MARANA PUBLIC DRAFT HABITAT CONSERVATION PLAN

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- 1B: Technical Biology Team

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3: Covered Species Life Histories
4: Species-specific Monitoring Protocols
5: Proposed Prohibited Plant Species List

Chapter 1
Introduction

This Habitat Conservation Plan (HCP) has been prepared to support the Town of Marana's application to the U.S. Fish and Wildlife Service (USFWS) for an Incidental Take Permit (Permit) in conformance with Section 10(a)(1)(B) of the Federal Endangered Species Act of 1973 (ESA). Through this HCP, the Town of Marana (Town) is committing to implement conservation actions that will avoid, minimize, and/or mitigate impacts that could occur to specified species as a result of the proposed covered activities, including planned urban development and associated capital improvement projects expected to occur within the Town over the next 25 years. The Town's activities may result in take of threatened or endangered species through direct loss of individuals of the covered species or through modification of habitat occupied by these species.

The Town is located in Pima County and a small portion of Pinal County, Arizona (Figure 1.1), and has been experiencing significant population growth over the past few decades. When the Town incorporated in 1977, it encompassed 2,590 hectares (ha) (6,400 acres [ac]) and supported 1,512 residents. From 1990 to 2000, population growth accelerated with an increase to 13,556 residents (over a 500-percent increase). The population increased to 29,989 by July of 2006, an increase of 121 percent greater than the year 2000. This population growth has been accompanied by an increase in the incorporated area of the Town. The Town currently encompasses approximately 324 square kilometers (125 square miles) and supports approximately 30,000 residents. By 2010, Marana is expected to become home to more than 46,000 people.

1.1 Purpose and Need for Document

The activities for which the Town is requesting coverage under the Permit are related to the Town's continued growth. Activities proposed for coverage include capital improvement projects (CIP) such as road construction, infrastructure installation, development of parks and trails, airport infrastructure improvements, and maintenance activities. Residential, commercial, or industrial development may be covered through voluntary inclusion or through conditions applied to development projects that require discretionary actions such as rezoning. These covered activities are described in detail in Chapter 2.

1.1.1 Endangered Species Act Compliance

Section 9 of the ESA prohibits the "take" of threatened and endangered species, including "the attempt or action to harass, harm, pursue, hunt, shoot, wound, kill, trap,

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Figure 1-1

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capture, or collect" such species (16 United States Code [U.S.C.] § 1531[18]). Harm is defined to include "significant habitat modification or degradation where it actually kills or injures wildlife by significantly impairing behavioral patterns such as breeding, feeding, or sheltering." Harass is defined "as intentional or negligent actions that create the likelihood of injury to listed species to such an extent as to significantly disrupt normal behavior patterns which include, but are not limited to, breeding, feeding, or sheltering. Please refer to Chapter 8 for a glossary of terms and list of abbreviations and acronyms.

Section 10(a)(1)(B) authorizes exceptions for non-Federal activities for take that may occur incidentally to otherwise lawful measures with the provision of an HCP (50 Code of Federal Regulations [CFR] § 17.3). Regulations governing Permits for listed species are codified at 50 CFR §§ 17.22 and 17.32. The HCP must thoroughly describe the anticipated effects that may result in take of covered species and also describe the measures proposed to avoid, minimize, and mitigate the resulting impacts.

The general purposes of the ESA Section 10(a)(1)(B) and the HCP requirement can be summarized as follows:

- To permit non-Federal projects to take Federally listed species while ensuring their long-term survival and enhancement
- To promote the long-term conservation of Federally listed species
- To reduce conflicts between endangered species and economic activities
- To develop "creative partnerships" between the public and private sectors

The purpose and need for the Section 10(a)(1)(B) Permit is to ensure that incidental take resulting from the proposed actions will be minimized and mitigated to the maximum extent practicable and will not appreciably reduce the likelihood of the survival and recovery of listed species.

1.1.2 Fulfillment of Town Vision

The Town supports notable natural resources. Riparian resources include major washes crossing the Tortolita Fan as well as the Santa Cruz River corridor. The Tortolita Fan is an extensive area in north-central and eastern Marana marked by natural drainage channels created by storm water runoff from the Tortolita Mountains. The Tortolita Fan supports a high-quality ironwood (*Olneya tesota*) community which provides important habitat for numerous wildlife species. Non-irrigated sections of the Town's western reaches support Sonoran desert vegetation. These areas, as well as some of the irrigated agricultural areas in the western portion of the Town, provide habitat for a variety of wildlife species, including species currently listed under the ESA or that may become listed in the future.

Conservation of natural resources has been and continues to be an important consideration for the Town in planning future land use. Therefore, the Town is concentrating future high-intensity development in agricultural areas in the western portion of the Town. A substantial amount of land area to the north and east of Interstate 10 has constraints to development due to natural conditions, including flooding, erosion, native vegetation, and wildlife habitat. Less-intensive development is proposed for those northeastern portions of the Town where native vegetation remains and provides habitat for many wildlife species, including several listed species and species of concern. This land may be considered for open space, scenic resource, water recharge, and conservation purposes. The Town envisions maintaining the Tortolita Fan as a low- or no-development zone in order to maintain quality wildlife habitat, natural open vistas, and areas for low-intensity recreation such as hiking.

Development in identified natural areas would be configured to minimize land disturbance and protect important natural areas by designating contiguous, well-connected areas of natural undisturbed open space (NUOS). Setting aside riparian areas and adjacent uplands as NUOS is a viable conservation measure that may allow land development while conserving the most valuable natural resources. The HCP will be specifically tailored to Town's unique habitat areas and will provide consistent regulation of public and possibly some private development impacts on natural resources and the management of those resources while providing for directed, continued growth.

The Town seeks to accomplish the following objectives with this HCP:

- Facilitate compliance with the ESA for planned urban development and capital improvement projects.
- Promote biodiversity and species conservation and recovery within the Permit Area (Town boundary).
- Promote regional economic objectives including the orderly and efficient development of certain lands, while recognizing property rights, and legal and physical land use constraints.
- Complement other regional conservation planning efforts such as Pima County's Sonoran Desert Conservation Plan (Pima County 2000), Draft Multi-species Conservation Plan (Pima County 2008), and draft Biological Effectiveness Monitoring Plan (Recon Environmental 2007); and the City of Tucson's ongoing efforts in developing an Avra Valley HCP.
- Meet goals outlined in the General Plan.

The vision of the Town's General Plan is for the HCP to guide land development, provide open space set-asides, acquisitions, and other mitigation measures to protect these valuable natural resources and ensure that development is compatible with existing conditions. The HCP will help the Town meet the following General Plan goals and policies:

- Protect and conserve natural resources.
- Protect areas of significant biological resource value.
- Create land use patterns that protect significant natural environments and provide open space.
- Protect and preserve natural open spaces.
- Work to create a connected system of wildlife corridors for movement between the Tortolita Mountains and the Santa Cruz River.
- Develop roadways that are sensitive to the natural environment.
- Assure that there is flexibility with planning and development procedures to define and refine growth areas based on updated information.
- Encourage land use decisions that maintain sensitive habitat areas.

1.2 Permit Holder, Permit Duration, and Permit Conditions

The Town will be the Permit holder and will be solely responsible for ensuring implementation of the HCP measures. The Permit will be in effect for a period of 25 years. This period encompasses the planned future growth in the Town. The Permit may be renewed, if the Town files a renewal request and the request is on file with the issuing USFWS office at least 30 days prior to the Permit's expiration. The Permit will remain valid while the renewal is being processed. The Town may not take listed species beyond the quantity authorized by the original Permit.

A Section 10 Permit is granted upon a determination by USFWS that all requirements for Permit issuance have been met. Statutory criteria for issuance of the Permit specify that:

- The taking will be incidental.
- The impacts of incidental take will be minimized and mitigated to the maximum extent practicable.

- Adequate funding for the HCP and procedures to handle unforeseen circumstances will be provided.
- The taking will not appreciably reduce the likelihood of survival and recovery of the species in the wild.
- The applicant will provide additional measures that USFWS requires as being necessary or appropriate.
- United States Fish and Wildlife Service (USFWS) has received assurances, as may be required, that the HCP will be implemented.

The Town will commit to implementing the HCP and timelines for completion, as required by the USFWS. During the post-issuance phase, the Town and other responsible entities implement the HCP, and USFWS monitors the Town's compliance with the HCP as well as the long-term progress and success of the HCP. The public is notified of Permit issuance by means of the *Federal Register* (FR).

The Habitat Conservation Plan Assurances (No Surprises) rule adopted by the U.S. Department of the Interior provides that landowners who have habitat for listed species on their property and agree to an HCP under the ESA will not be subject to later demands for more land, water, or financial commitment, if the HCP is adhered to and even if the needs of the species changes over time (63 FR 8859). The inclusion of the "No Surprises" rule in HCPs has been subject to legal dispute and was upheld by the District of Columbia District Court (Civil Action No. 1998-1873: Spirit of the Sage Council, et al. v. Kempthorne, et al.). Adaptive management will be used to address the need for changes in conservation strategies as identified through monitoring.

1.3 Permit Area

The HCP planning area (approximately 67,987 ha [168,000 ac]) includes the lands within the incorporated area of the Town (approximately 30,958 ha [76,500 ac]) and adjacent lands considered during the development of the HCP, as shown on Figure 1.2. The actual Permit Area includes only the lands within the Town limits. Areas where mitigation lands may be located are identified in the conservation program detailed in Chapter 4.

Although the Town does not currently have any annexation plans, it is the intent of the Town to apply the terms and conditions of the HCP to lands annexed by the Town during the term of the Permit. All annexed lands would be evaluated by the Town, Technical Biology Team (TBT), and USFWS, and the applicable HCP conservation measures would be implemented based on the presence of covered species or their habitat within the annexed area. The Town would then work with the USFWS to amend the Permit through the approved process (Section 5.3) to include the annexed area and appropriate

Figure 1-2

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covered activities expected to occur on annexed lands. Because future activities on annexed lands are not addressed in this HCP, or the associated National Environmental Policy Act (NEPA) analysis documents, these documents would need to be revised or new versions prepared addressing the proposed amendment.

1.4 Species Proposed for Coverage under the Permit

The Marana HCP proposes to cover 13 species under the Permit (Table 1.1). These species, referred to as "covered species," were identified using the following criteria: (1) the species is listed or has the potential to be listed as threatened or endangered within the duration of the Permit, (2) the species has the potential to occur within the HCP boundaries, and (3) the species has the potential to be impacted by activities covered by this HCP. The population status, natural histories, and known occurrences of the species are described in Chapter 4 and in Appendix 3. Not all species with Federal status are included under State Species of Concern status, and vice versa.

1.5 Regulatory Framework

1.5.1 Federal Endangered Species Act

The ESA and its implementing regulations prohibit the take of any fish or wildlife species that is Federally listed as threatened or endangered unless exempted or permitted pursuant to either Section 4, 7, or 10 of the ESA. Section 10(a)(1)(B) was also intended by Congress to authorize the USFWS to approve HCPs for unlisted as well as listed species. Moreover, if an HCP treats unlisted species as if they were already listed, additional mitigation will not be required within the area covered by the HCP upon listing of that species. The "No Surprises" rule provides that landowners who have habitat for listed species on their property and agree to an HCP under the ESA will not be subject to later demands for more land, water, or financial commitment, if the HCP is adhered to, even if the needs of the species changes over time (63 FR 8859).

TABLE 1.1
HCP COVERED SPECIES

Species	Federal Status	State Status[1]
Birds		
Cactus ferruginous pygmy-owl (*Glaucidium brasilianum cactorum*)	None (Petitioned[2]) MBTA[3]	Species of Concern
Burrowing owl (*Athene cunicularia*)	Species of Concern MBTA[3]	None
Southwestern willow flycatcher (*Empidonax traillii extimus*)	Endangered MBTA[3]	Species of Concern
Western yellow-billed cuckoo (*Coccyzus americanus occidentalis*)	Candidate[4] MBTA[3]	Species of Concern
Mammals		
Lesser long-nosed bat (*Leptonycteris curasoae yerbabuenae*)	Endangered	Endangered
Pale Townsend's big-eared bat (*Corynorhinus townsendii pallescens*)	None	None
Merriam's mesquite mouse (*Peromyscus merriami*)	None	None
Reptiles		
Tucson shovel-nosed snake (*Chionactis occiptalis klauberi*)	None (Petitioned[2])	None
Ground snake (valley form) (*Sonora semiannulata*)	None	None
Mexican garter snake (*Thamnophis eques megalops*)	Candidate[4]	Species of Concern
Desert tortoise – Sonoran population (*Gopherus agassizii*)	None (Petitioned[2])	Species of Concern
Amphibians		
Lowland leopard frog (*Rana yavapaiensis*)	None	Species of Concern
Invertebrates		
Talus snail (*Sonorella* spp.)	None	None

[1] There is no regulatory authority tied to Arizona State Status as a Species of Concern.
[2] The USFWS has been petitioned to list these species as Threatened or Endangered.
[3] MBTA = Migratory Bird Treaty Act (refer to section 1.5.4 of this HCP for details).
[4]Candidate species warrant listing under the ESA, but are precluded by higher priority listing actions.

1.5.2 The Section 10 Process—Habitat Conservation Plan Requirements and Guidelines

The ESA Section 10 process for obtaining a Permit has three primary phases: (1) the HCP development, (2) the formal Permit processing, and (3) the post-issuance implementation.

During the HCP development phase, the project applicant prepares a plan that integrates the proposed project or activity with the protection of listed species. This HCP submitted in support of a Permit application includes the following required information:

- Impacts likely to result from the proposed taking of the species for which Permit coverage is requested, as described for each species (Chapter 4).
- Measures that will be implemented to monitor, minimize, and mitigate impacts; funding that will be made available to undertake such measures; and procedures to deal with unforeseen circumstances (Chapter 5).
- Alternative actions considered that would not result in take (Chapter 1).
- Additional measures USFWS may require as necessary or appropriate for purposes of the plan.
- In the update addendum to the HCP Handbook (U.S. Department of the Interior 2000), a “5-point policy” focuses on the integration of five components of the Habitat Conservation Planning program. This policy is satisfied within the HCP as follows:
- Biological goals commensurate with the scope of the proposed actions (Chapter 4)
- Adaptive management to address uncertainty (Chapter 5)
- Monitoring to ensure compliance, gauge the effectiveness of conservation measures, and indicate adaptive management provisions (Chapter 5)
- Permit duration (the Permit duration requested is 25 years)
- Public participation and a comment period (Chapter 1)

The USFWS believes that the biological goals and objectives should be consistent with recovery, but in a manner that is commensurate with the scope of the HCP. Under Section 10 of the ESA, the USFWS does not explicitly require an HCP to recover listed species or contribute to the recovery objectives outlined in a recovery plan, but also does not intend to permit activities that preclude recovery. This approach reflects the intent of the Section 10(a)(1)(B) Permit process to provide for authorization of incidental take, not to mandate recovery (65 FR 35243).

The HCP development phase concludes and the Permit processing phase begins, when a complete application package is submitted to the appropriate Permit-issuing office. A complete application package consists of (1) an HCP, (2) a Permit application, and (3) an application fee from the applicant. An Implementing Agreement is not required, but is recommended due to the long-term commitments in the HCP. The USFWS must also publish a Notice of Availability of the HCP package in the *Federal Register* to allow for public comment. The USFWS also prepares an Intra-service Section 7 Biological Opinion and prepares a Set of Findings, which evaluates the Section 10(a)(1)(B) Permit Application in the context of Permit issuance criteria (see below). An Environmental Assessment (EA) or Environmental Impact Statement (EIS) serves as USFWS's record of compliance with the NEPA of 1969, as amended, after a 60-day to 90-day public comment period on the document (see Section 1.5.3). No further NEPA review is required. A Section 10 Permit is granted upon a determination by USFWS that all requirements for Permit issuance, as described above in Section 1.2, have been met. The public is notified of Permit issuance by means of the *Federal Register*.

During the post-issuance phase, the Permittee and other responsible entities implement the HCP. The USFWS monitors the Permittee's compliance with the HCP as well as the long-term progress and success of the HCP.

1.5.3 National Environmental Policy Act

Issuance of a Permit is a Federal action; therefore an EA or EIS must be completed in compliance with NEPA. The EIS considers effects to water quality, air quality, and cultural resources, as well as natural resources. A Draft EIS for this Permit application is being prepared, with a 60-day public comment period. A final EIS will be completed following the public comment period, and the EIS process will culminate in issuance of a Record of Decision.

1.5.4 Migratory Bird Treaty Act

The Migratory Bird Treaty Act (MBTA) of 1918 prohibits the take of any migratory bird, or any part, nest, or egg of any such bird. Under the MBTA, take is defined as the attempt to "pursue, hunt, shoot, capture, collect, or kill" a protected species. This act applies to all persons and organizations in the United States, including Federal and State agencies. The MBTA is administered by the U.S. Fish and Wildlife Service with regulation of listed migratory birds delegated to the USFWS Endangered Species Division. Regulation of unlisted migratory birds is delegated to the USFWS Migratory Birds Division.

The MBTA provides no process for authorizing incidental take of MBTA-protected birds. All four birds covered by this HCP are also protected under the MBTA. If the HCP is approved and the USFWS issues an ESA Permit to the Town, the terms and conditions

of that Permit will also constitute a special purpose permit under 50 CFR 21.27 for the take of the southwestern willow flycatcher (*Empidonax traillii extimus*) under the MBTA. Therefore, subject to the terms and conditions to be specified in the Permit, if issued, any such take of listed covered species also will not be in violation of the MBTA. MBTA-listed birds (burrowing owl, cactus ferruginous pygmy-owl, western yellow-billed cuckoo) that are not protected by the ESA and that may be adversely affected by the Town's proposed activities will not be covered by a special purpose permit.

1.6 Habitat Conservation Plan Alternatives

As required in Section 10(a)(1)(B), the Town has considered alternative scenarios for this HCP which are summarized below and in Table 1.2. The Town reviewed regional habitat conservation efforts for determination of open space set-aside percentages and also referred to the TBT members' recommendations. Detailed mapping, developed by the Town for HCP or other planning purposes, has been utilized where possible.

Alternative A represents the "no action" alternative. Under this alternative, the Town would not proceed with the application for a Section 10(a)(1)(B) Permit. Every individual project or action would be evaluated for its ESA compliance on a project-by-project basis.

Alternatives B and C vary primarily in the aspect of participation and therefore in the extent of covered activities.

Alternative B represents an alternative in which participation would be limited to the Town, to cover their public works and capital improvement projects, and to private entities on a voluntary basis. This voluntary inclusion alternative is an opportunity for private parties to obtain incidental take coverage for the 13 species covered under the HCP. The Town will issue a "certificate of inclusion" to the applicant, if they implement the conservation measures for the area in which their project is proposed. Since the Town will have already negotiated the mitigation plan for each species with USFWS, the applicant will be able to save time, costs, and extra planning efforts. Voluntary inclusion also allows regulatory certainty for projects that may impact covered species, since the conservation measures are identified, with a "No Surprises" clause in the HCP.

Alternative C represents an alternative in which participation would include the Town and private landowners whose land-development activities are subject to the discretionary action decisions of the Town (e.g., rezoning approvals). Alternative C would also allow for private developers whose land-development activities are not subject to the discretionary decisions of the Town to choose voluntary inclusion and be included under the Town's Permit.

Under all alternatives, the USFWS would conduct a programmatic consultation with the United States Army Corps of Engineers (USACE) and the Federal Highway Administration to evaluate the range of covered activities included in this HCP that have a nexus to these Federal agencies. The USFWS would also consult separately with the Bureau of Reclamation (BOR) and the Federal Aviation Administration to review the proposed BOR Regional Park and airport infrastructure improvement activities. Through this process, the Town and landowners participating in the HCP will be covered for any Section 7 regulatory requirements related to covered activities.

Alternative C represents the Town's preferred HCP alternative. Additional and/or more detailed alternatives may be developed during the agency and public review.

TABLE 1.2
HCP ALTERNATIVES

Description	Alternatives		
	A	B	C
No HCP (ESA Compliance on a Project-by-Project Basis)	✓		
Projects & Activities Covered: CIP Activities		✓	✓
Projects & Activities Covered: Discretionary Action Projects			✓
Projects & Activities Covered: Voluntary Inclusion		✓	✓

1.7 Public Involvement

Lesser long-nosed bat at hummingbird feeder, 2007. Photograph provided by Sigrid Jones

The Town initiated its conservation planning process in December 2002 and has incorporated elements of public involvement into the process since that time. This process has included a series of open public meetings that are planned to continue through Permit issuance. Meeting notices, schedules, agendas, and minutes are posted on the Town's website for the HCP (http://www.marana.com/hcp).

The Town has encouraged public involvement in scientific studies as well. One example of this is the Bats and Hummingbird Feeders Study which was initiated in 2007 by the Town and City of Tucson, and continued in 2008. This study is a collaborative effort between the Town, USFWS, Arizona Game and Fish Department (AZGFD), Arizona-Sonora Desert Museum (ASDM), and volunteer citizen-scientists in the western Tucson Basin. Data collected from this study will be used to better

understand the lesser long-nosed bat (*Leptonycteris curasoae yerbabuenae*), a species listed as endangered under the Federal ESA, and will be used by both the Town and the City of Tucson in development of their HCPs. Volunteers who have signed up to participate in this study input their data by either submitting hard copies of data forms at the end of the field season or inputting the data on this website throughout the field season. Information and instructions on how to gather and report data are located on a web-link on the Town's website.

The public may continue to be involved in the future with activities such as continued monitoring of lesser long-nosed bat use of hummingbird feeders; participation in Tucson shovel-nosed snake (*Chionactis occiptalis klauberi*) surveys or burrowing owl (*Athene cunicularia*)road-side surveys; the removal of the invasive species, buffelgrass (*Pennisetum ciliare*); and tree planting for wildlife habitat enhancement.

1.7.1 Advisory Groups

The Town established both a TBT and a Stakeholder Working Group (SWG). These two advisory groups have been instrumental in the planning process. They have provided both invaluable technical input and perspective on how the Town HCP corresponds with other regional conservation plans and objectives. Members of both groups were invited to participate by Town management staff and they serve under the direction of the Town Manager's office. Members of the TBT and the SWG are listed in Chapter 6—Preparers and Contributors. The charters of the TBT and the SWG are included in Appendix 1. All TBT and SWG meetings are open to the public.

1.7.1.1 Stakeholder Working Group

For the SWG, the Town sought to gather a diverse group of stakeholders who would provide varied perspectives on the conservation strategies and ultimate implementation of the HCP.

The purpose of the SWG, as stated in the Town of Marana Habitat Conservation Plan Stakeholder Working Group Charter, is that group members

> share a common interest in balancing the biological integrity of natural ecosystems with economic development interests through regional conservation planning. Efforts to coordinate conservation actions among local, state, and Federal agencies, organizations, and private landowners are well-established in Pima County. The Marana regional planning effort seeks to continue coordination among interested parties and to establish a framework for collaborative conservation planning within the planning area.

1.7.1.2 Technical Biology Team

For the TBT, the Town sought to gather a group of people with appropriate technical backgrounds, including expertise in specific endangered species, hydrology, herpetology, landscape and reserve design, biology, ecology, geology and geomorphology, and riparian ecosystems. At the request of the Town and the TBT, other biological scientists have also provided their expertise and collected detailed Town-specific data on particular species, including the Tucson shovel-nosed snake, the cactus ferruginous pygmy-owl, the lesser long-nosed bat, and other species proposed for coverage by the HCP. The additional expertise, knowledge base, and field survey data have contributed to the HCP being developed with the best available science.

The purpose of the TBT, as stated in the Town of Marana Habitat Conservation Plan Technical Biology Team Charter, is

> to bring the best available science to bear on the development of conservation recommendations that will assist the SWG in attaining the goals they have established for the Town of Marana Habitat Conservation Planning project. Specifically, these recommendations will provide the SWG, Town of Marana, and other jurisdictions, at their discretion, with the technical information to assist with the development of a Habitat Conservation Plan, and other appropriate land use policies.

The TBT met between December 2002 and May 2003, and was reconvened in spring of 2007.

1.7.2 Public Scoping Meetings

The USFWS formally initiated the public scoping process for the HCP by announcing its intent to prepare an EIS for the HCP. In support of this process, the Town and USFWS held a series of three public, open house meetings for the public scoping as required under NEPA. The meeting dates were July 9, July 11, and July 24, 2007. Meeting notices were publicly posted, e-mailed, and noticed in the *Federal Register*[1] (see Appendix 2). Additionally, several articles that discussed the HCP and mentioned the meeting dates appeared in local newspapers.

Public sentiment expressed during the public open house meetings ranged from concerns over how the HCP might limit use of private lands to support for interim conservation policies being adopted by the Town until the HCP is finalized. Ideas were also presented for public/private partnerships that could forward the goals of habitat

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conservation. Comments were summarized and documented as part of the NEPA process.

1.7.3 Collaboration with other Jurisdictions and Regional Planning

In an effort to develop conservation measures that are regionally cohesive for species covered by the Marana Draft HCP, as well as other regional wildlife, the Town, the City of Tucson, and Pima County staff met with Scott Richardson of USFWS to investigate the possibility of developing a collaborative approach to species conservation measures between jurisdictions on February 8 and March 11, 2008. Phil Rosen, PhD, University of Arizona reptile expert, attended the March 11 meeting as well.

To address the issues of protecting wildlife habitat and linkages, the Town proposes to collaborate with Tucson Water to protect land in the Brawley/Robles and Blanco Washes and the Santa Cruz River. These washes were identified in the March and April meetings attended by the City of Tucson, the Town, Pima County, USFWS, and Phil Rosen as being important potential habitat corridors for conservation of the Tucson shovel-nosed snake, ground snake, burrowing owl, and other wildlife species.

Several Tucson Water-managed properties were identified during these meetings as important habitat and connectors on which the Town could contribute to research or management and for which both Tucson and the Town could receive conservation credit on their HCPs from USFWS.

The Town proposes to provide funding for such conservation measures as:

- The installation of artificial burrows for burrowing owls and the relocation of burrowing owls when they are endangered by encroaching development
- Research and surveys for species covered under Marana and Tucson HCPs
- Monitoring of species of concern on Tucson Water lands
- Fencing of protected habitat areas
- Conservation easements

The Town also participated with Pima County, the City of Tucson, and the Town of Oro Valley in discussions for a cohesive approach to invasive species management by the participating jurisdictions on May 2, 2007. These jurisdictions began meeting monthly beginning in May 2008 to coordinate invasive species management strategies and actions.

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Chapter 2
Activities Covered by the Permit

Activities that would be covered by the Permit include any activities carried out by or authorized by the Town on covered lands (i.e., the Permit Area identified in Section 1.3 and Figure 1.2). Covered activities would include CIP activities such as widening or resurfacing of existing roads and the construction of new roads, bridges, and parks. Maintenance activities associated with public infrastructure and HCP implementation activities also would be covered. Residential, commercial, and private industrial development within the Town boundaries would be treated as covered activities, if they were permitted through a rezoning or other discretionary action. Private actions that do not require a rezoning or discretionary action would not be included in this Permit, unless they were voluntarily submitted by the project proponent for inclusion in the Town's HCP.

2.1 Residential/Commercial/Industrial Development

Residential, commercial, and industrial development may be covered in addition to the Town's CIP activities, depending on the alternative selected. These developments may be included voluntarily, or conditions would be applied to development projects that require discretionary action. Section 1.6 of this HCP provides a complete discussion of the alternatives.

Over the next 25 years, up to 19,430 ha (48,013 ac) of land development is planned in the Town. This planned development will be residential, commercial, and industrial in nature. Agricultural use is anticipated to decline. Population growth is projected to increase from approximately 30,000 people in 2006 to approximately 82,250 people by the year 2025.

The Town of Marana General Plan identifies development areas using a range of land use classes including residential (rural, low, medium, high, and mixed density), agricultural, commercial (interstate corridor and airport), and industrial (Town campus and general). Due to the range of uses permitted within these development categories and uncertainty with respect to changes in allowed uses over time, these categories have been simplified into low intensity and moderate-to high-intensity development designations for use in the HCP (Table 2.1).

Low intensity uses include rural and low-density residential development, specifically developments with ground disturbance of no more than 30 percent. Other low intensity land use categories include vacant/undeveloped properties, conservation lands, parks and recreation facilities, and the floodway zone. Moderate to high density residential land use is

described as ranging from 3.1 to 8.1 residences per ac in the Town of Marana General Plan (Town 2007).

TABLE 2.1
COMPARISON OF GENERAL PLAN AND HCP LAND USE CATEGORIES

Land Use Categories: Residencies per Acre (RAC)	Marana 2007 General Plan	Marana Draft HCP
0.1 – 0.5 RAC	Rural Residential	Low Intensity Development (≤30% Disturbance)
0.51 – 3.0 RAC	Low Density Residential	
3.1 – 8.0 RAC	Medium Density Residential	Moderate – High Intensity Development (>30% Disturbance)
≥8.1 RAC	High Density Residential	
N/A	Commercial	
N/A	Industrial	

For purposes of this HCP, moderate-to high-intensity uses include residential developments that can have greater than 30-percent ground disturbance, all areas of planned commercial or industrial development (such as sand and gravel extraction from the Santa Cruz River), and agricultural areas. Conservation lands are areas that developers have or will set aside for the purpose of complying with their individual Section 7 Consultations or Section 10 Permits. Parks and recreation facilities range from small, turf-covered neighborhood parks to large regional parks that provide a wide range of uses and may include both developed and undisturbed areas. The floodway zone is designated through the General Plan as a sensitive area with limited development possibilities, which may include sand and gravel operations, bridge improvements, new bridges, or bank protection.

Figure 2.1 shows the current land uses and Figure 2.2 illustrates the location and extent of future land uses within the Town. Figure 2.3 shows the relationship between existing development and entitled lands and the combined modeled habitat for the 13 covered species. Hectares of current land use and anticipated future development are shown in Table 2.2. The spatial distribution of these future land uses is tied to current land conditions. The resource conditions in the Town include undeveloped areas (vacant land) with largely native vegetation, an effluent-dominated river and associated riparian habitat, active agricultural lands, and high-density urban and industrial areas.

The intensity of future development (Table 2.3) has been planned to minimize impacts on natural areas and concentrate high-intensity uses in agricultural areas or on otherwise degraded land. In addition to the areas impacted by agriculture in the west-side valley floor and existing urban development in the southern part of the Town, degraded lands include a portion of the Tortolita *bajada* that has been isolated hydrologically in part by the Central Arizona Project (CAP) canal. The area of the Tortolita fan west of the CAP canal does not

FIGURE 2.1, COLOR, OVERSIZE

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FIGURE 2.2, COLOR, OVERSIZE

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Figure 2.3

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TABLE 2.2
EXISTING[1] AND ESTIMATED FUTURE LAND USE CATEGORIES AND HECTAREAGES

Land Use Categories	Current Total Hectareage (Acreage)	Future Total Hectareage (Acreage)	Current State Land Hectareage (Acreage)	Future State Land Hectareage (Acreage)
Agriculture	4,620 (11,417)	0	1,210 (2,990)	0
Developed	4,819 (11,908)	25,606 (63,273)	569 (1,405)	14,431 (35,660)
Undeveloped/ Vacant	16,862 (41,667)	0	13,236 (32,707)	0
Existing Mitigation/ Conservation Land	1,971 (4,870)	2,951 (7,193)	1,201 (2,967)	1,201 (2,967)
Parks	706 (1,745)	706 (1,745)	0	0
Floodway	1,179 (2,914)	1,129 (2,789)	518 (1,280)	507 (1,252)
CAP	794 (1,962)	600 (1,483)	0	0

[1] As of July 1, 2007.

TABLE 2.3
ESTIMATED FUTURE LOW- ,MODERATE- AND HIGH-INTENSITY DEVELOPMENT BY LAND USE AREA

		Area Planned for Development	
Current Land Use Category	Current Hectareage (Acreage)[1]	Planned for Low Intensity	Planned for Moderate/High Intensity
Agriculture	4,620 (11,417)	244 (602)	4,377 (10,815)
Developed	4,819 (11,908)	0	0
Undeveloped/Vacant	16,862 (41,667)	10,795 (26,674)	6.067 (14,993)
Mitigation Land	1,971 (4,870)	450 (1,111)	24 (60)
Parks	706 (1,745)	0	0
Floodway	1,179 (2,914)	17 (41)	241 (596)
CAP	794 (1,962)	0	0

[1] As of July 1, 2007.

receive surface flow and is sustained only by direct rainfall. Over time, there has been a reduction in vegetation diversity and volume in this area that will likely continue. Therefore, future urban development has been planned in this area as well.

The Town borders the City of Tucson to the south and rapid growth of that municipality has resulted in development of most of the southern portion of the Town. A few opportunities for future development within this area do exist, however. These opportunities consist of urban infill (i.e., development on land bounded on all sides by existing development) and urban expansion (i.e., development on the outer fringes of existing development). Urban infill and expansion are included in the activities covered by the HCP.

In addition to addressing take of covered species that could result from conversion of habitat to urban development, this HCP covers all activities undertaken during the normal process of residential, commercial, or industrial land development. These activities include:

- Pre-construction clearance surveys for natural and cultural resources
- Clearing, grubbing, grading, and other land-disturbance activities necessary to construct buildings, parks, utilities, roads, trails, stormwater retention basins, and all other associated infrastructure located within the Permit Area
- Construction of these structures or facilities and any resulting noise and disturbance

2.2 Capital Improvement Projects

Growth in population, housing, and employment opportunities during the next 25 years will bring about the need for increased public infrastructure. The Town will provide new roads, road improvements, airport improvements, parks, trails, and other recreation opportunities necessary to support the growing community. Future sewer service may be provided by Pima County or the Town; water service is provided by the City of Tucson and the Town; power, telephone, cable television, fiber optic, and natural gas services are provided by private utility companies. Future expansion of utility services provided by the Town would be covered under this HCP, but future expansions of utility infrastructure conducted by other entities would not be covered in this HCP, unless it is associated with private development covered under this HCP. Capital improvement activities are estimated to impact 75,601 ha (186,815 ac) of habitat for species covered by this HCP over the next 25 years.

The Town plans to undertake the following CIP activities: (1) road construction and improvement, (2) public water infrastructure, (3) parks and trails, (4) airport infrastructure improvements, and (5) maintenance activities of these facilities. Figure 2.4 shows the relationship between CIP activities and the combined modeled habitat for the 13 covered species.

FIGURE 2.4

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For actions that may affect threatened or endangered species, and are not covered under this HCP, the Town or entities permitted by the Town will have to address ESA compliance through an individual Section 7 process or Section 10 Permit. The covered activities are described in detail in the sections that follow.

2.2.1 Road Construction and Improvement

The 2001-2025 Transportation Plan Update for the Town identifies 229 kilometers (km) (142 miles [mi]) of public road projects planned for the next 20 years. These road improvements include the construction of new roads, widening of existing roads, and resurfacing of existing roads. Four existing roads and two future roads will cross the Santa Cruz River; new bridges, and associated grade control structures, bank protection, and channel modification are planned as a part of these projects. Table 2.4 lists all of the anticipated projects.

TABLE 2.4
ANTICIPATED TRANSPORTATION PROJECTS IN THE TOWN

Project Type	Total Extent of Projects	Approximate Hectares (Acres) of Disturbance
Road resurfacing		0
Road widening	266 lane km (165 lane mi)	1,056 (2,609)
New roads	351 lane km (218 lane mi)	
Bridges	242,811 sq m (261, 200 sq ft)	24 (60)
Grade control structures	254,951 sq m (2,744,280 sq ft)	25 (63)

The Town's Environmentally Sensitive Roadway Design Guidelines (ESRDG) will be implemented for all road widening and new road construction, and associated utilities, on public roads that meet any of the following criteria: (1) within or crossing an HCP Conservation Zone, (2) within or crossing the Tucson Mountains–Tortolita Mountains Linkages as identified by the Arizona Wildlife Linkages Working Group (Beier et al. 2006), (3) near Wildland Blocks as identified by the Arizona Wildlife Linkages Working Group (Beier et al. 2006), (4) within or crossing a Pima County High or Moderate Archaeological Sensitivity Zone or Priority Cultural Resource, (5) identified as a Historic Roadway or Route, or (6) identified as a Pima County scenic route. Existing roads that meet these criteria are identified in Figure 2.5.

2.2.1.1 Road Resurfacing

Road resurfacing generally consists of milling the existing surface, adding a new asphalt driving surface, signing, and striping. Resurfacing projects can be accomplished at a rate of

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FIGURE 2.5

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0.16 km (0.1 mi) per day with a six-person crew. All activities associated with road resurfacing are restricted to currently disturbed areas. Projects may include adding paved shoulders where none currently exist. If shoulders are added to an existing roadway, they would generally be from 2 to 3 meters (m) (5 to 8 feet [ft]) in width. The shoulders would be added in existing graded areas so that no disturbance to potential habitat would occur.

While this activity will not result in any habitat alteration or removal, potential effects to covered species could result from temporary disturbance related to noise and increased activity during resurfacing work. Each existing road is expected to be resurfaced once during the life of the HCP. An average of 48 lane km (30 lane mi) of roadway is resurfaced annually. No new ground disturbance is anticipated due to road resurfacing.

2.2.1.2 Road Widening

Road widening generally consists of excavation and embankment creation, importing or exporting embankment material, minor changes in horizontal and vertical alignment, drainage improvements, asphalt surfacing, signing, and striping. Other possible improvements include street lighting, traffic signal installations, and landscaping. A 1-mile-road-widening project takes approximately 9 months. Crew sizes range from 25 to 30 at any one time. Utility installation or relocation located within road rights-of-way is included in the road widening impact area calculations. Staging areas are approved by the Town and generally are in currently disturbed locations.

Potential temporary impacts related to this activity include noise disturbance and increased human activity during construction. Potential permanent impacts include habitat alteration or removal, alteration of drainage patterns, increased traffic noise and volume, increased lighting, and increased dust and air pollutants. The Town anticipates widening 265.57 lane km (165.02 lane mi) of roadway over the next 25 years. The area of ground disturbance due to road widening and new road construction is described in the following section.

2.2.1.3 New Road Construction

New road construction generally consists of excavation and embankment creation, importing or exporting embankment material, drainage improvements, asphalt surfacing, signing, and striping where an existing roadway does not currently exist. Other possible improvements include street lighting, traffic signal installations, and landscaping. A 1.5-km (1-mile) section of new road requires approximately 6 to 9 months for construction. Crew sizes range from 25 to 30 at any one time. Utility installation or relocation located within road rights-of-way is included in the road widening impact area calculations. Staging areas are approved by the Town and usually are in currently disturbed locations. The Town anticipates constructing 351 lane km (218 lane mi) of new roadway over the next 20 years.

Potential temporary impacts related to this activity include noise disturbance and increased human activity during construction. Potential permanent impacts include habitat loss or fragmentation, alteration of drainage patterns, increased traffic noise and volume, and increased lighting. There is also the potential for lethal take due to collisions with vehicles for some species such as reptiles, amphibians, rodents, and burrowing owls. Placement of utility lines along new roads (both above and below ground) is generally included in the road right-of-way and is therefore not treated as a separate activity.

The combination of road widening and new road construction will involve approximately 1,056 ha (2,609 ac) of ground disturbance (see Table 2.4).

2.2.1.4 Bridge Construction over Waterways

Bridge construction over waterways will occur where roadway widening, new road construction, railroad crossings, or pedestrian walking paths need to be constructed over existing or future drainage ways. Bridge construction generally consists of the sub-structure and the super-structure. The sub-structure is composed of abutments, piers, and girders. Piers are located in waterways and generally consist of several drilled shafts. The super-structure is composed of the bridge deck. Utility installation or relocation located within rights-of-way is included in the bridge construction impact area calculations. A 152-m (500-ft) new bridge section takes approximately 6 to 9 months to construct. Crew sizes for a span of this size range from 25 to 30 at any one time. Staging areas are approved by the Town and usually are in currently disturbed locations and out of water drainage areas. Bridges crossing the Santa Cruz River that may be constructed within the next 25 years include a new Twin Peaks bridge and a new bridge at the Tangerine Road realignment, and upgraded bridges at Sanders Road, Trico-Marana, and Ina Road. Bridges crossing Prospect Wash near the Foothills Subdivision will include one at-grade crossing and one bridge.

Potential temporary impacts related to this activity include noise disturbance, temporary alterations in the channel, temporary access roads, increased human activity during construction, and increased erosion and sedimentation. Potential permanent impacts include habitat fragmentation or loss, permanent alterations in the flow channel, increased traffic noise and volume, and increased lighting. Assuming an additional 2 ha (5 ac) of disturbance per bridge over what is listed above in the acreage for road widening or new road construction associated with each bridge, the area of ground disturbance related to new bridges over waterways is approximately 18 ha (45 ac).

2.2.1.5 Bridge Construction over Transportation Ways

Bridge construction over transportation ways consists of grade separated intersections, overpasses and underpasses. This construction generally is more complex than for bridges over waterways due to factors such as traffic control and pedestrian safety. Bridge construction generally consists of the sub-structure and the super-structure. The sub-

structure is composed of abutments, piers, and girders. The super-structure is composed of the bridge deck. Utility installation or relocation within road rights-of-way is included in the bridge construction impact area calculations. Construction generally takes approximately 9 to 12 months to complete. Crew sizes range from 25 to 30 at any one time. Staging areas are approved by the Town and usually are in currently disturbed locations and away from traffic and pedestrian activities. New bridges over Interstate 10 (I-10) that may be constructed within the next 25 years include the Tortolita Parkway, Moore Road, Tangerine Road, and Twin Peaks bridges. Upgraded bridges over I-10 that may be constructed within the next 25 years include Marana Road, Avra Valley Road, Cortaro Road, and Ina Road. Three new bridges over the CAP canal are expected to result in approximately 6 additional ha (15 ac) of ground disturbance over what is included in the hectareage listed above for road widening or new road construction associated with the bridges.

Impacts to natural resources associated with this type of bridge construction are usually reduced in comparison to bridges over waterways. Typically, natural vegetation and habitat have already been impacted by existing transportation ways, but potential temporary impacts related to this activity include noise disturbance, habitat alteration at construction staging areas, temporary access roads, and increased human activity during construction. Potential permanent impacts include minimal habitat fragmentation or loss, increased traffic noise and volume, and increased lighting. The area of ground disturbance associated with bridges over the CAP canal, in addition to the road widening and new road construction listed above is approximately 6 ha (15 ac).

2.2.2 Bank Protection and Channel Modification

Bank protection consists of river bank stabilization along the edges of rivers and washes to reduce soil erosion and scour. Types of bank protection may include soil stabilization by dynamic compaction and soil-cement stabilized earth. Bank protection can also be accomplished with the use of geotextiles, gabions, rip-rap lined banks, and shot-crete protection. Utility installation or relocation within rights-of-way is included in the impact area calculations related to these activities. Construction duration for bank protection varies by the method implemented and can take from 1 to 9 months for one mile of construction. Crew sizes range from 5 to 15 for any given time. Staging areas will be approved by the Town and generally will be at locations that are disturbed and out of the wash or river area.

Potential temporary impacts related to this activity include noise disturbance, habitat alteration at construction staging areas, temporary access roads, increased human activity during construction, increased erosion and sedimentation, impacts to the hydrology of the area. Potential permanent impacts include habitat alteration or removal. The anticipated area of ground disturbance is approximately 295 ha (728 ac), which represents the maximum impact area should bank protection be installed along all remaining reaches of the Santa Cruz River within the Town.

2.2.3 Channel Creation

Future development in the northwest portion of the Town will require the creation of new drainage channels in what is now agricultural land. The locations and number of new channels are unknown, but the channels will be located in existing agricultural or other disturbed areas. One channel that is currently planned for construction will be located along the current Barnett Road alignment. A park will also be created at the Barnett channel, which is described in further detail under Section 2.2.6.1. The anticipated area of disturbance is 35 ha (86 ac).

Impacts to natural resources associated with this activity are likely to be reduced in comparison to activities located in natural desert or riparian areas. Typically, natural vegetation and habitat have already been impacted by previous land uses, but other impacts related to noise, erosion, and hydrology could occur. Additional impacts related to the Barnett Channel are discussed below under the Parks and Trails section (2.2.6.1).

2.2.4 Grade Control Structures

Grade control structures are assumed at all existing bridges, which may need to be improved in the future and at any new bridges, for an estimated total of 26 ha (63 ac) of grade control structures within the 25-year life of the Permit.

2.2.5 Public Water Infrastructure Installation

Public water infrastructure installation consists of new water plant construction and new pipeline construction. These specific activities are described below.

2.2.5.1 New Water Plant Construction

A new Tucson Northwest Entities Regional Reliability and Storage for the Central Arizona Project and a treatment plant is planned at the termination of the above-ground CAP canal at Tangerine Road. New water plants generally are constructed at sites that are less than 1 ha (2 ac) in size. Water infrastructure facilities include the installation of reservoirs—both buried concrete and aboveground steel, potable water wells, and booster pumping equipment required to pressurize water service zones. These sites require electrical power and have remote telemetry units and communications equipment to communicate the operational conditions of the sites to the system operators. Construction activities associated with the installation of new water plants include site clearing and building of block walls. Construction activities often required to minimize visual impacts include the addition of exterior aesthetic treatments such as landscaping. The construction of these facilities requires construction crews of 2 to 10 people, and project duration ranges from 3 to 12 months.

Potential temporary impacts related to this activity include noise disturbance and increased human activity during construction. Potential permanent impacts related to this activity include habitat loss and/or fragmentation, alterations in drainage patterns, increased noise, human activity, traffic, and lighting. The new Tucson Northwest Entities Regional Reliability and Storage for the CAP and treatment plant is anticipated to be built within the next 25 years and will involve approximately 65 ha (160 ac) of ground disturbance, including a 42-ha (104-ac) lake.

2.2.5.2 New Pipeline Construction

New pipeline construction usually follows existing rights-of-way and cleared areas within easements, but can include the establishment of new easements over previously undisturbed lands. In the event a pipeline requires installation in uncleared areas, clearing widths are usually limited to 15 m (50 ft) or less, though larger pipelines can require up to 23 m (75 ft) of clearance. New pipeline construction generally consists of excavations from 1 to 6 m (3 to 20 ft) in depth. Pipeline crossings are typically deeper at wash crossings. Construction crew sizes are usually 2 to 10 people. Pipelines are bedded and shaded with imported material (sand). Location tape is placed on top of the sand layer. Pipeline types are typically polyvinyl chloride (PVC), ductile iron, or reinforced concrete. Tracer wires are installed atop the pipelines for future locating. Pipeline trenches are backfilled with screened (15-cm [6-in] or smaller) material and are compacted to 90- to100-percent standard proctor density. Air release valves are installed at high points along the alignments, and the pipelines can withstand 14 kilogram per square centimeter (200 pounds per square inch) of pressure. Approximately 80 linear km (50 linear mi) of new pipeline will be installed within road rights-of-way or under sidewalks.

Potential temporary impacts related to this activity include noise disturbance and increased human activity during construction. Permanent impacts may include habitat loss, a discussion of which has been included above in Section 2.2.1.3 —New Road Construction, since new pipelines will be located within the road rights-of-way or under sidewalks in subdivisions.

2.2.6 Parks and Trails

The Town of Marana plans to develop several parks and trails as recreational opportunities for the community. Neighborhood parks, local trails, and connector trails are the responsibility of individual developers and are included in the impact footprint of residential development. The following describes the parks and trails planned by the Town during the next 25 years. They are depicted in Figure 2.6.

2.2.6.1 Barnett Linear Park

The Barnett Linear Channel will be a 61-m-wide (200-ft-wide) drainage structure approximately 6 km (4 mi) long running from the west side of I-10 to the Santa Cruz River. The purpose of the channel is to carry flood water from the Tortolita Fan to the Santa Cruz River.

The channel also will be constructed to serve as a recreational facility on the eastern end of the project near I-10 and will include turfgrass areas, paths and trails, picnic areas, ramadas, court sport facilities, skate park, performance areas, dog park, horseshoe pits, and restrooms.

The anticipated area of disturbance related to the Barnett Channel and Park will be approximately 35 ha (86 ac).

2.2.6.2 Heritage Park

Heritage Park will be located on 111 ha (275 ac) of farmland between the Santa Cruz River and the Gladden Farms community. The focus of the park will be on the heritage and history of agriculture in the Town. Construction and improvement features in the park will include:

- Agriculture fields
- Agriculture facilities consisting of a farmers' market, community garden, ethnobotanical garden, and small crop plots
- Train station and track. The train track will run in a 2.5-km (1.5-mi) loop through the park.
- Non-potable water and agricultural detention basin. The water body will act as a detention basin within the park.
- Trails. The Santa Cruz River Corridor Trail will run through the western portion of the park along the Santa Cruz River.
- Equestrian facilities
- Open space
- Habitat restoration. A portion of the park will be restored to the original native habitat of the area prior to agriculture. The area will be adjacent to the Santa Cruz River floodplain.
- Recreation area, including a ramada, playground, and a small train depot

FIGURE 2.6

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- Heritage Center and Cultural Arts Center
- Parking lots
- Burrowing owl artificial burrows will be installed along the perimeter adjacent to the Santa Cruz River

The anticipated area of disturbance related to the Heritage Park will be approximately 111 ha (275 ac), 16 ha (40 ac) of which will be off-set by habitat restoration measures including a burrowing owl management area.

2.2.6.3 Silverbell/Cortaro Road District Park

The Silverbell/Cortaro Road District Park will cover 21 ha (53 ac) and serve as a district park for the Continental Ranch area. Portions of the park will be left as open space, and a trail system will be installed. Other construction plans include: two soccer/multipurpose fields, three baseball/softball fields, two sand volleyball courts, two basketball courts, restrooms, parking, a playground, horseshoe pits, picnic ramadas with barbeque pits, a fenced dog park, and a water tank with interpretive signage.

The anticipated area of disturbance related to the Silverbell/Cortaro Road District Park will be approximately 21 ha (53 ac).

2.2.3.4 Marana Regional Community Center

In partnership with the Marana Unified School District, the Town plans to construct a 3,716-sq m (40,000-sq ft) multi-generational center that features a two-court gymnasium, indoor track, climbing wall, aerobic/dance room, fitness facility with cardiovascular equipment and weights, preschool playroom, two art rooms, two classrooms, a divisible multi-purpose room, locker rooms, concession area, and administrative offices. Alongside this project and with assistance from Pima County, a 1,858-sq m (20,000-sq ft) library and a competition-size aquatic center are planned for construction. Associated parking and site amenities will be developed as part of these facilities. The anticipated acreage of disturbance associated with the Marana Regional Community Center will be approximately 18 ha (45 ac).

2.2.6.5 Bureau of Reclamation Regional Park

The BOR Park will encompass 194 ha (479 ac) of vacant and retired agricultural land near the Marana Regional Airport.

As of 2008, proposed plans for the park include:

- Eighteen lighted soccer fields

- Twelve lighted softball fields
- Four softball fields
- Twelve lighted baseball fields
- Two picnic areas with playgrounds
- Maintenance area
- Ramada
- Four restrooms
- Band shell near soccer fields
- Skate park
- Two paved parking areas and one overflow gravel parking area
- Non-potable water and agricultural detention basin. The water body will act as a detention basin within the park.
- Burrowing owl artificial burrow installation area and open space (32 ha [80 ac])

Development will occur on both sides of Avra Valley Road with baseball, softball, and equestrian facilities to the north and soccer and a special events area to the south. The anticipated acreage of disturbance associated with the BOR Regional Park will be approximately 194 ha (479 ac).

2.2.6.6. Santa Cruz River Linear Park

Another 3.5 km (2.2 mi) of multi-use path are planned for the Santa Cruz Linear Park, which will connect the Marana Heritage Park with the proposed Beard House Environmental Center. Construction of 7.2 km (4.5 mi) of multi-use path is planned to join the Marana Heritage Park with the existing path in Continental Ranch. An addition of 3 km (2 mi) of multi-use path will connect the existing trail and Wade McLean Park to the Silverbell/Cortaro Road District Park and continue south to Ina Road. The anticipated acreage of disturbance associated with the Santa Cruz Linear Park will be approximately 85 ha (210 ac).

For all new park construction, potential temporary impacts related to the creation of parks include noise disturbance and increased human activity during construction. Permanent impacts include habitat loss, habitat fragmentation, alteration of drainage patterns, increased noise and activity by recreationists, increased lighting including evenings, activities of maintenance workers, and harassment or predation of wildlife by dogs and

outdoor or feral cats. The total acreage of parks proposed within the Town boundaries within the next 25 years is 355 ha (876 ac).

2.2.6.7 Trails

The 5-km (3-mi) Cochie Spring Trail will be developed in the Tortolita Mountains. Another 5 km (3 mi) of the Wild Burro Trail starting north of Tangerine Road and continuing to the Tortolita Preserve are planned for construction along with an associated trail head. A 1-ha (3-ac) trailhead at Pima Farms Road with trail connections into Saguaro National Park will be constructed. A multi-use path atop the bank protection along the Cañada Del Oro wash from the Santa Cruz River northeast to the Town limits and a multi-use path atop the bank protections along the Rillito River are planned for construction.

For all new trail construction, potential temporary impacts related to the creation of trails include noise disturbance and increased human activity during construction. Potential permanent impacts include habitat loss, fragmentation, alteration of drainage patterns, increased noise and human activity, increased traffic, increased lighting, activities of maintenance workers, and harassment or predation of wildlife by dogs and outdoor or feral cats. Total anticipated ground disturbance, excluding open space and burrowing owl management areas, is approximately 80 km (50 mi) or 148 ha (365 ac) assuming an average width of 18 m (60 ft).

2.2.7 Airport Infrastructure Improvements

The Marana Regional Airport is located to the east of the intersection of Sanders and Avra Valley roads in Marana, Arizona. The airport serves the aviation needs of the Town, northwest Tucson, and northeast Pima County. Given the anticipated population increases in the Town and Tucson, air traffic as well as plane size and weight are expected to increase over the next 25 years. The airport intends to accommodate these increases through the improvement of existing runways and construction of a new runway, tower, new hangars, and parking facilities, among other projects.

2.2.7.1 Runways and Taxiways and Tower

Runway 12L-30R (Runway 30), the primary airport runway, will be extended by 914 m (299 ft) to the southeast for a final length of 2,195 m (7,200 ft). Taxiway A, which serves and runs parallel to Runway 30, also will be extended by 914 m (299 ft). Net surface area for the runway and taxiway extensions will be approximately 7 ha (17 ac), all of which will be on land that has already been cleared. Avra Valley Road will also be realigned 792 m (2,600 ft) south to accommodate the new runway and taxiway length. Taxiway C, which connects Runway 30 and Runway 3, will be widened to 15 m (50 ft) (from an existing width of 11 m [35 ft]). The pavement strength of the Runway 30 and its associated taxiways A and C will

be increased to a pavement strength rating of 68,039 kilograms (kg) (150,000 pounds [lbs]) dual wheel gear loading (DWL).

Runway 3-21 (Runway 3) will be extended 152 m (499 ft) to the southwest of the airport. Taxiway B, which serves Runway 3, will be extended the same distance. Net surface disturbance will be approximately 1 ha (2 ac), and the runway will be extended through what is now vacant land and agricultural fields. Pavement strength for Runway 3 will also be increased to 13,608 kg (30,000 lbs) DWL.

To service future air traffic needs, a new runway has been recommended for construction parallel to and southwest of Runway 30. Designated as Runway 12R-30L, it will be 1,433 m (4,700 ft) long and 23 m (75 ft) wide (approximately 3 ha [8 ac]) and have a pavement strength of 13,608 kg (30,000 lbs) DWL. Taxiway D would be built concurrently and would be 1,433 m (4,700 ft) by 15 m (50 ft) (approximately 2 ha [6 ac]). Exit taxiways would also be constructed. Net surface disturbance would be approximately 6 ha (14 ac) for the new Runway 12R-30L and Taxiway D.

A new control tower (approximately 23 sq m [250 sq ft]) is planned at the Marana Airport.

2.2.7.2. Hangars, Aircraft Parking Ramps, Auto Parking

A new parking ramp will be built to double the capacity of the existing ramp. The current tie-down area will be moved and will replace the current parking ramp. A new aircraft wash rack facility also will be constructed, and a new fuel storage site will be added. Hangar capacity will be increased with the addition of eight new T-hanger facilities, and an area will be reserved for a future access road and automobile parking.

A new hangar facility also is proposed near the existing Hangar D structure, and a new parking area will be added south of Hangar D. Future hangars, parking ramp, and automobile parking could also be constructed in a reserve area south of Avra Valley Road.

For all airport improvements, potential temporary impacts include noise disturbance and increased human activity during construction. Potential permanent impacts related to this activity include habitat loss and/or fragmentation, alterations in drainage patterns, and increased noise, human activity, traffic, and lighting. The anticipated acreage of disturbance associated with the airport improvements will be approximately 874 ha (2,160 ac).

2.2.7.3. Lighting

Airport runway lighting will be altered to match runway and taxiway extensions. Lighting is confined to the cleared areas on or adjacent to runways; therefore, all surface disturbance is encompassed by the construction or extension of the runway.

Potential temporary impacts related to this activity include noise disturbance and increased human activity during construction. Permanent impacts include habitat loss and fragmentation, possible alteration of drainage patterns, increased noise and activity (at night as well as during the day), increased lighting, and activities of maintenance workers.

2.2.8 Maintenance activities

Operations and maintenance activities carried out by the Town are covered by this HCP. The Town conducts maintenance activities on roads, water infrastructure, parks, and trails as described below.

2.2.8.1 Road Maintenance

Road-maintenance activities are required to keep the roads and associated structures—such as rights-of-way, landscaping, signs, bridges, grade control structures, and bank protection—in good repair and working condition. Minor improvements undertaken during the normal process of performing these activities are also included. Covered maintenance activities include the following activities relating to the road system and associated facilities: inspection activities, pavement rehabilitation, right-of-way maintenance (including sign installation, landscaping maintenance, trash pick-up, and grading of road shoulders), structure maintenance, culvert cleaning, street sweeping, street striping and markings, graffiti removal and painting, weed control, wash maintenance, and storm and flood response. Each of these activities is described below.

Inspection Activities

The Town continuously inspects its road system to determine where and when maintenance is required. No ground disturbance is anticipated from inspection activities. There will be a minor amount of traffic, noise, and workers involved in these activities.

Pavement Rehabilitation

Pavement rehabilitation is limited to the existing roadbed and includes sealing of cracks on the road surface, filling in potholes, and patching degraded portions of the road. Temporary impacts will include equipment usage, noise, and workers present during pavement rehabilitation, but no additional ground disturbance is anticipated.

Right-of-Way Maintenance

The rights-of-way for roads range from 24 to 37 m (80 to 120 ft) in width, depending on whether they are a major or minor route. The rights-of-way for roads may consist of a clear zone, signage, and landscaping. Maintenance activities include sign installation, landscaping maintenance, trash pick-up, and grading of road shoulders. There will be some

equipment usage, noise, and workers present during right-of-way maintenance, but no additional ground disturbance is anticipated outside of the rights-of-way.

Structure Maintenance

Aside from periodic maintenance of the road surface, regular activities are not undertaken to modify existing bridge pylons or other major infrastructure. Bridges needing structural improvements are replaced rather than repaired. No bridge repair is anticipated other than the bridge replacement projects discussed in Section 2.2.1.4; therefore, no ground disturbance is anticipated under this category.

Culvert Cleaning

Culvert cleaning is conducted on an as-needed basis under roads and highways in the Town. Culverts are cleaned using high pressure water to loosen material which is then vacuumed out of the culvert. The material is transported to the local landfill. Temporary impacts will include equipment usage, noise, and workers present during right-of-way maintenance, but no additional ground disturbance is anticipated outside of the rights-of-way.

Street Sweeping

Streets are swept on a regular basis to remove road debris and dust. A water spray is used to control dust, and sweeping schedules are altered to suit the conditions. Temporary impacts will include equipment usage, noise, and workers present during this activity, but no additional ground disturbance is anticipated.

Street Striping and Markings

Roads and streets are re-striped biannually or more often as needed in the Town. Long lines are currently contracted out to a specialty contractor, whereas crosswalks, arrows, and stop bars are generally done in-house. In some instances, thermo-plastic materials are used. Temporary impacts will include equipment usage, noise, and workers present during this activity, but no additional ground disturbance is anticipated.

Graffiti Removal and Painting

As necessary, graffiti is removed by non-toxic solvents or by painting over surfaces that have been painted. Temporary impacts will include equipment usage, noise, and workers present during this activity, but no additional ground disturbance is anticipated.

Weed Control

Rights-of-way and shoulder areas are physically removed or sprayed for weed control with over-the-counter herbicide products (e.g., Roundup®, diuron) by a Certified Pesticide

Applicator and in a manner that will avoid contamination to water sources. Applications are arranged to coincide with weather or other conditions that would produce beneficial results. Temporary impacts will include equipment usage, noise, and workers present during this activity, but no additional ground disturbance is anticipated.

Wash Maintenance

Common storm drainage ways are routinely maintained to ensure correct flow and conditions acceptable to residents. This involves activities such as mowing, weed control, disking, and handwork as necessary. Temporary impacts will include equipment usage, noise, and workers present during this activity, but no additional ground disturbance is anticipated beyond what has already been disturbed.

Storm and Flood Response

As conditions require, responses to intense weather will employ many applications to reduce and mitigate storm damage. Areas may be closed and barricaded as determined by public safety concerns or debris removal efforts.

Potential temporary impacts related to road maintenance activities include minor habitat alteration, noise disturbance, and increased human activity. There is no ground disturbance associated with these activities.

2.2.8.2 Park and Trail Maintenance

Maintenance activities required for the parks system include keeping existing irrigation, drainage, and related facilities in good repair and working condition. Minor improvements undertaken during the normal process of performing these activities are also included.

Other covered maintenance activities include management of open space and trail maintenance. Open space within park areas is maintained through irrigation, routine mowing of grass, and trash collection. Weeds are controlled in the grassy, open spaces of parks with herbicides. Maintenance of trails includes routine trash patrol along trail routes, sign mending, and repair of vandalized sites and wash-out areas. Trail maintenance will occur on regional park trails, trail connections to Saguaro National Park, and the Tortolita Mountain trail system within the Town. There will be some equipment usage, noise, and workers present during this activity, but no additional ground disturbance is anticipated.

Potential impacts related to park and trail maintenance activities include habitat alteration, noise disturbance, and increased human activity. There are no acreages of impact associated with these activities.

2.2.8.3 Water and Wastewater Infrastructure Maintenance

Pipeline and Valve Maintenance

Maintenance activities associated with pipelines and valves include valve exercising, marking blue stakes for main locations, routine hydrant and main flushing, chlorine residual and bacteriological testing, and routine inspections to ensure that the existing facilities are in good repair and in working condition. These activities are generally performed quarterly by one- to two-person crews with light trucks (one ton or less). There will be some equipment usage, noise, and workers present during this activity, but no additional ground disturbance is anticipated.

Pipeline and Valve Repairs

Pipeline and valve repairs include repairing mainline breaks and the replacement of leaking and/or failing valves. The ground disturbance associated with these activities generally is limited by easement width or within public rights-of-way. These activities are not regularly scheduled and typically are performed on an emergency basis. Construction crews usually consist of 2 to 10 people. Project duration typically is less than one week, but can be much longer in extreme cases. Repair or replacement can include aboveground installation of temporary pipelines to maintain service.

Potential temporary impacts related to pipeline and valve maintenance activities may include minor habitat alteration, noise disturbance, and increased human activity. There is no ground disturbance associated with these activities.

2.2.8.4 Airport Maintenance

The maintenance of the runways, taxiways, and apron areas consist of daily inspections and sweeping of the paved areas. The shoulders of these areas are also maintained with fill dirt as needed to ensure proper drainage without having more than a 2.5-cm (1-in) drop off the edges of pavement. The airport lighting system is inspected daily and weekly, and fill dirt also is used as needed to ensure that there is not more than a 2.5-cm (1-in) rise to the lights in the shoulder areas. The lighting and shoulder areas of all pavements are sprayed to prohibit all plant growth for visibility around the low-level airport lights. All other areas of the airport property are mowed to ensure minimum plant growth around the airport.

Potential temporary impacts include noise and workers present during this activity, but no additional ground disturbance is anticipated.

