protected**[21]	**Acres to be Enhanced or Protected**	**Habitat Type to be Enhanced or Protected**
Sonoita Creek Ranch (purchased, to be enhanced and excluded from grazing)	Enhanced	5 miles in length with 5.7 miles of meandering enhanced channel and 3.8 miles new ephemeral channel	730 floodplain acres enhanced Approx. 590 AF of certificated surface water rights from Monkey Spring Includes 6 acres of pond 850 upland acres protected	Xeroriparian
Davidson and Barrel Canyons Parcels (6 parcels purchased and excluded from grazing)[22]	Protected	1.8	83 xeroriparian acres protected Approx. 16 acres of potential waters of the U.S. and 3 springs (Barrel Spring, Questa Spring, and an unnamed spring), 446 acres of uplands protected	Xeroriparian
To be determined ($1.25 million for hydroriparian habitat enhancement)	Enhanced	≥0.5 mile (≥ 250 ft wide)	≥31 acres	Hydroriparian

21 Our measures may differ from other measures. We measured straight-line distances between two points in the main channel. We did not measure meanders.
22 Rosemont purchased six parcels, totaling 545 acres in Mulberry, Barrel, East Fork Davidson, and Davidson canyons (WestLand Resources, Inc. 2014). Of these acres, 83 are xeroriparian. Four parcels are within 2.5 miles of the proposed mine area and two parcels are five miles away. By protecting these parcels from development, they contribute toward additional conservation of Davidson Canyon. To be consistent with how adverse effects on habitat were calculated, tributaries to Davidson and Barrel canyons were not included in miles measured.

Effects to Yellow-billed Cuckoo Proposed Critical Habitat

The analyses contained in the Effects to Aquatic Ecosystems and Effects to Riparian Ecosystems sections as well as the preceding analysis of adverse effects to the yellow-billed cuckoo inform the analysis of the effects to proposed critical habitat, and are incorporated herein by reference.

Mine construction, operation, and post-closure drawdown will affect proposed PCEs by (1) reducing depth to groundwater and wetted length and width of the stream that will result in reduced riparian and mesquite habitat quality and quantity, (2) reducing prey population, and (3) reducing flood flows that promote regeneration as well as scouring out any regeneration that grows in the narrowed stream channel. These effects would be in addition to relatively larger effects of natural variation (including drought and climate change). Overall, we expect mine construction, operation, and drawdown to adversely affect 10 percent of the habitat throughout units AZ-25, Empire Gulch and Upper Cienega Creek, and AZ-30, Lower Cienega Creek, with the exception of 100 percent in EG1 and 18 percent in EG2. That is, the proposed action is expected to adversely affect 860.5 acres of the 7,284.3 acres of proposed cuckoo critical habitat in the action area (Table YBCU-8). This amounts to 13 percent of proposed critical habitat miles and 12 percent of the critical habitat acres in AZ-25 (Empire Gulch and Upper Cienega Creek) and AZ-30 (Lower Cienega Creek). This loss of PCEs in Empire Gulch and Cienega Creek will occur within 0.02 percent of proposed critical habitat rangewide. We note that not all occupied cuckoo habitat is proposed as critical habitat; Barrel, McCleary and Wasp canyons; Davidson Canyon; and Gardner Canyon are examples of drainages with no proposed critical habitat. A 7-mile primarily xeroriparian reach between the Upper Cienega Creek and Lower Cienega Creek Units is also not proposed as critical habitat.

Table YBCU-8. Expected effects of the proposed Rosemont mine on yellow-billed cuckoo critical habitat, without climate change. The anticipated percent of yellow-billed cuckoo breeding habitat affected is based on Table GC-3 overall percent loss of surface flow for Empire Cienega and Cienega Creek at 150 years. Percent flow loss is derived from one value for each reach, as displayed in Table GC-3. Acreages correspond to proposed critical habitat within a given reach. EG = Empire Gulch, CC = Cienega Creek

Reach	**Habitat along Drainage**[23]	**Miles**[24]	**Acres**[25]	**Percent Critical Habitat Affected without Climate Change**[26]	**Adversely Affected Critical Habitat Miles**	**Adversely Affected Critical Habitat Acres**
Upper Cienega Creek and Empire Gulch outside of EG1, EG2	Hydroriparian	15.2	4,554.0	10	1.5	455.4
EG1	Hydroriparian	0.7	124.8	100	0.7	124.8
EG2	Hydroriparian	0.9	247.7	18	0.2	44.5
Subtotal	Hydroriparian	16.8	4,926.5		2.4	624.7
Lower Cienega Creek	Hydroriparian	9.4	2,357.8	10	0.9	235.8
Total	Hydroriparian	26.2	7,284.3	10-100	3.3	860.5[27]

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23 Habitat classified is the primary habitat type, but small patches of other habitat types occur within these reaches.
24 Our measures may differ from other measures. We measured straight-line distances between two points in the main channel. We did not measure meanders.
25 205.4 acres of proposed critical habitat were subtracted from the total number of acres on upper Cienega Creek, where habitat receives flow from eastern tributaries. Flow from eastern tributaries will not be affected by the proposed mine activities.
26 The percent loss is based on loss of surface flow, but represents loss of cuckoo breeding and foraging habitat, reduction in the number of breeding cuckoos, loss of prey species, and contamination of breeding cuckoos eating contaminated prey species near the mine site. Climate change has greater effects (38 percent in upper and lower Cienega Creek, 100 percent in EG-1, and 28 percent in EG-2).
27 An unknown portion of the 3.3 miles and 860.5 acres is expected to gradually convert from hydroriparian to xeroriparian habitat as streamflow declines, with a reduced density of cuckoos.

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.

The primary cumulative effects to the riparian vegetation (including within proposed critical habitat) and prey species where yellow-billed cuckoos occur are the stresses associated with decreases in water availability due to non-Federal actions. This suite of cumulative effects was described in detail in the sections containing descriptions of general effects to aquatic and riparian ecosystems and in the cumulative effects analysis for Gila chub in the 2013 Rosemont BO and is still accurate, thus incorporated by reference.

Conclusion – Yellow-billed Cuckoo

As discussed in full in the Sources of Uncertainty section, above, we have chosen to base our effects analysis on the upper end of the 95th percentile analysis. Given the long time frames involved, long distances involved, and small amounts of drawdown in the aquifer, there is a high degree of uncertainty associated with groundwater predictions. The scenario represented by the upper end of the 95th percentile analysis is not the scenario most probable to occur. Rather, by selecting it we are analyzing a conservative position that ensures almost all of potential and reasonable outcomes disclosed by the models would be encompassed by this BO analysis. This conservative approach ensures that under almost all potential outcomes that can be reasonably predicted (using our model assumptions), the conclusion of non-jeopardy and no destruction or adverse modification, below, would remain valid.

After reviewing the current status of the yellow-billed cuckoo and its critical habitat, the environmental baseline for the action area, the effects of the Rosemont Copper Mine, and the cumulative effects, it is the FWS's biological opinion that the Rosemont Mine, as proposed, is not likely to jeopardize the continued existence of the yellow-billed cuckoo, and is not likely to destroy or adversely modify proposed yellow-billed cuckoo critical habitat. We present this conclusion for the following reasons:

- We anticipate 3.3 miles of hydroriparian habitat will be adversely affected due to mine-driven loss of surface flow in Empire Gulch and upper and lower Cienega Creek (Table YBCU-6), although an indeterminate portion of the hydroriparian habitat may transition to xeroriparian habitat as streamflow declines. The xeroriparian habitat that eventually replaces the hydroriparian habitat may support cuckoos, although in reduced density.

- Although the reduction of yellow-billed cuckoos and 3.3 miles of hydroriparian and 7.3 miles of xeroriparian breeding habitat in the action area represents a permanent loss, breeding cuckoos and suitable habitat not affected by climate change will continue to exist in the action area as well as within a 30-mile radius in the drainages and foothills of the Santa Rita Mountains, Canelo Hills, Patagonia Mountains, Whetstone Mountains, San Pedro River, and Sonoita Creek (Corman and Magill 2000,WestLand Resources, Inc.

2013a, 2013b; Arizona Game and Fish Department 2015; Cornell Lab of Ornithology 2016; Tucson Audubon 2015a and 2015b). Much of the nearby offsite breeding habitat is either on public land or conservation properties in the Coronado National Forest, San Pedro River National Conservation Area, Patagonia-Sonoita Creek Preserve, Patagonia State Park, and Canelo Hills Preserve.

- Proposed yellow-billed cuckoo critical habitat exists in Empire Gulch and along upper and lower Cienega Creek; effects to the proposed critical habitat parallel the effects to the species. Overall, we expect mine construction, operation, and drawdown to adversely affect 10 percent of the habitat throughout units AZ-25, Empire Gulch and Upper Cienega Creek, and AZ-30, Lower Cienega Creek, with the exception of 100 percent in EG1 and 18 percent in EG2. That is, the proposed action is expected to adversely affect 860.5 of the 7,284.3 acres of proposed cuckoo critical habitat in the action area. This amounts to 13 percent of critical habitat miles and 11 percent of the critical habitat acres in AZ-25, Empire Gulch and Upper Cienega Creek, and AZ-30, Lower Cienega Creek. This loss of proposed critical habitat in Empire Gulch and Cienega Creek is only 0.02 percent of proposed critical habitat rangewide. The anticipated climate change-driven drawdowns of 38 percent in upper and lower Cienega Creek and 28 percent in EG-2 will proposed critical habitat.

- The conservation measure to provide $1.25 million for riparian enhancement will help minimize adverse effects of the proposed action on hydroriparian habitat. Because the actual number of miles and acres of hydroriparian habitat to be enhanced depends on the cost and type of enhancement, we project that at least 0.5 miles and 31 acres of hydroriparian habitat will be enhanced with the funding to provide at least some offset to the 3.3 miles and 860.5 acres of hydroriparian habitat expected to be lost (Table YBCU-6) due to mining activities. The actual number of miles and acres of hydroriparian habitat to be enhanced may be greater.

- Rosemont Copper Mine’s purchase, protection, and fencing of 1.8 miles of Barrel Canyon and Davidson Canyon xeroriparian habitat will help minimize adverse effects of the proposed action on xeroriparian habitat. Some additional cuckoo habitat may develop in conjunction with livestock exclusion (Table YBCU-7).

- Rosemont Copper Mine’s purchase, enhancement, and management of 730 floodplain acres in Sonoita Creek Ranch will help minimize adverse effects of the proposed action (Table YBCU-7). See tables for miles and acres of habitat to be enhanced. Fencing to exclude grazing, enhancement of and creation of channels to direct flow, seeding and planting native trees, and restoring natural drainage from the uplands to the floodplain will increase the amount of xeroriparian habitat in Sonoita Creek Ranch.

- Conservation measures in the Davidson Canyon parcels and Sonoita Creek Ranch fully minimize effects of the action on cuckoos in xeroriparian habitat (but not in hydroriparian habitat). Although additional channels enhanced and created within Sonoita Creek Ranch will compensate for 0.5 fewer xeroriparian miles enhanced than adversely affected, the acreage protected and enhanced is greater by 301.3 acres than the number adversely affected (83 acres + 730 acres = 813 acres protected or enhanced vs 428.7 affected).

Please note that in the Terms and Conditions, below, Rosemont will be required to monitor groundwater drawdown and the USFS (and Corps, as appropriate) will compare observed drawdown to modeled drawdown. Groundwater drawdown greater than modeled may require reinitiation of section 7 consultation.

This distinct population segment has only been listed since 2014 and we are still learning about its occurrence and habitat requirements in southeastern Arizona. Although cuckoos will be extirpated from the vicinity of the mine pit and will decline in Davidson Canyon, Empire Gulch, and Cienega Creek, they are expected to continue to breed in much of the action area.

Since the impacts of the proposed action affect a small portion of the yellow-billed cuckoo population and the action area is small compared to the range of the species, and cuckoos are expected to still be present in Empire Gulch, Cienega Creek and Davidson Canyon 150 years after mine closure, it is unlikely that a tipping point away from recovery would be reached. While the action area does include an important population of the species, effects will not cause the loss of the population. Suitable and occupied cuckoo habitat will remain in the action area and within a 30-mile radius in the drainages and foothills of the Santa Rita Mountains, Canelo Hills, Patagonia Mountains, Whetstone Mountains, San Pedro River, and Sonoita Creek. We expect 22.9 miles of cuckoo hydroriparian habitat to remain in Empire Gulch and upper and lower Cienega Creek, 6.3 miles of cuckoo xeroriparian habitat to remain between upper and lower Cienega Creek, and 13.3 miles of cuckoo xeroriparian habitat to remain in Davidson Canyon within the action area. We believe that cuckoos will still be present in Empire Gulch, Davidson Canyon and Cienega Creek 150 years after closure of the mine, although in reduced numbers as a result of reduced suitable habitat.

The adverse effects that occur in the action area do not reach the scale where recovery of the species would be precluded. Adverse effects are anticipated to be of a small scale in relation to the entire range of the cuckoo, and are unlikely to destroy or adversely modify the critical habitat in the action area to the extent that recovery would be precluded for many of the reasons found in the conclusion and discussion above.

Based on the above analyses and summary, it is the FWS‘s biological opinion that the proposed action will not alter the ability of this proposed critical habitat to retain its PCEs and to function properly. As such, yellow-billed cuckoo proposed critical habitat is anticipated to remain functional to serve its intended conservation role for the species. Therefore, we conclude that the proposed action is not likely to destroy or adversely modify yellow-billed cuckoo proposed critical habitat nor affect its role in recovery of the species.

The conclusions of this biological opinion are based on full implementation of the project as described in the Description of the Proposed Action and Description of the Proposed Conservation Measures sections of this document.

INCIDENTAL TAKE STATEMENT – YELLOW-BILLED CUCKOO

Section 9 of the Act and Federal regulations pursuant to section 4(d) of the Act 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 further defined (50 CFR 17.3) 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. “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 of 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 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 included by the USFS as binding conditions of any grant or permit issued to the applicant, as appropriate, for the exemption in section 7(o)(2) to apply. The USFS has a continuing duty to regulate the activity that is covered by this Incidental Take Statement. If the USFS (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 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, the USFS, Corps, or the applicant 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 – Yellow-billed Cuckoo

We anticipate that the proposed action will result in incidental take of yellow-billed cuckoos in the form of harm through permanent direct loss of occupied habitat from mine construction and placement of tailings. In addition, we anticipate indirect loss of occupied habitat from groundwater drawdown and related loss of surface flow in Barrel, McCleary, Wasp, and Davidson canyons; Barrel Canyon; Empire Gulch; upper and lower Cienega Creek; and the reach between upper and lower Cienega Creek.

We recognize that providing a numerical estimate of incidental take is the preferred method of measuring take. However, we must use habitat as a surrogate for the amount or extent of take because the number of cuckoos in a given area cannot be determined with existing information and techniques. Counting yellow-billed cuckoos is difficult because males and females look and sound alike, they have large overlapping home ranges, they are behaviorally secretive, they have short breeding cycles, and they can move to different locations within and between breeding seasons (Halterman *et al*. 2015). These factors can lead to either underestimating or overestimating the number of cuckoos. Moreover, yellow-billed cuckoo surveys have been conducted only in a portion of suitable habitat to date; in Barrel, McCleary, and Wasp canyons; Empire Gulch; and parts of Cienega Creek. Protocol surveys (Halterman *et al*. 2015) are designed only to determine presence/absence in a given reach rather than an accurate count of individual birds. Additional surveys and methods, including banding and possibly monitoring telemetered birds, would need to be employed to obtain an accurate count of individual birds and pairs throughout the breeding season.

It is reasonable to assume that the abundance of yellow-billed cuckoo is correlated with the extent of suitable riparian habitat. We therefore quantified the adverse effects of the proposed action as the number of stream miles and corresponding acres of xero- and hydroriparian habitat that we anticipate will be lost due to mine-driven groundwater drawdown. The estimated number of miles and acres anticipated to be adversely affected by construction and operation of the mine appears in Table YBCU-5, above and is summarized below.

We anticipate that 6 miles and 345.6 acres of occupied xeroriparian vegetation in Barrel, McCleary, and Wasp Canyons will be directly adversely affected as a result of construction and operation of the mine. We anticipate that 0.6 miles and 38.3 acres of xeroriparian habitat will be indirectly adversely affected due to mine-driven loss of surface flow in Davidson Canyon. Combined, the total xeroriparian habitat adversely affected is 7.3 miles and 428.7 acres. We anticipate that 0.7 miles and 44.8 acres of xeroriparian habitat will be indirectly adversely affected due to mine-driven loss of surface flow in the reach of Cienega Creek between upper and lower Cienega Creek. We also anticipate that 3.3 miles and 860.5 acres of hydroriparian habitat will be indirectly adversely affected due to loss of surface flow in Empire Gulch and upper and lower Cienega Creek.

While we anticipate that mine-driven groundwater drawdown will affect xero- and hydroriparian habitat to the extent described above, the habitat will also be affected by flow reductions attributable to climate change (see Tables A-1 through A-4 in the Effects to Aquatic Ecosystems section, incorporated herein by reference). Riparian vegetation in the Cienega Creek system is also successional in nature and variable in its extent (Powell 2013b). These aspects of the ecology render it difficult to determine what portion of future losses of xero- and hydroriparian riparian vegetation are attributable solely to mine-driven drawdown.

Hydroriparian vegetation is supported by the subsurface and surface flows of water in the affected streams. Xeroriparian vegetation also depends on groundwater, although at a somewhat greater depth than hydroriparian vegetation. Decreases in groundwater elevation within the shallow alluvium and decreases in stream baseflow therefore result in stress to both hydro- and xeroriparian ecosystems. Groundwater elevations, which can be readily measured, are consequently an effective surrogate measure of effects to xero- and hydroriparian habitat, which in turn, is an effective surrogate for yellow-billed cuckoo abundance. Therefore, for the purpose of determining take, we will employ groundwater drawdown as a surrogate measure of take for the yellow-billed cuckoo.

The specific levels of incidental take of yellow-billed cuckoo are expressed in terms of the groundwater drawdowns. anticipated (based on modeling) in the locations and time frames (0, 20, 50, 150 years) discussed above in the Gila chub analysis (see the Amount or Extent of Take subsection of the Gila Chub Incidental Take Statement, incorporated herein by reference and summarized in Table GC-4). We believe this surrogate measure is also appropriate for the yellow-billed cuckoo because the most significant effects to this species result from the anticipated loss of riparian habitat, which is supported by shallow groundwater and surface water discharged from shallow groundwater sources.

A program of groundwater monitoring is the appropriate means to evaluate, over time, changes in groundwater elevation (again, as a surrogate for xero- and hydroriparian habitat and yellow-billed cuckoo abundance). An effective groundwater monitoring program was developed to monitor the groundwater elevation-based surrogate for the incidental take of Gila chub (see the Amount or Extent of Take subsection of the Gila chub Incidental Take Statement, incorporated herein by reference). The locations for the groundwater monitoring program and their justifications appear in Table GC-5, above.

In summary, and stated differently, the maximum allowable incidental take of yellow-billed cuckoo is represented by the surrogate measure of groundwater drawdowns at the sites and time intervals stated in Table GC-4, above. The to-be-modeled groundwater drawdowns at a suite of potential sites specified in Table GC-5, above, will serve as proxies for the incidental take at the sites in Table GC-4. The manner by which Rosemont and the USFS shall monitor compliance with the amount of incidental take is described further in the Terms and Conditions, below.

Effect of the Take – Yellow-billed Cuckoo

In this BO, the FWS determined that this level of anticipated take is not likely to result in jeopardy to the yellow-billed cuckoo nor likely to result in destruction or adverse modification of proposed critical habitat for the reasons stated in the Conclusions section, above. Suitable and occupied yellow-billed cuckoo habitat will remain in the action area and within a 30 mile radius in the drainages and foothills of the Santa Rita Mountains, Canelo Hills, Patagonia Mountains, Whetstone Mountains, San Pedro River, and Sonoita Creek. We expect 22.9 miles of yellow-billed cuckoo hydroriparian habitat to remain in Empire Gulch and upper and lower Cienega Creek, 6.3 miles of yellow-billed cuckoo xeroriparian habitat to remain between upper and lower Cienega Creek, and 13.3 miles of yellow-billed cuckoo xeroriparian habitat to remain in Davidson Canyon within the action area.

Reasonable and Prudent Measures – Yellow-billed Cuckoo

In addition, the FWS believes the following reasonable and prudent measures are necessary and appropriate to minimize impacts of incidental take of yellow-billed cuckoos:

1. The USFS and Corps shall ensure that Rosemont monitor groundwater levels (as a proxy for the xero- and hydroriparian vegetation surrogate measure of take for yellow-billed cuckoo) at least annually (see also FEIS mitigation measure FS-BR-27);
2. The USFS and Corps shall ensure that Rosemont appropriately implements and monitors the hydroriparian habitat proposed to be created at a to-be-determined location, also as described in Revised Conservation Measure 3.
3. The USFS and Corps shall ensure that Rosemont monitors the xeroriparian habitat proposed to be created on the Sonoita Creek Ranch.

Terms and Conditions – Yellow-billed Cuckoo

In order to be exempt from the prohibitions of section 9 of the Act, Rosemont, the USFS, and Corps must comply with the following terms and conditions, which implement the Reasonable and Prudent Measures described above and outline required reporting/monitoring requirements. These terms and conditions are non-discretionary.

1. The USFS and Corps shall ensure that Gila chub Terms and Conditions 1.1, 1.2, 1.3, 1.4, and 1.5 are implemented. This Term and Condition implements the yellow-billed cuckoo Reasonable and Prudent Measure 1, above.
2. The USFS and Corps shall ensure that Rosemont's implementation and monitoring plans for xero- and hydroriparian habitat are submitted to the USFS, Corps, and FWS (in consultation with other wildlife agencies, as appropriate) in advance for review, comment, and approval. This Term and Condition implements yellow-billed cuckoo Reasonable and Prudent Measures 2 and 3, above.

These reasonable and prudent measures, with their implementing terms and conditions, are designed to minimize the effects of 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. The Coronado National Forest and/or Corps must immediately provide an explanation of the causes.

Conservation Recommendations – Yellow-billed Cuckoo

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 critical habitat, to help implement recovery plans, or to develop information. The FWS recommends the following conservation activities:

1. We recommend that USFS and Corps ensure that Rosemont restores additional acreage of hydroriparian habitat, beyond what will be funded by Revised Conservation Measure 3.
2. We recommend that the USFS and Corps ensure that Rosemont researches techniques for reducing the use and loss of groundwater from the proposed action in the project area, considering any and all current and future techniques that may be technologically and economically feasible.
3. We recommend that the USFS implement Forest-specific actions to assist in recovery of the yellow-billed cuckoo.
4. We recommend the USFS continue conducting yellow-billed cuckoo surveys (per Halterman *et al*. 2015 or subsequent protocols) yellow-billed cuckoo surveys forest-wide to assess cuckoo habitat in the Sky Islands of Arizona.
5. We recommend the USFS and Corps ensure that Rosemont surveys for yellow-billed cuckoos (per Halterman *et al*. 2015 or subsequent protocols) in the adversely affected portion of the action area.

6. We recommend the USFS and Corps ensure that Rosemont surveys for yellow-billed cuckoos (per Halterman *et al*. 2015 or subsequent protocols) on Sonoita Creek Ranch and in suitable habitat on other conservation properties.
7. We recommend that USFS and Corps ensure that Rosemont incorporates the creation of suitable xeroriparian and upland yellow-billed cuckoo habitat in the to-be-reclaimed portions of the mine site.

In order 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.

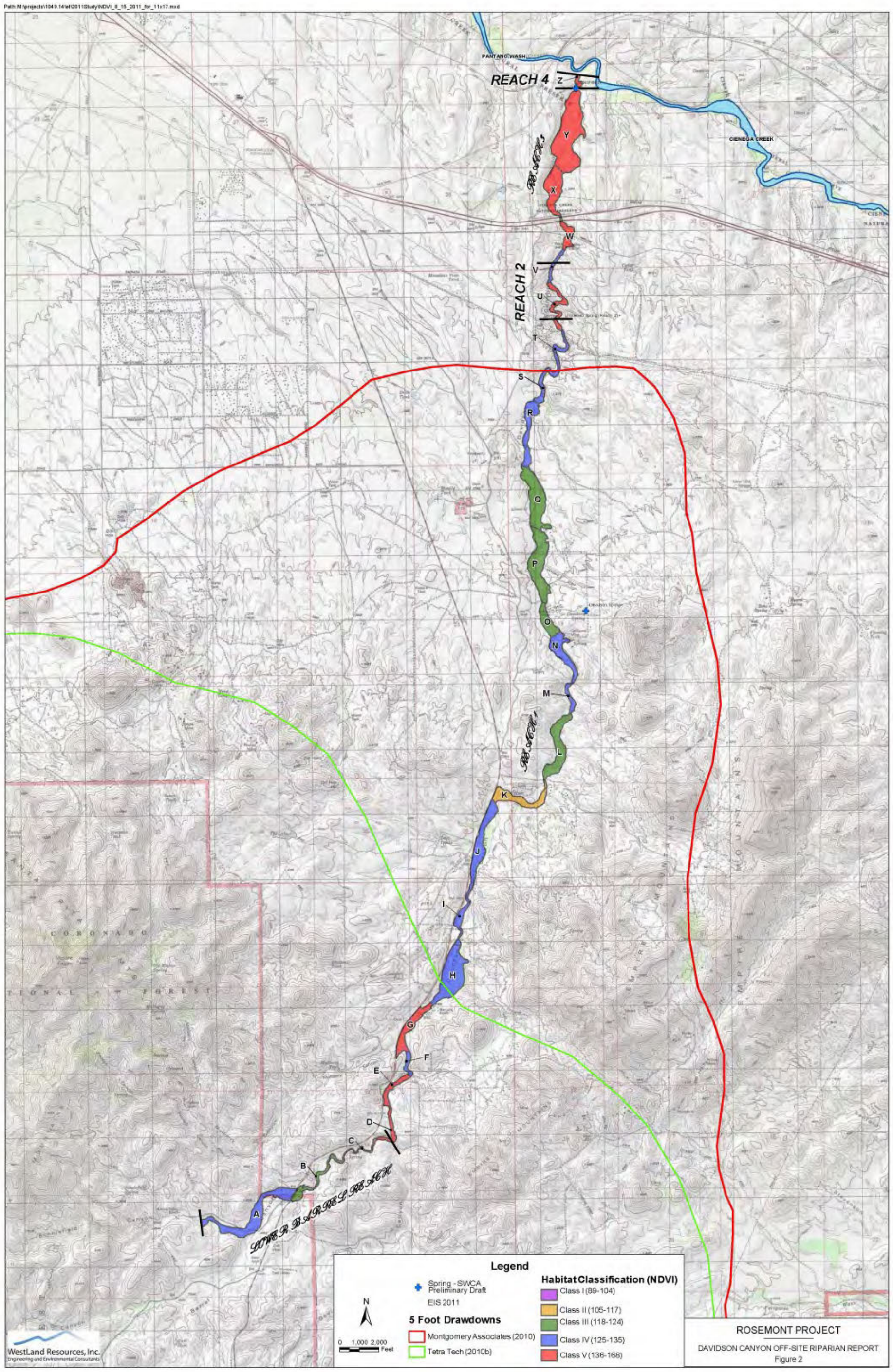

Figure YBCU-1

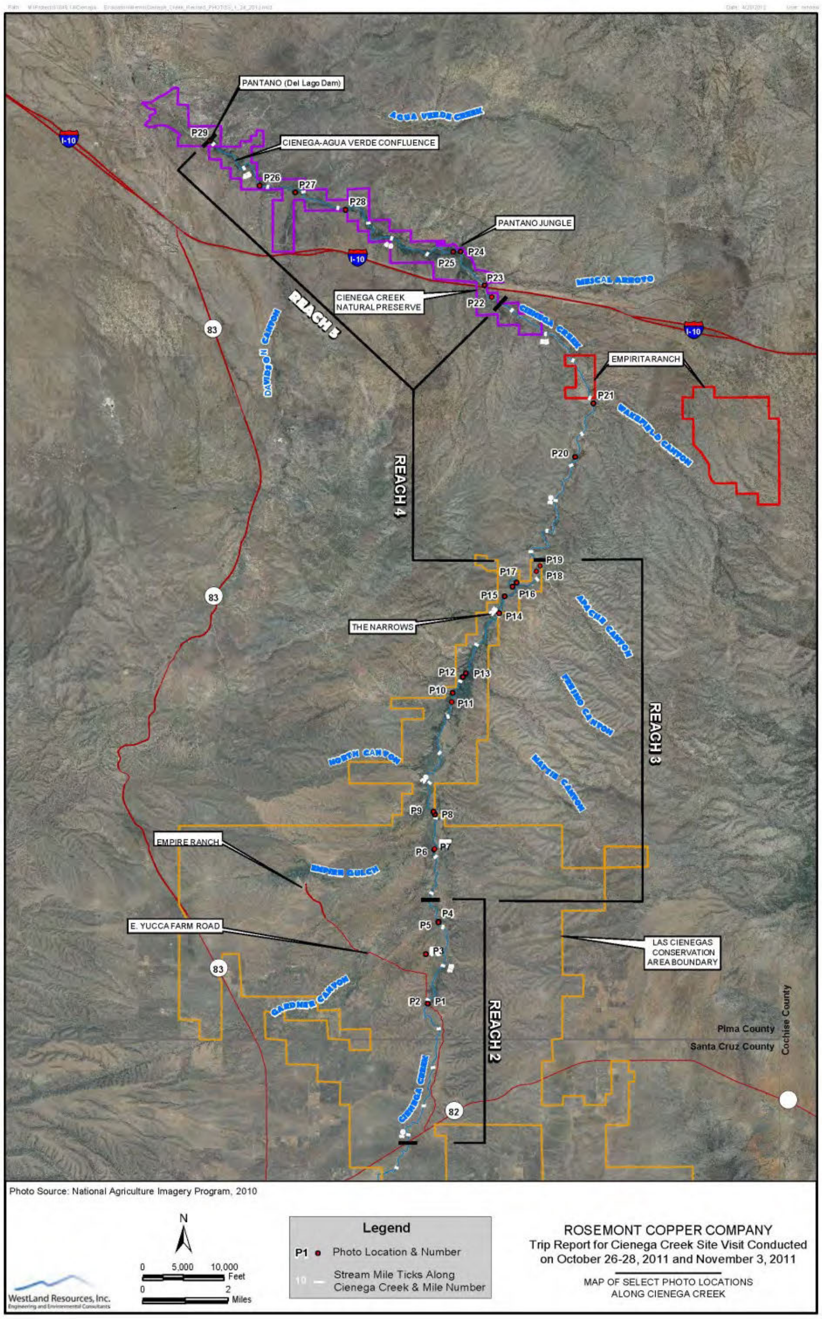

Figure YBCU-2

SOUTHWESTERN WILLOW FLYCATCHER

Status of the Species – Southwestern Willow Flycatcher

The rangewide status of the southwestern willow flycatcher remains substantively unchanged since we completed the October 30, 2013, BO. We reiterate that a complete description of the biology of the southwestern willow flycatcher (*Empidonax traillii extimus*) is contained in the *Southwestern Willow Flycatcher Recovery Plan* (FWS 2002). The content of these respective documents is incorporated herein via reference.

Environmental Baseline – Southwestern Willow Flycatcher

<u>Formal Consultations in the Empire Gulch/Cienega Creek Action Area and Broader Santa Cruz Management Area.</u>

Few formal consultations from 1995 to 2012 addressed impacts to the flycatcher and its habitat within the Cienega Creek watershed in the Action Area and the Santa Cruz River in the Santa Cruz Management Area. Along Cienega Creek, the BLM evaluated grazing (FWS 1995; 2-21-95-F-177), stream restoration (FWS 1998b; 2-21-98-F-373), Management Plan implementation for the Phoenix Resource Management Area (FWS1998a; 2-21-88-F-167).and Management Plan implementation at Las Cienegas National Conservation Area (FWS 2002c; 02-21-02-F-162). Santa Cruz River (FWS 2001; 1999; 2-21-99-F-096) and the National Park Service at Tumacácori National Historic Park conducted tamarisk removal to reduce fire risk along the Santa Cruz River (FWS 2006; 02-21-05-F-0829). The Working Lands for Wildlife Program (FWS 2012; 02E0000-2012-F-0013) concluded that there may be short-term adverse effects to the flycatcher and its critical habitat across the bird's range when trying implement private land habitat improvement projects. These projects resulted in evaluations that concluded possible and likely short-term adverse impacts to the flycatcher from harassment and nest parasitism, minor habitat impacts, and also long-term flycatcher habitat improvement/protection from stream restoration, land management, and fire prevention.

<u>Status of the Southwestern Willow Flycatcher in the Action Area</u>

The action area includes the streams and associated riparian communities affected by the proposed action, as detailed within the Effects to Aquatic Ecosystems and Effects to Riparian Ecosystem section, above. Southwestern willow flycatcher detections in the action area, informed by species-specific surveys and other avian monitoring projects, remain as described in the October 30, 2013, BO. It must be noted that surveys are conducted infrequently and only in portions of Empire Cienega and Cienega Creek. Therefore, the number of southwestern willow flycatchers detected during the breeding season is most certainly an underestimate. These prior data are summarized below:

- A southwestern willow flycatcher pair and nest were located in 2001 (within the critical habitat segment) in upper Cienega Creek.
- Two migrant flycatchers were documented in the same reach of upper Cienega Creek—one in 1999 and one in 2003.

- A single flycatcher territory was detected along Cienega Creek in 2001 (Smith *et al*. 2002). An individual flycatcher was documented on Cienega Creek during formal surveys in August 2003 (Keith Hughes, BLM files, as cited in BLM 2013).
- A willow flycatcher of an unknown subspecies *(Empidonax traillii* ssp.) was documented at the Empire Gulch Monitoring Avian Productivity and Survivorship (MAPS) station in July 2006 (Institute for Bird Populations 2006).
- A flycatcher (or flycatchers) was documented at the Empire Gulch Monitoring Avian Productivity and Survivorship (MAPS) station on June 8 and 17, 2011; the detection was listed as "probable breeder-song" for these dates (BLM 2013 and 2014, Paxton 2012). An after-hatch-year flycatcher was caught on June 17, 2011, and a hatch-year bird was caught on August 6, 2011, which provides evidence that willow flycatchers were likely breeding in Empire Gulch (M. Radke, pers. obs., as cited in BLM 2014).

From 2010 to 2012, an approximately 1-mile length of the so-called Claypit Reach of lower Cienega Creek was surveyed by Pima County in order to evaluate a potential Partners for Fish and Wildlife project that would remove tamarisk. The southwestern willow flycatcher has not been found during recent surveys at the CCNP in 2008, 2010, 2011, or 2012 (Rodden 2010, 2011, 2012). In 2014, surveys were not conducted but habitat appeared dry and unsuitable during an early season field trip (Brian Powell and Susan Sferra, unpublished data). Regular surveys have not been conducted at CCNP.

<u>Status of the Southwestern Willow Flycatcher Critical Habitat in the Action Area</u>

The southwestern willow flycatcher critical habitat within the action area remains much as it was described in the October 30, 2013 BO. The prior narrative is incorporated herein via reference, with the exception of the information found below.

We have refined our discussion regarding the southwestern willow flycatcher's occupancy of the critical habitat within the action area. The 6 detections on upper Cienega Creek occurred between Cinco Canyon south to Wood Canyon (Fig 10, USFS 2015a), a length of 5.3 miles within critical habitat. Four detections in Empire Cienega occurred within critical habitat in EG1, although the 0.68-mile reach includes habitat within and outside of critical habitat. The presence of a pair and nest in upper Cienega Creek confirms breeding in 2001 and the presence of territorial flycatchers and hatch year birds in Empire Gulch provides evidence of breeding in 2011.

The stream segments within the action area fall within the Santa Cruz Management Area, and were designated (along with a portion of the Santa Cruz River) to follow and meet the geographic and territory and habitat-related goals described in the species' Recovery Plan (FWS 2002a). The Santa Cruz Management Area is, in turn, a component of the larger Gila Recovery Unit. These areas, as are all critical habitat segments, are anticipated to provide flycatcher habitat for metapopulation stability, gene connectivity through this portion of the flycatcher's range, protection against catastrophic population loss, and population growth and colonization potential, and/or the feeding and sheltering needs of migratory and dispersing flycatchers.

Given that the proposed action will affect southwestern willow flycatcher critical habitat, we have restated the physical and biological features of critical habitat as well as the primary constituent elements (PCE). This will serve as a point of reference for our subsequent analyses and conclusions.

The physical and biological features of flycatcher critical habitat are the principal biological or physical elements essential to flycatcher conservation which may require special management considerations or protection (FWS 2013). We primarily identified the features and functions of rivers that generate flycatcher habitat and its food such as low gradient/broad floodplains, water, saturated soil, hydrologic regimes, elevated groundwater, and fine sediments, etc. (FWS 2013).

Based on our current knowledge of the physical or biological features and habitat characteristics required to sustain the southwestern willow flycatcher's life-history processes, we determined that the PCEs of its critical habitat are:

(1) Primary Constituent Element 1— *Riparian vegetation.* Riparian habitat along a dynamic river or lakeside, in a natural or manmade successional environment (for nesting, foraging, migration, dispersal, and shelter) that is comprised of trees and shrubs (that can include Goodding's willow, coyote willow, Geyer's willow, arroyo willow, red willow, yewleaf willow, pacific willow, boxelder, tamarisk, Russian olive, buttonbush, cottonwood, stinging nettle, alder, velvet ash, poison hemlock, blackberry, seep willow, oak, rose, sycamore, false indigo, Pacific poison ivy, grape, Virginia creeper, Siberian elm, and walnut) and some combination of:

(a) Dense riparian vegetation with thickets of trees and shrubs that can range in height from about 2 to 30 m (about 6 to 98 ft). Lower-stature thickets (2 to 4 m or 6 to 13 ft tall) are found at higher elevation riparian forests and tall-stature thickets are found at middle- and lower-elevation riparian forests;
(b) Areas of dense riparian foliage at least from the ground level up to approximately 4 m (13 ft) above ground or dense foliage only at the shrub or tree level as a low, dense canopy;
(c) Sites for nesting that contain a dense (about 50 percent to 100 percent) tree or shrub (or both) canopy (the amount of cover provided by tree and shrub branches measured from the ground);
(d) Dense patches of riparian forests that are interspersed with small openings of open water or marsh or areas with shorter and sparser vegetation that creates a variety of habitat that is not uniformly dense. Patch size may be as small as 0.1 ha (0.25 ac) or as large as 70 ha (175 ac).

(2) Primary Constituent Element 2— *Insect prey populations.* A variety of insect prey populations found within or adjacent to riparian floodplains or moist environments, which can include: flying ants, wasps, and bees (Hymenoptera); dragonflies (Odonata); flies (Diptera); true bugs (Hemiptera); beetles (Coleoptera); butterflies, moths, and caterpillars (Lepidoptera); and spittlebugs (Homoptera).

We have also performed analyses to examine how the critical habitat present in the action area relates to critical habitat in nearby areas. This informs the understanding of how effects to southwestern willow flycatcher habitat in the Santa Cruz Management Area can, or cannot, be considered offset by the presence of nearby, unaffected Management Units. It must be noted that Empire Gulch and Upper Cienega Creek are the only occupied reaches in the Santa Cruz Management Area.

The nearest southwestern willow flycatcher critical habitat outside of the action area is situated approximately 22 miles away on lower San Pedro River near the southern boundary of Middle Gila/San Pedro Unit. Further, with the exception of the occasionally-occupied Upper San Pedro River reach in the Middle Gila-San Pedro Management Unit, Empire Gulch and Upper Cienega Creek are the farthest south breeding locations in the U.S. The distance from the southwestern willow flycatcher critical habitat segments within the action areas to the nearest critical habitat segment outside the action area are shown in Table WIFL-1.

<u>Relationship Between Flycatcher Critical Habitat and Recovery Plan Goals, and Habitat for Flycatcher Territories</u>

For the 2013 flycatcher critical habitat designation, critical habitat was proposed (FWS 2011) in order to meet the numerical flycatcher territory and habitat-related goals established for Management and Recovery Units in the Flycatcher Recovery Plan (FWS 2002a) and to provide habitat for migrating flycatchers (FWS 2011, 2013). As a result, critical habitat segments were proposed for each of the 29 Management Units with numerical territory goals (FWS 2011). Within the Santa Cruz Management Area, a total of about 29 miles along Cienega Creek, Empire Gulch, and the Santa Cruz River were designated as flycatcher critical habitat (FWS 2013).

Critical habitat was designated within the Santa Cruz Management Area to meet the 25 flycatcher territory numerical goal, along with double the amount of habitat needed to help sustain those territories over time (and habitat for migratory flycatchers) (FWS 2001). Flexibility in the Recovery Plan exists so that not every Management Unit has to meet its targeted number as long as 80 percent of the minimum target is met in the Management Unit and the 20 percent is made up elsewhere within the Recovery Unit and the overall Recovery Units meets its goals (FWS 2002a). Based upon the most recent rangewide flycatcher territory estimate, the Gila Recovery Units has 659 flycatcher territories, for a goal of 650 (Durst *et al*. 2008). Three (Roosevelt, Upper Gila, and Gila/San Pedro) of the seven Management Units within the Gila Recovery Unit have surpassed their numerical goals, while four Management Units have not (Verde, Hassayampa/Agua Fria, San Francisco, and Santa Cruz).

Riparian habitat patches that southwestern willow flycatchers use to establish territories and nest in vary in size and shape, as do the size of flycatcher territories (FWS 2001). Along the Rio Grande in New Mexico, some habitat patches as small as 0.25 acres have been used, as well as larger 175 acre patches on the upper Gila River in New Mexico (FWS 2001). Some estimates have concluded that an average of 2.7 acres of dense riparian vegetation is needed for each territory in a patch (FWS 2001), where others have concluded that the overall amount of vegetation typically needed for adult and juvenile flycatchers to forage and nest is closer to 11 acres (FWS 2002).

Table WIFL-1. Distance from southwestern willow flycatcher critical habitat segments within the Santa Cruz Management Area to the nearest critical habitat segment outside the action area, but within the Gila Recovery Unit. The action area is within the Santa Cruz Management Area. Management Units are described in the Southwestern Willow Flycatcher Recovery Plan (FWS 2002a).

Management Unit	From Affected Critical Habitat Segment	To Unaffected Critical Habitat Segment	Miles
Within Santa Cruz Unit	Empire Gulch	Northern border of Santa Cruz River	26
	Southern border of Upper Cienega Creek	northern border of Santa Cruz River	28
From Santa Cruz Unit to Middle Gila/San Pedro Unit	Empire Gulch	Southern border of lower San Pedro River	31
	Northern border of Upper Cienega Creek	Southern border of lower San Pedro River	22

Background for Analyses and Definition of Baseline

The hydrologic data upon which a portion of the following southwestern willow flycatcher-specific analyses are based were described in both the Effects of the Proposed Action section (below) and Effects to Aquatic Ecosystems sections (above).

The hydrologic data are based on a 95th percentile analysis of the Tetra Tech (2010), Montgomery (2010), and Myers (2010) groundwater model best-fit and sensitivity analyses, as applicable. The 95th percentile analyses were developed for the SIR and were included in the May 2015 SBA to address FWS concerns with the use of multiple groundwater models with oftentimes divergent results. The 95th percentile analysis was described in detail in these prior documents, and was summarized in the Sources of Uncertainty subsection of the Effects of the Proposed Action section, above.

We are aware of the analytical strengths and weaknesses of this approach, but reiterate that our selection of the upper end of the 95th percentile values results in analyses in which 97.5 percent (which includes the 2.5 percent of the least well-represented values at the lower end of the distribution) of the other possible hydrologic outcomes (using our same assumptions and sensitivity analyses) exhibit lesser effects. The 95th percentile approach does not represent the most probable outcome (but it does provide reasonable certainty that the effects to this species given the same assumptions are unlikely to be greater than those described below). Due to the uncertainty inherent in these modeling efforts, there are no results that can be definitively said to be the most likely to occur (see the Effects to Aquatic Ecosystems section for additional detail).

Secondly, the following species-specific analysis considers the present-day state of the hydrology to represent the baseline condition. All streamflow-only effects, whether the result of anticipated climate change alone, mine drawdown alone, and/or climate change and mine drawdown combined, are described in terms of their divergence from present, pre-project conditions. Climate change is *not* viewed as an ongoing and evolving baseline condition of stream discharges against which mine-only effects are incrementally assessed.

The analysis of effects to the hydroriparian habitat for southwestern willow flycatchers diverges from this approach. While the hydrologic effects of climate change were modeled, we are unable to predict the full suite of effects of climate change on riparian ecosystems. While we do anticipate that reduced flows will adversely affect the extent and vigor of riparian vegetation, the hydrologic modeling contained in the SIR and May 2015 SBA do not address future temperatures, rainfall patterns, or other factors we anticipate would affect riparian vegetation. For this reason, the analyses of riparian-related effects to southwestern willow flycatchers are based largely on the mine-only drawdowns and their impact on hydroriparian vegetation.

Effects of the Action - Southwestern Willow Flycatchers

The section in this BO entitled Effects to Aquatic Ecosystems describes the hydrologic basis for effects to streams. The subsequent analysis of effects to riparian vegetation appears in the Effects to Riparian Ecosystems section. These prior analyses are incorporated herein via reference.

Direct Effects to Southwestern Willow Flycatchers

We anticipate no direct effects to southwestern willow flycatcher territories because the footprint of the Rosemont Mine and associated ground-disturbing activities will occur where no breeding habitat exists or is likely to develop in the future. There are no known flycatcher territories or areas anticipated to have or to develop flycatcher breeding habitat within the mine site. The mine site also lacks the hydroriparian vegetation communities necessary for a riparian-obligate bird such as the southwestern willow flycatcher to use as stopover habitat during migration, nor do we expect such habitat to develop. As we concluded in our October 30, 2013 BO, we do not anticipate that any breeding or migrating flycatchers will be directly affected by the construction or operation of the mine.

Indirect Effects to Southwestern Willow Flycatchers

The Effects to Aquatic Ecosystems section discusses the proposed action’s effect to surface flows and the extent of pools in Cienega Creek and Empire Gulch. The relationship between base- and flood-flow hydrology, depth to groundwater, and the recruitment, maturation, and retention of the riparian forests in which flycatchers occur was analyzed in the sections entitled Effects to Riparian Ecosystems and Effects of the Proposed Action and Western Yellow-Billed Cuckoo in this document. These prior narratives regarding effects to riparian vegetation are incorporated herein via reference. We note, however, that southwestern willow flycatcher’s breeding activities are more closely tied to hydroriparian habitat (Goodding’s willow and, to a lesser extent, Fremont cottonwood), a subset of the larger riparian plant community, than are yellow-billed cuckoos’ breeding activities. The latter species occurs not only in hydroriparian sites, but also further landward into mesoriparian and xeroriparian sites dominated by velvet mesquite. The southwestern willow flycatcher analyses, therefore, will focus on effects to hydroriparian vegetation.

We anticipate that there will be losses of southwestern willow flycatcher hydroriparian habitat in parts of Empire Gulch (EG1, EG2) and upper Cienega Creek. A small number of southwestern willow flycatchers breeding in the to-be-affected reaches are likely be harmed by hydroriparian vegetation losses resulting from implementation of the proposed action. The species’ occurrence in the action area during the breeding season is sporadic and in low numbers. Although only two known nesting willow flycatchers were found, one in 2001 and one in 2011, additional willow flycatchers have been detected during surveys. Surveys have not been conducted regularly nor in all suitable habitats. Small patches of suitable habitat have developed in the past in the Gardner Canyon and Mattie Creek confluences with Cienega Creek, and may develop in the future in these and other areas prior to mine activity. Habitat has been gradually improving following removal of cattle (M. Radke pers. comm. December 9, 2015, Radke 2016).

The Effects to Riparian Ecosystems section discusses the potential for groundwater drawdowns to reduce the wetted length of the affected streams. The width of habitat (and critical habitat) was also taken into consideration for calculating take. The lateral extent of habitat is important for willow flycatcher occupancy. Changes in alluvial groundwater elevations can result in mortality of the shallow-rooted understory component of southwestern willow flycatcher habitat, thus causing a narrowing or contraction of the riparian corridor from the stream's banks landward. Declining alluvial groundwater can also cause stress and mortality of riparian trees situated up-gradient from the stream, thus causing a narrowing of the riparian corridor from the landward areas towards the channel. The combined result is a narrowing of the overall habitat currently available to flycatchers, with some areas potentially becoming too narrow to support the species.

We acknowledge that southwestern willow flycatcher habitat is dynamic and that any given site is likely to cycle in and out of suitability as succession, climatic, and environmental conditions change over time. The entire extent of critical habitat is unlikely to be suitable at one time but the entire reach is part of a functioning unit.

<u>Habitat Loss</u>

<u>Reduction in groundwater and related streamflow</u>

As discussed in the Effects to Aquatic Ecosystems and Effects of the previous BO (FWS 2013) and in this BO, and in the yellow-billed cuckoo section of this BO, the proposed action will adversely affect the subsurface and, eventually, the surface hydrology of Empire Gulch 1 and 2 (EG1, EG2 ;Figure A1). This information is incorporated by reference. EG1 is the stream segment where a flycatcher territory was most recently detected, and it is also expected to experience a greater increase in depth to groundwater and impacts to flycatcher habitat than EG2. As early as 20 years post-mine closure, the depth to groundwater is expected to increase, which will cause the loss of perennial surface flow. This change will shift the streamside vegetation from hydro-riparian habitat to xeroriparian vegetation. Because willow flycatchers do not breed in xeroriparian habitat, EG1 is not expected to support breeding willow flycatchers in the future.

<u>Habitat Measurements: Linear Miles</u>. We measured straight-line distances between two points in the main channel. We did not measure meanders. Therefore, our measurements may differ from other measures. Willow flycatcher habitat is not uniformly distributed throughout the drainages within the action area, but exists as reaches or patches of suitable habitat interspersed with openings. We analyzed each drainage continuously from one end to the other rather than measuring each patch of habitat separately. We chose this approach to encompass the changing vegetation over time and the ecosystem function of the drainages.

Habitat Measurements: Area. We used both southwestern willow flycatcher critical habitat and areas with hydroriparian vegetation outside of flycatcher critical habitat (but within the action area) to estimate the total area of flycatcher habitat affected by the proposed action (Table WIFL-5).

Riparian vegetation primarily obtains water from the shallow alluvial aquifer associated with Cienega Creek. This shallow alluvial aquifer likely is recharged by multiple sources of water, including a hydraulic connection with the regional aquifer and periodic recharge by storm flows (Garrett 2016).

The analysis assumes that drawdown in the regional aquifer caused by the mine would affect the shallow alluvial aquifer in multiple ways. Drawdown could lower the water table directly below riparian vegetation, increasing the depth that roots need to reach to obtain water, causing reduction in streamflow, and causing pool levels to decline. Drawdown could also reduce the contribution of surface flow from upstream tributaries like Empire Gulch. These flow losses upstream would then propagate downstream through the alluvial system (Garrett 2016).

The riparian vegetation that lies away from the shallow alluvial aquifer along tributary drainage is more typically xeroriparian, subsisting on rainfall and the additional moisture concentrated along ephemeral stream channels. These areas are not likely to be impacted by drawdown in the regional aquifer. For this reason, for purposes of estimating impacts to habitat, impacts were not assumed to occur beyond the estimated boundary of the shallow alluvial aquifers along Cienega Creek and Empire Gulch, unless those areas are directly disturbed by the mine footprint (Garrett 2016).

Associated Effects of Loss of Surface Flow. Although we chose the loss of surface flow as the basis for habitat loss, additional associated effects that were not modeled contribute toward a reduction in suitable habitat and breeding willow flycatchers. We have no measures for these effects, but describe them qualitatively. They provide additional justification for our adverse effects determination. These associated effects include habitat fragmentation, increased loss of trees at outer periphery of habitat where depth to groundwater is the greatest, loss of trees where length of streamflow is reduced, increased headcutting where dead trees can no longer hold the stream bank intact, increased temperature, reduced humidity, reduced prey abundance, loss of nesting substrate, loss of cover, lack of regeneration and young trees to replace older trees, reduced length and width of riparian habitat reaches, reduced tree vigor, and reduced density of habitat. We provide the following summary of associated effects to southwestern willow flycatchers, based on the predicted percent loss of surface flow and associated increase in depth to groundwater over the next 150 years:

Narrowing of Habitat and Migration of Habitat Toward Center Channel. The inner perimeter of hydroriparian habitat will gradually migrate toward the wetted stream channel center as the wetted channel width narrows. The periodic scouring floods in the narrowed low-flow channel will remove riparian seedlings and saplings, largely eliminating the youngest age class from developing into future riparian gallery forest. Where no replacement habitat is growing, suitable habitat will eventually die out. Willow flycatchers are most frequently found in association with young willow, shrub, and herbaceous vegetation at the edge or understory of larger woody cottonwood and willow woodlands.

Lack of Tree Regeneration and Survival. Hydroriparian tree regeneration and seedling survival will decline as wetted streambed narrows and decreases in length and depth to groundwater increases. Where tree regeneration and survival are lacking in narrow reaches, suitable willow flycatcher habitat may cease to exist or may support fewer willow flycatchers when mature trees die.

Increasing Temperature and Evapotranspiration, Decreasing Humidity. Humidity, important for prey production and willow flycatcher nesting in southeastern Arizona, will decline and temperature and evapotranspiration will increase as habitat declines and fragmentation increases. These factors may reach a threshold in which willow flycatchers may no longer breed or may breed in reduced densities in some reaches.

Lateral Effects. The outer perimeter of hydroriparian and xeroriparian habitat farther from the channel center and at the greatest depth to groundwater will degrade at a greater rate than habitat closer to the channel center and groundwater. Lateral narrowing of habitat will likely reduce the density of breeding willow flycatchers and the habitat may eventually reach a threshold which is too narrow for breeding.

Although the SIR (USFS 2015b) predicts only small changes as a result of groundwater drawdown, these small changes occur within and, in some areas, immediately adjacent to the stream bed. The groundwater drawdown estimated to be less than 0.2 feet in most of Cienega Creek does not include the depth to groundwater change with lateral distance from the channel center. Expected changes in vegetation with increasing groundwater depth, per the literature, are described in Table 42 of the SIR (USFS 2015b). To apply and quantify expected changes to vegetation in affected reaches in the action area would require modeling and analyses across cross-sections of the drainages. Because this lateral modeling and analyses were not conducted, the effects to hydroriparian and xeroriparian habitat can only be described qualitatively. The depth to groundwater increases with lateral distance from the stream center. That is, depth to groundwater is naturally most shallow within the stream bed but increases incrementally moving from the stream bed to the stream bank and adjacent uplands. We can expect the herbaceous, shrub, and tree diversity and cover to decline with lateral distance from the channel center. This change can be expected to occur first on the perimeter of the riparian habitat adjacent to the more arid upland.

Reductions in Tree, Shrub, and Herbaceous Vegetation Density. Tree, shrub, and herbaceous vegetation density is anticipated to decrease as stream flow and depth to groundwater decline. Vegetation thinning may reach a threshold at which vegetation is too open for breeding (Powell *et al*. 2014).

Loss of Habitat from Increased Erosion. Erosion along increasingly dry reaches will accelerate as roots from dead and dying trees fail to stabilize stream banks, further reducing suitable habitat. Erosion is likely to increase as less water flows through Empire Gulch and Cienega Creek, as is currently occurring with the drought. Headcutting has accelerated loss of riparian habitat in the

Cienega Creek watershed. A major erosion head-cut in the streambed of lower Cienega Creek progressively erodes after major flood events when those floods are preceded by dry periods (Pima Association of Governments 2015). Erosion is also occurring in upper Cienega Creek. Head cutting in the Cienega Creek watershed demonstrates sediment fluctuation within the stream system. The head cut in lower Cienega Creek has changed from being a nick point with a steep drop in elevation within the three stream channels to a more gradual incline and a destabilized flood plain as it continues to move upstream (Pima Association of Governments 2015). The consequence of continued head cutting is an even greater loss of riparian habitat from bank collapse than from reduced flows alone.

<u>Potential Loss of Permanent Willow Flycatcher Recruitment</u>. The number of willow flycatchers supported by hydroriparian habitat will permanently decline, along with the number of offspring produced. Where hydroriparian habitat converts to xeroriparian habitat and where general thinning or loss of habitat occurs, willow flycatchers will no longer breed.

<u>Decline in the Quantity and Quality of Willow Flycatcher Habitat and Prey Abundance.</u> The combined result of the effects to regional groundwater, changes in the baseflow hydrology of streams, decreases in stream length, and increased temperature and riparian ET is a likely decline in the quantity and quality of willow flycatcher habitat along Empire Gulch and Cienega Creek. The reduced substrate for nest locations, prey species, and escape cover, in turn reduces reproductive success and increases the exposure to predation. Indirect effects to willow flycatchers could also result from prey species experiencing the same indirect effects as the willow flycatchers from groundwater drawdown, hence altering their predator-prey relationships. Aquatic and hydroriparian prey abundance will decline as streamflow, width of wetted channel, pool volume, pool area, and habitat decrease. Reduced prey abundance will likely result in reduced density of breeding and foraging willow flycatchers. Changes to food sources could also result in changes in dispersal and hunting success (USFS 2015a).

<u>Quantification of Indirect Effects to Habitat and Critical Habitat</u>

The suite of habitat loss-related impacts described in the preceding sections requires quantification in order to make an informed analysis of the effects of the proposed action. Subsequent sections will describe the manner by which these effects were quantified.

As stated above and in the Effects to Riparian Ecosystems section, diminished alluvial water levels and stream flow losses will result in adverse effects to riparian ecosystems. We employed the percent loss of stream flow from the present-day, baseline condition (see Table GC-3 for the calculations), to calculate the amount of habitat loss, expressed in terms of the length and width of riparian vegetation. The anticipated percent of flow loss will vary by reach: Cienega Creek (Key Reaches CC2, CC4, CC7, CC9, CC13, and CC15; averaging 10 percent), upper Empire Gulch (Key Reach EG1; 100 percent), and lower Empire Gulch (Key Reach EG 2; 18 percent). As stated in the effects analysis for the yellow-billed cuckoo, above, we are assuming that there will be a 1:1 relationship between percent streamflow lost and percent habitat lost or degraded to the point of being incapable of supporting the occurrence of southwestern willow flycatchers.

Effects to the length and width of habitat are straightforward calculations (percent flow loss multiplied by habitat patch length). The effect to riparian habitat width was expressed similarly, but multiplied by the overall acreage rather than contemplating a reach-by-reach change in the width of riparian forest. We felt this approach better accommodated the dynamic, successional nature of riparian habitat. The results of our calculations appear in Table WIFL-2, below.

We also anticipate that climate change will degrade hydroriparian habitat to the point of being incapable of supporting the occurrence of southwestern willow flycatchers. We reiterate that the modeled effect of climate change to streams is considered an effect relative to the present-day baseline, just as mine-driven drawdown's effects to streams are. In Table GC-3, the estimated percent losses of the mine and climate change combined are 48 percent in Cienega Creek, 100 percent in EG-1, and 46 percent in EG-2. Subtracting the mine-driven drawdowns of 10 percent in Cienega Creek, 100 percent in EG-1, and 18 percent in EG-2, we anticipate climate change-only drawdowns of 38 percent in Cienega Creek, no measurable effect in EG-1 (which loses 100 percent of its flow to mine-driven drawdown), and 28 percent in EG-2.

The subsequent analyses, including the effects appearing in Table WIFL-2, will focus primarily on mine-driven drawdown, as this informs not only the effects solely attributable to the proposed action, but also the subsequent anticipated amount or extent of take for the species. Furthermore, the relationship between drawdowns and riparian vegetation is not as straightforward as the relationship between drawdowns and stream flow, permanence, and pool geometry. The modeled effects of climate change to stream flows are readily interpreted into effects to aquatic ecosystems and the species that occur in them (Gila chub, Gila topminnow, desert pupfish, Chiricahua leopard frog, northern Mexican gartersnake, and Huachuca water umbel). Stream flows and water availability are only one aspect of the ecology of riparian vegetation, which is also influenced by the increased air temperatures and altered flood-flow hydrology that may also accompany a changing climate (Lenart 2007). We will therefore include the anticipated effects of climate change on riparian vegetation in our effects analysis and conclusion, but we will not perform detailed calculations of mileage- and acreage-based losses of hydroriparian vegetation.

Western Yellow-Billed Cuckoo and Southwestern Willow Flycatcher Habitat Enhancement and Monitoring, Surveying, and Conservation Property Management (Revised Conservation Measure 3). The hydroriparian habitat will be developed specifically for willow flycatchers (although it will also benefit yellow-billed cuckoos; see above). We have calculated that at least 0.5 miles and 31 acres of hydroriparian habitat would be enhanced with the $1.25 million in this fund and that this activity will provide some offset for the 1.64 miles and 303.77 acres of hydroriparian habitat expected to be lost. The proposed conservation measure is expected to fund planning, compliance and permitting, site preparation, implementation, monitoring, maintenance, and reporting. The expected number of miles and acres to be enhanced may be greater than the minimum estimated; costs for different enhancements vary widely.

Implementation of the conservation measure to fund enhancement of hydroriparian habitat will help minimize adverse effects (Table WIFL-4). Subtracting the minimum miles and acres to be enhanced from the miles and acres of acres adversely affected by the proposed action results in minimized adverse effects; the minimized adverse effects are ≤1.14 miles and ≤273 acres of hydroriparian habitat.

Calculation of the Mitigative Value of all Conservation Measures. The tables below contain calculations of the proposed action's net effects to southwestern willow flycatchers. As stated above, subtracting the anticipated (and estimated) miles and acres of habitat to be restored via the $1.25 million enhancement fund from the adversely affected acres yields the minimized adversely affected miles and acres of habitat. If the miles and acreage anticipated to be enhanced under the Hydroriparian Conservation Fund are not met, the adverse effects to xero- and hydroriparian vegetation will be greater than analyzed in this BO, thus necessitating consideration of reinitiation by the USFS and Corps.

Table WIFL-2. Expected effects of the proposed Rosemont mine on southwestern willow flycatcher breeding habitat, without climate change, and without any offsetting habitat enhancement. The anticipated percent southwestern willow flycatcher breeding habitat affected is based on Table GC-3 overall percent loss of surface flow for Empire Cienega and Cienega Creek at 150 years. Percent flow loss is derived from one value for each reach, as displayed in Table GC-3. Acreages correspond to critical habitat within a given reach or to the width of riparian vegetation where critical habitat is not designated. EG = Empire Gulch, CC = Cienega Creek

Reach	Within Critical Habitat?	Total Habitat Miles*	Total Habitat Acres**	Percent Habitat Affected (without Climate Change) ***	Adversely Affected Miles	Adversely Affected Acres	Habitat along Drainage
Total EG1	Yes, No	0.68	87.96	100	0.68	87.96	Hydroriparian
within EG1 W of critical habitat	No	0.26	41.64				
EG1 critical habitat	Yes	0.25	32.20				
within EG1 E of critical habitat	No	0.17	14.12				
Cienega Creek N of Hilton Wash (near S border of CC2) N to S border of EG2	Yes	1.29	501.31	10	0.13	50.13	Hydroriparian
EG2 (includes part of Cienega Creek)	Yes	0.94	280.3	18	0.17	50.45	Hydroriparian
Cienega Creek from S border of EG2 N to N border of Las Cienegas NCA	Yes	6.57	1152.33	10	0.66	115.23	Hydroriparian
Cienega Creek critical habitat	Yes	8.8	1933.94	Varies	0.96	215.81	Hydroriparian
Grand Total	**Yes, No**	**9.48**	**2021.9**		**1.64**	**303.77**	**Hydroriparian**

* Our measures may differ from other measures. We measured straight-line distances between two points in the main channel. We did not measure meanders.
**10.4 acres of critical habitat were subtracted from the total number of acres on upper Cienega Creek, where habitat receives flow from eastern tributaries. Flow from these eastern tributaries will not be affected by the proposed mine activities.
*** Climate change has greater effects (38 percent in upper and lower Cienega Creek and 28 percent in lower Empire Gulch) and no additional effect in upper Empire Gulch, which is anticipated to be dewatered by mine-related drawdowns alone.

As shown in Table WIFL-2, above, we anticipate that approximately 1.6 miles and 304 acres of flycatcher habitat are expected to be adversely affected by the proposed action (Table WIFL-2). We further anticipate that implementation of Revised Conservation Measure 3 (Western Yellow-Billed Cuckoo and Southwestern Willow Flycatcher Habitat Enhancement and Monitoring, Surveying, and Conservation Property Management; see the Description of the Proposed Conservation Measures section, above), will partially minimize the adverse effects of the proposed action.

Conservation Measure 3 includes a commitment to expend $1,250,000 on habitat enhancements for southwestern willow flycatchers, but no specific projects or further details were provided. We therefore investigated the potential costs of habitat enhancement, eventually employing costs estimates based on Stillwater Sciences (2015); the results of these efforts are detailed in Table WIFL-3, below. In brief, we anticipate that implementation of Revised Conservation Measure 3 – $1.25 million of funding – will result in approximately ≥0.5 mile and ≥31 acres of hydroriparian enhancements. The proposed conservation measure is expected to fund planning, compliance and permitting, site preparation, implementation, monitoring, maintenance, and reporting. The expected number of miles and acres to be enhanced may be greater than the minimum estimated; costs for different enhancements vary widely.

Table WIFL-3. Potential implementation of the $1,250,000 hydroriparian habitat enhancement fund for southwestern willow flycatchers. The costs in this table represent the possible use of the fund. The actual costs and on-the-ground activities to enhance willow flycatcher habitat will depend on the specific needs of the selected site, but the length and acres to be enhanced will be ≥ 0.5 miles and ≥ 31 acres. The hydroriparian enhancement project will replace the same type of habitat that will be lost as a result of the proposed action. Cost per acre estimates based on those summarized in Stillwater Sciences (2015). Costs do not account for inflation.

Activity	Frequency	Cost
Start-up and oversight costs (planning, compliance[28] documents, permits)	Ongoing	$1,250,000 x 33 % = $412,500
Minor site grading[1]	One time	$15,000 x 10 acres = $150,000
Subtotal		$412,500 + $150,000 = $562,500
Remaining implementation funds		$1250000 – 562,500 = $687,500
		Cost/Acre
Site preparation; clearing and grubbing, biomass left on-site	One time	$3,967
Hydroseeding	One time	$3,461
Herbicide application/ maintenance	Every other year for 20 years	$1,444 x 10 yrs = $14,440
Site and success monitoring	Every other year for 20 years	$25 x 10 yrs = $250
Subtotal		*$22,118/acre*
Minimum # of acres to be enhanced		$687,500 ÷ $22,118/acre = **31acres** (≥ 1 mile, ≥ 250 ft wide)

[1] Our assumption is that grading will be required only for 10 acres of a 31 acre site.

Given our anticipated adverse effects as well as the anticipated magnitude of minimization associated with Conservation Measure 3 (in stream miles and acres of habitat), we were able to determine the minimized adverse effects of the proposed action to the southwestern willow flycatcher. Our analysis of these minimized adverse effects appears in Table WIFL-4, below.

Table WIFL-4. Expected minimization of the adverse effects of the proposed Rosemont mine on southwestern willow flycatcher breeding habitat, without climate change, with offsetting habitat enhancement. The anticipated percent of willow flycatcher breeding habitat affected is based on Table GC-3 overall percent loss of surface flow for Empire Cienega and Cienega Creek at 150 years minus the number of miles and acres to be enhanced by implementation of Revised Conservation Measure 3 – Western Yellow-Billed Cuckoo and Southwestern Willow Flycatcher Habitat Enhancement and Monitoring, Surveying, and Conservation Property Management. Percent flow loss is derived from one value for each reach, as displayed in Table GC-3. Acreage by reach is shown in Table WIFL-1.

Adversely Affected Miles*	Adversely Affected Acres**	Habitat Type Affected	Miles to be Enhanced	Acres to be Enhanced	Adversely Affected Miles minus Miles to be Enhanced	Adversely Affected Acres minus Acres to be Enhanced	Habitat Type to be Enhanced or Protected
1.64	303.77	Hydroriparian	≥0.5	≥31	≤1.14	≤273	Hydro-riparian

* Our measurements may differ from other measurements. We measured straight-line distances between two points in the main channel. We did not measure meanders.
**10.4 acres of critical habitat were subtracted from the total number of acres on upper Cienega Creek, where habitat receives flow from eastern tributaries. Flow from these eastern tributaries will not be affected by the proposed mine activities.

Lastly, we were also able to determine the proposed action's minimized adverse effects to southwestern willow flycatcher *critical* habitat, a subset of the effects to flycatcher habitat in general. These minimized effects are shown in Table WIFL-5, below, and amount to ≤0.71 mile and ≤217 acres of critical habitat. It is important to note that these anticipated minimized effects to flycatcher critical habitat are valid only if the to-be enhanced sites are situated entirely within areas already designated as critical habitat. We anticipate that the presence of critical habitat will be an important site selection criterion when habitat enhancement areas are pursued.

Table WIFL-5. Expected minimization of adverse effects of the proposed Rosemont mine on southwestern willow flycatcher critical habitat, without climate change, with offsetting habitat enhancement. The anticipated percent of willow flycatcher breeding critical habitat affected is based on Table GC-3 overall percent loss of surface flow for Empire Cienega and Cienega Creek at 150 years minus the number of miles and acres to be enhanced. Percent flow loss is derived from one value for each reach, as displayed in Table GC-3. Acreage is based on critical habitat as shown in Table WIFL-1. It was assumed that enhancement sites will also be within critical habitat.

Adversely Affected Critical Habitat Miles*	Adversely Affected Critical Habitat Acres **	Habitat Type Affected	Miles to be Enhanced	Acres to be Enhanced	Adversely Affected Miles minus Miles to be Enhanced	Adversely Affected Acres minus Acres to be Enhanced
1.21	248	Hydro-riparian	≥0.5	≥31	≤0.71	≤217

* Our measures may differ from other measures. We measured straight-line distances between two points in the main channel. We did not measure meanders.
From Table WIFL-2: 0.25 + 0.96 miles of critical habitat (EG1 + CC) = 1.21 miles; 32.2 acres + 215.81 acres of critical habitat (EG1 + CC) = 248 acres
**10.4 acres of critical habitat were subtracted from the total number of acres on upper Cienega Creek, where habitat receives flow from eastern tributaries. Flow from these eastern tributaries will not be affected by the proposed mine activities.

Discussion of Effects

The quantification of adverse effects to southwestern willow flycatcher habitat discussed above must be evaluated in terms of the species' ecology, specifically the manner in which it is distributed within available habitat. The greater the distance between small populations, the greater the extirpation risk due to the reduced likelihood of immigration from other populations to offset impacts from catastrophic dynamic habitat events (e.g. drought, flooding) and demographic-related issues (e.g. birth/death rates and sex ratios) (Finch and Stoleson 2000). The discovery of flycatcher fidelity to breeding sites, year-to-year movement of adult and young-of-the-year flycatchers, and the interconnected nature of breeding sites during a 10-year flycatcher banding and re-sighting study in AZ (Paxton *et al*. 2007, Ellis *et al*. 2008) improved our understanding about how territory distribution and abundance may affect population persistence and flycatcher recovery (FWS 2014). The estimated 1,299 rangewide flycatcher territories are distributed in a large number of small breeding groups and a small number of relatively large breeding groups (Durst *et al*. 2008). The current widespread distribution of the flycatcher territories (Durst *et al*. 2008) and the bird's ability to move long distances and quickly colonize habitat help to prevent the threat of small populations from having a greater impact rangewide. When we apply the improved understanding of flycatcher movement to the varied rangewide configuration of flycatcher territories, we reach complex conclusions about the vulnerability of the flycatcher breeding population. Although willow flycatchers move between sites and larger flycatcher population centers benefit other nearby populations, the rarity and limitation of long-distance flycatcher movements causes concern for the persistence of territories that are the most isolated from population centers (FWS 2014).

The relatively isolated Empire Gulch and Cienega Creek sites are known to be occupied by a breeding pair willow flycatchers in some years. Both sites are vulnerable to extirpation considering there was only a single pair detected at each location and the long distance these sites are from other occupied flycatcher sites outside the action area. The added effects of groundwater drawdown and related reduced stream flow from the proposed action will likely result in extirpation at the Empire Cienega site and will increase the likelihood of extirpation at the locations within the Cienega Creek site.

Effects to Critical Habitat for Southwestern Willow Flycatchers

All habitat adversely affected is within southwestern willow flycatcher critical habitat, with the exception of approximately 56 acres of additional hydroriparian habitat surrounding EG1 (Table WIFL-2).

Southwestern willow flycatcher critical habitat exists in Empire Gulch and along Cienega Creek. The mine drawdown-driven flow losses in Cienega Creek are likely to cause mortality of hydroriparian habitat in 0.96 mile and 215.81 acres (see the Cienega Creek critical habitat row in Table WIFL-2, above) of hydroriparian vegetation (PCE 1), in addition to the effects of climate change. Together, the proposed action and climate change are anticipated to result in adverse effects; the proposed action’s incremental effect is that critical habitat units on the mainstem of Cienega Creek will experience a small loss in ability to function in the recovery of the southwestern willow flycatcher.

Flow losses in upper Empire Gulch due solely to the proposed action - independent of the effects of climate change - are anticipated to be more severe, and reach magnitudes capable of causing the woody riparian community to transition to a more xeric species composition. The anticipated dewatering of upper Empire Gulch (Key Reach EG1) would likely result in losses (0.25 mile, 32.2 acres) of riparian vegetation (PCE 1). The dewatering will also halt the export of aquatic macro-invertebrates upon which southwestern willow flycatchers feed (PCE2). In the future, this may prevent this small critical habitat segment of upper Empire Gulch from contributing to southwestern willow flycatcher recovery.

We cannot determine in advance if any of the proposed conservation measures will result in enhanced habitat within the critical habitat boundaries. If the to-be-enhanced areas lie entirely within critical habitat, then they may minimize the propose action’s effects to critical habitat. In this scenario, the anticipated, minimized effects of the proposed action appearing in Table WIFL-5 are valid. If to-be-enhanced areas are not entirely within critical habitat, we would anticipate that the effects to critical habitat would be minimized to a lesser extent.

Cumulative Effects – Southwestern Willow Flycatcher

The cumulative effects were described in detail in the October 30, 2013 BO, remain unchanged and are incorporated herein via reference, with the exception that we consider the effects described in the prior document to apply to both southwestern willow flycatcher habitat as well as the species' critical habitat. Effects to critical habitat are a subset of effects to riparian vegetation throughout the range of the flycatcher.

Conclusion

As discussed in full in the Sources of Uncertainty section, above, we have chosen to base our effects analysis on the upper end of the 95th percentile analysis. Given the long time frames involved, long distances involved, and small amounts of drawdown in the aquifer, there is a high degree of uncertainty associated with groundwater predictions. The scenario represented by the upper end of the 95th percentile analysis is not the scenario most probable to occur. Rather, by selecting it we are analyzing a conservative position that ensures almost all of potential and reasonable outcomes disclosed by the models (using our assumptions) would be encompassed by this BO analysis. This conservative approach ensures that under almost all potential outcomes that can be reasonably predicted (using our assumptions), the conclusions of non-jeopardy and no destruction or adverse modification, below, would remain valid.

After reviewing the current status of the flycatcher and its critical habitat, the environmental baseline for the action area, the effects of the Rosemont Copper Mine, and the cumulative effects, it is the FWS's biological opinion that the Rosemont Mine, as proposed, is not likely to jeopardize the continued existence of the flycatcher, and is not likely to destroy or adversely modify designated flycatcher critical habitat. We present this conclusion for the flycatcher for the following reasons:

- Previous formal flycatcher consultations within the Action Area and Santa Cruz Management Area have not reached adverse effect determinations for critical habitat, older formal consultations prior to designation of critical habitat were minor in impact, and some proposed actions were anticipated to conserve/improve flycatcher habitat. Therefore, the environmental baseline within the Santa Cruz Management Area has not been markedly degraded from past projects evaluated under section 7 of the ESA.
- While survey effort has not been comprehensive or regular since listing, only a few (three or fewer) flycatcher territories have been detected in any one season along upper Cienega Creek, Empire Gulch, and in the action area. The most recent record within the Santa Cruz Management Area was the flycatcher territory detected in 2011 along Empire Gulch. Although flycatchers are important within the Santa Cruz Management Area given so few occur there, they are more numerous in other management units within the Gila Recovery Unit (of which the Santa Cruz Management Area is a subdivision). A single flycatcher territory represents only 0.15% of the flycatcher territories found across the greater Gila Recovery Unit and 0.07 % of all the territories across its breeding range. A total of 659 territories were estimated for the Recovery Unit in 2007 and 1299 territories across its range (the last year for which a comprehensive, area-wide estimate/analysis was conducted) (Durst *et al.* 2008).
- We anticipate that the proposed action will result in losses of hydroriparian vegetation in Cienega Creek and lower Empire Gulch. We anticipate the complete loss of EG1 (0.68 miles, 87.96 acres) and degradation of habitat throughout Empire Gulch and upper Cienega Creek from the conclusion of

mining through the modeled 150-year duration of the May 2015 SBA's analysis and onward from that point.

- The proposed conservation measure of $1.25 million for hydroriparian habitat enhancements is expected to fund planning, compliance and permitting, site preparation, implementation, monitoring, maintenance, and reporting. We expect funding to cover at least 0.5 miles and at least 31 acres of hydroriparian enhancement in a location yet to be determined. The expected number of miles and acres to be enhanced may be greater than the minimum estimated; costs for different enhancements vary widely. Implementation of the conservation measure to fund enhancement of hydroriparian habitat will help minimize adverse effects. Subtracting the minimum miles and acres to be enhanced from the miles and acres of adverse effects, the minimized adverse effects are ≤1.1 miles and ≤273 acres of southwestern willow flycatcher habitat.
- The proposed action is expected to affect 1.6 miles and 304 acres of flycatcher habitat in the Cienega Creek watershed, which includes permanently altering the physical and biological features and primary constituent elements of a 1.21 mile and 248 acre subset of designated flycatcher critical habitat. The permanent impacts to 1.21 miles of affected flycatcher critical habitat represent 4.2 percent (1.21 miles divided by 28.8 total miles x 100) of the designated flycatcher critical habitat within the broader Santa Cruz Management Area. About 95 percent of the area (about 27 miles) designated as flycatcher critical habitat on the landscape within the Santa Cruz Management Area is expected to be unaffected by the proposed Rosemont Mine project and available to reach flycatcher numerical and habitat-related recovery goals.
- We expect the 27 stream miles of flycatcher critical habitat unaffected by the proposed project will provide sufficient area to meet the 25-territory flycatcher recovery goal (and double the habitat). This conclusion is based upon estimates of the amount of flycatcher habitat found in the Action Area (about 200 acres/mile) and a conservative amount of vegetation estimated needed for each flycatcher territory (11 acres).
- The aforementioned effects to critical habitat in the action area relative to elsewhere in the Santa Cruz Management Area, Gila Recovery Unit, and rangewide designation are of a magnitude too small to diminish the value of critical habitat for the conservation of southwestern willow flycatchers; critical habitat will therefore not be adversely modified nor destroyed.
- We understand that riparian habitat (including southwestern willow flycatcher critical habitat) is dynamic and its quality and availability are not uniform through time. However, the use of riparian vegetation measurements from this opinion can broadly illustrate why we anticipate that adequate area exists on the landscape in the Santa Cruz Management Area to reach flycatcher recovery goals. Twenty-seven stream miles are estimated to possess approximately 5,400 acres of riparian vegetation for flycatcher habitat (27 miles x 200 acres). At a conservative estimate of 11 acres per flycatcher territory, 25 territories would need about 275 acres (11 acres x 25 territories). If we double the habitat needed to maintain these territories through time as described in the Recovery Plan (FWS 2002a), it increases the flycatcher's recovery requirement to 550 acres. As a rough estimate, there are about 5,400 acres available across 27 miles of critical habitat in the Santa Cruz Management Area to meet the 550 acres needed for flycatchers (after the impacts from the proposed project). This exercise and rough estimate illustrates the broad area remaining in the Santa Cruz Management Area for flycatcher recovery and why the proposed project is not anticipated to appreciably diminish the conservation value of designated critical habitat.
- The analyses contained in this BO support the conclusion that the magnitude of the proposed action's effects to hydroriparian vegetation occupied or likely to be occupied by southwestern willow flycatchers is small relative to the amount of southwestern willow flycatcher critical habitat present in

the action area. The proposed action therefore will not destroy nor adversely modify southwestern willow flycatcher critical habitat.