2.2.8.5 Implementation Activities

Any incidental take of covered species that results from activities associated with the implementation of the HCP mitigation measures and the monitoring program would be

covered under this HCP. These covered activities include management of habitat that is acquired, created, or restored in implementing the HCP, as well as required surveys and monitoring activities. Mitigation, management, restoration, and monitoring activities implemented by qualified third parties on behalf of the Town for these purposes are also covered.

2.3 Activities Not Covered by the Permit

The activities not covered by this Permit will depend on the HCP alternative selected. Activities carried out or authorized by public or private parties other than the Town are not covered by this HCP or the resulting Permit, unless identified as a covered project through the permitting process and the selected alternative. Covered activities will be specifically restricted to those impacts occurring within Town boundaries.

Activities within the Permit Area that are not covered by this HCP include those occurring on any properties that have current zoning where no discretionary actions are necessary.

Activities relating to grade control structure maintenance are not covered under the HCP because grade control structures are replaced rather than repaired. Bank protection maintenance is performed by Pima County Flood Control District and therefore is not covered. This Permit also does not cover any activities currently carried out within the Town by Pima County. This includes Pima County-owned and -operated wastewater treatment plants, and landfill operations.

Also not covered are the impacts of increased, decreased, or otherwise altered water quality or availability, except for those impacts directly resulting from activities carried out or authorized by the Town and having all required Federal Permits.

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Chapter 3
Environmental Setting/Biological Resources

This section provides an overview of the environmental setting and biological resources in the Town of Marana and adjacent lands as relevant to this HCP. Existing habitat conditions and population status for covered species are contained in Chapter 4—Conservation Program.

The Town can be viewed as encompassing three broad geographic areas, each defined by the following landform features (Figure 3.1):

1. Tortolita Mountains and Fan

2. Santa Cruz River Corridor

3. Valley (Basin) Bottom Lands

Each area has a distinctive landform, topography, geology, hydrology, and soil conditions. These abiotic features, along with climate, have a profound influence on the vegetation and wildlife inhabiting each area. As discussed here, the Tortolita Mountains and Fan include all mountains, hills with moderate relief, dissected bajadas and fans, non-dissected bajadas and fans, and the drainage ways through these landforms. The general descriptions of upland areas of bajadas and fans associated with the Tucson Mountains in the southernmost part of the Town are combined in this Chapter with the Tortolita Mountains and Fan, even though they are geographically separated areas. The Santa Cruz River Corridor is defined as the floodway, a portion of the floodplain that the Town does not plan to develop and within which future flood events would be constrained. The Valley Bottom Lands encompass terraces, non-dissected alluvial plains, and floodplains excluding the Santa Cruz River Corridor and accounts for the remaining land area (Figure 3.1).

3.1 Physical Setting: Landform

The Town is situated within the Basin and Range Physiographic Province. This province is typified by broad alluvial basins lying between relatively isolated mountain ranges and dissected uplands. Within this province, sediments from the mountain ranges are slowly filling the intervening basins (Bates and Jackson 1997). Elevations within the Town range from a low of 580 m (1,900 ft) at the Santa Cruz River channel to a high of 1,330 m (4,360 ft) above mean sea level in the Tortolita Mountains.

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Figure 3.1

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3.1.1 Tortolita Mountains and Fan

The primary landform in this area generally includes the fan or bajada which extends over much of the north–central and eastern portions of the Town. In general, a bajada forms at the base of a mountain range and extends out onto the floodplain. The bajada is formed by the merging of a series of alluvial fans created by storm water runoff, in this case from the Tortolita Mountains. The sheet flow on this heavily dissected bajada is a powerful erosive force, particularly when a watercourse has been modified. Modifying a watercourse by way of development can accelerate down-cutting and affect conditions both upstream and downstream, including xeroriparian vegetation. The CAP canal has functionally separated the floodplain at the base of the bajada from the basin bottom and Santa Cruz River (see Figure 3.1). Slopes on the fan are gentle, varying from 2 to 5 percent and grading into very steep slopes (greater than 50 percent) in the Tortolita Mountains.

3.1.2 Santa Cruz River Corridor

The Santa Cruz River runs in a northwesterly direction through the Town. The surface hydrology of floodplain areas outside of the floodway has been separated from the river as a result of flood control measures. The width of the river is constricted in many places by bank protection and flood control measures, although in some reaches, the river is unconstrained and the natural floodplain is relatively wide.

Except for flood events, all of the water in the Santa Cruz River in Marana is discharged from the wastewater treatment plants located at Ina Road and Roger Road. An *Intergovernmental Agreement—Permitting and Operating Managed In-Channel Recharge of Effluent in the Santa Cruz River Channel (Managed Recharge IGA* 2003*)* governs the recharge of effluent and the associated credits made available from recharging effluent into Lower Santa Cruz Managed Recharge Project (LSCMRP) between the Ina Road Water Pollution Control Facility (WPCF) and Trico Road in Marana. Participants include the Town of Marana, Cortaro–Marana Irrigation District, Avra Valley Irrigation District, Metropolitan Domestic Water Improvement District, Flowing Wells Irrigation District, Oro Valley, Pima County, and the City of Tucson. Secondary effluent is chlorinated and discharged as Class B reclaimed water or to the Santa Cruz River. Approximately 66,509 acre-feet (af) per year of effluent wastewater are produced with approximately 80 percent (53,342 af per year) released back into the Lower Santa Cruz River (Pima County 2006).

At times, there is very little effluent in the channel due to daily variations in wastewater releases. The distance the water travels downstream from the treatment plants is related to the effects of flood events and subsequent infiltration rates. Typically, the river bottom is covered by a dense algal mat that inhibits the infiltration of water. Flood events scour the sediments, removing the algal layer and increasing the infiltration rate. Following

such events, the channel geometry stabilizes, and infiltration rates decrease as the algal layer redevelops (Galyean 1996). The algal layer can reform within several days. The average distance that the Lower Santa Cruz River flows perennially is approximately 6 km (4 mi), based on measurements from the Pima County Sonoran Desert Conservation Plan geographic information system (GIS) maps online (http://www.dot.co.pima.az.us/gis/maps/mapguide/). According to Chapter Four of the *Santa Cruz Valley National Heritage Area* report (Center for Desert Archaeology website: http://www.cdarc.org/ accessed September 8, 2008), ephemeral flows vary with the year, season, and amount of rainfall, flowing from the Roger Road wastewater treatment facility to sometimes as far north as Red Rock, a distance of 48 km (30 mi). The Santa Cruz River has experienced major flood events in the recent past. On October 2, 1983, a flow of 1,840,595 liters (L) (65,000 cubic feet [cu ft]) per second was recorded that widened the river channel, scoured the floodway, and removed vegetation. In January 1993, two separate peak flows of 1,104357 and 1,132,674 L (39,000 and 40,000 cu ft) per second occurred just 10 days apart (WLB Group 1996). In 2006, a storm deposited 27.94 millimeters (mm) (1.10) inch [in]) of rain at Marana Regional Airport in 24 hours and caused widespread flooding.

As the need for additional water supply and the value of the effluent increases, more water is likely to be reused. As a result, the volume of wastewater released into the Santa Cruz River that flows through the Town is likely to decrease. The regional water table in the area of the lower Santa Cruz River is approximately 76 m (250 ft) below the surface according to the Lower Santa Cruz Managed Recharge Project Application 2000 (Pima County 2005). In some areas, such as in the vicinity of Avra Valley Road, the regional water table is substantially higher. Nevertheless, the depth to groundwater is great enough to have resulted in a hydraulic disconnection between surface flows in the Santa Cruz River and groundwater.

There are currently two restoration projects along the Santa Cruz River. The Tres Rios del Norte project is a cooperative effort between the City of Tucson, Pima County Regional Flood Control District, and the Town of Marana in conjunction with the USACE. The purpose of this study is to evaluate an approximate 29 km (18 mi) stretch of the Santa Cruz River from Prince Road to Sanders Road for projects such as ecosystem restoration, groundwater recharge, flood damage reduction, recreation and protection of cultural resources. This project would have habitat protection value, but it is not finalized at this point.

A 32 ha (80 ac) riparian restoration project was begun in 2007, along the Santa Cruz River north of Cortaro Road, by Pima County Regional Flood Control District. The project involved planting a mesquite bosque and the project goal was to increase the vegetation structure and biological diversity of the floodplain and to provide wildlife habitat, particularly forage and nesting areas for birds.

3.1.3 Valley (Basin) Bottom Lands

The valley bottom area (see Figure 3.1) is relatively flat with alluvial soils deposited from the Santa Cruz River or from runoff from the Tortolita Mountains and Fan. The surface hydrology of the valley bottom has now been separated from both the Santa Cruz River and Tortolita Mountains and Fan. The area between the CAP canal and I-10 is best considered the lowermost portion of the bajada; however, since it is now functionally disconnected from the outwash from the Tortolita Mountains by the CAP canal, this area is included here as part of the valley bottom.

3.2 Climate

The average precipitation within the Town is between 270 and 305 mm (11 and 12 in) per year (WRRC 2005). However, actual precipitation in the Town is variable as a result of elevation differences in the Town. Lowe (1964) estimated that an increase in elevation of 205 m (1,000 ft) results in a 102 to 127 mm (4 to 5 in) increase in annual precipitation. Thus, the Tortolita Mountains and upper bajada may receive more precipitation than the valley bottom. Precipitation occurs in a bi-seasonal pattern distributed between the summer monsoons and winter storms. Winter temperatures range from an average low of 3 degrees Celsius (^{o}C) (38 degrees Fahrenheit [^{o}F]) to an average high of 19°C (67°F). In the summer, the average low is 22°C (71°F), and the average high is 38°C (101°F) (National Oceanic and Atmospheric Association [NOAA] 1997).

3.3 Vegetation

3.3.1 Tortolita Mountains and Fan

Vegetation of the Tortolita Mountains and Fan is characteristic of the Arizona Upland Subdivision of the Sonoran Desertscrub Biome (Brown 1994). Plant associations of the Paloverde–Cacti–Mixed Scrub Series cover most of the mountains and fan (Figure 3.2; Table 3.1).

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Figure 3.2

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TABLE 3.1
PLANT ASSOCIATION COVER TYPES OF THE TORTOLITA MOUNTAINS AND FAN

Plant Association/Land Cover Type	Hectares (Acres)	Percent
Creosote-Bursage	1,411 (3,487)	5
Cottonwood-Willow	59 (146)	< 0.1
Mesquite	114 (282)	< 0.1
Paloverde-Cacti-Mixed Scrub	15,262 (37,713)	56
Xeroriparian	3,114 (7,695)	11
Developed	7,390 (18,260)	27
Total	27,350 (67,583)	

The vegetation of this series is dominated by leguminous trees with an overstory of saguaro cactus (*Carnegiea gigantea*). Common trees include foothill paloverde (*Parksinsonia microphylla*), ironwood, and velvet mesquite (*Prosopis velutina)*. Typically there are one or more layers of shrubs and perennial succulents. Tall shrub-layer vegetation commonly includes acacia (*Acacia* spp.), desert hackberry (*Celtis pallida*), graythorn (*Ziziphus obtusifolia*), and prickly pear (*Opuntia* spp.). Lower shrub-layer vegetation often includes creosote bush (*Larrea tridentata*), triangle-leaf bursage (*Ambrosia deltoidea*), and white bursage (*Ambrosia dumosa*).

A relatively small portion of the fan is creosote-bursage (Table 3-1), more representative of the Lower Colorado River Valley Subdivision. Ground cover in this area consists of perennial and annual grasses and forbs.

Xeroriparian vegetation is well-developed in the numerous washes (drainageways) traversing the fan. These washes often support large trees, such as ironwood, blue paloverde (*Parkinsonia florida*), velvet mesquite, and desert hackberry. Some isolated patches of the fan, typically near springs, support more hydric riparian vegetation that can include Fremont cottonwood (*Populus fremontii*), Goodding willow (*Salix gooddingii*), and seepwillow (*Baccharis salicifolia*). Under the HCP, the Town would adopt a riparian habitat map (Figure 3.3) that would be linked to the revised Title 17 of the Town's Land Development Code (LDC).

The Tortolita Fan supports high-quality ironwood forests. As mentioned, these trees grow in both washes and inter-wash upland areas. They tend to be larger in the washes. The ASDM (2003) recently summarized the ecological importance of ironwoods in *Biological Survey of Ironwood Forest National Monument*. They identified the ecological function of ironwoods as including the role of "nurse plants," because ironwoods provide safe areas for seed dispersal, protect seedlings from temperature extremes and large herbivore predation, and enrich soils with nutrients, particularly nitrogen. As ironwoods can persist for as long as 800 years, they can function in this important role for extended periods (ASDM 2003).

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Figure 3.3

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3.3.2 Santa Cruz River Corridor

The current hydroriparian vegetation of the Santa Cruz River floodway is dominated by cottonwood-willow habitat, the rarest habitat type in the southwestern U.S. (Krueper 1996; Minckley and Brown 1982). In the stretch of the Santa Cruz River within the Town, the cottonwood-willow habitat is maintained entirely by the effluent discharged from the Ina and Roger Road treatment plants (see Figure 3.2). A riparian corridor can function as an important source of materials both to the aquatic habitat and the adjacent uplands. The sediment delivered from uplands during rain events, or produced during flood-caused scour, can provide new sites for vegetation to re-establish quickly after a flood event. Baker (2000) conducted a vegetation study focused on the Santa Cruz River in the Town and attributed a 46-percent loss of willow woodland to the 1993 floods. Baker (ibid) also found that the Goodding willow vegetation was approximately 6 years old, suggesting that the 1993 floods also provided opportunities for new seedlings to establish.

Based on Baker's (ibid.) study, other hydro-mesic vegetation along the river includes velvet mesquite, tamarisk (*Tamarix sp.*), burrobush (*Ambrosia dumosa*), desert broom (*Baccharis sarothroides*), and Bermuda grass (*Cynodon dactylon*). While much of the floodway has been disturbed, vegetation associations in the uplands adjacent to the river include creosote bush, desert saltbush (*Atriplex polycarpa*), and blue paloverde. Invasive species found in the river corridor include tamarisk, giant reed (*Arundo donax*), Johnson grass (*Sorghum halepense*), and buffelgrass.

3.3.3 Valley (Basin) Bottom Lands

More than half of the Valley Bottom Land in the Town is in active agriculture, developed land (i.e., Marana Regional Airport, commercial and residential development), or otherwise disturbed (e.g., abandoned agriculture, mining pond). Specific crop types and the extent of area in active production vary from year to year, with the most common crop being cotton. The vegetation in relatively undisturbed areas is representative of both the Lower Colorado River Valley and Arizona Upland subdivisions of the Sonoran Desertscrub Biome. The most widespread native plant associations are those of Paloverde–Mixed Cacti, Creosote–Bursage, Saltbush, and Xeroriparian Scrub (see Figure 3.2).

3.4 Wildlife

Wildlife habitat for any given species can be best described as a combination of vegetation and landform. Landform reflects topography, soils, and other habitat features. The Tortolita Mountains and Fan is the least disturbed of the three areas in the Town. Both the Santa Cruz River Corridor and valley bottom systems have been highly

modified by human activity. Human activity, especially in the valley bottom riparian vegetation area, extends back over 12,000 years. The wildlife communities present in the three areas reflect these human-caused modifications.

3.4.1 Tortolita Mountains and Fan

Wildlife in the upland areas of the Town (mountains, fans, and *bajadas*) is characteristic of the Arizona Upland subdivision of the Sonoran Desertscrub biome. The Paloverde–Mixed Cacti vegetation supports a wide variety of nesting bird species and is an important resource for migrating birds. The flowering of paloverde, mesquite, and ironwood corresponds with the arrival of migrating songbirds during spring migration. These flowering events support a rich insect fauna, which in turn provide forage for migrating and resident insectivorous birds and insectivorous bats. The flowering of saguaro cacti and agave provides forage for two nectivorous bat species. Many mammalian species forage on seeds produced by the leguminous trees.

The xeroriparian vegetation of the washes is an important habitat feature for many species of wildlife, providing relatively more food, cover, and water than the inter-wash areas. These washes represent habitat linkages by providing areas of nearly continuous cover or regularly spaced trees and shrubs that can support wildlife movement within and among habitat patches. In addition, the washes provide shade and cover where wildlife can escape temperature extremes. The Tortolita Mountains and Fan also support a high-quality ironwood vegetation community that provides important wildlife habitat, notably habitat for the cactus ferruginous pygmy-owl and foraging habitat for bat species.

Common reptiles of this area include desert tortoise, zebra-tailed lizard (*Callisaurus draconoides*), collared lizard (*Crotaphytus collaris),* desert spiny lizard (*Sceloporus clarki*), and western diamondback rattlesnake (*Crotalus atrox*). Commonly occurring birds include Harris's hawk (*Parabuteo unicinctus*), white-winged dove (*Zenaida asiatica*), elf owl (*Micrathene whitneyi*), and curve-billed thrasher (*Toxostoma curvirostre*). Rock-dwelling species of mammals such as the rock pocket mouse (*Chaetodipus intermedius*), white-throated woodrat (*Neotoma albigula*), and the gray fox (*Urocyon cinereoargenteus*) are common in the area.

3.4.2 Santa Cruz River Corridor

Riparian habitats in the Sonoran Desert have the potential to support a diverse assemblage of wildlife and are regionally important for maintaining biological diversity. Stretches of the Santa Cruz River floodway lack perennial water flow; however, so fish and amphibian species normally associated with southwestern riparian systems may be lacking. Despite the high variability in effluent discharge into the Santa Cruz River, the diversity of vegetation, in conjunction with the persistence of surface water in places,

provides habitat for a large assemblage of bird species. Within this area, important habitats for bird species are the cottonwood-willow galleries and the relatively widespread velvet mesquite woodlands.

Common reptiles of the Santa Cruz River corridor include common gopher snake (*Pituophis melanoleucus*), western diamondback rattlesnake, desert spiny lizard, western whiptail (*Cnemidophorus tigris*), side-blotched lizard (*Uta stansburiana*), and zebra-tailed lizard (Stebbins 1985). Amphibians include the southern spadefoot (*Scaphiopus multiplicatus*) and Sonoran Desert toad (*Bufo alvarius*), and the non-native bullfrog (*Rana catesbeiana*). Small mammals typical of riparian habitats include the cactus mouse (*Peromyscus eremicus*), desert pocket mouse (*Chaetodipus penicillatus*), and the western harvest mouse (*Reithrodontomys megalotis)* (Hoffmeister 1986). Riparian areas are also important for large mammals for food and cover, and can function as movement corridors. The Santa Cruz River corridor also provides important habitat for a variety of bat species. Seasonal colonies of Mexican free-tailed bats (*Tadarida brasiliensis*) occur in two bridges over the Santa Cruz River within the Permit Area. Additionally, the water and riparian vegetation found along the Santa Cruz river corridor supports important foraging resources (insects) for a number of insectivorous bats, including the pale Townsend's big-eared bat. Some large mammals, such as javelina (*Pecari tajacu*) and coyotes (*Canis latrans*), can adapt to urban development; however, others, such as mule deer (*Odocoileus hemionus*), are less likely to persist in a predominately developed environment. The lack of consistent, perennial flow downstream of Cortaro Road virtually precludes establishment of fish in this reach of the Santa Cruz River. Only the exotic mosquitofish (*Gambusia affinis*) is known from the area.

During 2008, a Town biologist and a volunteer conducted three bird surveys along a stretch of the Santa Cruz River and ephemeral ponds just south of the Avra Valley Bridge. The surveys resulted in a rich diversity of bird species. Sightings near the ponds included: snowy egret (*Egretta thula*), northern shoveler duck (*Anas clypeata*)*,* ruddy duck (*Oxyura jamaicensis*), cinnamon teal (*Anas cyanoptera*)*,* mallard (*Anas platyrhynchos*), pied-billed grebe (*Podilymbus podiceps*), canvasback duck (*Aythya valisineria*)*,* black-crowned night heron (*Nycticorax nycticorax*), great blue heron (*Ardea herodias*), black phoebe (*Sayornis nigricans*), and northern rough-winged swallow (*Stelgidopteryx serripennis*). Along the river south of the Avra Valley Bridge, additional species sighted included: Abert's towhee (*Pipilo aberti*), red-winged blackbird (*Agelaius phoeniceus*), Gambel's quail (*Callipepla gambelii*), red-tailed hawk (*Buteo jamaicensis*), ruby-crowned kinglet (*Regulus calendula*), mourning dove (*Zenaida macroura*), lesser goldfinch (*Carduelis psaltria*), yellow-rumped warbler (*Dendroica coronata*), killdeer (*Charadrius vociferus*), house finch (*Carpodacus mexicanus*), brown-headed cowbird (*Molothrus ater*), Gila woodpecker (*Melanerpes uropygialis*)*,* black-chinned hummingbird (*Archilochus alexandri*), Wilson's warbler (*Wilsonia pusilla*), white-tailed kite (*Elanus leucurus)*, verdin (*Auriparus flaviceps*), yellow warbler (*Dendroica coronata*), Bell's vireo

(*Vireo bellii*), roadrunner (*Geococcyx californianus*), Hutton's vireo (*Vireo huttoni*), northern harrier hawk (*Circus cyaneus*), Cooper's hawk (*Accipiter cooperii*), and ladder-backed woodpecker (*Picoides scalaris*). A set of two surveys were also conducted along the Santa Cruz River north of the Avra Valley Bridge in 2008. The riparian habitat is less dense in this area; however, bird sightings not seen at the previously-described sites included: black-necked stilt (*Himantopus mexicanus*), white-winged dove, western sandpiper (*Calidris mauri*), great-horned owl (*Bubo virginianus*), lark sparrow (*Chondestes grammacus*), and cactus wren (*Campylorhynchus brunneicapillus*).

3.4.3 Valley (Basin) Bottom

Areas of valley bottom with intact native vegetation support wildlife characteristic of the Lower Colorado River Valley subdivision of the Sonoran Desertscrub Biome. These areas, including those that have been disturbed, are important to some species of wildlife such as the burrowing owl, ground snake, and the Tucson shovel-nosed snake. Soil conditions rather than vegetation are a key habitat feature for many species, especially fossorial species. Due to the extreme aridity, amphibians are unlikely to occur outside of the Santa Cruz River Corridor; however, the area does support a wide variety of reptiles. Common reptiles include the sidewinder (*Crotalus cerastes*), western diamondback rattlesnake, gopher snake, western whiptail, desert iguana (*Dipsosaurus dorsalis*), zebra-tailed lizard, and side-blotched lizard (Stebbins 1985). Common bird species include black-throated sparrow (*Amphispiza bilineata*), cactus wren, greater roadrunner (*Geococcyx californianus*), loggerhead shrike (*Lanius ludovicianus)*, white-winged dove, mourning dove, and turkey vulture (*Cathartes aura*). Most mammals, particularly rodents, have adapted to high temperatures by living underground in burrows (Turner and Brown 1982). Mammals common to the area include the round-tailed ground squirrel (*Spermophilus tereticaudus*), Merriam's kangaroo rat (*Dipodomys merriami*), several species of pocket mouse (*Perognathus* spp.), desert cottontail rabbit (*Syvilagus auduboni*), black-tailed jackrabbit (*Lepus californicus*), and coyote.

Agricultural areas generally support a diminished community of wildlife species relative to natural habitats, although burrowing owls occupy the areas adjacent to concrete-lined irrigation ditches in northern Marana. Agricultural areas also provide important wintering habitat for many raptor species because of the small bird and rodent prey base available. Typical species in agricultural areas include white-winged dove, mourning dove, great-tailed grackle (*Quiscalus mexicanus*), Brewer's blackbird (*Euphagus cyanocephalus*), raven (*Corvus corax*), desert cottontail, and a variety of rodents.

Chapter 4
Conservation Program

The Town is proposing the following 13 species to be covered by its HCP. Species were evaluated by experts from the TBT and other species experts to determine the species' likelihood of being listed by the USFWS within the 25-year time span covered by this HCP. Other factors evaluated to determine which species to include in the HCP included the likelihood of the species to occur within the HCP planning boundaries, and whether the species is likely to be impacted by the Town's CIP activities or private development requirement discretionary approval. The species that met these three criteria for inclusion are listed below.

- Western burrowing owl (*Athene cunicularia*)
- Cactus ferruginous pygmy-owl (*Glaucidium brasilianum cactorum*)
- Ground snake - valley form (*Sonora semiannulata*)
- Lesser long-nosed bat (*Leptonycteris curasoae yerbabuenae*)
- Lowland leopard frog (*Rana yavapaiensis*)
- Merriam's mesquite mouse (*Peromyscus merriami*)
- Mexican garter snake (*Thamnophis eques megalops*)
- Pale Townsend's big-eared bat (*Corynorhinus townsendii pallenscens*)
- Sonoran Desert tortoise (*Goperus agassizii*)
- Southwestern willow flycatcher (*Empidonax traillii extimus*)
- Talus snail (*Sonorella* spp.)
- Tucson shovel-nosed snake (*Chionactis occipitalis klauberi*)
- Western yellow-billed cuckoo (*Coccyzus americanus occidentalis*)

The Town's conservation program consists of species-specific conservation strategies designed to: (1) minimize and mitigate the impact of the proposed taking to the maximum extent practicable as required by Section 10 of the ESA, and (2) contribute to the long-term persistence of these species at a regional and/or local level. As required by the USFWS's 5-Point Policy, the Town has developed monitoring and adaptive management programs to ensure the biological goals and objectives for each species are achieved.

Within the Permit Area, four Conservation Zones have been designated (Figure 4.1).

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Figure 4.1

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These zones were developed based on the importance of habitat for covered species, with riparian habitat and NUOS on the Tortolita Fan and riparian areas being given the highest priority and therefore, the highest levels of protection. The Town will also identify and delineate Environmentally Sensitive Lands (ESL) (Figure 4.2) within its General Plan. In addition to the Conservation Zones, the HCP identifies wildlife linkages arranged in a southwest-northeast orientation across Tangerine Road and Conservation Zones 2, 3, and 4. These linkages would have a target of 95 percent protection. Species-specific conservation measures are listed under species sections below.

Zone 1 (Table 4.1) includes riparian areas along the Santa Cruz River, and sets a goal of 95 percent protection from ground disturbance from activities permitted under Title 21 of the Marana Land Development Code, which prohibits permanent structures and generally maintains riparian habitat for covered species. Impacts to riparian habitat resulting from bridge construction, bank protection, or possibly sand and gravel operations will be mitigated through riparian restoration or acquisition of existing riparian habitat in accordance with the revised LDC Title 17 (see below). Zone 1 encompasses 1,411 ha (3,486 ac). Under the HCP, 70 ha (174 ac) of Zone 1 would be subject to impacts and 1,340 ha (3,312 ac) would be protected as NUOS.

TABLE 4.1
HECTARES (ACRES) DEVELOPED AND PRESERVED THROUGH CONSERVATION ZONE 1 IN THE TOWN

Conservation Zone 1 = 1,411 (4,486)						
Existing Development = 0	Entitled Lands = 0				HCP Discretionary Lands = 1,411 (3,486)	
100% Impact / No NUOS	100% Impact	No NUOS	20% Impact	80% NUOS	5% Impact	95% NUOS
0	0	0	0	0	70 (174)	1,340 (3,312)
Total NUOS within Zone 1 = 1,340 (3,312)						

Zone 2 (Table 4.2) includes the Arizona Upland Subdivision of the Sonoran Desert Scrub Biome (Brown 1994) on the Tortolita Fan to the east of Interstate 10. The Town has identified the Tortolita Fan as environmentally sensitive and the Town has proactively moved to find other areas within the Town to direct new growth and development. The Tortolita Fan will be planned for protected open space, scenic resource, water recharge, and conservation purposes with a goal of protecting biodiversity and providing land-use guidelines that preserve landscape integrity and connectivity for native fauna and flora in the Tortolita Fan area. If a permanent reserve can not be developed, or in the interim until such a reserve is developed, State Land parcels that are sold to private entities requesting an up-zoning will be required to

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Figure 4.2

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conserve 80 percent of the parcel in perpetuity as natural open space. These conservation areas will include those portions of the parcel that support the highest habitat values. Corridors identified in the HCP and/or any new corridors identified through future research and monitoring will be protected as part of the 80 percent open space. Open space must provide wash protection and be configured to compliment any adjacent protected open space, as well as provide north-south habitat connectivity across the Tortolita Fan. Zone 2 encompasses 10,548 ha (26,064 ac), of which 1,757 ha (4,341 ac) are already developed. If there is no voluntary inclusion of entitled lands within Zone 2, a total of 2,159 ha (5,335 ac) would be subject to new impacts and 5,661 ha (13,988 ac) would be protected as NUOS, in addition to the existing 971 ha (2,400 ac) Tortolita Preserve. Conversely, if all entitled lands in Zone 2 participate in the HCP through voluntary inclusion, a total of 1,564 ha (3,865 ac) would be subject to new impacts and 6,256 ha (15,458 ac) would be protected as NUOS, in addition to the existing 971 ha (2,400 ac) Tortolita Preserve.

TABLE 4.2
HECTARES (ACRES) DEVELOPED AND PRESERVED WITHIN CONSERVATION ZONE 2 IN THE TOWN

Conservation Zone 2 = 10,548 (26,064)						
Existing Development = 1,757 (4,341)	Entitled Lands = 744 (1,838)				HCP Discretionary Lands = 7,076 (17,485)	
	If No Voluntary Inclusion Participation		If Complete Voluntary Inclusion Participation			
100% Impact / No NUOS	100% Impact	No NUOS	20% Impact	80% NUOS	20% Impact	80% NUOS
1,757 (4,341)	744 (1,838)	0	149 (368)	595 (1,470)	1,415 (3,497)	5,661 (13,988)
Total NUOS in Zone 2 with no voluntary inclusion = 5,661 (13,988)						
Total NUOS in Zone 2 with 100 percent voluntary inclusion = 6,256 (15,458)						

Zone 3 (Table 4.3) includes an area that has more existing development and which is planned for further development. Zone 3 would require the protection of between 40 and 70 percent of each parcel as NUOS, with riparian habitat and areas adjacent to existing NUOS to be given the highest priority. Parcels protecting less than 70 percent NUOS would be required to mitigate for the additional impacts. Corridors identified in the HCP and/or any new corridors identified through future research and monitoring will be protected. Zone 3 encompasses 2,894 ha (7,152 ac), of which 461 ha (1,139 ac) are already developed. If there is no voluntary inclusion of entitled lands within Zone 3, 1,452 ha (3,585 ac) would be subject to new impacts and 981 ha (2,425 ac) would be protected as NUOS. Conversely, if all entitled lands in Zone 3 participate in the HCP through voluntary inclusion, a total of 679 ha (1,678 ac) would be subject to new impacts and 1,754 ha (4,335 ac) would be protected as NUOS.

TABLE 4.3
HECTARES (ACRES) DEVELOPED AND PRESERVED WITHIN CONSERVATION ZONE 3 IN THE TOWN

Conservation Zone 3 = 2,894 (7,152)								
Existing Development = 461 (1,139)	Entitled Lands = 1,104 (2,729)				HCP Discretionary Lands = 1,125 (2,780)		Wildlife Linkages = 204 (504)	
	If No Voluntary Inclusion Participation		If Complete Voluntary Inclusion Participation					
100% Impact / No NUOS	100% Impact	No NUOS	30% Impact	70% NUOS	30% Impact	70% NUOS	5% Impact	95% NUOS
461 (1,139)	1,104 (2,279)	0	331 (819)	773 (1,910)	338 (834)	787 (1,946)	10 (25)	194 (479)
Total NUOS in Zone 3 with no voluntary inclusion = 981 (2,425)								
Total NUOS in Zone 3 with 100 percent voluntary inclusion = 1,754 (4,335)								

Zone 4 (Table 4.4) includes areas planned for 100 percent future development outside the wildlife linkages. There are no NUOS goals established for Zone 4, outside of the designated linkages, because the proposed development limits and NUOS objectives within all of the other zones, as well as the three wildlife linkages extending across Tangerine Road (see Figure 4.1) will mitigate the proposed impacts within the entire permit area as a whole. The target width of each linkage will be 305 m (1,000 ft), as allowed by existing constraints, with a goal of 95-percent protection, except for future Tangerine Road improvements. The boundaries of the wildlife linkages will be established such that all parcels will retain opportunities for allowed land use.

TABLE 4.4
HECTARES (ACRES) DEVELOPED AND PRESERVED THROUGH CONSERVATION ZONE 4 IN THE TOWN

Conservation Zone 4 = 1,994 (4,927)						
Existing Development = 581 (1,435)	Entitled Lands = 78 (192)		HCP Discretionary Lands = 892 (2,205)		Wildlife Linkages = 443 (1,095)	
100% Impact / No NUOS	100% Impact	No NUOS	100% Impact	No NUOS	5% Impact	95% NUOS
581 (1,435)	78 (192)	0	892 (2,205)	0	22 (55)	421 (1,040)
Total NUOS within Zone 4 = 421 (1,040)						

Zone 4 encompasses 1,994 ha (4,927 ac), of which 581 ha (1,435 ac) are already developed. Under Alternative C, 992 ha (2,452 ac) would be subject to new impacts and 421 ha (1,040 ac) would be protected as NUOS.

Other general conservation measures in the HCP would include revisions to existing Land Development Codes and the adoption of guidance policies. Title 17 (Environmental Resource Protection, Native Plant Protection, Landscape Requirements) would be revised to provide more detailed guidance for the Site Resource Inventory (SRI) and pre-construction survey requirements, native plant and riparian habitat protection and mitigation, and invasive species control requirements.

The Town would also adopt a Riparian Habitat Map (see Figure 3.3) linked to the revised Title 17. For project impacts to mapped riparian habitat that are less than 0.4 ha (1 ac), impacts may be mitigated through the appropriate replacement of impacted plants as outlined in the existing native plant mitigation sections of Title 17.

For impacts to mapped riparian habitat greater than 0.4 ha (1 ac), the mitigation requirements in Table 4.5 would apply. Revisions to Title 17 would also require impacts to riparian habitat within Zone 1 to be mitigated in Zone 1, while impacts outside of Zone 1 would be mitigated with like habitat within any Zone at the ratios specified in the Table 4.5.

TABLE 4.5
PROPOSED TITLE 17 MITIGATION REQUIREMENTS FOR IMPACTS TO MAPPED RIPARIAN HABITAT

Location of Impacts	Conservation of Existing Riparian Habitat	Restoration of Riparian Habitat	Location of Mitigation
Within Zone 1	1.5:1	3:1	Within ½ mile
	2:1	4:1	Outside ½ mile
Outside of Zone 1	1.5:1	2.5:1	Within ½ mile
	2:1	3.5:1	Outside ½ mile

Conservation of existing riparian habitat would be defined to mean that mitigation would occur through the permanent protection (e.g., acquisition, easement, management agreement) of offsite riparian habitat that already exists in a natural state. Restoration would be defined to mean that a degraded, offsite parcel will be restored to functional riparian habitat of the type impacted by the covered activity. Implementation and determination of effectiveness of the both types of mitigation will require management and monitoring provisions. Mitigation may occur in the form of in-lieu fees at the indicated ratio if an appropriate mitigation bank or project has been established. Fees would be based on current land values and the per acre cost of restoration. Mitigation proposed outside of the Permit Area would be evaluated on a case-by-case basis by the Town and USFWS.

Title 19 (Grading and Hillside) would also be revised to provide more detailed guidance on protection of slopes greater than 15 percent from both direct impacts from development as well as indirect impacts from invasive species.

In addition to revising existing LDCs, conservation measures in the HCP would include the establishment of Burrowing Owl Management Areas (BOMAs), the development of an educational program to distribute information on the requirements and benefits of the HCP, and the adoption of ESRDGs. The ESRDGs would require a detailed evaluation and consideration of biological, cultural, and visual resources in the design, construction, and mitigation of road and utility projects on designated roads. The ESRDGs will be implemented for all road widening and new road construction, and associated utilities, on public roads that meet the criteria listed in Section 2.2.1.3.

For each species, baseline information on the existing population status and habitat conditions in the Permit Area, and the biological goals and objectives of the conservation measures are presented. Within the Permit Area, a combined total of 17,406 ha (43,010 ac) of habitat was modeled for all 13 covered species (Table 4.6). A total of 1,031 ha (2,547 ac) of impacts are anticipated to the combined modeled habitat resulting from the Town's CIP activities and 8,329 ha (20,582 ac) of impacts from development. A minimum of 9,054 ha (22,373 ac) of combined modeled habitat would be protected as NUOS. However, because the HCP assumes that all currently entitled lands would be developed, the total amount of NUOS may ultimately be higher, depending on the level of voluntary participation by private landowners in the HCP (voluntary inclusion).

TABLE 4.6
COVERED SPECIES MODELED HABITAT AND PROJECTED FUTURE IMPACTS IN THE TOWN

Type of Habitat or Impact	Area
Modeled habitat	17,406 ha (43,010 ac)
Total habitat impacted by Town's CIP activities	1,043ha (2,577 ac)
Total habitat impacted by development within HCP Conservation Zones	2,748 ha (6,790 ac)
Total habitat impacted by development outside of HCP Conservation Zones	5,581 ha (13,792 ac)
Total Impacts	8,341 ha (20,602 ac)
Total NUOS	9,042 ha (22,343 ac)

Direct and indirect impacts to each covered species from the proposed covered activities are described below, followed by the level of anticipated take of individuals, or of potential habitat where lethal take is not anticipated. Each species section includes an evaluation of the effects of implementing the HCP on the species. Monitoring is described in each section and is also discussed in the Monitoring and Adaptive Management section in Chapter 6.

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4.1 Burrowing Owl (*Athene cunicularia hypugaea*)

4.1.1 Existing Conditions

4.1.1.1 Species Ecology, Rangewide Status, Distribution, and Threats

Burrowing owls are approximately 25 cm (10 in) tall, with long legs and white eyebrows. These diminutive owls weigh an average of 0.2 kg (6 ounces [oz]). Their diet consists of small mammals; insects, especially grasshoppers and beetles; birds; amphibians; and reptiles. They often nest in colonies.

Burrowing owls inhabit open, dry areas and sparse, open grassland where there is an availability of suitable burrows, and an absence of trees or other perches for raptors that prey on the owls. They also nest in uncultivated portions of agricultural lands (Haug et al. 1993). The species name, *cunicularia*, means “miner” in reference to this owl’s unusual habit of spending time underground. Western burrowing owls do not dig their own burrows, and are dependent on fossorial mammals such as round-tailed ground squirrels (*Spermophilus tereticaudus*), coyotes (*Canis latrans*), and badgers (*Taxidea taxus*) for burrows. Burrowing owls are diurnal, being active during daylight hours, and use underground burrows for nesting and escape cover. Despite the fact that they are often active during the day, they can easily go unnoticed because of their secretive nature and cryptic coloration. Their use of burrows makes them very susceptible to ground disturbing activities. Additional information on this species is provided in Appendix 3.

The breeding range of the burrowing owl includes southern Canada, from southern British Columbia eastward to south-central Manitoba, and extends as far south as Mexico (Haug et al. 1993). Western burrowing owl numbers have rapidly decreased throughout most of its range in North America over the past 50 years (NatureServe 2008). The burrowing owl is listed by the USFWS as a National Bird of Conservation Concern, listed as endangered in Canada, and as threatened in Mexico. This species is also protected by the MBTA of 1918 and Arizona state law (Arizona Revised Statutes Title 17-235). Violation of these laws, intentional or unintentional, may result in prosecution.

In Arizona, the burrowing owl is widely distributed, but uncommon (Brown 2001b). The burrowing owls in northern Arizona are thought to be migratory, while the owls in southern Arizona appear to be year-round residents. A “leap-frog” effect has been observed, where the burrowing owls whose breeding grounds are the farthest north tend to migrate the farthest south; therefore, southern Arizona may host wintering owls or migrants passing through from Canada and the northern United States (Burrowing Owl

Survey Training March 4, 2008). Grandmaison and Urreiztieta (AZGFD 2006a) reported a higher number of burrowing owls in the Avra Valley during the winter than was observed during the summer.

Burrowing owls are often found in areas of Arizona where urbanization and other human activities are occurring. Arizona is one of the fastest growing states in the U.S., leading to frequent conflicts between burrowing owls and development. Owls can be affected by disturbance and habitat loss even though there may be no direct impacts to the birds themselves or their burrows. Burrowing owls are known to occur within the HCP Permit Area and are likely to be impacted by one or more of the Town's covered activities. Because of the generally declining burrowing owl population range-wide and increasing threats, it is foreseeable that the burrowing owl could be considered for listing under the ESA during the life of the Permit.

Primary threats to the burrowing owl are habitat loss and fragmentation through the conversion of agricultural and open lands to intensive development, and loss of available burrows due to the extermination of colonial burrowing mammals. The lack of burrows can be a limiting factor in habitat that could support burrowing owls. These owls are relatively tolerant of human activity, but are vulnerable to predation by dogs and cats, and vandalism by humans, associated with urbanized areas.

4.1.1.2 Population in and Near the Town

A systematic survey for burrowing owls in the Town was conducted during June through early September 2003 by AZGFD (Figure 4.3; Alanen 2003a). The surveys were focused on areas of potentially suitable habitat in over 46 sections of land in the HCP planning area and much of the potentially suitable habitat viewable from the road network was surveyed using a standardized roadside survey protocol (Conway and Simon 2003). This survey found one adult pair with two juveniles within the Town limits. Several other burrowing owls were detected just outside the Town limits, west of Trico Road. The surveys were conducted toward the end of and slightly after the recommended survey period of mid-March through mid-July. As a result, some owls may not have been detected.

In addition to these surveys, burrowing owls have been reported in the Marana area during AZGFD's winter raptor surveys, and there are several anecdotal reports of burrowing owls in and near the Town. Survey blocks 10A and 10B of AZGFD's winter raptor survey cover the Town. Table 4.7 summarizes detections of burrowing owls in these survey blocks. It is important to recognize that these raptor surveys do not focus on detecting burrowing owls because surveyors typically search perches off the ground and can miss burrowing owls, which are most often found at ground level.

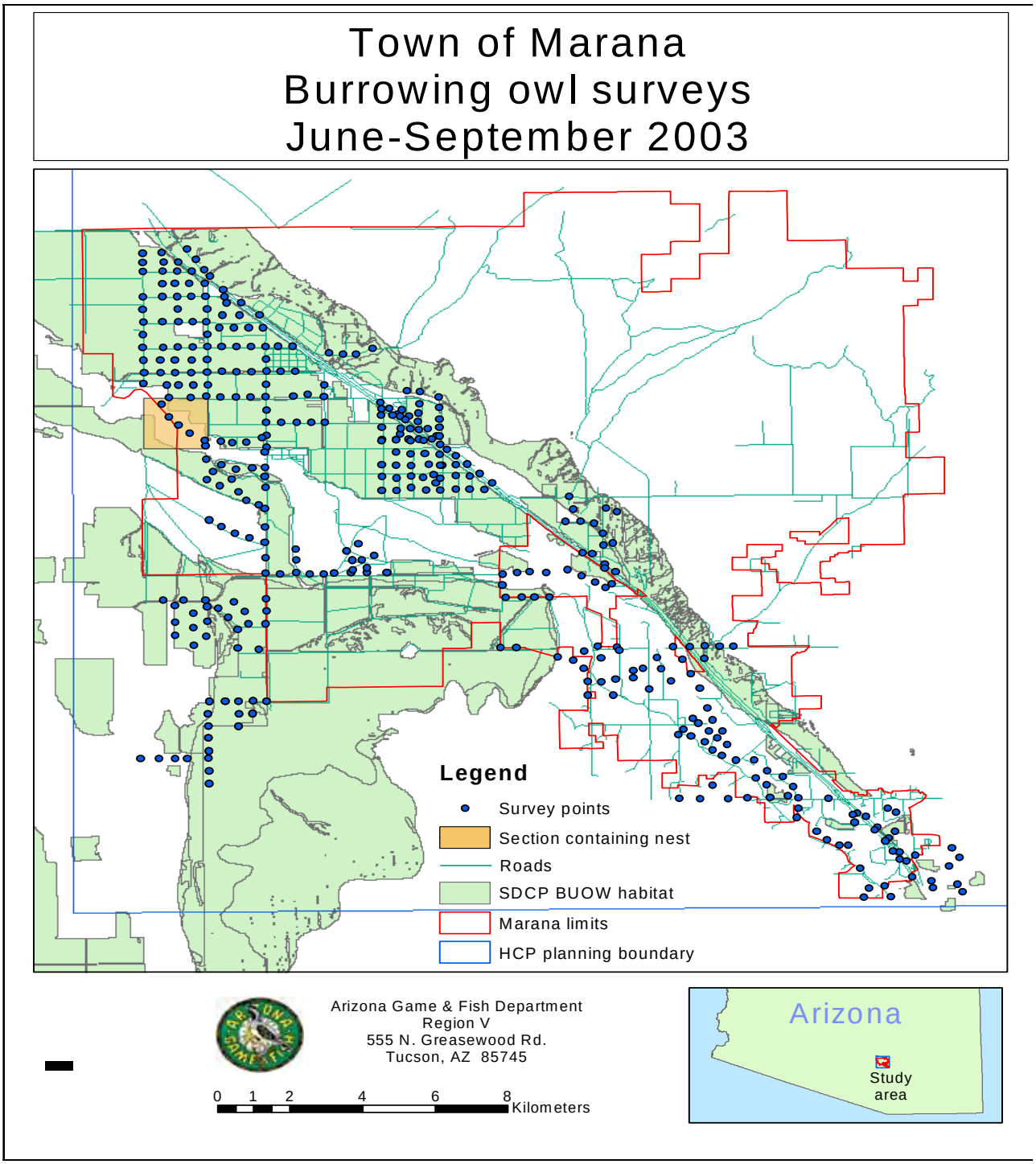

Figure 4.3 Arizona Game and Fish Department 2003 burrowing owl survey call points in the Town of Marana.

TABLE 4.7
NUMBER OF BURROWING OWLS REPORTED IN AZGFD'S WINTER RAPTOR SURVEYS FOR THE TWO SURVEY BLOCKS (10A AND 10B) THAT ENCOMPASS THE TOWN

Year	Survey Block 10A	Survey Block 10B
1997	1	N/A
1999	2	1
2000	1	1
2002	2	0
2008[1]	0	0

Source: AZGFD, unpublished data.
[1] Burrowing owls were located by Town staff during the 2008 breeding season.

A survey conducted by Town staff in April and June 2008, resulted in additional burrowing owls detected within the Town limits. Three pair and three young-of-the-year burrowing owls were detected (Figure 4.4) in the northwestern portion of the Town. Roads in the north-south grid within the Town boundaries, Sandario Road between Barnett and Twin Peaks Roads, and Twin Peaks Road east of Sandario Road were surveyed. The banks of the Santa Cruz River between Sanders and Quarry Road were surveyed on foot; however, no burrowing owls were located along the river.

Several reports place burrowing owls along Trico Road and near the Santa Cruz River (Alanen pers. comm. 2003a; Alanen pers. comm. 2004a), at the Tucson Audubon Society's Simpson Farm property, on the north side of Hardin Road east of Trico Road (Alanen pers. comm. 2004b), on the east side of Sandario Road just north of Emigh Road (Alanen pers. comm. 2004c) and at the Arthur Pack Desert Golf Course (Alanen 2003a). Brown and Mannan (2002) reported one burrowing owl near the Marana Pinal Airpark, and Brown (2001) shows two occurrences of burrowing owls along I-10 in the vicinity of the Town. Local birders regularly report burrowing owls at the Marana pecan grove located outside the Town boundary on Trico Road just north of the Santa Cruz River. These observations demonstrate the occurrence of burrowing owls in the vicinity of the Town and indicate the potential for burrowing owls to inhabit portions of the Town. Figure 4.4 depicts the occurrences of burrowing owls relative to the Town boundary based on the 2005, 2006, and 2008 survey results and anecdotal reports.

4.1.1.3 Habitat in and Near the Town

The habitat model for burrowing owls was specifically developed for the Town by the TBT in 2004. The model was developed through TBT review, consultation with AZGFD and University of Arizona researchers, and field visits to areas potentially providing

Figure 4.4

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habitat in the Town. The burrowing owl habitat model consisted of two habitat designations—nesting habitat and foraging habitat. One primary variable, landform, was used for the model, and only the floodplain landform type was identified as suitable for owl nesting within the Town. Suitable nesting habitat was defined as the Santa Cruz River and Brawley Wash floodplain and active agricultural areas with concrete-lined ditches or with natural vegetation along the perimeter, but did not include river channels, adjacent riparian vegetation, or developed areas.

Foraging habitat for the owl was defined as any undeveloped area within 600 m (1,968 ft) of the nesting habitat (Haug and Oliphant 1990; Rosenberg and Haley 2001). Based on field observations by AZGFD personnel in February 2004, the model was refined further to include potential nesting habitat to the south of the Santa Cruz River floodplain and the removal of foraging habitat north of I-10.

Based on this habitat model, there are 2,371 ha (5,858 ac) of potential nesting and foraging habitat and 1,865 ha (4,608 ac) of foraging habitat for a total of 4,235 ha (10,466 ac) of habitat for burrowing owls within the HCP boundary. The habitat model does not include entitled lands which have already been zoned for development. Table 4.8 depicts the amount of burrowing owl habitat in HCP Conservation Zones, and the habitat area expected to be impacted by development. Much of the burrowing owl habitat does not fall within the Conservation Zones, and therefore will be addressed through other mitigation measures such as creating BOMAs, as described below in Section 4.1.4. Much of the burrowing owl's nesting habitat in the Town is near the Santa Cruz River corridor and southwest Marana, although there are breeding pairs in northwestern Marana as well. Most foraging habitat is in undeveloped land north and south of the river. Intensive studies of burrowing owls have been concentrated in southern Arizona for the past seven years. All of the work in southern Arizona has been (1) in and around Tucson, (2) in the areas between Coolidge and Casa Grande, and (3) in the Avra Valley. Conway (pers. comm. Nov. 2007) reported that, based on work following individually-marked owls for the past seven years in the Tucson area; there was no evidence of an influx of burrowing owls during the fall (i.e., indicating a separate wintering population); most of the breeding adults do over-winter and individual owls tend to move around more during the winter (they are not as tied to one burrow as they are during the breeding season). Conversely, Grandmaison and Urreiztieta (AZGFD 2006) located 38 burrowing owls during their winter survey, but located only four owls in the same areas during their summer survey. They concluded that areas that meet burrowing owl habitat criteria for breeding and foraging are suitable as wintering habitat (i.e., areas with short vegetation, the absence of trees, and the presence of suitable burrows). Figures 4.5 and 4.6 show the distribution of modeled burrowing owl habitat in the Town in relation to CIP activities and existing development and entitled lands, respectively.

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Figure 4.5

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Figure 4.6

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4.1.1.4 Local Relation to Species' Range and Ecology

In 2008, three known burrowing owl nesting pairs and three young-of-the-year were located within the Town boundaries. In 2003, at least one breeding pair of burrowing owls was located in the Town. Arizona is known to provide wintering habitat for burrowing owls from Canada and the northern United States (Grandmaison and Urreiztieta 2006). Burrowing owl habitat in the Town may be important to birds from Canada and the northern United States that winter in or migrate through southern Arizona.

Whether owls move between activity areas in Tucson and Phoenix is undetermined. However, given the Town's central position between these two breeding population segments in Arizona, its proximity to Mexico, and the apparent availability of suitable habitat within the Town, it is reasonable to consider portions of the Town's planning area as serving an ecological role for this species. The Town may provide a movement corridor between these two local populations, as well as for seasonal migrations by owls between breeding and wintering grounds from different regions.

4.1.2 Potential Impacts of Town's Proposed Activities

4.1.2.1 Direct Effects

Construction activities for development and CIP activities have the potential to directly kill or injure owls by filling in or collapsing burrows. According to the Marana General Plan (Town 2007), all agricultural lands within the Town limits are planned for development. This loss of agricultural land will result in the loss of and fragmentation of foraging and nesting habitat for the burrowing owl. Vehicle strikes also can cause mortality of owls. Thus, the construction of new roads, widening of existing roads, wash maintenance, and increased urbanization expected in the Town may contribute to mortality of resident and wintering burrowing owls. A higher, post-fledging mortality from vehicle collisions has been reported in fragmented, agricultural landscape compared to unfragmented rangeland (NatureServe 2008). Fragmentation and isolation are threats to small and localized populations, with increased risks of predation, pesticides, and illegal shooting. Scarcity of nesting habitat may also reduce the opportunity for individuals to find a mate (ibid). The total area of burrowing owl habitat subject to impacts from CIP and development activities is 3,743 ha (9,250 ac) (Table 4.8).

Surveys conducted during 2008 in the Town identified three pair of burrowing owls with three young along an eroded concrete-lined irrigation ditch. Another pair was located in 2003 in the Santa Cruz River floodplain and probably would not be directly affected unless a sand and gravel operation is developed in the area. Additional established pairs of owls or recent immigrants setting up new territories and not yet detected may also be present in the Town, and there may be owls on private property where surveyors did not

have access. Depending on the timing of construction, wintering owls could be vulnerable to construction activities. No information is available to estimate the number of wintering owls potentially impacted.

4.1.2.2 Indirect Effects

Burrowing owls can be adversely affected through indirect mechanisms caused by urban development. Burrowing owls are vulnerable to predation or disturbance of burrows by domestic and feral cats and dogs, whose numbers increase in association with urban development. Other potentially adverse effects to burrowing owls indirectly resulting from urban development include increased use of pesticides; increased disturbance from maintenance activities associated with drainageways; disturbance, injury or mortality from shooting or rock throwing; and increased exposure to trichomoniasis.

4.1.2.3 Changes in Habitat

Under the HCP, a total of 3,743 ha (9,250 ac) of modeled habitat (nesting/foraging and foraging only) for burrowing owls would be impacted by CIP and development activities (Table 4.8). The remaining 492 ha (1,216 ac) of habitat, mainly along the Santa Cruz River, would be protected as NUOS.

A summary of impacts from development, both within and outside the Conservation Zones, is provided in Table 4.9. Figures 4.5 and 4.6 show the distribution of modeled burrowing owl habitat in the Town in relation to CIP activities and existing development and entitled lands, respectively. Because burrowing owls are somewhat more tolerant of some types of human activity than other birds, suitable burrowing owl habitat could remain in some portions of the areas proposed for low-intensity development as well as some parks schools, or industrial areas associated with high-intensity development, as long as sufficient area for burrows and foraging is available.

TABLE 4.8
BURROWING OWL MODELED HABITAT AND PROJECTED FUTURE IMPACTS IN THE TOWN

Type of Habitat or Impact	Area
Modeled habitat	4,235 ha (10,466 ac)
Total habitat impacted by Town's CIPs	502 ha (1,241 ac)
Total habitat impacted by development within HCP Conservation Zones	77 ha* (191 ac)
Total habitat impacted by development outside of HCP Conservation Zones	3,164 ha* (7,818 ac)
Total Impacts	3,743 ha (9,250 ac)
Total NUOS	492 ha (1,216 ac)

* These figures are derived from Table 4.9.

TABLE 4.9
SUMMARY OF DEVELOPMENT IMPACTS TO BURROWING OWL HABITAT

	Burrowing owl Modeled Habitat	Percent allowable impact by Zone	Area impacted
Zone 1	916 ha (2,263 ac)	0.05	46 ha (113 ac)
Zone 2	151 ha (374 ac)	0.20	30 ha (75 ac)
Zone 3	5 ha (11 ac)	0.30	1 ha (3 ac)
Zone 4	0	1.00	0
Habitat not in Zones	3,164 ha (7,818 ac)	1.00	3,164 ha (7,818 ac)
Proposed Wildlife Linkages	0	0.05	0
Existing Wildlife Linkages	0	N/A	0
Total	4,235 ha (10,466 ac)	N/A	3,241 ha (8,009 ac)

It is important to recognize that not all modeled habitat identified in the Town is currently used by owls. For example, burrowing owl occurrence and abundance is strongly linked to the presence of burrows, which was not specifically accounted for in the habitat model. Only a portion of the area identified as modeled burrowing owl habitat in the Town is known to be occupied; however, it is important to maintain areas of unoccupied habitat to provide habitat connectivity, areas for population expansion, and sites for wintering and migrating owls.

4.1.2.4 Population Effects

Urban development will displace burrowing owls where owls occupy areas proposed for development and capital improvement projects, resulting in reduction in the local burrowing owl population. If burrowing owl habitat in the Town is used by wintering owls from within and outside of Arizona, urban development and capital improvement related reductions in habitat could contribute to reductions in burrowing owl populations that nest elsewhere. Development in the Town would increase the vulnerability of owls in the planning area during the non-breeding season to hazards such as vehicle collisions, predation by domestic or feral cats and dogs, and disease due to displacement from preferred locations.

4.1.2.5 Anticipated Take

Burrowing owl take may occur in the form of harm due to habitat loss or harassment from eviction or translocation from burrows, and lethal take due to vehicle collisions, predation, shooting, and other activities described in Section 4.1.2.1 above. Anticipated take due to loss of modeled habitat is 3,743 ha (9,250 ac). The anticipated lethal take of individual owls is 5 over the 25-year life of the Permit. There are approximately 594 ha (1,468 ac) of modeled habitat for this species in entitled lands that could potentially be included under the HCP if the landowners voluntarily choose to be covered under the HCP. If the burrowing owl becomes listed under the ESA, voluntary inclusion would provide certainty of conservation requirements and eliminate the necessity of individual landowners and the Town conducting Section 7 consultation with the USFWS for activities that potentially affect this species or its habitat and have a Federal nexus because of the consultations outlined in Section 1.6.

4.1.3 Biological Goals and Objectives

The Town is known to have supported three breeding pairs in 2008. Similarly, burrowing owls are known to winter and migrate through southeastern Arizona. Based on this information, the Town's biological goals and objectives for burrowing owls relate to providing conditions to support breeding, wintering and migration by burrowing owls. Specifically, the Town's biological goal for burrowing owls is to contribute to maintaining local and regional populations of burrowing owls.

The Town's specific objectives are to:

- Provide habitat for breeding, wintering, and migrating birds
- Work with adjacent municipalities and land owners/managers to achieve regional conservation of the burrowing owl through a consistent and coordinated conservation strategy

4.1.4 Conservation Measures

Through implementation of a burrowing owl conservation program the Town seeks to make a positive and long-term contribution to the conservation of burrowing owls. The Town's burrowing owl conservation strategies include:

- Provisions for the long term availability of nesting and foraging habitat
- Improvements to nesting habitat availability and quality
- Reduction of adverse impacts from development and urbanization
- Promotion of integrated, regional conservation planning for burrowing owls

The specific conservation measures that the Town will implement are detailed below. A monitoring and adaptive management program detailed in Chapter 6 complements these conservation measures.

Burrowing Owl Measure 1. The Town will identify and delineate ESL within its General Plan, including areas important for burrowing owl conservation. Within the ESL, the Town will develop and implement ESRDG. The ESRDG would require a detailed evaluation and consideration of biological, cultural, and visual resources in the design, construction, and mitigation of road and utility projects in designated areas. Using the ESRDG, appropriate site-specific design criteria will also be developed for each project.

Burrowing Owl Measure 2. The Town will establish four habitat Conservation Zones (see Figure 4.1) to protect suitable habitat for various species covered under this HCP. Zone 1 will provide the greatest conservation value for the burrowing owl. Zone 1 will generally consist of all ESL along the Santa Cruz River floodway. The Town will provide protections for modeled burrowing owl habitat in this zone by limiting the types of development to those uses permissible under Title 21 of the Land Development Code, which prohibits permanent structures, except for bridges and bank protection, and generally maintains burrowing owl habitat features.

Burrowing Owl Measure 3. The Town will establish 43 ha (106 ac) of BOMAs within 5 years of Permit issuance. The total hectares of BOMAs was derived through consultation with USFWS and in consideration of anticipated impacts from covered activities and the

additional habitat protected within the Santa Cruz River floodway. Potential BOMA locations within the Town are depicted in Figure 4.7. The Town will also collaborate with the City of Tucson to establish one BOMA on lands within the City's jurisdiction, with the Town committing to fund mutually agreed upon conservation measures such as artificial burrow creation, vegetation management, and research on the effectiveness of various burrow densities and designs. While the floodway of the Santa Cruz River will not be designated as an official BOMA, a majority of the area will remain unimpacted. The inclusion of artificial burrows into the design of Town projects in this area will be promoted where feasible. Each BOMA will include open, treeless areas, away from heavily-used roads, and located near suitable dispersal habitat such as the Santa Cruz River. Artificial burrows may be necessary if natural burrows are not present in the area. Wildlife-friendly fencing may be necessary to prevent disturbance to the burrowing owls. The Town will develop and implement a site-specific management plan concurrent with the formal establishment of each BOMA. The creation and management of the BOMAs will utilize AZGFD's *Burrowing Owl Management Guidelines for Municipalities in Arizona* (AZGFD 2007a). The creation of BOMAs or their management plans will be evaluated to address site-specific characteristics or as more information is gained on BOMA creation and management. The specific locations and management plans for each BOMA will be determined through consultation with USFWS and AZGFD. The Town will ensure the long-term conservation of the BOMAs through purchasing the land, obtaining a conservation easement, or other mechanisms approved by the USFWS.

Burrowing Owl Measure 4. The Town will incorporate development standards into Title 17 of the Land Development Code and require project proponents to conduct pre-construction surveys for burrowing owls in accordance with the *Burrowing Owl Project Clearance Guidance for Landowners* (AZGFD 2009). This protocol is attached in Appendix 4. Occupied burrows will not be disturbed during the nesting season, February 1 through August 31, unless AZGFD verifies that the birds have not begun egglaying or incubation or that juveniles from these burrows are foraging independently and are capable of independent survival at an earlier date. A minimum of a 100 m (600 ft) foraging radius around natal burrow will be maintained for breeding burrowing owl pairs. If burrowing must be moved away from a proposed disturbance area, the project proponents will provide resources, as directed by the USFWS, to evict the burrowing owls prior to the commencement of construction. If eviction of burrowing owls during nesting season is unavoidable, the project proponent will be required to coordinate with the USFWS and AZGFD and provide resources to evict or translocate the burrowing owls in a manner that minimizes the potential harm to adults and eggs or nestlings.

Burrowing Owl Measure 5. The Town will develop and implement an educational program designed to inform the general public, specific neighborhoods, permit applicants, and contractors of the various requirements of the HCP and their associated benefits to species and habitats. The educational program will also provide resources and instruction for Town personnel involved in operations and maintenance activities.

Figure 4.7

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On-site educational programs within BOMAs will be conducted in a manner that avoids disturbance of burrows or burrowing owls.

Burrowing Owl Measure 6. The Town will inform neighboring jurisdictions about the Town's conservation program for burrowing owls and encourage implementation of compatible conservation measures throughout jurisdictions. The Town will coordinate with regional conservation efforts for burrowing owls in implementing its conservation program and encourage other jurisdictions to coordinate conservation actions for burrowing owls at a regional level. Specific areas where inter-jurisdictional efforts could be most effective are in the Avra Valley (City of Tucson, Tucson Water) and along the Santa Cruz River corridor (Pima County).

Burrowing Owl Measure 7. The Town will update Title 17 of the Land Development Code to include invasive species management guidelines and an official list of plants prohibited for use in landscaping. An inventory of all state- and Federally protected plant species, saguaro cacti, and ironwood trees shall also be conducted within the area not included in any area designated as a NUOS. Plants removed from the site, damaged, or destroyed during development shall be mitigated in accordance with the revised Title 17.

4.1.5 Effects of Implementing the HCP on Burrowing Owls

Proposed future CIP and development activities in the Town could directly impact up to 3,731 ha (9,220 ac) of modeled habitat for burrowing owls in the Town during the term of the Permit. Under the HCP, approximately 504 ha (1,246 ac) of modeled burrowing owl habitat would remain protected as NUOS. Although there appears to be a considerable amount of suitable habitat in the Town, approximately 4,235 ha (10,466 ac), existing information suggests that few owls inhabit the Town. The Town's conservation approach to burrowing owls is to proactively create and manage designated areas specifically for burrowing owls in an effort to attract and maintain burrowing owls in the Town.

Under the HCP, the Town would establish management areas for burrowing owls and prohibit development activities to the extent possible within the floodplain of the Santa Cruz River. The management areas would total at least 43 ha (106 ac) and would be managed specifically to provide habitat for burrowing owls. Artificial burrows would also be placed in other areas with proximity to foraging habitat, for potential use by wintering owls.

The location of these management areas has not been finalized, but several potential areas have been identified (see Figure 4.7). Under the HCP, the Town would work with burrowing owl experts to assess conditions at these potential areas, select areas to use as BOMAs, and develop management plans to establish, improve, and maintain habitat quality for burrowing owls. The specific actions to be undertaken would depend on the

unique characteristics of each site, but some actions may specifically focus on providing nesting opportunities or wintering habitat for burrowing owls.

The amount of foraging habitat required by a pair of burrowing owls in this environment is unknown. Home range size varies widely in studies in various states, depending on the prey base and availability of burrows. Wild at Heart, a raptor rehabilitation and rescue organization, recommended that a 12 ha (30 ac) site have approximately 100 burrows, for approximately 25 pairs of owls (Greg Clark, pers. comm. February 20, 2007). The Town's commitment to allow use of the management areas as hacking or release sites for burrowing owls from other locations increases the likelihood that burrowing owls will become established in the management areas.

In addition to providing habitat for breeding burrowing owls over the long-term, implementation of the HCP will provide habitat for wintering and migrating burrowing owls. In southeastern Arizona, breeding burrowing owls can be year-round residents. Burrowing owls breeding in the northern portions of the U.S and southern Canada may winter in southeastern Arizona or pass through the area during seasonal migrations. The level of use of habitats in the Town by wintering and migrating burrowing owls is uncertain, but with maintenance of habitat in the Santa Cruz River floodplain and in the BOMAs under the HCP, the Town will continue to provide habitat for wintering and migrating burrowing owls.

Burrowing owls are generally tolerant of human activity and commonly inhabit open space areas within otherwise developed landscapes (e.g., school/university grounds, airports, parks, golf courses). Nonetheless, burrowing owls can be adversely affected by indirect consequences associated with urbanization. Potential indirect effects include, but are not limited to, increased predation caused by an increase in the number of free-ranging cats, harassment by dogs, recreationists, and incidental or intentional shooting. To address these potential effects, the Town will implement an education program targeted at residents living near BOMAs, recreationists that may use areas adjacent to the BOMAs, and school children attending school near the BOMAs. These programs will educate the public about the Town's conservation program for burrowing owls, the ecology and life history of owls, how certain activities can adversely affect owls, and what individuals can do to minimize adverse effects to owls. In Florida, harassment, mainly by school children, was a leading cause of nest failure. Following implementation of a mandatory burrowing owl education program in public schools, nest failures decreased significantly (Milsap and Bear 2000). This finding suggests that targeted educational programs can be effective at reducing some of the indirect effects associated with urbanization.

Burrowing owls can be killed or injured during construction activities that collapse their burrows. Milsap and Bear (2000) found that nest destruction during construction activities was the leading cause of nest failure in their Florida study area. To minimize this potential direct impact under the HCP, the Town will require developers to conduct

surveys for burrowing owls prior to construction, and, if burrowing owls are found, they will be protected through passive eviction and destruction of all potential burrows before beginning of construction. By evicting the owls, the potential for mortality or injury from construction activities will be reduced.

Passively evicting owls from burrows is commonly used to avoid direct impacts from construction and has generally been more successful in terms of owls becoming established at a new location than active relocation where owls are captured and released at a new location (Trulio 1997). While evicting owls will reduce the likelihood of mortality or injury from construction activities, the long-term survival of evicted owls will depend on the availability and location of alternate habitat. Evicted owls have been reported to successfully colonize nearby burrows soon (within 1 week to 1 month) after eviction (Smith and Belthoff 2001; Trulio 1995). In other cases, however, evicted owls could not be found at a new location (Feeney 1997; Smith and Belthoff 2001). The number of owls that would be affected by this measure over the term of the HCP is unknown. Other alternatives, such as active relocation or establishing a preserve on-site for at least 10 years, may be coordinated through USFWS and AZGFD (AZGFD 2009).

Overall, the Burrowing Owl Conservation Strategy is intended to minimize any loss of burrowing owls and if possible, to increase the population of burrowing owls in the Town by ensuring the long-term availability of nesting and foraging habitat and proactively improving nesting opportunities. If implementation of HCP strategies is successful, we believe they will contribute to the conservation of local and regional populations of burrowing owls.

4.1.6 Burrowing Owl Monitoring Program

The Town will require pre-construction surveys (presence/absence) for burrowing owls for both CIP and development activities occurring in suitable habitat using the most current protocol. The Town will also survey for burrowing owl occupancy and monitor reproductive success and use of artificial nest burrows by burrowing owls at BOMAs. The Town will use the most current methodology or protocol approved by the USFWS and AZGFD, and may include banding and telemetry.

The Town will develop a site-specific management plan for each BOMA during the first year the HCP is in effect. The Town will monitor BOMAs for maintenance needs and identify issues (e.g. disturbance by people, pets, and feral cats and dogs) that require adaptive management.

The Town will document its efforts to cooperate on a regional level to conserve burrowing owls, including any collaborative management actions on Tucson Water lands and regional research and monitoring projects.

Monitoring will also consist of habitat monitoring using GIS and aerial photography to detect changes in vegetation and in land use to assure that the amount of NUOS set-aside complies with the HCP Conservation Zone and Wildlife Linkages requirements. The Town will also monitor for invasive species and implement an invasive species management plan. A database will be maintained to ensure that areas designated as NUOS are preserved in a natural state, to maintain connectivity and foraging opportunities through the preservation of native species such as saguaros and agaves. A base year of vegetation monitoring will be performed once open space is set aside, and then every three years thereafter. Species and habitat monitoring are described in greater detail in Chapter 6 of this document.

4.2 Cactus Ferruginous Pygmy-owl (*Glaucidium brasilianum cactorum*)

4.2.1 Existing Conditions

4.2.1.1 Species Ecology, Rangewide Status, Distribution, and Threats

Pygmy-owls are reddish-brown with reddish-brown streaks on their cream-colored breasts, a relatively long tail, and no ear tufts. They average 15 to 18 cm (6 to 7 in) in length and weigh a mere 0.06 kg (2.2 oz) (males) to 0.07 kg (2.6 oz) (females). They are diurnal (i.e., most active in the early morning and early evening), and are known to eat birds, small mammals, lizards, insects, frogs, and earthworms.

Pygmy-owls inhabit fairly dense thicket or woodland areas of the Sonoran Desert. They require saguaros or trees that are large enough for nesting cavities. Multi-layered ground cover, mid-story, and canopy cover are important to provide habitat for the pygmy-owl's prey. Additional information regarding the life history and status of the pygmy-owl can be found in Appendix 3.

The cactus ferruginous pygmy-owl, *Glaucidium brasilianum cactorum*, was listed as an endangered species in 1997. Following a series of lawsuits, the USFWS removed the pygmy-owl from the endangered species list in 2006. In 2007, the USFWS was petitioned to list the species again based on additional genetic, taxonomic, and threats information. Specifically, the petition relies largely on a recently proposed scientific reclassification of the pygmy-owl to *Glaucidium ridgwayi cactorum* based on Proudfoot et al. (2006a, 2006b) and Konig et al. (1999). This proposed reclassification recognizes the *cactorum* subspecies in southern Arizona, and Sonora and Sinaloa, Mexico, as distinct and defined by a smaller range than the subspecies recognized in 1997. In May 2008, the USFWS issued the 90-day finding in response to the petition and found that the pygmy-owl may warrant Federal protection under the ESA and initiated a 12-month status review (FR 73:31418-31424). The pygmy-owl still remains protected by the MBTA and ARS Title 17. Low population numbers, long-term drought, loss and modification of habitat, disease, and predation are thought to be the primary threats to pygmy-owls (FR 73:31418-31424).

4.2.1.2 Population in and Near the Town

The total number of pygmy-owls in Arizona is unknown due to an inconsistent and incomplete survey effort. Surveyors detected only 28 pygmy-owls in Arizona in 2006. Some areas of Arizona have not been surveyed for the presence of pygmy-owls, some

have been surveyed once or occasionally, and there are some areas (such as northwest Tucson) that have had a fairly consistent survey effort over the past 10 years. Specifically, AZGFD conducted surveys within the Town boundaries in 2003 and 2004. In addition, during the time the pygmy-owl was listed, surveys were conducted at the request of private developers and local governments as part of their efforts to comply with the ESA requirements. The occupancy history of pygmy-owls within the Town has benefited from this survey effort and there is a relatively reliable record of pygmy-owl occupancy to inform the development of this HCP. While there are currently no known pygmy-owl locations within the Town boundaries, the Town does contain significant areas of pygmy-owl habitat and has a history of pygmy-owl occupancy. Since 1995, there have been a total of 14 pygmy-owl territories within the Town (Richardson et al. 2000). For these reasons, the pygmy-owl was included as a covered species in the HCP.

The last known pygmy-owl within this area was taken into captivity in 2006 as part of AZGFD's captive breeding research project. In addition to the northwest Tucson area, pygmy-owls have also been found in:

- Tucson Mountains—unknown breeding status
- Rincon Mountains—unknown breeding status
- Organ Pipe Cactus National Monument—nesting
- Tohono O'odham Nation—nesting
- Southern Pinal County—nesting
- Altar Valley—nesting
- Roskruge Mountains—nesting

The patchy, dispersed nature of the pygmy-owl population in Arizona suggests that the overall population may function as a metapopulation, with local groups of owls functioning as subpopulations (USFWS 2003a).

4.2.1.3 Habitat in and Near the Town

With the 2006 delisting of the pygmy-owl, the designation of critical habitat and recovery areas are no longer legally binding. However, because these designations were developed by biologists and represent the best science available, the Town used these designations in developing the HCP pygmy-owl habitat model. In addition, the Town considered Pima County's pygmy-owl habitat model. The habitat variables (Table 4.10) in the Pima County model were ranked as 0, 1, 2, or 3; with 0 indicating no habitat and 3 indicating a high habitat value.

TABLE 4.10
VALUE RATINGS FOR CHARACTERISTICS OF THE VARIABLES USED IN THE PYGMY-OWL HABITAT MODEL IN THE SDCP

Variable/Category	Value Rating
Hydrology	
Intermittent stream	2
Adjacent habitat within 0.8 km (0.5 mi) of intermittent stream	1
Perennial stream	2
Vegetation	
Sonoran Riparian Woodland Xeroriparian mesquite (124.7)	3
Scrub-Grassland Mixed grass-scrub (143.15)	1
Scrub-Grassland Xeroriparian biome (143.10.XR)	1
Sonoran Desertscrub Upland Paloverde-mixed cacti (154.12)	3
Sonoran Desertscrub Xeroriparian Paloverde-mixed cacti (154.12XR)	3
Sonoran Desertscrub Urban Paloverde-mixed cacti (154.12U)	2
Interior Southwestern Riparian Deciduous Forest and Woodland Meso-riparian biome (223.20)	3
Interior Southwestern Riparian Deciduous Forest and Woodland Meso-riparian cottonwood-willow (223.21)	3
Interior Southwestern Riparian Deciduous Forest and Woodland Meso-riparian mixed broadleaf (223.22)	3
Interior Southwestern Riparian Deciduous Forest and Woodland Urban biome (223.20U)	2
Sonoran Riparian and Oasis Forests Meso-riparian mesquite (224.52)	3
Sonoran Riparian and Oasis Forests Meso-riparian cottonwood-willow (224.53)	3
Sonoran Riparian and Oasis Forests Urban mesquite (224.52U)	2
Sonoran Riparian and Oasis Forests Meso-riparian cottonwood-willow (224.53U)	2
Sonoran Deciduous Swamp and Riparian Scrub Meso-riparian biome (234.70)	1
Sonoran Deciduous Swamp and Riparian Scrub Meso-riparian mixed scrub (234.71)	1
Sonoran Deciduous Swamp and Riparian Scrub Meso-riparian saltcedar disclimax (234.72)	1
Slope	
0 to 2%	1
2 to 5%	1
Elevation	
195 to 400 m (640 to 1,312 ft)	1
401 to 600 m (1,313 to 1,969 ft)	2
601 to 800 m (1,970 to 2,625 ft)	2
801 to 1000 m (2,626 to 3,281 ft)	2
1001 to 1200 m (3,282 to 3,937 ft)	2
Land Form	
Drainageways	2
Floodplains	2
Terraces	2

Source: RECON 2002

Using this habitat model, 10,398 ha (25,693 ac) of potential habitat is predicted to occur in the Town. The habitat model does not include entitled lands which have already been zoned for development. Much of the modeled habitat is located on the Tortolita Fan, which is considered to be of value to the proposed reserve system of the Sonoran Desert Conservation Plan (SDCP) and as an important landscape linkage for the owl (Pima County 2001a).

4.2.1.4 Local Relation to Species' Range and Ecology

Much of the northeast portion of the Town is thought to include the most contiguous and highest quality pygmy-owl habitat in Arizona. This unit has had one of the highest known densities of owls in Arizona. The Tortolita Fan was identified as an important area to provide for breeding, foraging, and dispersal of pygmy-owls (USFWS 2003b). The Permit Area functions as a central link in the historical distribution of the pygmy-owl in Arizona providing population support and connecting habitat for populations found to the south and west in Altar Valley and the Tohono O'odham Nation and to the north in Pinal County. Pygmy-owl habitat within the Town is important in providing larger regional connectivity and population support for Arizona.

4.2.2 Potential Impacts of Town's Proposed Activities

4.2.2.1 Direct Effects

Construction activities for new residential, commercial, and industrial development and supporting infrastructure have potential for take in the form of harassing or harming owls. The covered activities would cause temporary and permanent habitat loss and fragmentation. In addition, construction activities could cause short-term noise disturbance and result in long-term disturbance from continued use of the project area (road or development). Short-term construction disturbances include noise, dust, traffic, and other human activity and can result in pygmy-owls leaving their established territories or may cause them to abandon their nest sites. Habitat impacts can also affect pygmy-owl use of the area.

As of the end of the 2004 pygmy-owl breeding season, there were no known active nest sites within the planning area, so there is currently only a minor risk of nest abandonment or mortality of juveniles associated with the covered activities. However, over the life of the Permit, the status of the pygmy-owl could change and alter the potential for these effects to occur, particularly if the augmentation program is successful. The Town will facilitate the augmentation of the regional pygmy-owl population by supporting the release of pygmy-owls within the HCP Permit Area in accordance with an approved augmentation plan developed with the USFWS and AZGFD. This may include the release of captive-bred pygmy-owls. In keeping with the intent of HCPs, augmentation activities are not meant to result in additional regulatory

burden for landowners and project proponents within the Permit Area who are already compliant with and covered under the HCP. It is unlikely that an owl would be directly killed as a result of the covered activities; however, lethal take of any individual would be a significant impact to the species.

4.2.2.2 Indirect Effects

Pygmy-owls are capable flyers, but rarely make flights greater than 30.5 m (100 ft), avoiding large open areas such as golf courses, roadways, and parking lots (USFWS 2003a). Therefore, roads and other developments can act as impediments to owl movements (USFWS 2003b). Wide roadways and associated clear zones also can result in lower flight patterns over roads which in turn can result in owls flying directly into the pathway of oncoming vehicles, significantly increasing the threat of an owl being struck by a vehicle (USFWS 2003a). Within the area formerly proposed as critical habitat (Figure 4.8), the Town has plans for two new roads and two road widening projects.

The introduction of exotic plant species, such as fountain grass, buffelgrass, Lehmann lovegrass, and red brome, which accompanies urbanization and grazing, can increase the risk of wildfires in pygmy-owl habitat (USFWS 2003b). Disturbance which often accompanies urban development (such as off-highway vehicles [OHV] and motorbike use and target practicing) could cause pygmy-owls to abandon their nest sites. Pygmy-owls are also vulnerable to predation from domestic cats whose numbers increase in association with urban development. Non-native cavity-nesting birds, such as starlings, tend to be found in greater numbers in disturbed areas and may compete with the pygmy-owl for nesting cavities. The availability of nesting cavities is not currently seen as a limiting factor for pygmy-owls in the Marana area and there are no known breeding pairs within the planning area. However, an influx of other cavity nesters associated with future urban development could cause a shortage of available nesting sites and reduce the suitability of nearby areas as breeding habitat. While the total impact of urban development within the Town is unknown, it could increase the vulnerability of owls to accidents, predation, disease, and genetic stochasticity.

4.2.2.3 Changes in Habitat

Based on the habitat model, there are 10,398 ha (25,693 ac) of modeled pygmy-owl habitat in the Town boundary (excluding areas entitled for development as of July 2007). Under the HCP, a total of 3,357 ha (8,295 ac) of modeled habitat for pygmy-owls would be impacted by CIP and development activities (Table 4.11). The remaining 7,041 ha (17,398 ac) of habitat would be protected as NUOS.

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Figure 4.8

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TABLE 4.11
PYGMY-OWL MODELED HABITAT AND PROJECTED FUTURE IMPACTS IN THE TOWN

Type of Habitat or Impact	Area
Modeled habitat	10,398 ha (25,693 ac)
Total habitat impacted by Town's CIPs	185 ha (457 ac)
Total habitat impacted by development within HCP Conservation Zones	3,071 ha* (7,588 ac)
Total habitat impacted by development outside of HCP Conservation Zones	101 ha* (250 ac)
Total Impacts	3,357 ha (8,295 ac)
Total NUOS	7,041 ha (17,398 ac)

* These figures are derived from Table 4.12.

A summary of impacts from development, both within and outside the Conservation Zones, is provided in Table 4.12. Figures 4.9 and 4.10 show the distribution of modeled pygmy-owl habitat in the Town in relation to CIP activities and existing development and entitled lands, respectively.

TABLE 4.12
SUMMARY OF DEVELOPMENT IMPACTS TO PYGMY-OWL HABITAT

	Pygmy-owl Modeled Habitat	Percent allowable impact by Zone	Area impacted
Zone 1	428 ha (1,057 ac)	0.05	21 ha (53 ac)
Zone 2	6,802 ha (16,808 ac)	0.20	1,361 ha (3,362 ac)
Zone 3	1,313 ha (3,244 ac)	0.30	394 ha (973 ac)
Zone 4	1,273 ha (3,146 ac)	1.00	1,273 ha (3,146 ac)
Habitat not in Zones	101 ha (250 ac)	1.00	101 ha (250 ac)
Proposed Wildlife Linkages	436 ha (1,077 ac)	0.05	22 ha (54 ac)
Existing Wildlife Linkages	45 ha (111 ac)	N/A	0
Total	10,398 ha (25,693 ac)	N/A	3,172 ha (7,838 ac)

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Figure 4.9

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Figure 4.10

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Areas of low-intensity development (i.e., disturbance of 30 percent or less of the land) have some potential for continuing as pygmy-owl habitat, depending on the amount of human use. Pygmy-owls have rarely been observed using areas of high human activity, and high-intensity development is considered to render habitat unsuitable for pygmy-owls. The hectares listed below for development impacts account for the percent set-aside of natural, undisturbed open space required by each Conservation Zone and 95 percent set-aside for wildlife linkages.

4.2.2.4 Population Effects

The planning area is subject to ongoing residential and commercial development pressures, capital improvements, and state, local, and private actions. Many individual parcels do not have a Federal nexus and, as they are developed, will not have to go through Section 7 consultations. These planned residential and commercial developments, schools, and churches within the HCP boundaries are likely to further reduce and fragment pygmy-owl habitat. These activities continue to reduce the amount of habitat and reduce possible movement corridors in the planning area. Within the Town, the proposed covered activities would contribute to an overall loss of pygmy-owl habitat and could lead to further fragmentation and adverse effects on movement corridors. Most of this development (72 percent), however, is slated to be low intensity (0.5 ha [1 ac] or more per home); a level of development that may be suitable for pygmy-owls, but only if an appropriate amount of open space remains in the surrounding area.

It is unlikely that there will be lethal take of a pygmy-owl due to implementation of covered activities. However, approximately 3,357 ha (8,295 ac) of suitable habitat would be lost or indirectly impacted in the Town, which could reduce the maximum number of breeding pairs that could be sustained within Arizona.

Another population effect is the impact of development and infrastructure improvements on owl movement corridors. Habitat fragmentation and loss of linkages could reduce the ability for pygmy-owls to disperse from or through or move into the Marana area. The habitat within the Town provides an important linkage between formerly proposed critical habitat on the west side of I-10 and habitat in Pinal County.

Much of the remaining habitat within the Town that is immediately adjacent to and northeast of I-10 and immediately southwest of I-10 is planned for development within the next 25 years. If this development occurs in a manner that is not conducive to owl occupancy and movement, the linkage between habitat in the Town and that to the southwest could be greatly impaired. The actual impact of these proposed covered activities would be dependent on the ability of pygmy-owls to use the Avra Valley/I-10 corridor (see Figure 4.1), which would require them to pass through extensive areas of development and cross a six lane, divided highway. There is no evidence that pygmy-owls are currently using this corridor between the western (Saguaro National Park and

south) and eastern (Tortolita Fan) portions of habitat; however no data suggests that this corridor is not or could not be used by pygmy-owls.

The bulk of formerly proposed critical habitat within the Town is located on the east side of I-10. The majority of owl detections within the Town have been located in the easternmost and southeastern portions. This area is linked to habitat within Pinal County (to the north) by an important habitat linkage that runs southeast to northwest. Future development in this area includes the widening of Tangerine Road from two to six lanes. This road-widening could reduce the likelihood of pygmy-owls occupying this area and dispersing to the north of the road and into Pinal County.

4.2.2.5 Anticipated Take

No lethal take is anticipated for the pygmy-owl. Pygmy-owl take may occur in the form of harm due to habitat loss or harassment or disturbance from eviction or translocation as described in Section 4.2.2.2 above. The anticipated modeled pygmy-owl habitat loss is approximately 3,357 ha (8,295 ac). There are approximately 1,919 ha (4,741 ac) of modeled habitat for this species in entitled private land that could potentially be included under the HCP if the landowners voluntarily choose to be covered under the HCP. If the pygmy-owl becomes listed under the ESA, voluntary inclusion would provide certainty of conservation requirements and eliminate the necessity of individual landowners and the Town conducting Section 7 consultation with the USFWS for activities that potentially affect this species or its habitat and have a Federal nexus because of the consultations outlined in Section 1.6.

4.2.3 Biological Goals and Objectives

The Town's biological goals and objectives for pygmy-owls relate to maintaining suitable breeding and dispersal habitat within the Town to allow for natural reoccupation or augmentation of pygmy-owls. Specifically, the Town's biological goal for pygmy-owls is to contribute to maintaining local and regional populations of pygmy-owls.

The Town's specific objectives are to:

- Minimize disturbance and fragmentation of existing suitable pygmy-owl habitat
- Prevent lethal take of pygmy-owls
- Provide for the long term availability of breeding/year-round and dispersal habitat
- Maintain habitat connectivity in important movement corridors for pygmy-owls
- Support efforts to supplement the pygmy-owl population through augmentation

4.2.4 Conservation Measures

A comprehensive conservation strategy for this species has been identified to achieve the goal and objectives outlined above. The strategy prioritizes the protection of a large tract of undisturbed pygmy-owl habitat east of I-10, as well as connectivity between the existing and any future reserves and surrounding habitat areas, and larger regional movement corridors. The specific conservation measures that the Town will implement are detailed below.

Pygmy-owl Measure 1. The Town will continue to manage the existing 971 ha (2,400 ac) Tortolita Preserve leased by the Town, and other Section 7 consultation lands under Town management, in a manner consistent with pygmy-owl survival and recovery. With the delisting of the pygmy-owl in 2006, the protections afforded these conservation lands were removed. Actions taken by the Town as part of this HCP are important to maintaining the conservation values established through section 7 consultations.

Pygmy-owl Measure 2. The Town will facilitate the augmentation of the regional pygmy-owl population by supporting the release of owls within the HCP Permit Area in accordance with an approved augmentation plan developed with the USFWS and AZGFD. The Town will provide logistic and administrative support for augmentation activities, but implementation of the augmentation plan will be the primary responsibility of the USFWS and the AZGFD.

In keeping with the intent of HCPs, augmentation activities are not meant to result in additional regulatory burden for landowners and project proponents within the Permit Area who are already compliant with and covered under the HCP. It is not intended that, should pygmy-owl augmentation result in occupancy of areas beyond those occupied at the time of Permit issuance, additional measures would be required beyond compliance with the HCP. Under the Permit associated with this HCP, landowners or project proponents are authorized to conduct any activity within a covered property that would not result in lethal take of a pygmy-owl and that is in compliance with the terms and measures included in the HCP. No loss of existing pygmy-owls or occupied habitat, as measured at the time of Permit issuance, is permitted as part of the Permit, unless agreed to by the USWFS. The only occupied habitat that may be altered in the future is habitat that was unoccupied at the time the Permit was issued. Landowners and project proponents agree to give the USFWS 60 days' notice prior to engaging in any activity that may cause take of pygmy-owls or occupied habitat to provide time to conduct salvage activities for any pygmy-owls that are potentially directly affected by the proposed activity.

Pygmy-owl Measure 3. The Town will implement landscape-level pygmy-owl surveys of the HCP Permit Area using the most current survey protocol (Appendix 4) and USFWS-permitted surveyors. The specific timing and locations of these surveys will be approved by USFWS, but the effort would focus on the Conservation Zones and any existing and

future reserve areas, and would be set up to track occupancy within the Town and the effectiveness of HCP pygmy-owl conservation measures. These planning area surveys would be conducted on public lands or within public rights-of-way. Because the Town's landscape-level surveys may not accurately determine occupancy of large, private parcels with restricted access, project clearance surveys on private property will also be required for development projects disturbing more than 202 ha (500 ac). If pygmy-owls are detected, either through protocol surveys or casual observance, the USFWS will be contacted and the following guidelines will be implemented for surface-disturbing activities:

- If an occupied pygmy-owl site is determined to support a nesting pair and is located in an area outside of urban development, development activities will not be permitted within 400 m (0.25 mi) of an active nest during the breeding season (February 1–July 31). For nests located in proximity to urban development, development activities will be restricted within 100 m (300 ft) during the breeding season due to the increased habituation of pygmy-owls in an urban setting.

- Following the breeding season, covered activities may continue at the nest site without any restrictions; however, if the nest site is located in an area that would provide for the long-term viability of the nest site, such as designated NUOS, efforts will be made to preserve pygmy-owl habitat components, including the nest site, within 100 m (300 ft) of the nest.

- If a non-breeding pygmy-owl is located and there is a need to implement a covered activity, the landowner or project proponent shall notify the Town and the USFWS at least 60 days prior to initiating the activity to allow time to conduct relocation or other activities to prevent lethal take of the individual pygmy-owl.

Pygmy-owl Measure 4. The Town will identify and delineate ESL (see Figure 4.2) in its General Plan (i.e., the four habitat Conservation Zones, wildlife linkages, and mapped riparian areas [see Figure 3.3] in Marana). Within the ESL, the Town will develop and implement ESRDG requiring a detailed evaluation and consideration of biological, cultural, and visual resources in the design, construction, and mitigation of road and utility projects in designated areas. Using the ESRDG, appropriate site-specific design criteria will also be developed for each project to promote and maintain pygmy-owl habitat connectivity in the Permit Area.

Pygmy-owl Measure 5. The Town will establish four habitat Conservation Zones to protect suitable habitat for wildlife, including the pygmy-owl (see Figure 4.1). The zones will have the following boundaries and restrictions:

- ZONE 1 will consist of all ESL along the Santa Cruz River. Within Zone 1, the Town will limit development to those uses permissible under Title 21, which prohibits permanent structures and generally maintains pygmy-owl habitat features.

- ZONE 2 will consist of all ESL east of I-10, starting 0.8 km (0.5 mi) south of Moore Road and extending north to the Town Boundary, and including ESL on the northern extension of the Tucson Mountains. Within Zone 2, the Town will:

  - Cooperate with and support regional land-use planning efforts to establish a permanent reserve on the Tortolita Fan providing breeding, dispersal, and year-round pygmy-owl habitat. This support may be in the form of coordination with Arizona State Land Department (ASLD), dedication of monies, management responsibility or assistance, or other means to be determined in consultation with the USFWS. The establishment of a permanent reserve will be the preferred conservation measure within Zone 2.

  - Require ASLD parcels that are sold to private entities requesting an up-zoning—if a permanent reserve can not be developed or until such a reserve is developed—to conserve 80 percent of the parcel in perpetuity as NUOS. These NUOS areas will include those portions of the parcel that support the highest habitat values. Open space must provide wash protection and be configured to complement any adjacent protected open space, including lands identified in the Pima County Conservation Lands System, as well as provide north-south habitat connectivity across the Tortolita Fan.

- ZONE 3 will consist of all ESL in the uplands adjacent to the Santa Cruz River and east of I-10, starting 1.5 km (1 mi) south of Tangerine Road. There will also be a buffer of Zone 3, 0.5 km (0.3 mi) in width, between Zone 4 and the Tortolita Preserve, from the eastern edge of the preserve west to the CAP canal. Within Zone 3, the Town will:

  - Extend one wildlife linkage across Tangerine to I-10/Avra corridor (see Figure 4.1). Target width of linkage will be 305 m (1,000 ft), as allowed by existing constraints, with goal of 95 percent protection (the 5 percent disturbance would account for driveway crossings and other minimal disturbances). Existing wildlife linkages across Tangerine Road will be preserved and widened when the road is widened.

  - Target NUOS in all other areas of the Zone to achieve a goal of 70 percent, with a minimum of 40 percent on-site. Open space must provide wash protection and be configured to compliment any adjacent protected open space, as well as provide north-south habitat connectivity across the Tortolita Fan. If less than 70 percent on-site NUOS is proposed, alternative mitigation would be required to make up any difference. This alternative mitigation could be in a number of forms. Suitable off-site lands may be acquired at an appropriate ratio and conserved for the benefit of the pygmy-owl. Mitigation funds may be contributed to the Town to support pygmy-owl conservation efforts including, but not limited to research, surveys, habitat acquisition, and augmentation efforts. Development

alternatives will be allowed if the parcel developer can demonstrate their project meets intent and NUOS goals listed above; any such alternative development must have USFWS and Town approval.

- ZONE 4 will consist of all ESLs east of I-10, 1.6 km (1 mi) north and south of Tangerine Road, except at the section of Zone 3 that will serve as a buffer between high-intensity development and the Tortolita Preserve. Within Zone 4, the Town will:

  - Allow 100 percent development outside the wildlife linkages. There are no NUOS goals established for Zone 4, outside of the designated linkages, because the proposed development limits and NUOS objectives within all of the other zones, as well as the three wildlife linkages extending across Tangerine Road (see Figure 4.1) will mitigate the proposed impacts within the entire permit area as a whole.

  - Extend three linkages across Tangerine Road (see Figure 4.1). The target width of each linkage will be 305 m (1,000 ft), as allowed by existing constraints, with a goal of 95-percent protection, except for future Tangerine Road improvements. The boundaries of the wildlife linkages will be established such that all parcels will retain opportunities for allowed land use. Additional benefits to covered species may also be achieved through on-site development configurations of the covered activities.

  - Implement the Town's ESRDGs for Tangerine Road improvements and include wildlife crossings aligned with the wildlife linkages above, and/or any new linkages identified through future research and monitoring.

Pygmy-owl Measure 6. To minimize impacts to pygmy-owl dispersal and movement corridors the Town will:

- Support efforts to purchase, preserve, and enhance parcels needed for a regional movement corridor across I-10 encompassing the former railroad underpass south of Avra Valley Road and any adjacent lands that are appropriate (see Figure 4.1).

- Require that continuity of NUOS be maintained within and among developments subject to discretionary action, and that open space be located in a manner that preserves wildlife access and movement within and through the site, consistent with adjacent efforts to do the same.

- Enforce restrictions in the Town Code (Title 12-4-2 Traffic) against OHV travel in publicly owned washes or other public lands when activities damage native vegetation or create significant erosion.

- Identify in the Environmental Element of its General Plan the importance of riparian areas as wildlife habitat and movement corridors.

- Incorporate specific requirements into Title 17 for riparian habitat protection and mitigation, including mitigation for each acre of impact at a ratio ranging from 1.5:1 up to 4:1, depending on the type of mitigation and distance from the impact location (see Section 4.0, Table 4.5, for details).

Pygmy-owl Measure 7. The Town will update Title 17 of the Land Development Code to include invasive species management guidelines and an official list of plants prohibited for use in landscaping. An inventory of all state- and Federally protected plant species, saguaro cacti, and ironwood trees shall also be conducted within the area not included in any area designated as a NUOS. Plants removed from the site, damaged, or destroyed during development shall be mitigated in accordance with the revised Title 17.

Pygmy-owl Measure 8. The Town will develop and implement an educational program designed to inform the general public, specific neighborhoods, permit applicants, and contractors of the various requirements of the HCP and the associated benefits to species and habitats. The educational program will also provide resources and instruction for Town personnel involved in operations and maintenance activities.

Pygmy-owl Measure 9. The Town will revise the SRI for clarification and quantification and will require that all development plans submitted to the Town for review and approval contain a narrative discussion documenting compliance with the conservation measures outlined and approved in the final HCP. This statement shall include maps and other graphics and analyses necessary to document this compliance. The submittal shall outline monitoring programs to document compliance with applicable grading limitations and the conservation measures approved in the HCP. This documentation also will include a drainage report that demonstrates that the proposed development will not significantly degrade the hydrologic regime of the property and includes an evaluation of the habitat impacts associated with the proposed drainage modifications.

Pygmy-owl Measure 10. The Town will require project proponents to establish and maintain a conservation easement (preferred) or restrictive covenant on all NUOS in Conservation Zones 1, 2, or 3 and wildlife linkages mapped in Figure 4.1, to be held by an approved third party or the Town, or with third party rights of enforcement. This easement or deed restriction will be recorded prior to initiation of construction.

The Town will require that the terms of the conservation easement or restrictive covenant include, but are not limited to the following requirements. To provide a consistent conservation effort, home owners associations shall also adapt the following as conditions, covenants, and restrictions (CC&Rs):

- Natural undisturbed open space will be maintained in a natural condition, except as approved by USFWS. A management plan must be submitted to the Town and approved by the USFWS within 6 months of the initiation of construction activities.

- Prior to occupancy of a residential lot, the disturbance limits of the lot shall be enclosed by temporary or permanent fencing unless prohibited by rocky ledges or other cost-prohibitive conditions. In that case, flagging or some other method of delineation may be used if the Town concurs. If the disturbance limits represent only a portion of a larger lot the property line of that lot may not be permanently fenced. Permanent fencing can only occur around the disturbance limits of each lot.

- Lot owners will be required to contain all domestic animals within the enclosed lot or keep them under strict control at all times. Pets that are outside of enclosed areas shall be leashed in conformance with Pima County Code 6.04.030.

- Native plants will be salvaged and replanted from any authorized disturbances, as approved by USFWS, which occur within the NUOS.

- No development or other activities are permitted in the NUOS except for approved pedestrian trails, developed in a manner that will avoid and minimize disturbance and removal of vegetation, and minor utility crossings (these will be revegetated per Title 17).

- The invasive species management guidelines will be implemented in accordance with the revised Title 17 to control invasive species.

- Landscape and plantings outside of developed common areas and the enclosed area of individual lots (e.g., rights-of-way, medians, trail alignments, retention basins) will be restricted to native, drought-tolerant plants. Planting of non-native, invasive species is prohibited. A list of prohibited plants can be found in Appendix 5. Landscaping will not be allowed in NUOS.

- The following activities are prohibited within the NUOS: (a) use of firearms, (b) any OHV use, (c) use of pesticides or herbicides for purposes other than controlling invasion of exotic species, and (d) racing events or other publicized events that attract large crowds, (e) the use of fires or barbeques.

4.2.5 Effects of Implementing the HCP on the Cactus Ferruginous Pygmy-owl

Proposed future CIP and development activities in the Town could directly impact up to 3,357 ha (8,295 ac) of modeled habitat for pygmy-owls in the Town during the term of the Permit. Under the HCP, approximately 7,041 ha (17,398 ac) of modeled pygmy-owl habitat would remain protected as NUOS. Although there appears to be a considerable amount of suitable habitat in the Town, approximately10,398 ha (25,693 ac), no pygmy-owls are known to inhabit the Town. The Town's conservation approach to pygmy-owls is to maintain a sufficient amount and configuration of breeding and dispersal habitat in

an effort to maintain owls in the Town and to allow future pygmy-owls to establish territories within the Town, either through natural processes or augmentation.

- The Town would minimize disturbance to suitable habitat within the Town by requiring that development comply with limits on maximum allowed disturbance. These limits are defined for each of the four Conservation Zones and were determined based the condition of existing habitat and on USFWS's and AZGFD's best understanding of what level of disturbance pygmy-owls seem to tolerate and that will not render the adjacent habitat unsuitable for long-term persistence of the pygmy-owl.

4.2.6 Cactus Ferruginous Pygmy-owl Monitoring Program

The Town will conduct landscape-level pygmy-owl surveys within the HCP Permit Area. The specific timing and location of the surveys will be approved by the USFWS. The surveys will focus on the Conservation Zones and on existing and future reserve areas. The surveys will be conducted on public lands or within public rights-of-way. The Town will also require project proponents to conduct pre-construction pygmy-owl surveys (presence/absence) for projects on private land greater than 500 acres.

The Town will cooperate with AZGFD monitoring efforts if cactus ferruginous pygmy-owl populations are augmented in the Tortolita Mountains and Fan. The type and location of monitoring efforts, and the role of the Town, will be decided later in consultation with AZGFD and USFWS.

Monitoring will also consist of habitat monitoring using GIS and aerial photography to detect changes in vegetation and in land use to assure that the amount of NUOS set-aside complies with the HCP Conservation Zone and Wildlife Linkages requirements. The Town will also monitor for invasive species and implement an invasive species management plan. A database will be maintained to ensure that areas designated as NUOS are preserved in a natural state, to maintain connectivity and foraging opportunities through the preservation of native species such as saguaros and agaves. A base year of vegetation monitoring will be performed once open space is set aside, and then every three years thereafter. All NUOS protected as part of the above conservation measures will be monitored on a regular basis to ensure that pygmy-owl habitat components are maintained or enhanced. Monitoring will include the review of annual reports submitted by the parties responsible for the long-term maintenance of these conservation areas, as well as by periodic visual inspection of the conservation areas. Species and habitat monitoring are described in greater detail in Chapter 6 of this document.

4.3 Southwestern Willow Flycatcher (*Empidonax traillii extimus*)

4.3.1 Existing Conditions

4.3.1.1 Species Rangewide Status, Distribution, and Threats

The southwestern willow flycatcher (willow flycatcher) is a small, migratory bird about 15 cm (6 in) long, with a grayish-green back and wings, a white throat, a light grey-olive breast, and a pale yellowish belly. Two wingbars are visible and the eye ring is faint or absent. The willow flycatcher is identified during breeding season by its call, a “fitz-bew.”

The willow flycatcher nests and forages in dense riparian habitat along streams, rivers, lakesides, and other wetlands. Some of the more common plant species used for nesting include willow, box elder (*Acer negundo*), tamarisk, Russian olive (*Elaeagnus angustifolia*), buttonbush (*Cephalanthus occidentalis*), cottonwood, and mesquite. Migration habitat is believed to primarily occur along riparian corridors. Habitat occurs at elevations below 2,590 m (8,500 ft). It is found throughout the southwest in portions of California, Nevada, Utah, Arizona, New Mexico, Texas, Colorado, and Mexico.

The willow flycatcher was listed as endangered in February 1995. Critical habitat was designated in 2005. The willow flycatcher is endangered primarily due to riparian habitat reduction, degradation, and elimination as a result of agricultural and urban development. The willow flycatcher is also affected by predation and brood parasitism by cowbirds (*Molothrus ater*). The invasion of non-native plants has affected the availability and quality of available flycatcher habitat. Additional information regarding the life history and status of the willow flycatcher can be found in Appendix 3 of this document.

While no willow flycatchers are currently known to occupy the Town, the Town does contain areas of potential habitat, especially migration habitat. In addition, restoration projects along the Santa Cruz River have the potential to develop flycatcher habitat in the future. For these reasons, the flycatcher was included as a covered species in this HCP.

4.3.1.2 Population in and Near the Town

The nearest confirmed southwestern willow flycatchers have occurred in Las Cienegas National Conservation Area in southeast Pima County and near the confluence of Peck Canyon with the Santa Cruz River in Santa Cruz County. The nearest potentially suitable habitat occurs on Simpson Farm approximately 1.6 km (1 mi) west of the Town. The Tucson Audubon Society (TAS) has been implementing a habitat restoration project in

this area and has conducted willow flycatcher surveys since 2001, with negative results (Scott Wilbor, TAS, pers. comm. July 2008).

4.3.1.3 Habitat in and Near the Town

Effluent-supported, riparian deciduous woodland along the Santa Cruz River contains patches of habitat potentially suitable for migrating willow flycatchers (Greg Beatty, USFWS, pers. comm., April 18, 2007). The riparian habitat of the Santa Cruz River is sustained by effluent discharges from the Roger and Ina Road wastewater treatment plants. While the effluent provides a relatively consistent source of water in some reaches of the river, this linear riparian vegetation along the river is strongly influenced by the interaction of flooding frequency and intensity, variation in infiltration rates, and the amount of regional groundwater pumping. This may result in spatial and temporal variation in habitat suitability for the willow flycatcher (CH2MHill 2003). As these riparian vegetation patches mature and expand, they have the potential to develop into suitable breeding habitat. Modeled habitat for southwestern willow flycatchers was developed by considering hydrology and vegetation, specifically tropical-subtropical swamp, Sonoran deciduous swamp, and riparian scrub series. Using this model, 462 ha (1,141 ac) of potential habitat is predicted to occur in the Town. These areas are contained within Conservation Zone 1 described below and depicted in Figure 4.1. The habitat model does not include entitled lands which have already been zoned for development.

Critical habitat for southwestern willow flycatcher was originally designated on 22 July 1997 (USFWS 1997), but on 11 May 2001, the 10th Circuit Court of Appeals set aside the critical habitat designation and instructed USFWS to issue a new designation in compliance with the court ruling. The final designation of southwestern willow flycatcher critical habitat was published in the *Federal Register* on 19 October 2005 (USFWS 2005). The nearest critical habitat for this species is approximately 48 km (30 mi) northeast of Marana along the Gila and San Pedro Rivers (Middle Gila/San Pedro Management Unit).

4.3.1.4 Relation to Species' Range and Ecology

The Town and vicinity represent a relatively small portion of this widely distributed species' range (i.e., seven western states and extreme northwestern Mexico). While Arizona contains the largest number of known willow flycatcher territories, and willow flycatchers were detected along 12 major drainages within Arizona in 2005, no breeding territories have been documented within the Santa Cruz River drainage. This is likely due to the lack of perennial flow in a substantial portion of the drainage and degraded habitat in those areas with surface water. This species is highly migratory and portions of the Santa Cruz may provide important migration habitat, especially if restoration efforts are undertaken to improve the extent and quality of habitat.

4.3.2 Potential Impacts of Town's Proposed Activities

4.3.2.1 Direct Effects

Direct effects to willow flycatchers may result from removal of riparian vegetation and from construction. Another potential direct effect to willow flycatchers may be traffic noise, as it has been shown to effect birds in general (Dooling and Popper 2007). Because activities within the floodway of the Santa Cruz River will be limited, removal of suitable habitat and noise from construction are expected to be minimal. Noise from increased traffic associated with new bridges across the river could cause individual birds to move to other areas, potentially increasing energetic demands and increasing their susceptibility to predation. However, because construction will occur while flycatchers are not present or following surveys, birds would likely only occupy habitat with an acceptable level of traffic noise. Further, no southwestern willow flycatchers have been documented within the Town, and given the current lack of breeding habitat; it is likely that very few breeding willow flycatchers will be affected by covered activities. There is a greater likelihood that migrating willow flycatchers will be affected, although that number is also expected to be low until habitat restoration projects have been implemented; at which point the numbers of willow flycatchers could increase, with some potential for breeding.

4.3.2.2 Indirect Effects

Southwestern willow flycatchers can be adversely affected through indirect mechanisms facilitated or caused by or associated with urban development. Specifically, these may include increased unauthorized public access to the floodway and introduction of non-native or invasive species, and increased erosion resulting from increased stormwater runoff, and increased predation by domestic cats.

4.3.2.3 Changes in Habitat

Based on the habitat model, there are 462 ha (1,141 ac) of modeled willow flycatcher habitat in the Permit Area. Under the HCP, a total of 119 ha (294 ac) of modeled habitat for willow flycatchers would be impacted by CIP and development activities (Table 4.13). The remaining 343 ha (847 ac) of habitat would be protected as NUOS.

A summary of impacts from development, both within and outside the Conservation Zones, is provided in Table 4.14. Figures 4.11 and 4.12 show the distribution of modeled willow flycatcher habitat in the Town in relation to CIP activities and existing development and entitled lands, respectively.

TABLE 4.13
SOUTHWESTERN WILLOW FLYCATCHER MODELED HABITAT AND PROJECTED FUTURE IMPACTS IN THE TOWN

Type of Habitat or Impact	Area
Modeled habitat	462 ha (1,141 ac)
Total habitat impacted by Town's CIPs	57 ha (140 ac)
Total habitat impacted by development within HCP Conservation Zones	25 ha* (62 ac)
Total habitat impacted by development outside of HCP Conservation Zones	37 ha* (92 ac)
Total Impacts	119 ha (294 ac)
Total NUOS	343 ha (847 ac)

* These figures are derived from Table 4.14.

TABLE 4.14
SUMMARY OF DEVELOPMENT IMPACTS TO SOUTHWESTERN WILLOW FLYCATCHER HABITAT

	Southwestern willow flycatcher Modeled Habitat	Percent allowable impact by Zone	Area impacted
Zone 1	410 ha (1,012 ac)	0.05	21 ha (51ac)
Zone 2	0	0.20	0
Zone 3	15 ha (37 ac)	0.30	4 ha (11 ac)
Zone 4	0	1.00	0
Habitat not in Zones	37 ha (92 ac)	1.00	37 ha (92 ac)
Proposed Wildlife Linkages	0	0.05	0
Existing Wildlife Linkages	0	N/A	0
Total	462 ha (1,411 ac)	N/A	62 ha (154 ac)

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Figure 4.11

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Figure 4.12

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The Santa Cruz River is likely to run dry at some point in the future due to reuse of effluent. How soon or if this will happen is dependent on the rate of population growth and the development of effluent reuse projects. The Town currently has no authority to influence the amount of water flow in the Lower Santa Cruz River, unless the Tres Rios del Norte Restoration Project or other projects are implemented to protect conservation flows in the river.

4.3.2.4 Population Effects

No breeding willow flycatchers are known from the Town and the level of use of modeled habitats in Marana by migrating willow flycatchers is unclear. If habitats in the Town are used by this species, future development in the Town could result in a small direct reduction in the regional willow flycatcher population. Reductions in habitat caused by urban development could contribute to reductions in willow flycatcher populations through such hazards as predation.

4.3.2.5 Anticipated Take

No lethal take is anticipated for the willow flycatcher. Take may occur as harm in the form of riparian habitat loss or fragmentation, and harassment due to noise, as described in Section 4.3.2.1 and 4.3.2.2 above. The loss of modeled habitat is projected to be 119 ha (294 ac). There are approximately 3 ha (7 ac) of modeled habitat for this species in entitled private land that could potentially be included under the HCP if the landowners voluntarily choose to be covered under the HCP. Voluntary inclusion would provide certainty of conservation requirements and eliminate the necessity of individual landowners and the Town conducting Section 7 consultation with the USFWS for activities that potentially affect this species or its habitat and have a Federal nexus because of the consultations outlined in Section 1.6.

4.3.3 Biological Goals and Objectives

The Town's biological goals and objectives for the southwestern willow flycatcher relate to maintaining suitable habitat components necessary for this species to carry out its life cycle. Specifically, the Town's biological goal is to contribute to maintaining local and regional populations of southwestern willow flycatcher.

The Town's specific objectives are to:

- Minimize disturbance and fragmentation of existing or restored suitable southwestern willow flycatcher habitat components
- Avoid lethal take of southwestern willow flycatchers

4.3.4 Conservation Measures

The Town does not control water flow in the Santa Cruz River and recognizes that it cannot guarantee the long term availability of willow flycatcher habitat that is supported by a dependable water supply. Even so, the Town can minimize impacts to important components of the hydro-riparian habitat along the Santa Cruz River, and avoid lethal take of individuals through the following conservation measures.

Southwestern Willow Flycatcher Measure 1. The Town will identify and delineate ESL within its General Plan, including areas of southwestern willow flycatcher habitat. Within the ESL, the Town will develop and implement ESRDG requiring a detailed evaluation and consideration of biological, cultural, and visual resources in the design, construction, and mitigation of road and utility projects in designated areas. Using the ESRDG, appropriate site-specific design criteria will also be developed for each project to promote and maintain willow flycatcher habitat and habitat connectivity in the Permit Area.

Southwestern Willow Flycatcher Measure 2. The Town will establish four habitat Conservation Zones (see Figure 4.1) to protect suitable habitat for wildlife, including willow flycatchers. Zone 1 will generally consist of all ESL along the Santa Cruz River floodway. The Town will provide protections for willow flycatcher habitat in this zone by limiting the types of development to those uses permissible under Title 21 of the Land Development Code, which prohibits permanent structures and generally maintains southwestern willow flycatcher habitat features.

Southwestern Willow Flycatcher Measure 3. The Town will further protect hydro-riparian habitat through the following actions:

- Identify in the Environmental Element of its General Plan the importance of riparian areas as wildlife habitat and movement corridors
- Incorporate specific requirements into Title 17 for riparian habitat protection and mitigation, including mitigation for each acre of impact at a ratio ranging from 1.5:1 up to 4:1, depending on the type of mitigation and distance from the impact location (see Section 4.0, Table 4.5 for details). The Town would also adopt a Riparian Habitat Map (Figure 3.3) linked to the revised Title 17.
- Enforce restrictions in the Town Code (Title 12-4-2 Traffic) against OHV travel in publicly-owned washes or other public lands when activities damage native vegetation or create significant erosion
- Update Title 17 of the Land Development Code to include invasive species management guidelines and an official list of plants prohibited for use in landscaping.

An inventory of all state- and Federally protected plant species, cottonwood, and willow trees shall also be conducted within the area not included in any area designated as a NUOS. Plants removed from the site, damaged, or destroyed during development shall be mitigated in accordance with the revised Title 17.

Southwestern Willow Flycatcher Measure 4. The Town will avoid lethal take of southwestern willow flycatchers through the following actions:

- Incorporate development standards into Title 17 of the Land Development Code requiring species-specific habitat evaluations. These standards will require project proponents to evaluate project areas for suitable southwestern willow flycatcher habitat and to conduct pre-construction surveys where such habitat exists. These surveys will utilize the *Southwestern Willow Flycatcher Natural History Summary and Survey Protocol* (Sogge et al. 1997 as revised by the USFWS in July 2000 [Appendix 4]) or the most current protocol as approved by USFWS.

- Notify AZGFD and USFWS to determine the appropriate course of action if southwestern willow flycatchers are detected during pre-construction surveys.

- Allow project proponents to schedule their surface disturbance activities to be initiated and completed between September 16 and April 14, while the southwestern willow flycatcher is not present in southern Arizona, as an option to pre-construction surveys.

Southwestern Willow Flycatcher Measure 5. The Town will develop and implement an educational program designed to inform the general public, specific neighborhoods, permit applicants, and contractors of the various requirements of the HCP and the associated benefits to species and habitats. The educational program will also provide resources and instruction for Town personnel involved in operations and maintenance activities.

4.3.5 Effects of Implementing the HCP on Southwestern Willow Flycatchers

Proposed future CIP and development activities in the Town could directly impact about 107 ha (264 ac) of modeled habitat for willow flycatchers in the Town. Under the HCP, approximately 355 ha (877 ac) of modeled willow flycatcher habitat would remain protected as NUOS.

Although the hydroriparian habitat currently present in the Town appears suitable to function as migratory habitat and may develop into suitable breeding habitat, no willow flycatchers are known to currently inhabit the Town. The Town's conservation approach for willow flycatchers is to maintain a sufficient amount and configuration of hydroriparian

habitat in an effort to allow migration of willow flycatchers through the Town and future establishment of breeding territories within the Town.

The Santa Cruz once had 2,833 to 3,238 ha (7,000 to 8,000 ac) of cottonwood-willow habitat. Less than 202 ha (500 ac) remain. Because of habitat losses, the river has suffered major reductions in the diversity and populations of birds, fish and other wildlife, according to the U.S. Army Corps of Engineers (USACE) (*Arizona Daily Star* June 10, 2008). The Town is revegetating drainage channels in Continental ranch with native trees, to provide potential wildlife corridors to the river.

The Town will restore a 16 ha (40 ac) wetland on a 32 ha (80 ac) site owned by the Town, which is adjacent to the Santa Cruz River at the site of an old Arizona Department of Transportation (ADOT) borrow pit. The restoration will include: contouring to reduce the percent slope on the banks, evaluating the need for adding supplemental wetland soils or nutrients, planting native hydrophytic vegetation and riparian species identified at "reference wetland sites" in the area, removing non-native or invasive species, potentially providing additional treated effluent water to maintain vegetation during the dry season (as part of a proposed wastewater treatment facility if it is located in the area), and developing a monitoring and adaptive management plan for the site.

Riparian restoration projects being performed by others include Pima County Regional Flood Control District's Cortaro Mesquite Bosque 32 ha (80 ac) riparian habitat restoration. This project was designed to increase the vegetation structure and biological diversity of the floodplain and to provide wildlife habitat, particularly forage and nesting area for birds. The planting zones consist of native cottonwood-willow trees, riparian mesquite Bosque, riparian grassland-willow, xeroriparian (drier area) mesquite, and upland vegetation-grassland.

Another project that may benefit willow flycatcher habitat, when it is implemented, is the Tres Rios del Norte Project, which is a comprehensive restoration project on the Santa Cruz River. The Army Corps of Engineers began conducting a feasibility study in 2001, with the three local sponsors (Pima County, the Town, and the City of Tucson). It is intended that the project will ultimately provide opportunities for flood control, groundwater recharge, and recreation, addressing common interests and goals of Pima County, the Town, and the City of Tucson. The study area comprises a 29 km (18 mi) stretch of the Santa Cruz River corridor that extends from Prince Road north to Sanders Road. In that reach are the confluences of the Santa Cruz with two of its major tributaries, the Rillito Creek and the Cañada del Oro Wash. Goals for the restoration plan include: restoring wetland and riparian vegetative communities within the river corridor to a more natural state and increase habitat diversity; minimizing disturbance-type impacts to proposed restoration areas; implementing a low-maintenance design; reducing flood damages in specified areas; water resource management opportunities including storm water harvesting, groundwater recharge, more efficient use of effluent; maximizing use

of vacant lands for restoration and utilizing sand and gravel mining areas as they are retired; and providing recreational resources where possible. The Cortaro Bosque and Tres Rios restoration projects are not included as part of the HCP, but complement HCP riparian restoration goals and may increase and improve willow flycatcher habitat through revegetation.

Under the HCP, the Town would minimize disturbance to suitable habitat within the Town by requiring that development within the Santa Cruz River floodway comply with the restrictions and mitigation requirements within and being developed for the Town's Land Use Code. Likewise, the Town would avoid lethal take of willow flycatchers through requirements for preconstruction surveys or seasonal restrictions.

4.3.6 Southwestern Willow Flycatcher Monitoring Program

The Town will require pre-construction surveys (presence/absence) prior to CIP or development activities in suitable habitat. The surveys will follow the most current southwestern willow flycatcher survey protocol approved by the USFWS.

The Town will also perform general bird richness/diversity surveys bi-monthly during the main breeding season (March–August) using Tucson Audubon Society's Important Bird Survey protocols. The bird surveys will record occupancy and abundance of more common riparian species that are indicators of healthy riparian habitat. Surveys will be conducted on Town-owned lands, public lands, within public rights-of-way, or on private lands where access in granted.

Monitoring will also consist of habitat monitoring using GIS and aerial photography to detect changes in vegetation and in land use to assure that the amount of NUOS set-aside complies with the HCP Conservation Zone and Wildlife Linkages requirements. The Town will also monitor for invasive species and implement an invasive species management plan. A database will be maintained to ensure that areas designated as NUOS are preserved in a natural state, to maintain connectivity and foraging opportunities through the preservation of native species. A base year of vegetation monitoring will be performed once open space is set aside, and then every three years thereafter.

Riparian habitats conserved or restored as a result of the conservation measures above will be regularly monitored to ensure that riparian habitat values are being maintained or enhanced. Monitoring may include photo points, transects, and annual reporting by the responsible parties. Species and habitat monitoring are described in greater detail in Chapter 6 of this document.

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4.4 Western Yellow-billed Cuckoo (*Coccyzus americanus occidentalis*)

4.4.1 Existing Conditions

4.4.1.1 Species Rangewide Status, Distribution, and Threats

The yellow-billed cuckoo (cuckoo) is a medium-sized bird, approximately 30 cm (12 in) in length and weighs about 60 g (2 oz). It has a slender, long-tailed profile, with a fairly stout and slightly down-curved bill, which is blue-black with yellow at the base. The tail feathers are boldly patterned in black and white below. Adults have a narrow, yellow eye ring. Males and females differ slightly, with males having a slightly larger bill.

Cuckoos are relatively late nesters in the southwestern United States. In Arizona, cuckoos begin to arrive around the last week of May and arrival peaks in mid- to late-June. Breeding often coincides with outbreaks of tent caterpillars, cicadas, and other large insects (AZGFD 2002a).

Yellow-billed cuckoo habitat differs in the eastern and western portions of the United States. Cuckoos breed in large blocks of riparian habitat, especially in cottonwood and willow stands, although they are also found in tamarisk. Habitat patches less than 10 ac in size are generally considered unsuitable (Laymon 1998; Halterman pers. comm. 2005). In the western U.S., habitat is limited to widely separated, riparian cottonwood-willow galleries. Dense under-story foliage appears to be an important factor in nest site selection, while the presence of cottonwoods is important for foraging, at least in California. The species is usually found at elevations less than 2,011 m (6,600 ft) in portions of California, Arizona, New Mexico, Oregon, Washington, Colorado, Wyoming, Utah, Idaho, Nevada, and possibly even British Columbia (Scott Richardson, pers. comm. January 2008).

The yellow-billed cuckoo is a candidate species under the Endangered Species Act. The USFWS was petitioned to list the yellow-billed cuckoo as a Distinct Population Segment in the west and listing was found to be warranted in 2001, but precluded by higher priority listing actions. It is listed as Wildlife of Concern by the State of Arizona and is also protected by the MBTA and ARS Title 17. The loss, degradation, and fragmentation of riparian habitat have been identified as the primary factors causing yellow-billed cuckoo declines in the western United States. Additional information regarding the life history and status of the yellow-billed cuckoo can be found in Appendix 3 of this document.

No breeding pairs of cuckoos have been documented in the Town, although breeding is suspected along the Santa Cruz River just north of the Town boundaries. Individual

cuckoos, likely migrants, have been documented within the Town limits. Migratory habitat currently exists along the Santa Cruz River. In addition, restoration projects along the Santa Cruz River have the potential to develop cuckoo habitat in the future. For these reasons, the yellow-billed cuckoo was included as a covered species in this HCP.

4.4.1.2 Population in and Near the Town

The nearest yellow-billed cuckoo occurrences have been documented at Simpson Farm approximately 1 mi west of the Town along the Santa Cruz River. Surveys by the TAS detected three cuckoos in 2004, six in 2005, two in 2006, and a probable pair in 2007 (Scott Wilbor, TAS, pers. comm. 2007). No cuckoos were detected in 2008 (Kendall Kroesen, pers. comm. 2008). No nests were confirmed, but the surveyors suspected two nests in 2005, and one in 2006. Other nearby historic records include sightings on the Santa Cruz near San Xavier Mission, along Tanque Verde Wash in the Rincon Mountains, and even within commercial areas of the City of Tucson.

4.4.1.3 Habitat in and Near the Town

The riparian habitat of the Santa Cruz River is sustained by effluent discharges from the Roger and Ina roads wastewater treatment plants. Regeneration of the riparian zone has been rapid where effluent is discharged. While the effluent provides a relatively consistent source of water in some reaches of the river, this linear riparian vegetation along the river is strongly influenced by the interaction of flooding frequency and intensity, variation in infiltration rates, and the amount of regional groundwater pumping. This may result in spatial and temporal variation in habitat suitability for the western yellow-billed cuckoo (CH2MHill 2003). Other considerations in evaluating yellow-billed cuckoo suitable or potential habitat include proximity to water and a patch size of 10 ac or greater of riparian woodland (Laymon 1998; Halterman 1991; Salt River Project 2007). Halterman also found the presence of low, woody vegetation to be a predictor of breeding habitat (Halterman 1991). Modeled habitat for yellow-billed cuckoos was developed by considering locations of known occurrences as well as hydrology and vegetation, specifically tropical-subtropical swamp, Sonoran deciduous swamp, and riparian scrub series, Using this model, 462 ha (1,141 ac) of modeled habitat is predicted to occur in the Town. These areas are contained within Conservation Zone 1 described below and depicted in Figure 4.1. The habitat model does not include entitled lands which have already been zoned for development.

SAGE Landscape and Architecture (2003) surveyed for yellow-billed cuckoos late in the breeding season (i.e., August and September 2002) for Pima County and observed two cuckoos along the Santa Cruz River. One cuckoo was located in the Town limits near where Sanders Road crosses the river, in habitat dominated by Goodding willow mixed with a few large tamarisk, mesquite, and cattails (*Typha* sp.). One other cuckoo was located near the Town limits in a dense stand of Goodding willow within a channelized

reach between El Camino del Cerro and the Sweetwater Wastewater Treatment Facility near Christopher Columbus Regional Park. Existing stream flow originates from effluent discharge. The reach supports Sonoran riparian deciduous forest and woodland dominated by Goodding willow, scrubland dominated by seep willow (*Baccharis salicifolia*), and strand communities dominated by annuals (Brown 1994; Minckley and Brown 1982). Recent records of cuckoos at Simpson Farm suggest that some riparian habitats along the Santa Cruz River may be developing into potential breeding habitat for cuckoos.

4.4.1.4 Relation to Species' Range and Ecology

The western yellow-billed cuckoo was documented along 25 drainages in Arizona in 1998 and 1999, with the major concentrations occurring along the Agua Fria, San Pedro and Verde rivers, and Cienega and Sonoita creeks (Corman and Magill 2000). It has been extirpated from most lower elevation localities, especially the Colorado River valley (AZGFD in prep.) and most of the Santa Cruz River in Pima County (Corman and Magill 2000). However, given the more recent records of cuckoos near the Town, there may be opportunities for cuckoos to re-establish breeding territories in suitable habitat along the Santa Cruz River.

4.4.2 Potential Impacts of Town's Proposed Activities

4.4.2.1 Direct Effects

Proposed activities may directly impact cuckoos through removal of riparian vegetation and from noise disturbances related to construction activity. A potential direct effect to cuckoos may be traffic noise, as it has been shown to affect birds in general (Dooling and Popper 2007). Because activities within the floodway of the Santa Cruz River will be limited, removal of suitable habitat and noise from construction are expected to be minimal. Noise from increased traffic associated with new bridges across the river could cause individual birds to move into marginal areas where they may be more susceptible to predation. Because the timing of construction will be determined by results of preconstruction surveys and restricted to periods when cuckoos are not present, we expect direct effects from these disturbances to be limited, as birds are more likely to select sites with acceptable levels of traffic noise when they arrive (Dooling and Popper 2007).

4.4.2.2 Indirect Effects

Western yellow-billed cuckoos can be adversely affected through indirect mechanisms facilitated or caused by or associated with urban development. Specifically, these may include increased unauthorized public access to the floodway and introduction of non-

native or invasive species, and increased erosion resulting from increased stormwater runoff and increased predation by domestic cats.

4.4.2.3 Changes in Habitat

Based on the habitat model, there are 462 ha (1,141 ac) of modeled cuckoo habitat in the Permit Area. Under the HCP, a total of 119 ha (294 ac) of modeled habitat for cuckoos would be impacted by CIP and development activities (Table 4.15). The remaining 343 ha (847 ac) of habitat would be protected as NUOS.