- In combination, the permanent degradation/alteration of 1.6 miles of flycatcher habitat (representing 304 Empire Gulch/Cienega Creek acres), the loss of habitat for a few (three or fewer) known flycatcher territories, and the counterbalancing potential flycatcher territories that could occur within this affected habitat, are not anticipated to result in jeopardy for the continued existence of the flycatcher because of the small number of flycatchers, territories, and habitat this unit represents and contributes to the subspecies locally and across its range. Based upon the most recent rangewide estimate (Durst *et al*. 2008), a single flycatcher territory represents 0.15% of the flycatcher territories found across the greater Gila Recovery Unit (n=659) and 0.07 % (n=1299) of all the territories across its breeding range. While a few flycatcher territories within the Santa Cruz Management Area have been erratically detected since listing, the estimated rangewide flycatcher population has grown from fewer than 400 territories to nearly 1,300 territories in 2008. And similarly, the Gila Recovery Unit has grown from 454 territories in 2001 to 659 in 2007. In other words, the local recovery unit with its rangewide population has persisted and increased its distribution since listing, and there is no expectation that the erratic persistence of the few territories has been essential to the continued growth of the Gila Recovery Unit or rangewide population.
- There are 12.2 miles of critical habitat in the Cienega Creek watershed, 28.8 miles in the Santa Cruz Management Area, 473.9 miles in the Gila Recovery Unit (of which the Santa Cruz Management Area is a subdivision), and 1,227 miles rangewide. The loss of habitat within Empire Gulch and a portion of Cienega Creek represents a small fraction of critical habitat in the Santa Cruz Management Area (4.2 percent), in the Gila Recovery Unit (of which the Santa Cruz Management Area is a subdivision) (0.25 percent) and in the rangewide critical habitat designation (0.1 percent). The proposed action's effects are small in magnitude and are thus unlikely to adversely modify or destroy southwestern willow flycatcher critical habitat.

The conclusions of this biological opinion are based on full implementation of the project as described in the Description of the Proposed Action and Description of the Proposed Conservation Measures sections of this document.

INCIDENTAL TAKE STATEMENT – SOUTHWESTERN WILLOW FLYCATCHER

Section 9 of the Act and Federal regulations pursuant to section 4(d) of the Act 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 further defined (50 CFR 17.3) 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. "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 of 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 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.

Amount or Extent of Take – Southwestern Willow Flycatcher

We anticipate that the proposed action will result in incidental take of southwestern willow flycatchers in the form of harm through indirect permanent loss of habitat occupied by nesting flycatchers in Empire Gulch and Cienega Creek. We recognize that providing a numerical estimate of incidental take is the preferred method of measuring take. However, we must use habitat as a surrogate for the amount or extent of take because thorough southwestern willow flycatcher surveys are conducted too infrequently to determine the number territories in the action area. In addition, the survey protocol (Sogge *et al.* 2010) is designed only to determine presence/absence in a given reach rather than an accurate count of individual birds. Additional surveys and methods, including banding and possibly monitoring telemetered birds, would need to be employed to obtain an accurate count of individual birds and pairs throughout the breeding season.

It is reasonable to assume that the abundance of southwestern willow flycatchers is correlated with the extent of suitable riparian habitat. We therefore quantified the adverse effects of the proposed action as the number of stream miles and corresponding acres of hydroriparian habitat that we anticipate will be lost due to mine-driven groundwater drawdown. The estimated number of miles and acres anticipated to be adversely affected by construction and operation of the mine appears in Table WIFL-2, above and is summarized below.

Nesting flycatchers have high site fidelity to nesting areas that possess the qualities to generate preferable habitat conditions (FWS 2002). We anticipate that 1.6 miles (approximately 304 acres) of hydroriparian habitat relied upon by nesting flycatchers (including areas that could be used for flycatcher recovery) will be indirectly adversely affected due to loss of surface flow in Empire Gulch and upper Cienega Creek. Nesting habitat is expected to be made permanently unusable due to mine-related actions that cause groundwater and stream flow reductions. Riparian vegetation and habitat patches are expected to gradually narrow, become thinner, and subsequently die. As habitat quality begins to decline, we can initially expect flycatchers to attempt to nest, resulting in reduced reproductive performance, nest failure, and/or increased predation or nest parasitism of eggs, nestlings, and adults. The elimination of suitable habitat is expected to eventually prevent flycatchers from establishing territories, building nests, laying and incubating eggs, and fledging nestlings.

Because the number of flycatchers that can use an area, nest, and reproduce is not predictable from one year to the next and also due to an incomplete survey history through time for the action area preventing us from having a comprehensive understanding of how the area has been used by flycatchers over time, we must use habitat as a surrogate for the amount or extent of incidental take. Given that southwestern willow flycatcher habitat within the action area occurs along the stream channels, the estimated number of acres anticipated to be adversely affected is meaningful only when used in conjunction with length of stream miles lost. We use the number of stream miles and corresponding width of hydroriparian habitat to determine acres.

Empire Gulch (near EG1 and 2), and upper Cienega Creek have been the occupied reaches within the Santa Cruz Management Area. Both are within the action area and will be adversely affected by the proposed action. We estimate effects to 1.64 miles and 304 acres of the 9.48 miles and 2021.9 acres of southwestern willow flycatcher habitat in Empire Gulch and Cienega Creek. Habitat occupied by flycatchers is dynamic and can vary widely in suitability, location, and occupancy over relatively short periods of time. Successional changes cycle through suitability, senescence or scouring, regeneration, and growth. Therefore, suitable habitat within Empire Gulch and Cienega Creek may not be present all at one time.

Depending on the reach, 10 to 100 percent of the habitat is expected to be adversely affected by groundwater drawdown and associated stream flow reduction within 150 years. Calculating the habitat loss expected for each corresponding reach, 1.6 miles and 304 acres in Empire Gulch and Cienega Creek are expected to be adversely affected by the proposed action. As a result, 1.6 miles and 304 acres will be used as a surrogate for incidental take and is the amount or extent of incidental take allowed. Because this habitat is expected to become permanently unusable, we anticipate that all flycatchers will be incidentally taken within these acres.

While we anticipate that mine-driven groundwater drawdown will affect hydroriparian habitat to the extent described above, the habitat will also be affected by flow reductions attributable to climate change (see Tables A-1 through A-4 in the Effects to Aquatic Ecosystems section, incorporated herein by reference). Riparian vegetation in the Cienega Creek system is also successional in nature and variable in its extent (Powell 2013). These aspects of the ecology render it difficult to determine what portion of future losses of hydroriparian riparian vegetation are attributable solely to mine-driven drawdown.

Hydroriparian vegetation is supported by the subsurface and surface flows of water in the affected streams. Decreases in groundwater elevation within the shallow alluvium and decreases in stream baseflow therefore result in stress to hydroriparian ecosystems. Groundwater elevations, which can be readily measured, are consequently an effective proxy for effects to hydroriparian habitat, which in turn, is an effective surrogate for southwestern willow flycatcher abundance. Therefore, for the purpose of determining take, we will employ groundwater drawdown as a surrogate measure of take for the southwestern willow flycatcher.

The specific levels of incidental take of southwestern willow flycatcher are expressed in terms of the groundwater drawdowns anticipated (based on modeling) in the locations and time frames (0, 20, 50, 150 years) discussed above in the Gila chub analysis (see the Amount or Extent of Take subsection of the Gila Chub Incidental Take Statement, incorporated herein by reference and summarized in Table GC-4). We believe this surrogate measure is also appropriate for southwestern willow flycatcher because the most significant effects to this species result from the anticipated loss of hydroriparian habitat, which is supported by shallow groundwater and surface water discharged from shallow groundwater sources.

A program of groundwater monitoring is the appropriate means to evaluate, over time, changes in groundwater elevation (again, as a surrogate for hydroriparian habitat and southwestern willow flycatcher abundance). An effective groundwater monitoring program was developed to monitor the groundwater elevation-based surrogate for the incidental take of Gila chub (see the Amount or Extent of Take subsection of the Gila chub Incidental Take Statement, incorporated herein by reference). The locations for the groundwater monitoring program and their justifications appear in Table GC-5, above.

In summary, and stated differently, the maximum allowable incidental take of southwestern willow flycatcher is represented by the groundwater drawdowns at the sites and time intervals stated in Table GC-4, above. The to-be-modeled groundwater drawdowns at a suite of potential sites specified in Table GC-5, above, will serve as proxies for the surrogate measure of incidental take in miles and acres of hydroriparian habitat appearing in Table WIFL-4, above. The manner by which Rosemont and the USFS shall monitor compliance with the amount of incidental take is described further in the Terms and Conditions, below.

Effect of the Take – Southwestern Willow Flycatcher

In this BO, the FWS determined that this level of anticipated take is not likely to result in jeopardy to the southwestern willow flycatcher, nor likely to result in destruction or adverse modification of southwestern willow flycatcher critical habitat. The loss occurs within a part of the only known southwestern willow flycatcher breeding area within the Santa Cruz Management Area, but the lost habitat is not essential to the recovery of this management area nor to the Gila Recovery Unit. At least 659 territories occur within the Gila Recovery Unit, of which the Santa Cruz Management Area is a subset.

Reasonable and Prudent Measures – Southwestern Willow Flycatcher

In addition, the FWS believes the following reasonable and prudent measures are necessary and appropriate to minimize impacts of incidental take of southwestern willow flycatchers:

1. The USFS and Corps shall ensure that Rosemont monitor groundwater levels (as a proxy for the hydroriparian vegetation surrogate measure of take for southwestern willow flycatcher) at least annually (see also FEIS mitigation measure FS-BR-27);

2. The USFS and Corps shall ensure that Rosemont appropriately implements restoration and monitors the hydroriparian habitat proposed to be created at a to-be-determined location, also as described in Revised Conservation Measure 3.

Terms and Conditions – Southwestern Willow Flycatcher

In order to be exempt from the prohibitions of section 9 of the Act, Rosemont, the USFS, and the Corps must comply with the following terms and conditions, which implement the reasonable and prudent measures described above and outline required reporting/monitoring requirements. These terms and conditions are non-discretionary.

1. The USFS and Corps shall ensure that Gila chub Terms and Conditions 1.1, 1.2, 1.3, 1.4, and 1.5 are implemented. This Term and Condition implements the southwestern willow flycatcher Reasonable and Prudent Measure 1, above.

2. The USFS and Corps shall ensure that Rosemont's implementation and monitoring plans for hydroriparian habitat are submitted to the USFS, Corps, and FWS (in consultation with other wildlife agencies, as appropriate) in advance for review, comment, and approval. This Term and Condition implements southwestern willow flycatcher Reasonable and Prudent Measure 2, above.

These reasonable and prudent measures, with their implementing terms and conditions, are designed to minimize the effect of incidental take that is anticipated to 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. The Coronado National

Forest and/or Corps must immediately provide an explanation of the causes and discuss with the FWS whether reinitiation of consultation is required.

Conservation Recommendations – Southwestern Willow Flycatcher

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.

1. We recommend that the USFS and Corps ensure that Rosemont restores additional acreage of hydroriparian habitat, beyond what will be funded by Revised Conservation Measure 3.

2. We recommend that the USFS and Corps ensure that Rosemont researches techniques for reducing the use and loss of groundwater from the proposed action in the project area, considering any and all current and future techniques that may be technologically and economically feasible.

3. We recommend that the USFS, Corps, and Rosemont Copper Company facilitate implementation of more consistent flycatcher presence/absence surveys (per Sogge *et al*. 2010 or subsequent protocols), including nest searching and monitoring along Empire Gulch, upper Cienega Creek, and the Santa Cruz Management Area to better understand the status of the flycatcher within the overall action area and the Management Area.

4. We recommend that the USFS, Corps, and Rosemont Copper Company implement long-term monitoring of groundwater resources in the Action Area, especially in areas where the groundwater models were less than certain in their conclusions. We recommend employing a third party entity that has experience designing, collecting, and analyzing these types of data, and one that can be held to high scientific scrutiny, such as the U.S. Geologic Survey. At a minimum, we recommend establishing baseline information to better understand how groundwater moves through the watershed, existing groundwater elevations, and other groundwater and surface water uses in the watershed. This information should be used to track the Rosemont Copper Mine’s use of water and its comparative impact to the watershed.

In order 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.

JAGUAR

Status of the Species - Jaguar

Legal Status

There have been no changes to the legal status of the jaguar since the October 30, 2013 BO; the prior narrative is incorporated herein via reference.

Life History

There have been no updates to the jaguar's life history information since the October 30, 2013 BO; the prior narrative is incorporated herein via reference.

Prey

There is no new information regarding jaguar prey. The narrative from the October 30, 2013 BO is incorporated herein via reference.

Home Range and Movement

The home range information contained in the October 30, 2013, BO remains current and is incorporated herein via reference, except for the updated information in the following paragraphs:

A small number of home range studies have been conducted in the NRU. 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) (Nuñez Perez 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 2011, pers. comm.). Additionally, camera trap data indicated that the average male home range in the municipality of Sahuaripa, Sonora, was 84 km^2 (32 mi^2) (López-González 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). Using camera traps and the 24-hour Mean Maximum Distance Moved (MMDM) method, Culver *et al*. (2016) estimated the home range for one adult male in the Santa Rita Mountains in Arizona was 90 km^2. However, this number should be cited with caution, as the study was not designed to determine home range size, and the 24-hour MMDM is a conservative estimate of this jaguar's home range, as it is known to have traveled from the Whetstone Mountains to the Santa Rita Mountains, a distance of at least 35.5 km.

Jaguars move regularly throughout their home ranges, with mean daily movements ranging from 1.8 ± 2.5 km (1.1 ± 1.6 mi) to 8.17 ± 7.26 km (5.08 ± 4.51 mi) using a variety of methods. 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 males moving significantly larger distances (3.3 ± 1.8 km (2.0 ± 1.1 mi)) than females (1.8 ± 2.5 km (1.1 ± 1.6 mi)) (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 (1.0 ± 1.3 mi)) (Crawshaw and Quigley 1991). In the forests of Jalisco, jaguars can move up to 20 km (12 mi) in a single night, frequently finishing very close to where they started (Nuñez Perez 2006). Hernandez-Santin (2007) found the mean daily movement of female jaguars in Paraguay ranged from 2.68 ± 2.20 to 3.82 ± 3.14 km (1.67 ± 1.37 to 2.37 ± 1.95 mi) and of males from 3.37 ± 2.69 to 8.17 ± 7.26 km (2.09 ± 1.67 to 5.08 ± 4.51 mi). Hernandez-Santin (2007) states the maximum distance traveled in one day by a male jaguar was 39 km (24 mi) and 30 km (19 mi) by a female. According to Rabinowitz and Zeller (2010), de Almeida (1990) cites jaguars moving 15 km or more in a single night on hunting patrols in the Brazilian Pantanal. In Nacori Chico, Sonora, female jaguars returned to a given location approximately every 20 days and males every 30 days (Rosas-Rosas and Bender 2012). Figueroa (2013) found, on average, jaguars moved 2.56 km (0.99 mi) per day in Belize, with the mean daily distance traveled during the dry season significantly larger than the distance traveled during the wet season or the average distance traveled for the duration of the study. The maximum daily distance traveled by jaguars during the study was 9.19 ± 3.78 km (3.55 ± 1.46 mi).

Habitat

There is no new information regarding jaguar habitat. The narrative from the October 30, 2013 BO is incorporated herein via reference.

Distribution, Abundance, Population Trends

The distribution, abundance, and population trend information contained in the October 30, 2013, BO remains current and is incorporated herein via reference, except for the updated information in the following paragraphs:

From 1996 through 2015, several individual adult jaguars have been documented in the U.S. (i.e., 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 jaguar, named *El Jefe* by Tucson-area school children in late 2015, has been repeatedly photographed (2012 to 2015) in the Santa Rita Mountains, within and near the proposed action area, as recently as September 2015 (https://www.flickr.com/photos/usfws_southwest/sets/72157632294203147/; see Environmental

Baseline section below). The rugged and arid conditions at the northern limit of this distribution contrast sharply to lush tropical forests to the south (Boydston and López González 2005); however, considering this jaguar has been regularly detected in the Santa Rita Mountains since 2012, we hypothesize he has established a home range in these mountains.

Threats

There is no new information regarding threats to the jaguar beyond what is contained in the October 30, 2013 BO; the prior narrative is incorporated herein via reference.

Jaguar Recovery Planning

The description of the state of jaguar recovery planning remains substantively as described in the October 30, 2013 BO. The prior narrative is incorporated herein via reference with the following updates.

Northwestern Recovery Unit (NRU)

This section is updated as follows:

The Northwestern Recovery Unit (NRU) extends from south-central Arizona and extreme southwestern New Mexico, United States south to Colima, Mexico (Figure J-1), and is approximately 226,826 km^2 (87,578 mi2); with 29,021 km^2 (11,205 mi2) in the U.S. and 197,805 km^2 (76,373 mi2) in Mexico (Table J-1). The estimated area of jaguar habitat within the NRU is 170,854 km^2 (65,967 mi2; Table J-1). Table J-1, below, describes the subdivisions within the NRU.

Table J-1: Northwestern Recovery Unit Area size and estimate of jaguar habitat within each Area (Sanderson and Fisher 2013).

NRU Area	**Area Size**		**Estimate of Jaguar Habitat within Area**	
	km^2	**mi2**	**km^2**	**mi2**
Jalisco Core Area	54,949	21,216	44,460	17,166
Sinaloa Secondary Area	31,191	12,043	28,723	11,090
Sonora Core Area	77,710	30,004	67,931	26,228
Borderlands Secondary Area – Mexico portion	33,955	13,110	22,901	8,842
Borderlands Secondary Area – U.S. portion	29,021	11,205	6,839	2,641
Total	226,826	87,578	170,854	65,967

The remainder of this section remains unchanged, with the exception that the Northwestern Management Unit designation has been removed - this area is now the Borderlands Secondary Area.

Critical Habitat

The critical habitat narrative in the October 30, 2013 BO is incorporated herein via reference, but is updated as follows:

Critical habitat (as defined under the ESA) for the jaguar is designated in the United States for approximately 309,263 ha (764,207 ac) in Pima, Santa Cruz, and Cochise counties, Arizona, and Hidalgo County, New Mexico in six critical habitat units (79 FR 12571; Figure J-2): (1) Baboquivari Unit divided into subunits (1a) Baboquivari-Coyote Subunit, including the Northern Baboquivari, Saucito, Quinlan, and Coyote Mountains, and (1b) the Southern Baboquivari Subunit; (2) Atascosa Unit, including the Pajarito, Atascosa, and Tumacacori Mountains; (3) Patagonia Unit, including the Patagonia, Santa Rita, Empire, and Huachuca Mountains, and the Canelo and Grosvenor Hills; (4) Whetstone Unit, divided into subunits (4a) Whetstone Subunit, (4b) Whetstone-Santa Rita Subunit, and (4c) Whetstone-Huachuca Subunit; (5) Peloncillo Unit, including the Peloncillo Mountains both in Arizona and New Mexico; and (6) San Luis Unit, including the northern extent of the San Luis Mountains at the New Mexico-Mexico border. The units affected by the proposed action, Units 3 and 4, are described below.

Unit 3: Patagonia Unit

Unit 3 consists of 147,248 ha (351,501 ac) in the Patagonia, Santa Rita, Empire, and Huachuca Mountains, as well as the Canelo and Grosvenor Hills, in Pima, Santa Cruz, and Cochise counties, Arizona. Unit 3 is generally bounded by a line running roughly 3 km (1.9 mi) east of Interstate 19 to the west; a line running roughly 6 km (3.7 mi) south of Interstate 10 to the north; Cienega Creek and Highways 83, 90, and 92 to the east, including the eastern slopes of the Empire Mountains; and the U.S.-Mexico border to the south. Land ownership within the unit includes approximately 101,354 ha (250,452 ac) of Federal lands; 11,847 ha (29,274 ac) of Arizona State lands; and 29,046 ha (71,775 ac) of private lands. The Federal land is administered by the Coronado National Forest, Bureau of Land Management, and National Park Service. We consider the Patagonia Unit occupied at the time of listing (37 FR 6476; March 30, 1972) based on the 1965 record from the Patagonia Mountains, and it is currently occupied based on a series of confirmed sightings from 2012 through August 2015 (https://www.flickr.com/photos/usfws_southwest/sets/72157632294203147/). The mountain ranges within this unit contain all primary constituent elements of the physical or biological feature essential to the conservation of the jaguar.

The primary land uses within Unit 3 include military activities associated with Fort Huachuca, as well as Federal forest management activities, border-related activities, grazing, and recreational activities throughout the year, including, but not limited to, hiking, camping, birding, horseback riding, picnicking, sightseeing, and hunting. Special management considerations or protections needed within the unit address human disturbances through such activities as military ground maneuvers and increased human presence in remote locations through mining and development activities, construction of impermeable fences, and widening or construction of roadways, power lines, or pipelines to ensure all PCEs remain compatible with jaguar use.

Subunit 4a: Whetstone Subunit

Subunit 4a consists of 25,284 ha (62,478 ac) in the Whetstone Mountains in Pima, Santa Cruz, and Cochise Counties, Arizona. Subunit 4a is generally bounded by a line running roughly 4 km (2.5 mi) east of Cienega Creek to the west, a line running roughly 6 km (3.7 mi) south of Interstate 10 to the north, Highway 90 to the east, and Highway 82 to the south. Land ownership within the subunit includes approximately 16,066 ha (39,699 ac) of Federal lands; 5,445 ha (13,455 ac) of Arizona State lands; and 3,774 ha (9,325 ac) of private lands. The Federal land is administered primarily by the Coronado National Forest and Bureau of Land Management. We consider the Whetstone Subunit occupied at the time of listing (37 FR 6476; March 30, 1972) based on photographs taken in 2011, and it may be currently occupied although the animal recently photographed in the Santa Ritas is the same male photographed in the Whetstones in 2011. The mountain range within this subunit contains all primary constituent elements essential to the conservation of the jaguar, except for connectivity to Mexico.

The primary land uses within Subunit 4a include Federal forest management activities, grazing, and recreational activities throughout the year, including, but not limited to, hiking, camping, birding, horseback riding, picnicking, sightseeing, and hunting. Special management considerations or protections needed within the subunit address human disturbances through development activities, and widening or construction of roadways, power lines, or pipelines to ensure all PCEs remain compatible with jaguar use.

Subunit 4b: Whetstone-Santa Rita Subunit

Subunit 4b consists of 5,143 ha (12,710 ac) between the Empire Mountains and northern extent of the Whetstone Mountains in Pima County, Arizona. Subunit 4b is generally bounded by (but does not include) the eastern slopes of the Empire Mountains to the west, a line running roughly 6 km (3.7 mi) south of Interstate 10 to the north, the western slopes of the Whetstone Mountains to the east, and Stevenson Canyon to the south. Land ownership within the subunit includes approximately 532 ha (1,313 ac) of Federal lands and 4,612 ha (11,396 ac) of Arizona State lands. According to the final rule, the Whetstone-Santa Rita Subunit provides connectivity from the Whetstone Mountains to Mexico and was not known to be occupied at the time of listing, but is essential to the conservation of the jaguar because it contributes to the species' persistence by providing connectivity to occupied areas that support individuals during dispersal movements during cyclical expansion and contraction from the nearest core area and breeding population in the NRU (FWS 2012, 2014).

The primary land uses within Subunit 4b include grazing and recreational activities throughout the year, including, but not limited to, hiking, camping, birding, horseback riding, picnicking, sightseeing, and hunting.

Subunit 4c: Whetstone-Huachuca Subunit

Subunit 4c consists of 7,722 ha (19,081 ac) between the Huachuca Mountains and southern extent of the Whetstone Mountains in Santa Cruz and Cochise Counties, Arizona. Subunit 4c is generally bounded by Highway 83, Elgin-Canelo Road, and Upper Elgin Road to the west; Highway 82 to the north; a line running roughly 4 km (2.5 mi) west of Highway 90 to the east; and up to but not including the Huachuca Mountains to the south. Land ownership within the subunit includes approximately 1,350 ha (3,336 ac) of Federal lands; 2,981 ha (7,366 ac) of Arizona State lands; and 3,391 ha (8,379 ac) of private lands. The Federal land is administered by the Coronado National Forest and Bureau of Land Management. According to the final rule, the Whetstone-Huachuca Subunit provides connectivity from the Whetstone Mountains to Mexico and was not occupied at the time of listing, but is essential to the conservation of the jaguar because it contributes to the species' persistence by providing connectivity to occupied areas that support individuals during dispersal movements during cyclical expansion and contraction of the nearest core area and breeding population in the NRU (FWS 2012).

The primary land uses within Subunit 4c include military activities associated with Fort Huachuca, as well as Federal forest management activities, grazing, and recreational activities throughout the year, including, but not limited to, hiking, camping, birding, horseback riding, picnicking, sightseeing, and hunting.

Models Used for Designating Critical Habitat

The description of the models used to designate critical habitat remain as stated in the October 30, 2013, BO and are incorporated herein via reference.

Primary Constituent Elements for Jaguar Critical Habitat

The primary constituent element subsection in the October 30, 2013, BO is incorporated herein via reference, but is updated as follows:

The primary constituent elements of critical habitat essential to the conservation of the jaguar within areas of expansive open spaces in the southwestern United States at least 100 km^2 (37 mi2) in size are those 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 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 semidesert 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) in 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 (expressed as an HII of less than 20).

Jaguar Recovery Planning in Relation to Critical Habitat

This section remains as written in the October 30, 2013, BO, except we remove the reference to the Northwestern Management Unit.

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.

In the environmental baseline analysis, we discuss the current condition of the critical habitat units in the action area, the factors responsible for that condition, and the conservation roles of the units. In particular, we discuss the relationship of the affected units in the action area to the entire designated critical habitat with respect to the conservation of the jaguar.

Action Area

The action area remains as described in the October 30, 2013 BO except as described in the Description of the Proposed Action section (see Table 1) and in the following text:

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 (the Borderlands Secondary Area) of the NRU, and at least one jaguar has recently occurred in and near the project area. For the purposes of the jaguar analysis, we use the Forest Service Action Area definition (i.e., defined by hydrology).

Terrain, Vegetation Communities, and Climate in the Action Area

The description of the action area's terrain, vegetation communities, and climate data remain as described in the October 30, 2013, BO, and are incorporated herein via reference.

Status of the Species within the Action Area

Life History and Habitat

The description of the jaguar's life history and habitat in the action area remains as it was described in the October 30, 2013, BO, and is incorporated herein via reference.

Distribution and Abundance

The distribution and abundance of jaguars in the action area is largely the same as it was described in the October 30, 2013, BO and is incorporated herein via reference. The subsection is updated as follows:

Confirmed jaguar detections have recently occurred within and near the proposed project and action area. The detections were from trail cameras placed by resident hunters, the Arizona Game and Fish Department, and researchers from the University of Arizona jaguar survey and monitoring project funded by the

Department of Homeland Security via the U.S. Fish and Wildlife Service. All detections, captured by photographs, were located on lands administered by the Coronado National Forest within designated critical habitat (Units 3 and 4). Analysis by jaguar experts of the comparison of rosette patterns concluded that the photographs are of the same male jaguar. The male jaguar photographed by a mountain lion hunter in the Whetstone Mountains (within critical habitat Subunit 4 – Whetstone Unit) in November 2011 is the same jaguar later detected in the Santa Rita Mountains (within critical habitat Unit 3 – Patagonia Unit) by the trail cameras. Detections of this male jaguar have occurred in the Santa Rita Mountains from September 2012 to September 2015 (https://www.flickr.com/photos/usfws_southwest/sets/72157632294203147/).

The Forest Service hypothesizes that this single resident male jaguar has established a territory that includes most of the Santa Rita Mountains (which includes the proposed action area) and possibly the Whetstone Mountains as well (from the June 2012 BA and February 2013 Supplemental BA).
This hypothesis is supported by Culver *et al*.'s (2016) study. They presume this jaguar, which was detected in 118 photographs/videos and 13 scats, is a resident because he was photographed by their cameras every month of the year from November 2012 to February 2015.

To move between the Whetstone and Santa Rita mountains, the male jaguar would have had to cross a two-lane highway, possibly State Route 83, although its exact movement pattern is unknown.

Threats

The threats to jaguars remain as they were described in the October 30, 2013, BO and are incorporated herein via reference. The only change is that we refer to the former Northwestern Management Unit as the Borderlands Secondary Area.

Critical Habitat within the Action Area as Defined by the Forest Service

This section is updated as follows:

***Current Condition of Critical Habitat* -** The action area as defined by the Forest Service occurs within the Patagonia Unit (Unit 3) (Figure J-2), which consists of 147,248 ha (351,501 ac) in the Patagonia, Santa Rita, Empire, and Huachuca Mountains, as well as the Canelo and Grosvenor Hills, in Pima, Santa Cruz, and Cochise Counties, Arizona. The mountain ranges within this unit contain all primary constituent elements essential to the conservation of the jaguar.

The action area is situated west of the Whetstone-Santa Rita Unit (Subunit 4b) (Figure 2) which consists of 5,143 ha (12,710 ac) between the Empire Mountains and northern extent of the Whetstone Mountains in Pima County, Arizona. The Whetstone-Santa Rita Subunit, which may provide connectivity from the Whetstone Mountains to Mexico through Unit 3, was not known to be occupied at the time of listing (FWS 2012, FWS 2013), and is not known to have ever been used by jaguars.

Factors Responsible for the Current Condition of Critical Habitat - The Patagonia Unit is designated as critical habitat because areas such as the Santa Rita Mountains contain the primary constituent elements essential to the conservation of the jaguar. In the jaguar habitat model developed for northwestern Mexico and the U.S.-Mexico borderlands area, Sanderson and Fisher (2011, 2013) described how low human influence is perhaps the most important feature defining jaguar habitat, as jaguars most often avoid areas with too much human pressure. The Santa Rita Mountains, where the proposed project is located, was identified by the model as having HII values between 14 and 18. As stated above, an HII value of less than 20 was the parameter identified as an essential component for the conservation of the jaguar in the United States (FWS 2014).

According to the final rule, connectivity between the United States and Mexico is necessary if viable habitat for the jaguar is to be maintained (FWS 2014). The intent of Subunit 4b is to connect Subunit 4a to Mexico via Unit 3, although connectivity is also provided through Subunit 4c, which is not affected by the proposed action. Jaguar habitat and the features essential to their conservation are threatened by the direct and indirect effects of increasing human influence into remote, rugged areas, as well as projects and activities that sever connectivity to Mexico. These may include, but are not limited to: significant increases in border-related activities, both legal and illegal; widening or construction of roadways, power lines, or pipelines; construction or expansion of human developments; mineral extraction and mining operations; military activities in remote locations; and human disturbance related to increased activities in or access to remote areas (FWS 2012, FWS 2013). In the final critical habitat rule for the jaguar, we noted the existence of the Rosemont Mine project, and stated that we had evaluated the project through the section 7 consultation process (FWS 2013). As a result, we determined that the project would not constitute destruction or adverse modification of jaguar critical habitat at that time (FWS 2014). We also found that the impacts of the critical designation on the Rosemont Project would be minimal (FWS 2014).

***Conservation Role of the Designated Critical Habitat Units* -** The FWS considers the Patagonia Unit 3 to have been occupied at the time of listing based on the 1965 record from the Patagonia Mountains. The Patagonia Unit is currently occupied based on the series of recent jaguar sightings in the Santa Rita Mountains (see above). The mountain ranges within this unit contain all primary constituent elements essential to the conservation of the jaguar. Connectivity between the United States and Mexico was referenced throughout the designated critical habitat rule as essential for the conservation of jaguars. Therefore, the intent of the final rule is to provide connectivity of Subunit 4a to Mexico through Unit 3 via Subunits 4b and 4c, although there are no records indicating that either of these subunits has been used by jaguars.

Past and Ongoing Federal Actions in the Action Area

No change to this section, except that four (not three) projects have undergone formal section 7 consultation for effects to the jaguar in southern Arizona. A summary of the fourth consultation is described below:

4. *Biological Opinion on Ongoing and Future Military Operations and Activities at Fort Huachuca, Arizona* (Consultation number 22410-2013-F-0247 issued May 16, 2014)

This consultation addressed the effects of operations and activities to meet mission objectives of Fort Huachuca, including 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.

EFFECTS OF THE ACTION – JAGUAR

The 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 or interdependent with that action (50 CFR §402.02). Indirect effects occur later in time but are reasonably certain to occur. 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 (50 CFR §402.02). In the effects of the action analysis, we also characterize the direct and indirect effects of the action and those of interrelated and interdependent actions on the designated critical habitat. We describe how the primary constituent elements or habitat qualities essential to the conservation of the species are likely to be affected and, in turn, how that will influence the function and conservation role of the affected critical habitat unit(s).

Effects of the Action on the Jaguar

This section is updated as follows:

As analyzed at length in the BA, Supplemental BA, and Second Supplemental BA, and supported by additional analyses below, the proposed project will result in degradation of jaguar habitat and disturbance to jaguars. Construction and operations of the mine, including the associated roads, will result in removal, destruction, and degradation of jaguar habitat and jaguar prey habitat and is likely to disturb jaguars, causing changes in, among other things, their habitat use and movement patterns. Conservation measures included in the project description may help offset adverse effects to jaguars to some extent. As of April 2016, we are aware of a single male resident jaguar in the Santa Rita Mountains. This jaguar will likely be subject to the effects analyzed in this section; however, other jaguars potentially occurring in the area in the future would also be affected.

Effects to jaguars and their habitat are categorized into permanent and long-term (30 years) effects. Permanent effects can be classified as both in perpetuity (e.g., the mine pit) and as very long term effects (e.g., impacted areas between the mine pit and the security fence) for which we cannot predict the overall outcome of revegetation and restoration activities. We do not know if the restored areas will become suitable habitat for jaguars, and it is possible that some areas may be converted from their current native vegetation state (Madrean evergreen woodland, semidesert grassland, etc.) and may not return to the previous condition, thus they are lost for certain plant and animal species (FEIS 2015, p. 1139). Therefore, for the purposes of our analysis, we are considering effects within the security fence to be permanent. Long-term (30 years) effects are those that are in place during mining operations and restoration activities (dust, increased lighting, disturbance, etc.), but that are expected to decrease quickly once these operations and activities cease. We expect these effects within the action area, including between the security fence and perimeter fence. See Table J-2 for acreages of permanent effects, long-term (30 years) effects, and conservation lands.

Table J-2: Acreages of permanent effects and long-term (30 years) effects, as well as conservation lands in southeastern Arizona (and within jaguar critical habitat) related to the construction of the proposed Rosemont Mine (U.S. Forest Service Process Memorandum to File, June 15, 2015).

Impact	Acres	Acres within jaguar critical habitat
Permanent effects* (total)	5,411	4,013

Security fence	*4,228*	*3,514*
New roads	*265*	*210*
Utility right-of-way	*899*	*280*
Trails	*19*	*9*
Long-term (30 years) effects** (total)	8,006	6,139
Permanent effects (total), above*	*5,411*	*4,013*
*Additional area within perimeter fence***	*2,595*	*2,126*
Conservation lands (total)	3,064	1,857
Sonoita Creek Ranch	*1,580*	*1,328*
Davidson Canyon Watershed Parcels	*545*	*527*
Helvetia Ranch North Parcels	*939*	*21*

* 20 acres of decommissioned roads are omitted from the calculation of permanent effects.
** Long-term effects include permanent effects plus an additional 2,595 acres encompassed by the perimeter fence, which surrounds the security fence and portions of the primary access road and utility right-of-way (note that these portions of the primary access road and utility right-of-way are considered part of the 5,411 acres of permanent effects). The perimeter fence will be removed at the end of the project. Long-term effects of noise, increased lighting, etc. (discussed below) will also impact areas outside of the perimeter fence; however, those areas are not quantified in this table.

1. Project Construction

The June 2012 BA defined the project area (BA Figure 3) as all areas in which any ground disturbance would take place as a result of the proposed project, including the mine pit, waste rock piles, tailings, access roads, utility corridors, and on-site facilities (i.e., the mine "footprint" or area within the security fence plus roads, corridors, and trails). The June 2012 BA indicated that 7,016 acres of land would be directly disturbed. The acreage of direct disturbance was refined in the May 2015 SBA to 5,431 acres, which includes areas within the security fence (4,228 acres), the primary access road (226 acres), the utility line corridor (899 acres), decommissioned or new forest roads (59 acres), and the rerouted Arizona National Scenic Trail and trailheads (19 acres). The total area excluded from public access (within the perimeter fence) would be 6,990 acres. The affected area appears in Figure J-2.

Vegetation types within this area are Madrean evergreen woodland and semidesert grassland, both important vegetation types for jaguars in the Borderlands Secondary Area of the NRU; and both xero- and hydroriparian. Therefore, the project will result in long term (30 years, after which the perimeter fence will be removed), direct effects to 8,006 acres (perimeter fence, roads, trails, and ROW) and the permanent removal of about 5,411 acres of jaguar habitat (security fence, new roads, and ROW; 20 acres of decommissioned roads are omitted from the calculation of permanent effects).

Although we do not know the average home range size of jaguars in Arizona, home ranges in Sonora range from 84 to 200 km^2 (20,757 to 49,421 acres). Note that the 24-hour MMDM home range estimate of the male jaguar in the Santa Rita Mountains (90 km^2) falls within this range, although this estimate should be used with caution. There will be a 6,990-acre temporal loss of up to approximately 14.1 to 33.7 percent of a jaguar home range. In the future, once the perimeter fence has been removed, the 5,411 acres within the security fence will be approximately 10.9 to 26.0 percent of a jaguar home range, with slightly lesser percentages of affected acreage if reclamation succeeds in reestablishing sufficient permanent canopy cover. It is also likely that the effects are slightly overestimated due to the fact that not all of the 899 acres of utility ROW are within the Madrean evergreen woodland or semidesert grassland vegetation types; the far westernmost portion is within the Arizona upland subdivision vegetation type, if not within human-disturbed habitats such as other, existing ROWs and similar features. Again, these are direct effects associated with the footprint of various mine features; indirect effects (light, noise, traffic, etc.) are discussed in subsequent sections. Regardless of the exact, directly-affected acreage, the jaguar known to be in the northern Santa Rita Mountains recently will most likely lose some portion of its home range. The extent of that loss is unknown because the animal's home range has not been determined.

Throughout most of the jaguar distribution, we know that home ranges most often overlap (Seymour 1989); however, we have not documented this overlap in Arizona so do not know whether the project footprint will impact additional jaguar home ranges. The definition of home range varies, but Burt (1943, as cited by Powell and Mitchell 2012) defined home range as ‘‘that area traversed by an individual in its normal activities of food gathering, mating, and caring for young.”. Given the recent, continuous use of the Santa Rita Mountains by a male jaguar, we hypothesize that he has established a home range in the U.S. that encompasses these mountains. Culver *et al.*'s (2016) study supports our hypothesis. Due to loss of habitat and additional human disturbance near the project area (e.g., lights, noises, traffic - see below for further discussion), the male jaguar detected in the Santa Rita Mountains will most likely adjust its home range southward.

As explained by Powell and Mitchell (2012), a home range provides information on the locations of resources (Folse *et al*. 1989; Saarenmaa *et al*. 1988; South 1999; Spencer 2012; Stillman *et al*. 2000; Turner *et al*. 1994; With and Crist 1996; all as cited by Powell and Mitchell 2012) and such knowledge affects an animal's fitness. Dispersing mammals often have higher mortality or lower reproduction than conspecifics in familiar territory (Blanco and Cort´es 2007; Gosselink *et al*. 2007; Soulsbury *et al*. 2008; all as cited by Powell and Mitchell (2012) (Powell and Mitchell 2012). Learning a home range requires time, leading to site fidelity, and site fidelity has been used to define whether an animal has established a home range (e.g., Spencer *et al*. 1990, as cited by Powell and Mitchell 2012) (Powell and Mitchell 2012).

There are no changes (relative to the October 30, 2013, BO) to the remainder of this subsection.

2. Lighting

There are no changes (relative to the October 30, 2013, BO) to the remainder of this subsection.

3. Noise

There are no changes (relative to the October 30, 2013, BO) to the remainder of this subsection.

4. Roads and Utility Maintenance Corridor

There are no changes (relative to the October 30, 2013, BO) to the remainder of this subsection.

5. Increase in Human Disturbance

There are no changes (relative to the October 30, 2013, BO) to the remainder of this subsection.

Effects of the Action on Critical Habitat

The Effects of the Action section from the October 30, 2013, BO is incorporated via reference, but is updates as follows:

Role and definitions of occupied (at the time of listing) versus unoccupied (at the time of listing) critical habitat

According to the final rule, the conservation role or value of jaguar critical habitat (both occupied and unoccupied at the time of listing) is to provide areas to support some individuals during transient movements by providing patches of habitat (perhaps in some cases with a few resident jaguars), and as areas for cyclic expansion and contraction of the nearest core area and breeding population in the NRU (FWS 2014). As explained in the final rule (FWS 2014), occupied critical habitat requires all PCEs to be present; however, if PCE 1 (connectivity to Mexico) is not present, then it must be provided by a unit not known to have been occupied at the time of listing. Per the final rule, unoccupied critical habitat (i.e., areas essential for the conservation of jaguars outside of occupied areas) does not require the presence of all PCEs; however, it must: (1) connect an area that may have been occupied that is isolated within the United States to Mexico, either through a direct connection to the international border or through another area that may have been occupied; and (2) contain low human influence and impact, and either adequate vegetative cover or rugged terrain.

The effects of the action on designated critical habitat, including each of the primary constituent elements, are discussed below.

Overarching requirement for jaguar critical habitat

<u>Expansive open spaces in the southwestern United States of at least 100 square kilometers (37 square miles; 24,710 acres)</u>

The proposed action will permanently affect open spaces because the security fence will encircle and directly affect 3,514 acres of designated critical habitat in Unit 3; new roads, trails, and the utility ROW will directly affect an additional 499 acres (17 acres of decommissioned roads are not permanent effects). These 4,013 acres of effects represent 1.1 percent of the 351,501-acre designated critical habitat Unit 3 and 0.53 percent of all designated critical habitat rangewide (764,207 acres).

Outside of the security fence, a perimeter barbed-wire fence will be constructed to AGFD wildlife-compliant standards, but the area between it and the security fence will be subject to road, powerline, and water line construction and use (note that some of this construction is considered a permanent effect), light, noise, and prey base effects. The perimeter fence will enclose an additional 2,126 acres beyond the security fence, thus affecting a total of 6,139 acres of jaguar designated critical habitat for up to 30 years (4,013 acres of permanent effects plus 2,126 acres of temporal effects; Table J-2), with some areas potentially becoming more suitable if vegetation reclamation is successful over the long term. The area of designated critical habitat permanently affected by roads and trails remains at 499-acres (17 acres of to-be-decommissioned roads are not a permanent effect). These 6,139 acres of combined long-term and permanent effects from both fences and the associated roads, trails, and rights-of-way represent 1.75 percent of the 351,501-acre critical habitat Unit 3, and 0.80 percent of all designated critical habitat rangewide (764,207 acres).

Although the proposed action will diminish the amount of expansive open space in Unit 3, it will still contain sufficient open space to retain its function (i.e., the proposed project will not reduce the remaining size of Unit 3 to less than 100 km^2).

Primary Constituent Elements

PCE 1: Connectivity to Mexico

Connectivity to Mexico is a trait of the designated critical habitat and exists throughout each unit. Should a project be constructed such that it directly excludes any of the designated critical habitat from access by jaguars moving to or from Mexico, the areal extent of the PCE is reduced. The proposed action will permanently remove connectivity to Mexico on 3,514 acres of land that will be encircled by the security fence, which will not be permeable to large, terrestrial animals such as jaguars. The perimeter fence and the section of access road between it and the security fence will likely remove or appreciably reduce connectivity to Mexico on 2,126 additional acres for 25 to 30 years. If connectivity to Mexico is to be stated in terms of width, rather than area, the mine (measured from the edge of the perimeter fence) will narrow the northern portion of Unit 3 from its present width of 3.6 km (2.2 mi) to approximately 1.5 km (0.93 mi) (see analysis in subsequent paragraph and Figure J-8, below). Designated critical habitat will remain in place outside of the perimeter fence, north of the proposed mine, south of the Imerys Quarry, and thus our analysis must consider if connectivity to Mexico is retained in that largely indirectly-affected area.

The location of the proposed project in the northern portion of Patagonia Unit 3 would constrict the width of the northeastern portion of the unit which, in turn, could restrict the connection between Unit 3 and the Whetstone-Santa Rita Subunit 4b to the east which, as stated in the final critical habitat rule (FWS 2014), may provide connectivity from the Whetstone Mountains to Mexico via the western portion of Unit 3 (see Figure J-2). We note, however, that no jaguar has ever been documented using Subunit 4b, and that other, more direct connectivity to Mexico would be through Subunit 4c (which also does not have documented jaguar occurrence records). The mine (measured from the edge of the perimeter fence) would constrict the northern portion of Unit 3 to a strip approximately 1.5 km (0.93 mi) in width from its present minimum width of 3.6 km (2.2 mi) (see Figure J-8 below).

There are no changes to the remainder of this subsection as it appeared in the October 30, 2013, BO.

PCE 2: Adequate levels of prey species

There are no changes to this subsection as it appeared in the October 30, 2013, BO.

PCE 3: Surface water sources within 12.4 miles (20 km) of each other

There are no changes to this subsection as it appeared in the October 30, 2013, BO.

PCE 4: Madrean evergreen woodland or semidesert grassland vegetation community between greater than 1 to 50 percent canopy cover

Within the project area (as described in the BA and above) and most of the action area (as described in the BA), the vegetation community is composed of semidesert grassland and Madrean evergreen woodland. The only part of the project area not in this vegetation type is along the spine of the mountains, where some rock outcrops and talus slopes may have less than 1% cover. The area also contains moderate to highly rugged terrain. The proposed action will affect PCE 4 within the project footprint because the security fence will encircle and directly affect and remove (for the construction and operational life of the mine) 3,514 acres of designated critical habitat in Unit 3; roads and trails will directly and permanently affect an additional 499 acres.

PCE 5: Moderate to highly rugged terrain

There are no changes to the PCE 5 subsection as it appeared in the October 30, 2013, BO. The subsection regarding PCE 6, below, has been added.

PCE 6: Are below 2,000 m (6,562 ft) in elevation

The entire project area is below 2,000 m (6,562 ft) in elevation. Effects to this PCE are not anticipated, as areas will not be created that exceed 2,000 m (6,562 ft) in elevation.

PCE 7: Little human influence or disturbance

This subsection is updated from the October 30, 2013, BO as follows:

This PCE was developed using research that highlights the fact that jaguars generally avoid areas of human activity. Pursuant to the final rule, an HII of less than 20 is an essential element of PCE 7. Specifically, this PCE includes minimal to no human population density, no major roads, and no stable nighttime lighting over any 0.4-square-mile (1-km^2) area (FWS 2014). The proposed project and action areas currently have a low human density and contain no large communities. The proposed project is currently in an area with HII values between 14 and 18.

As described below, as a result of the proposed project, overall human influence and disturbance (from roads, lights, etc.) will increase, which will likely remove PCE 7 from the project area and a portion of the action area. Although the level of human influence will increase, at this time we cannot quantify the extent by which the HII will be affected due to the complicated way a number of variables interact to create HII. For example, road density is a component of HII, but we cannot determine if the existing roads in the area (e.g., the current Sycamore Canyon access road), already drive observed human disturbance to the same extent that the proposed Primary Access Road will. Similarly, although overall human influence and disturbance will increase within the areas between Imerys Quarry and the proposed action, we cannot determine the resulting value of the HII in that area.

As described above, primary and secondary access roads and the Sycamore connector road will be constructed as part of the proposed project. The physical construction of these roads and their associated traffic, as well as likely increased public access to and use of areas around the mine (due to the roads), will further contribute to increased human influence in the area, and possibly increased HII. Additionally, increased traffic on SR 83, and possible upgrades to SR 83 (as described above) and on Box Canyon will further contribute to increased human influence in the area, and possibly increased HII. Increased traffic on SR 83 may further limit jaguar access to the northeastern portion of Unit 3. Lighting from the proposed mine, as discussed in detail under the Effects of the Proposed Action on Jaguar, will result in increased horizontal lighting and sky glow in jaguar habitat, will further contribute to increased human influence in the area, and possibly result in increased HII.

The presence of a jaguar in the action area from 2012 through 2015 suggests that the amount of ambient light present is not great enough to repel the jaguar, indicating the area is currently "dark enough" for jaguars. It also suggests that the current HII is currently "low enough" for jaguars. The September 2012 camera detection of the jaguar was particularly close to the proposed mine site and was approximately 6.4 km (4 mi) away from the existing mine (Imerys). However, once the proposed action is in place, jaguars may avoid the area between the proposed mine and the Imerys mine because of the decreased width of the corridor and increased human disturbance (roads, lighting, etc.), which may further functionally narrow the corridor. Once mine operations cease, human activity and disturbance will decrease dramatically. Operating facilities and some fencing will be removed and the waste and tailings landform will be revegetated. This will reduce many of the effects described above, including nighttime lighting, noise and traffic associated with the mine.

<u>Summary of Effects to PCEs</u>

This subsection has been updated from the October 30, 2013, BO as follows:

In summary, the mine's project footprint will adversely affect all PCEs except PCE 6 (i.e., connectivity to Mexico, prey, surface water, canopy cover, rugged terrain, and little human influence, but not elevation) to some degree in the northern portion of Unit 3 for 25 to 30 years, although some of the effects will be offset to varying degrees by the proposed conservation measures. Many PCEs outside of the project footprint but within portions of the action area will also be indirectly adversely affected by the proposed project (from increased lighting, noise, traffic, human use, etc.). While the extent to which jaguars will traverse the constricted portion of Unit 3 is unknown, it is reasonable to conclude that access through this area will be hampered to some extent. We reiterate, however, that we are unable to predict whether jaguars will use this connection between the Whetstones and Santa Ritas. If jaguars will not move through the constricted area of Unit 3, then the role of Subunit 4b to the east, as defined in the final critical habitat rule (i.e., to connect Subunit 4a to Mexico via Unit 3) would be lost. That said, connectivity of Subunit 4a to Mexico would still exist via Subunit 4c. Additionally, if the constricted corridor creates a barrier to jaguar movement, the function of the northeastern portion of Unit 3 could be diminished, primarily during mining operations but less so after operations have ceased. Again, however, the remaining portion of Unit 3 (i.e., south of the mine) would still remain functional. The direct loss of critical habitat (in Unit 3) and possible indirect loss of critical habitat (in Unit 4b) will somewhat reduce the conservation value of those critical habitat units for the jaguars.

Effects to the Conservation Value of Critical Habitat with the Proposed Action

There are no changes to this subsection as it appeared in the October 30, 2013, BO.

Effects of the Action on Critical Habitat in Relation to Recovery

There are no changes to this subsection as it appeared in the October 30, 2013, BO.

Proposed Conservation Measures and Their Effects

There are no changes to this subsection as it appeared in the October 30, 2013, BO with the exception of Conservation Measure 7, below:

7. Rosemont will acquire or record restrictive covenants or conservation easements on the following parcels of land (3,064 acres total within the NRU, including 1,857 acres of jaguar critical habitat; Table J-2):

a. <u>Sonoita Creek Ranch</u>: This land will be conserved (see details in the description of the proposed action) and will provide wildlife conservation benefits as described in the conservation measures. It contains a total of approximately 1,580 acres of semidesert grassland, Madrean evergreen woodland, and riparian habitat along upper Sonoita Creek and includes surface water rights that support two perennial ponds and associated riparian vegetation. A total of 1,328 acres of the Ranch occur within jaguar critical habitat. Sonoita Creek Ranch will be managed for conservation purposes to provide habitat and connectivity for jaguars and ocelots between the Canelo Hills/Patagonia Mountains and the Santa Rita Mountains, slightly over a mile away to the west of the ranch, in perpetuity. The southern portion of the ranch has been identified by the Arizona Wildlife Linkages Workgroup and the Arizona Missing Linkages Corridor design as a likely corridor between these two CNF land blocks. We assume in our analysis that managing for connectivity between the Canelo Hills/Patagonia Mountains and the Santa Rita Mountains as stated above includes ensuring that jaguars can safely cross Highway 82, which runs between these mountain ranges, using crossings (e.g., underpasses or overpasses and associated fencing) appropriate for large cats. If this is not the case, connectivity between Canelo Hills/Patagonia Mountains and the Santa Rita Mountains will not be achieved. We provided suggested conservation measures to address connectivity between the Santa Rita and Patagonia Mountains; however, these measures were not incorporated into the Rosemont Mine proposed action.

b. <u>Davidson Canyon Watershed Parcels</u>: Rosemont will record a restrictive covenant or conservation easement on these parcels. These properties consist of six parcels on the eastern side of the Santa Rita Mountains and total approximately 545 acres of semidesert grassland and associated xero- or mesoriparian habitat. All but one of these parcels are within jaguar critical habitat (a total of 527 acres within critical habitat). These will be included as available land for the establishment of water features beneficial to listed species such as jaguars.

c. <u>Helvetia Ranch North</u>: Rosemont will record a restrictive covenant or conservation easement on these parcels which contain approximately 939 acres of semidesert grassland on the west side of the northern Santa Rita Mountains near the proposed project's infrastructure corridor. There are approximately 21 acres of jaguar critical habitat on the far southeastern portion of these parcels. These will be included as available land for the establishment of water features beneficial to listed species such as jaguars.

Summary of Effects of the Action

Jaguar

The proposed project will directly and indirectly affect jaguars and jaguar habitat within the Borderlands Secondary Area of the NRU. The proposed action will result in an up to 30-year temporal loss of up to approximately 16.2 to 38.6 percent of a jaguar home range. The proposed action will result in a permanent loss of up to approximately 10.9 to 26.0 percent of a jaguar home range. Lesser effects may be anticipated as reclamation activities proceed and successfully reestablish sufficient permanent canopy cover; permanent habitat losses will then be largely due to the security-fenced area and pit.

The mine will also permanently reduce the abundance of jaguar prey, estimated by AGFD (2012) to amount to 14 white-tailed deer and 56 collared peccary (javelina), both key prey species for jaguar. However, this habitat loss will be partially offset by Rosemont's conservation commitment to protect 3,064 acres of land within the NRU (including 1,857 acres of jaguar critical habitat) in perpetuity.

There are no changes to the remainder of this subsection as it appeared in the October 30, 2013, BO.

Designated Jaguar Critical Habitat

1. Direct loss of designated critical habitat due to the proposed project footprint:

The security fence will encircle and directly affect 3,514 acres of designated critical habitat in Unit 3; the direct effects of new roads, trails, and the utility ROW bring the total affected area to 4,013 acres. These 4,013 acres of effects represent 1.1 percent of the 351,501-acre designated critical habitat Unit 3 and 0.53 percent of all designated critical habitat rangewide (764,207 acres).

The perimeter fence will enclose an additional 2,126 acres beyond the security fence, thus affecting a total of 5,640 acres of jaguar critical habitat for up to 30 years, with some areas potentially becoming more suitable if vegetation reclamation is successful over the long term. The addition of road, trail, and utility ROW effects brings the affected area to 6,139 acres of combined long-term and permanent effects, which represents 1.75 percent of critical habitat Unit 3, and 0.80 percent of all critical habitat rangewide. Conservation lands (totaling 3,064 acres), however, will be protected and managed in perpetuity within the NRU, including 1,857 acres of jaguar critical habitat, and therefore will offset some of this habitat loss.

2. Indirect effects to critical habitat and reduced connectivity due to the proposed project:

As described above, the location of the proposed project in the northern portion of Patagonia Unit 3 will likely restrict connectivity between Patagonia Critical Habitat Unit 3 and the Whetstone-Santa Rita Subunit 4b to some unknown extent, particularly during mining operations but less so after these operations have ceased. The latter unit, according to the final rule, provides connectivity from the Whetstone Mountains to Mexico through Unit 3 (see Figures J-2 and J-3). We do not have enough information on the ability of jaguars to move through habitat affected by human influence in Arizona to determine definitively whether or not a jaguar will move through the constricted corridor between the mines. However, if jaguars will not move through the constricted portion of northeastern Unit 3, then the functional role of Subunit 4b, as defined in the final critical habitat rule (i.e., to connect Subunit 4a to Mexico via Unit 3), would be removed. That said, connectivity of Subunit 4a to Mexico would still exist via Subunit 4c. Additionally, if the constricted corridor area creates a barrier to jaguar movement, the function of the northeastern portion of Unit 3 (i.e., the portion of Unit 3 from the constricted corridor to the western boundary of Subunit 4b) would also be diminished. Again, however, the remaining portion of Unit 3 (i.e., south of the mine) would still remain functional. Further, Rosemont's permanent protection of 1,857 acres of private lands within critical habitat will further protect connectivity within critical habitat.

3. Effects to recovery:

By definition, critical habitat is habitat determined to be essential for the conservation (i.e., recovery) of the species. Adverse effects to some of these limited critical habitat areas and to one potential pathway from the Whetstones to Mexico, as may occur during mining operations as described above, but less so after these operations have ceased, somewhat reduces the ability of critical habitat and the northernmost secondary area (i.e., the Borderlands Secondary Area) to contribute to the recovery of jaguars in the NRU. That said, the majority (758,068 acres or 99.2 percent of all critical habitat rangewide, taking only into consideration the direct impacts to critical habitat) of designated critical habitat will remain unaffected and therefore retain its ability to contribute to jaguar recovery in the NRU. Additionally, although some recovery objectives for the jaguar may be affected by the proposed project, it is unlikely that the level of the effect will lead to measurable delays in the recovery of jaguars within the NRU because the majority of the jaguar population, including two important Core Areas, in the NRU occurs outside of the United States and will not be directly affected by the proposed project.

4. Effects to conservation:

This partial loss of function of Unit 3 and possible reduction in function of Subunit 4b will somewhat diminish the conservation value of designated critical habitat as a whole during mining operations, but less so after these operations have ceased. As explained above, areas that provide the primary constituent elements essential to jaguar habitat are limited within the U.S. and therefore have an important conservation role for the jaguar. Adverse effects to portions of these areas (i.e., designated critical habitat areas), as are likely to occur as a result of the proposed action, reduce the ability of jaguar critical habitat to function as intended by the final rule. That said, the vast majority of designated critical habitat will be unaffected by the proposed action and will therefore retain its function and conservation value. Further, the effects of the proposed action on the designated critical habitat will not considerably reduce the capability of jaguar critical habitat to be used in a way such that research, census, law enforcement, habitat acquisition and maintenance, propagation, live trapping and transplantation, and other similar conservation measures are precluded.

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 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.

Critical Habitat Units 3 and 4 are closer to rapidly expanding urban areas than any other units and therefore more vulnerable to loss of connectivity. Tucson, Patagonia, and Sierra Vista are all expanding populations with increasing land development. On the eastern flank of the Whetstone Mountains near Benson is the proposed development of Las Villages de Vignetto, which may house 80,000 people in 24,000 homes. Immediately southwest of the Mustang Mountains (Subunit 4c) is the proposed Rain Valley development. On the other (east) side of the Mustang Mountains, the community of Huachuca City is poised for additional development with the impending completion of a new wastewater treatment plant. The proposed Villages at Vignetto near Benson could result in approximately 8,000 to 15,000 acres of suburban development east of the Whetstone Mountains. Subunit 4b, through the Empire Mountains, lies between growth both to the north (Tucson) and the south (Patagonia and Sonoita). The aforementioned actions, the effects of which are considered to be cumulative, may result in fragmentation, loss, or degradation of jaguar habitat and disturbance to jaguars. Although not documented recently in the U.S., illegal hunting of jaguars adversely affects the species. 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.

CONCLUSIONS - JAGUAR

Jaguar

After reviewing the current status of the jaguar, the environmental baseline for the action area, the effects of the proposed action, and the cumulative effects, it is our opinion that the Rosemont Copper Mine, as proposed, is not likely to jeopardize the continued existence of the jaguar. Pursuant to 50 CFR §402.02, “jeopardize the continued existence of” means to engage in an action that reasonably would be expected, directly or indirectly, to reduce appreciably the likelihood of both survival and recovery of a listed species in the wild by reducing the reproduction, numbers, or distribution of that species. We base this conclusion on the following:

1. Jaguars range from southern U.S., i.e., Arizona and New Mexico, to south America, i.e., Argentina, Belize, Bolivia, Brazil, Colombia, Costa Rica, Ecuador, French Guiana, Guatemala, Guyana, Honduras, Mexico, Nicaragua, Panama, Paraguay, Peru, Suriname, Venezuela (Swank and Teer 1989, Caso *et al.* 2008). Permanent habitat loss (assuming a 5,411-acre (8.5-mi^2) area) from the proposed action will affect a miniscule amount of habitat from this global perspective. The proposed action’s effect to the 15.1 million km^2 (5.8 million mi^2) combined NRU and Pan-American Recovery Units, which encompass the entire range of the jaguar, is small, at 1.4×10^{-6} percent. The effects of habitat loss are also small at the recovery unit scale. According to Table J-1, the proposed action will permanently affect approximately 0.01 percent of the 65,967 mi^2 of jaguar habitat within the NRU, approximately 0.07 percent of the 11,483 mi^2 of jaguar habitat within the Borderlands Secondary Area, and 0.3 percent of the 2,641 mi^2 of jaguar habitat within the in the U.S. portion of the Borderlands Secondary Area.

2. Only one jaguar will likely be incidentally taken via harassment under the proposed action, and there are an estimated 30,000 jaguars throughout the species' range. Sanderson and Fisher (2013) estimate a carrying capacity of 6 jaguars in the U.S. portion of the Borderlands Secondary Area, 43 jaguars in the entire Borderlands Secondary Area, and 3,414 jaguars within the NRU; actual population numbers are unknown.

3. 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 Rosemont Copper mine will not have an appreciable impact on the population at the rangewide, NRU-specific, or Borderlands Secondary Area-specific scales. 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.

Critical Habitat

Legal Standards and Definitions

As stated in the introductory paragraphs of this BO, we published a final rule on February 11. 2016 (81 FR 7214), revising the definition for destruction or adverse modification of critical habitat the Act's implementing regulations at 50 CFR 402.02. Specifically, we finalized the following regulatory definition: "Destruction or adverse modification means a direct or indirect alteration that appreciably diminishes the value of critical habitat for the conservation of a listed species. Such alterations may include, but are not limited to, those that alter the physical or biological features essential to the conservation of a species or that preclude or significantly delay development of such features." This revised definition has been applied to the jaguar critical habitat analysis in this consultation. The revised definition also supersedes the October 30, 2013, Final BO's and November 30, 2015, Draft BO's reliance 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), which we used, at those times, to complete our analyses with respect to critical habitat.

There are otherwise no changes to this subsection as it appeared in the October 30, 2013, BO.

Therefore, following guidance from each of these four sources and considering the effects noted above, it is our opinion that implementation of the proposed action will not likely destroy or adversely modify designated critical habitat. We base this conclusion on the following rationale:

Habitat Loss

1. Although the proposed action will result in the direct loss of critical habitat in Unit 3, the majority of Unit 3 will retain its PCEs and function. The security fence and roads will permanently remove 4,013 acres of critical habitat in Unit 3. These 4,013 acres of permanent effects represent 1.1 percent of critical habitat Unit 3 and 0.53 percent of all critical habitat rangewide. The additional 2,126 acres surrounded by the perimeter fence brings the long-term (25-30 years) effects to 6,139 acres, which represents 1.75 percent of critical habitat Unit 3, and 0.80 percent of all critical habitat rangewide. Further, proposed conservation measures will permanently protect 1,857 acres within designated critical habitat that could otherwise be subject to development or other adverse

effects. This provides an offset of 30 to 46 percent to the critical habitat expected to be lost.

2. If the constriction of the designated critical habitat between the proposed Rosemont Mine and Imerys Quarry render the northeastern portion of Unit 3 inaccessible (but see discussion below), an additional 32,992 acres of Unit 3 would be removed from its function in jaguar conservation. The perimeter fence, roads, and utility ROW will affect 6,139 acres of critical habitat for the long term (25 to 30 years). Adding this acreage to that of the inaccessible portion of Unit 3, the areal extent of the long-term loss of designated critical habitat containing all the PCEs to support jaguars would be 36,131 acres. This would constitute approximately 11.1 percent of Unit 3 and 5.1 percent of all critical habitat rangewide. Adding the acreage of the inaccessible portion of Unit 3 to the 4,013 acres of designated critical habitat in which all PCEs are permanently affected by the security fence and roads brings the total impact to 37,005 acres. This would constitute a permanent loss of 10.5 percent of Unit 3 and 4.8 percent of all critical habitat rangewide. Both the long-term and permanent hypothetical losses are partially offset by the aforementioned permanent protection of 1,857 acres of conservation lands within jaguar critical habitat. Although the proposed action could potentially cause long-term and permanent, direct and indirect losses of function in Unit 3, function would be retained in 88.9 (long-term) to 89.5 (permanent) percent of Unit 3 and in 94.9 (long-term) to 95.2 (permanent) percent of all designated critical habitat.

3. If the lost function of northeastern Unit 3 analyzed in Item 2, above, removed the connectivity-to-Mexico role of the 12,710-acre Subunit 4b and also rendered the 62,479-acre Subunit 4a inaccessible via northeast Unit 3, the resulting 75,189-acre loss of function would represent an additional 9.8 percent of the overall designated critical habitat (8.2 percent in Subunit 4a, 1.7 percent in Subunit 4b). We note, however, that connectivity to Mexico for Subunit 4a exists through Subunit 4c and the southeastern portion of Unit 3 in the Huachuca Mountains, regardless of the potential functional loss of Subunit 4b.

4. When the 6,139 acres occupied by the perimeter fence, roads, trails, and utility ROW are added to the potential for a functional losses of 32,992 acres of northeastern Unit 3 and all of the 12,710-acre Subunit 4b (as in Items 2 and 3, above), there would be a 51,841-acre long-term loss of function within the 364,211-acre combined area of Unit 3 and Subunit 4b. Considering the 4,013-acre security-fenced area and roads, there would be a 49,715-acre permanent loss of function to the combined area of Unit 3 and Subunit 4b. Under these hypothetical scenarios, function would be retained in 85.8 to 86.3 percent of the combined acreage of Unit 3 and Subunit 4b and in 93.2 to 93.5 percent of all designated critical habitat. We reiterate that connectivity to Mexico for Subunit 4a exists through Subunit 4c and the southeastern portion of Unit 3 in the Huachuca Mountains, regardless of the potential functional loss of Subunit 4b. We again note that both the long-term and permanent potential losses would be partially offset by the aforementioned permanent protection of 1,857 acres of conservation lands.

5. When the 6,139 acres occupied by the perimeter fence, roads, trails, and utility ROW are added to the potential for a functional losses of 32,992 acres of northeastern Unit 3, the 62,479-acre Subunit 4a, and the 12,710-acre Subunit 4b (as in Items 2 and 3, above), there would be a 114,320-acre long-term loss of function within the 426,690-acre combined area of Unit 3 and Subunits 4a and 4b. Considering the 4,013-acre security-fenced area and roads, there would be a 112,194-acre permanent loss of function to the combined area of Unit 3 and Subunits 4a and 4b. Under these

hypothetical, worst-case scenarios, function would be retained in 73.2 to 73.7 percent of the combined acreage of Unit 3 and Subunits 4a and 4b and in 85.0 to 85.3 percent of all designated critical habitat. We reiterate that connectivity to Mexico for Subunit 4a exists through Subunit 4c and the southeastern portion of Unit 3 in the Huachuca Mountains, regardless of the potential functional loss of Subunit 4b, and that both the long-term and permanent potential losses would be partially offset by the aforementioned permanent protection of 1,857 acres of conservation lands.

Effects to Jaguar Movement

In order to reach a conclusion that the proposed action is "likely" to result in destruction or adverse modification of critical habitat, the analysis would have to show a "high probability" for ***each*** of the following: (1) that the jaguar would be unable to traverse the constricted area in Unit 3 and access Subunit 4b; (2) that such a preclusion would render Subunits 4b and 4a inaccessible to jaguars and/or preclude connectivity between the U.S. and Mexico; and (3) that both of those results would preclude or significantly diminish the conservation value of designated critical habitat for jaguar recovery. It is our opinion that the standard of "highly probable" is not met for any of these arguments singly, l*et al*one all of them combined.

1. Our analysis makes a plausible argument that jaguar movement between units 3 and 4b will become somewhat restricted, but does not reach the level that such movement will likely be precluded. Known male jaguars have been documented as having traveled widely around southern Arizona in recent years, apparently despite the presence of numerous roads, lit areas, and other human disturbances. Even if movement through the constricted corridor were completely blocked, our analysis would have to show that precluding such movement would appreciably reduce the functionality of the array of designated critical habitat. Two arguments might be made in this regard: that both units 4a and 4b will become inaccessible to jaguars if movement through the 1.5-km strip is curtailed, thus removing another 9.8 percent of critical habitat (8.2 percent in 4a, 1.7 percent in 4b) (see Item 3 in Habitat Loss analysis, above); and that preclusion of this connectivity will significantly impair jaguar movement into and out of Mexico. Neither of these arguments is adequately supported by the best available information. Further, we have analyzed three other hypothetical combinations, including: (1) the loss of function in Subunits 4a and 4b (see Item 3 under Habitat Loss section, above); (2) the effects of the action, the loss of function in Unit 3 and Subunit 4b (see Item 4, above); and (3) the effects of the action, the loss of function in Unit 3 and Subunits 4a and 4b (see Item 5, above). These hypothetical, and increasingly worst-case effects, are similarly unsupported by the best available information.

No change to the remainder of this subsection.

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.

The measures described below are non-discretionary, and must be included by the USFS as binding conditions of any grant or permit issued to the applicant, as appropriate, for the exemption in section 7(o)(2) to apply. The USFS has a continuing duty to regulate the activity that is covered by this Incidental Take Statement. If the USFS (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 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, the USFS, or the applicant 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

Confirmed detections of the presence of one jaguar have occurred within the action area as recently as August 2015. The most recent detections were from trail cameras placed by researchers from the University of Arizona, originally as part of a jaguar and ocelot survey and monitoring project funded by the FWS and the Department of Homeland Security, but now as part of a citizen science initiative. All detections were located on lands administered by the Coronado National Forest and are of a single male jaguar. One of the earlier detections (from a resident hunter) was from a trail camera located to the west of and adjacent to the proposed project area. Thus, incidental take in the form of harassment of a jaguar is likely to occur because trail cameras have detected a male jaguar within the area subject to direct and/or indirect effects of the proposed project (the action area).

Incidental take of one jaguar over the life of the project in the form of harassment is anticipated for the following activity:

1. Disturbance of jaguars due to construction, operation, and restoration of the mine and associated roads which disrupts normal behavior patterns which include, but are not limited to, breeding, feeding or sheltering. Construction and operation of the mine is anticipated cause jaguars to shift home range location and travel longer distances, possibly through less suitable habitat. Extra travel would require jaguars to expend additional energy and increase the potential for encounters with humans, vehicles, potential competitors, and other stresses.

We anticipate the above anticipated incidental take will be difficult to detect. However, monitoring and reporting requirements will allow us to assess the effects of proposed project activities on jaguars. In addition, Rosemont will report to us any mortality or injury of jaguars due to collisions with vehicles or other activities. The amount of anticipated incidental take will have been exceeded, triggering a requirement for reinitiation (50 CFR §402.16[c]) if, for example:

1. Based on the annual and emergency reporting on the status of the proposed project:

a. A jaguar is injured or killed through collision with a vehicle(s) associated with the proposed project;
b. Unanticipated events occur that are attributable to the proposed action (e.g. toxic spills or plumes, wildfires, landslides) that are reasonably certain to have resulted in take; or
c. Additional jaguar(s) are documented in the action area and those jaguar(s) are reasonably certain to be taken by the proposed action. Presence of additional jaguar(s) in the action area will not necessarily result in take being exceeded; however, if additional jaguar(s) are detected in the action area, the Forest Service and FWS will immediately discuss the situation and determine if reinitiation is required.

In summary, and stated differently, the maximum allowable incidental take of jaguar is the harassment of one individual.

Effect of the Take

We conclude that this level of anticipated take is not likely to result in jeopardy to the jaguar, for the effects are not expected to appreciably reduce the survival and recovery of the species. The jaguar's range consists of about 11.7 million km^2 from southern United States all the way to Argentina. Also, there are about 30,000 jaguars in the wild. Therefore, take of one jaguar in the form of harassment in the U.S. will not jeopardize the species.

REASONABLE AND PRUDENT MEASURES - JAGUAR

The FWS believes the following Reasonable and Prudent Measures are necessary and appropriate to minimize impacts of incidental take of jaguar:

1. Minimize the effects of disturbance from noise and roads to the jaguar.
2. Monitor jaguars in the area of the Santa Rita Mountains described in Term and Condition Number 2.
3. Monitor incidental take resulting from the proposed action and report to the FWS the findings of that monitoring.

TERMS AND CONDITIONS - JAGUAR

To be exempt from the prohibitions of section 9 of the Act, the Forest Service shall ensure that Rosemont complies 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 Conditions implement Reasonable and Prudent Measure Number 1:

a. The USFS and Corps shall ensure that Rosemont Copper Company minimizes road-related noise, especially at night, through the use of techniques such as avoiding, to the extent practicable (i.e., that allows for safe driving conditions), horn use and "Jake-braking" (the use of an engine's compression combined with downshifting the transmission to slow a vehicle). Compliance with this Term and Condition may be demonstrated by placing signs advising vehicle operators to not employ “Jake-brakes” at both ends and the midpoint of the primary access road.

b. The USFS and Corps shall ensure that Rosemont Copper Company limits speeds on the primary and secondary access roads and the Sycamore connector road to no more than 25 miles per hour and employ the use of wildlife crossing signs. Speed limits will be made known to employees and contractors during safety training or equivalent and via the use of speed limit signs. Compliance with this term and condition may be demonstrated by placing speed limit signs in appropriate locations. Compliance may also be demonstrated by placing signs cautioning vehicle operators of the presence of wildlife both at ends and the midpoint of the primary access road and at any other locations determined necessary by the USFS Biological Monitor (while implementing the wildlife movement-related Conservation Measure).

2. The following Term and Condition implements Reasonable and Prudent Measure Number 2:

The USFS and Corps shall ensure that Rosemont conduct (or provide funding to conduct) jaguar surveys and monitoring for the life of the proposed mine and for 5-years post-closure. Jaguar surveys and monitoring shall be conducted by a contractor with expertise in large felid survey and monitoring, sampling design, GIS, and data analysis. Objectives of the survey and monitoring project include, but are not limited to the following: (1) determine if the male jaguar previously detected near the proposed mine continues to use the area; (2) determine if additional jaguars are present in the vicinity of the mine; (3) gather basic information on jaguar movement and habitat use patterns in the vicinity of the mine, including, if possible, determining travel routes; and (4) enable operations to take into account the presence of jaguars in the immediate vicinity. The exact design, scope, and location of the survey and monitoring project will be determined in the survey and monitoring plan and updated as needed to gather the best possible information on jaguars.

Unless another survey and monitoring design of equal or lesser effort is determined to be potentially more scientifically effective (i.e., to allow for the best scientific information possible to be obtained), surveys and monitoring will be conducted for the first five years in a 200 km^2 area of jaguar proposed critical habitat roughly centered on the perimeter fence of the mine. Jaguars detected in this area will then be subject to focused monitoring. We note that 200km^2 is the largest home range (obtained via radio-telemetry) documented from the northern portion of the species range by Rosas-Rosas and Bender (2012) (see Home Range and Movement section, above). After five years, FWS (in coordination with AGFD), USFS, and Rosemont will meet to discuss and determine if the existing survey and monitoring design should be continued with the same level of effort, or if a new design with a similar level of effort should be employed; the goal of either effort will be to continue to obtain the best information possible on jaguars in the action area. Rosemont shall implement the new survey and monitoring design, if warranted, for the life of project plus 5-years post-closure, unless another design of equal or lesser effort is determined to be more effective.

All jaguar detections will be reported to FWS and AGFD within 24 hours.

Jaguar survey and monitoring must commence prior to significant surface disturbance. Jaguar survey and monitoring will be conducted through non-invasive means, including, but not limited to the use of trail cameras, and/or scat-detection dogs. Prior to the commencement of any field work: (1) a survey and monitoring plan (draft and final) will be submitted to and approved by the FWS and other entities (AGFD in particular); and (2) all necessary permits will be obtained, copies of which must be sent to FWS and other entities as applicable.

The survey and monitoring plan will include, among other information: (1) the objectives; (2) a detailed description of survey and monitoring methods and analysis techniques to be employed, including the location and spatial array of paired cameras, track plots, or scat-detection dog transects, and frequency with which photos will be downloaded and viewed (at least monthly), track plots read, or scat-detection transects run; (3) a communications plan that explains, among other things, how jaguar detections will be relayed to the FWS, AGFD, and the general public; and how media requests will be handled; (4) reporting format and schedule (reporting will include draft and final reports, as well as monthly updates); and (5) qualifications of the survey and monitoring team. All aspects of the plan and implementation of the plan (including, but not limited to, who will conduct the survey and monitoring, how the survey and monitoring will be conducted, and when reports will be due) must be coordinated with FWS (in coordination with AGFD) and approved by FWS. Additionally, all survey and monitoring efforts must be coordinated with the FWS (in coordination with AGFD), USFS, other entities, affected land owners and managers, and other parties determined to be appropriate by the FWS.

The aforementioned survey and monitoring effort expands on the Conservation Measure in the Description of the Proposed Action of the BA which states “Rosemont will provide $50,000 to AGFD or other suitable entity approved by the CNF to support camera studies for large predators including jaguar and ocelot. The money will be provided for additional monitoring efforts between the Santa Rita and the Whetstone Mountains and along the Santa Rita Mountains. In addition to increasing knowledge regarding the movement of wildlife in the area, information collected during this investigation may identify a suitable wildlife crossing structure location.” Please note that AGFD has requested that the agency not be referred to within task-oriented conservation measures; it only appears here due to the agency name appearing in quoted text. Reasonable and Prudent Measure Number 2 is required because the $50,000 camera study identified in the Conservation Measures is a small fraction of funding needed to conduct jaguar surveys and monitoring for the life of the proposed mine, and 5-years post-closure. To reduce survey and monitoring redundancy and possible disturbance to jaguars in the area, this Conservation Measure and the aforementioned survey and monitoring effort should be conducted by the same entity.

3. The following Term and Condition implements Reasonable and Prudent Measure Number 3:

To monitor incidental take resulting from the proposed action, the USFS and Corps shall ensure that Rosemont monitors the impacts of the action as they relate to jaguar and that Rosemont reports these to the FWS for the life of the project. A report will be due to the FWS annually on December 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 email and telephone.

In summary, the FWS believes that no more than one jaguar 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 the impact of 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 reinitiation of consultation and review of the reasonable and prudent measures provided. USFS must immediately provide an explanation of the causes of the taking and review with the FWS-AESO the need for possible modification of the reasonable and prudent measures.

CONSERVATION RECOMMENDATIONS - JAGUAR

1. Further minimize the effects of night lighting and noise within the action area by:

    a. Minimizing the light levels and the distance light emanates from the project site through the use of techniques such as decreasing the use of bright lights, employing methods to deflect lights coming out of project site, and minimizing the lights coming from buildings at the project site;

    b. Coordinating the aforementioned Conservation Recommendations with FWS and other entities before the measures are employed.

2. Support jaguar recovery through implementing and/or funding priority recovery actions for the jaguar as determined by the Jaguar Recovery Team.

3. Provide funding to contribute toward the conservation and management of unprotected/undeveloped lands for wildlife connectivity in the wildlife corridor referred to as Strand B in the Patagonia-Santa Rita Linkage Design (Beier *et al*. 2008) or the wildlife corridor determined by the USFWS to be the best biological corridor for wildlife connecting the Santa Rita and Patagonia Mountains.

4. Provide funding to contribute toward the conservation and management of unprotected/undeveloped lands for wildlife connectivity in the best biological corridor for wildlife connecting the Santa Rita and Whetstone Mountains.