TABLE 4.15
WESTERN YELLOW-BILLED CUCKOO MODELED HABITAT AND PROJECTED FUTURE IMPACTS IN THE TOWN

Type of Habitat or Impact	Area
Modeled habitat	462 ha (1,141 ac)
Total habitat impacted by Town's CIPs	57 ha (140 ac)
Total habitat impacted by development within HCP Conservation Zones	25 ha* (62 ac)
Total habitat impacted by development outside of HCP Conservation Zones	37 ha* (92 ac)
Total Impacts	119 ha (294 ac)
Total NUOS	343 ha (847 ac)

* These figures are derived from Table 4.16.

A summary of impacts from development, both within and outside the Conservation Zones, is provided in Table 4.16. Figures 4.13 and 4.14 show the distribution of modeled cuckoo habitat in the Town in relation to CIP activities and existing development and entitled lands, respectively.

TABLE 4.16
SUMMARY OF DEVELOPMENT IMPACTS TO WESTERN YELLOW-BILLED CUCKOO HABITAT

	Western yellow-billed cuckoo Modeled Habitat	Percent allowable impact by Zone	Area impacted
Zone 1	410 ha (1,012 ac)	0.05	21 ha (51 ac)
Zone 2	0	0.20	0
Zone 3	15 ha (37 ac)	0.30	4 ha (11 ac)
Zone 4	0	1.00	0
Habitat not in Zones	37 ha (92 ac)	1.00	37 ha (92 ac)
Proposed Wildlife Linkages	0	0.05	0
Existing Wildlife Linkages	0	N/A	0
Total	462 ha (1,411 ac)	N/A	63 ha (164 ac)

Figure 4.13

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Figure 4.14

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The Santa Cruz River is likely to run dry at some point in the future due to reuse of effluent. How soon or if this will happen is dependent on the rate of population growth and the development of effluent reuse projects. The Town currently has no authority to influence the amount of water flow in the Lower Santa Cruz River, unless the Tres Rios del Norte Restoration Project or other projects are implemented to protect conservation flows in the river.

4.4.2.4 Population Effects

The level of use of modeled habitats in the Town by breeding or migrating cuckoos is unclear. If habitats in the Town are used by this species, future development in the Town could result in a small direct reduction in the regional cuckoo population. Reductions in habitat caused by urban development could contribute to reductions in cuckoo populations through such hazards as predation. Linear transportation projects, such as bridges across the Santa Cruz River, could potentially have a small impact on cuckoo populations from vehicle strikes.

4.4.2.5 Anticipated Take

No lethal take is anticipated for the cuckoo. Take may occur as harm in the form of riparian habitat loss or fragmentation, and harassment due to noise, as described in Section 4.4.2.1 and 4.4.2.2 above. Modeled habitat loss is projected to be 119 ha (294 ac). There are approximately 2 ha (4 ac) of modeled habitat for this species in entitled private land that could potentially be included under the HCP if the landowners voluntarily choose to be covered under the HCP. If the cuckoo becomes listed under the ESA, voluntary inclusion would provide certainty of conservation requirements and eliminate the necessity of individual landowners and the Town conducting Section 7 consultation with the USFWS for activities that potentially affect this species or its habitat and have a Federal nexus because of the consultations outlined in Section 1.6.

4.4.3 Biological Goals and Objectives

The Town's biological goal and related conservation objectives for the western yellow-billed cuckoo are focused on maintaining suitable habitat components necessary for this species to carry out its life cycle. The Town's biological goal is to contribute to maintaining local and regional populations of western yellow-billed cuckoo.

The Town's supporting objectives are to:

- Minimize disturbance and fragmentation of existing or restored suitable western yellow-billed cuckoo habitat components
- Avoid lethal take of western yellow-billed cuckoo

4.4.4 Conservation Measures

The Town does not control water flow in the Santa Cruz River and recognizes that it cannot guarantee the long-term availability of western yellow-billed cuckoo habitat that is supported by a dependable water supply. Even so, the Town can minimize impacts to important components of the hydro-riparian habitat along the Santa Cruz River, and reduce lethal take of individuals through the following conservation measures:

Western Yellow-Billed Cuckoo Measure 1. The Town will identify and delineate ESL within its General Plan (see Figure 4.2), including areas of yellow-billed cuckoo habitat. Within the ESL, the Town will develop and implement ESRDG requiring a detailed evaluation and consideration of biological, cultural, and visual resources in the design, construction, and mitigation of road and utility projects in designated areas. Using the ESRDG, appropriate site-specific design criteria will also be developed for each project to promote and maintain yellow-billed cuckoo habitat and habitat connectivity in the Permit Area.

Western Yellow-Billed Cuckoo Measure 2. The Town will establish four habitat Conservation Zones (see Figure 4.1) to protect suitable habitat for wildlife, including yellow-billed cuckoos. Zone 1 generally consists of all ESL along the Santa Cruz River floodway. The Town will provide protections for cuckoo habitat in this zone by limiting the types of development to those uses permissible under Title 21 of the Land Development Code, which prohibits permanent structures and generally maintains yellow-billed cuckoo habitat features.

Western Yellow-Billed Cuckoo Measure 3. The Town will further protect riparian habitat components through the following actions:

- Identify in the Environmental Element of its General Plan the importance of riparian areas as wildlife habitat and movement corridors.
- Incorporate specific requirements into Title 17 for riparian habitat protection and mitigation, including mitigation for each acre of impact at a ratio ranging from 1.5:1 up to 4:1, depending on the type of mitigation and distance from the impact location (see Section 4.0, Table 4.5 for details). The Town would also adopt a Riparian Habitat Map (see Figure 3.3) linked to the revised Title 17.
- Enforce restrictions in the Town Code (Title 12-4-2 Traffic) against OHV travel in publicly owned washes or other public lands when activities damage native vegetation or create significant erosion
- Update Title 17 of the Land Development Code to include invasive species management guidelines and an official list of plants prohibited for use in landscaping. An inventory of all state- and Federally protected plant species, cottonwood, and

willow trees shall also be conducted within the area not included in any area designated as a NUOS. Plants removed from the site, damaged, or destroyed during development shall be mitigated in accordance with the revised Title 17.

Western Yellow-Billed Cuckoo Measure 4. The Town will avoid lethal take of western yellow-billed cuckoos through the following actions:

- Incorporate development standards into Title 17 of the Land Development Code requiring species-specific habitat evaluations. These standards will require project proponents to evaluate project areas for suitable western yellow-billed cuckoo habitat and to conduct pre-construction surveys where such habitat exists. These surveys will utilize a USFWS-approved protocol or a modified survey methodology as approved by USFWS.

- Notify AZGFD and USFWS to determine the appropriate course of action if western yellow-billed cuckoo are detected during pre-construction surveys.

- Allow project proponents to schedule their surface disturbance activities to be initiated and completed between September 1 and June 14, while the western yellow-billed cuckoo is not present in southern Arizona, as an option to pre-construction surveys.

Western Yellow-Billed Cuckoo Measure 5. The Town will develop and implement an educational program designed to inform the general public, specific neighborhoods, permit applicants, and contractors of the various requirements of the HCP and their associated benefits to species and habitats. The educational program will also provide resources and instruction for Town personnel involved in operations and maintenance activities.

4.4.5 Effects of Implementing the HCP on Western Yellow-billed Cuckoos

Proposed future CIP and development activities in the Town could directly impact about 107 ha (264 ac) of modeled habitat for western yellow-billed cuckoos in the Town. Under the HCP, approximately 355 ha (877 ac) of modeled cuckoo habitat would remain protected as NUOS.

Although the riparian habitat present in the Town appears suitable to function as migratory habitat and may develop into suitable breeding habitat, no cuckoos are known to currently inhabit the Town. The Town's conservation approach for cuckoos is to maintain a sufficient amount and configuration of hydroriparian and mesquite bosque habitat in an effort to allow migration of cuckoos through the Town and future establishment of breeding territories within the Town.

The Santa Cruz once had 2,833 to 3,238 ha (7,000 to 8,000 ac) of cottonwood-willow habitat. Less than 202 ha (500 ac) remain. Because of habitat losses, the river has suffered major reductions in the diversity and populations of birds, fish and other wildlife, according to the USACE (*Arizona Daily Star* June 10, 2008). The Town is revegetating drainage channels in Continental ranch with native trees, to provide potential wildlife corridors to the river.

The Town will restore a 16 ha (40 ac) wetland on a 32 ha (80 ac) site owned by the Town, which is adjacent to the Santa Cruz River at the site of an old ADOT borrow pit. The restoration will include: contouring to reduce the percent slope on the banks, evaluating the need for adding supplemental wetland soils or nutrients, planting native, hydrophytic vegetation and riparian species identified at “reference wetland sites” in the area, removing non-native or invasive species, potentially providing additional treated effluent water to maintain vegetation during the dry season (as part of a proposed wastewater treatment facility if it is located in the area), and developing a monitoring and adaptive management plan for the site. This project may provide a stop-over site for migrating cuckoos, and potentially could develop into nesting habitat in the future.

Riparian restoration projects being performed by others include Pima County Regional Flood Control District’s Cortaro Mesquite Bosque 32 ha (80 ac) riparian habitat restoration. This project was designed to increase the vegetation structure and biological diversity of the floodplain and to provide wildlife habitat, particularly forage and nesting area for birds. The planting zones consist of native cottonwood-willow trees, riparian mesquite Bosque, riparian grassland-willow, xeroriparian (drier area) mesquite, and upland vegetation-grassland. The Town is revegetating drainage channels in Continental Ranch with native trees, to provide potential wildlife corridors to the river.

A comprehensive river restoration project on the Santa Cruz River is the Tres Rios del Norte Project, which is an environmental restoration project on the Santa Cruz River in Pima County, Arizona. The USACE began conducting a feasibility study in 2001, with the three local sponsors (Pima County, the Town, and the City of Tucson). It is intended that the project will ultimately provide opportunities for flood control, groundwater recharge, and recreation, addressing common interests and goals of Pima County, the Town, and the City of Tucson. The study area comprises a 29 km (18 mi) stretch of the Santa Cruz River corridor that extends from Prince Road north to Sanders Road. In that reach are the confluences of the Santa Cruz with two of its major tributaries, the Rillito Creek and the Cañada del Oro Wash. Specific planning objectives were developed to guide formulation of a restoration plan. Goals for the plan include: restoring wetland and riparian vegetative communities within the river corridor to a more natural state and increase habitat diversity; minimizing disturbance-type impacts to proposed restoration areas; implementing a low maintenance design; reducing flood damages in specified areas; water resource management opportunities including storm water harvesting, groundwater recharge, more efficient use of effluent; maximizing use of vacant lands for

restoration and utilizing sand and gravel mining areas as they are retired; and providing recreational resources where possible. These restoration projects are not included as part of the HCP, but complement HCP riparian restoration goals and may enhance cuckoo habitat through revegetation.

Under the HCP, the Town would minimize disturbance to suitable habitat within the Town by requiring that development within the Santa Cruz River floodway comply with the restrictions and mitigation requirements within and being developed for the Town's Land Use Code. Likewise, the Town would avoid lethal take of cuckoos through requirements for preconstruction surveys or seasonal restrictions.

4.4.6 Western Yellow-billed Cuckoo Monitoring Program

The Town will require pre-construction surveys (presence/absence) prior to CIP or development activities in suitable habitat. The surveys will follow the most current western yellow-billed cuckoo survey protocol approved by the USFWS.

The Town will also perform general bird richness/diversity surveys bi-monthly during the main breeding season (March–August) using Tucson Audubon Society's Important Bird Survey protocols. The bird surveys will record occupancy and abundance of more common riparian species that are indicators of healthy riparian habitat. Surveys will be conducted on Town-owned lands, public lands, within public rights-of-way, or on private lands where access in granted.

Monitoring will also consist of habitat monitoring using GIS and aerial photography to detect changes in vegetation and in land use to assure that the amount of NUOS set-aside complies with the HCP Conservation Zone and Wildlife Linkages requirements. The Town will also monitor for invasive species and implement an invasive species management plan. A database will be maintained to ensure that areas designated as NUOS are preserved in a natural state, to maintain connectivity and foraging opportunities through the preservation of native species. A base year of vegetation monitoring will be performed once open space is set aside, and then every three years thereafter.

Riparian habitats conserved or restored as a result of the conservation measures above will be regularly monitored to ensure that riparian habitat values are being maintained or enhanced. Monitoring may include photo points, transects, and annual reporting by the responsible parties. Species and habitat monitoring are described in greater detail in Chapter 6 of this document.

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4.5 Lesser Long-nosed Bat (*Leptonycteris curasoae yerbabuenae*)

4.5.1 Existing Conditions

4.5.1.1 Species Ecology, Rangewide Status, Distribution, and Threats

The lesser long-nosed bat is medium-sized, averaging 7 to 9.5 cm (2.7 to 3.7 in) in length. It is yellowish-brown or pale grey above and cinnamon-brown below. It has elongated, slender nose with a small nose-leaf on the tip.

The lesser long-nosed bat is migratory. It is found in Arizona and New Mexico from April to October and then migrates south into Mexico and Central America for the winter. Pregnant females congregate at maternity roosts, give birth to one pup per year, and raise their young throughout the summer months. Males form separate, smaller colonies. This species can be found at elevations ranging from 480 to 3,450 m (1,600 to 11,500 ft) and habitat ranges from low deserts, where it feeds on the nectar and fruit of the saguaro and organ pipe cacti, up to pine-oak woodlands where it feeds on agave (*Agave* spp.) nectar. Their spring migration from central Mexico northward is thought to follow the sequential blooming of certain flowers from south to north. The lesser long-nosed bat roosts in caves, abandoned mines, and occasionally in unoccupied buildings.

This species was listed as endangered in 1988. Population declines can be tied to the loss of forage due to agave harvesting, over-grazing, drought, non-native and invasive species, and habitat conversions due to urbanization and agriculture. Large numbers of lesser long-nosed bats congregate at relatively few roosts, increasing their vulnerability. Additional information on the life history and status of the lesser-long-nosed bat can be found in Appendix 3 of this document.

No roosts for the lesser long-nosed bat are documented within the HCP Permit Area; however, there are several roosts within foraging distance and this species is documented foraging near the Town limits (Abbate pers. comm. October 2007; Grandmaison pers. comm. September 2008). A new roost was located by AZGFD in 2008 based on radio-tracking a lesser long-nosed bat that was captured as a result of the hummingbird monitoring project. This roost is within approximately 16 km (10 mi) of the Town limits. Suitable foraging habitat is found within a significant portion of the Town and ongoing impacts to saguaros, an important forage plant, are anticipated. Impacts are also anticipated to habitat connectors among foraging areas and between roost sites and foraging areas. For these reasons, the lesser long-nosed bat was included as a covered species.

4.5.1.2 Population in and Near the Town

According to Heritage Data Management System (HDMS) (AZGFD 2007), there are no known roost sites within the HCP planning area. Roosts are known in the Rincon Mountains (35 km [22 mi] and 71 km [44 mi] southeast of Marana), Santa Rita Mountains (58 and 64 km [36 and 40 mi] south of Marana), and the Santa Catalina Mountains (approximately 16 and 32 km+ [10 and 20+ mi] east of Marana). Within Pima County, the largest known maternity roost in North America is found in Organ Pipe Cactus National Monument (Pima County 2000a).

The degree of urbanization that a lesser long-nosed bat will tolerate to forage and move through is not well understood. The lesser long-nosed bat/hummingbird feeder study project was designed to determine the movement patterns (e.g., flight corridors, location of foraging patches and night roosts) in and around the Town and the City of Tucson. Citizens volunteered to watch their hummingbird feeders for evidence of bat use; AZGFD then netted the bats and attached a radio telemetry devise to track their movements. From this lesser long-nosed bat/hummingbird feeder study data, there were documented lesser long-nosed bats in proximity to the Town boundaries at the following sites: (1) Cortaro and Thornydale roads, (2) La Cañada Road at the Cañada del Oro Wash, (3) Ina Road and Paseo del Norte near Tohono Chul Park, (4) First Avenue and River Road, (5) Hardy and Oracle roads, and (6) Prince and Country Club roads. Two lesser long-nosed bats were captured between September 8-9, 2006, and 20 were captured August 21-October 31, 2007. Of the bats captured, two were fitted with radio transmitters in 2006, nine were fitted with radio transmitters in 2007, and six were fitted in 2008. Based on the close proximity of known lesser long-nosed bat activity to the Town, these bats probably use foraging resources within the HCP planning boundary (Abbate pers. comm. June 2008).

4.5.1.3 Habitat in and Near the Town

Suitable roost sites are not believed to occur in the Town, but Sonoran desertscrub habitat within the Town limits provides potential foraging habitat for lesser long-nosed bats (Pima County 2000b), and as stated above, lesser long-nosed bats have been documented foraging in, and in close proximity to, the Town limits during the bat/hummingbird feeder study (Abbate pers. comm. October 2007). Habitat linkages between roosts and foraging areas and among foraging areas are also likely found within the Permit Area. A habitat model for the lesser long-nosed bat was developed by Pima County as part of the SDCP consisting of the following four primary variables: elevation, slope, carbonates, and vegetation (RECON 2002).

TABLE 4.17
HABITAT POTENTIAL RATINGS FOR CHARACTERISTICS OF THE VARIABLES USED IN THE LESSER LONG-NOSED BAT HABITAT MODEL IN THE SDCP

Variable/Category	Habitat Potential Rating
Elevation	
194 to 400 meters	2
401 to 600 meters	2
601 to 800 meters	2
801 to 1000 meters	2
1001 to 1200 meters	2
1201 to 1400 meters	2
1401 to 1600 meters	2
1601 to 1800 meters	2
1807 to 2000 meters	2
Slope	
Moderate	3
Steep	3
Flat within 0.8 km (0.5 mi) of Moderate to Steep Slopes	2
Flat within 3.2 km (2 mi) of Moderate to Steep Slopes	1
Carbonates	
Carbonates	2
Area within 1.6 km (1 mi) of carbonates	1
Vegetation	
Pinyon-Juniper (122.41)	1
Pine (122.82)	1
Encinal (Oak) (123.31)	1
Oak-Pine (123.32)	1
Manzanita (133.32)	1
Mixed Evergreen Sclerophyll (133.36)	1
Mixed Grass-Scrub (143.15)	1
Shrub-Scrub Disclimax (143.16)	1
Paloverde-Mixed Cacti (154.12)	2
Urban (999.2)	2

Source: RECON 2002

The Santa Cruz River is likely to run dry at some point in the future due to reuse of effluent. How soon or if this will happen is dependent on the rate of population growth and the development of effluent reuse projects. The Town currently has no authority to influence the amount of water flow in the Lower Santa Cruz River, unless the Tres Rios del Norte Restoration Project or other projects are implemented to protect conservation flows in the river.

The TBT revised the SDCP habitat model based on more refined knowledge of lesser long-nosed bat habitat parameters within the Town. Using the Town's habitat model, 12,988 ha (32,094 ac) of potential habitat is predicted to occur in the Town. The habitat model does not include entitled lands which have already been zoned for development.

4.5.1.4 Relation to Species' Range and Ecology

The nearest known maternity colony is approximately 640k (40 mi) northwest of the Town (Old Mammon Mine); although historic records indicate that there was a maternity roost within 56 km (35 mi) (Colossal Cave). Known non-maternity roost sites include the Rincon Mountains (35 and 71 km [22 mi and 44 mi] southeast of the Town), Santa Rita Mountains 58 and 64 km [36 and 40 mi] south of the Town), and the Santa Catalina Mountains (16 and 32 km+ [10 and 20+ mi] east of the Town). From the hummingbird feeder project data, there are documented lesser long-nosed bats within the Town (Continental Ranch) and in proximity to the Town boundaries (Cortaro and Old Father roads, Shannon and Magee roads, and La Cholla and Overton roads). All known roost sites in Pima County are protected by land management agencies and large areas of potential forage habitat can be found with the various National Parks, Monuments, and Wildlife Refuges (Pima County 2000a).

There is little potential for colonies to occur in the Town. The Tortolita Mountains, which extend into the northeastern portion of the Town, have no history of significant mining activity and there are no known mine tunnels which could be used as maternity roosts by the bats. The Yuma Mine, which is located at the northern end of Tucson Mountains approximately 2.4 km (1.5 mi) from the Town's boundaries, has some potential for bat roosting. Bats have been recorded flying as far as 40 mi (one way) from roosting sites to foraging sites. Lesser long-nosed bats have been recorded feeding from hummingbird feeders in and near the Town boundaries (Abbate pers. comm. October 2007).

Nectar and pollen from the flowers of saguaro and organ pipe cactus are the core of the bat's diet in early summer. Later in the summer, as they move up in elevation, they feed on agave. Their spring migration from central Mexico northward is thought to follow the sequential blooming of certain flowers from south to north. Recently bats have also been observed using hummingbird feeders near residential homes, possibly due to the ongoing drought (which may have led to less available food sources in their natural environment). In the summer of 2007, volunteer citizen-scientists in the eastern Tucson

Basin began monitoring their hummingbird feeders for use by bats. As a result of volunteers reporting bat activity at their hummingbird feeders, AZGFD was able to attach radio telemetry equipment to the bats to track when the bats showed up, where they foraged in town, and when they migrated to Mexico. All of the bats captured were males. Nine bats were tracked through the use of radio telemetry, and 35 km (21.75 mi) was the longest distance recorded for a bat's travel in one night (Abbate, AZGFD pers. comm. March 2007).

The bat/hummingbird feeder telemetry study recorded lesser long-nosed bats commuting long distances from foraging to roosting sites (Abbate pers. com. October 2007). In addition to foraging habitat, the Town could serve as a corridor for movement between roosts in the Slate Mountains and roosts in the Santa Rita, Catalina, and Rincon mountains, as well as for seasonal migrations.

4.5.2 Potential Impacts of Town's Proposed Activities

4.5.2.1 Direct Effects

Lesser long-nosed bats are not known to roost in the Town; however, they have been documented foraging within the Town limits. Predation by domestic cats, the loss of foraging plants such as saguaros and agaves, and the loss of habitat connectivity may adversely affect lesser long-nosed bats within the Town limits.

4.5.2.2 Indirect Effects

Lesser long-nosed bats can be adversely affected through indirect mechanisms facilitated or caused by urban development, such as the effects of increased lighting which bats appear to avoid when foraging (Abbate pers. comm. October 2007).

4.5.2.3 Changes in Habitat

Based on the habitat model, there are 12,988 ha (32,094 ac) of modeled lesser long-nosed bat habitat in the Town boundary (excluding areas entitled for development as of July 2007). Under the HCP, a total of 4,836 ha (11,951 ac) of modeled habitat for lesser long-nosed bats would be impacted by CIP and development activities (Table 4.18). The remaining 8,152 ha (20,143 ac) of habitat would be protected as NUOS.

A summary of impacts from development, both within and outside the Conservation Zones, is provided in Table 4.19. Figures 4.15 and 4.16 show the distribution of modeled lesser long-nosed bat habitat in the Town in relation to CIP activities and existing development and entitled lands, respectively.

TABLE 4.18
LESSER LONG-NOSED BAT MODELED HABITAT AND PROJECTED FUTURE IMPACTS IN THE TOWN

Type of Habitat or Impact	Area
Modeled habitat	12,988 ha (32,094 ac)
Total habitat impacted by Town's CIPs	460 ha (1,138 ac)
Total habitat impacted by development within HCP Conservation Zones	3,297 ha* (8,148 ac)
Total habitat impacted by development outside of HCP Conservation Zones	1,079 ha* (2,665 ac)
Total Impacts	4,836 ha (11,951 ac)
Total NUOS	8,152 ha (20,143 ac)

* These figures are derived from Table 4.19.

TABLE 4.19
SUMMARY OF DEVELOPMENT IMPACTS TO LESSER LONG-NOSED BAT HABITAT

	Lesser long-nosed bat Modeled Habitat	Percent allowable impact by Zone	Area impacted
Zone 1	917 ha (2,265 ac)	0.05	46 ha (113 ac)
Zone 2	8,024 ha (19,827 ac)	0.20	1,604 ha (3,965 ac)
Zone 3	1,279 ha (3,160 ac)	0.30	384 ha (948 ac)
Zone 4	1,243 ha (3,072 ac)	1.00	1,243 ha (3,072 ac)
Habitat not in Zones	1,079 ha (2,665 ac)	1.00	1,079 ha (2,665 ac)
Proposed Wildlife Linkages	408 ha (1,009 ac)	0.05	20 ha (50 ac)
Existing Wildlife Linkages	39 ha (96 ac)	N/A	0
Total	12,989 ha (32,094 ac)	N/A	4,376 ha (10,813 ac)

Figure 4.15

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Figure 4.16

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Habitat fragmentation could occur, which would negatively impact this widely foraging species, especially when food resources are scarce during times of drought or reduced foraging habitat. The habitat model identifies general vegetation and physical conditions that could support suitable conditions for lesser long-nosed bats, but does not distinguish small scale conditions that determine where bats occur (e.g., potential day roost sites, presence of saguaros or other columnar cacti); therefore, lesser long-nosed bats may not use the entire area considered habitat by the model.

The loss of modeled foraging habitat for lesser long-nosed bats in the Town habitat has the potential to result in indirect take. The USFWS previously determined that several development projects in the Town were not likely to adversely affect lesser long-nosed bats (USFWS 2000a, 2000b, 2002a, 2002b); however, the cumulative effect of on-going development in the entire Tucson basin area impacts the extent of foraging opportunities for the lesser long-nosed bat and potentially affects connectivity between foraging areas. The availability of alternative foraging areas is important as a buffer against local forage plant failure events.

4.5.2.4 Population Effects

Urban development in the Town could reduce the potential foraging habitat and fragment habitat associated with present or historical roosting locations in the Rincon Mountains, Santa Rita Mountains, Slate Mountains, and the Santa Catalina Mountains. During the bat and hummingbird feeder study in 2007, AZGFD documented bats in the vicinity of Marana at Hardy and Oracle roads, La Cañada Road and the Cañada del Oro Wash, Ina Road and Paseo del Norte, First Avenue and River Road, Prince and Country Club roads, and Thornydale and Cortaro roads (Abbate pers. comm. June 11, 2008).

The cumulative impacts of development on lesser long-nosed bat foraging areas may have a deleterious effect on the bat. The preservation of foraging plants in and near the Town and areas of habitat connectivity may be especially important during drought or local failures of bat foraging plants in other areas. If foraging habitat outside of the Town is reduced, then foraging habitat within the Town would become more important and reductions in this habitat from urban development could contribute to reductions in bat populations. Use of forage resources within the Permit Area occurs at times when lesser long-nosed bats potentially have increased energy demands, maternity season and migration, making the availability of adequate forage resources a key habitat component.

4.5.2.5 Anticipated Take

No lethal take is anticipated for the lesser long-nosed bat. Take may occur in the form of harm due to habitat loss, fragmentation, and reduced connectivity between foraging areas. Potential take in the form of habitat loss is projected to be 4,836 ha (11,951 ac). There are approximately 2 ha (4 ac) of modeled habitat for this species in entitled private

land that could potentially be included under the HCP if the landowners voluntarily choose to be covered under the HCP. Voluntary inclusion would provide certainty of conservation requirements and eliminate the necessity of individual landowners and the Town conducting Section 7 consultation with the USFWS for activities that potentially affect this species or its habitat and have a Federal nexus because of the consultations outlined in Section 1.6.

4.5.3 Biological Goals and Objectives

As described above, lesser long-nosed bats are not expected to roost in the Town but do forage in the Town while roosting outside the Town or during their seasonal migrations. To the extent that lesser long-nosed bats use habitats in the Town, the Town's biological goal is to contribute to maintaining regional populations of lesser long-nosed bats.

The Town's specific objectives are to:

- Provide foraging opportunities for lesser long-nosed bats during their summer residency period and migration
- Maintain habitat connectivity in critical movement corridors between and among roosts and foraging habitat

4.5.4 Conservation Measures

The conservation objective for the lesser long-nosed bat consists of ensuring that areas used for foraging opportunities and as corridors will remain viable. Lesser long-nosed bats forage on nectar from saguaro and columnar cacti, which occur in the Town principally in the Tortolita Fan in the northwestern portion of the Town.

Lesser Long-nosed Bat Measure 1. The Town will continue to manage the existing 2,400 ac Tortolita Preserve and other Section 7 consultation lands under Town management, in a manner consistent with lesser long-nosed bat survival and recovery.

Lesser Long-nosed Bat Measure 2. The Town will identify and delineate ESL within its General Plan (see Figure 4.2), including areas of lesser long-nosed bat habitat. Within the ESL, the Town will develop and implement ESRDG requiring a detailed evaluation and consideration of biological, cultural, and visual resources in the design, construction, and mitigation of road and utility projects in designated areas. Using the ESRDG, appropriate site-specific design criteria will also be developed for each project to promote lesser long-nosed bat habitat protection and promote habitat connectivity.

Lesser Long-nosed Bat Measure 3. The Town will establish four habitat Conservation Zones (see Figure 4.1) to protect foraging and movement corridors for wildlife, including the lesser long-nosed bat. The zones will have the following boundaries and restrictions:

Zone 1 will generally consist of all ESL along the Santa Cruz River floodway. Within Zone 1, the Town will protect lesser long-nosed bat foraging habitat in this zone by limiting the types of development to those uses permissible under Title 21 of the Land Development Code, which prohibits permanent structures, except bridges and bank protection, and generally maintains lesser long-nosed bat habitat features.

Zone 2 will generally consist of all ESL east of I-10, starting 0.8 km (0.5 mi) south of Moore Road and extending north to the Town Boundary, and including ESL on the northern extension of the Tucson Mountains. Within Zone 2, the Town will:

- Cooperate with and support regional land-use planning efforts to establish a permanent reserve on the Tortolita Fan, providing lesser long-nosed bat foraging habitat. This support may be in the form of coordination with ASLD, dedication of monies, management responsibility or assistance, or other means to be determined in consultation with the USFWS. The establishment of a permanent reserve will be the preferred conservation measure within Zone 2.

- Require ASLD parcels that are sold to private entities requesting an up-zoning—if a permanent reserve can not be developed or until such a reserve is developed—to conserve 80 percent of the parcel in perpetuity as NUOS. These NUOS areas will include those portions of the parcel that support the highest habitat values. Open space must provide wash protection and be configured to complement any adjacent protected open space, including lands identified in the Pima County Conservation Lands System, as well as provide north-south habitat connectivity across the Tortolita Fan.

Zone 3 will generally consist of all ESL in the uplands adjacent to the Santa Cruz River, and east of I-10, starting 1.5 km (1 mi) south of Tangerine Road. There will also be a buffer of Zone 3, 0.5 km (0.3 mi) in width, between Zone 4 and the Tortolita Preserve, from the eastern edge of the preserve west to the CAP canal. Within Zone 3, the Town will:

- Extend wildlife linkages across Tangerine to the I-10/Avra corridor. Target width of the linkage will be 305 m (1,000 ft), as allowed by existing constraints, with goal of 95 percent protection (the 5 percent disturbance would account for driveway crossings and other minimal disturbances). Existing wildlife linkages across Tangerine Road will be preserved and widened when the road is widened.

- Target NUOS in all other areas of the Zone to achieve a goal of 70 percent, with a minimum of 40 percent on-site. Open space must provide wash protection and be configured to compliment any adjacent protected open space, as well as provide north-south habitat connectivity across the Tortolita Fan. If less than 70 percent on-site NUOS is proposed, alternative mitigation would be required to

make up any difference. This alternative mitigation could be in a number of forms. Suitable off-site lands may be acquired at an appropriate ratio and conserved for the benefit of the lesser long-nosed bat. Mitigation funds may be contributed to the Town to support lesser long-nosed bat conservation efforts including, but not limited to research, surveys, and habitat acquisition. Development alternatives will be allowed if the parcel developer can demonstrate their project meets intent and NUOS goals listed above; any such alternative development must have USFWS and Town approval.

Zone 4 will generally consist of all ESL east of I-10, 1.6 km (1 mi) north and south of Tangerine Road, except at the section of Zone 3 that will serve as a buffer between high-intensity development and the Tortolita Preserve. Within Zone 4, the Town will:

- Allow 100-percent development outside the wildlife linkages. There are no NUOS goals established for Zone 4, outside of the designated linkages, because the proposed development limits and NUOS objectives within all of the other zones, as well as the three wildlife linkages extending across Tangerine Road (see Figure 4.1) will mitigate the proposed impacts within the entire permit area as a whole.

- Extend three linkages across Tangerine Road (see Figure 4.1). The target width of each linkage will be 305 m (1,000 ft), as allowed by existing constraints, with a goal of 95-percent protection, except for future Tangerine Road improvements. The boundaries of the wildlife linkages will be established such that all parcels will retain opportunities for allowed land use. Additional benefits to covered species may also be achieved through on-site development configurations of the covered activities.

- Implement the Town's ESRDG for Tangerine Road improvements and include wildlife crossings aligned with the wildlife linkages above, and/or any new linkages identified through future research and monitoring.

Lesser Long-nosed Bat Measure 4. The Town will minimize impacts to lesser long-nosed bat dispersal and movement corridors through the following measures:

Support efforts to purchase, preserve, and enhance parcels needed for a regional movement corridor across I-10 encompassing the former railroad underpass south of Avra Valley Road and any adjacent lands that are appropriate (see Figure 4.1).

Limit development within the floodway of the Santa Cruz River to those uses permissible under Title 21 of the Land Development Code.

Require that continuity of NUOS be maintained within and among developments subject to discretionary action, and that open space be located in a manner that preserves

wildlife access and movement within and through the site, consistent with adjacent efforts to do the same.

Enforce restrictions in the Town Code (Title 12-4-2 Traffic) against OHV travel in publicly owned washes or other public lands when activities damage native vegetation or create significant erosion

Identify in the Environmental Element of its General Plan the importance of riparian areas as wildlife habitat and movement linkages.

Incorporate specific requirements into Title 17 for riparian habitat protection and mitigation, including mitigation for each acre of impact at a ratio ranging from 1.5:1 up to 4:1, depending on the type of mitigation and distance from the impact location (see Section 4.0, Table 4.5 for details).

Lesser Long-nosed Bat Measure 5. The Town will update Title 17 of the Land Development Code to include invasive species management guidelines. An inventory of all state- and Federally protected plant species, saguaro cacti, and ironwood trees shall also be conducted within the area not included in the NUOS. Native plants removed from the site, damaged, or destroyed during development shall be replaced by plants of the same genus and species at a 1:1 ratio. The updated Title 17 will include an official list of plants prohibited for use in landscaping.

Lesser Long-nosed Bat Measure 6. The Town will develop and implement an educational program designed to inform the general public, specific neighborhoods, permit applicants, and contractors of the various requirements of the HCP and their associated benefits to species and habitats. The educational program will also provide resources and instruction for Town personnel involved in operations and maintenance activities.

Lesser Long-nosed Bat Measure 7. The Town will require that all development plans submitted to the Town for review and approval contain a narrative discussion documenting compliance with the conservation measures outlined and approved in the final HCP. This statement shall include maps and other graphics and analyses necessary to document this compliance. The submittal shall outline monitoring programs to document compliance with applicable grading limitations and the conservation measures approved in the HCP. This documentation also will include a drainage report that demonstrates that the proposed development will not significantly degrade the hydrologic regime of the property and includes an evaluation of the habitat impacts associated with the proposed drainage modifications.

Lesser Long-nosed Bat Measure 8. The Town will require project proponents to establish and maintain a conservation easement (preferred) or restrictive covenant on all NUOS, in Conservation Zones 1, 2, or 3 and wildlife linkages mapped in Figure 4.1, to

be held by an approved third party or the Town, or with third party rights of enforcement. This easement or deed restriction will be recorded prior to initiation of construction.

The Town will require that the terms of the conservation easement or restrictive covenant include, but are not limited to the following requirements. To provide a consistent conservation effort, home owners associations shall also adapt the following as CC&Rs:

- Natural undisturbed open space will be maintained in a natural condition, except as approved by USFWS. A management plan must be submitted to the Town and approved by the USFWS within 6 months of the initiation of construction activities.

- Prior to occupancy of a residential lot, the disturbance limits of the lot shall be enclosed by temporary or permanent fencing unless prohibited by rocky ledges or other cost-prohibitive conditions. In that case, flagging or some other method of delineation may be used if the Town concurs. If the disturbance limits represent only a portion of a larger lot, the property line of that lot may not be permanently fenced. Permanent fencing can only occur around the disturbance limits of each lot.

- Lot owners will be required to contain all domestic animals within the enclosed lot or keep them under strict control at all times. Pets that are outside of enclosed areas shall be leashed in conformance with Pima County Code 6.04.030.

- Native plants will be salvaged, particularly saguaros, and replanted from any authorized disturbances, as approved by USFWS, which occur within the NUOS. Replanting will include requirement to replace agaves as well.

- No development or other activities are permitted in the NUOS except for approved pedestrian trails, developed in a manner that will avoid and minimize disturbance and removal of vegetation, and minor utility crossings (these will be revegetated).

- The invasive species management guidelines will be implemented in accordance with the revised Title 17 to control invasive species.

- Landscape and plantings outside of developed common areas and the enclosed area of individual lots will be restricted to native, drought-tolerant plants. Planting of non-native, invasive species is prohibited. A proposed list of prohibited plants can be found in Appendix 4. Landscaping will not be allowed in NUOS.

- The following activities are prohibited within the NUOS: (a) use of firearms, (b) any OHV use, (c) use of pesticides or herbicides for purposes other than controlling invasion of exotic species, and (d) racing events or other publicized events that attract large crowds, (e) the use of fires or barbeques.

4.5.5 Effects of Implementing the HCP on Lesser Long-nosed Bats

Proposed future CIP and development activities in the Town could directly impact up to 4,826 ha (11,925 ac) of modeled habitat for lesser long-nosed bats in the Town during the term of the Permit. Under the HCP, approximately 8,162 ha (20,169 ac) of modeled lesser long-nosed bat habitat would remain protected as NUOS.

No roost sites for lesser long-nosed bats are known or expected to occur in the Town. Thus, potential effects to lesser long-nosed bats from urban development consist of decreases in the availability of foraging habitat and reduced connectivity between foraging areas. Lesser long-nosed bats have been documented foraging in, and in close proximity to, the Town limits during the bat/hummingbird feeder study (Abbate pers. comm. October 2007). The Town's conservation approach to lesser long-nosed bats is to retain modeled foraging habitat and retain habitat connectivity for the lesser long-nosed bats.

4.5.6 Lesser Long-nosed Bat Monitoring Program

The Town will continue its cooperation with USFWS in a volunteer-based study of lesser long-nosed bats at hummingbird feeders. This program encourages volunteers to document lesser long-nosed bats feeding at hummingbird feeders and record data such as time and date of first arrival in the area, and allows documentation of areas where the bats occur within Marana. The Town will keep records of lesser long-nosed bat sightings to include location, time, and date. The Town will continue to host a website for the collection of data from volunteers as long as USFWS and AZGFD provide language for the website and as long as the results remain useful to the Town, as determined by the TBT.

The Town will continue to work with AZGFD and USFWS to obtain funding to continue the study of lesser long-nosed bats in the Marana area, such as the current study of lesser long-nosed bat movements and habitat use within the Town.

Monitoring will also consist of habitat monitoring using GIS and aerial photography to detect changes in vegetation and in land use to assure that the amount of NUOS set-aside complies with the HCP Conservation Zone and Wildlife Linkages requirements. The Town will also monitor for invasive species and implement an invasive species management plan. A database will be maintained to ensure that areas designated as NUOS are preserved in a natural state, to maintain connectivity and foraging opportunities through the preservation of native species such as saguaros and agaves. A base year of vegetation monitoring will be performed once open space is set aside, and then every three years thereafter. All NUOS protected as part of the above conservation measures will be monitored on a regular basis to ensure that pygmy-owl

habitat components are maintained or enhanced. Monitoring will include the review of annual reports submitted by the parties responsible for the long-term maintenance of these conservation areas, as well as by periodic visual inspection of the conservation areas. Species and habitat monitoring are described in greater detail in Chapter 6 of this document.

4.6 Merriam's Mesquite Mouse (*Peromyscus merriami*)

4.6.1 Existing Conditions

4.6.1.1 Species Rangewide Status, Distribution, and Threats

Merriam's mesquite mouse is a medium-sized mouse, with a body length of 97 to 102 mm (3.8 to 4.0 in) and a tail length of 102 to 122 mm (4.0 to 4.8 in). Merriam's mesquite mouse has a pale grey body with a faint tawny wash. The underbelly is cream-colored, and the tail is long, thinly haired, and bi-colored. Merriam's mesquite mouse is very difficult to distinguish from the more common cactus mouse (*Peromyscus eremicus*). There are some morphological differences, but DNA analysis is often used to distinguish the species (Kingsley 2006).

Merriam's mesquite mouse is found in the large mesquite forests along rivers throughout Pinal, Pima, and Santa Cruz counties in Arizona and into Sonora, Mexico, in semi-desert grassland, Sonoran Desertscrub–Xeroriparian Scrub, and Sonoran Riparian Deciduous Forest and Woodlands-Mesquite Series (Kingsley 2006). This mouse apparently selects areas with thick, forest-like stands of mesquite (bosques), but has also been found in thick stands of cholla, prickly pear, paloverde, and grasses (Richardson pers. comm. January 2008).

The Merriam's mesquite mouse has no Federal status under the ESA but is protected by Arizona State law (ARS Title 17). The greatest threat to Merriam's mesquite mouse is the loss and degradation of mesquite forest and other dense woodland habitats due to de-watering of riparian areas and development. Fragmentation of riparian habitat and predation by domestic cats likely also affect Merriam's mesquite mouse populations. Additional information on the ecology and status of Merriam's mesquite mouse can be found in Appendix 3.

Suitable habitat for the Merriam's mesquite mouse is found within the Town boundaries. This is an uncommon-to-rare species and impacts from covered activities to riparian habitats, including xeroriparian drainages, are likely. For this reason, Merriam's mesquite mouse is included as a covered species in this HCP.

4.6.1.2 Population in and Near the Town

Limited information exists as to the current existence of Merriam's mesquite mouse within the Town. Historically, this species occurred along the Santa Cruz River and was collected from near Avra Valley Road in 1969 (Kingsley 2006). The most recent trapping

effort within Pima County (Kingsley 2006) did not conduct trapping sites within the Town limits, but did document a Merriam's mesquite mouse along the Santa Cruz River approximately 1 mi west of the Town. The observed decrease in collection of specimens of *P. merriami* probably reflects a decreased effort of trapping in the appropriate vegetation types by knowledgeable collectors, combined with the extreme difficulty in recognizing the species on the basis of morphology.

4.6.1.3 Habitat in and Near the Town

Most of the known specimens of Merriam's mesquite mouse were collected from mesquite bosque (woodland) areas in Pima County. Potential mesquite bosques and contiguous xeroriparian areas along the Santa Cruz River and in the uplands were mapped as potential Merriam's mesquite mouse habitat in the Town. Approximately 11,392 ac of modeled habitat occur in the HCP boundary. It is apparent from Kingsley's (2006) work that Merriam's mesquite mice are not only found in large mesquite bosques, but also in a wider variety of mesquite-dominated communities on floodplain soils, including xeroriparian areas of semi-desert grasslands and Sonoran desertscrub. Based on this analysis, suitable habitat for this species remains within the Town along the Santa Cruz River floodway and may extend up into mesquite-dominated tributaries.

Modeled habitat for the Merriam's mesquite mouse was developed by considering locations of known occurrences as well as vegetation, specifically Sonoran deciduous swamp, mesquite woodlands, and riparian scrub series. The habitat model does not include entitled lands which have already been zoned for development.

4.6.1.4 Relation to Species' Range and Ecology

Given the difficulty with correct identification of this species and the limited amount of occurrence data available, it is difficult to evaluate the importance of the habitat within the Town. Of the 295 Merriam's mesquite mice known from Pima County, 114 specimens are from one general location—the historic mesquite bosque south of Tucson on the San Xavier District of the Tohono O'odham Nation (Kingsley 2006). While this bosque was unique in its scale and quality, the number of collections from this site was probably also a product of the focus of numerous researchers on the area. Given the loss of this bosque, the remaining habitat patches have become increasingly important.

4.6.2 Potential Impacts of Town's Proposed Activities

4.6.2.1 Direct Effects

Development and CIP activities have the potential to directly harm Merriam's mesquite mice through mortality from construction equipment and vehicle strikes. Merriam's

mesquite mice that are displaced by the covered activities could also experience higher mortality while searching for suitable, unoccupied habitat. In Kingsley's study (2006) Merriam's mesquite mice were absent from mesquite bosques or mesquite-lined washes adjacent to residential development or urban infrastructure. Feral and roaming cats were observed at nearly every one of these sites. Therefore, fragmentation of mesquite bosques into small patches adjacent to urban or residential development may not be suitable for mesquite mouse survival.

4.6.2.2 Indirect Effects

Merriam's mesquite mice can be adversely affected through indirect mechanisms facilitated or caused by urban development. New roads and increased traffic can increase mortality from vehicle strikes. Roadways also often act as the first point of entry for invasive species into a new landscape, and can serve as a corridor along which plants move farther into the landscape (Lonsdale and Lane 1994; Greenberg et al. 1997). Over the longer term, conversion of suitable habitat to urban uses could result in take of Merriam's mesquite mice through a variety of mechanisms, including reduced foraging opportunities and increased predation associated with urban development.

4.6.2.3 Changes in Habitat

Based on the habitat model, there are 4,610 ha (11,392 ac) of modeled mesquite mouse habitat in the Permit Area. Under the HCP, a total of 1,514 ha (3,742 ac) of modeled habitat for this species would be impacted by CIP and development activities (Table 4.20). The remaining 3,096 ha (7,650 ac) of habitat would be protected as NUOS. A summary of impacts from development, both within and outside the Conservation Zones, is provided in Table 4.21. Figures 4.17 and 4.18 show the distribution of modeled mesquite mouse habitat in the Town in relation to CIP activities and existing development and entitled lands, respectively.

4.6.2.4 Population Effects

Potential habitat for Merriam's mesquite mouse exists within the Town limits and this species has been documented in proximity to the Town. Activities by the Town covered under the HCP will occur in modeled habitat. The potential fragmentation of mesquite woodlands along drainages could affect the Merriam's mesquite mouse population dynamics by reducing movements of individuals and by increasing the potential for predation by domestic cats in smaller mesquite patches with a greater amount of edge effect.

TABLE 4.20
MERRIAM'S MESQUITE MOUSE MODELED HABITAT AND PROJECTED FUTURE IMPACTS IN THE TOWN

Type of Habitat or Impact	Area
Modeled habitat	4,610 ha (11,392 ac)
Total habitat impacted by Town's CIPs	182 ha (450 ac)
Total habitat impacted by development within HCP Conservation Zones	1,083 ha* (2,676 ac)
Total habitat impacted by development outside of HCP Conservation Zones	249 ha* (616 ac)
Total Impacts	1,514 ha (3,742 ac)
Total NUOS	3,096 ha (7,650 ac)

* These figures are derived from Table 4.21.

TABLE 4.21
SUMMARY OF DEVELOPMENT IMPACTS TO MERRIAM'S MESQUITE MOUSE HABITAT

	Merriam's mesquite mouse Modeled Habitat	Percent allowable impact by Zone	Area impacted
Zone 1	1,007 ha (2,488 ac)	0.05	50 ha (124 ac)
Zone 2	2,142 ha (5,293 ac)	0.20	428 ha (1,059 ac)
Zone 3	554 ha (1,368 ac)	0.30	166 ha (410 ac)
Zone 4	429 ha (1,059 ac)	1.00	429 ha (1,059 ac)
Habitat not in Zones	249 ha (616 ac)	1.00	249 ha (616 ac)
Proposed Wildlife Linkages	196 ha (484 ac)	0.05	10 ha (24 ac)
Existing Wildlife Linkages	34 ha (84 ac)	N/A	0
Total	4,610 ha (11,392 ac)	N/A	1,332ha (3,292 ac)

Figure 4.17

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Figure 4.18

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4.6.2.5 Anticipated Take

Lethal take of Merriam's mesquite mouse could occur during site grading and due to vehicle collisions on roadways adjacent to mesquite mouse habitat. Take of the Merriam's mesquite mouse could also occur in the form of harm due to forage loss, habitat loss, habitat fragmentation, and other activities described in Section 4.6.2.1 above. The anticipated mesquite mouse habitat lost is 1,514 ha (3,742 ac). The anticipated take of individual Merriam's mesquite mouse is 10 mice over the 25-year duration of the Permit. There are approximately 909 ha (2,245 ac) of modeled habitat for this species in entitled private land that could potentially be included under the HCP if the landowners voluntarily choose to be covered under the HCP. If the Merriam's mesquite mouse becomes listed under the ESA, voluntary inclusion would provide certainty of conservation requirements and eliminate the necessity of individual landowners and the Town conducting Section 7 consultation with the USFWS for activities that potentially affect this species or its habitat and have a Federal nexus because of the consultations outlined in Section 1.6.

4.6.3 Biological Goals and Objectives

The Town's biological goals and objectives for the Merriam's mesquite mouse relate to maintaining suitable habitat necessary for this species to carry out its entire life cycle. Specifically, the Town's biological goal for the Merriam's mesquite mouse is to contribute to maintaining local and regional populations of Merriam's mesquite mouse.

The Town's specific objectives are to:

- Minimize disturbance and fragmentation of existing suitable Merriam's mesquite mouse habitat
- Provide for the restoration of degraded Merriam's mesquite mouse habitat
- Maintain habitat connectivity in critical movement corridors for the Merriam's mesquite mouse

4.6.4 Conservation Measures

A comprehensive conservation strategy for this species has been identified to achieve the goal and objectives outlined above. The strategy includes both the protection of existing and restoration of degraded mesquite-dominated riparian systems, as well as protection of corridors between and among habitat patches and larger regional movement corridors. The specific conservation measures that the Town will implement are detailed below.

Merriam's mesquite mouse Measure 1. The Town will conduct habitat restoration efforts in selected degraded watercourses identified in consultation with the USFWS. Habitat will be restored or enhanced with mesquite-dominated riparian vegetation where conditions are capable of supporting such habitat.

Merriam's mesquite mouse Measure 2. The Town will minimize impacts to Merriam's mesquite mouse habitat and movement corridors through the following measures:

- Support efforts to purchase, preserve, and enhance parcels needed for a regional movement corridor across I-10 encompassing the former railroad underpass south of Avra Valley Road and any adjacent lands that are appropriate (see Figure 4.1).
- Plant mesquite around a portion of the water reservoir portion of the former ADOT borrow pit north of Coachline Road to increase Merriam's mesquite mouse habitat (another portion will be left treeless as burrowing owl habitat).
- Require that continuity of NUOS is maintained within and among developments subject to discretionary action and that open space is located in a manner that preserves wildlife access and movement within and through the site, consistent with adjacent efforts to do the same.
- Enforce restrictions in the Town Code (Title 12-4-2 Traffic) against OHV travel in publicly owned washes or other public lands when activities damage native vegetation or create significant erosion.
- Identify in the Environmental Element of its General Plan the importance of riparian areas as wildlife habitat and movement corridors.
- Incorporate specific requirements into Title 17 for riparian habitat protection and mitigation, including mitigation for each acre of impact at a ratio ranging from 1.5:1 up to 4:1, depending on the type of mitigation and distance from the impact location (see Section 4.0, Table 4.5 for details). The Town would also adopt a Riparian Habitat Map (see Figure 3.3) linked to the revised Title 17.

Merriam's mesquite mouse Measure 3. The Town will identify and delineate ESL within its General Plan (see Figure 4.2), including areas of Merriam's mesquite mouse habitat. Within the ESL, the Town will develop and implement ESRDG requiring a detailed evaluation and consideration of biological, cultural, and visual resources in the design, construction, and mitigation of road and utility projects in designated areas. Using the ESRDG, appropriate site-specific design criteria will also be developed for each project to promote Merriam's mesquite mouse habitat protection and habitat connectivity.

Merriam's mesquite mouse Measure 4. The Town will establish four habitat Conservation Zones (see Figure 4.1) to protect suitable habitat for various species covered under this HCP. Zone 1 will provide the greatest conservation value for the Merriam's mesquite mouse. Zone 1 will generally consist of all ESL along the Santa Cruz River floodway. Within Zone 1, the Town will limit development to those uses permissible under Title 21 of the Land Development Code, which prohibits permanent structures and generally maintains mesquite mouse habitat features.

Merriam's mesquite mouse Measure 5. The Town will update Title 17 of the Land Development Code to include invasive species management guidelines and an official list of plants prohibited for use in landscaping. An inventory of all state and Federally protected plant species, saguaro cacti, and ironwood trees shall also be conducted within the area not included in any area designated as a NUOS. Native plants removed from the site, damaged, or destroyed during development shall be mitigated in accordance with the revised Title 17.

Merriam's mesquite mouse Measure 6. The Town will develop and implement an educational program designed to inform the general public, specific neighborhoods, permit applicants, and contractors of the various requirements of the HCP and their associated benefits to species and habitats. The educational program will also provide resources and instruction for Town personnel involved in operations and maintenance activities.

4.6.5 Effects of Implementing the HCP on Merriam's Mesquite Mouse

Proposed future CIP and development activities in the Town could directly impact about 1,502 ha (3,712 ac) of modeled habitat for the mesquite mouse in the Town. Under the HCP, approximately 3,108 ha (7,679 ac) of modeled mesquite mouse habitat would remain protected as NUOS.

Although the mesquite-dominated riparian habitat currently present in the Town appears suitable to function as habitat for this species, no Merriam's mesquite mice are known to currently inhabit the Town; however, no specific efforts have been made to survey for this species within the Town. The Town's conservation approach for this species is to maintain or restore a sufficient amount and configuration of mesquite-dominated riparian habitat in an effort to allow occupancy within the Town.

The Town will restore a 16 ha (40 ac) wetland on a 32 ha (80 ac) site owned by the Town, which is adjacent to the Santa Cruz River at the site of the former ADOT borrow pit. The restoration will include: contouring to reduce the percent slope on the banks, evaluating the need for adding supplemental wetland soils or nutrients, planting native hydrophytic vegetation and riparian species identified at "reference wetland sites" in the

area, removing non-native or invasive species, providing additional treated effluent water to maintain vegetation during the dry season (as part of a proposed wastewater treatment facility in the area), and developing a monitoring and adaptive management plan for the site. Site restoration may provide foraging habitat for the Merriam's mesquite mouse.

Riparian restoration projects being performed by others include Pima County Regional Flood Control District's Cortaro Mesquite Bosque 32 ha (80 ac) riparian habitat restoration. This project was designed to increase the vegetation structure and biological diversity of the floodplain and to provide wildlife habitat, particularly forage and nesting area for birds, but this project will also increase Merriam's mesquite mouse habitat along the Santa Cruz River.

Another project that may benefit Merriam's mesquite mouse habitat, when it is implemented, is the Tres Rios del Norte Project which is a comprehensive restoration project on the Santa Cruz River. The USACE began conducting a feasibility study in 2001, with the three local sponsors (Pima County, the Town, and the City of Tucson). It is intended that the project will ultimately provide opportunities for flood control, groundwater recharge, and recreation, addressing common interests and goals of Pima County, the Town, and the City of Tucson. The study area comprises an 29 km (18 mi) stretch of the Santa Cruz River corridor that extends from Prince Road north to Sanders Road. The Cortaro Bosque and Tres Rios restoration projects are not included as part of the HCP, but complement HCP riparian restoration goals and may increase and improve Merriam's mesquite mouse habitat through revegetation.

The Santa Cruz River is the primary area where Merriam's mesquite mouse is expected to occur, but drainages of xeroriparian habitat are also important if they contain dense mesquite. Under the HCP, the Town would minimize disturbance to suitable habitat within the Town by requiring that development within the Santa Cruz River floodway comply with the restrictions and mitigation requirements within and being developed for the Town's LDC.

4.6.6 Merriam's Mesquite Mouse Monitoring Program

Monitoring will consist of habitat monitoring using GIS and aerial photography to detect changes in vegetation and in land use to assure that the amount of NUOS set-aside complies with the HCP Conservation Zone and Wildlife Linkages requirements. The Town will also monitor for invasive species and implement an invasive species management plan. A database will be maintained to ensure that areas designated as NUOS they are preserved in a natural state, to maintain connectivity and habitat through the preservation of native species. A base year of vegetation monitoring will be performed once open space is set aside, and then every three years thereafter. The

Town will cooperate as appropriate with any future research and monitoring efforts related to clarifying the status of the Merriam's mesquite mouse in the planning area. Species and habitat monitoring are described in greater detail in Chapter 6 of this document.

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4.7 Pale Townsend's Big-eared Bat (*Corynorhinus townsendii pallescens*)

4.7.1 Existing Conditions

4.7.1.1 Species Ecology, Rangewide Status, Distribution, and Threats

The pale Townsend’s big-eared bat is a medium-sized bat with a wingspan of 29 to 31 cm (11.5 to 12.5 in), and a body length of 5 to 7 cm (2 to 2.5 in). It is a pale yellowish-brown bat with large, hairless ears measuring 30 to 39 cm (1.2 to 1.6 in) in length.

The pale Townsend’s big-eared bat is found primarily in the western United States, as well as western Canada and Mexico. This species generally roosts in mines and caves, and occasionally in buildings. During hibernation, they prefer roosts with temperatures between approximately 0° to 12°C (32° to 54°F). This bat feeds primarily on small moths it catches in flight, but may also glean insects off of vegetation while in flight.

The populations of pale Townsend’s big-eared bats appear to be declining throughout this species’ range. Disturbance of roosts (both summer and hibernation) and loss or fragmentation of foraging habitat are the primary threats to this species. The largest known colony in Arizona (Stanton Cave in the Grand Canyon) disappeared in the 1970s. This species currently has no Federal status under the ESA but is protected by Arizona State law (ARS Title 17). Additional information on the ecology and status of the pale Townsend’s big-eared bat can be found in Appendix 3 of this document.

While there are no known pale Townsend’s big-eared bat roosts in the Town limits, known and potential roosts occur in Colossal Cave Mountain Park, Tucson Mountain Park, and Saguaro National Park. Foraging habitat occurs throughout the Town and covered activities are likely to affect this species’ habitat. Declining population trends and the presence of suitable habitat that is likely to be affected are the reasons this species is included in the HCP.

Primary threats are habitat loss through declines of caves and mines and foraging habitat fragmentation through the conversion of agricultural and open lands to intensive development.

4.7.1.2 Population in and Near the Town

According to HDMS (AZGFD 2007b), there are no known roost sites within the Planning Area. In Pima County, this species is known to use Colossal Cave Mountain.

Park, Tucson Mountain Park, Organ Pipe Cactus National Monument, and Saguaro National Park (Pima County 2000a). There may be roosts that are not currently identified in the Tortolita Mountains, Tucson Mountains, and Silverbell Mountains.

4.7.1.3 Habitat in and Near the Town

A habitat model for the pale Townsend's big-eared bat was developed by Pima County as part of the SDCP (RECON 2002) consisting of the following eight primary variables: (1) elevation; (2) slope; (3) aspect; (4) carbonates; (5) perennial streams; (6) intermittent streams; (7) springs; and (8) vegetation.

The habitat potential of the categories of each variable were ranked as 0, 1, 2, and 3, with 0 indicating that the category provided no habitat and 3 indicating that the category provided high potential habitat. The eight variables were combined to provide an overall habitat potential. Table 4.22 shows the specific categories of the eight variables considered to provide habitat for the pale Townsend's big-eared bat and their habitat potential ratings. This potential habitat predominantly occurs in the northeastern portion of the Town, although a small amount occurs on the south side of the Santa Cruz River.

TABLE 4.22
HABITAT POTENTIAL RATINGS FOR CHARACTERISTICS OF THE VARIABLES USED IN THE PALE TOWNSEND'S BIG-EARED BAT HABITAT MODEL IN THE SDCP

Variable/Category	Habitat Potential Rating
Elevation	
194 to 400 meters	1
401 to 600 meters	1
601 to 800 meters	1
801 to 1000 meters	1
1001 to 1200 meters	2
1201 to 1400 meters	2
1401 to 1600 meters	2
1601 to 1800 meters	2
1807 to 2000 meters	2
2001 to 2200 meters	2
2201 to 2400 meters	2
2401 to 2600 meters	2
2601 to 2800 meters	2

TABLE 4.22
HABITAT POTENTIAL RATINGS FOR CHARACTERISTICS OF THE VARIABLES USED IN THE PALE TOWNSEND'S BIG-EARED BAT HABITAT MODEL IN THE SDCP (CONT.)

Variable/Category	Habitat Potential Rating
Slope	
Moderate	3
Steep	3
Flat within ½ mile of Moderate to Steep Slopes	2
Flat within 2 miles of Moderate to Steep Slopes	1
Aspect	
South (157.5-202.5)	1
Southwest (202.5-247.5)	2
West (247.5-292.5)	2
Northwest (292.5-337.5)	1
Carbonates	
Carbonates	2
Area within 1 mile of carbonates	1
Hydrology	
Intermittent Stream	1
Perennial Stream	1
Spring	1
Vegetation	
Pinyon-Juniper (122.41)	2
Douglas-Fir-Mixed Conifer (122.61)	2
Pine (122.82)	2
Encinal (Oak) (123.31)	2
Oak-Pine (123.32)	2
Mesquite (124.71)	1
Manzanita (133.32)	1
Mixed Evergreen Sclerophyll (133.36)	1
Sacaton-Scrub (143.14)	1
Mixed Grass-Scrub (143.15)	1
Shrub-Scrub Disclimax (143.16)	1
Creosotebush-Tarbush (153.21)	1
Mixed Scrub (153.26)	1
Creosote-Bursage (154.11)	2
Paloverde-Mixed Cacti (154.12)	2
Agriculture (999.1)	1
Urban (999.2)	1

Source: RECON 2002

The TBT revised the SDCP model based on more refined knowledge of pale Townsends' big-eared bat habitat parameters within the Town. The Town's habitat model does not include entitled lands which have already been zoned for development.

4.7.1.4 Relation to Species' Range and Ecology

No roost sites are known to occur in the Town, although several roosts are known outside of the Town, and the Yuma Mine is a potential roost location located within 2.4 km (1.5 mi) of the Town. Bats from these roosts could potentially forage in portions of the Town. The habitat within the Town is primarily foraging habitat. The pale Townsend's big-eared bats have an average foraging radius of 6.4 to 8 km (4 to 5 mi) (AZGFD 2003). Connectivity between foraging patches is important to the survival this wide-ranging species.

4.7.2 Potential Impacts of Town's Proposed Activities

4.7.2.1 Direct Effects

Big-eared bats require caves or mines as hibernacula and maternity roosts. No known roost sites occur in the Town and no suitable roost sites are expected to occur in areas of projected urban development. Therefore, take of bats from disturbance or destruction of roosts during construction activities is not anticipated. Noise and other construction-related disturbance could cause bats to move to other foraging areas, potentially increasing energetic demands and increasing the vulnerability of the bats; however, since these bats forage at night or at dawn when construction activities are not typically being conducted, few direct impacts to foraging bats are anticipated. There is the potential for foraging by Townsend's big-eared bats within all modeled suitable habitat. Habitat fragmentation caused by covered activities can affect the ability of pale Townsend's big-eared bats to move from roosts to foraging areas and among foraging areas. There are no known locations of pale Townsend's big-eared bats in the Town; however, no specific surveys have been conducted for this species. There is potential for foraging within all modeled suitable habitat.

4.7.2.2 Indirect Effects

Increased growth and recreation heightens the potential for roost disturbance even if the roost is not located within the Town limits. Other effects to foraging bats include increased usage of pesticides and increased lighting, which are detrimental to the bats.

4.7.2.3 Changes in Habitat

Based on the habitat model, there are 18,020 ha (44,528 ac) of modeled big-eared bat habitat in the Town boundary (excluding areas entitled for development as of July 2007). Under the HCP, a total of 9,834 ha (24,2303 ac) of modeled habitat for pale Townsend's

big-eared bats would be impacted by CIP and development activities (Table 4.23). The remaining 8,186 ha (20,225 ac) of habitat would be protected as NUOS.

Figures 4.19 and 4.20 show the distribution of modeled pale Townsend's big-eared bat habitat in the Town in relation to CIP activities and existing development and entitled lands, respectively. A summary of impacts from development, both within and outside the Conservation Zones, is provided in Table 4.24.