5. Provide funding to contribute to researchers' efforts to evaluate and enhance existing and/or construct new wildlife crossings (e.g., wildlife overpasses or underpasses and associated fencing) along and across Highways 82 and 83. These crossings would improve connectivity between the Santa Rita and Patagonia Mountains and the Santa Rita and Whetstone Mountains, respectively. To be effective, at least four wildlife crossings should be located along Highways 82 and 83 based on studies of carnivore movement in the area.

6. Provide funding to FWS for a full-time Fish and Wildlife Biologist for the life of the project to assist in study design, and to track the implementation of all conservation measures and adherence to all terms and conditions of this Final BO.

7. Protect jaguar habitat and corridors in the NRU in Sonora to allow for expansion of jaguars from the nearest core area into the U.S. and help offset the partial loss of function of Jaguar Critical Habitat Units 3 and 4a.

Figure J-1: Northwestern Jaguar Recovery Unit.

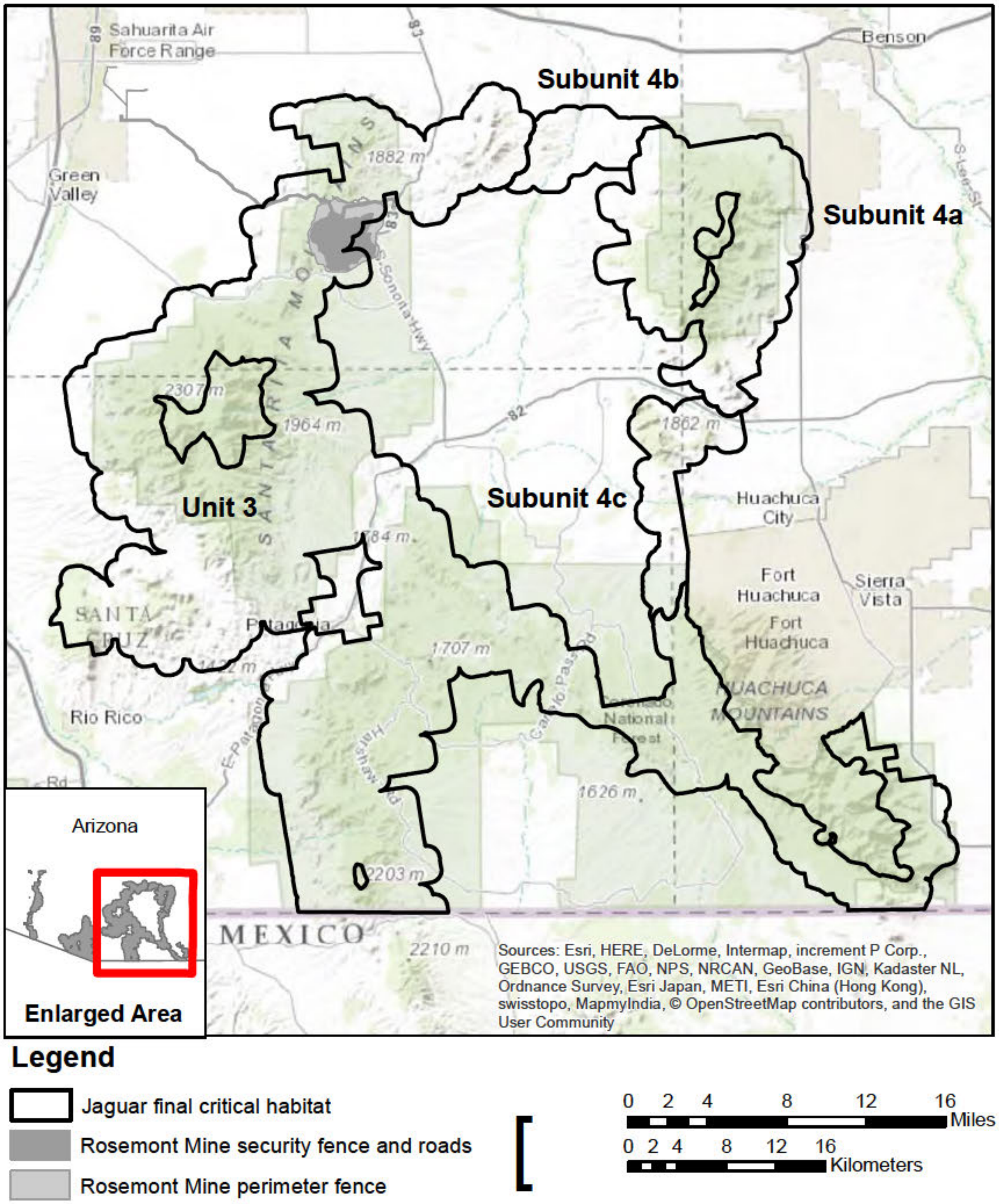

Figure J-2: Map showing the proposed action within designated jaguar critical habitat Unit 3 in relation to Critical Habitat Unit 4 (Subunits a, b, and c).

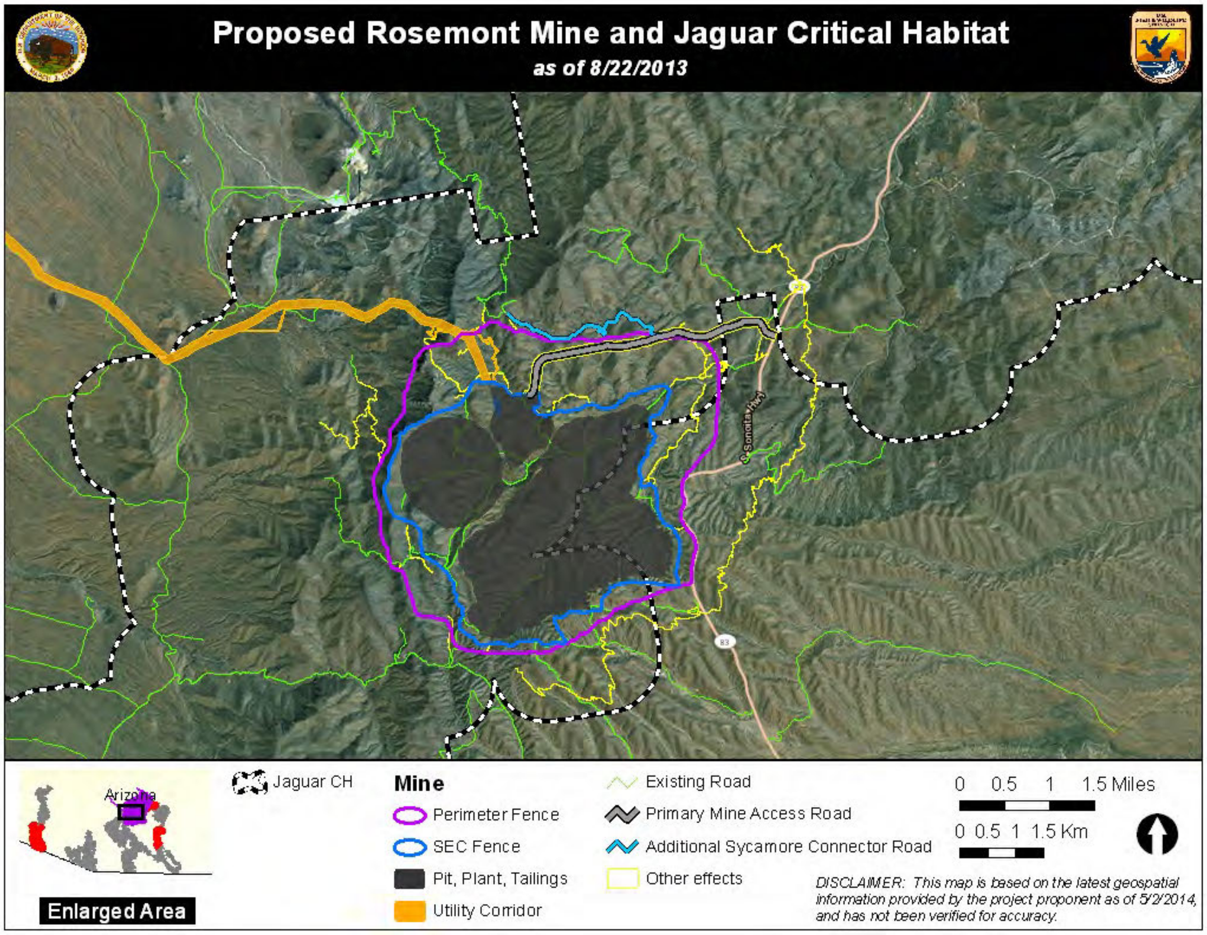

Figure J-3: Proposed Rosemont Mine Project and Jaguar Critical Habitat. Note the "Enlarged Area" shows revised proposed critical habitat for the jaguar, which is identical to final designated critical habitat in this area.

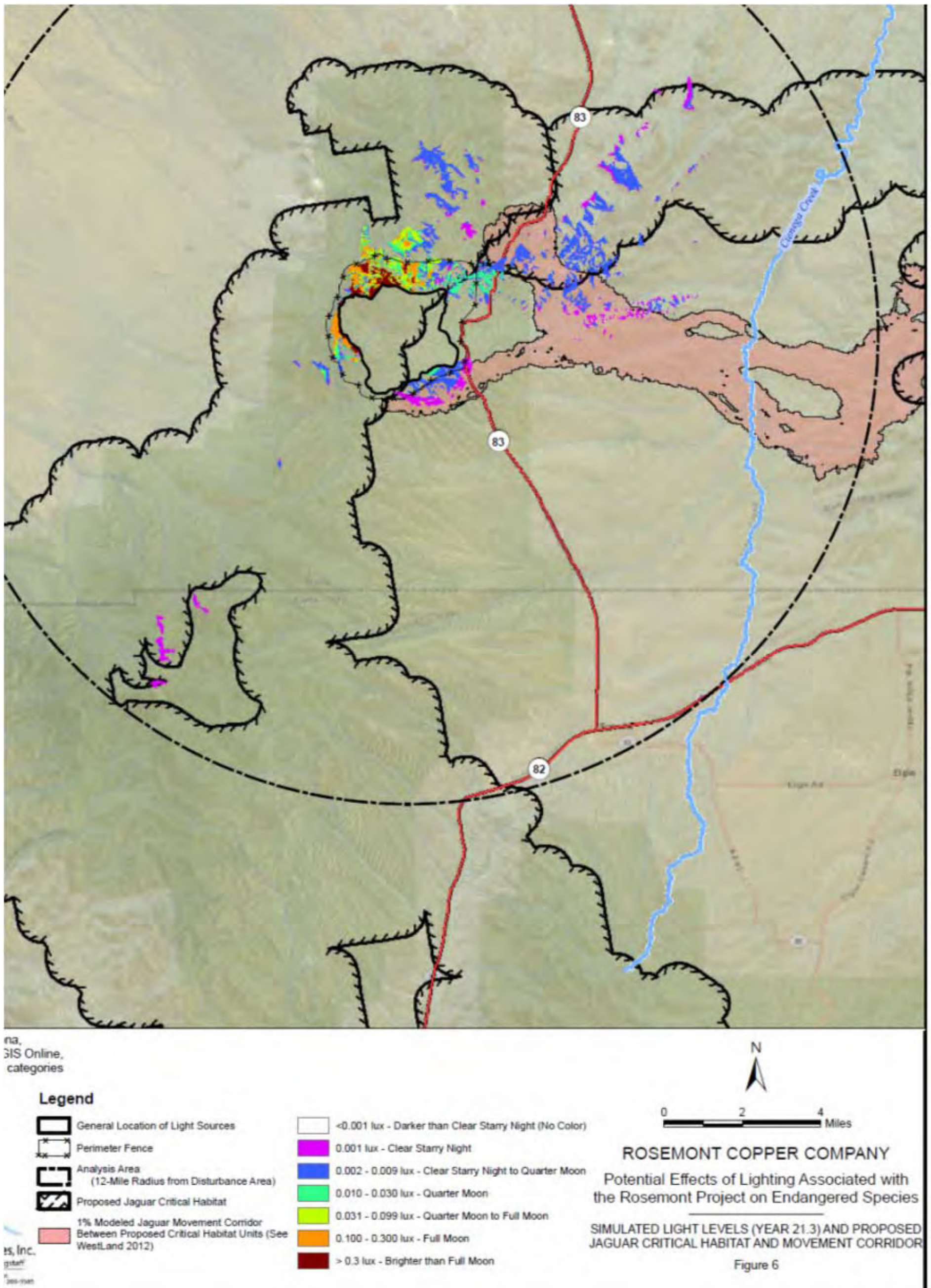

Figure J-4: Simulated light (horizontal) levels as a result of the proposed Rosemont Mine project in relation to jaguar critical habitat (Figure 6 of WestLand Resources Inc, 2012). Please note that this map uses a version of the proposed critical habitat boundaries superseded by the March 5, 2014, final rule (79 FR 12572).

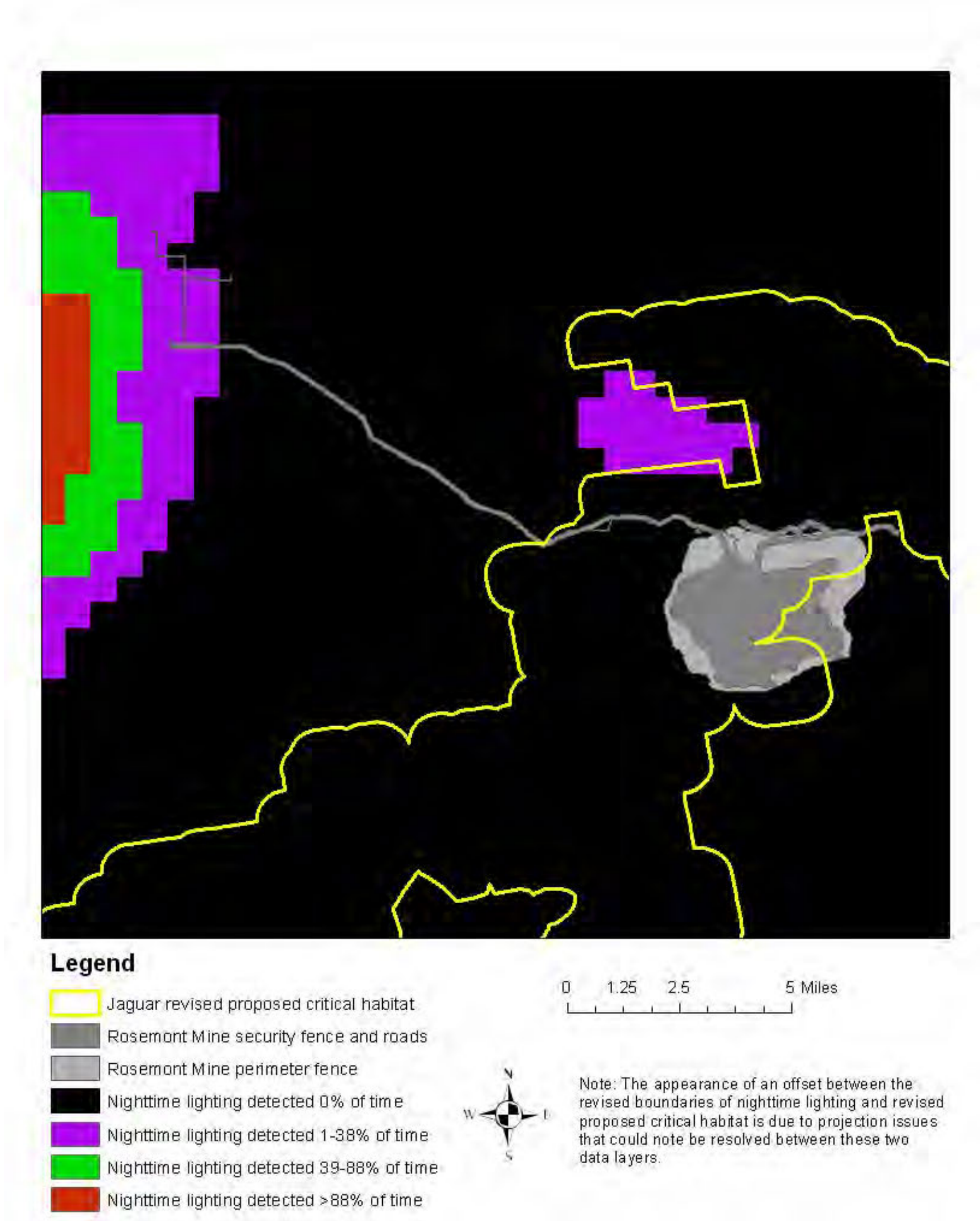

Figure J-5: Map showing nighttime lighting (based on data provided to FWS by the Wildlife Conservation Society) from the current Imerys Quarry (purple area) in relation to the proposed Rosemont mine and designated jaguar critical habitat. Note that Figures J-6 and J-7 appear only in the October 30, 2013, Final BO.

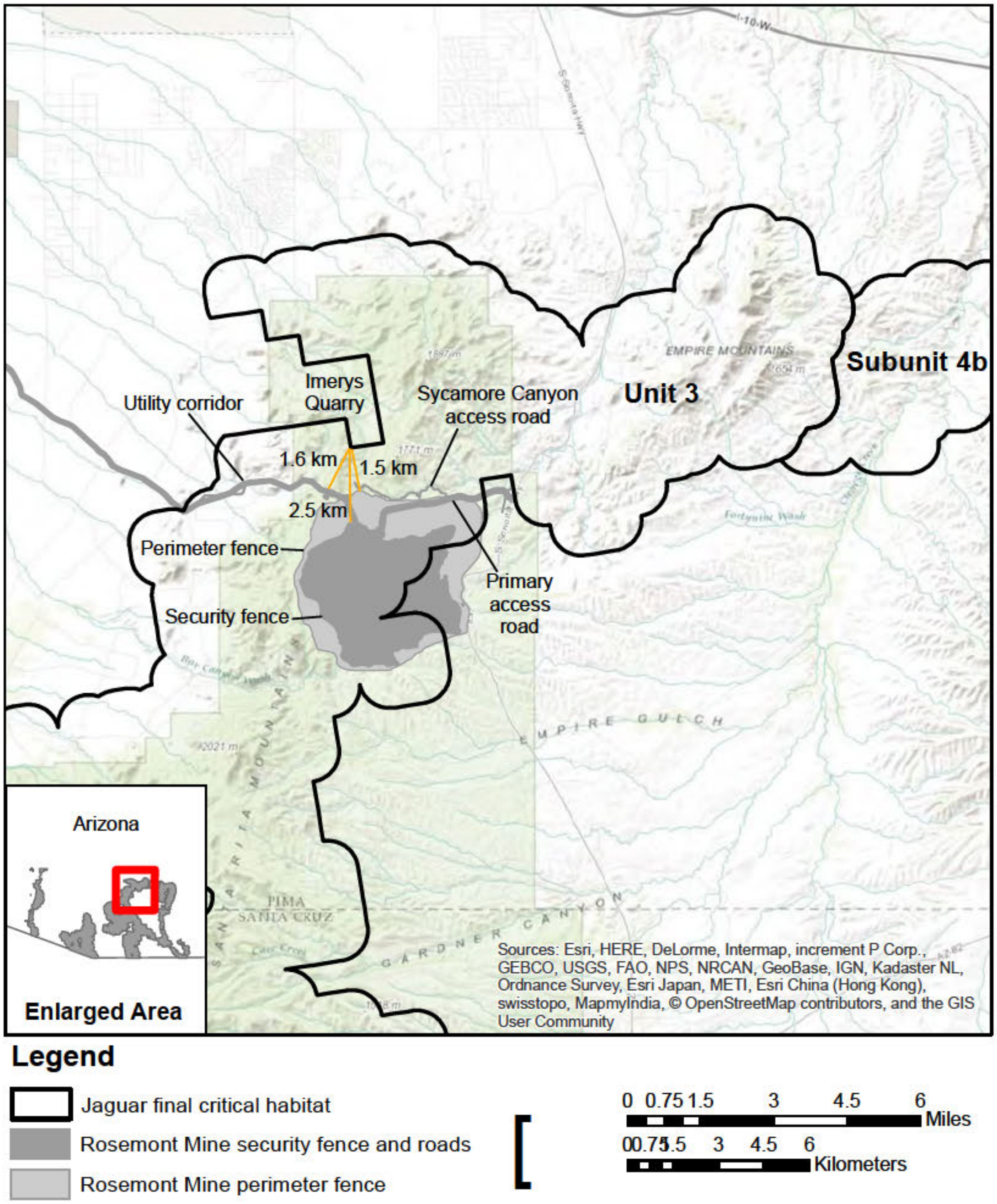

Figure J-8: The proposed action within jaguar critical habitat Unit 3 and the narrowest distances between the perimeter fence (1.5 km), security fence (2.5 km), and utility corridor (1.6 km) of the proposed action and the edge of critical habitat. Note that the area of the northeastern portion of Unit 3 between the 1.5-km line and the western boundary of Subunit 4b is 32,992 acres (13,351 hectares). Note that Figures J-6 and J-7 appear only in the October 30, 2013, Final BO.

OCELOT

Status of the Species - Ocelot

Description, Legal Status, and Recovery Planning

There have been no changes to this section as it appeared in the October 30, 2013, BO. The prior narrative is incorporated herein via reference.

Life History and Habitat

As stated in our last biological opinion, no home range studies have been done for ocelots in Arizona or northwestern Mexico. Recently, however, Culver *et al.* (2015) estimated minimum observed ranges for ocelots in Arizona and Sonora. The average minimum observed range of three Arizona ocelots was 30.09 km² (11.62 mi²), with minimum observed ranges ranging from 7.76 to 63.40 km² (3.00 to 24.48 mi²). The average minimum observed range of 9 Sonora ocelots was 11.75 km² (4.54 mi²) (< 1.97 km² - 0.76 mi²) to (> 31.49 km² - 12.16 mi²) (Culver *et al.* 2015).

The following are additions to information on ocelot habitat in Arizona. A male ocelot that was killed by a vehicle west of Globe, Arizona, in 2010 (Holbrook *et al.* 2011) was in the interior chaparral vegetation community, at an elevation of 1,334 m within the Greater Oak Flat Watershed (AGFD as cited by Featherstone *et al.* 2013). Recent detections of three other ocelots in Arizona were located in the semidesert grassland (46%), Madrean evergreen woodland (46%), and Great Basin grassland (8%) biotic communities (Culver *et al.* 2015). On average, all ocelot locations had 23% tree cover and were found at an elevation of 1,832 m. Additionally, on average, they were 2,335 m from perennial water sites and 6,337 m from major roads (Culver *et al.* 2015).

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, FWS 2010). In Mexico, it has disappeared from much of its historic range on the west coast (Caso *et al.* 2008). There are reports of the species up to 3,000 meters (9,842 feet) (Caso *et al.* 2008). We are not aware of any range-wide estimates of suitable ocelot habitat.

Estimating population sizes of secretive nocturnal carnivores, especially species that inhabit dense vegetative cover, such as the ocelot, is difficult. We are not aware of any range-wide estimates for ocelots; however, population size has been estimated in a number of countries. An effective population size of 10,000 to 528,732 individuals was estimated for Brazil (Oliveira 2013). A total population of 1,500 to 8,000 individuals was estimated for Argentina (Aprile *et al*. 2012). A population of 2,025 + 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. Gómez-Ramírez (2015) estimated a population of 1,421 ocelots in Sonora. Currently the U.S. population of the Texas ocelot subspecies has fewer than 100 individuals, found in two separated populations in southern Texas (FWS 2010). A third and larger population of the

Texas/Tamaulipas ocelot subspecies occurs more than 200 km (~124 mi) south of the Texas/Mexico border in the Sierra of Tamaulipas, Mexico (Caso 1994). Stasey (2012) reported a population estimate of 371 ocelots in a 1,560 km^2 patch of habitat in the Sierra of Tamaulipas.

Since 2009, a total of five ocelots have been detected in Arizona, including four detected by trail cameras and hunting dogs, and one dead ocelot that had been struck by a vehicle. A description of these detections follows. In November 2009, a live ocelot (sex unknown) was documented in the Whetstone Mountains in Cochise County, Arizona, with the use of camera-traps (Avila-Villegas and Lamberton-Moreno 2013). In April 2010, a second ocelot was found dead on a road near Globe, Arizona. A genetic analysis was conducted and all data indicated the young male ocelot was not of captive but wild origin (Holbrook *et al.* 2011). Origin of the ocelot recovered in Globe is still unclear due to a lack of comparative samples from Arizona or Sonora although in the DNA analysis, it clustered with samples from Mexico. A two-year camera-trap study in the area near Globe, Arizona, did not photograph any additional ocelots (Featherstone *et al.* 2013).

In February 2011, a third male ocelot was treed by a hunting dog and photographed in the Huachuca Mountains. He was subsequently detected multiple times by trail cameras, including once in the Patagonia Mountains in May 2012 (Culver *et al.* 2015), and was also treed by hunting dogs again (in the Huachuca Mountains). After being detected in the Patagonia Mountains he returned to the Huachuca Mountains, meaning that he traveled an approximate round trip distance of 84 km (Culver *et al.* 2015). He was most recently detected in May 2013. In May 2012, a fourth male ocelot was detected in the Huachuca Mountains via trail camera. He has been detected many times via trail cameras, most recently in October 2015, and treed by hunting dogs once. In April 2014, a fifth male ocelot was detected in the Santa Rita Mountains via trail camera. He was photographed several times over a two-month period and has not been detected since. Additionally, an ocelot was detected in December 2013 in the Santa Rita Mountains; however it is unknown if this was the same as the fifth ocelot described above or a different ocelot.

In addition to the recent Arizona sightings, a number of ocelots have been documented just south of the U.S. border in Sonora, Mexico. Specifically, with the use of camera traps, 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 (Avila-Villegas and Jessica Lamberton-Moreno 2012). Additionally, one ocelot was documented in 2009 in the Sierra de Los Ajos, about 30 miles south of the U.S. border near Naco, Mexico (FWS 2010). 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. Out of the 36 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).

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); 25/100 km^2 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

There have been no changes to this section as it appeared in the October 30, 2013, BO. The prior narrative is incorporated herein via reference.

Planning and Conservation Efforts

There have been no changes to this section as it appeared in the October 30, 2013, BO. The prior narrative is incorporated herein via reference.

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.

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 (FWS 2010). Ocelots have recently been documented in the Santa Rita Mountains. For the purposes of the ocelot analysis, we use the Forest Service Action Area definition (i.e., defined by hydrology).

Terrain, Vegetation Communities, and Climate in the Action Area

There have been no changes to this section as it appeared in the October 30, 2013, BO. The prior narrative is incorporated herein via reference.

Status of the Ocelot in the Action Area

Life History and Habitat

As stated in our last biological opinion, no home range studies have been done for ocelots in Arizona. Recently, however, Culver *et al.* (2015) estimated minimum observed ranges for ocelots in Arizona and Sonora. The average minimum observed range of the three Arizona ocelots was 30.09 km^2 (11.62 mi^2), with minimum observed ranges ranging from 7.76 to 63.40 km^2 (3.00 to 24.48 mi^2). The minimum observed range of the ocelot detected in the Santa Rita Mountains was 19.11 km^2 (7.38 mi^2).

Based on limited records, in Arizona ocelots appear to be associated with Madrean evergreen woodland (Culver *et al.* 2015, Avila-Villegas and Jessica Lamberton-Moreno 2013), semidesert grassland, and Great Basin grassland biotic communities (Culver *et al.* 2015). In the Santa Rita Mountains, ocelots were detected by Culver *et al.* (2015) in semidesert grassland and Madrean evergreen woodland. Four of the five ocelot detection cameras were located in semidesert grassland and one was located in Madrean evergreen woodland (Culver *et al.* 2015). As depicted in Figure 1b in Culver *et al.* (2015), the detection locations in semidesert grassland were close (<0.7 mile) to Madrean evergreen woodland; therefore the sites likely shared characteristics of both biotic communities. All ocelot detections in the Santa Rita Mountains were at night.

Distribution, Abundance, and Population Trends

Culver *et al.* (2015) recently documented ocelot use of the Santa Rita Mountains. Their team obtained 7 photographs (including 6 in Pima County and one in Santa Cruz County) of at least one adult male ocelot in the Santa Rita Mountains (one photo was not adequate for individual identification). The male ocelot was photographed 6 times by Culver *et al.* (2015) over a 43 day period, from April 2014 to May 2014. During this time, a private citizen also captured a video of this animal, the location of which was verified by Culver *et al.* (2015). Additionally, in December 2013, Culver *et al.* (2015) photographed an ocelot in the vicinity of the other photos of the male ocelot; however, they were not able to positively identify the ocelot due to the poor quality of the photograph. If it was the same individual as subsequently detected in April and May, the duration this ocelot was observed would increase to 150 days (Culver *et al.* 2015). Ocelot detections ranged from 0.3 to 11 miles (to the southwest) from the proposed project perimeter fence.

In addition to ocelots being recently detected in the Santa Rita, Huachuca, and Whetstone mountains of Arizona and the Sierra Azul of Sonora (as described above and in our last biological opinion), a male ocelot was also detected in the Patagonia Mountains in May 2012. The Patagonias lie between the Santa Ritas and the Sierra Azul and are connected to areas south of the border, do not have an impermeable border fence, and habitat there is similar to that found in the Sierra Azul.

Threats

There have been no changes to this section as it appeared in the October 30, 2013, BO. The prior narrative is incorporated herein via reference.

Planning and Conservation Efforts

There have been no changes to this section as it appeared in the October 30, 2013, BO. The prior narrative is incorporated herein via reference.

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 (with the exception of our previous biological opinion for this project) has undergone formal consultation for effects to ocelot; therefore, no incidental take has been anticipated for ocelots in the action area.

Effects of the Proposed 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 or interdependent with that action (50 CFR

§402.02). Indirect effects occur later in time but are reasonably certain to occur. "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 (50 CFR §402.02).

The proposed action may result in degradation of ocelot habitat and disturbance to ocelots. Construction and operation of the mine, including the associated roads, will result in removal, destruction, and degradation of ocelot and ocelot prey habitat and may disturb ocelots, causing changes in, among other things, their habitat use and movement patterns. Conservation measures included in the project description may help offset adverse effects to ocelots to some extent.

Direct and Indirect Effects of Project Construction

The 2012 BA defines the project area as all areas in which any ground disturbance would take place as a result of the proposed action, including the mine pit, waste rock facilities, tailings, access roads, utility corridors, and on-site facilities (i.e., the mine “footprint” or area within the security fence plus roads, corridors, and trails). Project activities within the project area will cause direct ground disturbance and removal of habitat. The project area is 5,431 acres, which includes areas within the security fence (4,228 acres), the primary access road (226 acres), the utility line corridor (899 acres), road disturbance/new roads (39 acres), decommissioned roads (20 acres), and the rerouted Arizona National Scenic Trail (19 acres) (U.S. Forest Service Process Memorandum to File, June 15, 2015). According to Table 122 in the FEIS, the Barrel alternative will directly impact 4,846 acres of upland vegetation (including 2,312 acres of semidesert grassland, 2,523 acres of Madrean evergreen woodland, and 11 acres of Sonoran desertscrub) and 585 acres of riparian vegetation.

In our previous biological opinion, we anticipated that ocelots were more likely to use Madrean evergreen woodland than semidesert grassland. Since the issuance of that opinion, however, as described above, ocelots were detected more frequently by Culver *et al.* (2015) in semidesert grassland than in Madrean evergreen woodland. As also discussed above, the location of detection cameras in semidesert grassland were close to Madrean evergreen woodland, so it is likely that the sites shared characteristics of both biotic communities. Therefore, we now anticipate that ocelots are likely to use Madrean evergreen woodland or semidesert grassland, particularly when the semidesert grassland is relatively close to or shares some characteristics of Madrean evergreen woodland. Ocelots may also use riparian vegetation.

Although we do not know the average home range size of ocelots in Arizona, ocelot home ranges in other parts of their distribution range from an average of 2.0 to 38.8 km^2 (494 to 9,588 acres) (see Emmons 1988 and Crawshaw 1995, respectively). Note that the average minimum observed range of the three Arizona ocelots, 30.09 km^2 (11.62 mi^2), falls within this range. Therefore, using the habitat area of 5,420 acres [5,431-11 acres of Sonoran desertscrub]) that will be removed by the project (including Madrean evergreen woodland, semidesert grassland, and riparian areas), an equivalent of about 0.6 to 11 potential ocelot home ranges may be directly impacted (eliminated) by the project footprint assuming no overlap in home ranges. However, because ocelot home ranges overlap (Murray and Gardner 1997, Fernandez 2002, Dillon and Kelly 2008), the project footprint could impact additional ocelot home ranges. As of April 2016, however, one, possibly two, ocelots have been detected near the project area and we are currently not aware of overlapping ocelot home ranges in the Santa Rita Mountains. That said, no surveys specifically designed to detect ocelots have been conducted in the Santa Rita Mountains and ocelots are known to be secretive animals that can be difficult to detect. In addition to removing 5,420 acres of ocelot habitat, the project will also result in the direct removal of the same acreage of ocelot prey habitat, possibly leading to a reduced prey base for ocelots. When the security fence is removed and if reclamation succeeds in reestablishing sufficient habitat, some of this area may be useable to ocelots and their prey in the future (30 plus years).

Outside of the security fence, a perimeter barbed-wire fence will be constructed. The perimeter fence will encompass 6,990 acres of land (U.S. Forest Service Process Memorandum to File, June 15, 2015); however, except where specific features such as the primary access road or utility line corridor are located, the habitat between the perimeter fence and the security fence will not be removed. Together, the perimeter fence plus roads, utility line corridor, decommissioned roads, and the Arizona Trail, will encompass a total of 8,199 acres, including 3,392 acres of Madrean evergreen woodland, 4,001 acres of semidesert grassland, 795 acres of riparian vegetation, and 11 acres of Sonoran desertscrub. Given the influence of human and vehicular activity, noise, and lighting (see discussion in the original biological opinion for information on effects of noise, lights, and traffic on ocelots) within the perimeter fence, we anticipate that ocelots, if they occur in the area, will likely avoid most or all areas within the perimeter fence, as well as additional affected areas outside the perimeter fence. If this is the case, then the mine will directly impact an equivalent of about 0.8 to 16.6 potential ocelot home ranges, possibly more considering home range overlap (note, this home range impact calculation was made without 11 acres of Sonoran desertscrub because ocelots have not been documented using this vegetation type in Arizona). After all mine operations end and the perimeter fence is removed (about 25-30 years), the area between the security fence and the perimeter fence will likely be suitable for ocelot use.

Construction activities associated with all aspects of the project may disturb ocelots and cause them to flee and/or avoid the areas affected by light, noise, traffic, and other human activities. Disturbance to ocelots can result in behavioral changes, increased energetic expenditures, and interference with habitat use, including use of movement corridors. These could lead to decreased dispersal opportunities; changes in home range size and location; increased inter- and intra-specific competition; increased difficulty meeting energetic needs; etc. The ocelot repeatedly detected in the vicinity of the proposed action may be subject to such effects if it occurs in the area when project construction begins; however other ocelots potentially occurring in the area in the future would also be affected.

Once project construction is complete and operations are underway, ocelots would be excluded from the project area as it will be devoid of habitat, as described above, as well as the larger area encompassed by the perimeter fence. Ocelot avoidance of this area could cause them to shift home ranges and 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., pumas, jaguars), and other stresses.

Effects of Lighting, Noise, and Vibrations from Mining Operations

There have been no changes to this section as it appeared in the October 30, 2013, BO.

Indirect Effects of Roads

There have been no changes to this section as it appeared in the October 30, 2013, BO.

Effects of Conservation Measures

There have been no changes to this section as it appeared in the October 30, 2013, BO, with the exception of the following. The description of the conservation measure concerning Sonoita Creek Ranch has been modified; please see the description of the proposed action for details.

We assume in our analysis that managing for connectivity between the Canelo Hills/Patagonia Mountains and the Santa Rita Mountains as stated in the conservation measures includes ensuring that ocelots can safely cross Highway 82, which runs between these mountain ranges, using crossings (e.g., underpasses or overpasses and associated fencing) appropriate for medium-sized cats. If this is not the case, connectivity between Canelo Hills/Patagonia Mountains and the Santa Rita Mountains will not be achieved. We provided suggested conservation measures to address connectivity between the Santa Rita and Patagonia Mountains; however, these measures were not incorporated into the Rosemont Mine proposed action.

Effects to Recovery of the Ocelot in the ASMU with the Project

There have been no changes to this section as it appeared in the October 30, 2013, BO.

Cumulative Effects - Ocelot

There have been no changes to this section as it appeared in the October 30, 2013, BO.

Conclusion - Ocelot

There have been no changes to this section as it appeared in the October 30, 2013, BO.

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 included by the USFS as binding conditions of any grant or permit issued to the applicant, as appropriate, for the exemption in section

7(o)(2) to apply. The USFS has a continuing duty to regulate the activity that is covered by this Incidental Take Statement. If the USFS (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 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, the USFS, or the applicant 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 - Ocelot

Confirmed ocelot detections have occurred within the action area as recently as May 2014. The detections were from trail cameras placed by researchers from the University of Arizona conducting a jaguar survey and monitoring project (see Culver *et al.* 2015). All detections were located on lands administered by the Coronado National Forest, photographed at night, and are suspected to be of a single male ocelot (although one photograph was too low quality to identify the ocelot). The detections ranged from 0.3 to 11 miles (to the southwest) from the proposed project perimeter fence. Thus, incidental take of an ocelot is likely to occur because trail cameras have detected a male ocelot within the area subject to direct and/or indirect effects of the proposed action (the action area).

Incidental take of one ocelot over the life of the project in the form of harassment is anticipated for the following activity:

> Disturbance of ocelots due to construction, operation, and reclamation of the mine and associated roads which disrupts normal behavior patterns which include, but are not limited to, breeding, feeding or sheltering. Construction and operation of the mine is 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 predators (i.e., pumas, jaguars), and other stresses.

We anticipate the above anticipated incidental take will be difficult to detect. However, monitoring and reporting requirements will allow us to assess the effects of proposed project activities on ocelots. In addition, Rosemont will report to us any mortality or injury of ocelots due to collisions with vehicles or other activities. The amount of anticipated incidental take will have been exceeded, triggering a requirement for reinitiation (50 CFR §402.16[c]) if, for example:

1. Based on the annual and emergency reporting on the status of the proposed project:
    a. An ocelot is injured or killed through collision with a vehicle(s) associated with the proposed project;
    b. Unanticipated events occur that are attributable to the proposed action (e.g. toxic spills or plumes, wildfires, landslides) that are reasonably certain to have resulted in take; or
    c. Additional ocelot(s) are documented in the action area and those ocelot(s) are reasonably certain to be taken by the proposed action. Presence of additional ocelots in the action area will not necessarily result in take being exceeded; however, if additional ocelots are detected in the action area, the Forest Service and FWS will immediately discuss the situation and determine if reinitiation of consultation is required.

In summary, and stated differently, the maximum allowable incidental take of ocelot is the harassment of one individual.

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. Also, while there are no range-wide population estimates for ocelots, there are over an estimated 1,350 ocelots in Sonora and many thousands more range-wide. Therefore, the take of one ocelot in the form of harassment in the U.S. will not jeopardize the species.

REASONABLE AND PRUDENT MEASURES- OCELOT

The FWS believes the following Reasonable and Prudent Measures are necessary and appropriate to minimize impacts of incidental take of ocelot:

1. Minimize the effects of disturbance from noise and roads to the ocelot.
2. Monitor ocelots in the area of the Santa Rita Mountains described in Term and Condition Number 2.
3. Monitor incidental take resulting from the proposed action and report to the FWS the findings of that monitoring.

TERMS AND CONDITIONS - OCELOT

To be exempt from the prohibitions of section 9 of the Act, The USFS shall ensure that Rosemont complies 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 Conditions implement Reasonable and Prudent Measure Number 1:

    a. The USFS and Corps shall ensure that the Rosemont Copper Company minimizes road-related noise, especially at night, through the use of techniques such as avoiding, to the extent practicable (i.e., that allows for safe driving conditions), horn use and “Jake-braking” (the use of an engine’s compression combined with downshifting the transmission to slow a vehicle). Compliance with this Term and Condition may be demonstrated by placing signs advising vehicle operators to not employ “Jake-brakes” at both ends and the midpoint of the primary access road.

    b. The USFS and Corps shall ensure that the Rosemont Copper Company limits speeds on the primary and secondary access roads and the Sycamore connector road to no more than 25 miles per hour and employ the use of wildlife crossing signs. Speed limits will be made known to employees and contractors during safety training or equivalent and via the use of speed limit signs. Compliance with this term and condition may be demonstrated by placing speed limit signs in appropriate locations. Compliance may also be demonstrated by placing signs cautioning vehicle operators of the presence of wildlife both at ends and the midpoint of the primary access road and at any other locations determined necessary by the USFS Biological Monitor (while implementing the wildlife movement-related Conservation Measure).

2. The following Term and Condition implements Reasonable and Prudent Measure Number 2:

The USFS and Corps shall ensure that Rosemont conducts (or provide funding to conduct) ocelot surveys and monitoring for the life of the proposed mine and 5-years post-closure. Ocelot surveys and monitoring shall be conducted by a contractor with expertise in felid survey and monitoring, sampling design, GIS, and data analysis. Objectives of the survey and monitoring project include, but are not limited to the following: (1) determine if the male ocelot previously detected near the proposed mine continues to use the area; (2) determine if additional ocelots are present in the vicinity of the mine; (3) gather basic information on ocelot movement and habitat use patterns in the vicinity of the mine, including, if possible, determining travel routes; and (4) enable operations to take into account the presence of ocelots in the immediate vicinity. The exact design, scope, and location of the survey and monitoring project will be determined in the survey and monitoring plan and updated as needed to gather the best possible information on ocelots. Unless another survey and monitoring design of equal or lesser effort is determined to be potentially more scientifically effective (i.e., to allow for the best scientific information possible to be obtained), surveys and monitoring will be conducted for the first five years in a 38.8 km^2 area of ocelot habitat very roughly centered on the perimeter fence of the mine (because ocelots have been detected to the southwest of the mine, the survey polygon may include more area to the southwest and less in the other directions; however this will be refined in the survey and monitoring plan). Ocelots detected in this area will then be subject to focused monitoring. We note that 38 km^2 is the largest average home range size (the estimate was obtained via radio-telemetry by Crawshaw 1995) noted from the species range. After five years, FWS, USFS, other entities if appropriate, and Rosemont will meet to discuss and determine if the existing survey and monitoring design should be continued with the same level of effort, or if a new design with a similar level of effort should be employed; the goal of either effort will be to continue to obtain the best information possible on ocelots in the action area. The USFS shall ensure that Rosemont implements the new design, if warranted, for the life of project and 5-years post-closure, unless another design of equal or lesser effort is determined to be more effective.

All ocelot detections will be reported to FWS and AGFD within 24 hours.

Ocelot survey and monitoring must commence prior to significant surface disturbance. Ocelot survey and monitoring will be conducted through non-invasive means, including, but not limited to the use of trail cameras and/or scat-detection dogs. Prior to the commencement of any field work: (1) a survey and monitoring plan (draft and final) will be submitted to and approved by the FWS in coordination with AGFD; and (2) all necessary permits will be obtained, copies of which must be sent to FWS and other entities as applicable.

The survey and monitoring plan will include, among other information: (1) the objectives; (2) a detailed description of survey and monitoring methods and analysis techniques to be employed, including the location and spatial array of paired cameras, track plots, or scat-detection dog transects, and frequency with which photos will be downloaded and viewed (at least monthly), track plots read, or scat-detection transects ran; (3) a communications plan that explains, among other things, how ocelot detections will be relayed to the FWS, AGFD, and the general public; and how media requests will be handled; (4) reporting format and schedule (reporting will include draft and final reports, as well as monthly updates); and (5) qualifications of the survey and monitoring team. All aspects of the plan and implementation of the plan (including, but not limited to, who will conduct the surveys and monitoring, how the survey and monitoring will be conducted, and when reports will be due) must be coordinated with FWS in coordination with AGFD and approved by FWS. Additionally, all survey and monitoring efforts must be coordinated with the USFS, FWS (in coordination with AGFD), affected land owners and managers, and other parties determined to be appropriate by the FWS.

The aforementioned survey and monitoring effort expands on the Conservation Measure in the Description of the Proposed Action of the BA which states "Rosemont will provide $50,000 to AGFD or other suitable entity approved by the CNF to support camera studies for large predators including jaguar and ocelot. The money will be provided for additional monitoring efforts between the Santa Rita and the Whetstone Mountains and along the Santa Rita Mountains. In addition to increasing knowledge regarding the movement of wildlife in the area, information collected during this investigation may identify a suitable wildlife crossing structure location." Please note that AGFD has requested that the agency not be referred to within task-oriented conservation measures; it only appears here due to the agency name appearing in quoted text. Reasonable and Prudent Measure Number 2 is required because the $50,000 camera study identified in the Conservation Measures is a small fraction of funding needed to conduct ocelot surveys and monitoring for the life of the proposed mine, and 5-years post-closure. To reduce study redundancy and possible disturbance to ocelots in the area, this Conservation Measure and the aforementioned survey and monitoring effort should be conducted by the same entity.

3. The following Term and Condition implements Reasonable and Prudent Measure Number 3:

To monitor incidental take resulting from the proposed action, the USFS and Corps shall ensure that Rosemont monitors the impacts of the action as they relate to ocelot and report these to the FWS for the life of the project. A report will be due to the FWS annually on December 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 email and telephone.

In summary, the FWS believes that no more than one 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 the impact of 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 reinitiation of consultation and review of the reasonable and prudent measures provided. USFS must immediately provide an explanation of the causes of the taking and review with the FWS-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. We recommend that the Forest Service and Rosemont:

1. Further minimize the effects of night lighting and noise within the action area by:
    a. Minimizing the light levels and the distance light emanates from the project site through the use of techniques such as decreasing the use of bright lights, employing methods to deflect lights coming out of project site, and minimizing the lights coming from buildings at the project site;
    b. Coordinating the aforementioned Conservation Recommendations with FWS and other entities before the measures are employed.
2. Support ocelot recovery through implementing and/or funding priority recovery actions for the ocelot as determined by the Ocelot Recovery Team.
3. Provide funding to contribute toward the conservation and management of unprotected/undeveloped lands for wildlife connectivity in the wildlife corridor referred to as Strand B in the Patagonia-Santa Rita Linkage Design (Beier *et al*. 2008) or the wildlife corridor determined by the USFWS to be the best biological corridor for wildlife connecting the Santa Rita and Patagonia Mountains.
4. Provide funding to contribute toward the conservation and management of unprotected/undeveloped lands for wildlife connectivity in the best biological corridor for wildlife connecting the Santa Rita and Whetstone Mountains.
5. Provide funding to contribute to researchers’ efforts to evaluate and enhance existing and/or construct new wildlife crossings (e.g., wildlife overpasses or underpasses and associated fencing) along and across Highways 82 and 83. These crossings would improve connectivity between the Santa Rita and Patagonia Mountains and the Santa Rita and Whetstone Mountains, respectively. To be effective, at least four wildlife crossings should be located along Highways 82 and 83 based on studies of carnivore movement in the area.
6. Protect ocelot habitat and corridors in Sonora to provide for connectivity of the Arizona-Sonora Management Unit.
7. Provide funding to FWS for a full-time Fish and Wildlife Biologist for the life of the project to assist in study design, and to track the implementation of all conservation measures and adherence to all terms and conditions of this Final BO.

LESSER LONG-NOSED BAT

Status of the Species - Lesser Long-Nosed Bat

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 (*Agave palmeri*)] (Hoffmeister 1986). The lesser long-nosed bat was listed (originally, as *Leptonycteris sanborni*; Sanborn's long-nosed bat) as endangered in 1988 (FWS 1988). No critical habitat has been designated for this species. A recovery plan was completed in 1997 (FWS 1997). 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, following the approval of the recovery plan. A five-year review has been completed and recommends downlisting to threatened (FWS 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, the lesser long-nosed bat 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 (FWS 1997). 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 time period in Arizona (FWS 1997, Hoffmeister 1986, Sidner and Houser 1990). 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 Mountains and, recently, the Galiuro

Mountains (personal communication with Tim Snow, Arizona Game and Fish Department, 1999), but also occur with adult females and young of the year at maternity sites (FWS 1997). Throughout 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 miles, and in Mexico, at 25 miles and 36 miles (one way) (Ober *et al.* 2000; Dalton *et al.* 1994, Ober and Steidl 2004, Lowery *et al.* 2009). Lowery *et al.* 2009 and Steidl (personal communication, 2001) found that typical one-way foraging distance for bats in southeastern Arizona is roughly 6 to 18 miles. A substantial portion of the lesser long-nosed bats at the Pinacate Cave in northwestern Sonora (a maternity colony) fly 25-31 miles each night to foraging areas in OPCNM (FWS 1997). Horner *et al.* (1990) found that lesser long-nosed bats commuted 30-36 miles round trip between an island maternity roost and the mainland in Sonora; the authors suggested these bats regularly flew at least 47 miles 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; personal communication with Yar Petryszyn, University of Arizona 1997).

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 elevational areas of the Sonoran Desert region, and paniculate agaves are found primarily in higher elevation desert scrub areas, 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 roost sites 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.

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 (Arizona Game and Fish Department 2005, Tibbitts 2005, Wolf and Dalton 2005, FWS 2007b; Tim 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 2009a). 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, 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 20 – 25 large lesser long-nosed bat roost sites, including maternity and late-summer roosts, have been documented in Arizona. Of these, 10 – 20 are monitored on an annual basis depending on available resources (FWS 2007b). Monitoring in Arizona in 2004 documented approximately 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 2009a). 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 relative number of known large roosts is quite small.

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 extinction 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 for a number of reasons. 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 mortality, 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 (FWS 2005a). 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 or 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.

In summary, 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 buffelgrass and other invasive species that can carry fire in Sonoran Desert scrub; wood-cutting; urban development; fires; and drought and climate change.

Large fires supported by invasive vegetation in 2005 affected some lesser long-nosed bat foraging habitat, although 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 acres) set a new state record, burning a larger area than the 2002 Rodeo-Chediski Fire (468,638 acres). The Horseshoe 2 Fire (222,954 acres) burned approximately 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 a total of 366,679 acres 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 (personal communication with Scott Richardson, FWS, January 11, 2008). 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, p. 2074). Monitoring bats and their forage during drought years is needed to better understand the effects of drought on this species.

The lesser long-nosed bat recovery plan (FWS 1997) identifies the need to protect roost habitats and foraging areas and food plants, such as columnar cacti and agaves. The lesser long-nosed bat recovery plan provides specific discussion and guidance for management and information needs regarding bat roosts and forage resources (FWS 1997). 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.

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 mortality 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 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 (FWS 2010). 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 (FWS 2009). 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 (FWS 2007c). The 2005 BO for implementation of the Coronado National Forest Land and Resource Management Plan (FWS 2005b) 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 a period of 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 (FWS 2004). The 2003 BO for Marine Corps Air Station–Yuma Activities on the BMGR 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 (FWS 2003). The 2007 BO for Department of the Army Activities at and near Fort Huachuca (Fort), Arizona anticipated incidental take in the form of direct mortality or injury (six bats over the life of the project), harassment (20 bats per year), and harm (10 bats over the life of the project) (FWS 2007a).

The lesser long-nosed bat recovery plan (FWS 1997), listing document (FWS 1988), and the 5-year review summary and evaluation for the lesser long-nosed bat (FWS 2007b), all discuss the status of the species, and threats, and are incorporated by reference.

Environmental Baseline - Lesser Long-Nosed Bat

Action Area

As stated previously, the action area is defined as 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). The FWS has described above the general action area for the Rosemont Mine project (see Action Area section above). The action area as it relates specifically to the lesser long-nosed bat extends beyond this general action area and includes the areas directly impacted by the Rosemont mine features identified, including utility corridors and access roads, as well as the area defined by a circle with a radius of 36 miles (the maximum documented one-way foraging distance of the lesser long-nosed bat) around the Rosemont Mine project. Lesser long-nosed bats may occur anywhere within this foraging radius around roosts occupied by lesser long-nosed bats during the time of annual occupancy in the area. The action area represents only a small portion of the lesser long-nosed bat’s range. However, using this definition increases the number of lesser long-nosed bat roosts in the action area from three, as described in the various BAs, to 13, which includes 10 lesser long-nosed bat roosts in the Santa Rita, Empire, Mustang, Whetstone, Patagonia, Rincon and Santa Catalina mountains that are within 36 miles of the proposed Rosemont Mine project.

The above description of the action area for lesser long-nosed bats is supplemented by the overall description of the action area used earlier in this document (see Action Area section above) with regard to land management and vegetation community description.

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

Bat surveys of the proposed action area and vicinity were conducted in 2008 (WestLand 2009f), 2009 (Buecher *et al.* 2010), 2010 (Buecher *et al.* 2011), and 2011 (WestLand 2011f). Methods included active and passive ultrasonic acoustic sampling at flowering agaves, infrared photography and observations of flowering agaves, and surveys of potential roost sites.

In 2008, 143 potential bat roost sites (i.e., caves, mine shafts, and adits) were evaluated within the action area and surrounding region (WestLand 2009f). Of these 143 sites, 59 were within the proposed action footprint, and 16 were near the proposed action footprint. Acoustic and/or roost site surveys were conducted on a total of 20 different dates between August 4 and November 12, 2008, and ultrasonic acoustic surveys and infrared surveys were conducted on five evenings between August 11 and September 16, 2008. Because lesser long-nosed bats often remain silent while foraging, several sites also were monitored in 2008 with night vision equipment to further document use of flowering agaves. Lesser long-nosed bats were documented foraging regularly on agaves in the proposed action area from late August to mid-September based on the results of acoustic and infrared surveys. Lesser long-nosed bat calls were recorded at 23 of the 27 Palmer agave sites where acoustic surveys were successful (i.e., no equipment failures), and night vision equipment was successful in detecting frequent lesser long-nosed bat visits to flowering Palmer agaves. Lesser long-nosed bats were documented roosting at three sites within the action area in 2008: Site 9 (the name was changed to Chicago Mine in Buecher *et al.* 2010), Site R-2, and the Helena Mine complex (Figure LLB-1). The Chicago Mine was visited five separate times during 2008; approximately 12 to 15 lesser long-nosed bats were present in August, and none were present in late September. The R-2 site was visited once in 2008, which resulted in the confirmed sighting of one lesser long-nosed bat. A small colony of 20 to 30 lesser long-nosed bats was roosting at the Helena Mine complex in 2008. Only one of these sites (Site 9/Chicago Mine) is within the proposed action footprint and is located within the proposed mine pit. Site R-2 is immediately adjacent to the southwestern portion of the proposed fence line of the Barrel alternative. Lesser long-nosed bats also were found at the Helena Mine complex approximately 1 mile north-northeast of the fence line for the Barrel alternative.

In 2009, 37 sites were examined during eight field visits conducted in August, September, and October (Buecher *et al.* 2010). Survey efforts in 2009 focused on sites that supported nectar-feeding bats in 2008 and sites where the potential for bats was considered high, including the following: 1) the Helena Mine complex, which is characterized by multiple entrances, supported small numbers of *L. yerbabuenae* in 2008; 2) Adit S and Adit R-47, where accumulations of insectivorous bat guano was found in 2008; 3) R-46, which was not visited in 2009 but was thought to have high potential for bat use; 4) Chicago Mine (referred to as Site 9 in WestLand 2009f), which supported small numbers of Leptonycteris in 2008; and 5) R-2 (located in Sycamore Canyon), where one *L. yerbabuenae* was found in 2008. Lesser long-nosed bats were documented at the same three roosts at which they were detected in 2008 (see LLB-1, below). The Chicago Mine was visited two times in 2009, and approximately 32 lesser long-nosed bats were documented exiting the mine. The R-2 site was visited three times in 2009. This resulted in a single lesser long-nosed bat observed on August 25, 2009, more than 50 detected with acoustic sampling and infrared video cameras on September 3, 2009, and the presence of lesser long-nosed bats on October 13, 2009. At the Helena Mine complex, more than 5,000 lesser long-nosed bats were detected during an exit count in September.

In 2010, three of the sites that were previously surveyed, including one site that contained lesser long-nosed bats in 2008 and 2009 (Helena Mine complex), were revisited (Buecher *et al.* 2011). Additionally, the BLM conducted surveys on their lands near Helvetia late in 2010, and lesser long-nosed bats were observed roosting on abandoned mine land features (Hughes 2011). Lesser long-nosed bats were documented roosting only at the Helena Mine complex site; however, the Chicago Mine and R-2 sites were not surveyed. Significantly fewer (approximately 150) lesser long-nosed bats were detected overall during exit counts in 2010 than in 2009 (more than 5,000). However, some of the emergence counts were stopped early because of inclement weather, so it is unclear whether the reduced counts were accurate representations of the number of bats at these roost locations.

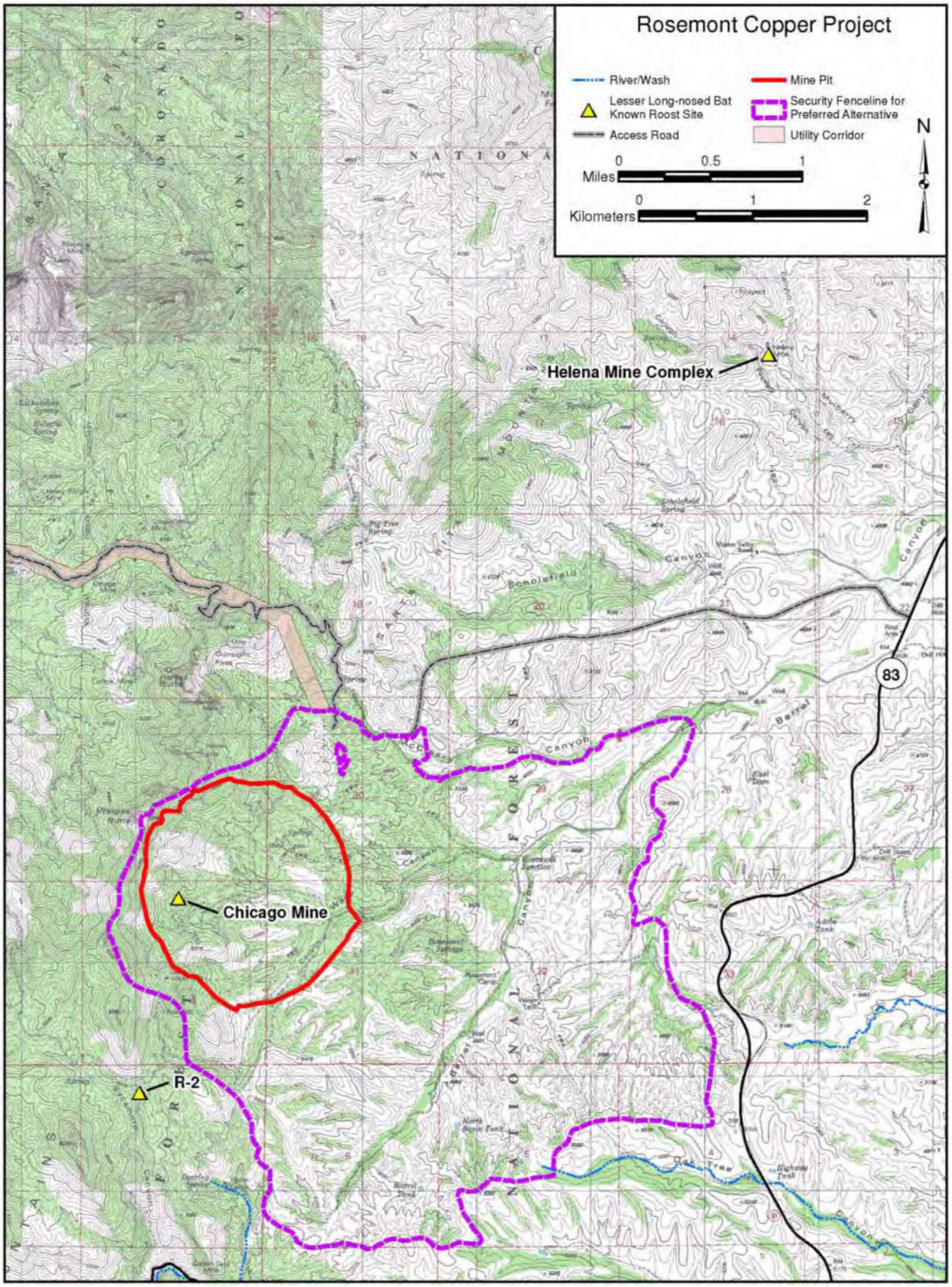

Figure LLB-1: Lesser Long-Nosed Bat roosts in the Action Area of the Rosemont Mine project

In 2011, 33 sites were examined in 10 field visits in July, August, and September (WestLand 2011f). Some sites surveyed were used by bats in previous years, and additional mines not covered during prior surveys were also evaluated. Evaluations included mine entry (internal surveys) and/or external roost evaluations (emergence surveys). Lesser long-nosed bats were documented roosting at the Helena Mine complex site, the Chicago Mine, and R-2 sites (see Figure LLB-1 below). At the Helena Mine complex, approximately 4,650 lesser long-nosed bats were detected during an exit count in August; during a second emergence count in September, approximately 2,021 Lesser Long-nosed Bats were recorded. At the Chicago Mine, one lesser long-nosed bat was detected roosting in July. At the R-2 site, three lesser long-nosed bats were detected roosting in July.

In 2013, five features at the Helena Mine Complex were monitored through three emergence counts using video recordings. During the simultaneous surveys of regional lesser long-nosed bat roosts on August 21, 2013, approximately 7,800 lesser long-nosed bats were counted. A subsequent survey on September 4 found 5,700 lesser long-nosed bats, and a survey on September 13 found 2,700. No internal surveys were conducted on the Helena Mine Complex. During a nighttime visit to Adit R-2 on August 22, 2013, a “considerable amount” of lesser long-nosed bat activity was observed. When Adit R-2 was surveyed during the day, one roosting lesser long-nosed bat was observed, along with “extensive” nectivorous bat splatter. Because Chicago Mine’s entrance construction does not allow for reliable night monitoring, it was only surveyed internally. Three lesser long-nosed bats were observed roosting, and a lot of fresh nectar bat splatter was observed.

Twenty-three new abandoned mine features were surveyed in 2013 within the 1-mile buffer. Two of the 23 new abandoned mine features contained nectivorous bat splatter (NS12 and NS14, both outside the perimeter fence but within the 1-mile buffer), but no bats were observed during surveys. Of the previously surveyed mines, seven contained some nectivorous bat splatter, but no bats were observed at these locations (30M and R-3 within the perimeter fences and R-5, R-5A, R-9, R-48, and DR-09 outside the perimeter fence but within the 1-mile buffer).

Regional monitoring of lesser long-nosed bats occurs in the vicinity of the Rosemont Mine project, including mountain ranges within 36 miles (maximum documented foraging distance for lesser long-nosed bats) of the Rosemont Mine project. Based on this regional monitoring data, 10 additional lesser long-nosed bat roosts occur within 36 miles of the Rosemont mine site. Bats from these roost sites potentially visit the Rosemont Mine area to forage on available agave plants. The number of lesser long-nosed bats using these additional roosts is generally from 1,000 – 12,000 bats. While it is unlikely that all of the lesser long-nosed bats from these roosts will use the Rosemont Mine area for foraging, it is likely that, in any given year, some of the bats from these roost sites will forage in the area of the Rosemont Mine.

In summary, the action area is located in the post-maternity dispersal region for lesser long-nosed bat (maternity colonies in southwestern Arizona disband in July and August), and there are numerous Palmer agaves and at least thirteen active roosts within the action area (three of which are within or in the immediate vicinity of the proposed action footprint). Of these roosts, only Chicago Mine is in the proposed action footprint. Although dates of arrival at post-maternity sites are variable in Arizona from one year to the next, surveys in the action area in 2008, 2009, 2010, and 2011 indicate that lesser long-nosed bats forage and occupy roosts in the area beginning at least in early August and, based on results at the Helena Complex, continuing into October. The large number of this species present at the Helena Mine complex in 2009 and 2011 indicates that this site could be a roost complex of regional importance to lesser long-nosed bats.

Lesser long-nosed bat numbers at post-maternity or transition roosts tend to fluctuate more than do numbers at maternity roosts. This fluctuation is apparently based on local forage availability (agave blooms). Agave blooming is subject to climatic conditions and during the ongoing, extended drought, some portions of the action area have been subject to forage failures. Lesser long-nosed bats are highly mobile and will switch to areas and roosts where forage is available.

A number of activities occur in the action area that could affect bats. Because of the extent of Federal lands in the action area, most activities that currently, or have recently, affected the lesser long-nosed bats or their habitat in the action area are Federal actions, many of which have undergone formal consultation. Ongoing illegal border activities are an exception. In the action area, efforts are ongoing that contribute to the conservation and protection of lesser long-nosed bat populations and habitat within the action area. For example, the National Park Service and the Coronado National Forest have constructed bat gates at two lesser long-nosed bat roosts in the Huachuca and Canelo Hills, respectively. The effectiveness of these efforts is being monitored. Research and monitoring activities funded by Customs and Border Protection on public and private lands within the action area are contributing to our knowledge of lesser long-nosed bat roost locations and developing appropriate protective measures for lesser long-nosed bat roost sites. In general, the lesser long-nosed bat populations within the action area are stable to increasing, but threats are ongoing, and in some cases increasing (climate change, invasive species, border activities, etc.)

Effects of the Action - Lesser Long-Nosed Bat

<u>Effects to Roosts</u>

The proposed action will directly affect and result in the permanent loss of at least one known lesser long-nosed bat post-maternity roost site (Chicago Mine) within the footprint of the proposed mine, which in August 2008 contained approximately 12 to 15 lesser long-nosed bats, in 2009 contained approximately 32 lesser long-nosed bats, and in July 2011 contained one roosting lesser long-nosed bat. Any individual lesser long-nosed bats present within the footprint of the mine infrastructure (including the pit, buildings, roads, tailings or waste piles, etc.) will either be crushed or forced to relocate. Rosemont will close the Chicago Mine when lesser long-nosed bats are not present in the Chicago Mine (excluded); therefore, no lesser long-nosed bats would be killed by the construction of the mine pit, if no individuals are in the mine during closure.

Given the anticipated levels of project related activity and associated disturbance from noise, vibrations, and light, there exists the potential for effects on two additional lesser long-nosed bat post-maternity roosts adjacent to the proposed mine footprint [i.e., R2 (immediately adjacent to the southwestern portion of the proposed fence line of the proposed action and the Helena Mine complex (approximately 1 mile north-northeast of the fence line for the proposed action)]. At the R2 site, one lesser long-nosed bat was detected each year in 2008 and 2009, and three lesser long-nosed bats were detected there in 2011. More than 5,100 lesser long-nosed bats were counted at the Helena Mine complex in 2009, and approximately 4,650 lesser long-nosed bats were detected in 2011. Any individuals present adjacent to the mine footprint would experience effects from light, noise, and vibrations. Although Rosemont has developed a light pollution mitigation plan (Monrad 2012), light from artificial illumination will increase light levels at night, and specific impacts of light on lesser long-nosed bats in the habitat within the project and actions areas are unknown; therefore, increased light levels could disrupt this nocturnal species, resulting in changes in dispersal, reproductive behavior, communication patterns, and decreased foraging success (Longcore and Rich 2004). Similarly, noise and vibrations from construction of the mine or blasting will disturb lesser long-nosed bats, likely causing changes in dispersal, reproductive behavior, communication patterns, decreased foraging success, increased predation and stress response, and possibly damaged hearing if the noise is loud enough (NoiseQuest 2011; Pater *et al.* 2009). The magnitude of impacts from noise, vibration, and light are uncertain, but these impacts are expected to decrease as the distance from the mine increases.

While not addressing impacts to lesser long-nosed bat roosts from noise and blasting, Rosemont will include a conservation measure as part of the proposed action that addresses the threat of human intrusion at these sites. Rosemont will fence or implement some other form of roost protection at the Helena Mine roost site and the R-2 Adit roost site. While these actions will potentially provide long-term protection of these known lesser long-nosed bat roost site, the fencing or other protective measures may also affect the use of these sites by lesser long-nosed bats. Studies show that such measures may alter the microclimate of the roosts, create impediments or hazards within the flight paths of bats entering and exiting the roosts, increase the vulnerability of bats to predators, or attract additional human activity to the sites (Derusseau and Huntly 2012, King 2005, Currie 2001, Spanjer and Fenton 2005, Ludlow and Gore 2000). Rosemont has committed to coordinating these efforts with FWS and suitable entities so that appropriate measures that minimize effects to lesser long-nosed bats will be selected. Many of the potential negative effects of these measures can be avoided or significantly reduced with the selection of appropriate measures and the proper design and implementation of those measures. We are confident that we can work with Rosemont to develop appropriate protective measures for these roost sites, which will also present us with an opportunity to evaluate the effectiveness of the selected protective measures with regard to lesser long-nosed bat roost conservation. Nonetheless, the implementation of protective measures at known lesser long-nosed bat roost sites will have effects and, potentially, incidental take that must be evaluated in this BO.

Effects to Forage

The proposed action will affect lesser long-nosed bats through the removal of potential lesser long-nosed bat forage plants (i.e., paniculate agaves) in the late-summer range of the species. Based on surveys, it is estimated that between 196,268 and 306,209 Palmer agave rosettes will be impacted as a result of the proposed action (WestLand 2009e). In terms of acres of lesser long-nosed bat foraging habitat, the mine pit and associated facilities, including roadways, will remove approximately 5,400 acres of foraging habitat. Effects on lesser long-nosed bat forage plants may also result from an increase in dust levels adjacent to access roads and mining areas. Agaves could be negatively impacted by windborne fugitive dust coating leaves, resulting in reduced photosynthetic activity. Physical effects of dust on plants may include blockage and damage to stomata, shading, and abrasion of leaf surface or cuticle (Goodquarry 2011). Reduced food sources could result in reduced reproduction success or could result in the abandonment of the action area and nearby roosts by lesser long-nosed bats. Known lesser long-nosed bat maternity roosts are all more than 75 miles from the proposed action area; therefore, no effects on lesser long-nosed bat maternity roosts are anticipated.

In some of the WestLand technical reports, particularly WestLand (2012j), various aspects of livestock grazing management on Forest Service-managed allotments that are leased by Rosemont are proposed as a conservation measure to increase the availability of agave flower stalks. The grazing proposals address issues relative to grazing intensity and duration, as well as stock tank management. The proposal to reduce grazing pressure is proposed as a measure (in addition to agave planting) to compensate for the effects of the project on forage of lesser long-nosed bats under the premise that reduced livestock grazing pressure during the agave bolting period will increase the number of available agave flower stalks when compared to the current livestock grazing approach. As outlined in Coronado National Forest's second supplemental BA, we agree that the revised grazing management cannot completely compensate for the loss of agaves in the project area, nor can any of the other proposed conservation measures (reclamation using agaves and additional agave planting) completely compensate for the loss of agaves. We agree with the rationale outlined in the second supplemental BA emphasizing that (1) some of the project area capable of growing agaves will be permanently removed from the landscape by the action (e.g., formation of the pit); (2) there are uncertainties about the ability to grow, transplant, and recruit Palmer's agave on the potentially capable areas following disturbance (e.g., waste rock facilities, roads, plant site); (3) previous consultation on livestock grazing has shown "no adverse effect" to lesser long-nosed bats from grazing anyway; (4) only 10 percent of the agaves lost from the project will be mitigated for by being planted; (5) seed mixes containing agave seeds are untested; (6) limited offsite, disturbed areas lacking agaves are proposed for restoration; and (7) conservation lands are not expected to differ significantly from the surrounding areas, with or without grazing (although easements could preclude future development or other actions with negative effects to lesser long-nosed bats). Nevertheless, FWS, like the Coronado National Forest, does support the concept of reduced grazing to help offset the effects of the action on Palmer agaves, the primary food source of the lesser long-nosed bat, although we do not have specific data to determine the extent of this reduction or the potential benefit to lesser long-nosed bats. Additionally, we have found in previous section 7 consultations that there has not been an adverse effect to lesser long-nosed bat from grazing on Palmer agave (FWS 2015, 2008, 2007d).

As part of the proposed action, Rosemont will reroute portions of the Arizona Trail. On the one hand, this will reduce the potential for human disturbance at the Helena Mine lesser long-nosed bat roost site, but it will also result in new disturbance of lesser long-nosed bat foraging habitat and increase the human disturbance along the new Arizona Trail route. The proposed reroute of the Arizona Trail will encompass approximately 13 miles and 19 acres of disturbance. The proposed trail reroute will not occur in proximity to any additional, known lesser long-nosed bat roosts. Effects to vegetation will occur, including the possibility of additional impacts to agaves. Rosemont has included the potential planting or revegetation with agaves of the old Arizona trail alignment. This will help offset the additional impacts to lesser long-nosed bat foraging habitat.

Effects from Noise and Lighting

Artificial light from the mine activities was recognized as a source of effects to lesser long-nosed bats in the Coronado National Forest's June BA and October Supplemental BA. The proposed action is expected to produce approximately 6.4 million lumens, which takes into account all lighting sources, including equipment-mounted lighting systems. To date, there is limited information on the existing condition, other than the qualitative observation that there is little existing artificial light, so the area is fairly dark. Because the project will operate around the clock, additional light pollution is of concern to astronomical interests and to the environmental community in general, particularly with regard to nocturnal species such as the lesser long-nosed bat. In the BA and Supplemental BA, there was some information on environmental consequences of light from the mine, but the existing technical reports targeted effects of “light pollution” and sky glow, primarily for astronomy and observatory concerns. More recently, WestLand produced another technical report related to the quantification of effects of the lighting associated with the Rosemont Mine Project (Westland 2012f). This report helped to quantify the intensity and attenuation of light within twelve miles of the project area, using predictive modeling based on known and assumed lighting sources and the topography of the area. This report displayed predicted increases in horizontal light from artificial sources at the proposed copper mine.

Increases in light were displayed as increases to ambient light levels in terms of natural light levels (i.e., increase in artificial night light, based on different phases in the moon). The report also made it easier for us to envisage the amount of light at night from sky glow—it stated the artificial light would emit about the same number of lumens as the towns of Sells or Ajo,Arizona. That can be compared to the previous expectation (related to the initial Mine Plan of Operation) of sky glow similar to that in Nogales, Arizona. The Monrad (2012) and WestLand (2012g) reports both emphasize the improvements in the most recent lighting plan. The design features (which are not considered species-specific conservation measures) in the revised lighting plan are somewhat responsive to mitigating effects of lighting on plants and animals (Rich and Longcore 2006). In particular, part of this edited book that focuses on birds, Gauthreaux and Belser (2006, p. 87), lists the following “lighting control strategy options” (albeit more geared to office buildings than mines):

- Installing motion-sensitive lighting
- Using desk lamps and task lighting
- Reprogramming timers
- Adopting lower-intensity lighting

Other taxa accounts in Rich and Longcore (2006) mention how certain wavelengths of emitted light can be adjusted to decrease effects to certain animals. At least some of the design features that employ these measures are discussed in Monrad (2012) and WestLand (2012g). These reports do show that there was a significant effort on the part of the proponent to reduce lighting effects, but artificial night-lighting will still affect the lesser long-nosed bat for the next 25 to 30 years, despite the fact that Rosemont has committed to use light sources that minimize short wavelengths of light in an effort to reduce potential effects to wildlife.

Vehicular traffic will be present on SR 83, the west and east access roads, and within the project area. It is important to consider synergistic effects of human activity related to artificial night lighting. Vehicular light, especially, will be compounded by noise at the source of activity. As an example, for a moving vehicle at night, effects of artificial lighting are synergistic with noise pollution and motion, resulting in a loud, bright, moving object).

The Rosemont Mine project will create an epicenter of relatively intense lighting, similar to the light output of “the towns of Sells and Ajo”, as mentioned above. This new occurrence of light in an area where such lighting has not occurred in the past can impact wildlife. For example, a migratory bird flying over the area could be affected by this epicenter of artificial light from the project (see Gauthreaux and Belser 2006). Certainly artificial night light in proximity to the source would have a more significant impact on nocturnal species, such as the lesser long-nosed bat, than areas where the light becomes more diffused, such as in areas peripheral to the light source. Another aspect that cannot be readily quantified is the amount of light at an angle above the horizontal, but below the vertical. This is a possible issue for volant species. For example, when lesser long-nosed bats exit their roosts, they will quickly be above the horizontal, in an area experiencing elevated artificial light levels; spatially, this would be an area larger than that depicted by the figures presented by WestLand (2102g).

There are many ways that plants and animals can be affected by artificial night lighting. Beier (2006) discussed some of the major physical and behavioral effects to mammals:

• Disruption of foraging behavior
• Increased risk of predation
• Disruption of biological clocks
• Increased deaths in collisions on roads
• Disruption of dispersal movements
• Disruption of corridor use

While the specific effects of the lighting associated with the proposed Rosemont mine are largely unknown and discussed in terms of our best professional judgment, we do anticipate a real effect on the use of the area in the vicinity of the mine by foraging lesser long-nosed bats and, potentially, effects on the use of roost sites affected by the lighting of the proposed mine.

In the past century, the extent and intensity of artificial night lighting has increased such that it has substantial effects on the biology and ecology of species in the wild (Longcore and Rich 2004). Recent studies have shown that artificial lights affect the movements of bats through the landscape, particularly slower flying bats. Stone *et al.* (2009) and Rydell (1992) showed in separate studies that street lighting disturbed and even prevented movements by certain species of bats; primarily bats with slower flight behavior. Recent telemetry research conducted by the Arizona Game and Fish Department (AGFD) on foraging lesser long-nosed bats in the Tucson Basin shows that foraging bats travel along washes as they move between foraging areas and roost locations. The AGFD believes that the washes provide areas of reduced lighting that provide pathways for movement while reducing the likelihood of predation and other threats (AGFD 2009b). Lesser long-nosed bats use a hovering, slow flight while foraging and, as the AGFD research suggests, may be avoiding areas with artificial lighting. A study by Scanlon and Petit (2008) showed that urban parks without artificial lighting had higher bat use and bat species diversity than urban parks with artificial lighting, further indicating that artificial lighting can affect bat use and movements. A number of other studies also show negative effects on bat emergence, roost sites, movements, feeding behavior, and prey relationships (Boldogh *et al.* 2007, Holsbeek 2008, Fure 2006, Bat Conservation Trust 2008, Downs *et al.* 2003). During a study on a nectar feeding bat species more closely related to the lesser long-nosed bat, Winter *et al.* (2003) found that *Glossophaga soricina* locates forage using ultraviolet light reflected by forage species. Because this attribute has not been researched in lesser long-nosed bats, it is not known whether lesser long-nosed bats have this same ability. However, these bats are in the same taxonomic family, and artificial light may cause interference or redirect foraging lesser long-nosed bats keying on ultraviolet light sources or reflections. We do not, however, have enough information to definitively evaluate this potential effect. Ongoing research by AGFD and others may provide additional information in the future regarding this issue. Information specific to the effects of lighting on lesser long-nosed bats are limited. We know that lesser long-nosed bats forage in areas which have increased levels of light compared to non-urbanized areas. However, given the observations of telemetered lesser long-nosed bats using areas of little or no urban lighting to move within the landscape, we anticipate that the light emitted as a result of the Rosemont will have effects to foraging and, potentially, roosting lesser long-nosed bats evidenced by reduced use or abandonment of the area.

Noise effects to lesser long-nosed bats are related to blasting and drilling, ore processing, and waste rock and tailings placement. Day-to-day operations of the plant and associated travel by trucks and other equipment also contribute to noise impacts in the vicinity of the Rosemont Mine project. While much of the more intense activity will occur during daylight hours, the proximity of known lesser long-nosed bat roosts make it likely that day-roosting bats will be affected by the increased noise levels of the proposed mine. Lighting and noise disturbance will also affect foraging lesser long-nosed bats in the vicinity of the mine as some mine activity will occur around the clock.

Changes in Lesser Long-Nosed Bat Status Within the Action Area

Lesser long-nosed bats exhibit high fidelity to maternity roosts, returning year after year. Fidelity to post-maternity roost sites, such as those located within the action area of the Rosemont Mine project, is not as strong. The numbers of lesser long-nosed bats using post-maternity roost sites varies from year to year, and some sites may not be used every year. This is apparently in response to variability in the quantity and location of available forage resources. In some ways, this makes the conservation and protection of known post-maternity sites equally as important as the protection of maternity roost sites. The availability of post-maternity roost sites distributed across the landscape allows lesser long-nosed bats to take advantage of variable and ephemeral food resources. Without the flexibility of multiple roost sites from which to select, the most efficient and effective use of forage resources by lesser long-nosed bats may be precluded. As a result, altered timing of migration and inability to obtain adequate resources may result in migrating lesser long-nosed bats in poor condition which can contribute to increased mortality and reduced productivity.