This habitat loss and fragmentation has the potential to result in take of big-eared bat through reduced foraging opportunities if big-eared bats forage in suitable habitat in the Town. No surveys have been performed for Townsend's big-eared bats in the vicinity of the Town, and there may be roosts that are not currently identified in the Tortolita Mountains, Tucson Mountains, and Silverbell Mountains.

4.7.2.4 Population Effects

Roosting pale Townsend's big-eared bats are not likely to be directly affected by urban development and associated infrastructure projects in the Town. The SDCP habitat model predicts that Pima County supports about 1.3 million ac of high potential habitat. Potential effects to big-eared bats from covered activities primarily relate to changes in foraging opportunities including reduced foraging habitat, connectivity between roosts and foraging areas and between foraging areas.

TABLE 4.23
PALE TOWNSEND'S BIG-EARED BAT MODELED HABITAT AND PROJECTED FUTURE IMPACTS IN THE TOWN

Type of Habitat or Impact	Area
Modeled habitat	18,020 ha (44,528 ac)
Total habitat impacted by Town's CIPs	492 ha (1,216 ac)
Total habitat impacted by development within HCP Conservation Zones	3,292 ha* (8,136 ac)
Total habitat impacted by development outside of HCP Conservation Zones	6,050 ha* (14,951 ac)
Total Impacts	9,834 ha (24,303 ac)
Total NUOS	8,186 ha (20,225 ac)

* These figures are derived from Table 4.24.

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Figure 4.19

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Figure 4.20

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TABLE 4.24
SUMMARY OF DEVELOPMENT IMPACTS TO PALE TOWNSEND'S BIG-EARED BAT HABITAT

	Pale Townsend's Big-eard Bat Modeled Habitat	Percent Allowable Impact by Zone	Area Impacted
Zone 1	904ha (2,233 ac)	0.05	45 ha (112 ac)
Zone 2	7,974 ha (19,703 ac)	0.20	1,595 ha (3,941 ac)
Zone 3	1,277 ha (3,155 ac)	0.30	383 ha (947 ac)
Zone 4	1,243 ha (3,071 ac)	1.00	1,243 ha (3,071 ac)
Habitat not in Zones	6,051 ha (14,951 ac)	1.00	6,050 ha (14,951ac)
Proposed Wildlife Linkages	524 ha (1,295 ac)	0.05	26 ha (65 ac)
Existing Wildlife Linkages	49 ha (120 ac)	N/A	0
Total	18,020 ha (44,528 ac)	N/A	9,342 ha (23,087 ac)

4.7.2.5 Anticipated Take

No lethal take is anticipated for the pale Townsend's big-eared bat. Take may occur as harm due to habitat loss, forage loss, fragmentation, and reduced connectivity between foraging areas or between roosts and foraging areas. Potential take in the form of habitat loss is projected to be 9,834 ha (24,303 ac). There are approximately 1,616 ha (3,994 ac) of modeled habitat for this species in entitled private land that could potentially be included under the HCP if the landowners voluntarily choose to be covered under the HCP. If the pale Townsend's big-eared bat becomes listed under the ESA, voluntary inclusion would provide certainty of conservation requirements and eliminate the necessity of individual landowners and the Town conducting Section 7 consultation with the USFWS for activities that potentially affect this species or its habitat and have a Federal nexus because of the consultations outlined in Section 1.6.

4.7.3 Biological Goals and Objectives

As described above, pale Townsend's big-eared bats are not expected to roost in the Town but may forage in the Town from roosts outside the Town. To the extent that pale Townsend's big-eared bats use habitats in the Town, the Town's biological goal is to contribute to maintaining regional populations of pale Townsend's big-eared bats.

The Town's specific objectives are to:

- Provide foraging opportunities for pale Townsend's big-eared bats
- Maintain habitat connectivity in critical movement corridors between and among roosts and foraging habitat

4.7.4 Conservation Measures

The conservation objective for the pale Townsend's big-eared bat consists of ensuring that both foraging opportunities and corridors for travel between and among roosts and foraging areas will remain in the Town. Pale Townsend's big-eared bats forage in a diversity of habitats, but with a preference for wetland and riparian areas. Foraging habitat for Townsend's big-eared bats will be retained in the Town through the protection of native Sonoran desert vegetation and riparian areas.

Pale Townsend's Big-eared Bat Measure 1. The Town will protect riparian areas as foraging habitat through the following actions:

- Limit the types of development within the floodway of the Santa Cruz River to those uses permissible under Title 21 of the Land Development Code, which prohibits permanent structures, except for bridges and bank protection, and generally maintains foraging habitat and habitat connectivity for the pale Townsend's big-eared bat.
- Enforce restrictions in the Town Code (Title 12-4-2 Traffic) against OHV travel in publicly owned washes or other public lands when activities damage native vegetation or create significant erosion.
- Incorporate specific design requirements into Title 17 for riparian habitat protection and mitigation, including mitigation for each acre of impact at a ratio ranging from 1.5:1 up to 4:1, depending on the type of mitigation and distance from the impact location (see Section 4.0, Table 4.5) for details). The Town would also adopt a Riparian Habitat Map (see Figure 3.3) linked to the revised Title 17.

Pale Townsend's Big-eared Bat Measure 2. The Town will continue to manage the existing 2,400 ac Tortolita Preserve leased by the Town in a manner consistent with protection of pale Townsend's big-eared bat foraging habitat.

Pale Townsend's Big-eared Bat Measure 3. The Town will identify and delineate ESL within its General Plan (see Figure 4.2) including areas of pale Townsend's big-eared bat habitat. Within the ESL, the Town will develop and implement ESRDG requiring a detailed evaluation and consideration of biological, cultural, and visual resources in the design, construction, and mitigation of road and utility projects in designated areas. Using the

ESRDG, appropriate site-specific design criteria will also be developed for each project to promote pale Townsend's big-eared bat habitat protection and promote habitat connectivity.

Pale Townsend's Big-eared Bat Measure 4. The Town will establish four habitat Conservation Zones (see Figure 4.1) to protect foraging and movement corridors for wildlife, including the pale Townsend's big-eared bat. The zones will have the following boundaries and restrictions:

- Zone 1 will generally consist of all ESL along the Santa Cruz River floodway. Within Zone 1, the Town will limit the types of development to those uses permissible under Title 21 of the Land Development Code.

- Zone 2 will generally consist of all ESL east of I-10, starting 0.8 km (0.5 mi) south of Moore Road and extending north to the Town Boundary, and including ESL on the northern extension of the Tucson Mountains. Within Zone 2, the Town will:

    - Cooperate with and support regional land-use planning efforts to establish a permanent reserve on the Tortolita Fan, providing pale Townsend's big-eared bat foraging habitat. This support may be in the form of coordination with ASLD, dedication of monies, management responsibility or assistance, or other means to be determined in consultation with the USFWS. The establishment of a permanent reserve will be the preferred conservation measure within Zone 2.

    - Require ASLD parcels that are sold to private entities requesting an up-zoning—if a permanent reserve can not be developed or until such a reserve is developed—to conserve 80 percent of the parcel in perpetuity as natural open space. These NUOS areas will include those portions of the parcel that support the highest habitat values. Open space must provide wash protection and be configured to complement any adjacent protected open space, including lands identified in the Pima County Conservation Lands System, as well as provide north-south habitat connectivity across the Tortolita Fan.

- Zone 3 will generally consist of all ESL in the uplands adjacent to the Santa Cruz River, and east of I-10, starting 1.5 km (1 mi) south of Tangerine Road. There will also be a buffer of Zone 3, 0.5 km (0.3 mi) in width, between Zone 4 and the Tortolita Preserve, from the eastern edge of the preserve west to the CAP canal. Within Zone 3, the Town will:

    - Extend wildlife linkages across Tangerine to the I-10/Avra corridor. Target width of linkage will be 305 m (1,000 ft), as allowed by existing constraints, with goal of 95 percent protection (the 5-percent disturbance would account for driveway crossings and other minimal disturbances). Existing wildlife linkages across Tangerine Road will be preserved and widened when the road is widened.

- Target NUOS in all other areas of the Zone to achieve a goal of 70 percent, with a minimum of 40 percent on-site. Open space must provide wash protection and be configured to compliment any adjacent protected open space, as well as provide north-south habitat connectivity across the Tortolita Fan. If less than 70 percent on-site NUOS is proposed, alternative mitigation would be required to make up any difference. This alternative mitigation could be in a number of forms. Suitable off-site lands may be acquired at an appropriate ratio and conserved for the benefit of the pale Townsend's big-eared bat. Mitigation funds may be contributed to the Town to support pale Townsend's big-eared bat conservation efforts including, but not limited to research, surveys, habitat acquisition, and augmentation efforts. Development alternatives will be allowed if the parcel developer can demonstrate their project meets intent and NUOS goals listed above; any such alternative development must have USFWS and Town approval.

- Zone 4 will generally consist of all ESL east of I-10, 1.6 km (1 mi) north and south of Tangerine Road, except at the section of Zone 3 that will serve as a buffer between high-intensity development and the Tortolita Preserve. Within Zone 4, the Town will:

  - Allow 100 percent development outside the wildlife linkages. There are no NUOS goals established for Zone 4, outside of the designated linkages, because the proposed development limits and NUOS objectives within all of the other zones, as well as the three wildlife linkages extending across Tangerine Road (see Figure 4.1) will mitigate the proposed impacts within the entire permit area as a whole.

  - Extend three linkages across Tangerine Road (see Figure 4.1). The target width of each linkage will be 305 m (1,000 ft), as allowed by existing constraints, with a goal of 95-percent protection, except for future Tangerine Road improvements. The boundaries of the wildlife linkages will be established such that all parcels will retain opportunities for allowed land use. Additional benefits to covered species may also be achieved through on-site development configurations of the covered activities.

  - Implement the Town's ESRDG for Tangerine Road improvements and include wildlife crossings aligned with the wildlife linkages above, and/or any new corridors identified through future research and monitoring.

Pale Townsend's Big-eared Bat Measure 5. The Town will minimize impacts to pale Townsend's big-eared bat dispersal and movement corridors through the following measures:

- Support efforts to purchase, preserve, and enhance parcels needed for a regional movement corridor across Interstate-10 encompassing the former railroad underpass south of Avra Valley Road and any adjacent lands that are appropriate (see Figure 4.1).

- Require that continuity of NUOS be maintained within and among developments subject to discretionary action and that open space be located in a manner that preserves wildlife access and movement within and through the site, consistent with adjacent efforts to do the same.

- Identify in the Environmental Element of its General Plan the importance of riparian areas as wildlife movement linkages.

Pale Townsend's Big-eared Bat Measure 6. The Town will update Title 17 of the Land Development Code to include invasive species management guidelines. An inventory of all state and Federally protected plant species, saguaro cacti, and ironwood trees shall also be conducted within the area not included in the NUOS. Native plants removed from the site, damaged, or destroyed during development shall be replaced by plants of the same genus and species at a 1:1 ratio. The updated Title 17 will include an official list of plants prohibited for use in landscaping.

Pale Townsend's Big-eared Bat Measure 7. The Town will develop and implement an educational program designed to inform the general public, specific neighborhoods, permit applicants, and contractors of the various requirements of the HCP and the associated benefits to species and habitats. The educational program will also provide resources and instruction for Town personnel involved in operations and maintenance activities.

4.7.5 Effects of Implementing the HCP on Pale Townsend's Big-eared Bats

Proposed future CIP and development activities in the Town could directly impact up to 9,823 ha (24,273 ac) of modeled habitat for big-eared bats in the Town during the term of the Permit. Under the HCP, approximately 8,197 ha (20,255 ac) of modeled pale Townsend's big-eared bat habitat would remain protected as NUOS.

The Town contains suitable foraging habitat which could be used for foraging by pale Townsend's big-eared bats. Use by big-eared bats from known roosts is likely to be low; however, all roost sites are not known and big-eared bats from unknown roosts in the Tortolita, Silverbell, and Tucson Mountains would be likely to forage within the Town. Effects from urban development consist of reductions in the availability of potential foraging habitat. The Town's conservation approach to pale Townsend's big-eared bats is to retain modeled foraging habitat.

The Town will restore a 16 ha (40 ac) wetland on a 32 ha (80 ac) site owned by the Town, which is adjacent to the Santa Cruz River at the site of the former ADOT borrow pit. The restoration will include: contouring to reduce the percent slope on the banks, evaluating the need for adding supplemental wetland soils or nutrients, planting native hydrophytic vegetation and riparian species identified at "reference wetland sites" in the area, removing non-native or invasive species, potentially providing additional treated effluent water to

maintain vegetation during the dry season (as part of a proposed wastewater treatment facility if it is located in the area), and developing a monitoring and adaptive management plan for the site. Site restoration may provide foraging habitat for the Townsend's big-eared bat.

Riparian restoration projects being performed by others (not as a part of this HCP) that may be beneficial to the pale Townsend's big-eared bat include Pima County Regional Flood Control District's Cortaro Mesquite Bosque 32 ha (80 ac) riparian habitat restoration. This project was designed to increase the vegetation structure and biological diversity of the floodplain and to provide wildlife habitat, particularly forage and nesting area for birds.

Another project that may benefit Townsend's big-eared bat foraging habitat, when it is implemented, is the Tres Rios del Norte Project—a comprehensive restoration project on the Santa Cruz River. Goals for the restoration plan include: restoring wetland and riparian vegetative communities within the river corridor to a more natural state and increase habitat diversity; minimizing disturbance-type impacts to proposed restoration areas; implementing a low maintenance design; reducing flood damages in specified areas; water resource management opportunities including storm water harvesting, groundwater recharge, more efficient use of effluent; maximizing use of vacant lands for restoration and utilize sand and gravel mining areas as they are retired; and providing recreational resources where possible.

4.7.6 Pale Townsend's Big-eared Bat Monitoring Program

Monitoring will consist of habitat monitoring using GIS and aerial photography to detect changes in vegetation and in land use to assure that the amount of open space set-aside complies with the HCP Conservation Zone and Wildlife Linkages requirements. The Town will also monitor for invasive species and implement an invasive species management plan. A database will be maintained to ensure that areas designated as NUOS are preserved in a natural state, to maintain connectivity and habitat through the preservation of native species. A base year of vegetation monitoring will be performed once open space is set aside, and then every three years thereafter. The Town will cooperate as appropriate with any future research and monitoring efforts related to clarifying the status of the pale Townsend's big-eared bat in the planning area. All NUOS protected as part of the above conservation measures will be monitored on a regular basis to ensure that pale Townsend's big-eared bat habitat components are maintained or enhanced. Monitoring will include the review of annual reports submitted by the parties responsible for the long-term maintenance of these conservation areas, as well as by periodic visual inspection of the conservation areas. Species and habitat monitoring are described in greater detail in Chapter 6 of this document.

4.8 Ground Snake (Valley Form) (*Sonora semiannulata*)

4.8.1 Existing Conditions

4.8.1.1 Species Ecology, Rangewide Status, Distribution, and Threats

The ground snake is a small snake that may reach approximately 45 cm (18 in) in length. This species can exhibit many different colors and color patterns. Dorsal color is brownish, orange, reddish, or gray. Patterns include plain, cross-banded, longitudinally banded (red or orange, if present), or a combination. Plain, striped, and cross-banded individuals can sometimes occur in the same locality.

This species is chiefly nocturnal and requires warm nighttime temperatures for activity, and loose soil for burrowing. It is known to occur in New Mexico, Arizona, Colorado, Utah, Nevada, Texas in the U.S. and Chihuahua and Sonora in Mexico. The Valley Form is known only from Pima County. The ground snake occupies plains, valleys, and foothill habitats. Its diet includes eggs, adult vertebrates, and arthropods. Scorpions, centipedes, and black widow spiders are also common food items.

The ground snake has no Federal status under the ESA but is protected by Arizona State law (ARS Title 17). It is primarily threatened by habitat destruction. Urban and agricultural developments remove and alter ground snake habitat. Pesticides are also a likely threat. The ground snake has been found in abandoned buildings, farm structures, and some older residential neighborhoods frequently enough that it may be thought to be tolerant to some level or types of development (Richardson pers. comm. 2008). Habitat connectivity is important for the continued survival of this species in the Town (Rosen pers. comm. 2008). Additional information on the ecology and status of the ground snake can be found in Appendix 3.

The ground snake has been found within the Town and suitable habitat has been modeled within the Town boundaries. This is an uncommon snake, and little information has been generated regarding population trends. The Valley Form is thought to be declining (Rosen, pers. comm. to D. Scalero, 4 March 1999). Covered activities will occur within suitable ground snake habitat and so therefore species has been included in the HCP.

4.8.1.2 Population in and Near the Town

Ground snakes have been documented within and near the Town. In June 2003, one ground snake was found at Blanco Wash and Silverbell Road, 6 miles north of a single previous (1969) record on Blanco Wash at Avra Valley Road (Rosen 2004). In 2004, ground snakes were confirmed to persist at Red Rock (Pinal County), were reasonably abundant at Blanco Wash in at least local areas between the two records described above, but has not been re-confirmed since 1995 in the area of I-10, near the Marana exit (Rosen 2004). An extant population was confirmed with photo vouchers from the base of the Tortolita Mountains in the Town, from Ruelas and Stone Canyons (Rosen 2004).

Surveys performed in 2008 located a population of ground snakes

> extending linearly 23 miles along Blanco Wash in the southern part of Avra Valley (outside of the Town limits). During the shovel-nosed snake sampling, two Western ground snakes were also found in Marana, near the I-10 frontage road at 0.1 mi N of the Marana exit, adding evidence that the population of this species in Marana is highly localized (Rosen 2008a).

However, these observations are not sufficient to determine the abundance or population status of the species in or adjacent to the Town.

4.8.1.3 Habitat in and Near the Town

Rosen (2004) concluded that ground snakes formerly occupied narrow bands of habitat on the periphery of the valley center where bajada washes discharged water and fine sediment on dense xeroriparian plains. He speculated that the ground snake's preferred habitat is the denser soils of the Brawley Wash floodplain. However, it appears unlikely that a population of the ground snake in this area would extend into the Town (Rosen 2004). Potential habitat, and possibly former habitat, includes portions of the Town and extends as far south as Avra Valley Road. The heavy soils of the valley bottom in the Town have the required soil conditions favored by the ground snake (Rosen 2003a).

This snake eats spiders, centipedes, crickets, grasshoppers, insect larvae and other arthropods (Stebbins 1954). The ground snake makes use of rocks and other ground cover when available, but also occurs in habitats where such cover is rare. Usually it burrows in fine, wind-blown sand at the base of bushes or grass hummocks (Stebbins 1954).

A habitat model, developed by Rosen for the Draft HCP, used three primary variables: (1) soils, (2) slope, and (3) vegetation. The habitat model does not include entitled lands which have already been zoned for development. The habitat value of the categories of each variable were ranked as 0, 1, 2, and 3, with 0 indicating that the category provided

no habitat value and 3 indicating that the category provided high habitat value. The three variables were combined to provide an overall habitat value (Table 4.25).

Rosen concluded that the soils layer provided an excellent, as well as logical, predictor of habitat. Snakes were known from fine soils (silty clay and Gila loam) on the flats and from very coarse, gravelly soils (gravelly loam) on lower rock slopes in desert grassland. The soils in the valley were selected based on broader experience in Pima and southern Pinal counties and the slope soils were selected based on the few reports of snakes in hilly or mountainside areas in southeastern Arizona. Potential habitat identified by the presence of gravelly soils was further refined using slope. A moderate score was given to steeper slopes (> 3 degrees), where there have been a few records, and a score of no value was given to intermediate slope angles of the bajada, where there have been no records of this species. In terms of vegetation/land use, active agriculture was identified as having zero habitat potential (i.e., masked) since these areas do not constitute potential habitat in their current state. Use of any other aspect of vegetation or inclusion of landform did not appear to improve the predictive value to the model, as soil conditions captured much or all of what is currently known of the snake's occurrence in these ecological settings. More refined information might warrant refinement of the model.

TABLE 4.25
HABITAT MODEL FOR THE GROUND SNAKE (VALLLEY FORM), VALUE RATINGS RECOMMENDED BY DR. PHIL ROSEN

Variable/Category	Value Rating
Soils	
Silty clay loam	3
Gila loam	3
Gravelly loam	1
Slope (applies only to gravelly loam soils)	
0 to 3 degrees (about 6.5%)	Mask
> 3 degrees	1
Vegetation	
Active agriculture	Mask*

*Active agriculture does not constitute potential habitat in its current state. These areas can be managed in the future, however, in a manner that improves their potential as ground snake habitat.

4.8.1.4 Relation to Species' Range and Ecology

The Town and vicinity represent a small portion of this widely distributed species' range (i.e., much of the western United States and north-central Mexico). The range of the valley form of the ground snake under consideration here extends north to Eloy and is

likely most abundant around Red Rock. Relative to the rest of Pima County, the modeled habitat within the Town represents less than 1 percent of the estimated 573,584 ha (1,417,358 ac) of modeled habitat in the County.

4.8.2 Potential Impacts of Town's Proposed Activities

4.8.2.1 Direct Effects

Urban development has the potential to directly and indirectly harm the ground snake. If construction occurs during the winter, construction activities can cause mortality or injury to snakes that are likely to be in underground dens during that time of year. During the summer, when snakes are active, they can be vulnerable to direct mortality and injury from construction equipment. Developments and roads could also fragment ground snake habitat and affect the long-term viability of the ground snake. Snakes that are displaced by urban development could experience higher mortality while searching for suitable, unoccupied habitat. Construction associated with road improvement projects could result in mortality or injury to snakes through similar means. Pesticide use could affect the ground snakes if they ingest insects or arthropods that have been sprayed.

4.8.2.2 Indirect Effects

Ground snakes can be adversely affected through indirect mechanisms facilitated or caused by urban development. New roads and increased traffic can increase mortality of snakes from vehicle strikes. Over the longer term, conversion of suitable habitat to urban uses could result in take of snakes through a variety of mechanisms, including reduced foraging opportunities, reduced or degraded denning opportunities, and increased predation associated with urban development. Pesticide use reduces the amount of foraging opportunities for the ground snake by reducing the quantity of insects and arthropods.

4.8.2.3 Changes in Habitat

Based on the habitat model, there are 3,027 ha (7,480 ac) of modeled ground snake habitat in the Permit Area. Under the HCP, a total of 892 ha (2,205 ac) of modeled habitat for this species would be impacted by CIP and development activities (Table 4.26). The remaining 2,135 ha (5,275 ac) of habitat would be protected as NUOS.

A summary of impacts from development, both within and outside the Conservation Zones, is provided in Table 4.27. Figures 4.21 and 4.22 show the distribution of modeled ground snake habitat in the Town in relation to CIP activities and existing development and entitled lands, respectively.

TABLE 4.26
GROUND SNAKE MODELED HABITAT AND PROJECTED FUTURE IMPACTS IN THE TOWN

Type of Habitat or Impact	Area
Modeled habitat	3,027 ha (7,480 ac)
Total habitat impacted by Town's CIPs	78 ha (192 ac)
Total habitat impacted by development within HCP Conservation Zones	570 ha* (1,409 ac)
Total habitat impacted by development outside of HCP Conservation Zones	244 ha* (604 ac)
Total Impacts	892 ha (2,205 ac)
Total NUOS	2,135 ha (5,275 ac)

* These figures are derived from Table 4.27.

TABLE 4.27
SUMMARY OF DEVELOPMENT IMPACTS TO GROUND SNAKE HABITAT

	Ground snake Modeled Habitat	Percent allowable impact by Zone	Area impacted
Zone 1	140 ha (345 ac)	0.05	7 ha (17 ac)
Zone 2	2,561 ha (6,329 ac)	0.20	512 ha (1,266 ac)
Zone 3	44 ha (108 ac)	0.30	13 ha (32 ac)
Zone 4	38 ha (94 ac)	1.00	38 ha (94 ac)
Habitat not in Zones	244 ha (604 ac)	1.00	244 ha (604 ac)
Proposed Wildlife Linkages	0	0.05	0
Existing Wildlife Linkages	0	N/A	0
Total	3,027 ha (7,480 ac)	N/A	814 ha (2,013 ac)

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Figure 4.21

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Figure 4.22

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Suitable habitat could remain in some portions of the areas proposed for development; particularly parks, schools, and other areas left as open space. Habitat fragmentation would affect the connectivity and long-term population maintenance. Conversion of existing undeveloped habitat to urban development is likely to have an adverse effect on the habitats' ability to support the species but the effect of converting agricultural lands to urban developments on this species habitat is unclear. Agricultural fields do not currently provide suitable soil conditions for ground snakes; however, farm homes, sheds, "bone" yards and other areas associated with agricultural operations could support ground snakes. As such, loss of these areas to urban development could represent a loss of habitat for the ground snake.

4.8.2.4 Population Effects

Ground snake habitat exists within the Town, as least some of which is likely to be occupied. Covered activities will impact ground snake modeled habitat. Direct effects to the snake are likely, as are indirect effects such as habitat fragmentation and predation by domestic cats. Maintenance of ground snakes within the Town, as well as maintenance of habitat connectivity, will both likely contribute to long-term, range-wide persistence of this species. In the Phoenix area, the species is known to persist in urban and modified environments, and in New Mexico, the species has been reported to tolerate or benefit from human developments including farm outbuildings (barns, silos, and sheds), and abandoned buildings (BISON-M 2000 *in* RECON 2002). Based on these observations, ground snakes could persist in portions of the Town following urban development. However, no specific information is available on the valley form of this species with respect to its tolerance to human development and activity (RECON 2002).

4.8.2.5 Anticipated Take

Lethal take of the ground snake could occur during site grading and due to vehicle collisions. The anticipated take of individuals is five over the 25-year duration of the Permit. Take of the ground snake could also occur in the form of harm due to forage loss, habitat loss, habitat fragmentation, and other activities described in Section 4.8.2.1 above. The anticipated ground snake habitat lost is 892 ha (2,205 ac). There are approximately 312 ha (771 ac) of modeled habitat for this species in entitled private land that could potentially be included under the HCP if the landowners voluntarily choose to be covered under the HCP. If the ground snake becomes listed under the ESA, voluntary inclusion would provide certainty of conservation requirements and eliminate the necessity of individual landowners and the Town conducting Section 7 consultation with the USFWS for activities that potentially affect this species or its habitat and have a Federal nexus because of the consultations outlined in Section 1.6.

4.8.3 Biological Goals and Objectives

As described above, the population status and distribution of ground snakes in the Town is poorly understood. Ground snakes have been documented in the Town and the Town appears to contain some suitable habitat for this species, but the relative importance of the Town in maintaining the valley form of the ground snake is uncertain. Based on this information, the Town's biological goal for ground snakes is to continue to support ground snakes within the Town limits.

The Town's specific objectives are to:

- Maintain the suitability of habitat for ground snakes in the Town
- Maintain habitat connectivity
- Minimize lethal take of ground snakes

4.8.4 Conservation Measures

Through implementation of the ground snake conservation program, the Town seeks to continue to support ground snakes in the Town. Although a few smaller patches of habitat (based on appropriate soil type) are scattered throughout the western portion of Town, the largest contiguous areas of modeled habitat for ground snakes consist of (a) portions of the Santa Cruz River floodway, (b) pockets of gravelly soil located in the Tortolita Mountains, and (c) the lands situated between I-10 and the CAP canal. These three areas are the focus of the ground snake conservation strategy.

Ground Snake Measure 1. The Town will collaborate with the City of Tucson to protect and enhance ground snake habitat within both the Town's and City's jurisdiction, with the Town committing to fund mutually agreed upon conservation measures focusing on habitat restoration and research. Habitat restoration would likely be done in open space or detention basins within existing or new developments and may include contouring for water collection, plantings of mesquite trees and other native plants, and the placement of cover materials or similar items. Research may include introduction of populations into the restoration sites or other suitable habitat and evaluation of home range and movement between habitat patches.

Ground Snake Measure 2. The Town will identify and delineate ESL within its General Plan (see Figure 4.2), including areas of ground snake habitat. Within the ESL, the Town will develop and implement ESRDG requiring a detailed evaluation and consideration of biological, cultural, and visual resources in the design, construction, and mitigation of road and utility projects in designated areas. Using the ESRDG, appropriate site-specific design criteria will also be developed for each project to promote ground snake habitat protection and promote habitat connectivity.

Ground Snake Measure 3. The Town will establish four habitat Conservation Zones (see Figure 4.1) to protect suitable habitat for wildlife, including the ground snake. Zones 1 and 2 will provide protections of modeled ground snake habitat along the Santa Cruz River and in the Tortolita Mountains through the following measures:

- Zone 1 will generally consist of all ESL along the Santa Cruz River floodway. Within Zone 1, the Town will limit the types of development to those uses permissible under Title 21 of the Land Development Code, which prohibits permanent structures except bridges and bank protection, and generally maintains ground snake habitat features.

- Zone 2 will generally consist of all ESL east of I-10, starting 0.8 km (0.5 mi) south of Moore Road and extending north to the Town boundary, and including ESL on the northern extension of the Tucson Mountains. Within Zone 2, the Town will:

    - Cooperate with and support regional land-use planning efforts to establish a permanent reserve on the Tortolita Fan, providing protection for modeled ground snake habitat. This support may be in the form of coordination with ASLD, dedication of monies, management responsibility or assistance, or other means to be determined in consultation with the USFWS. The establishment of a permanent reserve will be the preferred conservation measure within Zone 2.

    - Require ASLD parcels that are sold to private entities requesting an up-zoning—if a permanent reserve can not be developed or until such a reserve is developed—to conserve 80 percent of the parcel in perpetuity as NUOS. These conservation areas will include the portions of the parcel that support the highest habitat values. Open space must provide wash protection and be configured to compliment any adjacent protected open space, as well as provide north-south habitat connectivity across the Tortolita Fan.

Ground Snake Measure 4. The Town will minimize impacts to ground snake movement corridors through the following measures:

- Support efforts to purchase, preserve, and enhance parcels needed for a regional movement corridor across I-10 encompassing the former railroad underpass south of Avra Valley Road and any adjacent lands that are appropriate (see Figure 4.1).

- Limit the types of development within the floodway of the Santa Cruz River to those uses permissible under Title 21 of the Land Development Code.

- Require that continuity of NUOS be maintained within and among developments subject to discretionary action and that open space be located in a manner that preserves wildlife access and movement within and through the site, consistent with adjacent efforts to do the same.

- Enforce restrictions in the Town Code (Title 12-4-2 Traffic) against OHV travel in publicly owned washes or other public lands when activities damage native vegetation or create significant erosion.

- Identify in the Environmental Element of its General Plan the importance of riparian areas as wildlife habitat and movement corridors.

- Incorporate specific requirements into Title 17 for riparian habitat protection and mitigation, including mitigation for each acre of impact at a ratio ranging from 1.5:1 up to 4:1, depending on the type of mitigation and distance from the impact location (see Section 4.0, Table 4.5, for details). The Town would also adopt a Riparian Habitat Map (see Figure 3.3) linked to the revised Title 17.

Ground Snake Measure 5. The Town will update Title 17 of the Land Development Code to include invasive species management guidelines. An inventory of all state and Federally protected plant species, saguaro cacti, and ironwood trees shall also be conducted within the area not included in the NUOS. Native plants removed from the site, damaged, or destroyed during development shall be replaced by plants of the same genus and species at a 1:1 ratio.

Ground Snake Measure 6. The Town will develop and implement an educational program designed to inform the general public, specific neighborhoods, permit applicants, and contractors of the various requirements of the HCP and their associated benefits to species and habitats. The educational program will also provide resources and instruction for Town personnel involved in operations and maintenance activities.

Ground Snake Measure 7. The Town will pursue long-term conservation commitments from Pima County and The City of Tucson for their lands within the Town limits.

Ground Snake Measure 8. The Town will support creation of the Marana Mounds Archaeological Site by Pima County in recognition of its value as ground snake habitat as well as a cultural resource.

4.8.5 Effects of Implementing the HCP on Ground Snakes

Proposed future CIP and development activities in the Town could directly impact up to 892 ha (2,205 ac) of modeled habitat for ground snakes in the Town during the term of the Permit. Under the HCP, approximately 2,135 ha (5,275 ac) of modeled ground snake habitat would remain protected as NUOS.

The Town's conservation approach for this species is to retain modeled habitat and movement corridors within the Town. Under the HCP, the Town would minimize disturbance to suitable habitat within the Town by requiring that development within the

Town comply with limits on maximum allowed disturbance and comply with the restrictions and mitigation requirements within and being developed for the Town's Land Use Code. Likewise, the Town would avoid lethal take of this species through requirements for preconstruction surveys.

4.8.6 Ground Snake Monitoring Program

The Town will look for opportunities to obtain grants or support cooperators to conduct surveys or research on ground snakes. Occupied sites identified within the Town boundaries will be prioritized for monitoring and research. In addition, the Town will implement monitoring measures on Tucson Water Lands if a cooperative agreement is reached.

Monitoring will consist of habitat monitoring using GIS and aerial photography to detect changes in vegetation and in land use to assure that the amount of NUOS set-aside complies with the HCP Conservation Zone and wildlife linkage requirements. The Town will also monitor for invasive species and implement an invasive species management plan. A database will be maintained to ensure that areas designated as NUOS are preserved in a natural state, to maintain connectivity and foraging opportunities through the preservation of native Sonoran Desert vegetation. A base year of vegetation monitoring will be performed once open space is set aside, and then every three years thereafter. Monitoring will also focus on occupancy and population trends in research areas and restoration sites. Species and habitat monitoring are described in greater detail in Chapter 6 of this document.

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4.9 Mexican Garter Snake (*Thamnophis eques megalops*)

4.9.1 Existing Conditions

4.9.1.1 Species Ecology, Rangewide Status, Distribution, and Threats

The Mexican garter snake is a relatively stout-bodied snake with a total length of 45 to 102 cm (18 to 40 in). Individuals are brown to greenish-brown with a yellow-white dorsal stripe flanked by stripes on the third and fourth scale rows in the anterior region. Large brown blotches are on the back of the head, separated from the corner of the mouth by light-colored crescents. The Mexican garter snake eats primarily native frogs, toads, fishes, and small mammals.

The Mexican garter snake is found throughout south-central and southeastern Arizona, far western New Mexico, and south to Oaxaca, Mexico. It is found in the Lower and Upper Sonoran Life Zones, at elevations from 530 to 1875 m (1,739 to 6,152 ft). It is usually found within 15 m (50 ft) of permanent water in areas of lush vegetation growth. Riparian areas, ponds, and cienegas are important habitats for the Mexican garter snake.

Populations of the Mexican garter snake have decreased historically, with several local extirpations since 1950 (Center for Biological Diversity 2003). Primary threats to the snake are habitat loss, reduction, and alteration, as well as predation by bullfrogs and other non-native species. In 2003, the USFWS was petitioned to list the Mexican garter snake and to designate critical habitat. In 2006, the USFWS found that the garter snake faces significant threats in the U.S., but because its status and threats in Mexico were not adequately known, the USFWS determined the subspecies did not warrant protection. The USFWS withdrew its initial finding in May 2008 and initiated a new status review (FR 73: 30596-30598) that was consistent with the legal guidance it received about determining the extinction danger of a species throughout a significant portion of its range. In November 2008, the USFWS found that listing the species as protected under the ESA was warranted but precluded by higher priority listing actions (FR 73: 71788-71826). The northern Mexican garter snake will be classified as a candidate species until a proposed rule can be prepared. This species remains protected by Arizona State law (ARS Title 17).

Additional information on the ecology and status of the Mexican garter snake can be found in Appendix 3.

The effluent-supported riparian habitat within the Town supports potential Mexican garter snake habitat. Covered activities will impact potential habitat within the Permit Area. This is a declining and rare species that has been found warranted for listing under the ESA. For these reasons, it has been included for coverage under the Town's HCP.

4.9.1.2 Population in and Near the Town

According to the AZGFD HDMS (accessed 2007), no Mexican garter snakes have been documented within the Town. The current distribution of this species within the United States is believed to be constrained to the middle/upper Verde River drainage, middle/lower Tonto Creek, and the Cienega Creek drainage as well as in a small number of isolated wetland habitats in southeastern Arizona. In 2007, AZGFD performed a reptile and amphibian survey on the Lower Santa Cruz River and found some bullfrogs (*Rana catesbeiana*) in pools, as well as 20 checkered garter snakes, but no Mexican garter snakes (Abbate pers. comm. April 20, 2008).

4.9.1.3. Habitat in and Near the Town

Source area wetlands, such as ciénegas, ciénega-streams, and stock tanks, are the most important habitat type in Arizona. In source-area wetlands like ciénegas, vegetation consists of knot grass (*Paspalum distichum*), spikerush (*Eleocharis*), bulrush (*Scirpus*), and cattail (*Typha*). Bank vegetation includes deergrass (*Muhlenbergia*), sacaton (*Sporobolus)*, Fremont cottonwood, Goodding's willow, and velvet mesquite (Rosen and Schwalbe 1988). Habitat can be found in the shallow waters, banks, and riparian vegetation of large river riparian woodlands and forests. Mexican garter snake populations are found in association with cottonwood, willow, seep willow, mesquite, and a variety of grasses. Mexican garter snake populations may be abundant in these habitats. Historically, populations were found in this habitat type in the Phoenix area along the Colorado River, downstream of Nogales on the Santa Cruz River, and in Tucson (Rosen and Schwalbe 1988). Potential habitat is also found in streamside gallery forests located on the margins of intermediate-sized streams at high elevations. Forests are deciduous and Mixed Broadleaf Woodlands (Rosen and Schwalbe 1988, Rosen et al. 2001). Modeled habitat for Mexican garter snakes was developed by the TBT considering primarily hydrology and secondarily vegetation, specifically tropical-subtropical swamp, Sonoran deciduous swamp, and riparian scrub series. Using this model, 453 ha (1,120 ac) of modeled habitat is predicted to occur in the Town. These areas are contained within Conservation Zone 1 described below and depicted in Figure 4.1. The habitat model does not include entitled lands which have already been zoned for development.

Effluent-supported riparian habitat along the Santa Cruz River, within Conservation Zone 1, may contain patches of aquatic habitat potentially suitable for Mexican garter snakes. While the effluent provides a consistent source of water in portions of the river, the

riparian vegetation along the river is strongly influenced by the interaction of flooding frequency and intensity, variation in infiltration rates, and the amount of regional groundwater pumping, resulting in the spatial and temporal variability of potentially suitable Mexican garter snake habitat (CH2MHill 2003). Water quality within the effluent-supported reaches is another concern.

4.9.1.4 Relation to Species' Range and Ecology

Given the isolation of the perennial reach of the Santa Cruz River and the potentially low water quality, the level of potential importance of habitats in the Town for Mexican garter snakes is uncertain. Nevertheless, the limited availability of perennial aquatic habitat within the range of this species makes all potential habitat areas valuable. If water quality is improved and perennial flow can be assured, this species could return to the aquatic habitat within the Santa Cruz River.

4.9.2 Potential Impacts of Town's Proposed Activities

4.9.2.1 Direct Effects

Direct effects to Mexican garter snakes may result from mortality from construction equipment and from loss of aquatic habitat. Because activities within the floodway of the Santa Cruz River will be limited, disturbance to aquatic habitat and the adjacent riparian vegetation from construction are expected to be minimal. Further, because construction will occur following surveys, the number of individual snakes potentially affected is likely to be low.

4.9.2.2 Indirect Effects

Mexican garter snakes can be adversely affected through indirect mechanisms facilitated or caused by or associated with urban development. Specifically, these may include increased unauthorized public access to the floodway and introduction of invasive species, including bullfrogs, and increased erosion resulting from increased stormwater runoff. The 2007 AZGFD survey along the Lower Santa Cruz River (Abbate pers. comm. April 2008) located some bullfrogs during their survey. Bullfrogs are native to North America east of the Rocky Mountains, but are now found throughout the world. Bullfrogs out-compete native species and are voracious predators. They may also be carriers of chytrid fungus in amphibians (*National Geographic News* website accessed August 5, 2008). Although the size of the current bullfrog population within the Town is not known, there is potential for the bullfrog population to increase in the future.

4.9.2.3 Changes in Habitat

Based on the habitat model, there are 453 ha (1,120 ac) of modeled garter snake habitat in the Permit Area. Under the HCP, a total of 102 ha (251 ac) of modeled habitat for Mexican garter snakes would be impacted by CIP and development activities (Table 4.28). The remaining 351 ha (869 ac) of habitat would be protected as NUOS.

TABLE 4.28
MEXICAN GARTER SNAKE MODELED HABITAT AND PROJECTED FUTURE IMPACTS IN THE TOWN

Type of Habitat or Impact	Area
Modeled habitat	453 ha (1,120 ac)
Total habitat impacted by Town's CIPs	44 ha (109 ac)
Total habitat impacted by development within HCP Conservation Zones	44 ha (108 ac)
Total habitat impacted by development outside of HCP Conservation Zones	14 ha (34 ac)
Total Impacts	102 ha (251 ac)
Total NUOS	351 ha (869 ac)

* These figures are derived from Table 4.29.

Figures 4.23 and 4.24 show the distribution of modeled garter snake habitat in the Town in relation to CIP activities and existing development and entitled lands, respectively. A summary of impacts from development, both within and outside the Conservation Zones, is provided in Table 4.29.

The Santa Cruz River is likely to run dry at some point in the future due to reuse of effluent. How soon or if this will happen is dependent on the rate of population growth and the development of effluent reuse projects. The Town currently has no authority to influence the amount of water flow in the Lower Santa Cruz River, unless the Tres Rios del Norte Restoration Project or other projects are implemented to protect conservation flows in the river.

4.9.2.4 Population Effects

The Mexican garter snake has not been documented within the Town; however, few efforts have been made to survey for this species. Modeled habitat exists along the

Figure 4.23

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Figure 4.24

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TABLE 4.29
SUMMARY OF DEVELOPMENT IMPACTS TO MEXICAN GARTER SNAKE HABITAT

	Mexican garter snake Modeled Habitat	Percent allowable impact by Zone	Area impacted
Zone 1	302 ha (747 ac)	0.05	15 ha (37 ac)
Zone 2	127 ha (314 ac)	0.20	26 ha (63 ac)
Zone 3	10 ha (25 ac)	0.30	3 ha (8 ac)
Zone 4	0	1.00	0
Habitat not in Zones	14 ha (34 ac)	1.00	14 ha (34 ac)
Proposed Wildlife Linkages	0	0.05	0
Existing Wildlife Linkages	0	N/A	0
Total	453 ha (1,120 ac)	N/A	58 ha (142 ac)

Santa Cruz River, and some impacts to this habitat are expected from covered activities. Direct and indirect effects to this species are anticipated, but due to the isolated nature of the Town's habitat, population effects are expected to be minimal. Should habitat restoration projects be implemented, improved habitat and potential for occurrence may increase the contribution of Mexican garter snakes in this area to the overall population.

4.9.2.5 Anticipated Take

The likelihood of lethal take for the Mexican garter snake is expected to be low, with estimated lethal take of two individuals over the 25-year duration of the Permit. Take may also occur in the form of harm due to riparian habitat loss and fragmentation. Some take through predation by non-native bullfrogs is likely, but not quantifiable. Loss of modeled habitat is projected to be 102 ha (251 ac).

4.9.3 Biological Goals and Objectives

The Town's biological goals and objectives for the Mexican garter snake relate to maintaining suitable habitat components necessary for this species to carry out its life cycle. Specifically, the Town's biological goal is to contribute to maintaining local and regional populations of Mexican garter snake.

The Town's specific objectives are to:

- Minimize disturbance and fragmentation of existing and restored suitable Mexican garter snake habitat components
- Minimize lethal take of Mexican garter snakes

4.9.4 Conservation Measures

The Town does not control water flow in the Santa Cruz River and recognizes that it cannot guarantee the long term availability of Mexican garter snake habitat that is supported by a dependable water supply. Even so, the Town can minimize impacts to important components of the hydroriparian habitat along the Santa Cruz River, and reduce lethal take of individuals through the following conservation measures:

Mexican Garter Snake Measure 1. The Town will identify and delineate ESL within its General Plan (see Figure 4.2), including areas of Mexican garter snake habitat. Within the ESL, the Town will develop and implement ESRDG requiring a detailed evaluation and consideration of biological, cultural, and visual resources in the design, construction, and mitigation of road and utility projects in designated areas. Using the ESRDG, appropriate site-specific design criteria will also be developed for each project to promote and maintain Mexican garter snake habitat protection habitat connectivity.

Mexican Garter Snake Measure 2. The Town will establish four habitat Conservation Zones (Figure 4.1) to protect suitable habitat for wildlife, including Mexican garter snakes. Zone 1 will generally consist of all ESL along the Santa Cruz River floodway. The Town will provide protections for Mexican garter snake habitat in this zone by limiting the types of development to those uses permissible under Title 21 of the LDC, which prohibits permanent structures except for bridges and bank protection, and generally maintains Mexican garter snake habitat features.

Mexican Garter Snake Measure 3. The Town will further protect aquatic and riparian habitat components through the following actions:

- Identify in the Environmental Element of its General Plan the importance of riparian areas as wildlife habitat and movement corridors.
- Incorporate specific requirements into Title 17 for riparian habitat protection and mitigation, including mitigation for each acre of impact at a ratio ranging from 1.5:1 up to 4:1, depending on the type of mitigation and distance from the impact location (see Section 4.0, Table 4.5, for details). The Town would also adopt a Riparian Habitat Map (see Figure 3.3) linked to the revised Title 17.

- Enforce restrictions in the Town Code (Title 12-4-2 Traffic) against OHV travel in publicly owned washes or other public lands when activities damage native vegetation or create significant erosion.

- Update Title 17 of the LDC to include invasive species management guidelines and an official list of plants prohibited for use in landscaping, such as tamarisk. An inventory of all state- and Federally protected plant species, cottonwood, and willow trees shall also be conducted within the area not included in any area designated as a NUOS. Plants removed from the site, damaged, or destroyed during development shall be mitigated in accordance with the revised Title 17.

Mexican Garter Snake Measure 4. The Town will minimize lethal take of Mexican garter snakes through the following actions:

- Incorporate development standards into Title 17 of the LDC requiring species-specific habitat evaluations. These standards will require project proponents to evaluate project areas for suitable Mexican garter snake habitat and to conduct pre-construction surveys where such habitat exists. These surveys will utilize a USFWS-approved protocol or a modified survey methodology as approved by USFWS (see Appendix 4).

- Notify AZGFD and USFWS to determine the appropriate course of action if Mexican garter snakes are detected during pre-construction surveys.

Mexican Garter Snake Measure 5. The Town will develop and implement an educational program designed to inform the general public, specific neighborhoods, permit applicants, and contractors of the various requirements of the HCP and their associated benefits to species and habitats. The educational program will also provide resources and instruction for Town personnel involved in operations and maintenance activities.

Mexican Garter Snake Measure 6. The Town will participate with other jurisdictions to promote the maintenance of water flows within the Santa Cruz River. The Town does not currently control water within the Santa Cruz River, but can work with the other jurisdictions to identify, as appropriate, potential actions to provide a conservation flow within the Santa Cruz River. If the Town does obtain control of flows within the Santa Cruz River at some point in the future, it will continue to work with other jurisdictions to plan for continued water flows in the river channel.

Mexican Garter Snake Measure 7. The Town will work with developers, golf course managers, and private citizens to reduce the presence of bullfrogs within the Town. This measure will be tied to public outreach and education to improve the identification of areas occupied by bullfrogs, encourage the eradication of bullfrogs where they exist, and discourage the spread of bullfrogs within the Town.

4.9.5 Effects of Implementing the HCP on Mexican Garter Snakes

Proposed future CIP and development activities in the Town could directly impact about 89 ha (221 ac) of modeled habitat for Mexican garter snakes. Under the HCP, approximately 364 ha (899 ac) of modeled garter snake habitat would remain protected as NUOS.

The perennial reaches of the Santa Cruz River in the Town may be only marginally suitable to function as habitat and currently do not support any known Mexican garter snakes. The Town's conservation approach for this species is to maintain a sufficient amount and configuration of aquatic habitat in an effort to allow reoccupation of the Town by Mexican garter snakes in the future.

The Santa Cruz once had 2,833 to 3,238 ha (7,000 to 8,000 ac) of cottonwood-willow habitat. Less than 202 ha (500 ac) remain. Because of habitat losses, the river has suffered major reductions in the diversity and populations of birds, fish and other wildlife, according to the USACE (*Arizona Daily Star* June 10, 2008). The Town is revegetating drainage channels in Continental Ranch with native trees, to provide potential wildlife linkages to the river.

The Town will restore a 16 ha (40 ac) wetland on a 32 ha (80 ac) site owned by the Town, which is adjacent to the Santa Cruz River at the site of an old ADOT borrow pit. The restoration will include contouring to reduce percent slope on the banks, evaluating the need for adding supplemental wetland soils or nutrients, planting native hydrophytic vegetation and riparian species identified at "reference wetland sites" in the area, removing non-native or invasive species, and providing additional treated effluent water to maintain vegetation during the dry season, and developing a monitoring and adaptive management plan for the site.

Riparian restoration projects being performed by others include Pima County Regional Flood Control District's Cortaro Mesquite Bosque 32 ha (80 ac) riparian habitat restoration. This project was designed to increase the vegetation structure and biological diversity of the floodplain and to provide wildlife habitat, particularly forage and nesting area for birds. The planting zones consist of native cottonwood-willow trees, riparian mesquite bosque, riparian grassland-willow, xeroriparian (drier area) mesquite, and upland vegetation-grassland.

Another project that may benefit Mexican garter snake habitat, when it is implemented, is the Tres Rios del Norte Project which is a comprehensive restoration project on the Santa Cruz River. The USACE began conducting a feasibility study in 2001, with the three local sponsors (Pima County, the Town, and the City of Tucson). It is intended that the project will ultimately provide opportunities for flood control, groundwater recharge, and recreation, addressing common interests and goals of Pima County, the Town, and

the City of Tucson. The study area comprises a 29 km (18 mi) stretch of the Santa Cruz River corridor that extends from Prince Road north to Sanders Road. In that reach are the confluences of the Santa Cruz River with two of its major tributaries, the Rillito Creek and the Cañada del Oro Wash. Goals for the restoration plan include: restoring wetland and riparian vegetative communities within the river corridor to a more natural state and increase habitat diversity; minimizing disturbance-type impacts to proposed restoration areas; implementing a low maintenance design; reducing flood damages in specified areas; water resource management opportunities including storm water harvesting, groundwater recharge, more efficient use of effluent; maximizing use of vacant lands for restoration and utilize sand and gravel mining areas as they are retired; and providing recreational resources where possible. The Cortaro Bosque and Tres Rios restoration projects are not included as part of the HCP, but complement HCP riparian restoration goals and may increase and improve Mexican garter snake habitat through revegetation.

Under the HCP, the Town would minimize disturbance to suitable habitat within the Town by requiring that development within the Santa Cruz River floodway comply with the restrictions and mitigation requirements within and being developed for the Town's Land Use Code. Likewise, the Town would avoid lethal take of this species through requirements for preconstruction surveys.

4.9.6 Mexican Garter Snake Monitoring Program

The Town will require project proponents to conduct pre-construction surveys (presence/absence) in suitable habitat. The surveys will follow a time/area constrained survey protocol plus trapping, as approved by the USFWS (see Appendix 4).

Monitoring will also consist of habitat monitoring using GIS, aerial photography, and established photo points to detect changes in vegetation and in land use to assure that the amount of NUOS set-aside complies with the HCP Conservation Zone and Wildlife Linkages requirements. The Town will also monitor for invasive species and implement an invasive species management plan. A database will be maintained to ensure that areas designated as NUOS are preserved in a natural state, to maintain connectivity and foraging opportunities through the preservation of native species. A base year of vegetation monitoring will be performed once open space is set aside, and then every three years thereafter. The Town will cooperate as appropriate in future research and monitoring projects to clarify the status of the Mexican garter snake within the Permit Area. Species and habitat monitoring are described in greater detail in Chapter 6 of this document.

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4.10 Sonoran Desert Tortoise (*Gopherus agassizii*)

4.10.1 Existing Conditions

4.10.1.1 Species Ecology, Rangewide Status, Distribution, and Threats

The Sonoran desert tortoise (tortoise) is a relatively large, herbivorous reptile with a domed shell and round, elephant-like legs. The tortoise grows to approximately 38 cm (15 in) in length. The carapace (upper shell) is dull brown to gray in color with a plastron (under portion of the shell) that is often a pale yellow in color. The forelimbs are covered with large, conical scales and the tail is short. Sonoran desert tortoises are excellent climbers.

Preferred habitat for the Sonoran desert tortoise is primarily rocky (often steep) hillsides and bajadas of Mohave and Sonoran desertscrub, but they may encroach into desert grasslands, the deeply incised caliche banks along washes, juniper woodlands, interior chaparral, and even pine-oak habitats. Washes and valley bottoms may be used for dispersal.

Tortoises in the Sonoran population are found from approximately 300 to 2,300 m (1,000 to 7,800 ft) in elevation. The Sonoran desert tortoise is found in Arizona, south and east of the Colorado River, and south into Sonora, Mexico.

The Mohave population of the desert tortoise is listed as a threatened species; however, the Sonoran population currently has no Federal protection under the ESA, but is protected by Arizona State law (ARS Title 17). The USFWS was recently petitioned (October 2008) to list the Sonoran desert tortoise and to designate critical habitat. In the petition, WildEarth Guardians and Western Watersheds Project citied severe declines in the Sonoran desert tortoise population. Threats to the Sonoran desert tortoise include loss and degradation of habitat, illegal collection and vandalism, predation by feral dogs, and diseases (upper respiratory tract disease and shell disease; USFWS 2005). Additional information on the ecology and status of the Sonoran desert tortoise can be found in Appendix 3.

Suitable Sonoran desert tortoise habitat is found within the Town, primarily in association with the Tortolita and Tucson mountains, although other rock outcrops and caliche-incised washes also provide habitat. Dispersal likely occurs throughout the Permit Area, with the exception of densely urbanized portions. Covered activities will impact suitable tortoise habitat within the Permit Area and could result in take of individuals. Sonoran desert tortoise populations are precarious and the species was recently petitioned for

listing under the ESA. For these reasons, the Sonoran desert tortoise is covered under this HCP.

4.10.1.2 Population in and Near the Town

The Sonoran desert tortoise is widespread across southern Arizona and has been documented numerous times within the Town (AZGFD 2007). They are most common among the rocky outcrops associated with the Tortolita Mountains and the caliche-incised washes of the Tortolita Fan. The Sonoran desert tortoise population basically exists on islands of habitat, and valley connectivity between the islands is crucial to population maintenance. For persistence of the metapopulation structure, it is important to maintain each individual population island over the long term for population rescue and connectivity. The Town serves as an important linkage between the Tortolita Mountains, Desert Peak, Tucson Mountains, Silverbell Mountains, and the Picacho Mountains.

4.10.1.3 Habitat in and Near the Town

As discussed in this species' life history (Appendix 3), Sonoran desert tortoises appear to be most abundant within the Arizona Upland subdivision where they occupy mountain slopes, hills, and upper bajadas. However, availability of shelter sites may be the most important habitat feature for the Sonoran population. A habitat model for the desert tortoise was developed using similar methods to those of the Sonoran Desert Conservation Plan (RECON 2002). The habitat model consisted of the following three primary variables:

- Vegetation
- Slope
- Landform

The habitat value of the categories of each variable was ranked as 0, 1, 2, and 3; with 0 indicating no potential habitat and 3 indicating high potential habitat. The three variables were combined to provide an overall habitat potential rating. Table 4.30 shows the specific categories of the three variables considered to provide habitat for the desert tortoise. Using this model, 3,000 ha (7,413 ac) of potential habitat is predicted to occur in the Town. These areas are contained within Conservation Zone 2 described below and depicted in Figure 4.1. The habitat model does not include entitled lands which have already been zoned for development.

TABLE 4.30
HABITAT POTENTIAL RATINGS FOR CHARACTERISTICS OF THE VARIABLES FOR THE DESERT TORTOISE HABITAT MODEL

Variable/Category	Habitat Potential Rating
Vegetation	
Sonoran Desertscrub Upland Creosote–Bursage (154.11)	1
Sonoran Desertscrub Upland Paloverde–Mixed Cacti (154.12)	3
Sonoran Desertscrub Urban Paloverde–Mixed Cacti (154.12U)	1
Slope	
10–15%	2
15–30%	3
30–50%	3
>50%	3
Land Form	
Dissected Bajadas and Fans	3
Hills with Low Relief	1
Hills with Moderate Relief	2
Mountains	3
Talus and Scree Slopes	3

4.10.1.4 Relation to Species' Range and Ecology

The Town contains tortoise habitat in the Tortolita and Tucson mountains and the caliche-incised washes on the Tortolita Fan. Valley connectivity through the Town is important in connecting populations in the mountains that surround it. Threats to this species increase with proximity to urbanized areas due to road-kill, loss of water if they are picked up, increased disease occurrence in urban areas, predation by dogs, illegal collection, habitat loss, increased fire hazard due to the presence of invasive species, and individuals being killed during construction activities.

4.10.2 Potential Impacts of Town's Proposed Activities

4.10.2.1 Direct Effects

Development and CIP activities have the potential to directly and indirectly harm desert tortoises. If construction occurs during the winter, construction activities can cause mortality or injury to tortoises that are likely to be in underground burrows during that time of year. During the summer, when tortoises are active, they can be vulnerable to direct mortality and injury from construction equipment and vehicle traffic. Desert tortoises that are displaced by construction could experience higher mortality while searching for suitable, unoccupied habitat. Urban development could result in mortality or injury to desert tortoises. Increased road network development can allow greater access to tortoise habitat and thereby increase the potential for illegal collection.

4.10.2.2 Indirect Effects

Desert tortoises can be adversely affected through indirect mechanisms facilitated or caused by urban development. New roads and increased traffic can increase mortality from vehicle strikes. Roadways also often act as the first point of entry for invasive species into a new landscape, and can serve as a corridor along which plants move farther into the landscape (Lonsdale and Lane 1994, Greenberg et al. 1997). Tracy et al. (2006) suggested that an invasion of high-fiber grass weeds such as buffelgrass (*Pennisetum ciliare*) may limit access of desert tortoise hatchlings and juveniles to diets lower in fiber and may negatively impact the physiological and behavioral ecology of young desert tortoises. Over the longer term, conversion of suitable habitat to urban uses could result in take of desert tortoises through a variety of mechanisms, including reduced or degraded burrowing opportunities and increased predation associated with urban development. Other threats to the tortoise include illegal collecting, loss of water when picked up, increased disease occurrence in urban areas, and increased fire hazard related to invasive, non-native species.

4.10.2.3 Changes in Habitat

Based on the habitat model, there are 3,000 ha (7,413 ac) of modeled desert tortoise habitat in the Permit Area. Under the HCP, a total of 611 ha (1,510 ac) of modeled habitat for this species would be impacted by CIP and development activities (Table 4.31). Much of modeled desert tortoise habitat occurs along the slopes of the Tortolita Mountains and may be unsuitable for development based on the percent slope of these areas. The remaining 2,389 ha (5,903 ac) of habitat would be protected as NUOS.

A summary of impacts from development, both within and outside the Conservation Zones, is provided in Table 4.32. Figures 4.25 and 4.26 show the distribution of modeled desert tortoise habitat in the Town in relation to CIP activities and existing development and entitled lands, respectively.

4.10.2.4 Population Effects

The Town serves as a connector between populations in the mountains that surround it. Connectivity through the Town is important to prevent genetic isolation and to prevent “blinking out” (extirpation) of isolated populations. Threats to this species increase with proximity to urbanized areas due to road-kill, loss of water if they are picked up, increased disease occurrence in urban areas, predation by dogs, illegal collection, habitat loss, increased fire hazard due to the presence of invasive species, and individuals being killed during construction activities.

TABLE 4.31
SONORAN DESERT TORTOISE MODELED HABITAT AND PROJECTED FUTURE IMPACTS IN THE TOWN

Type of Habitat or Impact	Area
Modeled habitat	3,000 ha (7,413 ac)
Total habitat impacted by Town's CIPs	1 ha (4 ac)
Total habitat impacted by development within HCP Conservation Zones	598 ha (1,477 ac)
Total habitat impacted by development outside of HCP Conservation Zones	12 ha (29 ac)
Total Impacts	611 ha (1,510 ac)
Total NUOS	2,389 ha (5,903 ac)

* These figures are derived from Table 4.32.

TABLE 4.32
SUMMARY OF DEVELOPMENT IMPACTS TO SONORAN DESERT TORTOISE HABITAT

	Sonoran desert tortoise Modeled Habitat	Percent allowable impact by Zone	Area impacted
Zone 1	0	0.05	0
Zone 2	2,988 ha (7,384 ac)	0.20	598 ha (1,477 ac)
Zone 3	0	0.30	0
Zone 4	0	1.00	0
Habitat not in Zones	12 ha (29 ac)	1.00	12 ha (29 ac)
Proposed Wildlife Linkages	0	0.05	0
Existing Wildlife Linkages	0	N/A	0
Total	3,000 ha (7,413 ac)	N/A	610 ha (1,506 ac)

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Figure 4.25

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Figure 4.26.

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4.10.2.5 Anticipated Take

There is a likelihood of lethal take for the Sonoran desert tortoise due to construction, collection, predation, and road-kill, with potential take of an estimated 10 individuals over the 25-year duration of the Permit. Take in the form of harm due to forage loss, habitat loss, and fragmentation is also expected, with an estimated loss of 611 ha (1,510 ac) of modeled tortoise habitat. There are approximately 552 ha (1,365 ac) of modeled habitat for this species in entitled private land that could potentially be included under the HCP if the landowners voluntarily choose to be covered under the HCP. If the Sonoran desert tortoise becomes listed under the ESA, voluntary inclusion would provide certainty of conservation requirements and eliminate the necessity of individual landowners and the Town conducting Section 7 consultation with the USFWS for activities that potentially affect this species or its habitat and have a Federal nexus because of the consultations outlined in Section 1.6.

4.10.3 Biological Goals and Objectives

The Town's biological goals and objectives for desert tortoises relate to maintaining suitable habitat within the Town to allow this species to carry out its full life cycle. Specifically, the Town's biological goal for the desert tortoise is to contribute to maintaining local and regional populations of desert tortoises.

The Town's specific objectives are to:

- Minimize disturbance and fragmentation of existing suitable desert tortoise habitat
- Minimize lethal take of desert tortoises
- Provide for the long term availability of desert tortoise habitat
- Maintain habitat connectivity in critical movement corridors for desert tortoises

4.10.4 Conservation Measures

A comprehensive conservation strategy for this species has been identified to achieve the goal and objectives outlined above. The strategy focuses on the protection of large tracts of undisturbed desert tortoise habitat east of I-10, as well as connectivity between the existing and any future reserves and surrounding habitat areas and larger regional movement corridors. The specific conservation measures that the Town will implement are detailed below.

Sonoran Desert Tortoise Measure 1. The Town will continue to manage the existing 2,400 ac Tortolita Preserve and other Section 7 consultation lands under Town management, in a manner consistent with Sonoran desert tortoise survival and recovery.

Sonoran Desert Tortoise Measure 2. The Town will identify and delineate ESL within its General Plan (Figure 4.2), including areas of Sonoran desert tortoise habitat. Within the ESL, the Town will develop and implement ESRDG requiring a detailed evaluation and consideration of biological, cultural, and visual resources in the design, construction, and mitigation of road and utility projects in designated areas. Using the ESRDG, appropriate site-specific design criteria will also be developed for each project to promote Sonoran desert tortoise habitat protection and promote habitat connectivity.