A number of the lesser long-nosed bat roosts within the action area occur on private lands and may or may not be subject to section 7 consultation for actions that could be proposed on these lands and which could affect lesser long-nosed bat roost sites. Lesser long-nosed bat roosts on public lands have been affected despite the efforts to protect those sites and despite the fact that such actions underwent section 7 consultation. In recent years, lesser long-nosed bat use at known roost locations has been affected by the occurrence of large wildfires and activities associated with illegal border crossing at these roost sites. These threats to lesser long-nosed bat roosts are not expected to diminish in the future. Ten additional post-maternity lesser long-nosed bat roost sites are located outside of the immediate vicinity of the Rosemont Mine project, but within the action area. Effects to any of these roost sites from fire, illegal border activities, poor forage production, or other threats may necessitate the use of the roost sites near the Rosemont Mine project. The converse is also true if the effects of the Rosemont Mine cause the roost sites near the mine to be abandoned or the use of those roosts to be reduced, necessitating the need for those bats to find and use alternative roost sites within the action area. If lesser long-nosed bats are unable to find alternative roost sites, their migratory patterns, body condition, and, ultimately, productivity may be affected.

We conclude that the availability of post-maternity roost sites across the range of the lesser long-nosed bat is crucial to this species' ability to meet its life history requirements. In particular, this availability contributes to the lesser long-nosed bat's ability to use an ephemeral and variable forage resource, as well as find protection afforded by roost sites if other roost sites within the range of the bat become compromised. The roost sites affected by the Rosemont Mine may reduce the availability of post-maternity roosts in this area of the lesser long-nosed bat's range, and correspondingly reduce options for this species to meet its life history requirements.

The *Lesser Long-nosed bat Recovery Plan* (FWS 1997) states that reclassification of the species from endangered to threatened would be warranted if all of the following criteria are met: (1) each major roost population in Arizona and Mexico is monitored for at least five years; (2) the results of that monitoring show that population numbers are stable or increase over the higher set of population figures appearing in this recovery plan; (3) sufficient progress has been made in the protection of roosts and forage plants from disturbance or destruction; (4) no new threats to the species or its habitat have been identified or there are no increases to currently recognized threats; and (5) the [FWS] Service determines the species is no longer endangered. The *Lesser Long-Nosed Bat* (Leptonycteris curasoae yerbabuenae) *5-Year Review: Summary and Evaluation* (FWS 2007b) considered additional data collected since the Recovery Plan was prepared and stated that the primary recovery actions are to monitor and protect known roost sites and foraging habitats. The proposed action will result in the loss of a single roost site as well as an appreciable acreage of forage resources, but the lesser long-nosed bat's flexibility in selecting roosts and foraging areas, the protection of roosts elsewhere, the partial replacement of forage resources on-site, and the continued presence of roosts and forage plants in areas not affected by the Rosemont Copper Mine, make it unlikely that the ability to recover the species (meet the recovery criteria) will be diminished.

Cumulative Effects - Lesser Long-Nosed Bat

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 BO. 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.

The majority of lands within the action area are managed by Federal agencies; thus, most activities that could potentially affect lesser long-nosed bats are Federal activities that are subject to section 7 consultation. The Coronado National Forest and BLM manage approximately 45 percent of the lands within the action area and administer projects and permits on those lands; therefore, some of the activities that could potentially affect lesser long-nosed bats are likely Federal activities subject to additional Section 7 consultation under the ESA. The effects of these Federal activities are not considered cumulative effects.

Residential and commercial development, farming, livestock grazing, actions resulting in the invasion of buffelgrass, 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 continued road maintenance, grazing activities, and recreation in the action area, current and future development, other nearby mining projects, and unregulated activities on non-federal lands, such as trespass livestock and inappropriate use of OHVs, 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.

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 considered in this BO.

Conclusion - Lesser Long-Nosed Bat

After reviewing the current status of the lesser long-nosed bat; the environmental baseline for the action area; the effects of the proposed action; and the cumulative effects, 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. Our conclusion is based on the following:

1. Take of lesser long-nosed bats will occur as a result of the proposed action. Direct take of individuals is possible related to potential collisions with fencing or other protective structures and/or increased predation associated with the proposed conservation measures related to the Helena and R-2 roost sites. Other direct take associated with the proposed action is not anticipated because of certain proposed conservation measures, including survey and exclusion, which is included in the project design. Indirect take is expected in the form of harm or harass as a result of the complete loss of one lesser long-nosed bat roost site, and effects to two adjacent lesser long-nosed bat roost sites from increased human activity, and associated noise and light effects. Additional indirect take is anticipated from the significant loss of forage resources within the mine footprint, and the reduced availability of forage resources for some distance around the mine due to increased human activity, and associated noise and light effects. However, Rosemont has proposed conservation measures (see Proposed Action section above) to offset and reduce the potential for such indirect take associated with the proposed action. We conclude that these measures address the anticipated effects to lesser long-nosed bats to the extent that the proposed action will not jeopardize the continued existence of the lesser long-nosed bat.

2. Monitoring and adaptive management will be applied to evaluate the effects of the proposed action, as well as the effectiveness of proposed conservation measures. This process will allow the Coronado National Forest and FWS to evaluate and adapt the approach of the proposed conservation measures to be as effective as possible.

3. Because of the patchy and random distribution of agaves on the landscape, it is very difficult to estimate the total acres of available lesser long-nosed bat foraging habitat in southern Arizona. However, we can conclude that the acreage of lesser long-nosed bat foraging habitat affected by the proposed action is a very small proportion of the available foraging habitat. Nonetheless, the proposed loss of lesser long-nosed bat foraging habitat in the action area is locally significant. The acquisition and conservation of lands in the vicinity of the proposed mine will provide conservation benefit to the lesser long-nosed bat. Currently, these lands are subject to potential actions that could affect lesser long-nosed bat forage resources. The conservation, monitoring, and adaptive management approach for these lands will provide a conservation benefit to lesser long-nosed bats.

4. Rosemont has proposed multiple conservation measures and project actions designed to reduce the effects of noise and light on the adjacent lesser long-nosed bat roosts. If these measures are

successful or, through adaptive management, can be revised to be successful, the protective measures implemented at the Helena and R-2 roost sites will reduce the potential for roost disturbance by human intrusion at these sites. This provides a conservation benefit for the lesser long-nosed bat.

5. Rosemont has proposed ongoing roost surveys and monitoring, and exclusion of bats prior to closure for small lesser long-nosed bat roosts to be lost as a result of the proposed mine. Currently, only one such small lesser long-nosed bat roost is known within the project area (the Chicago Mine). The potential for direct mortality of lesser long-nosed bats within this roost, as well as any other small lesser long-nosed bat roosts found within the construction area, will be reduced by implementing exclusion of lesser long-nosed bats prior to construction.

6. Agaves will be included in restoration and reclamation activities associated with the proposed Rosemont Mine project. While there will be a temporal loss of forage resources, these restoration and reclamation activities will reduce the long-term loss of lesser long-nosed bat forage resources. Additionally, if the proposed changes to livestock grazing management, as outlined in the conservation measures above, are effective in reducing livestock impacts to agave flowering, some level of additional lesser long-nosed bat forage resources may be available on those allotments within the action area.

7. The effects and actions noted under Conclusions 2 through 6, above, will make the proposed action unlikely to diminish the potential to recover the lesser long-nosed bat.

The conclusions of this BO 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 - LESSER LONG-NOSED BAT

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 included by the USFS as binding conditions of any grant or permit issued to the applicant, as appropriate, for the exemption in section 7(o)(2) to apply. The USFS has a continuing duty to regulate the activity that is covered by this Incidental

Take Statement. If the USFS (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 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, the USFS, or the applicant 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 - Lesser Long-Nosed Bat

We anticipate incidental take of lesser long-nosed bats as a result of this proposed action in the form of direct mortality, as well as harm or harassment due to the effects of locally-significant loss of forage resources, and to human disturbance and associated effects of noise and light. These effects are anticipated to cause lesser long-nosed bats to reduce their occupancy or abandon adjacent roost sites and move to alternate roost sites in the area, potentially affecting the regional population of lesser long-nosed bats through overuse of limited local forage and roost resources.

Specifically, incidental take for the currently proposed Rosemont Mine project is anticipated as follows:

Take associated with roosts – It is difficult to assess take in the form of harm or harass for individual lesser long-nosed bats at roost sites because the number of individual bats fluctuates over time, and the take of individuals may actually occur away from the original roost site as a result of bats abandoning a known roost. Direct take (mortality of those bats left inside inadvertently and harm of those forced to relocate) resulting from the closure of a known roost site is more easily quantified, but is still dependent on the number of bats present if the closure occurs while the roost is occupied. Even if bats are excluded prior to closure, or if closure of the roost occurs during a time of year when the bats are not present, take of lesser long-nosed bats in the form of harm can still occur as a result of the loss of necessary habitat elements supporting the life history requirements of lesser long-nosed bats. The effects of noise, lights, and increased human activity in proximity to known lesser long-nosed bat roost sites, to the extent that such effects result in reduced occupancy or abandonment of the roost site, represents take in the form of harass. It is more logical to quantify take of lesser long-nosed bats in relation to the number of roosts affected, rather than at the scale of individual lesser long-nosed bats.

For the reasons described above, we use the number of roosts lost or affected as a surrogate for take, rather than quantifying individual bats. We anticipate the loss of the Chicago Mine roost site as a result of the proposed mine. We also anticipate the loss of the R-2 and Helena roost sites if noise and light conservation measures and best management practices outlined earlier in this BO prove to be ineffective. While there is some potential for loss of other roost sites (Rosemont will continue reconnaissance-level surveys and may close additional occupied small roosts following exclusion of the bats), we conclude this is unlikely to occur because no additional occupied roosts have been found within the action area during previous surveys. If additional roosts are found, closure would be limited to small roost sites and exclusion should eliminate direct take of the bats occupying these small sites. Total take related to lesser long-nosed bat roosts for the Rosemont Mine project is three post-maternity roosts (approximately 6,000 bats); this is a relatively small proportion of the total numbers of bats known from population surveys (see Status of the Species section, above).

While the implementation of protective measures at known lesser long-nosed bat roosts should result in long-term conservation benefits to the species, these measures can also result in mortality of individual bats due to collisions with the structures (gates, fences, etc.) or increased predation due to altered exit and return behavior of the bats. We believe most of these potential issues can be avoided by proper installation and design. However, the potential exists for some mortality of lesser long-nosed bats to occur. Therefore, we anticipate that up to 10 lesser long-nosed bats may be directly taken as a result of the implementation of protective measures at known lesser long-nosed bat roosts.

<u>Indirect take associated with the loss of locally significant lesser long-nosed bat forage resources</u> – Indirect take of lesser long-nosed bats associated with the loss of important forage resources will occur in the form of harm or harass. Harm will occur due to the permanent loss of locally significant forage resources. Take in the form of harass will occur if lesser long-nosed bats are precluded from using available forage resources due to noise, light, or increased human activities associated with the proposed Rosemont Mine. Such take is difficult to quantify and document at the level of individual bats. 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. Loss or reduced availability of lesser long-nosed bat forage resources can result in energetic impacts to lesser long-nosed bats. These effects can result in lesser long-nosed bats having to travel farther to find available forage resources, thereby using additional energetic reserves. If available forage resources are more limited than those lost due to the Rosemont Mine project, energetic rewards will be reduced, potentially affecting the wellbeing of affected individuals. Because lesser long-nosed bats are migratory, the inability of individual bats to acquire the needed resources for migration, due to reduced forage availability, affects multiple aspects of this species' natural history.

Additional intra-specific competition for reduced forage resources may also occur. Lesser long-nosed bats have high roost fidelity and increasing the number of bats using particular foraging areas due to lost forage resources resulting from Rosemont's mining project can lead to increased intra-specific conflicts. Increased travel distance to use available forage also exposes lesser long-nosed bats to increased risk of predation, collision, and other environmental threats. As indicated in the Recovery Plan and the 5-Year Review, adequate forage appropriately distributed across the range of the lesser long-nosed bat is needed to achieve recovery of the population. The widespread failure of agave flowering in 2006 impacted the lesser long-nosed bat population through increased use of hummingbird feeders as a source of food and migration out of the area earlier that would occur under normal agave flowering conditions. If lack of forage on the landscape in southeast Arizona results in changes in lesser long-nosed bat migration patterns as was seen in 2006, this can affect whether forage resources are available to the bats along the migration route due to the need to time forage availability with occupancy of the landscape by lesser long-nosed bats. The ability of this species to migrate, breed, and over-winter is dependent on adequate forage available at the time the bats are present. If this does not happen, population level effects to the species could occur. Given a reduced baseline of available lesser long-nosed bat forage due to recent large, intense wildfires in the Chiricahua, Huachuca, and Atascosa mountains, additional forage losses due to the proposed action could limit available forage in the region and result in more widespread, population level impacts to this species resulting from the potential need to switch roosts, travel longer distances to forage, and possible changes to the timing of migration, which, if the timing of migration changes enough, may affect forage availability as the bats migrate south.

Therefore, we will use the number of acres of forage resources lost as a surrogate for take of individual lesser long-nosed bats. With regard to the amount of incidental take authorized under this BO, using habitat as a surrogate for take of individual lesser long-nosed bats, the FWS authorizes take in the form of harm and harass due to the loss of significant forage resources for up to and including 5,431 acres (see the May 2015 Supplemental BA, USFS 2015) of lesser long-nosed bat foraging habitat (acres of habitat supporting Palmer's agave). This take is anticipated for the long-term loss of foraging habitat within the footprint of the mine pit and mine facilities, including roadways, utility corridors and relocation of the Arizona National Scenic Trail.

In summary, and stated differently, the maximum allowable incidental take of lesser long-nosed bats is: (1) harassment of 6,000 individuals at three post-maternity roosts; (2) harm of ten individuals at known lesser long-nosed bat roosts subject to the implementation of protective measures; and (3) loss of 5,401 acres of affected habitat containing Palmer's agave, a surrogate measure of take (via harm and harassment) of individuals. We estimate that approximately 80,000 lesser long-nosed bats occupy southern Arizona from April through October, using 40+ known roost sites. The number of bats using individual roosts fluctuates within and among years due to forage and weather conditions. The estimated level of take anticipated in this BO will not reduce the potential for recovery of this species because the numbers of bats and roosts affected by the proposed action is a small proportion of the bats and roosts statewide and represents post-maternity use that is naturally variable based on the lesser long-nosed bat's life history. The loss of 5,000+ acres of lesser long nosed bat foraging habitat, while locally important, will also not reduce the potential for recovery of this species rangewide because of the small fraction of available lesser long-nosed bat habitat that this represents.

Effect of the Take - Lesser Long-Nosed Bat

In this BO, the FWS determines that this level of anticipated take is not likely to result in jeopardy to the species for the reasons stated in the Conclusions section. No critical habitat has been designated for the lesser long-nosed bat; therefore, no critical habitat will be destroyed or adversely modified.

Reasonable and Prudent Measures - Lesser Long-Nosed Bat

The Rosemont Copper Company has included a number of measures and design elements within their proposed action that should, once completely implemented, reduce the proposed action's adverse effects to lesser long-nosed bats. The following Reasonable and Prudent Measures are necessary and appropriate to minimize the effects of take on lesser long-nosed bats:

1. The USFS (and Corps, as appropriate) shall ensure that Rosemont works with the USFS and FWS to permanently protect a known lesser long-nosed bat roost site within, or as close to the action area as possible.

2. In the event that either the R-2 and/or Helena lesser long-nosed bat roosts are abandoned or experience a significant reduction in occupancy over time, and these occurrences can be reasonably attributed to the proposed Rosemont Mine, the USFS (and Corps, as appropriate) shall ensure that Rosemont works with the USFS, Corps, and FWS to permanently protect an additional lesser long-nosed bat roost site (for a total of two sites, including the site protected in Reasonable and Prudent Measure 1, above) within the action area.

3. The USFS and Corps shall ensure that the Rosemont Copper Company Rosemont shall monitor

the effectiveness of protective measures implemented at the Helena and R-2 roost sites, including effects to bat behavior, and bat mortality or predation, and occupancy of the sites. Monitoring shall also occur at any other lesser long-nosed bat roosts where protective measures are implemented as part of the conservation measures outlined in the proposed action.

4. In addition to the agave planting outline in Conservation Measure 11 (see the Description of the Proposed Action section in the October 30, 2013, Final BO) for lesser long-nosed bats, Rosemont shall implement additional agave planting and monitoring within the action area to help offset losses of lesser long-nosed bat forage resources associated with the proposed action.

5. Rosemont shall implement conservation measures and Reasonable and Prudent Measures, except for survey and monitoring activities, during the times of year when lesser long-nosed bats are not present.

6. Rosemont shall annually report to the FWS the results of the implementation and results of the Terms and Conditions outlined below.

Terms and Conditions - Lesser Long-Nosed Bat

In order to be exempt from the prohibitions of section 9 of the Act, Rosemont shall comply with the following terms and conditions, which implement the reasonable and prudent measures described above and outline required reporting/monitoring requirements. These terms and conditions are non-discretionary.

1. The following terms and conditions implement Reasonable and Prudent Measures 1 and 2 for the lesser long-nosed bat:

    a. The USFS and Corps shall ensure that Rosemont implements protective measures at a known lesser long-nosed bat roost site within, or as close to the action area as possible. The known roost where this term and condition will be applied, as well as the appropriate associated protective measures, will be evaluated and selected through coordination with FWS (in coordination with other appropriate wildlife agencies), and the USFS (for biological and technical input as well as to incorporate concerns with the agency's existing Abandoned Mine Lands program).
    b. Based on information gathered as outlined in the Conservation Measures for lesser long-nosed bats in the October 30, 2013, Final BO, if Rosemont or their agents observe during monitoring at either the R-2 or Helena lesser long-nosed bat roosts: (1) an up to 25 percent decline in the numbers of lesser long-nosed bats for 3 consecutive years; or (2) a greater than 25 percent decline in each of 2 years; or (3) a complete abandonment of the roost in 1 year, the adaptive management as described in Conservation Measure 9 will include selection of protective measures to be applied to another known lesser long-nosed bat roost within or as close to the action area as possible. Known roosts and associate protective measures will be evaluated and selected through coordination with FWS and AGFD.
    c. Protective measures agreed upon by the Coronado National Forest and the FWS at the selected roost sites on National Forest System and/or Rosemont private lands shall include completion of any environmental compliance requirements and initiation of project

elements within one year of roost site selection.

d. Pre- and post-implementation monitoring will occur at these roost sites, with an annual report to the FWS for a period of four years (1 season of pre-implementation monitoring and 3 seasons of post-implementation monitoring).

2. The following term and condition implements Reasonable and Prudent Measure #3 for the lesser long-nosed bat:

With input from the USFS, and FWS, in coordination with AGFD, and other bat experts, the USFS and Corps shall ensure that Rosemont implements a monitoring program to evaluate the effectiveness of protective measures implemented at known lesser long-nosed bat roosts as part of the conservation measures included in the proposed action. Monitoring shall include a minimum of three visits per season and include methods to evaluate:

- as appropriate, any collisions, increased predation over existing levels, or other sources of lesser long-nosed bat mortality associated with the protective measures.
- the long-term integrity of structures installed as part of the protective measures.
- any impacts to exit and return behavior of lesser long-nosed bats that may be caused by the protective measures. Note that pre-installation monitoring must be conducted so that changes can be detected.
- the effectiveness of the protective measures in reducing disturbance and other impacts to lesser long-nosed bat roosts. Pre-installation assessment of the disturbance and other impacts must be conducted so that changes can be detected.

Results of this monitoring program shall be reported in the annual report to FWS as outlined in the Conservation Measures section of this BO.

3. The following terms and conditions implement Reasonable and Prudent Measure #4 for the lesser long-nosed bat. The objective of these terms and conditions is to seek to restore an equivalent acreage of agave habitat affected by the proposed action:

a. The USFS and Corps shall ensure that Rosemont reclaims the short road segment leading to the R-2 Adit roost site, including the use of agave planting (if the USFS, Rosemont, and FWS, in coordination with AGFD, determine site conditions would support the species) to reduce the likelihood of human intrusion at this roost site.

b. The USFS and Corps shall ensure that Rosemont investigates the feasibility of agave plantings at ecologically appropriate sites on proposed conservation lands, including Sonoita Creek Ranch, Davidson Canyon Watershed parcels, and Helvetia Ranch North parcels. Plant agaves at ecologically appropriate densities([as determined by Rosemont and FWS in coordination with AGFD) and conduct follow-up monitoring at sites where such plantings are feasible and have a high likelihood of success. The status and success of these efforts should be included in the annual report to FWS as outlined in the Conservation Measures section of this BO.

4. The following term and condition implements Reasonable and Prudent Measure #5 for the lesser

long-nosed bat:

a. The USFS and Corps shall ensure that Rosemont implements conservation measures related to known lesser long-nosed bat roost protection, to the proposed rerouting of the Arizona Trail, to reclamation and revegetation, and any other project activities that will occur in proximity to known lesser long-nosed bat roosts during the time of year when lesser long-nosed bats are not present in the project action area. Such activities could typically be carried out from November 1 to July 1 of each year.

5. The following term and condition implements Reasonable and Prudent Measure #6 for the lesser long-nosed bat:

a. In addition to the reporting requirements already specified as part of the proposed action, the USFS and Corps shall ensure that Rosemont, or their agents, report to FWS as follows:

The monitoring and adaptive management process outlined in the BA and this BO is key to reducing take of lesser long-nosed bats resulting from the implementation of this project. Therefore, Rosemont shall report to the FWS the results of all monitoring and adaptive management actions undertaken as a result of this project. Annually, and in compliance with the reporting deadlines outlined above in this BO, Rosemont shall provide a report to FWS that includes: (a) any new lesser long-nosed bat roosts documented as a result of monitoring; (b) monitoring data for all roost sites occupied by lesser long-nosed bats for which Rosemont has monitoring responsibility including dates and numbers of lesser long-nosed bats counted; (c) classification of each lesser long-nosed bat roost monitored with regard to season of use; (d) any documented negative effects of the protective measures as discussed in Term and Condition #2 above, e) any recommendations to remove or alter the roost protective measures or change the monitoring protocol; (f) results of monitoring to document the effectiveness of the roost protection measures implemented at the Helena and R-2 roost sites, as well as any additional lesser long-nosed bat roost protected as a result of the implementation of the conservation measures outlined in the proposed action; (g) any other pertinent information related to monitoring and adaptive management under this project.

b. The USFS Biological Monitor shall report to the FWS all data received from Rosemont related to the monitoring of known lesser long-nosed bat roosts and reconnaissance level surveys within 10 working days of each monitoring or survey effort. The USFS Biological Monitor shall report the intent to close any feature that supports 30 or more lesser long-nosed bats to FWS at least 30 days prior to initiating exclusion and closure of the feature. Note that since the USFS Biological Monitor will be employed by the Coronado National Forest, this portion of the Term and Condition applies to the Forest Service.

Review requirement: The reasonable and prudent measures, with their implementing terms and conditions, are designed to minimize the effect of incidental take that might 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. The Coronado National Forest and/or Corps must immediately provide an explanation of the causes of the taking and review with the FWS the need for possible modification of the reasonable and prudent measures.

Conservation Recommendations-Lesser Long-Nosed Bat

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.

1. We recommend that the Coronado National Forest and Corps participate in the development of a revised long-term monitoring protocol for the lesser long-nosed bat as outlined in the most recent Lesser Long-Nosed Bat 5-year review and the recently completed evaluation by the University of Arizona (Cerro 2012).
2. We recommend that the Coronado National Forest and Corps participate in the development of a range-wide agave monitoring program with a standardized monitoring protocol.
3. We encourage the Coronado National Forest and Corps to initiate or participate in additional lesser long-nosed bat research related to the foraging patterns, roost occupancy patterns, and seasonal behavior of lesser long-nosed bats in southern Arizona.
4. We encourage the Coronado National Forest to work with Border Patrol and the Department of Homeland Security to assess and minimize the impacts of border fences and other facilities on Forest Service lands on the lesser long-nosed bat.

In order for the FWS to be kept informed of actions minimizing or avoiding adverse effects or benefiting listed species or their habitats, the FWS requests notification of the implementation of any conservation recommendations.

Pima Pineapple Cactus

Status of the Species - Pima Pineapple Cactus (*Coryphantha scheeri* var. *robustispina*)

The rangewide status of the Pima pineapple cactus remains substantively the same as it was described in our October 30, 2013, BO. The prior Status of the Species section is incorporated herein via reference with the following updates:

Abundance

As of the autumn of 2015, the Arizona Natural Heritage Program database of individual plant locations for this taxon consisted of 7,558 records, of which 1,837 were known to be dead. Most of the dead plants were reported as a result of a handful of development and mining projects over several years.

We are aware of four instances where repeat measures of individual Pima pineapple cactus have been conducted. First, on fourteen occasions between 1995 and 2010, 45 individual Pima pineapple cactus were followed in an exclosure on Coronado National Forest land in the Santa Cruz Valley. By the last check of these individuals in 2010, no living plants were found (Coronado National Forest 2010). It should be noted, however, that in a partial survey of this area in 2015, some Pima pineapple cactus were found both within and outside of this exclosure (FWS 2015b). Second, in 2003, a total of 260 individuals were located on six monitoring plots in the Altar Valley. These plants were evaluated on six additional occasions through 2012, when 93 of the original plants remained; new individuals were found in some years (Baker 2013). Third, on the Pima County Pima Pineapple Cactus Conservation Bank in 2006, 67 plants were located and mapped. These plants are monitored regularly and when last counted in 2014, 13 of the original plants remained alive and 11 new plants had been found (Pima County 2015). Fourth, on the Palo Alto Pima Pineapple Cactus Conservation Bank in 2001, 49 plants were located and mapped. These plants are monitored regularly and when last counted in 2015, 9 of the original individuals remained alive and 11 new plants were discovered (Westland 2015). In all of these studies, factors such as drought and predation by rodents and insects were the primary causes of death noted (Schmalzel and McGibbon 2010; Baker 2013; FWS 2015a).

Anthropogenic Effects

Urban and suburban development in the areas of Tucson, Green Valley, and Nogales, Arizona and mining in the Sierrita Mountains and Green Valley, threats first recognized in the 1980s (Phillips *et al.* 1981; Mills 1991; Reichenbacher 1985; FWS 2000), are responsible for complete and permanent modification of lands that previously supported Pima pineapple cactus and its pollinators. By 2000, we estimated that 43 percent of the total habitat surveyed to date had been modified or destroyed due to urbanization (FWS 2001). For example, 143 hectares (353 acres) of habitat and 47 individual plants were lost to a single housing development project in 1998 (FWS 1998). The trend continues; in 2014, 197 ha (487 ac) of suitable Pima pineapple cactus habitat and 99 individual plants were lost to a single infrastructure development project.

Since its listing in 1993, there have been 76 formal section 7 consultations under the Act involving Pima pineapple cactus in southern Arizona resulting in the direct mortality of more than one thousand individual Pima pineapple cactus , and 3,238 ha (8,000 acres) of suitable habitat, most of which were related to construction activities. Consultations under the Act only occur for projects with a Federal nexus, either occurring on Federal lands or using Federal dollars or needing a Federal permit. Therefore, many projects that occur within the range of Pima pineapple cactus do not undergo section 7 consultations, and the FWS does not typically receive information regarding the status or loss of plants or habitat associated with those projects.

Predation

Predation by mammals and insects occurs on both adult and seedling Pima pineapple cactus (Phillips *et al*. 1981; Mills 1991; Roller 1996; Schmalzel & McGibbon 2010; Baker 2011; FWS 2015b).Primary insect predators of Pima pineapple cactus are the native cactus weevil (*Gerstaeckeria* sp.; Schmalzel 2002), the native cactus beetle (*Moneilema* sp.), and the native pyralid moth (*Cactobrosis* sp.; SWCA 1999). Harris' Antelope Squirrel (*Ammospermophilus harrisii*) , antelope jackrabbit (*Lepus alleni*), and desert cottontail (*Sylvilagus audubonii*) are known to eat stem material of Pima pineapple cactus, especially when other food sources are scarce, such as in times of drought (Phillips *et al*. 1981; Mills 1991; Schmalzel & McGibbon 2010; Baker 2011; FWS 2015a; FWS 2015b). Many individual Pima pineapple cactus die or become disposed to death annually from predation which has been recorded on numerous occasions over the past decade.

Fire and Non-native Plants

Occurring roughly every 10 to 20 years and following periods of adequate moisture, large-scale low-severity fire defined historical disturbance regimes of desert-grassland plant communities of southern Arizona and northern Mexico (McPherson and Weltzin 2000; Brooks and Pyke 2002; McDonald and McPherson 2011a). Desert-scrubland, where there is decreased annual precipitation compared to desert-grasslands, is typically characterized by low and discontinuous plant fuels, plants that lack fire-adapted characteristics, and fire return interval that may have historically been greater than 250 years (McLaughlin and Bowers 1982; Thomas 1991; Alford *et al*. 2005; Brooks and Pyke 2002; Brooks and Chambers 2011). Pima pineapple cacti occur in both the desert-grassland and desert-scrubland plant communities, especially in the ecotone of the two (Roller 1996, p. 9).

Non-native grasses in both communities compete with native plants for water and nutrients, reduce community composition and structure, and alter fire frequency and intensity. Response of cacti to alterations in fire frequency and intensity have been studied to some extent and some insight can be gleaned from studies of other cacti species. Most studies indicate that, in general, that cacti are not well adapted to fire (e.g. Humphrey and Everson 1951; Thomas 1991; Robinett 1996; Thomas 2006; Schmalzel 2000; McDonald and McPherson 2011b). It is largely believed that Pima pineapple cacti may escape fires in microsites with little fuel (Maender 1993; Roller and Halverson 1997; McDonald 2005; McDonald and McPherson 2006). Microsites become more scarce in non-native grass invaded landscapes (58 FR 49875; McPherson and Weltzin 2000; Brooks and Pyke 2002).

Drought and Climate Change

Southeastern Arizona and much of the American Southwest have experienced serious drought in recent decades (Bowers 2005; Overpeck *et al*. 2013; CLIMAS 2015a) and precipitation is projected to be less and temperatures higher in the future with climate change (Seager *et al*. 2007; Karl *et al*. 2009; Overpeck *et al*. 2013). Plants already stressed from prolonged drought are more susceptible to insect attack and disease (Mattson and Haack 1987). Drought is also directly related to Pima pineapple cactus population health with regard to reproduction and establishment, as adequate precipitation during the seedling's first year of growth is essential for survival (Roller 1996). In addition, extreme temperatures can negatively impact seedling survival, and drought coupled with high temperatures lessens temperature tolerance in seedlings (Nobel 1984). These impacts will continue to affect the Pima pineapple cactus and its habitat throughout its range into the foreseeable future.

Genetics

Three varieties of *Coryphantha scheeri, robustispina*, *uncinata* and *scheeri*, have been investigated recently and were shown to be geographically isolated (Baker 2005), significantly different morphologically (Baker 2003), and significantly different genetically (Butterworth 2010; Baker and Butterworth 2013), warranting subspecific division.

Fehlberg and Nidey noted that cacti species, even rare species, may have higher levels of heterozygosity and outcrossing, in general, with Pima pineapple cactus being no exception (Fehlberg and Nidey 2015). Habitat fragmentation reduces the likelihood of successful pollination as Pima pineapple cactus become more and more isolated from one another and plant community diversity is reduced

Locally, loss of individual cacti reduces the genetic variability in the population through loss of these individuals and their contribution to random assortment. This decreases the potential to maintain and improve variability for adaptation to changing conditions. The implications of the loss of these individuals to the genetic neighborhood size and robustness of the portion of the population near the action area cannot be quantified, as the total number of individuals in the area was not included in surveys conducted, only the number of individuals that would be affected by project activities.

Environmental Baseline - Pima Pineapple Cactus

The Pima pineapple cactus' status in the action area remains substantively the same as that described in the October 30, 2013, BO. The prior Environmental Baseline is incorporated herein via reference, with the following addition based on data contained in the May 2015 SBA:

Recent Surveys

In 2012, WestLand conducted Pima pineapple cactus habitat evaluations on approximately 939 acres of land at Helvetia Ranch Annex North Parcels, 705 acres of which currently support Pima pineapple cactus or which contain soils and other habitat conditions suitable for the species (WestLand Resources Inc. 2012). WestLand surveyed approximately 117 acres (approximately 12 percent of the parcels, or 17 percent of the available habitat) for pineapple cactus. Crews walked parallel belt transects through suitable Pima pineapple cactus habitat. Fourteen Pima pineapple cactus were observed (13 live and 1 dead): 8 were west of the large wash that bisects the parcel, and 6 were west of Gunnery Range Wash. It is likely there are greater numbers of individual Pima pineapple cactus extant within the remaining unsurveyed suitable habitat on the Helvetia Ranch Annex North Parcels.

Recovery Planning – Pima Pineapple Cactus

We have prepared a Draft Recovery Plan for the Pima pineapple cactus (FWS 2016); it is currently under internal staff review and has not been subject to public comment and/or peer review. It must be noted that the draft criteria are subject to refinement during the internal FWS review process, and additional revisions are possible following the eventual public participation and peer review processes. The Draft Recovery Plan identifies the criteria that must be met before we can downlist or delist the taxon; delisting equates with recovery.

<u>Downlisting of Pima pineapple cactus to threatened status may be considered when all of the following conditions have been met to address the threats and stressors to the species:</u>

1. Threat-based objective: Reduce or mitigate habitat loss and degradation, non-native species spread and the resultant altered fire regimes and increased competition, and other stressors, to enhance the continued survival of Pima pineapple cactus and its pollinators.

   Criterion: The successful accomplishment of threat and stressor reduction and mitigation is demonstrated by an increased number of acres of optimal or good Pima pineapple cactus habitat. Habitat is considered optimal when: it is protected for conservation purposes; it is managed in a manner that promotes the long-term survival of Pima pineapple cactus; it has less than 20 percent cover of non-native plant species; it contains contiguous habitat and corridors for pollinators; and where Pima pineapple cactus numbers are observed to be stable or increasing. Habitat is considered good when the cover of non-native plants is between 20 and 35 percent and the land is managed in such a way that promotes the continued existence or expansion of the Pima pineapple cactus population.

   Justification: Accomplishment of this criterion depends on successful promotion of habitat conservation (e.g. land preservation, conservation banking, and strategic habitat restoration) and land management planning to reduce threats and stressors to Pima pineapple cactus (e.g. non-native species management and restoration, land use planning, and soil compaction and erosion prevention) on all lands where Pima pineapple cactus occur.

2. Habitat-based objective: Conserve, restore, and properly manage the quantity and quality of habitat needed for the continued survival of Pima pineapple cactus and its pollinators.

   Criterion: At least 8,094 ha (20,000 acres) of Pima pineapple cactus habitat per recovery unit are documented to be in optimal condition. At least 24,281 ha (60,000 acres) of Pima pineapple cactus habitat per recovery unit are documented to be in good condition. Collectively, this represents approximately 43 percent of the known range of Pima pineapple cactus. Additional acres of lesser quality Pima pineapple cactus also exist throughout the range of the species; some of which occurs on lands where ongoing efforts may continue to improve habitat quality. While no analysis exists which can help us estimate the total acres of habitat needed to support a viable Pima pineapple cactus population, it is our conclusion that achieving the above targets of optimal and good habitat could significantly improve the conservation trajectory and status of this taxon to the point of downlisting under the Act.

   Justification: *Coryphantha scheeri* var. *robustispina* plants that occur in optimal or good condition habitats, as defined above, should have the greatest resilience to non-native plant invasion and associated high severity fire, as well as, climatic extremes and other threats or stressors that are currently unknown. We expect that these habitats will have healthy pollinator populations that enable gene flow within and between Pima pineapple cactus individuals, thus maintaining their long-term genetic diversity.

3. Population-based objective: Conserve, protect, and restore existing and newly discovered Pima pineapple cactus individuals and their associated seedbanks needed for the continued survival of the taxon. The population must be self-sustaining, of sufficient number to endure climatic variation, stochastic events, and catastrophic losses, and must represent the full range of the species' geographic and genetic variability.

   Criterion: Protect mature Pima pineapple cactus individuals and their seedbanks in each recovery unit. Quantitative monitoring of established plots across a variety of land ownerships and with landowner support is conducted within each of the two recovery units every 3 to 5 years with plots demonstrating that the population is increasing a minimum of 10 years over a 15 year period.

   Justification: A mature individual is one that is capable of flowering and producing viable seed. Only mature individuals are considered in meeting this criterion, since large numbers of Pima pineapple cactus seeds may germinate following sporadic rainfall but not live long enough to reproduce. The number of monitoring plots and transects and their locations will be determined within a monitoring plan to be written within five years of the finalization of this document. The 15-year length of this time frame reflects the minimum period required to judge whether a population is stable, declining, or increasing. Due to the wide variation in the region's annual rainfall and the frequencies of severe droughts and freezes, populations will naturally fluctuate. The numbers of individuals during a single year or short span of years may provide a skewed representation of a population's longer-term trend.

To delist Pima pineapple cactus, the first two criteria for downlisting must be met or surpassed, and monitoring demonstrates the population is increasing for a minimum of 20 years over a 30-year period.

The following are the Internal Draft Recovery Plan's list of actions needed to recover Pima pineapple cactus:

1. Reduce the effects of human population growth and development by protecting Pima pineapple cactus habitat, seedbanks, and pollinator corridors.
2. Increase Pima pineapple cactus habitat quality by reducing non-native plant competition, improving native plant diversity and structure, and restoring ecosystem function and natural fire regimes.
3. Conduct research and monitoring that will facilitate better understanding of the taxon's: a) population dynamics and trends, b) life history, c) response to threats, stressors, and land management activities, d) distribution and genetics, and e) other relationships key to its recovery.
4. Develop effective propagation, transplant, and *in situ* planting strategies to promote the introduction and augmentation of Pima pineapple cactus throughout the range of the taxon.

5. Assure the long-term success of Pima pineapple cactus through collaborative partnerships, community involvement, application of regulations, and public education and outreach.
6. Practice adaptive management in which recovery is monitored and recovery tasks are revised by the FWS in coordination with a recovery implementation team as new information becomes available.

Again, we note that the draft recovery actions appearing above are subject to refinement during the internal FWS review process. Additional revisions are possible following the eventual public participation and peer review processes.

Effects of the Proposed Action - Pima Pineapple Cactus

The use of the proposed utility corridor to provide power and water for the Rosemont Mine project will result in direct effects to Pima pineapple cactus owing to the placement of electrical and water transmission lines and associated access roads. This permanent disturbance will remove portions of the seed bank, and areas of associated temporary disturbance could alter the taxon's seed bank. Disturbance of soils will change water infiltration, compact soil, and change local site conditions. Recently disturbed areas have an increased potential to be invaded by noxious weeds (e.g., Lehmann lovegrass), which can negatively affect Pima pineapple cactus. Pima pineapple cactus can be found in areas of recent disturbance, as competition with other plants for nutrients and light are reduced. Although some areas of temporary disturbance may recover, it may take many years before full recovery is achieved. Vasek *et al.* (1975) found that desert vegetation is fragile and easily destroyed, but does have a long-term potential (probably measured in centuries) to recover from substantial disturbance such as that associated with the construction of a utility corridor.

Any individual Pima pineapple cactus growing in the action area outside the mine footprint may experience indirect effects, such as fugitive dust. Effects from dust are likely to occur along the utility corridor as a result of traffic along the associated roadway. Existing traffic occurs in the area of the utility corridor, but the Rosemont mine project will result in a limited increase in traffic in the area of Santa Rita Road as a result of inspections and maintenance along the utility corridor. The FEIS confirms an increase in fugitive dust despite minimization measures.

The physical effects of windborne fugitive dust on plants may include blockage and damage to stomata and shading and abrasion of the plant surface, which could result in reduced photosynthetic activity (Goodquarry 2011) and possibly reproductive success. We hypothesize that fugitive dust may also impact arthropod pollinators of Pima pineapple cactus via occlusion of respiratory spiracles.

The utility corridor component of the proposed action will result in the direct removal of 67 Pima pineapple cactus and permanent or temporary effects to approximately 33.2 acres of Pima pineapple cactus habitat within the action area. Within the context of Pima pineapple cactus individuals and surveyed area we have reviewed through section 7 consultation on development projects, this project adds 67 individuals and effects to 33.2 acres of Pima pineapple cactus habitat to the known baselines. This represents a loss of approximately 3.3 percent of the known individuals and 0.2 percent of the surveyed area we have reviewed through section 7 consultations (including this one). Within the range of the Pima pineapple cactus in Arizona, this brings baseline numbers up to 2,764 Pima pineapple cactus individuals, of which, 2,051 will have been destroyed, removed, or transplanted, and 15,275 acres surveyed, of which

14,612 will have been permanently or temporarily impacted by development projects. To put this into context, the Arizona Natural Heritage Program reports fewer than 6,000 extant individual Pima pineapple cacti throughout the range of the taxon.

To minimize the direct impacts to Pima pineapple cactus and its habitat in the utility corridor, Rosemont proposes to record a restrictive covenant on the Helvetia Ranch Annex North parcels, which contain approximately 939 acres of land that support approximately 705 acres of habitat for Pima pineapple cactus. These parcels were purchased from a developer and were being marketed for residential development. At least 13 individual Pima pineapple cactus were found during a survey of 117 acres of habitat (12 percent of the parcel, or 17 percent of the 705 acres of available habitat). It is likely additional individuals are present in the as-yet unsurveyed habitat. We cannot make estimates of the number or density of plants which may be present on the unsurveyed area because Pima pineapple cactus is not uniformly distributed within its suitable habitat.

To further minimize the indirect effects to Pima pineapple cactus and its habitat from invasive plant species that are likely to colonize disturbed areas within and around the mine site, Rosemont has developed an *Invasive Species Management Plan*. This plan, incorporated herein by reference, is distinct from and in addition to the more-recent Harmful Nonnative Species Management and Removal program, and includes measures such as using weed-free seed and hay in reclamation and compliance actions, avoiding the use of invasive ornamental plants in landscaping and reclamation activities, and cleaning heavy equipment prior to use on the project to remove dirt, plant parts, and other materials that could carry invasive plant seeds. As part of the Invasive Species Management Plan, Rosemont will conduct monitoring of the project area once per year to determine the occurrence of invasive plant species. The goal of monitoring is to detect newly-introduced invasive species and eliminate them before they infest the area and spread to other locations where they can compete with Pima pineapple cactus and/or increase fire frequencies in the cactus' habitat. We note that no comparable invasive species monitoring is proposed for the Helvetia Ranch Annex North parcels.

In summary, the proposed action will result in the direct loss of 67 Pima pineapple cactus and effects to 33.2 acres of Pima pineapple cactus habitat. The proposed action will also result in the protection of at least 13 individual Pima pineapple cactus and 705 acres of habitat for the taxon. Efforts will be undertaken to reduce the potential for invasive plants to colonize the mine site and spread to habitat occupied by Pima pineapple cactus.

Effects to Recovery – Pima Pineapple Cactus

The internal review version of the Draft Recovery Plan for the Pima pineapple cactus (FWS 2016) identifies the criteria that must be met before we can downlist or delists the taxon; delisting equates with recovery (see above). The proposed action is situated in the draft Santa Cruz Valley Recovery Unit.

The proposed action will adversely affect 33.2 acres of habitat occupied by 67 Pima pineapple cactus in the utility corridor, thus failing to implement draft recovery action 1 (reduction of the effects of human development by protecting habitat, seedbanks, and pollinator corridors). This, in turn, adversely affects the implementation of draft downlisting criterion 1 (threat and stressor reduction and mitigation via an increase increased number of acres of optimal or good Pima pineapple cactus habitat), draft downlisting criterion 2 (at least 20,000 acres of Pima pineapple cactus habitat per recovery unit in optimal condition and at least 60,000 acres per recovery in good condition), and draft downlisting criterion 3 (protection of mature Pima pineapple cactus individuals and their seedbanks in each recovery unit). We do not have the data to indicate if the adversely-affected acreage is in optimal and/or good condition, but it supports 67 Pima pineapple cactus). Given that there is a reduced potential to achieving downlisting criteria 1, 2, or 3 in the adversely affected portion of the action area, the proposed action does not contribute to the potential to achieve the sole delisting (recovery) criterion (meeting or surpassing the first two downlisting criteria, and demonstrating, by monitoring, that the Pima pineapple cactus population is increasing for a minimum of 20 years over a 30 year period).

The proposed action will beneficially affect, via permanent conservation, at least 13 Pima pineapple cactus within 705 acres in the 939-acre Helvetia Ranch Annex North parcels, thus implementing draft recovery action 1 (reduction of the effects of human development by protecting habitat, seedbanks, and pollinator corridors). This, in turn beneficially affects the implementation of draft downlisting criterion 1 (threat and stressor reduction and mitigation via an increase increased number of acres of optimal or good Pima pineapple cactus habitat), draft downlisting criterion 2 (at least 20,000 acres of Pima pineapple cactus habitat per recovery unit in optimal condition and at least 60,000 acres per recovery in good condition), and draft downlisting criterion 3 (protection of mature Pima pineapple cactus individuals and their seedbanks in each recovery unit). Again, we do not have the data to indicate if this beneficially-affected conservation property acreage is in optimal and/or good condition, but a survey of 117 acres of the property found 13 individual Pima pineapple cactus; additional individuals are likely present. Monitoring for nonnative plants is not proposed for this site, but we note that the removal of unnecessary roads will involve revegetation with a native-species seed mix (see Description of the Proposed Action section, above). Overall, this aspect of the proposed action represents a positive contribution to achieving downlisting criteria 1, 2, or 3 and thus, the proposed action contributes to the potential to achieve the sole delisting (recovery) criterion.

The proposed *Invasive Species Management Plan* implements draft recovery action implements draft recovery action 2 (increase Pima pineapple cactus habitat quality by reducing non-native plant competition). This contributes to achievement of draft downlisting criterion 1 (threat and stressor reduction and mitigation via an increase increased number of acres of optimal or good Pima pineapple cactus habitat) in that it will minimize the potential for invasive plants to become established at the mine site and be spread to sites containing Pima pineapple cactus. This aspect of the proposed action represents a positive contribution to achieving downlisting criteria1or 2 and thus, the proposed action contributes to the potential to achieve the sole delisting (recovery) criterion.

The FEIS (Volume 2, pages 222-226) discloses that, despite mitigating measures, particulate emissions (which include fugitive dust) will increase. This manner of effect was not specifically considered within the recovery actions and criteria, but it most closely represents a failure to implement draft recovery action 1 (reduction of the effects of human development by protecting habitat, seedbanks, and pollinator corridors). This, in turn, adversely affects the implementation of draft downlisting criterion 1 (threat and stressor reduction and mitigation via an increase increased number of acres of optimal or good Pima pineapple cactus habitat), draft downlisting criterion 2 (at least 20,000 acres of Pima pineapple cactus habitat per recovery unit in optimal condition and at least 60,000 acres per recovery in good condition.), and draft downlisting criterion 3 (protection of mature Pima pineapple cactus individuals and their seedbanks in each recovery unit). This aspect of the proposed action represents a negative contribution to achieving downlisting criteria 1 and 2 thus reducing the potential to achieve the sole delisting (recovery) criterion.

It is difficult to assess the net effect of the proposed action in terms of recovery. On an acreage basis, the adverse effect to 33.2 acres of Pima pineapple cactus in the utility corridor would appear to be more than minimized by the permanent protection of 705 acres of suitable habitat on Helvetia Ranch Annex North. We note, however, that the conservation property is already Pima pineapple habitat and supports individuals. Habitat is not being created, though it is being protected from potential future development. In terms of effects to individual Pima pineapple cactus, however, 67 cacti will be adversely affected in the corridor while 13 plants are known to occur within 117 acres of surveyed habitat on Helvetia Ranch Annex North. It is likely that additional Pima pineapple cacti exist in the 623 acres of unsurveyed area within the 705 acres of Pima pineapple cactus habitat on the parcel, but we cannot estimate their abundance. Further, no matter how many individual Pima pineapple cacti exist on the site, they are extant. No additional individuals are being established, but the cacti present are being protected from potential future development. The beneficial effects of the *Invasive Species Management Plan* are prospective, but they do minimize the potential for the newly-disturbed portions of the Rosemont Mine site to further facilitate nonnative plant invasions.

Recovery Tipping Point

The tipping point at which recovery of Pima pineapple cactus would be precluded requires that we determine the likelihood that the proposed action’s effects to Pima pineapple cactus will appreciably impede or preclude the achievement of the draft down- and de-listing criteria; and if so, are the impediments and/or preclusions of such a scale and/or magnitude that the taxon can no longer be recovered? A tipping point and recovery analysis need not be conducted for critical habitat, as none has been designated for Pima pineapple cactus.

Again, the proposed action will result in a net negative effect to individual Pima pineapple cactus (67 adversely affected, 13 conserved) and a net positive effect to Pima pineapple cactus habitat (33.2 acres adversely affected, 705 acres conserved). The proposed action will minimize the spread of nonnative plants, but will increase particulate pollution.

The stated Recovery Strategy in the Draft Recovery Plan is to preserve and restore quality Pima pineapple cactus habitat to protect individuals and their seedbanks within two recovery units (the Altar and Santa Cruz valleys) which represent the range of the taxon. The preservation and restoration of habitat within these two recovery units will allow a stable, self-sustaining population to persist with some level of connectivity between individuals. Conservation of both individual Pima pineapple cactus and the taxon’s habitat are emphases for recovery, but habitat is given greater weight in the draft downlisting criteria (1 and 2) while populations (groupings of individual plants) are a component of draft downlisting criterion 3. We therefore consider the net effects to Pima pineapple cactus habitat to have somewhat greater analytical importance than the net number of individuals lost.

Pima pineapple cactus habitat is found across approximately 368,702 acres of land within the Altar and Santa Cruz Valleys in Pima and Santa Cruz Counties, Arizona, including acreage of some lands that connect the two valleys. The proposed action will adversely affect 33.2 acres (minimized by the preservation of 705 acres) of existing Pima pineapple cactus habitat; this is an immeasurably small fraction of the 368,702 acres rangewide, regardless of the aforementioned effects to the species recovery potential. Effects of this *de minimis* magnitude are incapable of tipping Pima pineapple cactus towards jeopardy.

With respect to the rangewide abundance of Pima pineapple cactus, the Arizona Natural Heritage Program database of locations for this taxon consisted of 5,721 records (7,558 total records, less 1,837 that were known to be dead) (Tonn pers. comm. November 4, 2015). The loss of 67 existing individual Pima pineapple cactus (partially minimized by the conservation of at least 13 existing individuals) is small relative to the taxon's overall abundance. Again, we anticipate that the proposed action's effects to habitat are incapable of tipping the Pima pineapple cactus towards jeopardy.

Cumulative Effects - Pima Pineapple Cactus

The effects of future State, Tribal, local, or private actions that are reasonably certain to occur in the action area remains the same as described in our October 30, 2013, BO. The Cumulative Effects section for the Pima pineapple cactus from the prior consultation is therefore incorporated via reference.

Conclusion - Pima Pineapple Cactus

After reviewing the current status of Pima pineapple cactus, the environmental baseline for the action area, the effects of the proposed action, and the cumulative effects, it is our biological opinion that the Rosemont Mine project is not likely to jeopardize the continued existence of the Pima pineapple cactus. No critical habitat has been designated for this species; therefore, none will be affected. Our rationale for this conclusion is as follows:

1. The loss of 67 Pima pineapple cactus and effects to 33.2 acres of Pima pineapple cactus habitat represents less than 0.8 percent of the 7,558 Pima pineapple cactus individuals for which HDMS data exist (Tonn, pers. comm.). Additional Pima pineapple cactus and habitat occur throughout the range of the taxon, but we do not have the information to determine the percentage of the overall range which these 67 Pima pineapple cactus and 33.2 acres represent. However, based on the sites we have evaluated in prior consultations and for which we have information, the number of Pima pineapple cactus and acres of Pima pineapple cactus habitat impacted related to this project are relatively small and, additively, contribute a relatively small number of plants and acres to the effects we have evaluated.
2. Rosemont is proposing measures to reduce direct impacts to Pima pineapple cactus during the construction of the utility corridor.
3. To offset effects from the Rosemont Mine project, Rosemont will protect approximately 939 acres within the Helvetia Ranch Annex North parcels by recording a restrictive covenant on the property. The 939-acre parcel contains approximately 705 acres of suitable Pima pineapple cactus habitat; at least 13 individuals were found within 117 acres of the within the 705 acres of suitable habitat. This action will protect Pima pineapple cactus from certain activities outlined as threats to Pima pineapple cactus in our discussion above. This action will also address to some extent the ongoing cumulative effects to Pima pineapple cactus habitat in the vicinity of the action area by removing the potential for future development of these lands.
4. The small magnitude of the effects described under Conclusion number 1, above, is not capable of delaying or precluding recovery of the species. Moreover, the conservation measures described under Conclusion statement number 3, above, may further minimize the adverse effects.

INCIDENTAL TAKE STATEMENT - PIMA PINEAPPLE CACTUS

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 - Pima Pineapple Cactus

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.

1. The FWS recommends that the USFS participate in efforts to identify and conserve Pima pineapple cactus throughout its range, including participation in forums that address the control of invasive, exotic plants (e.g. buffelgrass and Lehmann lovegrass).

2. The FWS recommends that USFS support research and monitoring proposals that will contribute to an increased understanding of important conservation efforts related to Pima pineapple cactus such as the effectiveness of translocating Pima pineapple cactus, appropriate management of conservation lands and conservation banks to promote recovery of Pima pineapple cactus, and effects of climate change and fire on Pima pineapple cactus.

3. The FWS recommends the USFS work with Rosemont to implement measures on the Helvetia Ranch North parcels, including appropriate monitoring of Pima pineapple cactus and Pima pineapple cactus habitat, so that the conservation approach on these parcels is consistent with other conservation lands, including Conservation Banks, established for the conservation of Pima pineapple cactus. These measures should include the following in order to ensure the conservation of Pima pineapple cactus in perpetuity:

   (a.) A management plan addressing actions needed for long-term conservation of the conservation lands, and all Pima pineapple cactus within the conservation lands, should be developed and implemented in perpetuity. The management plan should address issues such as fencing and fence maintenance, invasive species management, fire management, approved and prohibited land uses, maintaining appropriate buffers from surrounding land uses, etc. The management plan should also address monitoring, which should include monitoring every three years to document the status of known cacti, as well as the presence of any new cacti. The term of this monitoring would be 6 years post-closure (to allow for two post-closure surveys). Annual reports on the status of the conservation lands should be submitted to the FWS.

   (b.) Adequate funding should be provided to implement the management plan and required monitoring.

4. The FWS recommends the USFS work with our agency and Rosemont to seedbank and experimentally transplant to appropriate locations (i.e., with no future development potential, including areas with non-severed mineral rights) any of the 67 individual Pima pineapple cactus present within the utility corridor that will be otherwise directly affected by construction and operation of the corridor. We recommend the USFS work with Rosemont to secure seed of the plants in the project area and vicinity on FS lands in a secure seed-bank (preferably the USDA-National Center for Genetic Resources Preservation) for long-term storage and future use. At a minimum, seed for the plants expected to be removed or lost due to the project should be collected prior to their removal. We further recommend that monitoring be performed to test/determine if survivorship is better in an approach using immediate transplant to a new location, or by first transferring the removed plants to an off-site cultivation facility (botanical garden partner, etc.) until they have recovered and formed new root tissue, and then transplanting them to the wild later.

In order that we are kept informed of actions minimizing or avoiding adverse effects or benefiting listed species or their habitats, the FWS requests notification of the implementation of any conservation recommendations.

Disposition of Dead or Injured Listed Species

Upon locating a dead, injured, or sick listed species initial notification must be made to the FWS's Law Enforcement Office (FWS OLE, Resident Agent In Charge, 4901 Paseo del Norte NE, Suite D, Albuquerque, New Mexico 87113; telephone: (505) 248-7889) 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 if possible, and any other pertinent information. The notification shall be sent to the Law Enforcement Office with a copy to this office. Care must be taken in handling sick or injured animals to ensure effective treatment and care, and in handling dead specimens to preserve the biological material in the best possible state.

REINITIATION NOTICE

This concludes formal and conference consultation on the actions outlined in your request. 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 retained (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 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 the listed species or critical habitat not considered in this opinion; or (4) a new species is listed or critical habitat designated that may be affected by the action. In instances where the amount or extent of incidental take is exceeded, any operations causing such take must cease pending reinitiation.

Please note that this consultation has been conducted based on complete implementation of the proposed action, including the proposed conservation measures. Should the conservation measures not be implemented, implemented incompletely, or altered – and those changes result in differing effects to threatened or endangered species and/or critical habitat – reinitiation of formal consultation must be requested. We make specific note of the Incidental Take Statements for the Gila chub, Gila topminnow, desert pupfish, northern Mexican gartersnake, Chiricahua leopard frog, yellow-billed cuckoo, and southwestern willow flycatcher. For these species, the authorized incidental take (or the surrogate measure of that incidental take) is the result of the total incidental take anticipated to result from the proposed action’s adverse effects less the minimized level of take resulting from implementation of the Conservation Measures. In these cases where funding has been provided in lieu of a specific project or projects, a failure to complete the amount of restoration or enhancement that we have anticipated from the funding will result in less of the adverse effects’ incidental take being minimized. This would necessitate an immediate analysis of the need to reinitiate formal consultation. The Huachuca water umbel is a plant and thus lacks an incidental take statement. Nevertheless, the species’ effects analysis includes the beneficial effects of Conservation Measures; the adverse effects of the proposed action would be less effectively minimized if the Conservation Measures are not implemented or are implemented to a lesser extent than anticipated. This may constitute new information with respect to the proposed action’s effects to Huachuca water umbel that was not considered in this opinion; thus also necessitating an immediate analysis of the need to reinitiate formal consultation.

The Incidental Take Statements for the lesser long-nosed bat, jaguar, ocelot, Chiricahua leopard frog, northern Mexican gartersnake, Gila chub, Gila topminnow, and desert pupfish contain Reasonable and Prudent Measures and Terms and Conditions that implement those measures. We reiterate that such measures are non-discretionary, and must be included by the USFS as binding conditions of any grant or permit issued to the applicant, as appropriate, for the exemption in section 7(o)(2) to apply. The USFS has a continuing duty to regulate the activity that is covered by the respective Incidental Take Statements. If the USFS (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 Statements 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, the USFS, or the applicant 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)].

Regarding the proposed action's effects to the respective proposed critical habitats for the yellow-billed cuckoo and northern Mexican gartersnake, you may request the FWS to confirm the conference opinion as a biological opinion issued through formal consultation when the yellow-billed cuckoo and/or northern Mexican gartersnake critical habitat critical habitat are designated. The request must be in writing. If the FWS 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 FWS will confirm the conference opinion as the biological opinion on the project and no further section 7 consultation will be necessary.

In keeping with our trust responsibility to American Indian Tribes for an action proposed by an agency not in the Department of Interior, subject to section 7 consultation, that may affect Indian lands, tribal trust resources, or tribal rights, we encourage you to coordinate with the Tohono O'odham Nation and the Hopi, Pascua Yaqui, and Yavapai Apache tribes and the Bureau of Indian Affairs (BIA). We also encourage you to coordinate implementation of the proposed action, including, as appropriate, actions identified in Reasonable and Prudent Measures and Terms and Conditions, with the Arizona Game and Fish Department.

If you have questions or concerns about this consultation or the consultation process in general, feel free to contact Jean Calhoun (520) 670-6150 (x223) or Steve Spangle at (602) 242-0210 (x244). Please refer to consultation number 22410-2009-F-0389R1 in future correspondence concerning this project.

Sincerely,

Steven L. Spangle
Field Supervisor

cc (hard copy):
- Field Supervisor, U.S. Fish and Wildlife Service, Phoenix, Arizona (2 copies)
- Jean Calhoun, Assistant Field Supervisor, U.S. Fish and Wildlife Service, Tucson, AZ
- Marjorie Blaine, Senior Project Manager, U.S. Army Corps of Engineers, Tucson, AZ

cc (electronic copy):
- Chief, Habitat Branch, Arizona Game and Fish Department, Phoenix, AZ
- Raul Vega, Regional Supervisor, Arizona Game and Fish Department, Tucson, AZ

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Appendix A: Concurrence for the Mexican Spotted Owl

Species Information

A complete description of the biology of the Mexican spotted owl appears in our September 2012 *Mexican Spotted Owl Recovery Plan, First Revision* (FWS 2012). The rangewide status of the species, including critical habitat, appears in our June 5, 2015, *Biological Opinion on the Flagstaff Watershed Protection Plan* (File number 02EAAZ00-2013-F-0190). This information is incorporated herein via reference.

After the publication of the October 2012 BA and February 2013 SBA, a Mexican spotted owl or owls was/were documented in (or very near) the action area two times with images collected from University of Arizona wildlife cameras; however, due to the sensitive nature of this information, exact locations of wildlife cameras were not provided. Approximate occurrence locations within the action area are indicated in 2013 SBA Figure 8 and described below.

An individual owl was detected with wildlife cameras north of Box Canyon within the action area, approximately 1 mile west of the project area (Douglas 2015) in November 2014 (see the northernmost detection site in Figure MSO-1, below); another owl was documented in Cave Creek Canyon just north of Gardner Canyon (SWCA2015), also in November 2014 (see the southernmost site in Figure MSO-1). However, it is not known whether the second owl observation is within the action area or just outside it to the south, as the exact location of the wildlife camera is not known.

While no protocol-level surveys for Mexican spotted owls have been conducted in the action area, the species has been detected there. It is unlikely the owl(s) observed with wildlife cameras were breeding, given the late dates of the detections (November).

Background for Determination of Effects

The action area for this analysis is based on a combination of: (1) the area of the mine footprint (the project area, as described in the Description of the Proposed Action, above); (2) areas outside the mine footprint that may be affected by noise, dust, light pollution, and other mining activities; (3) all areas for which mining activity may affect groundwater and surface water; and (4) other areas outside the footprint that are related to mining activity, such as road modifications, power lines, and pipelines (i.e., connected actions).

The Coronado National Forest compiled all known Mexican spotted owl locations from the Santa Rita Mountains, and there were no records of owls within the action area prior to November 2014. There are three Mexican spotted owl protected activity centers (PACs) adjacent to (but not within) the action area (see Table MSO-1 and Figure MSO-1, below): (1) The Ramanote PAC; (2) the Sawmill PAC; and (3) the Florida Spring PAC. Please see Page VII in FWS 2012 for a description of the constituents of a PAC.

The closest occupied area is the Ramanote Canyon PAC, which is located approximately 0.7 mile to the west-southwest of the action area and 4.8 miles from the mine footprint. The Cave Creek-area detection occurred closer to the PACs and further from the mine footprint; the Box Canyon-area detection was more remote but closer to the mine footprint.

The mine footprint within the core of the greater action area contains areas with low topographic relief featuring semidesert grasslands and Madrean Encinal Woodlands (interchangeable with the term Madrean evergreen woodlands used elsewhere in this BO). Mexican spotted owls are known to occur in Madrean encinal woodlands, primarily within canyons (FWS 2012). Given that the two detections of Mexican spotted owls occurred outside of the March 1 through August 31 breeding season (FWS 2012), it is likely these were dispersing and/or foraging birds. It is unlikely that they were breeding, given the timing. Breeding activity is similarly unlikely within the mine site due to the absence of deeper canyons there.

One of the indirect effects that define the action area is the noise associated with the proposed action. The action area's sound-based limits were defined in the June 2012 BA, by 50 A-weighted decibel (dBA) surface blasting and 55 dBA traffic noise contours, an area that is approximately 54,336 acres (Tetra Tech 2008, 2009). We note that it has been determined that weighting systems developed for humans (i.e., dBA) are not necessarily appropriate for wildlife species; however, weighting is species specific, and received sound levels depend on many factors (e.g., distance from source to receiver, source emission strength, source directivity, atmospheric attenuation, terrain, ground cover, weather, and frequency energy) (Pater *et al.* 2009).

The Recovery Plan (FWS 2012) recommends breeding-season restrictions if an activity generates noise greater than 69 dBA at a nest site; elicitation of a flush response during breeding may have direct consequences in terms of reduced breeding success. The action area is, by definition, delimited by the 55 dBA contour; therefore it is unlikely that noise will be sufficient to affect Mexican spotted owls at their nest sites within the PACs. The larger action area also includes approximately 430 acres of critical habitat unit BR-W-12. The critical habitat is also within the area affected only by the 55 dBA contour. Again, this is below the disturbance threshold for breeding owls. The critical habitat is therefore also unaffected.

Table MSO-1. Mexican spotted owl PACs near the action area for the Rosemont Project.

PAC Name (Number)	Distance from Project Area	Distance from Action Area
Ramanote Canyon (#0502019)	4.8 miles	0.7 mile
Sawmill Canyon (#0502013)	5.6 miles	1.3 miles
Florida Spring (#0503001)	6.4 miles	2.5 miles

Determination of Effects

We concur with your determination that the proposed action may affect, but will not likely adversely affect, the Mexican spotted owl. We base our concurrence on the following:

- The proposed action will not directly affect the key habitat components of Mexican spotted owl nest/roost habitat. The project and action areas do contain Madrean encinal woodlands, but lack the canyons in which nesting and roosting typically occurs (FWS 2012). The owl or owls detected within or near the action area were unlikely to have been breeding there given the late date of the detections.
- The project area is located approximately 4.8 miles northeast of the nearest PAC and the action area is located approximately 0.7 mile northeast of the nearest PAC. The project will not result in noise disturbance to Mexican spotted owls in those PACs during the breeding season (March 1 through August 31) or at any other time.
- The effects described in the paragraphs above and summarized in this section are insignificant and discountable and will not reduce the potential to achieve recovery of the Mexican spotted owl.
- There are 430 acres of Mexican spotted owl critical habitat in the action area; but like the Ramanote PAC, it will only be affected by noise at a level unlikely to disturb breeding owls. The proposed action will therefore result in no diminishment of the critical habitat's ability to contribute to the recovery of the Mexican spotted owl.

Conservation Recommendations- Mexican Spotted Owl

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:

- We recommend that the USFS conduct (or ensure that Rosemont conducts) Mexican spotted owl surveys within and near the action area prior to mining, with a special emphasis on Box Canyon. Two incidental detections of Mexican spotted owls with trail cameras intended to photograph terrestrial mammals indicate that owls may more frequently disperse through or forage within the action area than is presently known.

- We recommend that the USFS monitor the Ramanote Canyon, Sawmill Canyon, and Florida Spring PACs prior to mining activity to determine baseline conditions, then at regular intervals following initiation of mining activities.

In order for the FWS to be kept informed of actions minimizing or avoiding adverse effects or benefiting listed species or their habitats, the FWS requests notification of the implementation of any conservation recommendations.

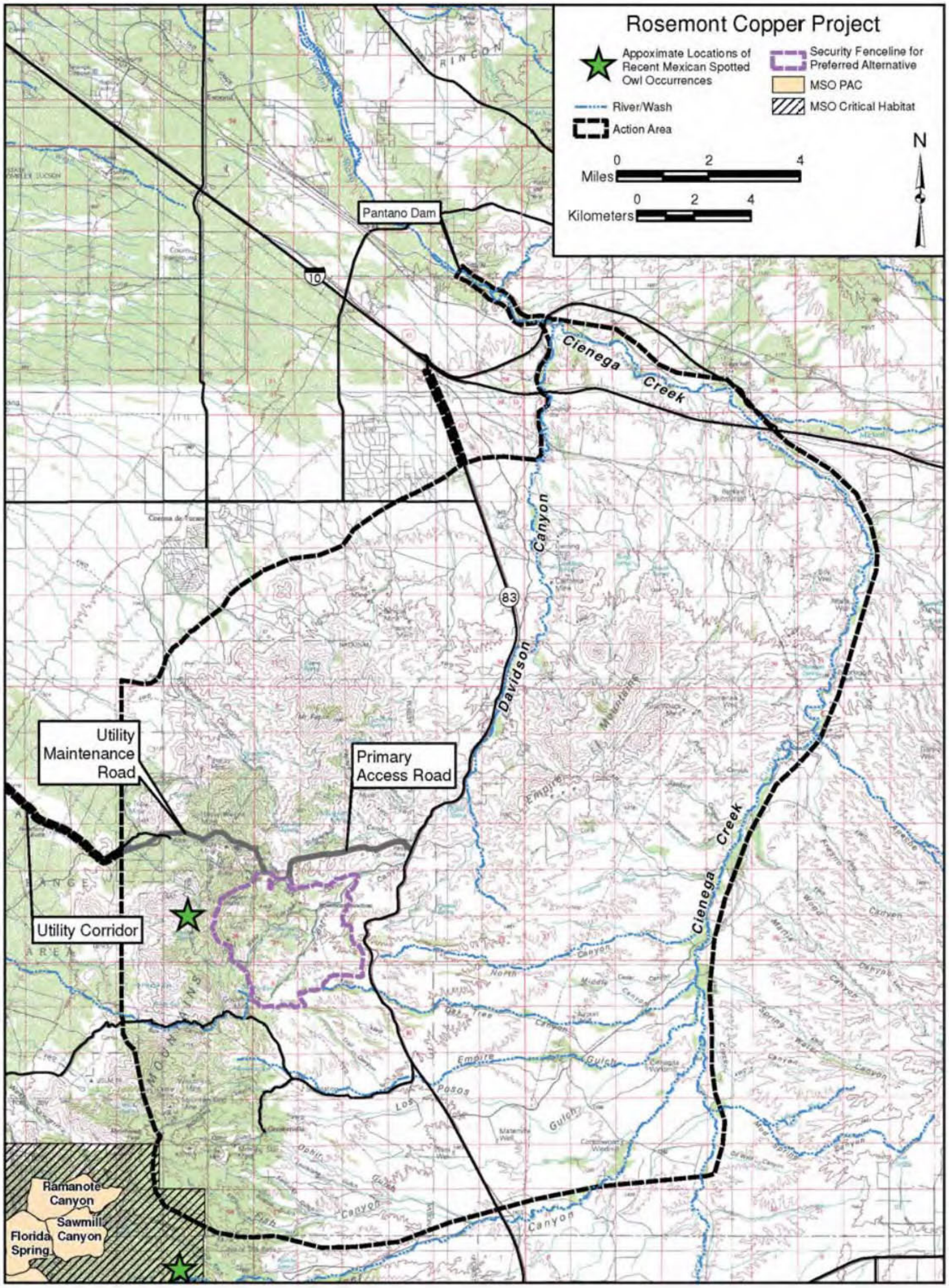

Figure MSO-1, adapted from Figure 8 in the May 2015 SBA

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In Reply Refer To:
AESO/22410-2009-F-0389R1

December 14, 2018

Kerwin Dewberry
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RE: Review of the Process Memorandum to File, Review of the September 12, 2017, Habitat Mitigation and Monitoring Plan for the Rosemont Copper Project

Dear Mr. Dewberry:

Thank you for your electronic mail correspondence of December 13, 2018, requesting our review of your document entitled *Process Memorandum to File, Review of the September 12, 2017, Habitat Mitigation and Monitoring Plan for the Rosemont Copper Project* (Draft Section 18 Review). Your Section 18 Review concluded that reinitiation of formal consultation pursuant to section 7 of the Endangered Species Act (16 U.S.C. 1531 *et seq*.) (ESA) for our April 28, 2016, Amended Final Reinitiated Biological and Conference Opinion (BO) for the Rosemont Copper Mine, Pima County, Arizona (File Number 22410-2009-F-0389R1) is not required. Your December 13, 2018, electronic correspondence requested the U.S. Fish and Wildlife Service's (USFWS) concurrence with the Section 18 Review's determination with respect to reinitiation.

We have reviewed your Section 18 Review and the September 12, 2017, *Habitat Mitigation and Monitoring Plan Permit No. SPL-2008-00816-MB* (2017 HMMP) upon which your review was conducted. We note that you have limited the scope of your Section 18 Review (and your December 13, 2018, request for USFWS review) to the content of the 2017, HMMP as it exists today. We understand that you do not consider the 2017 HMMP to represent a final document unless and until the U.S. Army Corps of Engineers (USACE) reaches a decision to issue a Department of the Army, Clean Water Act permit for the Rosemont Copper Project. Our review is therefore similarly limited to the 2017 HMMP, and our findings may differ should the final HMMP's content change. We also note that the 2017 HMMP contains new information regarding the removal of four (4) stock ponds and proposed earthwork to be performed to return storm water flow downstream within the project area. This stock pond work was not previously analyzed under your National Environmental Policy Act (NEPA) documentation nor our ESA consultation. Therefore, the Coronado National Forest (CNF) will be evaluating the final HMMP and may require the proponent to prepare a supplement to the Mine Plan of Operations (MPO) under 36 CFR §228.4(d) in order to evaluate the stock pond proposal. As part of that evaluation, the CNF will be conducting a review under NEPA to evaluate new information and reinitiating consultation under the ESA, if needed.

A description of the content and context of your review appears on page 3 in your Section 18 Review. In brief, and for purposes of our present review, the effects analyses in our April 28, 2016, BO, relied on conservation measures found, in part, within Rosemont Copper's September 26, 2014, *Habitat Mitigation and Monitoring Plan, Permit No. SPL-2008-00816-MB*. The 2017 HMMP supplanted the 2014 HMMP, thus altering conservation measures specifically analyzed in the 2016 BO. These revisions, in part, precipitated your review in order to determine if reinitiation of consultation based on regulations at 50 CFR §402.16 was necessary.

As stated in the Reinitiation Notice in our 2016 BO, reinitiation of formal consultation is required by regulation where discretionary Federal agency involvement or control over the action has been retained (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 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 the listed species or critical habitat not considered in this opinion; or (4) a new species is listed or critical habitat designated that may be affected by the action.

We have reviewed your Section 18 Review, and the contents of its Appendix A specifically, and agree that reinitiation of formal consultation is not necessary at this time. Appendix A, entitled Review of 2014 and 2017 HMMPs and Comparison to the 2016 Biological Opinion and the 2017 HMMP, contains detailed, action-by-action discussions of the changes between the 2014 and 2017 HMMPs followed by analyses of the effect those changes may have on the effects analyses and conclusions in our 2016 BO.

We reviewed your determinations with respect to the 2014 and 2017 HMMPs and the relevance of those differences to our 2016 BO; we agree that reinitiation of formal consultation is not necessary at this time.

We, however, made particular note of the analyses with respect to changes in the channel design and riparian restoration measures at Sonoita Creek Ranch. We identified these as specific concerns during meetings with your staff and USACE during meetings and conference calls regarding the 2017 HMMP. The review of the changes to the Sonoita Creek Ranch project indicate some uncertainty with respect to the miles of ephemeral stream channels to be restored (see reference to pages 13-14 in Appendix A). The 2016 BO's sections entitled Description of the Proposed Action (see page 14) and the Effects of the Action - Yellow-billed Cuckoo (*Coccyzus americanus*) (see pages 248 and 252) are based on the 2014 HMMP, and include reference to construction of 3.8 miles of new ephemeral channel at Sonoita Creek Ranch. The 2017 HMMP incorporates only approximately 2.6 miles of ephemeral channel, an approximate 1.2 mile decrease.

We analyzed the effect of adversely affected ephemeral channel miles relative to restored ephemeral channel miles (see the Adversely Affected Miles minus Miles to be Enhanced or Protected column in Table YBCU-6 on page 251), finding the proposed action would result in a net decrease of 0.5 mile of ephemeral channel. The 2017 HMMP will implement 1.2 fewer stream miles of ephemeral channel, the net adverse effect therefore increases to 1.7 miles of ephemeral channel (though this is partially minimized; see below).

The 2016 BO's yellow-billed cuckoo effects analysis discusses the potential for the proposed $1.25 million riparian enhancement conservation measure (see pages 248-249; Table YBCU-6 on page 251; and Table 7 on page 252) to help minimize the 0.5-mile net loss of ephemeral channel. The subsequent Conclusion – Yellow-billed Cuckoo section (pages 255-257) states that "[t]he conservation measure to provide $1.25 million for riparian enhancement will help minimize adverse effects of the proposed action on hydroriparian habitat. Because the actual number of miles and acres of hydroriparian habitat to be enhanced depends on the cost and type of enhancement, we project that at least 0.5 miles and 31 acres of hydroriparian habitat will be enhanced with the funding to provide at least some offset to the 3.3 miles and 860.5 acres of hydroriparian habitat expected to be lost (Table YBCU-6) due to mining activities. The actual number of miles and acres of hydroriparian habitat to be enhanced may be greater." We cannot, at this time, determine if the ephemeral channel miles to be enhanced with the $1.25 million riparian enhancement fund will be sufficient to minimize 1.2 additional affected miles.

We conclude that the change in stream mileage does not alter our 2016 BO's conclusions with respect to the yellow-billed cuckoo. Our rationale is that the 2017 HMMP's establishment of 1.2 fewer miles of ephemeral channel represent an immeasurably small change relative the largely acreage-based determinations in our 2016 BO's Conclusion – Yellow-billed Cuckoo (pages 255-257). The 2016 BO's focus on riparian acreage corresponds with the largely acreage-based analyses in our October 2, 2014, final rule listing the yellow-billed cuckoo as endangered (79 FR 59992) and our August 15, 2014, proposed critical habitat rule (79 FR 45848) for the species.

The 2016 BO's sections entitled Description of the Proposed Action (see page 14), the Effects of the Action - Yellow-billed Cuckoo (see pages 248-249; Table YBCU on page 251; Table YBCU-7 on page 252) and Conclusion – Yellow-billed Cuckoo (pages 255-257) consider the acreage of riparian vegetation affected and restored in tandem with ephemeral channel miles. The Conclusion states, in part, that "…additional channels enhanced and created within Sonoita Creek Ranch will compensate for 0.5 fewer xeroriparian miles enhanced than adversely affected, the acreage protected and enhanced is greater by 301.3 acres than the number adversely affected (83 acres + 730 acres = 813 acres protected or enhanced vs 428.7 affected)." Your Section 18 Review (see reference to pages 13-14 in Appendix A) includes the determination that the riparian acreage to be restored at Sonoita Creek Ranch under the 2017 HMMP is 731.5 acres. The 2014 HMMP and our 2016 BO analyze 730 acres of riparian restoration (again, see pages 248-249; Table YBCU on page 251; Table YBCU-7 on page 252; and pages 255-257). The net effect to riparian vegetation under the 2017 HMMP relative the 2014 HMMP-driven analyses in our 2016 BO are therefore similar.

The 2017 HMMP's changes are therefore unlikely to trigger items 2 or 3 from the Reinitiation Notice in our 2016 BO, wherein reinitiation is required if "new information reveals effects of the agency action that may affect listed species or critical habitat in a manner or to an extent not considered in this opinion" or "the agency action is subsequently modified in a manner that causes an effect to the listed species or critical habitat not considered in this opinion," respectively.

Lastly, we considered the content of the 2016 BO's Amount or Extent of Take Anticipated subsection of the Incidental Take Statement – Yellow-Billed Cuckoo (see pages 259-260). The Amount or Extent of Take section, like the effects analyses discussed above, also employed both stream miles and riparian acreage, and although we note the subset of ephemeral channel impacts are associated with xeroriparian vegetation in the narrative. We subsequently determined that a surrogate measure of incidental take – observed and modeled groundwater drawdowns –, which exhibits a causal relationship with affected stream miles and riparian acreage, would be employed. There is no practicable method for evaluating a 1.2-mile change in ephemeral channel restoration relative to groundwater observations or model results. The 2017 HMMP's changes are therefore unlikely to trigger item 1 from the Reinitiation Notice in our 2016 BO, wherein reinitiation is required if "the amount or extent of incidental take is exceeded."

This concludes our review of your Section 18 Review. Should the 2017 HMMP be subject to further revisions, or if information on the distribution or abundance of listed species or proposed or final critical habitat becomes available, our determinations may need to be reconsidered. In all future correspondence on this project, please refer to consultation number 22410-2009-F-0389R1. If we can be of further assistance, please contact Jason Douglas at (520) 670-6150 (x226) or Julie McIntyre at (520) 670-6150 (x223).

Sincerely,

Jeffrey A. Humphrey

Jeffrey A. Humphrey
Field Supervisor

cc (electronic):

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