Sonoran Desert Tortoise Measure 3. The Town will establish four habitat Conservation Zones (see Figure 4.1) to provide foraging and movement corridors for wildlife, including desert tortoise. Conservation Zone 1 provides no significant habitat for the Sonoran desert tortoise. Conservation Zone 2 will encompass all the modeled desert tortoise habitat. Conservation Zones 3 and 4 will provide important dispersal habitat. The zones will have the following restrictions:

- Zone 2 will generally consist of all ESL east of I-10, starting 0.8 km (0.5 mi) south of Moore Road and extending north to the Town boundary, and including ESL on the northern extension of the Tucson Mountains. Within Zone 2, the Town will:
    - Cooperate with and support regional land-use planning efforts to establish a permanent reserve on the Tortolita Fan, providing desert tortoise habitat. This support may be in the form of coordination with ASLD, dedication of monies, management responsibility or assistance, or other means to be determined in consultation with the USFWS. The establishment of a permanent reserve will be the preferred conservation measure within Zone 2.
    - Require ASLD parcels that are sold to private entities requesting an up-zoning—if a permanent reserve can not be developed or until such a reserve is developed—to conserve 80 percent of the parcel in perpetuity as NUOS. These conservation areas will include those portions of the parcel that support the highest habitat values. Open space must provide wash protection and be configured to complement any adjacent protected open space, including Pima County's Conservation Lands System, as well as provide north-south habitat connectivity across the Tortolita Fan.
- Zone 3 will generally consist of all ESL in the uplands adjacent to the Santa Cruz River, and east of I-10, starting 1.5 km (1 mi) south of Tangerine Road. There will also be a buffer of Zone 3, 0.5 km (0.3 mi) in width, between Zone 4 and the Tortolita Preserve, from the eastern edge of the preserve west to the CAP canal. Within Zone 3, the Town will:
    - Extend wildlife linkages across Tangerine to the I-10/Avra corridor. Target width of the linkage will be 305 m (1,000 ft), as allowed by existing constraints, with goal of 95 percent protection (the 5 percent disturbance would account for

driveway crossings and other minimal disturbances). Existing wildlife linkages across Tangerine Road will be preserved and widened when the road is widened.

- Target NUOS in all other areas of the Zone to achieve a goal of 70 percent, with a minimum of 40 percent on-site. Open space must provide wash protection and be configured to compliment any adjacent protected open space, as well as provide north-south habitat connectivity across the Tortolita Fan. If less than 70 percent on-site NUOS is proposed, alternative mitigation would be required to make up any difference. This alternative mitigation could be in a number of forms. Suitable off-site lands may be acquired at an appropriate ratio and conserved for the benefit of the Sonoran desert tortoise. Mitigation funds may be contributed to the Town to support Sonoran desert tortoise conservation efforts including, but not limited to research, surveys, habitat acquisition, and augmentation efforts. Development alternatives will be allowed if the parcel developer can demonstrate their project meets intent and NUOS goals listed above; any such alternative development must have USFWS and Town approval.

- Zone 4 will generally consist of all ESL east of I-10, 1.6 km (1 mi) north and south of Tangerine Road, except at the section of Zone 3 that will serve as a buffer between high-intensity development and the Tortolita Preserve. Within Zone 4, the Town will:

  - Allow 100 percent development outside the wildlife linkages. There are no NUOS goals established for Zone 4, outside of the designated linkages, because the proposed development limits and NUOS objectives within all of the other zones, as well as the three wildlife linkages extending across Tangerine Road (see Figure 4.1) will mitigate the proposed impacts within the entire permit area as a whole.

  - Extend three linkages across Tangerine Road (see Figure 4.1). The target width of each linkage will be 305 m (1,000 ft), as allowed by existing constraints, with a goal of 95-percent protection, except for future Tangerine Road improvements. The boundaries of the wildlife linkages will be established such that all parcels will retain opportunities for allowed land use. Additional benefits to covered species may also be achieved through on-site development configurations of the covered activities.

  - Implement the Town's ESRDG for Tangerine Road improvements and include wildlife crossings aligned with the wildlife linkages above, and/or any new linkages identified through future research and monitoring.

Sonoran Desert Tortoise Measure 4. The Town will minimize impacts to desert tortoise dispersal and movement corridors through the following measures:

- Support efforts to purchase, preserve, and enhance parcels needed for a regional movement corridor across I-10 encompassing the former railroad underpass south of Avra Valley Road and any adjacent lands that are appropriate (see Figure 4.1).

- Limit the types of development within the floodway of the Santa Cruz River to those uses permissible under Title 21 of the LDC.

- Require that continuity of NUOS be maintained within and among developments subject to discretionary action and that open space be located in a manner that preserves wildlife access and movement within and through the site, consistent with adjacent efforts to do the same.

- Enforce restrictions in the Town Code (Title 12-4-2 Traffic) against OHV travel in publicly owned washes or other public lands when activities damage native vegetation or create significant erosion.

- Identify in the Environmental Element of its General Plan the importance of riparian areas as wildlife habitat and movement corridors.

- Incorporate specific design requirements into Title 17 for riparian habitat protection and mitigation, including mitigation for each acre of impact at a ratio ranging from 1.5:1 up to 4:1, depending on the type of mitigation and distance from the impact location (see Section 4.0, Table 4.5, for details). The Town would also adopt a Riparian Habitat Map (see Figure 3.3) linked to the revised Title 17.

Sonoran Desert Tortoise Measure 5. The Town will minimize lethal take of desert tortoises through the following actions:

- Incorporate development guidelines into Title 17 of the LDC requiring species-specific habitat evaluations. These guidelines will require proponent of projects within Town-modeled desert tortoise habitat to evaluate project areas and to conduct pre-construction surveys where such habitat exists. These surveys will utilize a USFWS-approved protocol or a modified survey methodology as approved by USFWS.

- Require construction personnel to follow *AZGFD Guidelines for Handling Desert Tortoises Encountered During Development Projects* when desert tortoises are detected prior to construction, either incidentally or through focused surveys. This provision will apply to all lands within the Town limits. This guidance will be included as a General Note on all Grading and Improvement Plans for reference by on-site construction personnel.

Sonoran Desert Tortoise Measure 6. The Town will update Title 17 of the LDC to include invasive species management guidelines. An inventory of all state and Federally protected plant species, saguaro cacti, and ironwood trees shall also be conducted within the area not included in the NUOS. Native plants removed from the site,

damaged, or destroyed during development shall be replaced by plants of the same genus and species at a 1:1 ratio.

Sonoran Desert Tortoise Measure 7. The Town will develop and implement an educational program designed to inform the general public, specific neighborhoods, permit applicants, and contractors of the various requirements of the HCP and their associated benefits to species and habitats. Education will include information on the AZGFD and ASDM "Adopt-A-Tortoise" Program to reduce the level of illegal collection. The educational program will also provide resources and instruction for Town personnel involved in operations and maintenance activities. These measures will include training on dirt road maintenance procedures developed by the Quivira Coalition (2006) that minimize the creation of barriers to desert tortoise movements.

Sonoran Desert Tortoise Measure 8. The Town will require that all development plans submitted to the Town for review and approval contain a narrative discussion documenting compliance with the conservation measures outlined and approved in the final HCP. This statement shall include maps and other graphics and analyses necessary to document this compliance. The submittal shall outline monitoring programs to document compliance with applicable grading limitations and the conservation measures approved in the HCP. This documentation also will include a drainage report that demonstrates that the proposed development will not significantly degrade the hydrologic regime of the property and includes an evaluation of the habitat impacts associated with the proposed drainage modifications.

Sonoran Desert Tortoise Measure 9. The Town will require project proponents to establish and maintain a conservation easement (preferred) or restrictive covenant on all NUOS, in Conservation Zones 1, 2, or 3 and wildlife linkages mapped in Figure 4.1,to be held by an approved third party or the Town, or with third party rights of enforcement. This easement or deed restriction will be recorded prior to initiation of construction. The Town will require that the terms of the conservation easement or restrictive covenant include, but are not limited to the following requirements. To provide a consistent conservation effort, home owners associations shall also adapt the following as CC&Rs:

- Natural undisturbed open space will be maintained in a natural condition, except as approved by USFWS. A management plan must be submitted to and approved by the USFWS within 6 months of the initiation of construction activities.

- Prior to occupancy of a residential lot, the disturbance limits of the lot shall be enclosed by temporary or permanent fencing unless prohibited by rocky ledges or other cost-prohibitive conditions; in that case flagging or some other method of delineation may be used if the Town concurs. If the disturbance limits represent only a portion of a larger lot, the property line of that lot may not be fenced.

- Lot owners will be required to contain all domestic animals within the enclosed lot or keep them under strict control at all times. Pets that are outside of enclosed areas shall be leashed in conformance with Pima County Code 6.04.030.

- Native plants will be salvaged and replanted from any authorized disturbances, as approved by USFWS, which occur within the NUOS.

- No development or other activities are permitted in the NUOS except for approved pedestrian trails, developed in a manner that will avoid and minimize disturbance and removal of vegetation, and minor utility crossings (these will be revegetated).

- The invasive species management guidelines will be implemented in accordance with the revised Title 17 to control invasive species.

- Landscape and plantings outside of developed common areas and the enclosed area of individual lots will be restricted to native, drought-tolerant plants. Planting of non-native, invasive species is prohibited. A proposed list of prohibited plants can be found in Appendix 4. Landscaping will not be allowed in NUOS.

- The following activities are prohibited within the NUOS: (a) use of firearms, (b) any OHV use, (c) use of pesticides or herbicides for purposes other than controlling invasion of exotic species, and (d) racing events or other publicized events that attract large crowds, (e) the use of fires or barbeques.

4.10.5 Effects of Implementing the HCP on Sonoran Desert Tortoise

Proposed future CIP and development activities in the Town could directly impact up to 611 ha (1,510 ac) of modeled habitat for desert tortoises in the Town during the term of the Permit. Under the HCP, approximately 2,389 ha (5,903 ac) of modeled desert tortoise habitat would remain protected as NUOS.

The Town's conservation approach for this species is to retain modeled habitat and movement corridors within the Town. Under the HCP, the Town would minimize disturbance to suitable habitat within the Town by requiring that development within the Town comply with limits on maximum allowed disturbance and comply with the restrictions and mitigation requirements within and being developed for the Town's Land Use Code. Likewise, the Town would avoid lethal take of this species through requirements for preconstruction surveys.

4.10.6 Sonoran Desert Tortoise Monitoring Program

The Town will require project proponents to conduct pre-construction surveys (presence/absence) for Sonoran desert tortoise using the survey protocol and timing of

survey guidelines recommended by the AZGFD (1999) and the *Guidelines for Handling Sonoran Desert Tortoises Encountered on Development Projects* (1997) included in Appendix 4.

Habitat monitoring will consist of using GIS and aerial photography to detect changes in vegetation and in land use to assure that the amount of open space set-aside complies with the HCP Conservation Zone and wildlife linkages requirement. The Town will also monitor for invasive species and implement an invasive species management plan. A database will be maintained to ensure that areas designated as NUOS are preserved in a natural state, to maintain connectivity and foraging opportunities through the preservation of native vegetation species. A base year of vegetation monitoring will be performed once open space is set aside, and then every three years thereafter. The Town will cooperate as appropriate with any future regional research and monitoring projects to clarify the status of the Sonoran desert tortoise in the Permit Area. Species and habitat monitoring are described in greater detail in Chapter 6 of this document.

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4.11 Tucson Shovel-Nosed Snake (*Chionactis occipitalis klauberi*)

4.11.1 Existing Conditions

4.11.1.1 Species Ecology, Rangewide Status, Distribution, and Threats

The Tucson shovel-nosed snake (shovel-nosed snake) is a small snake approximately 25 to 42 cm (10 to 17 in) in length. Markings can vary considerably among individuals. Tucson shovel-nosed snakes have a cream-colored, whitish, or yellowish body with 21 or more black or brown bands across the back, reaching almost to the belly or completely encircling the body. Between those bands are black or brown smaller bands. The snout is flattened and shaped somewhat like a shovel.

The Tucson shovel-nosed snake has been found in an area from northern Pima County, across southern Pinal County, into southern Maricopa County, in Arizona. Soil type is an important habitat feature for the Tucson shovel-nosed snake, with loose, sandy soil being suitable for shovel-nosed snake habitat. These soil types facilitate the snake's movement, which is accomplished by a swimming, sideways swaying motion under the surface of the soil. It has been found in xeroriparian scrub, creosote bush areas, Sonoran desertscrub, and mesquite bosques. The shovel-nosed snake eats insects, spiders, scorpions, centipedes, and buried moth larvae. They prefer soft-bodied prey over hard-bodied prey.

This species is protected by Arizona State law (ARS Title 17). In 2004, the USFWS was petitioned to list the Tucson shovel-nosed snake and to designate critical habitat. The Center for Biological Diversity cited in its petition the potential threats to the shovel-nosed snakes, including urban development, the inadequacy of existing regulations, drought, and climate change. The USFWS issued its 90-day finding (73 FR 43905) in response to the petition in July 2008 and found that the shovel-nosed snake may warrant Federal protection as endangered or threatened under the ESA and has initiated a 12-month status review.

This particular subspecies is rare, but the genetics of the more common western shovel-nosed snake group, of which the Tucson shovel-nosed snake is a part, needs to be clarified. Additional information on the ecology and status of the Tucson shovel-nosed snake can be found in Appendix 3.

Suitable habitat for the Tucson shovel-nosed snake has been modeled for the Town. No recent records are known within the Permit Area, but additional survey effort is needed.

Because this subspecies is so uncommon and being evaluated for Federal listing, it is included as a covered species in the HCP.

4.11.1.2 Population in and Near the Town

The last record of the Tucson shovel-nosed snake in the vicinity of the Town was at Sanders Road and Avra Valley Road in 1982. It is unknown whether the species persists within the Town boundaries. It was not observed during surveys in 2003 initiated during the latter half of the species seasonal activity cycle (Rosen 2003b). Rosen (2008a) reported a 2006 photo-voucher specimen of a Tucson shovel-nosed snake from south of Picacho Reservoir. In 2007, during surveys in northeastern Pima County and southeastern Pinal County, Arizona, three shovel-nosed snakes were found in Pinal County; two north of Picacho Peak, and one on the lowest bajada north of the West Silverbell Mountains (Rosen 2008b).

No Tucson shovel-nosed snakes were documented within the Town during a full season of surveys in 2007, or during 2008 surveys in Avra Valley (Rosen, unpublished data). In 2008, one shovel-nosed snake was found near Ajo, Arizona, one was found in the Sonoran Desert National Monument on State Route 238, and one was found on a dune in the Pinacate Biosphere Reserve, Mexico (Rosen 2008a).

4.11.1.3 Habitat in and Near the Town

Rosen (2003b) identified suitable habitat for the Tucson shovel-nosed snake in or near the Town as remaining in the Avra Valley, including portions of the Town. Areas of potential habitat include: around the Town's airport; north of Twin Peaks Road between Tucson Mountains and Sanders Road; northwest of Avra Valley Road and Sanders Road between Silverbell Road and the agricultural fields southwest of the Brawley Wash diversion channel; the large area south of Avra Valley Road to about 2 miles south of the Magee Road alignment, from Pump Station and Anway; and roads east across the Brawley flats to Avra Valley Road or Sanders Road (Rosen 2003b).

Potential habitat for the Tucson shovel-nosed snake was modeled using methods developed as part of Pima County's Sonoran Desert Conservation Plan (RECON 2002). The habitat model, developed by Rosen, consisted of three primary variables: (1) land use, (2) elevation, and (3) soils. The habitat value of the categories of each variable were ranked as 0, 1, 2, and 3, with 0 indicating that the category provide no habitat value and 3 indicating that the category provided high habitat value. The three variables were combined to provide an overall habitat value (Table 4.33).

TABLE 4.33
REVISED SDCP MODEL FOR TUCSON SHOVEL-NOSED SNAKE
VALUE RATING RECOMMENDED BY DR. PHIL ROSEN

Variable/Category	Value Rating
Land Use	
Developed areas	Mask
Active agriculture	Mask
Elevation	
< 640 meters	3
640–670 meters	2
670–700 meters	1
> 700 meters	Mask
Soils	
Sandy loam	3
Sandy clay loam	3
Clay loam	3
Loam (except Gila loam)	3
Gila loam	2
Silty clay loam	2
Clay	1
Gravelly loam	2

Rosen concluded that soils provided the best and most logical predictor of habitat for Tucson shovel-nosed snakes. Higher elevations (greater than 700 meters or about 2,300 feet), were masked as the species records indicate that the higher areas cannot support the species. Agricultural lands were masked because soil conditions have been modified to an extent that they could not support this species. Developed areas also were masked because these areas do not provide suitable soils for shovel-nosed snakes.

Landform, as used in the SDCP model, did not appear to be important other than as a predictor of soil conditions. Other than Creosote bush (*Larrea tridentata*)–Bursage (*Ambrosia dumosa*), vegetation also was determined to be a poor predictor relative to soil type. After looking at habitat model results based on soils, elevation, and vegetation, Rosen concluded that the use of vegetation resulted in an inaccurate emphasis on areas with less potential for snakes and de-emphasized areas of higher quality habitat. Vegetation was therefore omitted from the habitat model. The habitat model does not include entitled lands which have already been zoned for development.

4.11.1.4 Relation to Species' Range and Ecology

The Town and vicinity represent a small and likely inconsequential portion of this widely distributed species' range (i.e., most of the Mohave and Sonoran deserts). The range of the subspecies under consideration here extends from southeastern Maricopa County through southwestern Pinal County to northern Pima County, inclusive of the Town. Relative to the rest of Pima County, the modeled habitat within the Town represents less

than 4 percent of the estimated 135,449 ha (334,703 ac) of potential habitat in the County. It is possible that the Tucson shovel-nosed snake might only be available for long-term conservation in the area of Mobile, Arizona (Rosen 2003b).

4.11.2 Potential Impacts of Town's Proposed Activities

4.11.2.1 Direct Effects

Urban development has the potential to directly and indirectly harm the shovel-nosed snake if it is still present. Construction activities can cause mortality or injury to snakes. Shovel-nosed snakes that are displaced by construction activities could experience higher mortality while searching for suitable, unoccupied habitat. Construction associated with road improvement projects could result in mortality or injury to snakes through similar means.

4.11.2.2 Indirect Effects

In addition, roads and increased traffic on roads can increase mortality of snakes from vehicle strikes. Over the longer term, conversion of suitable habitat to urban uses could result in take of snakes through a variety of mechanisms, including reduced foraging opportunities, reduced or degraded denning opportunities, and increased predation associated with urban development. Alteration of habitat as a result of covered activities can change habitat conditions in such a way that banded sand snakes (*Chilomeniscus cinctus*) have a competitive advantage over Tucson shovel-nosed snakes and may displace Tucson shovel-nosed snakes over time (Rosen 2008a).

4.11.2.3 Changes in Habitat

Based on the habitat model described above, there are 5,208 ha (12,870 ac) of modeled shovel-nosed snake habitat in the Permit Area. Under the HCP, a total of 3,879 ha (9,586 ac) of modeled habitat for this species would be impacted by CIP and development activities (Table 4.34). The remaining 1,329 ha (3,284 ac) of habitat would be protected as NUOS.

TABLE 4.34
TUCSON SHOVEL-NOSED SNAKE MODELED HABITAT AND PROJECTED FUTURE IMPACTS IN THE TOWN

Type of Habitat or Impact	Area
Modeled habitat	5,208 ha (12,870 ac)
Total habitat impacted by Town's CIPs	169 ha (1,160 ac)
Total habitat impacted by development within HCP Conservation Zones	1,069 ha (2,642 ac)
Total habitat impacted by development outside of HCP Conservation Zones	2,341 ha (5,784 ac)
Total Impacts	3,879 ha (9,586 ac)
Total NUOS	1,329 ha (3,284 ac)

A summary of impacts from development, both within and outside the Conservation Zones, is provided in Table 4.35. Figures 4.27 and 4.28 show the distribution of modeled shovel-nosed snake habitat in the Town in relation to CIP activities and existing development and entitled lands, respectively.

TABLE 4.35
SUMMARY OF DEVELOPMENT IMPACTS TO TUCSON SHOVEL-NOSED SNAKE HABITAT

	Tucson shovel-nosed Snake Modeled Habitat	Percent allowable impact by Zone	Area impacted
Zone 1	542 ha (1,339 ac)	0.05	27 ha (67 ac)
Zone 2	945 ha (2,335 ac)	0.20	189 ha (467 ac)
Zone 3	407 ha (1,006 ac)	0.30	122 ha (302 ac)
Zone 4	718 ha (1,774 ac)	1.00	718 ha (1,774 ac)
Habitat not in Zones	2,341 ha (5,784 ac)	1.00	2,341 ha (5,784 ac)
Proposed Wildlife Linkages	256 ha (632 ac)	0.05	13 ha (32 ac)
Existing Wildlife Linkages	0	N/A	0
Total	5,208 ha (12,780 ac)	N/A	3,410 ha (8,426 ac)

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Figure 27

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Figure 28

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4.11.2.4 Population Effects

Tucson shovel-nosed snakes have been documented by Rosen (2007, 2008b) in the general vicinity of the Town. This species is relatively specialized to occupy loose, sandy loam with more open habitat because it uses “sand-swimming” as its main movement pattern (FR 73:43905-43910). The area between Tucson and Phoenix includes most of the current range of the Tucson shovel-nosed snake, mainly concentrated “west of Tucson northward along Avra Valley Road to Pinal County, and westward into Maricopa County” (ibid). The Town is located in what is thought to be the current range of this subspecies and may be important for habitat and connectivity. Conversion of desert to agriculture, roads, and urban areas have reduced and fragmented the amount of habitat available.

4.11.2.5 Anticipated Take

The potential exists for lethal take of this species due to construction, collection, predation, or road-kill, with potential take of an estimated two individuals over the 25-year duration of the Permit. Take in the form harm due to forage loss, habitat loss, and fragmentation is also expected. The anticipated shovel-nosed snake habitat loss is 3,879 ha (9,586 ac). There are approximately 296 ha (732 ac) of modeled habitat for this species in entitled private land that could potentially be included under the HCP if the landowners voluntarily choose to be covered under the HCP. If the Tucson shovel-nosed snake becomes listed under the ESA, voluntary inclusion would provide certainty of conservation requirements and eliminate the necessity of individual landowners and the Town conducting Section 7 consultation with the USFWS for activities that potentially affect this species or its habitat and have a Federal nexus because of the consultations outlined in Section 1.6.

4.11.3 Biological Goals and Objectives

The Town’s biological goal for the Tucson shovel-nosed snake is to contribute to maintaining local and regional populations of the Tucson shovel-nosed snake.

The Town’s specific objectives are to:

- Contribute to the conservation of regional Tucson shovel-nosed snake populations
- Minimize lethal take of Tucson shovel-nosed snakes

4.11.4 Conservation Measures

Developing a conservation strategy for the Tucson shovel-nosed snake is complicated by lack of recent records of the snake in the Town. There have been no detections in the

Town since 1979. Much of the modeled habitat for the Tucson shovel-nosed snake is located outside of the Conservation Zones. Therefore, conservation measures proposed for this species include collaboration with other jurisdictions on regional conservation activities including the restoration and protection of potential habitat on lands outside the Town's boundaries.

The shovel-nosed snake habitat—identified as being most important in conservation efforts at regional meetings initiated by the Town and including Rosen, the City of Tucson, Pima County, and the USFWS on February 8 and March 11, 2008—occurs outside the Town limits. Therefore, conservation efforts involving a multi-jurisdictional approach were identified as being most beneficial for the species needing open, sparsely vegetated Sonoran Desert, such as the Tucson shovel-nosed snake, ground snake, burrowing owl, and other species with similar habitat needs.

Shovel-nosed Snake Measure 1. The Town will collaborate with the City of Tucson to protect some of the more valuable shovel-nosed snake habitat within the City's jurisdiction, with the Town committing to fund mutually agreed upon conservation measures focusing on surveys of known populations outside the Town and research to inform potential habitat restoration or species reintroduction efforts. Research may include experimental plots to evaluate the suitability of artificial sand dunes or soil mounds as habitat, and effectiveness of captive propagation methods. Additional conservation measures may include habitat restoration, fencing to exclude off-road vehicles, control of invasive species, or other measures.

Shovel-nosed Snake Measure 2. The Town will update Title 17 of the LDC to include invasive species management guidelines and an official list of plants prohibited for use in landscaping, and incorporate development standards to evaluate the design and configuration of detention basins within developments where shovel-nosed snake may exist. An inventory of all state- and Federally protected plant species, saguaro cacti, and ironwood trees shall also be required within the area not included in any area designated as a NUOS. Native plants removed from the site, damaged, or destroyed during development shall be mitigated in accordance with the revised Title 17.

Shovel-nosed Snake Measure 3. The Town will incorporate into Title 20 of the LDC language to minimize development on culturally sensitive lands between Los Robles Wash and the Santa Cruz River that also support modeled shovel-nosed snake habitat.

Shovel-nosed Snake Measure 4. The Town will develop and implement an educational program designed to inform the general public, specific neighborhoods, permit applicants, and contractors of the various requirements of the HCP and the associated benefits to species and habitats. The educational program will also provide resources and instruction for Town personnel involved in operations and maintenance activities.

4.11.5 Effects of Implementing the HCP on Tucson Shovel-nosed Snakes

Proposed future CIP and development activities in the Town could directly impact a total of 3,867 ha (9,556 ac) of modeled habitat for this species. Under the HCP, approximately 1,341 ha (3,314 ac) of habitat would be protected as NUOS. Additional acreages of habitat will be protected or restored outside the Town boundaries through actions with the City of Tucson.

The Town's goal is to contribute to maintaining local and regional populations of the Tucson shovel-nosed snake. This goal will be accomplished through working with the City of Tucson and Pima County by committing to fund mutually agreed upon conservation measures such as surveys, habitat restoration, fencing to exclude off-road vehicles, control of invasive species, or other measures, on potential habitat on City of Tucson or Pima County lands. This subspecies' ability to persist is dependent on conservation measures taken on larger tracts of habitat in Pima County west of the Town and in the Picacho, Florence, and Mobile areas in Pinal and Maricopa counties. In light of this circumstance, the Town's conservation strategy is to mitigate the loss of suitable habitat from development by protecting habitat for the snake outside of the Town in areas of higher quality habitat and where the snake is believed to still persist. This strategy would result in protection of important suitable habitat that is, where possible, contiguous with other lands receiving protection. The net result over the life of the HCP Permit would be more suitable habitat receiving protection regionally than would occur if the HCP were not implemented.

4.11.6 Tucson Shovel-nosed Snake Monitoring Program

The Town will look for opportunities to obtain grants or support cooperators to conduct surveys or research on Tucson shovel-nosed snakes. Occupied sites identified within the Town boundaries will be prioritized for monitoring and research. In addition, the Town will implement monitoring measures on Tucson Water Lands if a cooperative agreement is reached.

Monitoring will consist of habitat monitoring using GIS and aerial photography to detect changes in vegetation and in land use to assure that the amount of NUOS set-aside complies with the HCP Conservation Zone and Wildlife Linkages requirements. The Town will also monitor for invasive species and implement an invasive species management plan. A database will be maintained to ensure that areas designated as NUOS are preserved in a natural state, to maintain connectivity and habitat through the preservation of native species. A base year of vegetation monitoring will be performed once open space is set aside, and then every three years thereafter. Monitoring will also focus on occupancy and population trends in research areas and restoration sites.

Species and habitat monitoring are described in greater detail in Chapter 6 of this document.

4.12 Lowland Leopard Frog (*Rana yavapaiensis*)

4.12.1 Existing Conditions

4.12.1.1 Species Ecology, Rangewide Status, Distribution, and Threats

The lowland leopard frog is a medium-sized frog. The dorsal field color of adults is light gray–green, green, tan, or brown, with dark brown spots and no halos. Adults can be distinguished from other leopard frogs by their prominent dorsolateral folds that are discontinuous posteriorly and deflected medially in the sacral area. The venter is cream-colored, and the yellow pigment of the groin often extends posterior to the venter and to the ventral portions of the legs.

The historical range of the lowland leopard frog included the lower elevations of the lower Colorado River and its tributaries in Nevada, California, Arizona, and New Mexico in the U.S., as well as northern Sonora and extreme northeast Baja California in Mexico. The current distribution is much reduced and this species now occurs primarily in Arizona. The lowland leopard frog requires permanent water below 1,700 m (5,500 ft) in elevation. This frog prefers small- to medium-sized streams over ponds, stock tanks, and other aquatic habitats. Adult frogs eat algae, plant tissue, organic debris, and probably small invertebrates.

Population numbers and the range of the lowland leopard frog are declining. Some large die-offs have occurred. This species is threatened by loss and degradation of aquatic habitats, predation by non-native species (including fish and bullfrogs), the invasion of the Rio Grande leopard frog, and disease. The lowland leopard frog currently receives no Federal protection under the ESA but is protected by Arizona State law (ARS Title 17). Additional information on the ecology and status of the lowland leopard frog can be found in Appendix 3.

The effluent-supported riparian habitat within the Town supports potential lowland leopard frog habitat. Covered activities will impact potential habitat within the Permit Area. This is a declining and rare species. For these reasons, it has been included for coverage under the Marana HCP.

4.12.1.2 Population in and Near the Town

According to the AZGFD HDMS (2007), no lowland leopard frogs have been documented within the Town. The current distribution of this species is central and southeastern Arizona, with nearly 60 percent of all localities occurring in Gila, Maricopa

and Yavapai counties. The nearest confirmed locations of this species to the Town are in Redington Pass and Saguaro National Park, East Unit, in the Rincon Mountains.

4.12.1.3 Habitat in and Near the Town

Effluent-supported riparian habitat along the Santa Cruz River, within Conservation Zone 1, may contain patches of aquatic habitat potentially suitable for lowland leopard frogs. While the effluent provides a consistent source of water in portions of the river, the habitat along the river is strongly influenced by the interaction of flooding frequency and intensity, variation in infiltration rates, and the amount of regional groundwater pumping, resulting in the spatial and temporal variability of potentially suitable lowland leopard frog habitat (CH2MHill 2003). Water quality within the effluent-supported reaches is another concern. Existing research suggests that many of the byproducts in effluent, such as pesticides, surfactants, fertilizers, are potentially harmful to amphibians (Broomhall 2004).

Modeled habitat for lowland leopard frogs was developed by considering primarily hydrology and secondarily vegetation, specifically tropical-subtropical swamp, Sonoran deciduous swamp, and riparian scrub series. Using this model, 680 ha (1,680 ac) of potential habitat is predicted to occur in the Town. These areas are contained within Conservation Zone 1 described below and depicted in Figure 4.1. The habitat model does not include entitled lands which have already been zoned for development.

4.12.1.4 Relation to Species' Range and Ecology

Given the isolation of the perennial reach of the Santa Cruz River and the potentially low water quality, the level of potential importance of habitats in the Town for lowland leopard frogs is uncertain. Nevertheless, the limited availability of perennial aquatic habitat within the range of this species makes all potential habitat areas valuable. If water quality is improved and perennial flow can be assured, this species could return to the aquatic habitat within the Santa Cruz River.

4.12.2 Potential Impacts of Town's Proposed Activities

4.12.2.1 Direct Effects

Direct effects to leopard frogs may result from mortality from construction equipment and from loss of aquatic habitat. Because activities within the floodway of the Santa Cruz River will be limited, disturbance to aquatic habitat and the adjacent riparian vegetation from construction are expected to be minimal. Further, because construction will occur following surveys, the number of individual frogs potentially affected is likely to be low.

4.12.2.2 Indirect Effects

Lowland leopard frogs can be adversely affected through indirect mechanisms facilitated or caused by or associated with urban development. Specifically, these may include increased unauthorized public access to the floodway and introduction of invasive species, including bullfrogs, and increased erosion resulting from increased storm-water runoff. Rosen (2008c) performed amphibian surveys near the Town limits in the Avra Valley in 2004–2006, and reported the presence of bullfrogs during the survey: "Although in the past the lowland leopard frog occurred in the valley in numerous localities associated with agriculture and stock ponds, [they] have been replaced by bullfrogs" (Rosen 2008c). Increased levels of fertilizer, pesticides, and predation by domestic cats are other potential threats to the lowland leopard frog as development increases.

4.12.2.3 Changes in Habitat

Based on the habitat model, there are 680 ha (1,680 ac) of modeled leopard frog habitat in the Permit Area. Under the HCP, a total of 153 ha (378 ac) of modeled habitat for leopard frogs would be impacted by CIP and development activities (Table 4.36). The remaining 527 ha (1,302 ac) of habitat would be protected as NUOS.

Figures 4.29 and 4.30 show the distribution of modeled lowland leopard frog habitat in the Town in relation to CIP activities and existing development and entitled lands, respectively. A summary of impacts from development, both within and outside the Conservation Zones, is provided in Table 4.37.

TABLE 4.36
LOWLAND LEOPARD FROG MODELED HABITAT AND PROJECTED FUTURE IMPACTS IN THE TOWN

Type of Habitat or Impact	Area
Modeled habitat	680 ha (1,680 ac)
Total habitat impacted by Town's CIPs	54 ha (133 ac)
Total habitat impacted by development within HCP Conservation Zones	33 ha (83 ac)
Total habitat impacted by development outside of HCP Conservation Zones	66 ha (162 ac)
Total Impacts	153 ha (378 ac)
Total NUOS	527 ha (1,302 ac)

* These figures are derived from Table 4.37.

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Figure 4.29

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Figure 4.30

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TABLE 4.37
SUMMARY OF DEVELOPMENT IMPACTS TO LOWLAND LEOPARD FROG HABITAT

	Lowland leopard frog Modeled Habitat	Percent allowable impact by Zone	Area impacted
Zone 1	603 ha (1,490 ac)	0.05	30 ha (75 ac)
Zone 2	0	0.20	0
Zone 3	11 ha (28 ac)	0.30	3 ha (8 ac)
Zone 4	0	1.00	0
Habitat not in Zones	66 ha (162 ac)	1.00	66 ha (162 ac)
Proposed Wildlife Linkages	0	0.05	0
Existing Wildlife Linkages	0	N/A	0
Total	614 ha (1,518 ac)	N/A	99 ha (245 ac)

The Santa Cruz River is likely to run dry at some point in the future due to reuse of effluent. How soon or if this will happen is dependent on the rate of population growth and the development of effluent reuse projects. The Town currently has no authority to influence the amount of water flow in the Lower Santa Cruz River, unless the Tres Rios del Norte Restoration Project or other projects are implemented to protect conservation flows in the river.

4.12.2.4 Population Effects

The lowland leopard frog has not been documented within the Town limits, but few efforts have been made to survey for this species. Modeled habitat exists along the Santa Cruz River in the areas of effluent flow, and some impacts to this habitat are expected from covered activities. Direct and indirect effects to this species are anticipated, but due to the isolated nature of the Town's habitat, population effects are expected to be minimal. Should habitat restoration projects be implemented, improved habitat and potential for occurrence may increase the contribution of frogs in this area to the overall population.

4.12.2.5 Anticipated Take

The likelihood of lethal take for the lowland leopard frog is expected to be low, with estimated lethal take of two individuals over the 25-year duration of the Permit. Take may also occur in the form of harm due to riparian habitat loss and fragmentation. Some take through predation by non-native bullfrogs is likely, but not quantifiable. Modeled habitat loss is projected to be 153 ha (378 ac).

4.12.3 Biological Goals and Objectives

The Town's biological goals and objectives for the lowland leopard frog relate to maintaining suitable habitat components necessary for this species to carry out its life cycle. Specifically, the Town's biological goal is to contribute to maintaining local and regional populations of lowland leopard frog.

The Town's specific objectives are to:

- Minimize disturbance and fragmentation of existing or restored suitable lowland leopard frog habitat components
- Minimize lethal take of lowland leopard frogs

4.12.4 Conservation Measures

The Town does not control water flow in the Santa Cruz River and recognizes that it cannot guarantee the long term availability of lowland leopard frog habitat that is supported by a dependable water supply. Even so, the Town can minimize impacts to important components of the hydroriparian habitat along the Santa Cruz River, and reduce lethal take of individuals through the following conservation measures.

Lowland Leopard Frog Measure 1. The Town will identify and delineate ESL within its General Plan (see Figure 4.2), including areas of lowland leopard frog habitat. Within the ESL, the Town will develop and implement ESRDG requiring a detailed evaluation and consideration of biological, cultural, and visual resources in the design, construction, and mitigation of road and utility projects in designated areas. Using the ESRDG, appropriate site-specific design criteria will also be developed for each project to promote lowland leopard frog habitat protection and maintain habitat connectivity.

Lowland Leopard Frog Measure 2. The Town will establish four habitat Conservation Zones (see Figure 4.1) to protect suitable habitat for wildlife, including lowland leopard frogs. Zone 1 will generally consist of all ESL along the Santa Cruz River floodway. Within Zone 1, the Town will limit the types of development to those uses permissible under Title 21 of the LDC, which prohibits permanent structures except for bridges and bank protection, and generally maintains lowland leopard frog habitat features.

Lowland Leopard Frog Measure 3. The Town will further protect aquatic and riparian habitat components through the following actions:

- Identify in the Environmental Element of its General Plan the importance of riparian areas as wildlife habitat and movement corridors.
- Incorporate specific requirements into Title 17 for riparian habitat protection and mitigation, including mitigation for each acre of impact at a ratio ranging from 1.5:1 up to 4:1, depending on the type of mitigation and distance from the impact location(see Section 4.0, Table 4.5, for details). The Town would also adopt a Riparian Habitat Map (see Figure 3.3) linked to the revised Title 17.
- Enforce restrictions in the Town Code (Title 12-4-2 Traffic) against OHV travel in publicly owned washes or other public lands when activities damage native vegetation or create significant erosion.
- Update Title 17 of the LDC to include invasive species management guidelines and an official list of plants prohibited for use in landscaping. An inventory of all state- and Federally protected plant species shall also be required within the area not included in any area designated as a NUOS. Plants removed from the site, damaged, or destroyed during development shall be mitigated in accordance with the revised Title 17.

Lowland Leopard Frog Measure 4. The Town will minimize lethal take of lowland leopard frogs through the following actions:

- Incorporate development standards into Title 17 of the LDC requiring species-specific habitat evaluations. These standards will require project proponents to evaluate project areas for suitable lowland leopard frog habitat and to conduct pre-construction surveys where such habitat exists. These surveys will utilize a USFWS-approved protocol or a modified survey methodology as approved by USFWS (see Appendix 4).
- Notify AZGFD and USFWS to determine the appropriate course of action if leopard frogs are detected during pre-construction surveys.

Lowland Leopard Frog Measure 5. The Town will develop and implement an educational program designed to inform the general public, specific neighborhoods, permit applicants, and contractors of the various requirements of the HCP and their associated benefits to species and habitats. The educational program will also provide resources and instruction for Town personnel involved in operations and maintenance activities.

Lowland Leopard Frog Measure 6. Participate with other jurisdictions to address and promote the maintenance of water flows within the Santa Cruz River. The Town does not currently control water within the Santa Cruz River, but can work with entities that do to identify, as appropriate, potential actions to provide a conservation flow within the Santa Cruz River. If the Town does obtain control of flows within the Santa Cruz River at some point in the future, it will continue to work with other jurisdictions to plan for continued water flows in the river channel.

Lowland Leopard Frog Measure 7. The Town will work with developers, golf course managers, and private citizens to reduce the presence of bullfrogs within the Town. This measure will be tied to public outreach and education to improve the identification of areas occupied by bullfrogs, encourage the eradication of bullfrogs where they exist, and discourage the spread of bullfrogs within the Town.

4.12.5 Effects of Implementing the HCP on Lowland Leopard Frogs

Proposed future CIP and development activities in the Town could directly impact about 141 ha (348 ac) of modeled habitat for lowland leopard frogs in the Town. Under the HCP, approximately 539 ha (1,332 ac) of modeled leopard frog habitat would remain protected as NUOS.

The Town will restore a 16 ha (40 ac) wetland on a 32 ha (80 ac) site owned by the Town, which is adjacent to the Santa Cruz River at the site of an old ADOT borrow pit. The restoration will include contouring to reduce percent slope on the banks, evaluating the need for adding supplemental wetland soils or nutrients, planting native hydrophytic vegetation and riparian species identified at “reference wetland sites” in the area, removing non-native or invasive species, and providing additional treated effluent water to maintain vegetation during the dry season, and developing a monitoring and adaptive management plan for the site.

Riparian restoration projects being performed by others include Pima County Regional Flood Control District’s Cortaro Mesquite Bosque 32 ha (80 ac) riparian habitat restoration. This project was designed to increase the vegetation structure and biological diversity of the floodplain and to provide wildlife habitat, particularly forage and nesting area for birds. The planting zones consist of native cottonwood-willow trees, riparian mesquite bosque, riparian grassland-willow, xeroriparian (drier area) mesquite, and upland vegetation-grassland.

Another project that may benefit lowland leopard frogs, when it is implemented, is the Tres Rios del Norte Project which is a comprehensive restoration project on the Santa Cruz River. The USACE began conducting a feasibility study in 2001, with the three local sponsors (Pima County, the Town, and the City of Tucson). It is intended that the project

will ultimately provide opportunities for flood control, groundwater recharge, and recreation, addressing common interests and goals of Pima County, the Town, and the City of Tucson. The study area comprises a 29 km (18 mi) stretch of the Santa Cruz River corridor that extends from Prince Road north to Sanders Road. In that reach are the confluences of the Santa Cruz River with two of its major tributaries, the Rillito Creek and the Cañada del Oro Wash. Goals for the restoration plan include: restoring wetland and riparian vegetative communities within the river corridor to a more natural state and increase habitat diversity; minimizing disturbance-type impacts to proposed restoration areas; implementing a low maintenance design; reducing flood damages in specified areas; water resource management opportunities including storm water harvesting, groundwater recharge, more efficient use of effluent; maximizing use of vacant lands for restoration and utilize sand and gravel mining areas as they are retired; and providing recreational resources where possible. The Cortaro Bosque and Tres Rios restoration projects are not included as part of the HCP, but complement HCP riparian restoration goals and may increase and improve riparian, and associated aquatic, habitat through revegetation.

Under the HCP, the Town would minimize disturbance to suitable habitat within the Town by requiring that development within the Santa Cruz River floodway comply with the restrictions and mitigation requirements within and being developed for the Town's Land Use Code. Likewise, the Town would avoid lethal take of this species through requirements for preconstruction surveys.

4.12.6 Lowland Leopard Frog Monitoring Program

The Town will require project proponents to conduct pre-construction surveys (presence/absence) in suitable habitat. The surveys will follow the most current Chiricahua leopard frog (*Rana chiricahuensis*) survey protocol (which is also appropriate for lowland leopard frogs), as approved by the USFWS (see Appendix 4).

Monitoring will also consist of habitat monitoring using GIS, aerial photography, and established photo points to detect changes in vegetation and in land use to assure that the amount of NUOS set-aside complies with the HCP Conservation Zone and Wildlife Linkages requirements. The Town will also monitor for invasive species and implement an invasive species management plan. A database will be maintained to ensure that areas designated as NUOS are preserved in a natural state, to maintain connectivity and foraging opportunities through the preservation of native species. A base year of vegetation monitoring will be performed once open space is set aside, and then every three years thereafter. The Town will cooperate as appropriate with future research and monitoring projects to clarify the status of the lowland leopard frog within the Permit Area. Species and habitat monitoring are described in greater detail in Chapter 6 of this document.

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4.13 Talus Snail (*Sonorella* spp.)

4.13.1 Existing Conditions

4.13.1.1 Species Ecology, Rangewide Status, Distribution, and Threats

Talus snails are small snails, less than 2.5 cm (1 in) in diameter with globose-depressed, umbilicate shells that are generally glossy, opaque pinkish buff, fading to nearly white around the umbilicus, and having shoulder bands that are some darker shade of brown. The spire is very low and conoidal. There may be approximately 4 to 5 whorls.

Available evidence supports the hypothesis that localized taxa are relicts of a previously widespread taxa isolated by repeated episodes of isolation and dispersal as a result of past climate change. Approximately 30 species or local populations are recorded for Pima County. Talus snails live in isolated, undisturbed areas of rock, generally limestone, and mostly, if not exclusively on north-facing slopes, usually at hilltops.

One species, *Sonorella eremite*, was proposed for listing as an endangered species, but the listing was withdrawn when a conservation agreement protecting the species' habitat was finalized. It has no other Federal status under the ESA, but is protected by Arizona State law (ARS Title 17). Most species of talus snail occupy habitat of limited size. Therefore, even minor disturbances or disruption of habitat can affect the entire species. Threats to these snails include urban development, construction, mining, vandalism, and road construction and maintenance. Additional information on the ecology and status of talus snails can be found in Appendix 3.

Some potential talus snail habitat does occur in the Town, in the Tucson and Tortolita Mountains. Snail shells located near the springs in Burro Canyon of the Tortolita Mountains in 2007 (Henley pers. comm. 2008) were identified as talus snails by Jeff Sorensen, Nongame Biologist, AZGFD (Sorensen pers. comm. 2008); however, according to Marty Tuegel, USFWS, "it is hard to tell from photos of shells and even with a live snail, you need someone with a lot of experience looking at reproductive anatomy of gastropods to make the determination" (Tuegel per. comm. 2008).

4.13.1.2 Population in and Near the Town

Talus snail surveys are successful during only a very short period of time each year and survey data is limited. In addition to the snail shells located in the Tortolita Mountains, talus snails are also known to occur in the Tucson Mountains. Some of the talus snail species in localities near the Town include the Santa Catalina talus snail (*Sonorella*

sabinoensis), Tucson talus snail (*S. tucsonica*), Sonoran talus snail (*S. magdalenensis*), Baboquivari talus snail (*S. baboquivariensis*), and the Tortolita talus snail (*Sonorella tortillita*) *(*Sorensen and Tuegel, pers. comms. 2008). Populations are hard to detect due to the fact that talus snail surveys are successful during only a very short period of time each year.

There has been some interest in listing talus snails under the ESA. Because of the possibility of listing and because of the limited distribution of these species and the potential impacts of covered activities, these snails were included in the HCP.

4.13.1.3 Habitat in and Near the Town

Limestone rocks with cracks or talus formations appear to be necessary for most talus snail species. Talus slopes occur on the northern extent of the Tucson Mountains and within the Tortolita Mountains. Modeled habitat for the talus snail in the Tucson Mountains was delineated using the *Talus Slopes* layer from Pima Association of Governments, digitized from 1977 Arizona Geological Survey-supplied, paper maps as a baseline. Areas with slopes greater than 15 percent were identified as potential habitat in order to encompass the talus slope areas. A buffer of 15.24 m (50 ft) was identified as potential habitat as well in order to include the effects of dust and vehicle exhaust. This buffer size was used in the San Xavier Talus Snail Conservation Renewed Agreement (El Paso Natural Gas Company et al. 2008). The habitat model does not include entitled lands which have already been zoned for development.

4.13.1.4 Relation to Species' Range and Ecology

The total known range of many of these species is a few hundred square meters, and is isolated from any other potential habitat. Given their extreme rarity, total dependence on extremely limited habitat, and the taxonomic uncertainties of each talus snail population, all populations should be considered significant.

4.13.2 Potential Impacts of Town's Proposed Activities

4.13.2.1 Direct Effects

Relatively minor perturbations of the habitat may result in changes that impact the snails. Dirt carried by erosion may fill crevices necessary for survival, and erosion may be exacerbated by human activities. Although unlikely to occur in modeled habitat, roadway and utility construction projects have the potential to directly and indirectly harm talus snails through direct mortality and erosion. Urban development could result in mortality or injury to talus snails through similar means.

4.13.2.2 Indirect Effects

Talus snails are more likely to be adversely affected through indirect mechanisms facilitated or caused by urban development. Buffelgrass is one non-native invasive species that has spread in the Sonoran Desert and which is highly flammable, posing a danger to talus snails and other native wildlife. Additional off-site effects to micro-climates, such as altered drainage due to roads and other development, increased dust from roads and construction, and heat island effects may be deleterious to the talus snail's habitat.

4.13.2.3 Changes in Habitat

Based on the habitat model, there are 2,582 ha (6,380 ac) of potential talus snail habitat in the Permit Area. Under the HCP, a maximum of 580 ha (1,432 ac) of potential habitat for this species would be impacted by development activities; CIP activities are not expected to affect this species (Table 4.38). The remaining 2,002 ha (4,948 ac) of habitat would be protected as NUOS.

TABLE 4.38
TALUS SNAIL MODELED HABITAT AND PROJECTED FUTURE IMPACTS IN THE TOWN

Type of Habitat or Impact	Area
Modeled habitat	2,582 ha (6,380 ac)
Total habitat impacted by Town's CIPs	0
Total habitat impacted by development within HCP Conservation Zones	501 ha (1,237 ac)
Total habitat impacted by development outside of HCP Conservation Zones	79 ha (195 ac)
Total Impacts	580 ha (1,432 ac)
Total NUOS	2,002 ha (4,948 ac)

* These figures are derived from Table 4.39.

Figures 4.31 and 4.32 show the distribution of potential talus snail habitat in the Town in relation to CIP activities and existing development and entitled lands, respectively. A summary of impacts from development, both within and outside the Conservation Zones, is provided in Table 4.39.

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Figure 4.31

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Figure 4.32

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TABLE 4.39
SUMMARY OF DEVELOPMENT IMPACTS TO TALUS SNAIL HABITAT

	Talus snail Modeled Habitat	Percent allowable impact by Zone	Area impacted
Zone 1	0	0.05	0
Zone 2	151 ha (374 ac)	0.20	501 ha (1,237 ac)
Zone 3	0	0.30	0
Zone 4	0	1.00	0
Habitat not in Zones	79 ha (195 ac)	1.00	79 ha (195 ac)
Proposed Wildlife Linkages	0	0.05	0
Existing Wildlife Linkages	0	N/A	0
Total	2,582 ha (6,380 ac)	N/A	580 ha (1,432 ac)

4.13.2.4 Population Effects

The potential effect of covered activities on the talus snail's population is uncertain because the current distribution and abundance of the species in the planning area is unknown. Because talus snail species occur as small, isolated populations and most species of talus snail occupy habitat of limited size, often smaller than the footprint of a house, even minor disturbances or disruption of habitat can affect the entire species.

4.13.2.5 Anticipated Take

While it is difficult to locate talus snails, no lethal take of individuals of this species is anticipated. Some take in the form of harm due to forage loss, habitat loss, and fragmentation is likely. Although a maximum of 580 ha (1,432 ac) of talus snail habitat would be subject to impacts, Title 19 would protect areas of modeled habitat with slopes of 15 percent or greater. Therefore, the actual number of hectares of modeled habitat impacted would likely be considerably less.

Additionally, there are approximately 529 ha (1,306 ac) of potential habitat for this species in entitled private land that could potentially be included under the HCP if the landowners voluntarily choose to be covered under the HCP. If the talus snail becomes listed under the ESA, voluntary inclusion would provide certainty of conservation requirements and eliminate the necessity of individual landowners and the Town

conducting Section 7 consultation with the USFWS for activities that potentially affect this species or its habitat and have a Federal nexus because of the consultations outlined in Section 1.6.

4.13.3 Biological Goals and Objectives

The Town's biological goals and objectives for talus snails relate to maintaining suitable habitat within the Town to allow for this species to complete its entire life cycle. Specifically, the Town's biological goal for talus snails is to contribute to maintaining local populations of talus snails.

The Town's specific objectives are to:

- Minimize disturbance and fragmentation of existing suitable talus snail habitat
- Avoid lethal take of talus snails

4.13.4 Conservation Measures

The specific conservation measures that the Town will implement are detailed below. A monitoring and adaptive management program described following the conservation measures) correlates to these conservation measures.

Talus Snail Measure 1. The Town will revise language in Title 19 (Grading/Hillside Development) of the LDC to define talus slopes, to include enforcement provisions, and to prohibit rock/boulder collection from talus slopes.

Talus Snail Measure 2. The Town will avoid lethal take of talus snails by incorporating development guidelines into Title 17 of the LDC requiring species-specific habitat evaluations. These guidelines will require project proponents to identify and map the locations of talus slopes on their parcel. Where talus slopes exist, they shall be treated as having greater than 15 percent slope and the restrictions of Title 19 will apply.

Talus Snail Measure 3. The Town will update Title 17 of the LDC to include invasive species management guidelines and an official list of plants prohibited for use in landscaping. An inventory of all state- and Federally protected plant species, saguaro cacti, and ironwood trees shall also be conducted within the area not included in any area designated as a NUOS. Native plants removed from the site, damaged, or destroyed during development shall be mitigated in accordance with the revised Title 17. One non-native, invasive species of particular concern is buffelgrass, because it is highly flammable and could cause lethal take of the talus snail since the snail's habitat requires moist, cooler microclimates.

Talus Snail Measure 4. The Town will develop and implement an educational program designed to inform the general public, specific neighborhoods, permit applicants, and contractors of the various requirements of the HCP and their associated benefits to species and habitats. The educational program will also provide resources and instruction for Town personnel involved in operations and maintenance activities.

4.13.5 Effects of Implementing the HCP on Talus Snails

Proposed future development activities in the Town could directly impact a maximum of 580 ha (1,432 ac) of potential habitat for the talus snail in the Town. Under the HCP, approximately 2,002 ha (4,948 ac) of modeled talus snail habitat would remain protected as NUOS.

Although the Town does contain a limited amount of potential habitat, proposed future development in the Town is not likely to significantly impact habitat for these species because of its location on steep talus slopes; however, should covered activities occur within modeled habitat, the conservation measures proposed will adequately mitigate any potential take.

4.13.6 Talus Snail Monitoring Program

Habitat monitoring will consist of using GIS and aerial photography to detect changes in vegetation and in land use to assure that the amount of open space set-aside complies with the HCP Conservation Zone and wildlife linkage requirements. The Town will monitor project proponent compliance with sections of the LDC related to the protection of hillsides and talus slopes. The Town will also monitor for invasive species and implement an invasive species management plan. A database will be maintained to ensure that areas designated as natural undisturbed open space are preserved in a natural state, to maintain connectivity and habitat through the preservation of natural, undisturbed open space that contains native Sonoran Desert vegetation. A base year of monitoring will be performed once open space is set aside, and then every three years thereafter. The Town will cooperate as appropriate in future regional research and monitoring projects to clarify the status of talus snails within the Permit Area. Species and habitat monitoring are described in greater detail in Chapter 6 of this document.

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Chapter 5
Plan Implementation

Implementation of this HCP will require a collaborative effort among the local jurisdictions, USFWS, AZGFD, ASLD, and the local community through the SWG. The Town will look at concurrent land management plans by entities such as the USFWS, Bureau of Land Management, and National Park Service and work to coordinate with these entities to be consistent in implementation of covered activities and the associated conservation measures. The Town will utilize existing Town land-use planning and approval processes as well as newly developed approaches, such as the establishment of Conservation Zones, education, and invasive species management programs. The Town will also coordinate with the City of Tucson and Pima County in their HCP efforts, in order to maintain consistency across jurisdictions. The Town may also contribute to HCP implementation through acquisition and management of reserve lands.

The Final Draft will detail the overall implementation policies and structure to be included in an Implementation Agreement (IA), a legal document that identifies the roles and responsibilities of the participating parties in implementing the HCP and the terms of the Permit. In addition, the IA describes legal remedies should any party fail to meet its obligations under the HCP and the Section 10 Permit.

5.1 Components

The primary components of the implementation plan will include (1) conservation zones; (2) conservation programs; (3) operation and maintenance activities; (4) regulatory measures; and (5) land acquisition. Because habitat conservation requires a multifaceted approach, portions of the various components may overlap with each other.

5.1.1 Conservation Zones

Conservation zones linked to particular regions within the Town (see Figure 4.6) have been recommended by the TBT to address multiple habitat protection and species conservation needs. Each zone will have specific conditions for covered activities related to species conservation, such as open space acreage and configuration, wildlife linkage protection, pre-construction surveys, NUOS restrictions, and mitigation alternatives. If Alternative C is selected (see Table 1.2), these conditions will be enforced through the discretionary action approval process.

5.1.2 Conservation Programs

Conservation programs will establish broad strategies for addressing public involvement, sustainability of native habitat and processes, and support of future conservation management. The specific programs are discussed below.

5.1.2.1 Public Education and Outreach Program

The public education and outreach program will provide appropriate information and guidance regarding covered species and habitat protection to three primary audiences: the community at large, land development permit applicants and contractors, and Town staff. This effort may utilize a variety of approaches and formats, including brochures distributed by Town staff as part of the permitting process, seminars to homeowner associations or contractors, and training for Town Operations and Maintenance staff.

5.1.2.2 Adaptive Management and Monitoring Program

Adaptive management and monitoring are covered in more detail in Chapter 6. Guidance regarding adaptive management programs for HCPs is described in Section 3.B.3.g of The USFWS/National Marine Fisheries Service (NMFS) *Habitat Conservation Planning Handbook* (November 1996) and in the handbook's five-point Addendum dated June 1, 2000. The *Federal Register* notice contains the following guidance regarding adaptive management programs:

- An adaptive management approach allows for up-front, mutually agreed-upon changes in an HCP's operating conservation plan that may be necessary for the species in light of new information. In order to be successfully implemented, adaptive management provisions must be linked to measurable biological goals and monitoring.

- Not all HCPs or all species covered in a Permit need an adaptive management strategy. However, an adaptive management strategy is essential for Permits that cover species that have biological data or information gaps that incur a significant risk to that species. Possible significant data gaps that could lead to the development of an adaptive management strategy include, but are not limited to, significant biological uncertainty regarding specific information about the ecology of the species or its habitat (e.g., food preferences, relative importance of predators, population numbers, territory size), habitat or species management techniques, or the degree of potential effects of the activity on the species covered in the Permit.

A limitation of the management plan is the current level of available baseline data on the species, vegetation communities, and threats. It is generally understood that uncertainty is an unavoidable component of restoring and managing natural systems. To address

such uncertainties, the HCP will implement an adaptive management strategy that allows conservation program goals, objectives, actions, and minimization measures to be adjusted over time based on results of monitoring to better ensure that HCP goals are achieved.

Monitoring the effectiveness of the conservation measures and ensuring compliance with the terms of the conservation program are mandatory elements of an HCP. The USFWS elaborated on monitoring and adaptive management requirements for HCPs in its *5-point Policy Guidance* (64 FR 11485). The USFWS identifies two types of monitoring required for HCPs:

1. *Compliance monitoring*—Monitoring and reporting necessary to demonstrate that HCP requirements are being carried out.

2. *Effectiveness monitoring*—Monitoring and reporting requirements necessary to evaluate whether the HCP measures are achieving the biological goals and objectives. Effectiveness monitoring also provides information to support adaptive management decisions.

5.1.2.3 Invasive Species Management Program

Several invasive non-native species are present within the Town, and these species can be expected to increase in number and distribution over the life of the HCP. Invasive species can be plants or animals that negatively impact the native flora and fauna by increasing competition and stress, changing fire patterns, and spreading disease. An invasive species management program will be implemented to protect the covered species from being compromised by the invasion of these species. The Town's invasive species program will be guided by the four key program concept areas:

- Adaptive Management, Maintenance, and Monitoring
- Regulatory Tools
- Cooperation and Coordination
- Education

The inclusion of these program concept areas will ensure that invasive species management is as comprehensive as possible, beginning with a solid management plan, following through with appropriate regulatory actions and coordination with adjacent land management jurisdictions, and concluded by an education program that ensures that the Town staff and the public understand the value of the program.

Invasive plants and animals are capable of traveling through the landscape, and therefore effective invasive species management will emphasize cooperation between adjacent land jurisdictions, such as the Bureau of Land Management, Saguaro National Park, Pima County, and the City of Tucson. Both Pima County and the City of Tucson are undertaking Section 10 Permit applications concurrently with the Town, which presents a unique opportunity for region-wide coordination.

In addition, the Town will be an active participant in the Pima–Santa Cruz Cooperative Invasive Species Management Area. A Town representative will cooperate with invasive species control efforts on a regional basis. Town departments (i.e., Building Services, Operations and Maintenance, Parks and Recreation, Planning, and Public Works) and the Northwest Fire District currently meet quarterly to share information on buffelgrass control.

The Town will implement an invasive species adaptive management, maintenance, and monitoring program to guide the treatment of invasive species. The program will include invasive species mapping (which has already been initiated) on a periodic basis on Town-owned lands, public lands, public rights-of-way, or on private lands where access is granted; preventative actions to reduce new infestations; treatment of existing infestations according to a tiered approach that prioritizes the most troublesome species and sensitive locations; and monitoring effectiveness. The invasive species adaptive management, maintenance, and monitoring program is described in detail in Section 6.2.3. The Town holds monthly volunteer buffelgrass pulls, and Town staff sprays buffelgrass areas during the growing season.

5.1.2.4 Education Program

Public outreach will target individual homeowners as well as homeowner associations, and could include workshops and presentations as well as the distribution of educational literature. In addition, the Town may employ appropriate modes of advertising (e.g., posters, public service announcements) to reach a broader audience for the information. The emphasis in these efforts will be to instill ecosystem values to residents, many of whom may be newcomers to the Town and unfamiliar with their new desert surroundings. Landscape and maintenance personnel and Zoning inspectors conducting work for the Town will be required to complete an invasive species certification program, which will consist of focused training workshops on the identification and treatment of specific invasive species in accordance with the management, maintenance, and monitoring component (described above). Certification will be renewed every two years so that personnel will remain up to date on emerging invasive species issues in the Town. The Town will develop and adopt a policy whereby invasive species management will be incorporated in all aspects of public works projects. Educational materials and medium may include brochures, public forums and workshops with volunteers and non-profit groups, website information, and on-the-ground opportunities for volunteer efforts.

5.1.3 Operations and Maintenance Activities

Maintenance of existing facilities is needed to protect the integrity of existing infrastructure. Examples of such routine activities include: general operation, routine maintenance, and minor construction activities for existing roads, erosion control activities, vegetation management control activities, pest control activities, removal of sediment from water control structures, and flood control channel maintenance.

5.1.3.1 Best Management Practices

Although generally not subject to the Town's permitting process, such routine maintenance activities could affect the species covered under this HCP and their habitats. To prevent unnecessary and potentially serious impacts to covered species and habitats, the Town will develop best management practices for routine operations and maintenance activities. The practices will outline standard protection measures to be implemented in conjunction with the appropriate species-specific conservation measures presented in Chapter 4.

5.1.3.2 Education and Training

A key component will be education and training of Town staff responsible for conducting operations and maintenance activities. This training will be closely coordinated with the general education program (see Section 5.1.2.4), but will focus on issues and scenarios likely to be encountered by Town staff.

5.1.4 Regulatory Authority

The Town's LDC will be revised where necessary to support the conservation measures outlined in Section 4. If the revisions to the Town's LDC detailed below are not passed by the Town Council, the Town would retain the authority to apply conditions to discretionary actions on a case-by-case basis. In that case, the Town will develop Policy Guidance Documents to ensure full and consistent application of HCP conservation measures. Some of the proposed revisions to the LDC Titles include:

- **Title 17—Environmental Resource Preservation Native Plant Protection Landscape Requirements.** The revised Title 17 will require species-specific habitat evaluations as part of the SRI. The SRI will require project proponents to evaluate project areas for suitable habitat for certain covered species and to conduct pre-construction surveys where such habitat exists, utilizing a USFWS-approved protocol. Title 17 will also be revised to require an inventory of all state and Federally protected plant species, saguaro cacti, and ironwood trees within any area not designated as NUOS. Title 17 will also include invasive species management guidelines and an official list of plants prohibited for use in landscaping, as well as

specific requirements for riparian habitat protection and mitigation, including mitigation for each acre of impact at a ratio ranging from 1.5:1 up to 4:1, depending on the type of mitigation and distance from the impact location (see Section 4.0, Table 4.5, for details).

- **Title 19—Grading/Hillside Development.** The Town will revise language in Title 19 of the LDC to define talus slopes, to include enforcement provisions, and to prohibit rock/boulder collection from talus slopes. In addition, any talus slopes identified during an SRI will automatically be assumed to have a slope greater than 15 percent and be afforded protections as such.

- **Title 21—Floodplain and Erosion Hazard Management Code.** The Town will limit the types of development to those uses permissible under Title 21 of the LDC, which prohibits permanent structures and generally maintains wildlife habitat features.

- **Environmentally Sensitive Roadway Design Guidelines.** The Town will develop and implement ESRDG requiring a detailed evaluation and consideration of biological, cultural, and visual resources in the design, construction, and mitigation of road and utility projects in designated areas. Using the ESRDG, appropriate site-specific design criteria will also be developed for each project.

- **Natural Undisturbed Open Space Protections.** The Town will require project proponents to establish and maintain a conservation easement or restrictive covenant on all NUOS, in Conservation Zones 1, 2, or 3 and wildlife linkages mapped in Figure 4.1, to be held by an approved third party or the Town, or with third party rights of enforcement. The Town will make the use of conservation easements a priority over deed restrictions. If a conservation easement is not possible, the Town will require a three-tiered approach: (1) place a deed restriction on the parcel; (2) place CC&Rs on the parcel to be enforced by home owners associations as applicable; and 3) link the deed and CC&Rs to the plat and/or the development agreement so that failure to comply will be a zoning violation, and therefore enforceable by the Town. This easement or deed restriction will be recorded prior to initiation of construction. The Town will require that the terms of the conservation easement or restrictive covenant include, but are not limited to the following requirements. To provide a consistent conservation effort, home owners associations shall also adapt the following as CC&Rs:

    - NUOS will be maintained in a natural condition, except as approved by USFWS. A management plan must be submitted to and approved by the USFWS within six months of the initiation of construction activities.

    - Prior to occupancy of a residential lot, the disturbance limits of the lot shall be enclosed by temporary or permanent fencing unless prohibited by rocky ledges or other cost-prohibitive conditions. In that case, flagging or some other method

of delineation may be used if the Town concurs. If the disturbance limits represent only a portion of a larger lot, the property line of that lot may not be fenced.

- Lot owners will be required to contain all domestic animals within the enclosed lot or keep them under strict control at all times. Pets that are outside of enclosed areas shall be leashed in conformance with Pima County Code 6.04.030.
- Native plants will be salvaged and replanted from any authorized disturbances, as approved by USFWS, which occur within the NUOS.
- No development or other activities are permitted in the NUOS except for approved pedestrian trails, developed in a manner that will avoid and minimize disturbance and removal of vegetation, and minor utility crossings (these will be revegetated).
- The invasive species management guidelines will be implemented in accordance with the revised Title 17 to control invasive species.
- Landscape and plantings outside of developed common areas and the enclosed area of individual lots will be restricted to native, drought-tolerant plants. Planting of non-native, invasive species is prohibited. Landscaping will not be allowed in NUOS.
- The following activities are prohibited within the NUOS: (a) use of firearms, (b) any OHV use, (c) use of pesticides or herbicides for purposes other than controlling invasion of exotic species, and (d) racing events or other publicized events that attract large crowds, (e) the use of fires or barbeques.

5.1.5 Land Acquisitions

Actual conservation and protection of land may be achieved by purchasing lands, by requiring lands to be set aside as part of discretionary actions, by collaborating with other jurisdictions and entities, and by encouraging voluntary participation (e.g., conservation easements). The Town will also explore opportunities in Pima County's Open Space Bond program. While the Town cannot issue bonds, its residents' taxes do contribute to Pima County bond programs. Town staff currently assists Pima County's Conservation Acquisition Commission by providing due diligence review of parcels and may be able to encourage acquisition of parcels which are priorities for the Town's HCP by offering staff time to contact landowners regarding voluntary selling. The Town may explore options for the purchase of development rights.

5.2 Costs and Funding

The total cost to the Town for the HCP over a period of 25 years is estimated to be $15,223,427.00 including existing staff, police, and additional staff hired for implementation of the HCP, vehicles, materials, and equipment (refer to Appendix 6 for all costs related to HCP implementation). Table 5.1 provides an analysis of estimated Town costs by categories which will be incurred above and beyond current expenses. These projected costs are estimated at the current price and do not include inflation or other issues that may affect the budget. Table 5.1 also does not include costs that would be the responsibility of private project proponents of discretionary actions or voluntary participants in the HCP for conservation measures including, but not limited to, preconstruction surveys, habitat mitigation, and NUOS management.

Several expenses currently funded by the Town are included in the HCP. The costs identified in Table 5.1 include only those additional expenses associated with items that are not already included in the Town's existing budget. For example, the Town's current pygmy-owl surveys for individual public projects will not be a new expense associated with the HCP, but will simply be a reallocation of the funding from the individual project budget sheets to the HCP budget and funding request. Therefore this cost is not shown in the annual costs in Table 5.1, but will be incorporated into the HCP budget in the future instead of being included under individual projects. Other examples of costs absorbed by current budgets that will contribute to the HCP include vehicle use, fuel, existing staff, materials, and equipment use.

Table 5.1 is not a reflection of all costs to be spent on the HCP nor is it a representation of the projected annual request for HCP funding from the Town's funds. It is an initial representation of the additional annual costs that the Town will be experiencing as a result of the HCP. The table estimates the costs for the first 10 years. Costs are expected to be lower after the establishment of some of the habitat restoration areas. For example the initial costs to set up the BOMAs and the Tucson shovel–nosed snake research areas are high, but the ongoing monitoring and maintenance costs will be lower in the following years. Costs are expected to stabilize by the ten-year mark.

The Town will be updating the HCP budget annually as the costs, projects, and necessary adaptive management are better known. Table 5.1 is meant to supplement the overall budget sheet for the HCP (Appendix 6) and reflects that not all of the HCP implementation costs are new expenses to the Town of Marana.

TABLE 5.1
SUMMARY OF TOWN OF MARANA'S NEW HCP IMPLEMENTATION COSTS*

Conservation Measures by Category	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10	Year 11
Additional Staff		$54,527	$127,103	$127,103	$127,103	$127,103	$127,103	$127,103	$127,103	$127,103	$127,103
Species Surveys, Monitoring	$1,500	$4,000	$1,500	$4,000	$1,500	$4,000	$1,500	$4,000	$1,500	$4,000	$1,500
Invasive Species	$300	$300	$300	$300	$300	$300	$300	$300	$300	$300	$300
Habitat Restoration	$12,000	$12,000	$12,000	$12,000	$12,000	$12,000	$12,000	$12,000	$12,000	$12,000	$12,000
Tucson Water Lands Habitat Restoration	$20,000	$20,000	$20,000	$20,000	$20,000	$20,000	$20,000	$20,000	$20,000	$20,000	
BOMA Development		$61,250	$7,250	$7,250	$7,250						
Habitat Monitoring	$5,000										
Environmentally Sensitive Roadway Design Guidelines	$40,000	$40,000	$40,000	$40,000	$40,000	$40,000	$40,000	$40,000	$40,000	$40,000	$40,000
Purchases				$22,865							
Annual Totals	$78,800	$192,077	$208,153	$233,518	$208,153	$203,403	$200,903	$203,403	$200,903	$203,403	$180,903

* Includes only HCP costs above and beyond existing expenses

Two additional staff are budgeted for the HCP, one included in Year 2 and another in Year 3. Without additional staff, costs for the HCP would be approximately 2.5 times greater than if staff were used for tasks such as developing the educational program, finalizing the revised ordinances, ESRDGs, NUOS monitoring, database management, developing an Invasive Species Management Plan, and annual reporting to the USFWS.

The Town commits to funding the implementation of the HCP by securing and/or pursuing a variety of funding sources as described below. Funding will be utilized to carry out components and functions of the Town of Marana HCP including but not limited to:

- New land acquisitions
- Creation of mitigation banks and species management areas
- Support of species augmentation efforts
- Land management, including control of invasive species
- Species surveys
- Habitat restoration and maintenance
- Contingency funding for changed and unforeseen circumstances
- Town staffing for plan administration and oversight
- Monitoring plan compliance and effectiveness

5.2.1 Existing Assured Funding Mechanisms

The Town will ensure funding for the establishment of the HCP program and for the continuing mitigation measures outlined above. A suite of funding sources will be utilized to guarantee that monies are available throughout a changing financial environment.

5.2.1.1 Conservation through Code and Ordinance Revisions

Much of the conservation measures will be accomplished through revisions to the Town's LDC and the Town Code. Examples include management of NUOS, control of invasive species, surveys required before issuance of grading permits, and other measures. Management of privately owned NUOS will be accomplished through conservation easements, or if a conservation easement is not a viable option, through deed restrictions, conditions of the CC&Rs, and linkage to the plat or development agreement, with the Town maintaining the authority to issue zoning violations in the

event that the open space is not managed in accordance with the management plan. Conservation zones will be primarily self-mitigating through development agreements with set asides of NUOS when rezoning or other discretionary actions are proposed.

5.2.1.2 Mitigation Fees

In Conservation Zone 3, mitigation funds may be negotiated in lieu of a portion of NUOS lands. The mitigation funds will be used to acquire lands in designated wildlife corridors, for habitat restoration, or other mitigation measures.

5.2.1.3 Regional Transportation Funding Proposals for Wildlife Crossings

Some of the funding for wildlife crossing structures and fencing will be sought through Regional Transportation Authority funding. A portion of wildlife crossing costs associated with culverts will also be included in the capital improvement projects for the expense that is greater than the culvert size needed for drainage.

5.2.1.4 Development Agreements

Development agreements will be negotiated for commercial properties on a project-by-project basis to include some funding for use in implementing the HCP for measures such as open space set-asides, habitat restoration and monitoring, or other conservation.

5.2.1.5 Permit and Development Review Fees

A portion of fees for Town services such as permit fees and development review fees will be used for conservation measures to ensure compliance with revised ordinances and codes related to HCP conservation measures.

5.2.1.6 Town General Fund

The Town will commit monies from the general fund for unmet funding needs for HCP implementation. Some of the responsibilities for implementing conservation measures will be absorbed through existing staff, equipment, and vehicles. Currently, CIP activities absorb costs for species surveys and mitigation, and these expenses will be reallocated in HCP funding.

5.2.1.7 Other Potential Funding Sources

Other potential sources of funding will be explored by the Town. Some of these measures are contingent upon voter approval or other issues not entirely under the control of the Town.

5.2.1.7.1 Community Facilities Districts

The Town will explore the possibility of establishing Community Facilities Districts (CFDs) for new developments in designated areas. The establishment of CFDs requires a vote by property owners.

5.2.1.7.2 Sales Tax

The Town will evaluate the potential for requesting voter approval for a small increase in the sales tax for conservation measures related to the HCP. This approach will share the costs of the HCP among all Marana citizens who benefit from improved quality of life related to natural open space, rather than solely targeting new development projects.

5.2.1.6.3 Bonds

The Town could establish a general obligation bond to be paid back by sales tax, and backed by Town property as security. A non-profit Conservation Authority could be established, with a board of directors, to oversee the bond process. Another option the Town may pursue is to seek a portion of the Pima County Open Space Bond monies, in proportion to the percentage of Town citizens who pay into this fund. An endowment fund would be established to sustain funding over time.

5.2.1.6.4 Voter-approved Special Assessment

Marana will explore the feasibility of creating a proposal for voter approval of a special assessment to preserve and protect open space within the Town boundaries.

5.2.1.6.5 Recreational User Fees

The Town will evaluate recreational user fees for NUOS as a means to maintain the open space in a natural and undisturbed state, through litter clean up, trail maintenance, etc.

5.2.1.6.6 State and Federal Grants

The Town will submit grant proposals for potential funding through State grants. Examples of State grants include heritage funds set aside from lottery revenues for parks, trails, natural areas, historic preservation, and wildlife conservation activities; and the Arizona Water Protection Fund, which is an annual source of monies for the

development and implementation of measures to protect water of sufficient quality and quantity to maintain, enhance, and restore rivers and streams and associated riparian habitat.

Although Federal grant money can not be used for HCP implementation measures agreed to by the Town and the USFWS, these funds can be used as a supplement to improve habitat in addition to the requirements of the HCP. An example of a Federal grant for which the Town will consider submitting proposals is the Farm and Ranchlands Protection Program, designed to acquire conservation easements to keep productive farm and ranchland in agricultural uses and develop and implement a conservation plan.

5.3 Permit Amendments

5.3.1 New or Proposed Listings of Uncovered Species

The new listing of a species not covered by this HCP may constitute a changed circumstance. The USFWS shall immediately notify the Town upon becoming aware that a species which is associated with the habitats found in the Planning Area and which is not a covered species (but an uncovered species) may be or has been proposed for listing.

Upon receipt of notice of the potential listing of an uncovered species, the Town may, but is not required to, enter into negotiations with the USFWS regarding necessary modifications, if any, to the Town's HCP. An amendment to the Federal Permit is then required to cover the uncovered species. If the Town elects to pursue amendment of the applicable Permit, the USFWS will provide technical assistance to the Town in identifying any modifications to the Town's HCP that may be necessary to amend the applicable Federal Permit.

In determining whether any further conservation or mitigation measures are required in order to amend the affected Permit to authorize incidental take of such uncovered species, the USFWS shall take into account the conservation and mitigation measures already provided in the HCP and cooperate with the Town to minimize the adverse effects of the listing of such uncovered species on the covered activities consistent with Section 10(a)(1)(B) of the ESA, as required by the Implementing Agreement (IA). Once a species is proposed or petitioned and is found to be warranted, the USFWS shall use its best efforts to identify any necessary measures to avoid the likelihood of jeopardy to or take of the uncovered species ("no take/no jeopardy" measures).

5.3.2 Significant Population Increases of Listed but Uncovered Species

Increases of populations or geographic distribution of listed species not covered by the Town's HCP, for example jaguars or wolves, also may constitute a changed circumstance to the extent that the likelihood of take from otherwise lawful activities covered by the plan is no longer negligible. The USFWS shall immediately notify the Town upon becoming aware that activities covered by this plan are affected by the prohibition of take of a species which is associated with the habitats found in the Planning Area and which is not a covered species (an uncovered species).

Upon receipt of notice of the potential taking of a listed but uncovered species, the Town may, but is not required to, enter into negotiations with the USFWS regarding necessary modifications, if any, to the HCP required to amend the applicable Federal Permit to cover the uncovered species. If the Town elects to pursue amendment of the applicable Permit, the USFWS will provide technical assistance to the Town in identifying any modifications to the HCP that may be necessary to amend the applicable Federal Permit.

In determining whether any further conservation or mitigation measures are required in order to amend the affected Permit to authorize incidental take of such listed but uncovered species, the USFWS shall take into account the conservation and mitigation measures already provided in the HCP and cooperate with the Town to minimize the adverse effects of the additional conservation measures of such listed but uncovered species on the covered activities consistent with Section 10(a)(1)(B) of ESA, as required by the IA.

5.3.3 Annexation of Lands Outside Permit Area

Although the Town does not currently have any annexation plans, it is the intent of the Town to apply the terms and conditions of the HCP to lands annexed by the Town during the term of the Permit. All annexed lands would be evaluated by the Town, TBT, and USFWS, and the applicable HCP conservation measures would be implemented based on the presence of covered species or their habitat within the annexed area. The Town would then work with the USFWS to amend the Permit through the approved process (Section 5.3) to include the annexed area and appropriate covered activities expected to occur on annexed lands. Because future activities on annexed lands are not addressed in this HCP or the associated NEPA analysis documents, these documents would need to be revised or new versions prepared addressing the proposed amendment.

5.4 Changed and Unforeseen Circumstances

Section 10 regulations (50 CFR 17.22[b][2][iii]) require that an HCP specify the procedures to be used for dealing with changed and unforeseen circumstances that may arise during the implementation of the HCP. In addition, the Habitat Conservation Plan Assurances ("No Surprises") Rule (50 CFR 17.2, 17.22[b][5] and [6]; 63 FR 8859) defines "changed circumstances," "unforeseen circumstances," and describes the obligation of HCP Permittees and the USFWS.

The Town has made every effort to anticipate the conservation measures necessary to conserve the covered species and the habitats that support those species and, to that end, have relied upon the best scientific and commercial information available. In addition, the Town's adaptive management plan is intended to meet and address future exigencies and emergency situations. Thus, the Town's HCP is intended to reduce the potential for adverse changed or unforeseen circumstances on the covered species and their habitats to a level of insignificance. Notwithstanding the provisions of the Town's HCP, if adverse changes or unforeseen circumstances result in, or threaten, a substantial change in the population of any covered species or the overall quality of any habitat of that species, as determined pursuant to the procedure outlined hereinafter, the Town and USFWS shall cooperate to resolve the adverse impacts in accordance with this section.

5.4.1 Changed Circumstances

Changed circumstances means "changes in circumstances affecting a species or geographic area covered by an HCP that can reasonably be anticipated by plan developers and the [USFWS] and that can be planned for (e.g., the listing of a new species, or a fire or other natural catastrophic event in areas prone to such events)" (50 CFR §17.3). If additional conservation and mitigation measures are deemed necessary to respond to changes in circumstances that were provided for in the HCP, the Permittee(s) will be expected to implement the measures specified in the HCP, but only those measures and no others. Should conservation measures in the HCP prove ineffective or not implementable due to changed circumstances, the actions outlined below in Table 5.1 would be implemented.

TABLE 5.2
CHANGED CIRCUMSTANCES AND ASSOCIATED CONSERVATION, MITIGATION, OR MANAGEMENT MEASURES TO BE IMPLEMENTED BY THE TOWN

Changed Circumstances	Conservation, Mitigation, or Management Measures
Invasion by new invasive species	The Town will implement eradication or control efforts (Section 6.2.3).
Detrimental impacts to species from new disease	In most areas, population levels of covered species typically occur in equilibrium with normal disease and predation, even if populations are occasionally experiencing severe, but localized reductions in numbers. However, the spread or introduction of diseases could adversely affect the populations of some covered species. If this occurs, the TBT will coordinate with the USFWS and AZGFD to prepare a report of recommended actions that need to be taken to control or eliminate the outbreak. Such actions could include vector control or research to better understand the disease.
Decline in extent or quality of riparian habitat in Santa Cruz River Corridor due to diversion or reuse of water	The Town will consult with the TBT and USFWS to determine alternative conservation measures for riparian habitat.
Habitat for covered species declines due to OHV use	The Town will implement additional monitoring and enforcement (Section 6.2.2).
Riparian restoration for Merriam's mesquite mouse is unsuccessful	The Town will consult with the TBT and USFWS to determine alternative conservation measures for Merriam's mesquite mouse.
Updates to the Town's LDC are not passed by Town Council or otherwise cannot be implemented	The Town would retain the authority to apply conditions to discretionary actions on a case-by-case basis. In that case, the Town will develop Policy Guidance Documents to ensure full and consistent application of HCP conservation measures.
ESRDG are found to be ineffective (no use by covered species)	The Town will consult with the TBT and USFWS to determine alternative conservation measures for wildlife linkages.
BOMAs are found to be ineffective (no use by burrowing owls)	The Town, in consultation with the TBT and USFWS, will implement adaptive management measures such as revisions to the BOMA management plans (Section 6.2.2).
Habitat-based monitoring finds unexpected decline in habitat quality or extent or decline in abundance of covered species (e.g., pygmy owls)	The Town, in consultation with the TBT and USFWS, will implement adaptive management measures such as additional research and monitoring to determine the cause of the decline and will implement corrective actions where feasible (Section 6.2.1).
Habitat for covered species is damaged or destroyed by fire	The Town, in consultation with the TBT and USFWS, will implement adaptive management measures to ameliorate impacts to covered species. Adaptive management might include monitoring regrowth of vegetation in the burned area.

TABLE 5.2
CHANGED CIRCUMSTANCES AND ASSOCIATED CONSERVATION, MITIGATION, OR MANAGEMENT MEASURES TO BE IMPLEMENTED BY THE TOWN

Changed Circumstances	Conservation, Mitigation, or Management Measures
Riparian habitat for covered species is damaged or destroyed by flooding	Many riparian species have adapted to this type of disturbance regime and many species and their ecosystems thrive after a flood event has occurred. However; flooding could destroy newly established restoration sites by downing trees or scouring vegetation from stream banks. Should flooding damage or destroy riparian habitat, the Town will prepare an assessment report to determine if natural successional processes are acting to restore the habitat. If not, the TBT will be tasked to develop response measures to remediate the disturbance. If restoration of habitat is deemed necessary, actions to repair the site shall be completed within two years from the date of the occurrence of the flood.
The HCP area is affected by prolonged drought	The Town, in consultation with the TBT and USFWS, will implement adaptive management measures to ameliorate impacts to covered species. Adaptive management might include providing supplemental water for covered species.
New listing of species not covered by the HCP or significant increases of listed but uncovered species	The Town will identify actions that may cause take of newly listed species or adverse modification of critical habitat. The Town will avoid such actions in the implementation of their covered activities until approval of an amendment to the HCP and Permit to address the newly listed species or designated critical habitat in accordance with the amendment procedures described in Section 5.3.
New designation of critical habitat within Permit Area.	If critical habitat for a species that is covered by the HCP is designated under ESA, the Permit will be reevaluated by USFWS and the HCP-covered activities may be modified, as necessary, to ensure that the activities covered under the HCP are not likely to adversely modify any designated critical habitat of any covered listed species.
Future listing of species covered by HCP	USFWS will automatically authorize take of newly listed covered species as prescribed by regulation (63 FR 35, February 23, 1998).

5.4.2 Response to Occurrence of Changed Circumstances—Adaptive Management

While the Town believes that the initial measures to be funded by the Town's HCP will be effective to conserve the covered species and their habitats, it is anticipated that conditions within the Permit Area, the status of habitats, and the overall conditions of individual species will change (changed circumstances) over time. In addition, it is quite likely that additional and different conservation measures, not contained within this HCP, will be suggested and be proven effective during the term of the Permit. Finally, measures currently funded by the Town's HCP may prove to be ineffective in the conservation of either species or the habitats in which they dwell. Therefore, the Town, with the cooperation of USFWS and AZGFD is proposing an adaptive management plan to gauge the effectiveness of existing conservation measures and to propose additional or alternative conservation measures as the need arises to deal with changed circumstances.

In order to address changed circumstances that may occur at any time during the plan term (including the first two years during which thresholds are being developed) and require immediate response, the Town and the appropriate state and Federal agencies will conduct an expedited analysis for the purposes of the development of appropriate management responses for the species, habitats, or key areas impacted by any changed circumstance. The analysis will begin as soon as the requisite personnel from the Town and the Federal and state agencies can be made available. If specific management strategies have been developed previously for such species, habitat, key areas, or circumstances, those strategies will be reviewed in light of the changed circumstances. If management protocols for the species, habitats, key areas, or circumstances have not been previously developed as part of the Adaptive Management Plan, their development will be made a priority.

If multiple changed circumstances occur sufficiently close to each other in time so that the response will be significantly delayed due to lack of immediately available personnel or other resources, the Town will meet and confer with the USFWS and other applicable agencies in order to prioritize the analyses that need to be done. The purpose of the prioritizing will be to first consider those species, habitats, key areas, or circumstances that are most at risk from further impacts.

The outcome of the analysis will be the development of appropriate measures to minimize to the extent practicable the occurrence of adverse effects resulting from the changed circumstances. The measures will then be implemented. Ongoing management activities may continue until new measures resulting from the analyses are developed. However, as the agencies deem necessary and in consultation with Town, measures will be promptly implemented to minimize adverse effects prior to completion of the analysis to the extent feasible.

5.4.3 Unforeseen Circumstances

Unforeseen circumstances means "changes in circumstances affecting a species or geographic area covered by an HCP that could not reasonably have been anticipated by plan developers and the USFWS at the time of the HCP's negotiation and development, and that result in a substantial and adverse change in the status of the covered species" (50 CFR §17.3). (e.g., the eruption of Mount St. Helens was not reasonably foreseeable.) The USFWS will not require the commitment of additional land, water, or financial compensation or additional restrictions on the use of land, water, or other natural resources even upon a finding of unforeseen circumstances, unless the Permittee(s) consents. Upon a finding of unforeseen circumstances, the USFWS will be limited to modifications within conserved habitat areas and the HCP's operating conservation program. Additional conservation and mitigation measures will not involve the commitment of additional land, water, or financial compensation or additional restrictions on the use of land, water, or other natural resources.

5.4.3.1 Climate Change

The effects of climate change on wildlife species has become an increasing concern as global warming and greenhouse gas impacts have been analyzed. The effects of climate change on wildlife will depend on the adaptability of wildlife and their habitats. Species least likely to withstand the effects of climate change are those with small and/or isolated populations and low genetic variability. Species that may withstand the effects of climate change or even experience beneficial effects are those with broader habitat ranges, wider niches, and greater genetic diversity (Wildlife Society 2004). The effects of climate change will likely have a greater impact on endangered, threatened, and other at risk species (USFWS 2008).

Climate change—along with other environmental stressors such as expanding urbanization, pollution, invasive species, ozone depletion, and unregulated exploitation of resources—will increase the challenges of maintaining wildlife populations. The ability of wildlife and their habitats to withstand the cumulative effects of these stressors along with climate change may improve if impacts can be minimized. Minimization of stressors should improve the ability of wildlife and their habitats to cope with and endure the effects of climate change and variability. Ensuring widespread habitat availability and managing for self-sustaining wildlife populations would likely enhance species' ability to withstand changes in climate (Wildlife Society 2004).

While changes in the long-term climate pattern may be a certainty and even foreseen, the nature of such changes are unknowable at this time. Some of the challenges posed by global warming and other climate changes that may impact the Southwest include: changing fire regimes; changing patterns of rain and snowfall; changing access to water resources; altered hydrology in rivers and wetlands; increased frequency of extreme

weather events; changes in the timing of growth stages; changes in migration patterns; lengthening of the growing season; and a changing abundance, composition, and distribution of fish, wildlife, and plant species (Rosenzweig et al 2007, USFWS 2008). Given the range of possible manifestations of climate change on the species covered by the Town's HCP, it is impossible to formulate a response prior to the actual change.

5.4.4 Response to Occurrence of Unforeseen Circumstances—Monitoring and Adaptive Management

The Town believes that the initial measures to be funded by the Town's HCP will be effective to conserve both habitats and the covered species for the period of the Permit. However, over time, unforeseen circumstances may affect the status of habitats and the condition of individual species within the ecosystems in the Permit Area. Therefore, the Town, with the cooperation of USFWS and AZGFD, is proposing a monitoring program to gauge the effectiveness of existing conservation measures and to propose alternative conservation measures as the need arises to deal with unforeseen circumstances. If additional conservation measures do not adequately address unforeseen circumstances, the Town will assist and coordinate with any additional conservation efforts undertaken by the USFWS.

5.4.5 Procedure for Determining Occurrence of Unforeseen Circumstances

Prior to making a determination regarding the occurrence of any unforeseen circumstance, the USFWS shall comply with the procedure described below.

The USFWS shall provide written notice to the Town together with a detailed statement of the facts regarding the unforeseen circumstance involved, the anticipated impact thereof on the covered species and its habitat, and all information and data that support the allegation. In addition, the notice shall include any proposed conservation measure(s) that is/are likely to effectively address the unforeseen circumstance, an estimate of the cost of implementing such conservation measure(s), and the likely effects upon (a) the Town and its Permittees and (b) the existing plans and policies of any involved Federal or state agencies.

The Town, in consultation with the USFWS, may choose to perform an expedited analysis of the covered species or its habitat affected by the alleged unforeseen circumstance and to modify or redirect existing conservation measures to mitigate the effects of the unforeseen circumstance within the scope of existing funded conservation actions. To the extent that these modified or redirected conservation measures do not affect conservation of other species, habitats, or key areas, this may be deemed an adequate response to the unforeseen circumstance. If the proposed modifications or

redirected conservation actions could affect the conservation of other covered species or its habitat, the procedure outlined below will be followed.

The Town and/or other entities shall have a meaningful opportunity to submit information to the USFWS and shall submit such information to the USFWS within 60 days of the written notice as provided above. Upon the written request of the applicant or participant, the time for submission of said information may be extended by the USFWS, and will not be unreasonably denied.

Within 30 days after the close of the period for submission of additional information, the Town shall assess: (a) the alleged unforeseen circumstances; (b) the proposed additional conservation measure(s); (c) their effects upon the species and its habitat and the economy and lifestyles of the Town and Permittees; and (d) possible alternatives to the proposed additional conservation measures which would result in the least adverse impacts upon the economy and lifestyles of the Town and Permittees, while at the same time leading to the survival and recovery of the affected species.

The USFWS shall have the burden of demonstrating that an unforeseen circumstance has occurred, that such unforeseen circumstance is having or is likely to have a significant adverse impact on the covered species or its habitat, and that the proposed conservation measure(s) is/are appropriate. The findings of the USFWS must be clearly documented and be based upon the best scientific and commercial data available regarding the status and habitat requirements of the species. In addition, based on the results of an expedited analysis of the changed or unforeseen circumstance and the information provided by the applicants and participants, the USFWS shall provide the justification and approval for any reallocation of funds or resources necessary to respond to the unforeseen circumstance within the existing commitments of the Town under this HCP.

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Chapter 6
Monitoring and Adaptive Management

6.1 Monitoring Plan

Monitoring the effectiveness of the conservation measures and ensuring compliance with the terms of the conservation program are mandatory elements of an HCP. The USFWS elaborated on monitoring and adaptive management requirements for HCPs in its *5-point Policy Guidance* (64 FR 11485). The USFWS identifies two types of monitoring required for HCPs:

- *Compliance monitoring* – Monitoring and reporting necessary to demonstrate that HCP requirements are being carried out.
- *Effectiveness monitoring* – Monitoring and reporting requirements necessary to evaluate whether the HCP measures are achieving the biological goals and objectives. Effectiveness monitoring also provides information to support adaptive management decisions.

The HCP Handbook (USFWS and NMFS 1996) describes monitoring measures required by Section 10 regulations of the ESA:

> For regional and other large-scale HCPs, monitoring programs should include periodic accountings of take, surveys to determine species status in project areas or mitigation habitats, and progress reports on fulfillment of mitigation requirements (e.g., habitat acres acquired).

The Town will monitor compliance with the terms and conditions of the Permit and the effectiveness of mitigation measures. Monitoring will also be used to assess the need for adaptive management in response to information gained during Monitoring Plan implementation and to relevant changed circumstances. The Town will provide monitoring for compliance and effectiveness throughout the 25-year duration of the Permit.

The Town will continue to track the progress of monitoring plans under development by Pima County and the City of Tucson, such that there is an appropriate level of congruity between the Town's monitoring efforts and those proposed and undertaken by Pima County's and City of Tucson's HCPs (see further discussion in Section 6.1.2.4.).

6.1.1 Monitoring Goals

The Town's monitoring goals are to:

- Document compliance with the HCP, and the terms and conditions of the Permit and IA (compliance monitoring).
- Detect and quantify positive and negative changes to habitat of covered species and the vegetation communities on which they depend (effectiveness monitoring).
- Detect and quantify changes in occupancy or abundance of certain covered species (effectiveness monitoring).
- Determine if the biological goal (ecosystem function) is being achieved (effectiveness monitoring).
- Assess the need for adaptive management.

As described in Chapter 4, the Town's biological goal is to help maintain local and regional populations of each species covered by the HCP. Specific monitoring objectives and activities are described below under Section 6.1.2—Habitat-based Monitoring and Section 6.1.3—Species-specific Monitoring.

6.1.2 Habitat-based Monitoring

Habitat-based monitoring focuses on monitoring changes in vegetation and other landscape features such as hydrological conditions, soils, or landform, which provide habitat for the species covered under the HCP. One goal of this HCP is to maintain functioning ecosystems and vegetation communities upon which the covered species depend. Changes in habitat are assumed to result in changes in the distribution or abundance of covered species. Habitat-based monitoring has the added benefit of tracking changes in habitat that may also affect many species that are not covered by the HCP.

Habitat-based monitoring will track impacts within three broad geographic areas identified within the Town boundaries:

- Tortolita Mountains and Fan
- Santa Cruz River Corridor
- Valley (Basin) Bottom Lands

Habitat-based monitoring will also track impacts to wildlife linkages within and between these geographic areas.

6.1.2.1 Tortolita Mountains and Fan

The landform, vegetation, and other natural resources of the Tortolita Mountains and Fan are described in Chapter 3 of the HCP. This geographic area generally corresponds with Conservation Zones 2, 3, and 4. Species covered by the HCP that potentially occur in the Tortolita Mountains and Fan include cactus ferruginous pygmy-owl, lesser long-nosed bat, pale Townsend's big-eared bat, Sonoran desert tortoise, talus snail, Merriam's mesquite mouse, ground snake, and Tucson shovel-nosed snake.

The Town's monitoring objectives for the Tortolita Mountains and Fan are to:

- Detect and quantify changes in area of Sonoran desert scrub, integrity of designated wildlife corridors, percent natural undisturbed open space, and extent of disturbed lands.
- Monitor encroachment by invasive plant species.
- Monitor effectiveness of ESRDG.
- Verify that project proponents have complied with the conservation measures outlined in the HCP.
- Monitor conditions at the Tortolita preserve and other conservation lands, and assess impacts.
- Monitor impacts of visitor use of the Tortolita Preserve and other areas as developed based on trailhead sign-ins.
- Monitor OHV use in the Tortolita Mountains and Fan area and assess impacts

The Town will take the following habitat-based monitoring actions for the Tortolita Mountains and Fan:

- **Monitor changes in the area of Sonoran desert scrub within the Tortolita Mountains and Fan using aerial photography**. Changes in vegetation will be reviewed once a year and quantified using GIS software. Changes in vegetation will be tracked to verify that required set-asides are being met. Mapping using aerial photography will be used to verify that 80 percent of lands within the Zone 2 area are set aside and maintained as NUOS. Aerial photography will also be used to verify that habitat connectivity is maintained across the Tortolita Mountains and Fan.
- **Verify Compliance with Title 17.** The Town will verify that project proponents conduct an SRI, implement native plant mitigation, and meet other requirements of Title 17 of the Town's LDC. The Town will verify that all native plant mitigation and

landscaping plans are implemented and maintained as required (e.g., proper number of plants preserved or transplanted and dead plants replaced).

- **Maintain a database of NUOS lands.** The Town will maintain a database of all NUOS lands set aside under the HCP and will maintain a file with copies of all conservation easements or deed restrictions implemented to protect NUOS lands.

- **Monitor encroachment by invasive plant species**. The Town will survey for invasive species listed on the Categorized List of Invasive Non-native Plants that Threaten Wildlands in Arizona (Arizona Wildlands Invasive Plant Working Group [AZ-WIPWG] 2005) and implement the Invasive Species Management Plan described in Section 6.2.3.

- **Monitor effectiveness of ESRDG.** The Town will monitor the effectiveness of ESRDG for transportation and linear utility projects within Zones 2, 3 and 4 on a project-by-project basis. Types of monitoring studies would include some or all of the following: wildlife tracking studies, use of motion-sensing cameras, and road-kill inventories.

- **Verify project proponent compliance with the HCP.** The Town will require project proponents to develop monitoring programs to document compliance with the HCP, as required by the Conservation Measures. The Town will review and approve monitoring programs submitted by project proponents and will maintain a file with documentation of compliance. Under Title 17 of the Town's LDC, a grading permit shall not be issued until the Town has verified that the landowner has complied with the HCP. Sampling for compliance will occur annually by conducting field checks on 25 percent of the plans submitted to the Town. Initial monitoring will occur during grading and at the close-out walk-through, as well as by remote sensing. Subsequent monitoring will primarily use remote sensing, with field verification.

- **Monitor impacts from visitor use.** The Town will conduct annual visitor use surveys of the Tortolita Preserve based on trailhead sign-ins. This information will be used to estimate visitor use patterns and numbers, and assess impacts such as invasive species, litter, fires, and unauthorized foot or OHV trails.

- **Monitor impacts from OHV use.** The Town will monitor OHV use of the Tortolita Mountains and Fan based on police reports and citizen complaints. The Town will also review aerial photography to identify areas where illegal OHV use has created trails or damaged vegetation. The Town will then implement adaptive management measures to reduce habitat damage from illegal OHV activities (refer to Section 6.2.2). The Town will also monitor for ongoing maintenance needs such as fences, gates, and signs in need of repair, and erosion resulting from OHV activities.

6.1.2.2 Santa Cruz River Corridor

The landform, vegetation, and other natural resources of the Santa Cruz River Corridor are described in Chapter 3 of the HCP. This geographic area generally corresponds with Conservation Zone 1. Species covered by the HCP that have the potential to occur in the Santa Cruz River Corridor include burrowing owl, southwestern willow flycatcher, western yellow-billed cuckoo, Merriam's mesquite mouse, ground snake, Mexican garter snake, Tucson shovel-nosed snake, and lowland leopard frog. The Town's monitoring objectives for the Santa Cruz River Corridor are to:

- Monitor encroachment by nonnative invasive plant and animal species.
- Monitor quantitative and qualitative changes in riparian habitat, including extent, vegetation types, extent of surface flow, and invasive species.
- Verify implementation of required mitigation measures for impacts to riparian habitat under Title 17.
- Monitor and assess impacts of OHV use in Santa Cruz River Corridor.
- Monitor restoration efforts in selected degraded watercourses to determine effectiveness of Merriam's mesquite mouse Conservation Measure 1.
- Monitor the condition of existing conservation areas and notify the management entity of any issues detected by the Town's monitoring.

The Town will take the following habitat-based monitoring actions for the Santa Cruz River Corridor as described below.

Monitor encroachment by invasive plant species. The Town will survey for invasive plant and animal species and implement the Invasive Species Management Plan described in Section 6.2.3. The surveys for invasive plants will cover species listed on the Categorized List of Invasive Non-native Plants that Threaten Wildlands in Arizona (AZ-WIPWG 2005).

Monitor changes in riparian vegetation. The Town will use aerial photography and permanently established photo points to monitor annual changes in extent of riparian vegetation. The Town will use publicly available data to monitor the presence and extent of water in the Santa Cruz River.

Conduct bird richness/diversity surveys. The Town will use Tucson Audubon Society's Important Bird Area Survey protocols to perform general bird richness/diversity surveys twice per month during the main breeding season (March–August). While all birds detected during these general surveys will be recorded, protocol surveys for those species covered in the HCP will be conducted as outlined in Sections 6.1.3.3 and

6.1.3.4. The general bird surveys will record occupancy and abundance of more common riparian species, which indicate healthy riparian habitat. Surveys will be conducted on Town-owned lands, public lands, within public rights-of-way, or on private lands where access is granted.

Monitor mitigation success. The Town will require annual monitoring for projects that require mitigation for impacts to riparian vegetation. The Town will require project proponents to submit documentation that the required mitigation has been achieved. Documentation submitted by project proponents will include photographs taken from established photo points, an evaluation of vegetative cover, and an evaluation of the presence and extent of invasive species, and will coordinate with the Town and USFWS to remedy any threats to habitat.

Monitor impacts from OHV use. The Town will use police reports and citizen complaints to monitor OHV use of the Santa Cruz River Corridor. The Town will also review aerial photography to identify areas where illegal OHV use has created trails or damaged vegetation. The Town will then implement adaptive management measures to reduce habitat damage from illegal OHV activities (see Section 6.2.2).

Monitor changes in the mesquite plant community using aerial photography. The Town will monitor the success of efforts to restore mesquite plant community along selected degraded watercourses within the Town boundaries. The Town will use aerial photography (where appropriate), site visits, and permanently established photo points to monitor annual changes in extent of mesquite plantings.

6.1.2.3 Valley (Basin) Bottom Lands

The landform, vegetation, and other natural resources of the Valley (Basin) Bottom Lands are described in Chapter 3 of the HCP. This geographic area does not correspond with a specific HCP Conservation Zone, but is generally located west of I-10, and east and west of the Santa Cruz River (refer to Figure 3.1). The Valley (Basin) Bottom Lands geographic area includes agricultural land, vacant undeveloped land, areas of sand and gravel operations, and other open space. Species covered by the HCP that have the potential to occur in the Valley (Basin) Bottom Lands include burrowing owl, ground snake, pale Townsend's big-eared bat, and Tucson shovel-nosed snake.

The Town’s monitoring objectives for the Valley (Basin) Bottom Lands are to:

- Monitor implementation of LDC requirements for SRIs and native plant mitigation.
- Monitor encroachment by non-native invasive species.
- Monitor the effectiveness of coordinated habitat protection efforts with Pima County and the City of Tucson.

The Town will take the following habitat-based monitoring actions for the Valley (Basin) Bottom Lands as described below.

Verify compliance with Title 17. The Town will verify that project proponents conduct an SRI and implement native plant mitigation as required under Title 17 of the Town's LDC.

Monitor encroachment by invasive plant species. The Town will survey for invasive species listed on the Categorized List of Invasive Non-native Plants that Threaten Wildlands in Arizona (AZ-WIPWG 2005), and implement the Invasive Species Management Plan described in Section 6.2.3.

Monitor habitat suitability of BOMAs. The Town will monitor BOMAs to assess habitat suitability as detailed in Section 6.1.3.1.

Monitor conservation lands. The Town will monitor existing conservation lands and notify the management entity of any issues detected by the Town's monitoring.

6.1.2.4 Monitoring and Collaborative Management of City of Tucson-owned Lands

The Town will monitor the effectiveness of conservation measures implemented on lands owned by City of Tucson Water at such time that a collaborative agreement is reached with the City of Tucson. The Town will contribute funding, to the extent feasible, for conservation measures for species covered under both Marana's HCP and Tucson's Avra Valley HCP as will be described in the Intergovernmental Agreement to be developed by the Town and City of Tucson. Collaborative efforts could include research to inform potential habitat restoration or species reintroduction efforts, experimental habitat restoration plots, invasive species management, and establishing a BOMA. Monitoring of these efforts would focus on occupancy and population trends in research areas and restoration sites.

6.1.2.5 Wildlife Linkages/Connectivity

Proposed wildlife linkages in the Tortolita Mountains and Fan area are shown in Figure 4.1. The importance of wildlife linkages for wildlife habitat connectivity, for daily and seasonal wildlife movements, and for dispersal is described in Chapter 3. In addition to wildlife linkages identified in the Tortolita Fan area, corridors also occur along the Santa Cruz River, and may occur in other locations not identified in the HCP. The Town's monitoring objectives for wildlife linkages are to:

- Monitor the effectiveness of ESRDG.
- Monitor the effectiveness of efforts to maintain wildlife connectivity within NUOS, specifically within the HCP boundary.
- Monitor developer compliance with requirements to establish wildlife linkages within large developments.
- Monitor OHV use within wildlife linkages and assess impacts.

The Town will take the following habitat-based monitoring actions for wildlife linkages as described below.

Monitor changes in wildlife linkages/connectivity. The Town will monitor habitat linkages designated within the HCP to assess ongoing suitability, including appropriate widths, land use encroachment, vegetation suitability, integrity of habitat patches, and other impacts from adjacent land uses. The Town will use aerial photography/remote sensing to monitor wildlife linkages. The Town will field check aerial photography data on public lands, within public rights-of-way, and on private lands where access is granted.

Monitor effectiveness of ESRDG. The Town will monitor the success of ESRDG measures on a project-by-project basis. The Town will use some or all of the following types of monitoring studies to document use of culverts and underpasses by wildlife: road-kill inventories; wildlife tracking studies at road crossings; motion-sensing cameras; and road-kill inventories on public lands, within public rights-of-way, or on private lands where access is granted.

Monitor wildlife linkages. The Town will monitor the effectiveness of the underpass at I-10 and Avra Valley Road as a wildlife movement linkage if the Town owns or manages lands this area. The Town will use some of all of the following types of monitoring studies to document wildlife use of the underpass: road-kill inventories, tracking studies at crossing sites, and motion-sensing cameras.

Monitor compliance with protection of wildlife linkages. The Town will monitor compliance with requirements to protect wildlife linkages preserved within development projects. The Town will use aerial photography to document compliance and to guide efforts to provide connectivity of wildlife linkages between properties.

Verify compliance with Title 17. The Town will verify that project proponents implement riparian habitat preservation and mitigation, and meet other requirements of Title 17 of the Town's LDC. If revisions to the Town's LDC are not passed by the Town Council, the Town would retain the authority to apply rezoning conditions to discretionary actions on a case-by-case basis in accordance with appropriate Policy Guidance Documents.

Monitor impacts from OHV use. The Town will use police reports and citizen complaints to monitor OHV use within wildlife linkages. The Town will also review aerial photography to identify areas where illegal OHV use has created trails or damaged vegetation. The Town will then implement adaptive management measures to reduce habitat damage from illegal OHV activities.

6.1.3 Species-specific Monitoring

6.1.3.1 Burrowing Owl

The Town's monitoring objectives for burrowing owls are to:

- Detect and monitor changes in burrowing owl habitat over time.
- Monitor compliance with requirements for pre-construction surveys.
- Monitor effectiveness of burrowing owl conservation measures, especially BOMAs.
- Cooperate with regional conservation and monitoring efforts for burrowing owls.

The habitat-based monitoring actions discussed above for the Santa Cruz River Corridor, Valley (Basin) Bottom Lands, and wildlife linkages will be used to detect and monitor changes to burrowing owl habitat. In addition, the Town will take the following species-specific monitoring actions for burrowing owls as described below.

Require pre-construction surveys. The Town will require project proponents to conduct pre-construction surveys (presence/absence) for burrowing owls in suitable habitat. The Town will require that reports summarizing the findings of pre-construction surveys be submitted to the Town. The reports will include survey locations identified by Township, Range, ¼ Section, or Universal Transverse Mercator (UTM) for both positive and negative surveys. Positive surveys will be reported to USFWS and the Town within 24 hours of detection. The Town will maintain a file with copies of the survey reports, and will summarize the results of the surveys in a brief table to be included in the annual report to the USFWS.

Survey bi-annually within BOMAs. The Town will survey for burrowing owls bi-annually at BOMAs and other known or potential habitat to detect both breeding season and wintering population abundance. The Town will use the most current survey protocol approved by the USFWS.

Monitor reproductive success. The Town will monitor reproductive success and use of artificial nest burrows by burrowing owls at BOMAs using a methodology or protocol approved by USFWS.

Prepare BOMA management plans. The Town will develop a site-specific management plan for each BOMA during the first year the HCP is in effect. The Town will monitor BOMAs for maintenance needs and identify issues (e.g., disturbance by people, pets, and feral cats and dogs) that require adaptive management.

Document regional conservation efforts. The Town will document its efforts to cooperate on a regional level to conserve burrowing owls.

Implement monitoring measures on Tucson Water Lands. The Town will implement monitoring measures on Tucson Water Lands if a cooperative agreement is reached (see habitat-based monitoring measures under Santa Cruz River Corridor, above).

6.1.3.2 Cactus Ferruginous Pygmy-owl

The Town's monitoring objectives for cactus ferruginous pygmy-owls are to:

- Detect and monitor changes in pygmy-owl habitat over time.
- Detect changes in abundance and occupancy of pygmy-owls over time.
- Monitor compliance with requirements for pre-construction surveys.
- Cooperate with AZGFD monitoring efforts if cactus ferruginous pygmy-owls are reestablished in the Tortolita Mountains and Fan.

The habitat-based monitoring actions discussed above for the Tortolita Mountains and Fan will be used to detect and monitor changes to pygmy-owl habitat. In addition, the Town will take the following species-specific monitoring actions for pygmy-owls as described below.

Conduct pygmy-owl surveys. The Town will use the most current survey protocol approved by the USFWS to conduct landscape-level pygmy-owl surveys within the HCP Permit Area. The specific timing and location of the surveys will be approved by the USFWS. The surveys would focus on the Conservation Zones and on existing and future reserve areas. The surveys will be conducted on public lands or within public rights-of-way.

Require pre-construction surveys. The Town will also require project proponents to conduct pre-construction pygmy-owl surveys (presence/absence) for projects on private land greater than 500 acres. The Town will require that reports summarizing the findings of pre-construction surveys by project proponents be submitted to the Town and USFWS. The reports will include survey locations identified by Township, Range, ¼ Section, or UTM for both positive and negative surveys. Positive surveys will be reported to FWS and the Town within 24 hours of detection. The Town will maintain a file with

copies of the survey reports and will summarize the results of the surveys in a brief table to be included in the annual report to the USFWS.

Cooperate with AZGFD monitoring efforts. The Town will cooperate with AZGFD monitoring efforts if cactus ferruginous pygmy-owls are reestablished in the Tortolita Mountains and Fan. The type and location of monitoring efforts, and the role of the Town, would be decided later in consultation with AZGFD and USFWS.

6.1.3.3 Southwestern Willow Flycatcher

The Town's monitoring objectives for southwestern willow flycatchers are to:

- Detect and monitor changes in southwestern willow flycatcher habitat over time
- Monitor compliance with requirements for pre-construction surveys

The habitat-based monitoring actions discussed above for the Santa Cruz River Corridor will be used to detect and monitor changes to southwestern willow flycatcher habitat. In addition, the Town will take the following species-specific monitoring actions for southwestern willow flycatchers as described below.

Conduct bird richness/diversity surveys. The Town will perform general bird richness/diversity surveys bi-monthly during the main breeding season (March–August) using TAS's Important Bird Survey protocols. The bird surveys will record occupancy and abundance of more common riparian species, as well as the southwestern willow flycatcher, that are indicators of healthy riparian habitat. Surveys will be conducted on Town-owned lands, public lands, within public rights-of-way, or on private lands where access is granted.

Require pre-construction surveys. The Town will require project proponents to conduct pre-construction surveys (presence/absence) in suitable habitat. The surveys will follow the most current southwestern willow flycatcher survey protocol approved by the USFWS. The Town will require that reports summarizing the findings of pre-construction surveys by project proponents be submitted to the Town. The reports will include survey locations identified by Township, Range, ¼ Section, or UTM for both positive and negative surveys. Positive surveys will be reported to USFWS and the Town within 24 hours of detection. The Town will maintain a file with copies of the survey reports and will summarize the results of the surveys in a brief table to be included in the annual report to the USFWS.

6.1.3.4 Western Yellow-billed Cuckoo

The Town's monitoring objectives for western yellow-billed cuckoo are to:

- Detect and monitor changes in western yellow-billed cuckoo habitat over time.
- Monitor compliance with requirements for pre-construction surveys.

The habitat-based monitoring actions discussed above for the Santa Cruz River Corridor will be used to detect and monitor changes to western yellow-billed cuckoo habitat. In addition, the Town will take the following species-specific monitoring actions for western yellow-billed cuckoo as described below.

Conduct bird richness/diversity surveys. The Town will perform general bird richness/diversity surveys bi-monthly during the main breeding season (March–August) using a currently accepted survey protocol. The bird surveys will record occupancy and abundance of more common riparian species, as well as the yellow-billed cuckoo, that are indictors of healthy riparian habitat. Surveys will be conducted on Town-owned lands, public lands, within public rights-of-way, or on private lands where access is granted.

Require pre-construction surveys. The Town will require project proponents to conduct pre-construction surveys (presence/absence) in suitable habitat. The surveys will follow the most current western yellow-billed cuckoo survey protocol approved by the USFWS. The Town will require that reports summarizing the findings of pre-construction surveys by project proponents be submitted to the Town. The reports will include survey locations identified by Township, Range, ¼ Section, or UTM for both positive and negative surveys. Positive surveys will be reported to USFWS and the Town within 24 hours of detection. The Town will maintain a file with copies of the survey reports and will summarize the results of the surveys in a brief table to be included in the annual report to the USFWS.

6.1.3.5 Lesser Long-nosed Bat

The Town's monitoring objectives for lesser long-nosed bats are to:

- Detect and monitor changes in lesser long-nosed bat habitat over time.
- Continue cooperation with USFWS in ongoing study of use of hummingbird feeders by lesser long-nosed bats to determine general occupancy and seasonal use.
- Continue cooperation with AZGFD in ongoing study of lesser long-nosed bat habitat use and movements in the Marana area.

The habitat-based monitoring actions discussed above for the Tortolita Mountains and Fan and wildlife linkages will be used to detect and monitor changes to lesser long nosed bat habitat. In addition, the Town will take the following species-specific monitoring actions for lesser long-nosed bats as described below.

Study lesser long-nosed bat use of hummingbird feeders. The Town will continue its cooperation with USFWS in a volunteer-based study of lesser long-nosed bats at hummingbird feeders. This program encourages volunteers to document lesser long-nosed bats feeding at hummingbird feeders and record data such as time and date of first arrival in the area, and allows documentation of areas where the bats occur within the Town. The Town will keep records of lesser long-nosed bat sightings to include location, time, and date. The Town will continue to host a website for the collection of data from volunteers as long as USFWS and AZGFD provide language for the website and as long as the results remain useful to the Town, as determined by the TBT (e.g., if there are no occurrences within one mile of the Town boundaries for three years).

Cooperate with AZGFD surveys for lesser long-nosed bats in the Town. The Town will continue to work with AZGFD and USFWS to obtain funding to continue the study of lesser long-nosed bats in the Marana area, such as the current study of lesser long-nosed bat movements and habitat use within the Town. The objectives of the study are to determine movements of lesser long-nosed bats within the Town, characterize roost sites and foraging patches used by the bats, and develop conservation guidelines for maintaining lesser long-nosed bats within the landscape (AZGFD 2007). The current study uses radio transmitters to track the bats during their travels between foraging and roosting habitat. Using this method, AZGFD researchers identified a new roost site within 16 km (10 mi) of the Town in 2008.

6.1.3.6 Merriam's Mesquite Mouse

The Town's monitoring objective for Merriam's mesquite mouse is to detect and monitor changes in Merriam's mesquite mouse habitat over time.

The Town will look for opportunities to obtain grants or support cooperators to conduct surveys or research on Merriam's mesquite mouse. Occupied sites identified within the Town boundaries will be prioritized for monitoring and research. Due to difficulties in identification of this species, no species-specific surveys will be required. The habitat-based monitoring actions discussed above for the Santa Cruz River Corridor and wildlife linkages will be used to detect and monitor changes to Merriam's mesquite mouse habitat. In addition, the Town will monitor the success of efforts to restore mesquite habitat in selected degraded watercourses within the HCP area (see Section 6.1.2.4).

6.1.3.7 Pale Townsend's Big-eared Bat

The Town's monitoring objective for pale Townsend's big-eared bat is to detect and monitor changes in pale Townsend's big-eared bat habitat over time.

No species-specific monitoring is proposed for pale Townsend's big-eared bat. Due to the difficulty detecting this species during foraging activities, no species-specific surveys will be required. The habitat-based monitoring actions discussed above for the Tortolita Mountains and Fan, Valley (Basin) Bottom Lands, Santa Cruz River Corridor, and wildlife linkages will be used to detect and monitor changes to pale Townsend's big-eared bat habitat. The Town will look for opportunities to obtain grants or support cooperators to conduct surveys or research on pale Townsend's big-eared bat. Occupied sites identified within the Town boundaries will be prioritized for monitoring and research.

6.1.3.8 Ground Snake

The Town's monitoring objective for ground snake is to detect and monitor changes in ground snake habitat over time.

No species-specific monitoring is proposed for ground snake. This species is not easily detectable during surveys; therefore, pre-construction surveys will not be required. Effectiveness and compliance monitoring for ground snakes will focus on habitat. The habitat-based monitoring actions discussed above for the Santa Cruz River Corridor, Valley (Basin) Bottom Lands, and wildlife linkages will be used to detect and monitor changes to ground snake habitat. The Town will look for opportunities to obtain grants or support cooperators to conduct surveys or research on ground snakes. Occupied sites identified within the Town boundaries will be prioritized for monitoring and research. Habitat restoration would likely be done in open space or detention basins within existing or new developments and may include contouring for water collection, plantings of mesquite trees and other native plants, and the placement of cover materials or similar items. In addition, the Town will implement monitoring measures on Tucson Water Lands if a cooperative agreement is reached (see Section 6.1.2.4). Research may include introduction of populations into the restoration sites or other suitable habitat, either within the Town or on Tucson Water Lands, and evaluation of home range and movement between habitat patches. Monitoring will focus on occupancy and population trends in these research areas and restoration sites.

6.1.3.9 Mexican Garter Snake

The Town's monitoring objectives for Mexican garter snake are to:

- Detect and monitor changes in Mexican garter snake habitat over time.
- Monitor compliance with requirements for pre-construction surveys.

The habitat-based monitoring actions discussed above for the Santa Cruz River Corridor will be used to detect and monitor changes to Mexican garter snake habitat. In addition, the Town will take the following species-specific monitoring actions for Mexican garter snake as described below.

Require pre-construction surveys. The Town will require project proponents to conduct pre-construction surveys (presence/absence) in suitable habitat. The surveys will follow a time/area constrained survey protocol plus trapping, as approved by the USFWS. Effectiveness of the surveys is likely to be limited by the low detectability of this species. Project proponents will be required to submit reports summarizing the findings of pre-construction surveys to the Town. The reports will include survey locations identified by Township, Range, ¼ Section, or UTM for both positive and negative surveys. Any detection of Mexican garter snakes will be reported to the Town and the USFWS within 24 hours. The Town will maintain a file with copies of the survey reports and will summarize the results of the surveys in a brief table to be included in the annual report to the USFWS.

6.1.3.10 Sonoran Desert Tortoise

The Town's monitoring objectives for Sonoran desert tortoise are:

- Detect and monitor changes in Sonoran desert tortoise habitat over time.
- Monitor compliance with requirements for pre-construction surveys.

The habitat-based monitoring actions discussed above for the Tortolita Mountains and Fan and wildlife linkages will be used to detect and monitor changes to Sonoran desert tortoise habitat. In addition, the Town will take the following species-specific monitoring actions for Sonoran desert tortoises as described below.

Require pre-construction surveys. The Town will require project proponents to conduct pre-construction surveys (presence/absence) for Sonoran desert tortoise. The Town will require all covered activities to comply with the AGFD's Tortoise Handling Guidelines, which outlines procedures for relocating tortoises outside development areas. Project proponents will be required to submit reports summarizing the findings of pre-construction surveys to the Town. The reports will include survey locations identified by Township, Range, ¼ Section, or UTM for both positive and negative surveys. Positive surveys will be reported to USFWS and the Town within 24 hours of detection. The Town will maintain a file with copies of the survey reports and will summarize the results of the surveys in a brief table to be included in the annual report to the USFWS.

Require project proponents to monitor construction. The Town will require project proponents to provide a qualified biologist (approved by the Town and USFWS) to monitor construction if a desert tortoise is found during pre-construction surveys or

during construction as required by Sonoran desert tortoise Conservation Measure 5 (see Section 4.10-4).

6.1.3.11 Tucson Shovel-nosed Snake

The Town's monitoring objective for Tucson shovel-nosed snake is to detect and monitor changes in Tucson shovel-nosed snake habitat over time.

No species-specific monitoring is proposed for Tucson shovel-nosed snake. This species is not easily detectable during surveys; therefore, pre-construction surveys will not be required. Effectiveness and compliance monitoring for Tucson shovel-nosed snake will focus on habitat. The habitat-based monitoring actions discussed above for the Tortolita Mountains and Fan, Santa Cruz River Corridor, Valley (Basin) Bottom Lands, and wildlife linkages will be used to detect and monitor changes to Tucson shovel-nosed snake habitat. The Town will look for opportunities to obtain grants or support cooperators to conduct surveys or research on Tucson shovel-nosed snakes. Occupied sites identified within the Town boundaries will be prioritized for monitoring and research. In addition, the Town will implement monitoring measures on Tucson Water Lands if a cooperative agreement is reached (see Section 6.1.2.4). Collaborative efforts may include surveys of known populations outside the Town and research to inform potential habitat restoration or species reintroduction efforts. Other research may be developed through consultations with local herpetologists. Monitoring will focus on occupancy and population trends in these research areas and restoration sites.

6.1.3.12 Lowland Leopard Frog

The Town's monitoring objectives for lowland leopard frog are to:

- Detect and monitor changes in lowland leopard frog habitat over time.
- Monitor compliance with requirements for pre-construction surveys.
- Monitor potential threats to lowland leopard frogs from nonnative invasive species

Monitoring actions for lowland leopard frog will include both habitat-based and species-specific monitoring actions. The habitat-based monitoring actions discussed above for the Santa Cruz River Corridor will be used to detect and monitor changes to lowland leopard frog habitat. In addition, the Town will take the following species-specific monitoring actions for lowland leopard frogs as described below.

Require pre-construction surveys. The Town will require project proponents to conduct pre-construction surveys (presence/absence) in suitable habitat. The surveys will follow the most current Chiricahua leopard frog survey protocol (which is also appropriate for lowland leopard frogs), as approved by the USFWS. The Town will require that reports summarizing the findings of pre-construction surveys by project

proponents be submitted to the Town. The reports will include survey locations identified by Township, Range, ¼ Section, or UTM for both positive and negative surveys. The Town will maintain a file with copies of the survey reports and will summarize the results of the surveys in a brief table to be included in the annual report to the USFWS.

Survey for invasive species. The Town will identify and survey small bodies of water, such as golf courses and park ponds for presence of nonnative invasive bullfrogs or crayfish that may pose a threat to lowland leopard frogs. Surveys will be limited to public property, lands owned by the Town, and private lands where access has been granted. Small water bodies will be surveyed for invasive species during first two years of the HCP (baseline surveys) and then every two years thereafter.

6.1.3.13 Talus Snail

The Town's monitoring objective for talus snails is to monitor project proponent compliance with sections of the LDC relating to protection of talus slopes.

No species-specific monitoring is proposed for talus snails. This species is not easily detectable during surveys; therefore, pre-construction surveys will not be required. Conservation measures for talus snails will focus on habitat protection and through avoidance of impacts. The Town will take the following monitoring actions for talus snails as described below.

Monitor impacts from OHV use. The Town will use police reports and citizen complaints to monitor OHV use. The Town will also review aerial photography to identify areas where illegal use by OHVs or other users has created trails or damaged vegetation. The Town will then implement adaptive management measures to reduce habitat damage from illegal activities.

Require compliance with LDC. The Town will require project proponents to identify and avoid impacts to talus slopes within their parcels, and will monitor compliance with this requirement. Monitoring will occur through verification that project proponents have complied with the sections of the Town's LDC relating to protection of talus slopes.

Pursue grants for surveys. The Town will look for opportunities to obtain grants or support cooperators to conduct surveys or research on talus snails. Occupied sites identified within the Town boundaries will be prioritized for monitoring and research.

6.2 Adaptive Management

Adaptive management will be an integral part of the HCP. The U.S. Department of the Interior Adaptive Management Working Group defines adaptive management as "a systematic approach for improving resource management by learning from management outcomes" (Williams et al. 2007). As described above, monitoring under the HCP

involves a repeated assessment of habitat for covered species, wildlife linkages used by covered species, and, where practicable, an assessment of covered species' abundance and occupancy. The Monitoring Plan described in Section 6.1 will be adaptive to incorporate new protocols and techniques, as appropriate. Based on the results of monitoring, the Town and USFWS will be able to determine how well the Conservation Measures proposed in the HCP are meeting the biological goals and objectives, and the steps necessary to modify activities to increase success. Adaptive management will also include modifying conservation and monitoring actions based on the results of HCPs implemented by nearby jurisdictions, or actions by entities that are otherwise involved in conservation of one or more of the covered species (e.g., AZGFD). The Town will coordinate with Pima County, City of Tucson, and the Town of Oro Valley on management strategies to develop a cohesive approach.

6.2.1 Covered Species Management

Covered species and their habitat will be monitored as described in Section 6.1. Adaptive management will be based on annual reports and data gathered from monitoring and new research as it becomes available.

The results of monitoring will be reviewed annually during the first five years by the TBT. The TBT includes a representative from the USFWS; therefore, coordination with the USFWS would be ongoing. After the first five years of the HCP Permit, the results of monitoring will be reviewed every two years by the TBT.

The first two years of monitoring data will be used to establish baseline conditions, because the Town does not currently have extensive baseline data for the covered species and habitat being monitored. During the first two years of monitoring, the TBT will review the monitoring data and recommend success criteria for monitoring. After the second year of monitoring, the TBT will identify recommended thresholds for adaptive management.

If monitoring in subsequent years indicates that conservation goals established for covered species in the HCP are not being met, the TBT will develop adaptive management recommendations for submittal to Town management and the Town Council. Adaptive management actions for covered species would be developed in consultation with USFWS and could include:

- Develop research or increased monitoring and control of invasive plant and animal species.
- Develop research or increased monitoring by the Town for compliance with conservation measures by project proponents.

- Develop research or increased monitoring by the Town for effectiveness of conservation measures.
- Requests for additional funding from outside sources to conduct additional research or surveys.
- Acquisition of additional mitigation lands by the Town.

Additional monitoring and conservation measures on Town-owned and -managed lands (described in Section 6.2.2).

6.2.2 Land Management

The Town has a management role on lands owned or leased by the Town and an oversight responsibility on certain lands under private ownership, such as lands set aside as NUOS under the HCP. The Town will establish management plans for BOMAs; the Tortolita Preserve; Town-owned lands such as parks, open space, and rights-of-way; and lands collaboratively managed with City of Tucson Water; The Town will also ensure privately owned NUOS lands are managed and monitored in accordance with associated conservation easement or deed requirements. The Town will make the use of conservation easements a priority over deed restrictions. If a conservation easement is not possible, the Town will require a three-tiered approach: (1) place a deed restriction on the parcel; (2) place CC&Rs on the parcel to be enforced by the home owner association as applicable; and (3) link the deed and CC&Rs to the plat and/or the development agreement so that failure to comply will be a zoning violation, and therefore enforceable by the Town. Annual monitoring results will be evaluated by the TBT to determine recommended thresholds for adaptive management for lands managed by the Town. The timing of annual reviews will be the same as described in Section 6.2.1.

Burrowing owl management areas. The Town will establish a site-specific management plan concurrent with the establishment of each BOMA, as described above in Section 4.1.4. The BOMA management plans will use AZGFD's *Burrowing Owl Guidelines for Municipalities in Arizona* to the extent practicable. If monitoring indicates that conservation goals established in the management plans for the BOMAs are not being met, the Town will implement adaptive management measures such as revisions to the BOMA management plans.

Tortolita Preserve. The Town will develop a management plan for the existing 2,400-acre Tortolita Preserve, which is currently leased and managed by the Town. The goal of the management plan will be to manage the preserve in a manner that promotes the survival and recovery of covered species, including the cactus ferruginous pygmy-owl, lesser long-nosed bat, pale Townsend's big-eared bat, Sonoran desert tortoise, and Tucson shovel-nosed snake. If monitoring indicates that conservation goals established in the management plan for the Tortolita Preserve are not being met, the Town will

revise the management plan to implement adaptive management measures. Adaptive management measures could include additional research and surveys for covered species, additional fencing to control access, additional restoration of riparian habitat, additional control of invasive species, and increased monitoring of and enforcement measures for illegal trail creation.

Other Town-owned lands. The Town will develop a management plan for other Town-owned lands such as rights-of-way, parks with natural undisturbed open space, Town-owned open space, and other Town-owned lands. If monitoring indicates that conservation goals established in the management plan for Town-owned lands are not being met, the Town will revise the management plan to implement adaptive management measures. Adaptive management measures could include additional research and surveys for covered species, additional fencing to control access, additional restoration of riparian habitat, additional control of invasive species, and increased monitoring of and enforcement measures for illegal trail creation (e.g., increased patrols by law enforcement and closure of trails with physical barriers).

Tucson Water lands. If an agreement is reached with the City of Tucson, the Town will collaborate with Tucson to develop a management plan for City of Tucson Water lands. Adaptive management would be used to modify the management plan if monitoring indicates changes to management methods are required. Adaptive management measures could include additional research and surveys for species covered under the Town's and Tucson's Avra Valley HCPs, additional fencing to control access, additional restoration of riparian habitat, and additional control of invasive species.

NUOS lands. The Town will require all NUOS lands to have site-specific management plan. For NUOS lands held within a conservation easement, the easement holder will be responsible for developing and implementing the management plan. Homeowner associations or holders of deeds with restrictions related to HCP conservation measures will also be responsible for developing and implementing management plans for NUOS lands under their ownership or management. Although all NUOS lands will be unique in terms of their existing conditions, shape, and configuration relative to other NUOS or land uses and the existence of sensitive species or their habitat, the following general management elements shall be addressed in all NUOS management plans:

- **Access Control**. Access to NUOS by motorized vehicles should be limited to law enforcement, NUOS management, or emergency personnel only. Install perimeter fencing or barriers as necessary to prevent unauthorized access. All fencing and barriers should accommodate wildlife movement. Fencing in the interior of NUOS lands is discouraged.

- **Trails/Recreation**. Limit recreational uses to passive uses such as birdwatching, photography and trail use. Feeding of wildlife shall be prohibited. Where trails are allowed, provide sufficient signage to clearly identify authorized access points.

Locate trails, view overlooks, and staging areas in the least sensitive areas, using barriers such as vegetation and rocks/boulders where necessary to direct pedestrians. Construct and repair trails as needed to counter the effects of erosion, including the use of stone or wood crossjoints and edge plantings of native vegetation.

- **Invasive Species Control**. At a minimum, the presence and distribution of invasive species occurring on NUOS lands shall be mapped and monitored in accordance with the Town's *Invasive Species Management Plan*. Eradication and ongoing control measures may also be required as part of project approvals and shall be performed in a manner acceptable to the Town.

- **Disturbance Response**. Remove homeless and itinerant camps in NUOS lands as soon as discovered. Remove litter and trash on a regular basis. Evaluate areas where OHV entry or dumping occurs for the need for installation, repair, or enhancement of fencing or barriers. Post signage and coordinate with law enforcement as necessary. All areas impacted by the types of disturbance described above shall be restored to approximate the pre-disturbance condition.

- **Restoration**. Restoration or revegetation may be required as part of project approvals or in response to disturbance and shall be performed in a manner acceptable to the Town. Restoration or revegetation plans shall be compliant with Title 17 at a minimum and include elements addressing site preparation, planting specifications, maintenance, monitoring and success criteria, and contingency measures.

If monitoring indicates that conservation goals established in the management plans for the NUOS are not being met, the Town will require the management plan be revised through adaptive management measures. Adaptive management measures could include additional research and surveys for covered species, additional fencing to control access, additional restoration of riparian habitat, additional control of invasive species, and increased monitoring of and enforcement measures for illegal trail creation.

6.2.3 Invasive Species Management

The Town will implement an Invasive Species Adaptive Management, Maintenance, and Monitoring Program to guide the treatment of invasive species. Some of the invasive species issues that the Town will face over the life of the Section 10 Permit are predictable (e.g., buffelgrass and Sahara mustard). Although it is probable that new invasive species and effective treatment methodologies will emerge over the life of the Permit, it is not possible at any one time to predict these changes. Therefore, the approach will be adaptive and will incorporate new information as it becomes available. The program will include preventative actions to reduce new infestations and keep the Town free of species that are not yet established. The most effective, efficient, and low-

cost invasive species control strategies prevent invasions from ever occurring and quickly detect invasions that do occur so that invasive species can be eradicated or contained before they spread (Bossard et al. 2000).

Management tools to prevent the establishment of invasive species within a given area include:

- Regular monitoring for invasive species
- Eradicating species immediately upon detection
- Removing exotic seed sources from neighboring areas
- Minimizing unnecessary ground disturbance
- Revegetating areas with native species as soon as disturbances occur
- Treating existing infestations according to a tiered approach that prioritizes the most troublesome species and sensitive locations

Effective treatment requires knowing which species are problems, where they occur, and how to prioritize treatment. The plan will include information on a variety of treatment options (as available) for each species to allow flexibility in management decisions. Species inclusion and appropriate treatment options will be updated as new information emerges. Identification of invasive plant species to be addressed in the Town's plan will begin with the *Categorized List of Invasive Non-native Plants that Threaten Wildlands in Arizona*. This list was developed by AZ-WIPWG who, in 2005, ranked 71 invasive plant species into Arizona's natural ecosystems through the application of a regionally developed objective assessment protocol (AZ-WIPWG 2005). Although this list is nonregulatory, it is endorsed by several State and Federal agencies as a guide for determining species to be included in invasive species management plans.

The Town will conduct invasive species mapping on a periodic basis on Town-owned lands, public lands, within public rights-of-way, or on private lands where access in granted at least once every two years to identify the current locations of invasive species infestations. Mapping will be scheduled to maximize detection of the species of interest (e.g., the optimum time to survey for buffelgrass is during the summer rainy season, since the plants are conspicuous and receptive to herbicide treatment).

Invasive nonnatives will be managed according to a tiered approach that will help managers prioritize treatment decisions. Invasive species will be assigned to one of three management tiers:

- ***Tier One: Heavy Control/Eradication***. Tier One consists of species that are known to occur in the Town and will be aggressively targeted for treatment because they

have the potential to cause the most ecological and economic damage. Plant species included in this tier are rated “high” or “medium” by AZ-WIPWG (2005). The Town will be surveyed for these species, and the species will be eliminated to the highest degree possible with the goal of complete eradication.

- ***Tier Two: Control.*** Tier Two consists of problematic species that are also capable of significant damage, but that are somewhat less of a priority than Tier One species. These species will be treated when possible, and the goal is control.
- ***Tier Three: Monitoring and Prevention.*** Tier Three consists of plants that are not yet present in the Town, but have the potential to become established and pose serious problems. If these species are detected during mapping efforts, they will be treated with the same urgency as Tier One species, with immediate control action.

All options of control will be considered before action is taken. These methods may include removal by hand, machine, passive management (allowing native species to become established and out-compete invasives), and/or application(s) of pesticides. Each of these management tools has advantages and disadvantages, and often the best approach is a combination of methods (Bossard et al. 2000). In addition, optimum timing of invasive species management strategies can vary by the particular species in question. For example, for many perennial plant species, timing of control may not be as critical as for annual species. Annual invasive species are best controlled before they set seed to limit costly repeat efforts. A number of operational considerations will be taken into account when considering the invasive species management tools. The first consideration a land manager faces is the varying cost of available management tools. Hand removal operations have the expenses of the removal equipment and significant labor costs. If ground is disturbed at the removal site, the costs of reseeding or container planting should be considered. Revegetating disturbed areas is an important preventative strategy for suppressing future invasive species infestations.

Monitoring invasive species is an important component of habitat-based monitoring described in Section 6.1.2. Ongoing monitoring is necessary to ensure success and identify adaptive management needs as new infestations arise, including early detection of new species. Results of invasive species monitoring will be reported in the monitoring report submitted to USFWS.

The Town will implement an Invasive Species Adaptive Management, Maintenance, and Monitoring Program to guide the treatment of invasive species. The program will include invasive species mapping on a periodic basis on Town-owned lands, public lands, public rights-of-way, or on private lands where access is granted; preventative actions to reduce new infestations; treatment of existing infestations according to a tiered approach that prioritizes the most troublesome species and sensitive locations; and monitoring effectiveness.

6.3 Annual Reporting

The Town will submit an annual report to the USFWS summarizing monitoring activities conducted under the HCP. Each report will cover monitoring and management activities conducted during the calendar year and will be submitted to the USFWS by March 1 of the following year. The Town will have regular meetings with the USFWS and the TBT to review the results of monitoring and to develop recommendations for adaptive management. Meetings will be held annually for the first five years of the HCP, and every two years thereafter. The annual report will include:

1. A quantification of take resulting from CIPs under the Permit. The report will include a table and map showing the acres of impacted habitat in each Conservation Zone from each category of impact source:
    - Road Construction and Improvement
    - Public Water Infrastructure Installation
    - Parks and Trails
    - Airport Infrastructure Improvements
    - Maintenance Activities
    - Discretionary Actions
    - Voluntary Inclusion
2. A summary of the results of habitat monitoring studies using representative photographs, photo points, maps, and aerial photographs to track land conversion, including a summary of acres of habitat converted in each zone.
3. A summary of NUOS lands set aside under the HCP, including new NUOS lands.
4. A summary of survey results for invasive species and a brief discussion of management activities for invasive species implemented under the Invasive Species Management Plan, including a discussion of the effectiveness of management actions.
5. A discussion of the methods used to monitor the effectiveness of ESRDG measures at wildlife crossings and a summary of monitoring results during the past year.
6. A brief discussion of the Town's actions to verify compliance with Title 17 of the Town's LDC, specifically the results of field checks to document compliance during

grading and at project close out, and the results of monitoring compliance using remote sensing.

7. A summary of survey results of visitor use at the Tortolita Preserve, and a discussion of visitor use patterns and possible implications for impacts from invasive species, litter, fires, and unauthorized foot or OHV trails.

8. A summary of results from monitoring illegal OHV use, and a discussion of remedial actions or adaptive management actions taken to address impacts from illegal OHV use in the past year.

9. A summary of results of monitoring changes in riparian vegetation using aerial photography and permanent photographic points. The report will also summarize the results of monitoring the presence and extent of water in the Santa Cruz River from publicly available data.

10. A summary of the results of general bird richness/diversity surveys within the Santa Cruz River Corridor and a discussion of implications for covered species.

11. A brief summary of annual monitoring for projects that require mitigation for impacts to riparian vegetation, and a discussion of implications for covered species.

12. A summary of the results of the Town's efforts to restore the mesquite plant community along selected degraded watercourses within the Town boundaries, and a discussion of remedial actions or adaptive management actions taken.

13. A summary of monitoring actions for wildlife linkages, including efforts to maintain wildlife connectivity within NUOS, monitoring developer compliance with requirements to maintain wildlife linkages for larger developments, and monitoring OHV use within wildlife linkages.

14. A summary of results of all pre-construction surveys for covered species, including both positive and negative results. The report will include a table summarizing results of the surveys, including location information, the species included in the surveys, the dates of the surveys, the name of the surveyors, and the name of the project.

15. A summary of the results of burrowing owl surveys and monitoring by the Town at BOMAs and other suitable habitat within the Town boundaries. The report will also include a discussion of the Town's efforts to cooperate on a regional level to protect burrowing owls.

16. A summary of results of cactus ferruginous pygmy-owl surveys by the Town, and a discussion of the Town's cooperation with AZGFD monitoring efforts if pygmy-owls are reestablished in the Tortolita Mountains and Fan.

17. A summary of results of lesser long-nosed bat studies conducted in the past year by USFWS and AZGFD, with the Town's cooperation, including the volunteer-based study of bat use of hummingbird feeders and AZGFD radio-tracking studies.

18. A summary of results of surveys for lowland leopard frogs, and invasive bullfrogs and crayfish that could pose a threat to lowland leopard frogs.

19. If a reserve system for talus snails is established, a summary of the results of the Town's monitoring of the reserve system for unauthorized trails.

20. If a collaborative agreement is reached with the City of Tucson, a summary of the results of monitoring actions by the Town on City of Tucson Water lands.

21. A brief summary of the Town's education program efforts within the past year.

22. After the first year, a summary of the adaptive management recommendations made by the TBT at the most recent meeting, and a discussion of whether or how these recommendations were implemented by the Town.

6.4 Estimated Costs of Monitoring and Adaptive Management Program

6.4.1 Estimated Costs

The expected costs of the monitoring and adaptive management program are presented in detail in Appendix 6.

In summary, the town will hire two additional employees, a mid-level technician and a mid-level aide, to implement the HCP education program and monitor compliance at a cost of approximately $127,103 per year. Most proposed monitoring and adaptive management activities will be carried out by existing and newly hired Town staff, including:

- Tracking impacts from CIP activities
- Monitoring and tracking land conversion
- Tracking NUOS lands set aside
- Monitoring invasive species
- Monitoring effectiveness of ESRDG guidelines
- Verifying compliance with Title 17 of the Town's LDC, and surveying visitor use

- Monitoring illegal OHV use
- Monitoring changes in riparian vegetation
- Conducting general bird richness/diversity surveys in the Santa Cruz River Corridor
- Monitoring the effectiveness of mesquite plant community restoration
- Maintaining a database of pre-construction surveys
- Monitoring compliance and impacts within wildlife linkages
- Monitoring biological effectiveness of BOMAs
- Conducting pre-construction surveys for CIP activities
- Coordinating ongoing volunteer studies of lesser long-nosed bats
- Coordinating with the City of Tucson if a collaborative agreement is reached for Tucson Water lands
- Oversight and coordination of Conservation Lands management by private owners (HOAs etc)
- Management of Town-owned rights of way, parks, NUOS, and other Conservation Lands
- Preparation and submittal of annual monitoring report to USFWS

The Town anticipates spending $1,210,615 on monitoring and adaptive management activities over the term of the Permit. These costs are estimated at the current price and do not include inflation. Just as with the costs for implementing the HCP Conservation Measures, monitoring costs for private discretionary actions or voluntary participants in the HCP would be the responsibility of project proponents.

6.4.2 Funding Sources

Potential funding sources for monitoring and adaptive management would be the same as those described in Section 5.2.1.

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Chapter 7
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- Preliminary Draft: Town of Marana Habitat Conservation Plan, September 2004.
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- Final Report: Town of Marana Conservation Planning Process, Phase I Report, June 2003.
    - CH2MHILL

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Chapter 8
Abbreviations, Acronyms, and Glossary

8.1 Abbreviations and Acronyms

ac	acre
ADOT	Arizona Department of Transportation
af	acre-feet
ARS	Arizona Revised Statute
ASDM	Arizona-Sonora Desert Museum
ASLD	Arizona State Lands Department
AZGFD	Arizona Game and Fish Department
AZ-WIPWG	Arizona Wildlands Invasive Species Working Group
BMP	Best Management Practice
BOMA	Burrowing Owl Management Area
BOR	Bureau of Reclamation
CAP	Central Arizona Project
CC&Rs	Conditions, Covenants, and Restrictions
CFD	Community Facilities District
CFR	Code of Federal Regulations
cm	centimeter
C	Celsius
CIP	capital improvement project
DWL	Dual Wheel Gear
EA	Environmental Assessment

EIS	Environmental Impact Statement
ESA	Endangered Species Act of 1973
ESL	Environmentally Sensitive Lands
ESRDG	Environmentally Sensitive Roadway Design Guidelines
F	Fahrenheit
FR	Federal Register
ft	feet
GIS	Geographic Information System
ha	hectare
HCP	Habitat Conservation Plan
HDMS	Heritage Data Management System (AZGFD)
I-10	Interstate 10
IA	Implementing Agreement
IGA	Intergovernmental Agreement
in	inches
kg	kilograms
km	kilometers
L	Liter
lbs	pounds
LDC	Land Development Code
LSCMRP	Lower Santa Cruz Managed Recharge Project
m	meter
MBTA	Migratory Bird Treaty Act
mi	miles

mL	mililiter
mm	milimeters
NEPA	National Environmental Policy Act of 1969, as amended
NMFS	National Marine Fisheries Service
NUOS	Natural, undisturbed open space
OHV	Off-highway vehicle
oz	ounces
Permit	Incidental Take Permit
PVC	Polyvinyl chloride
RAC	Residencies per acre
SDCP	Sonoran Desert Conservation Plan
sq	square
SRI	Site Resource Inventory
SWG	Stakeholder Working Group
TBT	Technical Biology Team
Town	Town of Marana
USACE	United States Army Corps of Engineers
U.S.C.	United States Code
USFWS	United States Fish and Wildlife Service
UTM	Universal Transverse Mercator
WPCF	Water pollution control facility
WSC	Wildlife of Special Concern in Arizona

8.2 Glossary of Terms

abiotic - Abiotic factors are essentially non-living components.

adaptive management - A systematic process for continually improving management and practices as new scientific information is gained about a species, or by learning the utcome of management practices.

alluvial - Related to, composed of, or found in alluvium.

aquifer - Water-bearing stratum of permeable rock, sand, or gravel.

bajada - A series of coalescing alluvial fans along the base of a mountain range.

biodiversity - The variety of organisms considered at all levels; includes the variety of ecosystems, which comprise both the communities of organisms within particular habitats and the physical conditions under which they live.

biology - The study of plant and animal life.

Biological Opinion - A written statement provided to the affected federal agency (National Marine Fisheries Service or the U.S. Fish and Wildlife Service) that details how the reviewed action affects the species or its critical habitat. If jeopardy or adverse modification of critical habitat is found to be a result of the activity, the opinion will contain suggestions for reasonable and prudent alternatives for that action that would minimize its impacts and allow the activity to proceed.

candidate species - A species for which concerns remain regarding their status, but for which more information is needed before they can be proposed for listing under the ESA as threatened or endangered.

Certificate of Inclusion – A certificate issued to individuals voluntarily conducting activities under the habitat conservation plan to provide coverage under the incidental take permit.

cienega - A permanently or seasonally saturated “seep wetland,” dominated by sedges and other herbaceous and woody wetland plants.

conservation - The use of methods and procedures necessary to bring any endangered or threatened species to the point at which the measures provided under the Endangered Species Act are no longer necessary; includes research, census, law enforcement, habitat acquisition, and maintenance, propagation, live trapping, and transportation, and, in the extraordinary case where population pressures within a given ecosystem cannot be otherwise relieved, may include regulated taking.

covered species - Listed and non-listed species that are being conserved and managed under an approved natural community conservation plan and that may be authorized for "take" under the provisions of the plan.

development - The process of developing a tract of land without structures or infrastructure into land with residences, commercial buildings, and other uses, structures, and supporting infrastructure.

discretionary actions - Discretionary actions apply to projects that require the exercise of judgment or deliberation when the approving authority decides to approve or disapprove a particular activity, as distinguished from situations where the Town Council merely has to determine whether there has been conformity with applicable statutes, ordinances or regulations. Discretionary actions in the Town of Marana include, but are not limited to, annexations, General Plan amendments, specific plans, significant land use changes, rezonings, and variances.

discretionary lands – Lands which are anticipated to be subject to discretionary actions, and thus where the majority of the HCP Conservation Measures will be implemented.

diurnal - Primarily active during daylight hours.

ecology - The study of totality or pattern or relations between organisms and their environment.

ecosystem - A dynamic and interrelating complex of plant and animal communities and their associated nonliving (such as physical and chemical) environment.

Endangered Species Act - According to Section Three of the Endangered Species Act of 1973, any species that is in danger of extinction throughout all or a significant portion of its range.

entitled lands – Properties that currently have entitlements for some level of development and that will not likely be submitting an application to the Town of Marana for a discretionary action. The application of HCP Conservation Measures on these lands would occur only through voluntary inclusion.

Environmental Assessment - A tool for determining the significance of environmental impacts; it provides a basis for rational decision making.

Environmental Impact Statement - A decision-making document required by NEPA when proposed actions (with a Federal nexus) will have a significant impact on the environment and on human health and safety (as determined by an environmental assessment).

ephemeral - Lasting only for a short time; related to watercourses that flow only in response to precipitation events.

Federally listed species - A species, subspecies, or distinct population segment that has been added to the Federal list of endangered and threatened wildlife and plants under the Endangered Species Act.

feral - Animals having escaped from domestication and become wild.

fossorial - Animals adapted for digging or burrowing.

General Plan - The General Plan is the primary tool for guiding future development, including growth, housing, transportation, environmental preservation, and services. The General Plan describes long-term goals that are the basis for policies and actions to guide day-to-day decisions.

geographic information system (GIS) - A type of software for digital mapping and data analysis on computers.

habitat - The physical, chemical, and biological features of an area that supplies food, water, shelter, and space necessary for a particular species existence.

Habitat Conservation Plan - A legally binding plan, agreed to by the U.S. Fish and Wildlife Service, to protect a specified area as habitat or to perform specific management activities for a threatened or endangered species. Under the Endangered Species Act (1973) the HCP is a mandatory component of an Incidental Take Permit application. This plan is negotiated by the lead federal agency and the applicant and specifies the activities that will be covered by the Incidental Take Permit and how their effects will be minimized and mitigated. This plan also describes the geographic limits of the covered activities.

harass - 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 behavior patterns which include, but are not limited to, breeding, feeding, or sheltering. Defined U.S. Fish and Wildlife Service regulations at 50 CFR 17.3.

harm - An act that kills or injures wildlife. Such acts may include significant habitat modification or degradation when it actually kills or injures wildlife by significantly impairing essential behavioral patterns including breeding, feeding, or sheltering. Defined by the U.S. Fish and Wildlife Service regulations at 50 CFR 17.3.

hydric - Pertaining to water; wet.

hydrology - The study of the properties, distribution, and circulation of water on the surface of the land, in the soil and underlying rocks, and in the atmosphere.

Implementing Agreement - An agreement that legally binds the Permitee to the requirements and responsibilities of a HCP and Section 10 Permit. It may assign the responsibility for planning, approving, and implementing the mitigation measures under the HCP.

incidental take - Take that results from, but is not the purpose of, carrying out an otherwise lawful activity.

invasive species - A species that is non-native to the ecosystem under consideration and whose introduction causes or is likely to cause economic or environmental harm, or cause harm to human health (Executive Order 13112; http://www.invasivespecies.gov/laws)

infrastructure - The underlying foundation or basic framework of a system or organization.

insectivorous - Feeding primarily or exclusively on insects.

mesic - Area that is supported by perennial or intermittent streams, or areas of shallow groundwater.

mitigate - The action of reducing or minimizing the severity of the impact or the likelihood of risk of an event [to a species].

natural undisturbed open space - An area of land that is unimproved and not occupied by structures or man-made impervious surfaces that is set aside, dedicated or reserved in perpetuity as a conservation area. Trimming plants or raking is prohibited. Rights-of-way (including alleys) are prohibited.

No Surprises Policy – This USFWS policy provides regulatory assurances to the holder of a Habitat Conservation Plan incidental take permit issued under section 10(a) of the ESA that no additional land use restrictions or financial compensation will be required of the permit holder with respect to species covered by the permit, even if unforeseen circumstances arise after the permit is issued indicating that additional mitigation is needed for a given species covered by a permit.

nocturnal - Primarily active during the nighttime.

non-native - Refers to plant or wildlife species outside of their hstoric range that are introduced to one ecosystem from another ecosystem in which they occur naturally and are indigenous. Some non-native species are invasive and effectively displace native species. Their invasion threatens native ecosystems or commercial, agricultural, or recreational activities dependent on these ecosystems.

omnivorous - Feeding on both animal and vegetable substances.

Permit Area - Area where the Section 10 Incidental Take Permit will apply.

Permit Planning Area – Area considered during development of the Habitat Conservation Plan.

perennial - Present at all seasons of the year.

petitioned species – A species for which the USFWS has been petitioned to list as endangered or threatened under the Endangered Species Act.

relict - A persistent remnant of an otherwise extinct flora or fauna or kind of organism.

riffles - Wave pattern in sand or gravel caused by water movement.

riparian - Related to, living in, or located on the bank of a natural watercourse.

riparian area - Area influenced by surface or subsurface water flows that are expressed (visually) by facultative wetland or obligate wetland plant species and hydric soils.

riparian habitat - The aquatic and terrestrial habitat adjacent to streams, lakes, estuaries, or other waterways.

Section 7 (ESA) - The section of the Endangered Species Act that requires all Federal agencies, in consultation, with the U.S. Fish and Wildlife Service, to ensure that their actions are not likely to jeopardize the continued existence of listed species or result in destruction or adverse modification of critical habitat.

Section 9 (ESA) - Prohibits take of a threatened or endangered species. Take is defined to include harass, harm, hunt, shoot, wound, kill, trap, capture, or collect, or attempt to engage in any such conduct. Such acts may include significant habitat modification or degradation where it actually kills or injures wildlife by significantly impairing essential behavior patterns, including breeding, feeding, or sheltering (50 CFR 17.3).

Section 10 (ESA) - The Section of the Endangered Species Act that lays out the guidelines under which a permit may be issued to authorize activities prohibited by Section 9, such as take of endangered or threatened species. Section 10 of the ESA is invoked for an area in which several projects will occur, for activities connected to a single project, or for takings as small as a single specimen. Under Section 10, the U.S. Fish and Wildlife Service and/or the National Marine Fisheries Service will evaluate potential effects of the project and require specific protection measures.

species - Any subspecies of fish, wildlife, or plants, and any distinct population segment of any species that interbreeds when mature.

species of concern - Refers to those species which USFWS believes might be in need of concentrated conservation actions. Such conservation actions vary depending on the health of the populations and degree and types of threats. Species of concern receive no legal protection and the use of the term does not necessarily mean that the species will eventually be proposed for listing as a threatened or endangered species.

Stakeholder Working Group (SWG) - A group that meets once or twice per month and includes large land owners, special interest groups, and neighboring jurisdictions. The U.S. Fish and Wildlife Service and Arizona Game and Fish Department attend as ex-officio members.

stochastisity - The variation in birth and death rates from one season to the next in response to weather, disease, competition, predation, or other factors external to the population.

subspecies - The taxonomic category that ranks immediately below a species.

take - Defined by the Endangered Species Act as "to harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or attempt to engage in any such conduct. Agency Consultation Sections 7 and 10 of the Act allow the U.S. Fish and Wildlife Service and the National Marien Fisheries Service to approve exceptions to the federal prohibition against take of a listed species.

Technical Biology Team (TBT) - The TBT includes local scientific experts, Arizona Game and Fish Department, and U.S. Fish and Wildlife Service biologists for development of the Marana Habitat Conservation Plan.

threatened species - An animal or plant species likely to become endangered within the foreseeable future throughout all or a significant portion of its range.

topography - The configuration of a surface including its relief and the position of its natural and man-made features.

vertebrate - A subphylum of chordates comprising animals (mammals, birds, reptiles, amphibians, and fishes) with a segmented spinal column.

watershed - A region or area bounded peripherally by topographic high points and draining ultimately to a particular watercourse or body of water.

wetland - Land where saturation with water is the dominant factor determining the nature of soil development and the types of plant and animal communities living in the soil and on its surface. The single feature that most wetlands share is soil or substrate that is at least periodically saturated with or covered by water. The water creates severe physiological problems for all plants and animals except those that

are adapted for life in water or in saturated soil. For purposes of this classification wetlands must have one or more of the following three attributes: (1) at least periodically, the land supports predominantly hydrophytes; (2) the substrate is predominantly undrained hydric soil; and (3) the substrate is non-soil and is saturated with water or covered by shallow water at some time during the growing season of the year.

wildlife linkage - An area that links with another or between other similar areas of habitat, allowing for connectivity of wildlife habitat.

xeroriparian - Areas associated with intermittent water supplies and that may include species from adjoining upland areas.

Chapter 9
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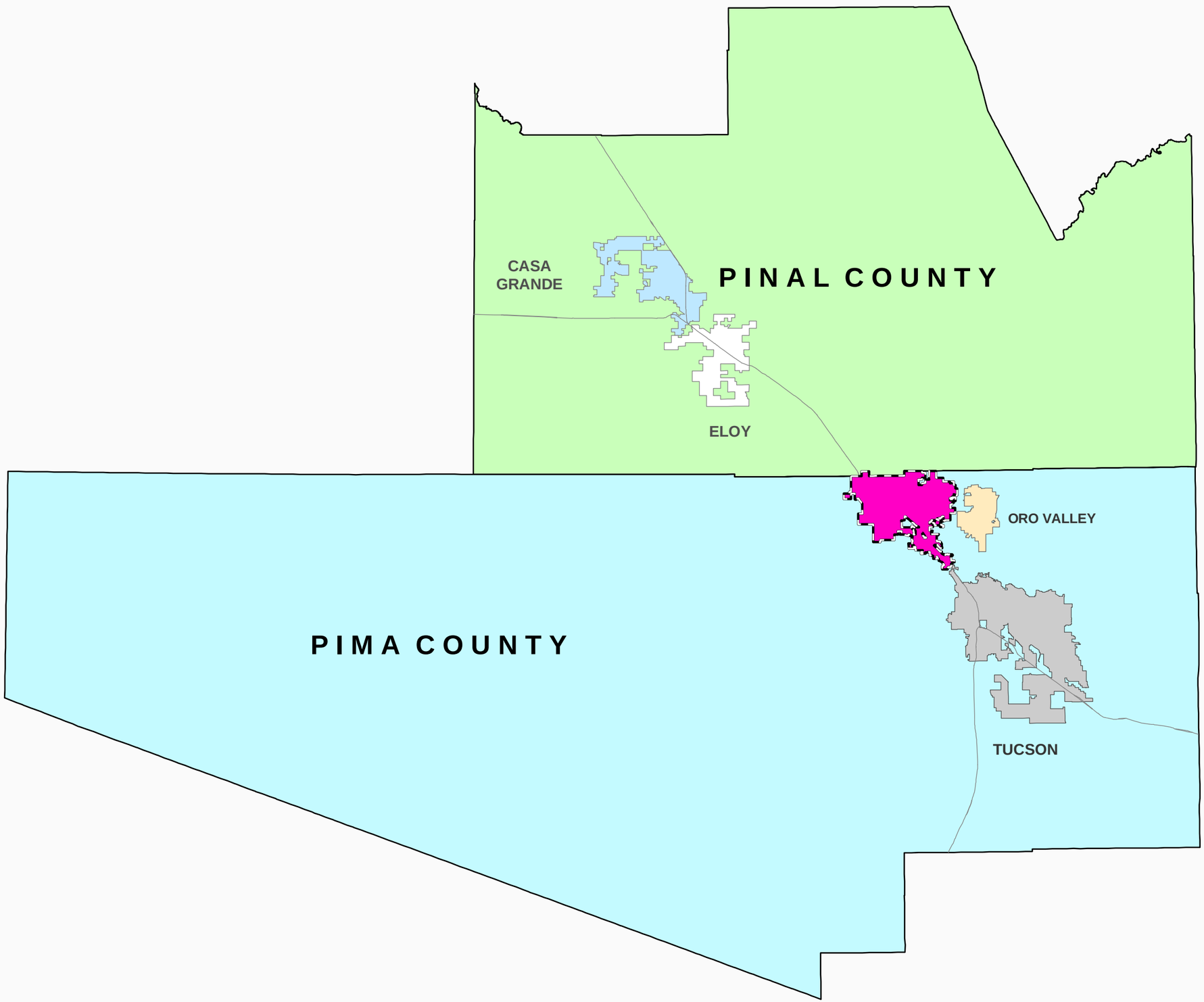

FIGURE 1.1
TOWN OF MARANA
LOCATION

HCP Permit Area
Marana Town Limits

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Miles

File: U:\PW_Environmental\HCP\final_figs\Figure 1.1 Town of Marana Location.mxd
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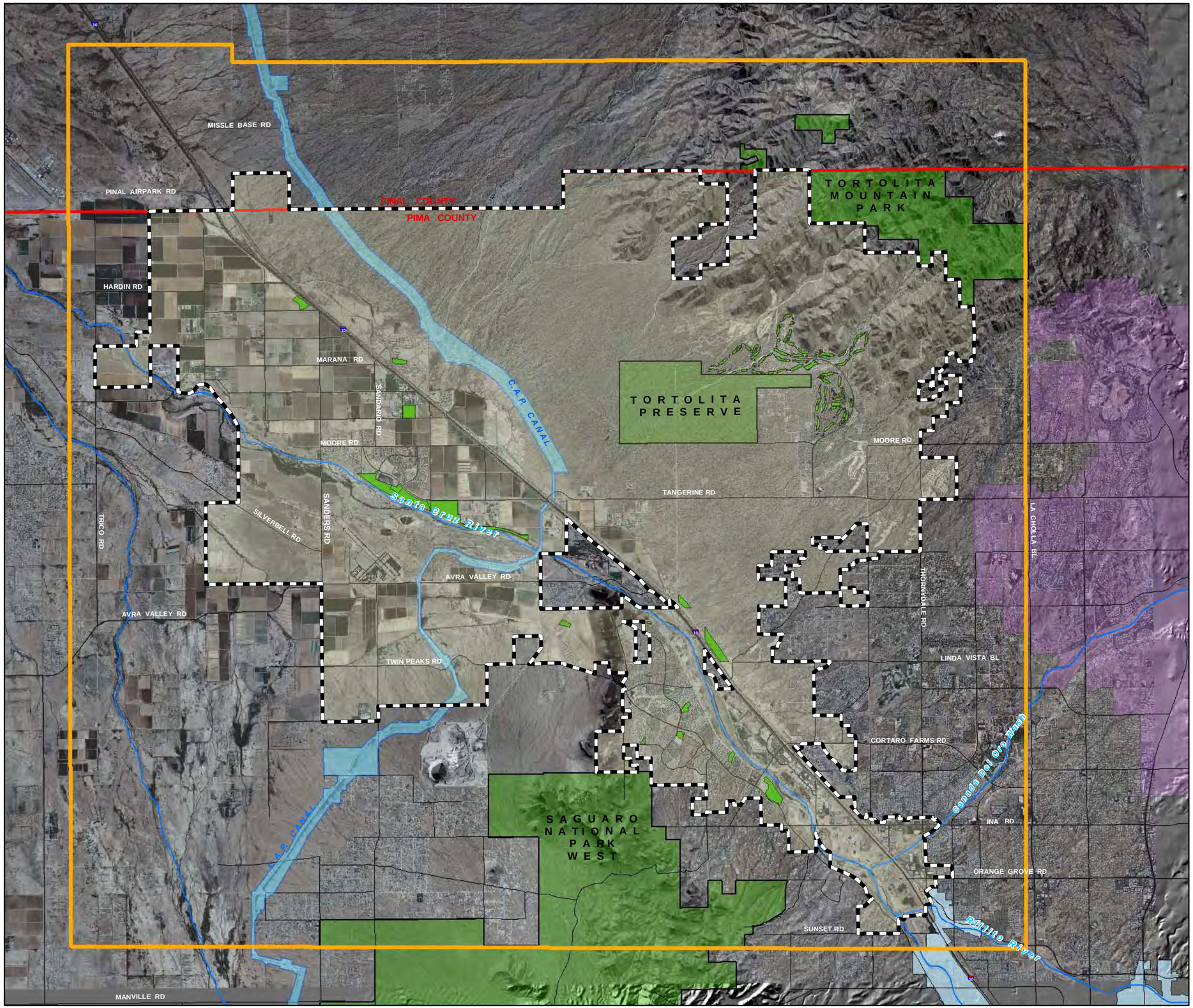

FIGURE 1.2
HCP Planning and Permit Areas

- HCP Planning Area
- HCP Permit Area/Marana Town Limits
- CAP Canal
- County Line
- Parks and Golf Courses
- Tucson City Limits
- Oro Valley Town Limits

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Background Imagery Data Source:
July 2007 NAIP Aerial Photos

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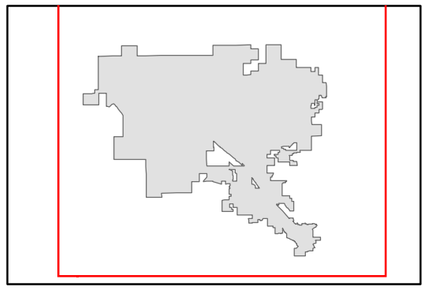

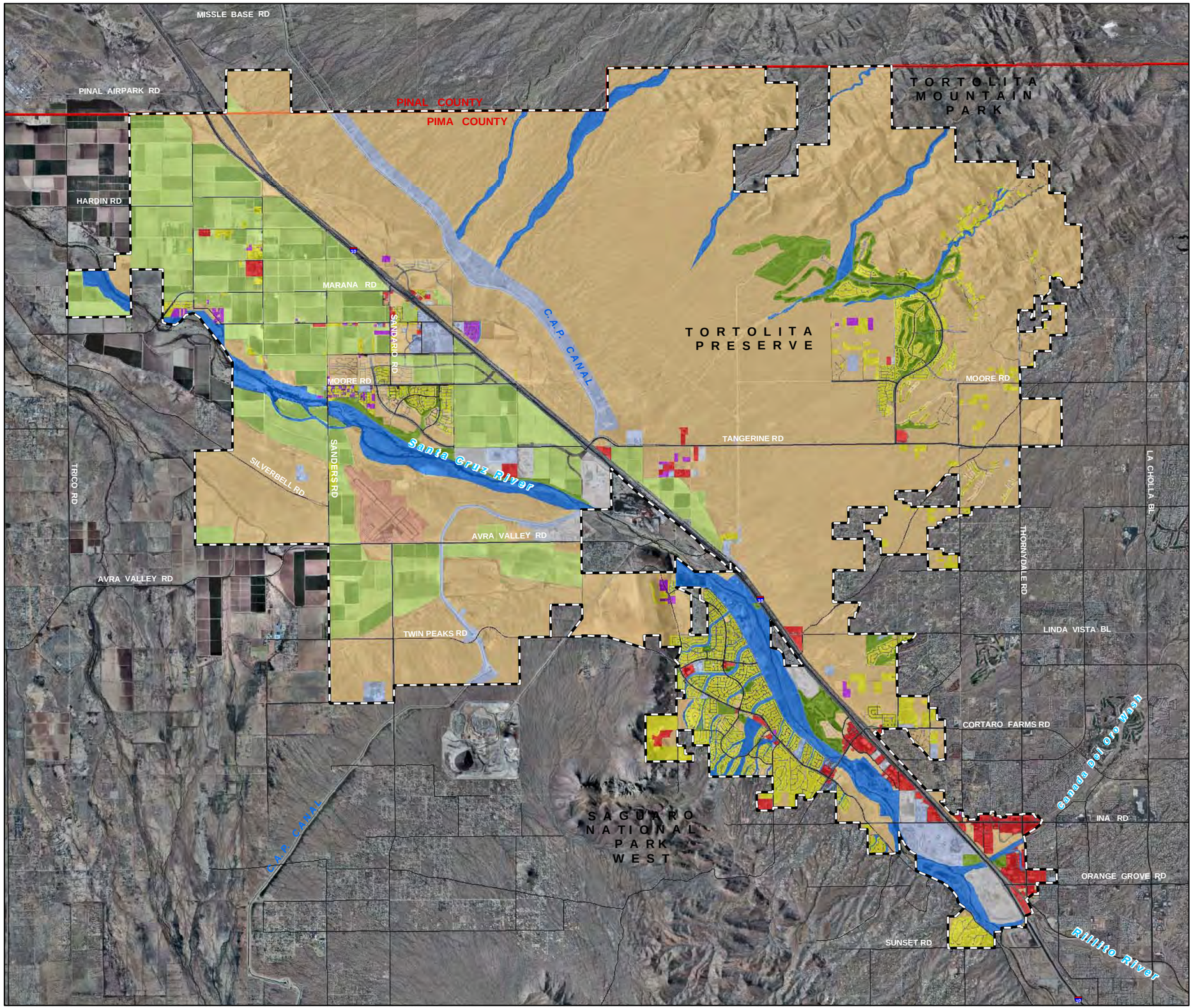

FIGURE 2.1
Existing Land Use

- AGRICULTURE
- AIRPORT
- COMMERCIAL
- INDUSTRIAL
- PARKS, RECREATION AND OPEN SPACE
- PUBLIC/INSTITUTIONAL
- RESIDENTIAL ATTACHED MULTI FAMILY
- RESIDENTIAL DETACHED SINGLE FAMILY
- RESIDENTIAL MANUFACTURED HOME
- RIVERS and MAJOR WASHES
- VACANT/UNDEVELOPED
- Marana Town Limits

N W E S

0 0.5 1 2 3 Miles

Background Imagery Data Source:
July 2007 NAIP Aerial Photos

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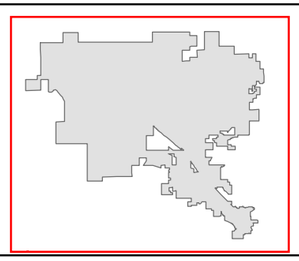

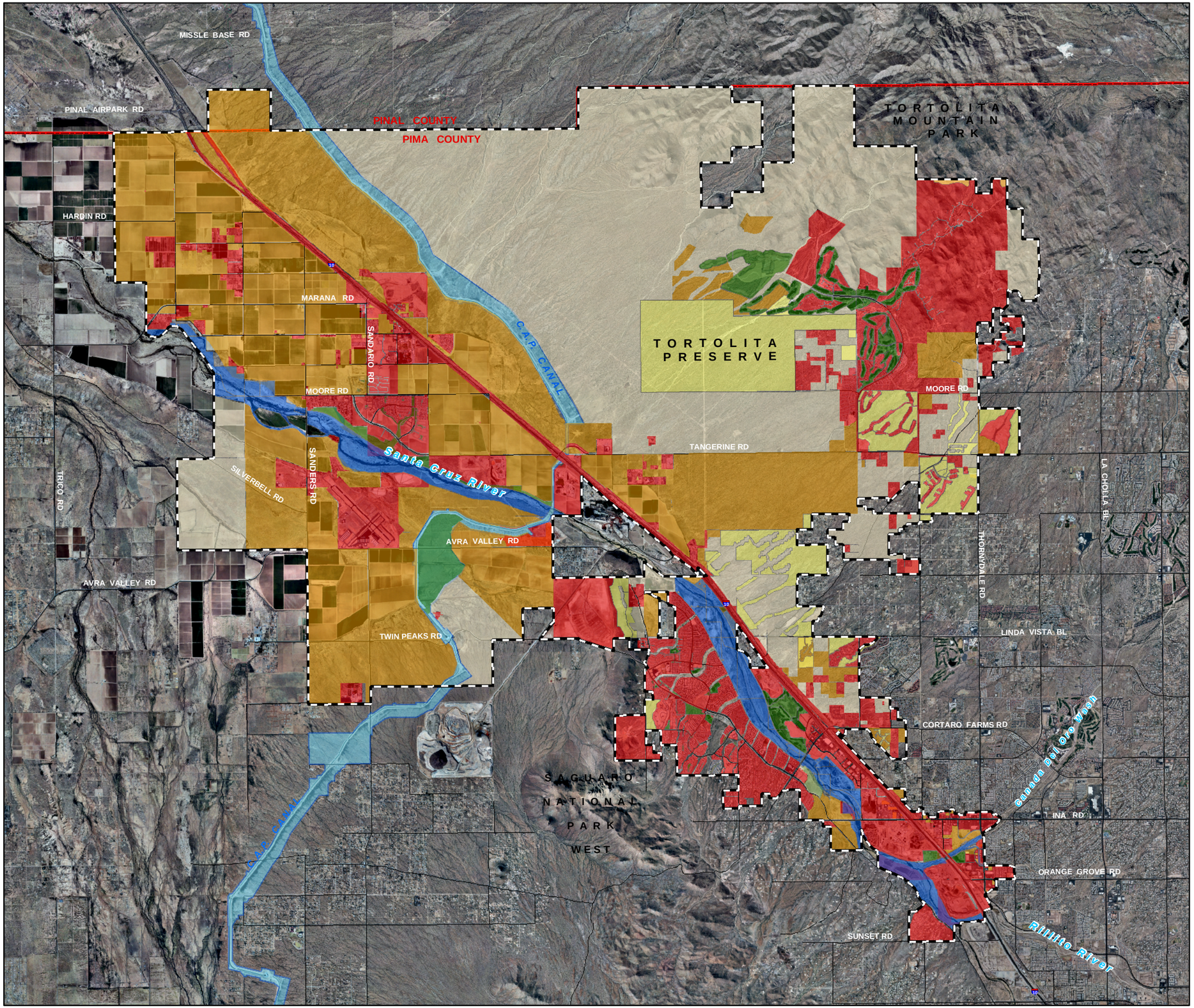

FIGURE 2.2
Future Land Development Status

- Developed Land
- Mitigation Lands
- CAP Canal
- Parks
- Rivers and Major Washes
- Marana Town Limits
- County Line

Future Development

- LOW INTENSITY
- MOD-HIGH INTENSITY

Background Imagery Data Source:
Pima County, March 2006
Pinal County, August 2005
1 Meter Imagery from Arizona State Cartographer's Office, Phoenix, Arizona

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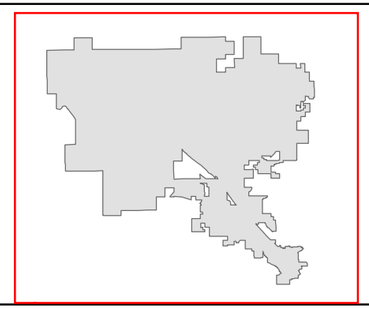

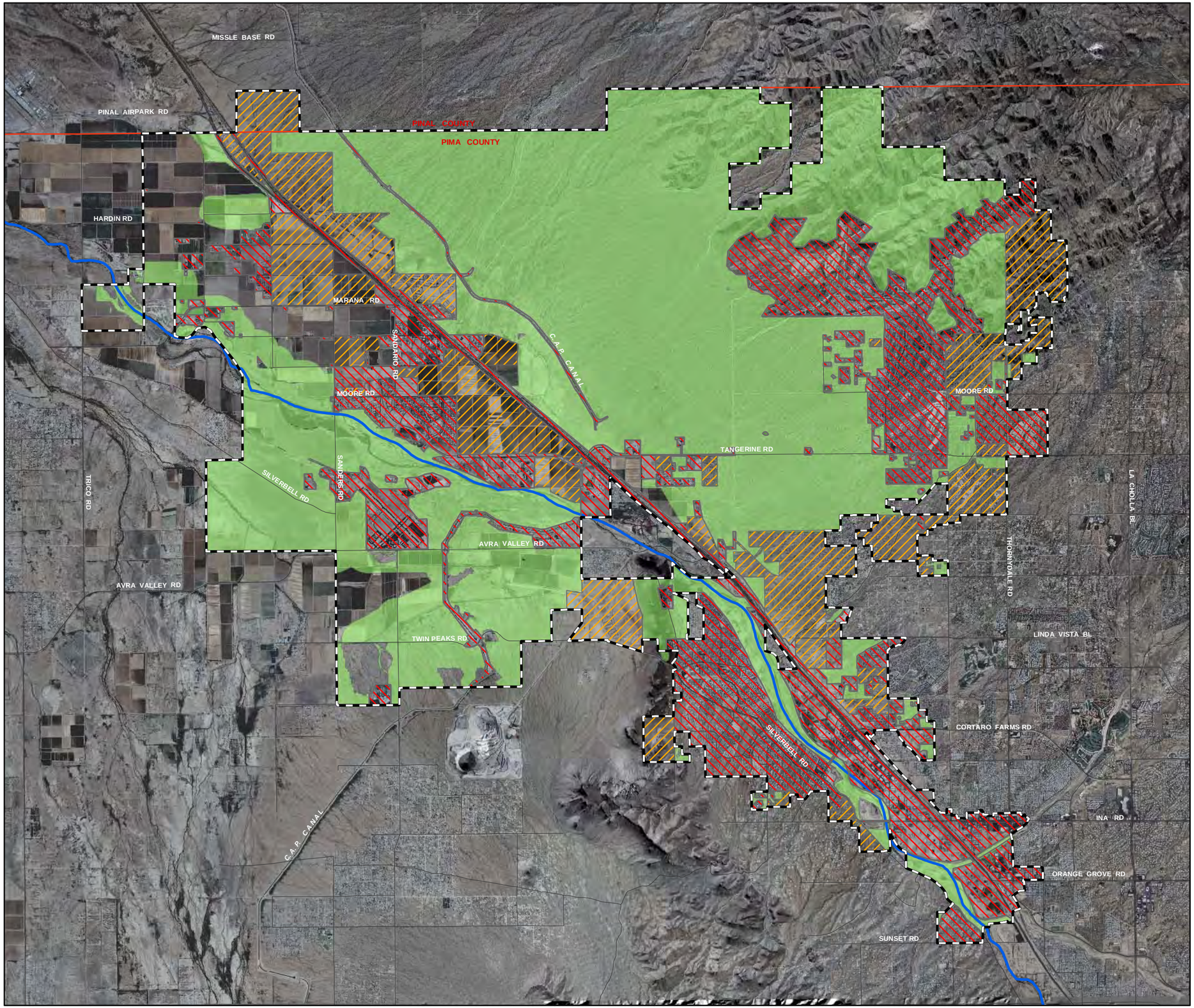

FIGURE 2.3
13 SPECIES MODELED HABITAT AND LAND DEVELOPMENT

- Combined Habitats 43,010 Acres
- Entitled Land
- Developed Land
- HCP Permit Area Marana Town Limits
- Santa Cruz River

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Background Imagery:
July 2007 NAIP Aerial Photography

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13 Species Potential Habitat and Development.mxd
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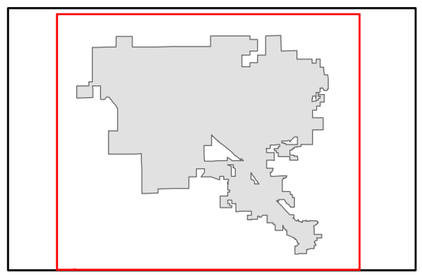

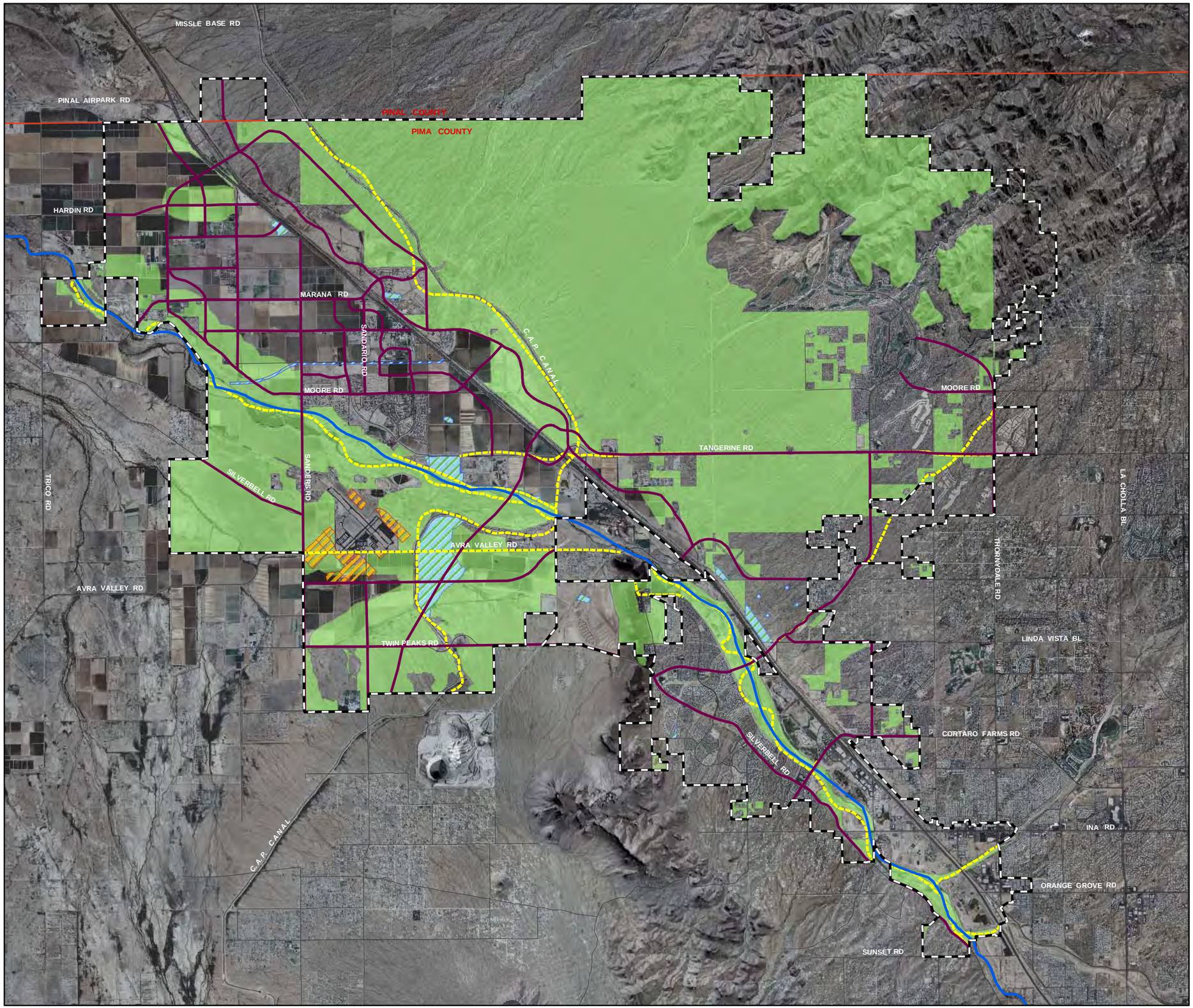

FIGURE 2.4
13 SPECIES MODELED HABITAT AND CIP

- Combined Habitats 43,010 Acres
- Proposed Streets 1,621 Acres Impact
- Proposed Trails 236 Acres Impact
- Airport Development 217 Acres Impact
- Barnett Channel 25 Acres Impact
- Proposed Parks 448 Acres Impact
- HCP Permit Area Marana Town Limits
- Santa Cruz River

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Background Imagery:
July 2007 NAIP Aerial Photography

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Figure 2.4 13 Species Modeled Habitat and CIP.mxd
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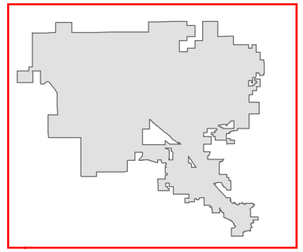

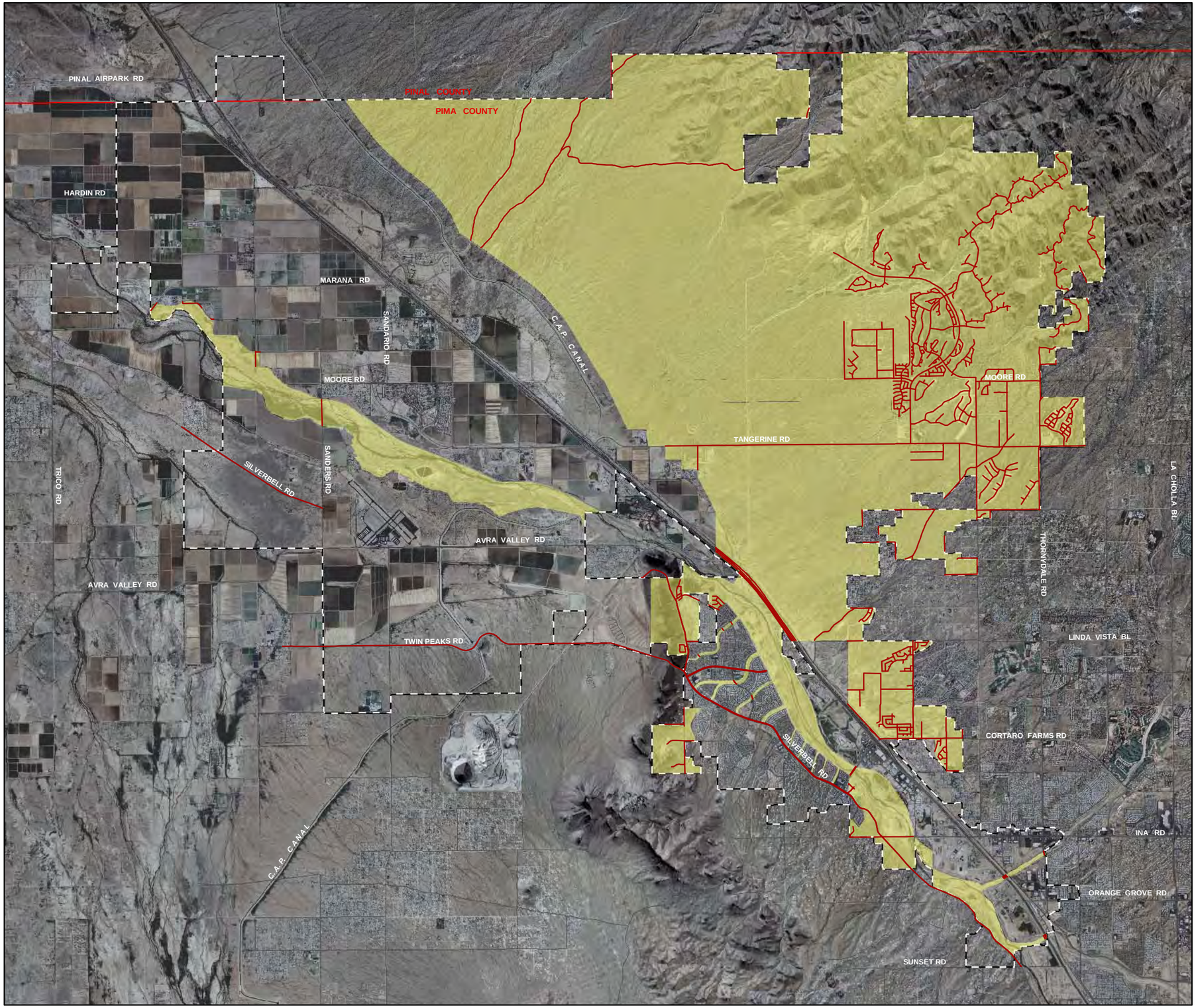

Figure 2.5 Environmentally Sensitive Roadway Design Guidelines for Marana

- Environmentally Sensitive Roadways
- Marana HCP Zones
- Marana Town Limits HCP Planning Area
- County Line

Background Imagery:
July 2007 NAIP Aerial Photography

File: U:\PW_Environmental\HCP\final_figs\November_08\12_15_08_for_CH\Figure 2.5 Environmentally Sensitive Roadway Design Guidelines for Marana.mxd

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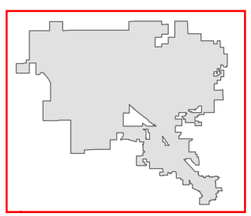

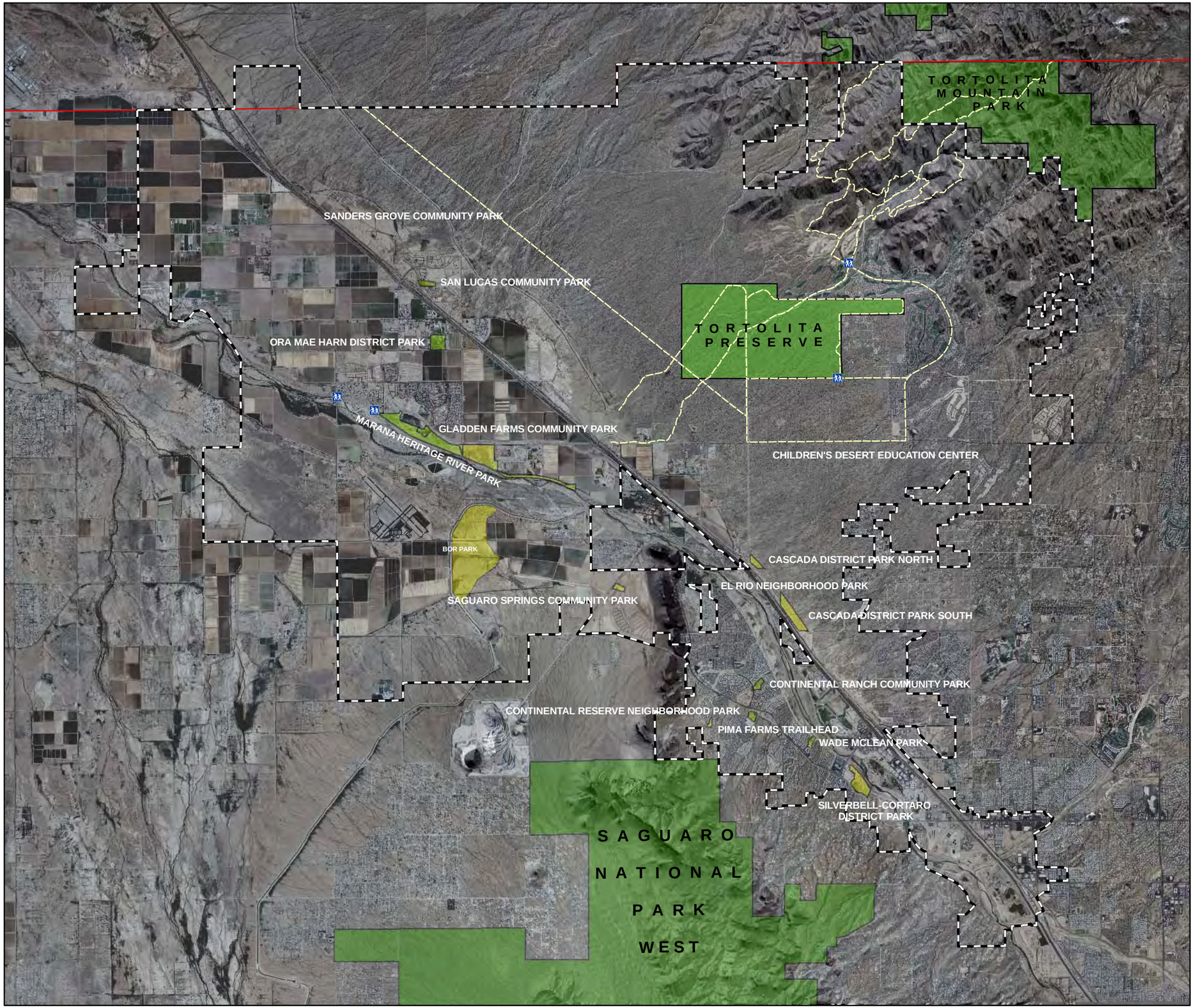

Figure 2.6
Parks and Trails

Marana Parks

- Existing
- Proposed
- Tortolita Mountain Trails
- Trailheads
- HCP Permit Area Marana Town Limits
- County Line

Background Imagery:
July 2007 NAIP Aerial Photography

File: U:\PW_Environmental\HCP\final_figs\November_08\12_15_08_for_CH\Figure 2.6 Parks and Trails.mxd
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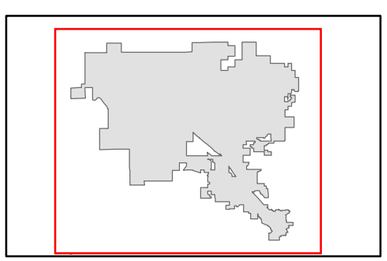

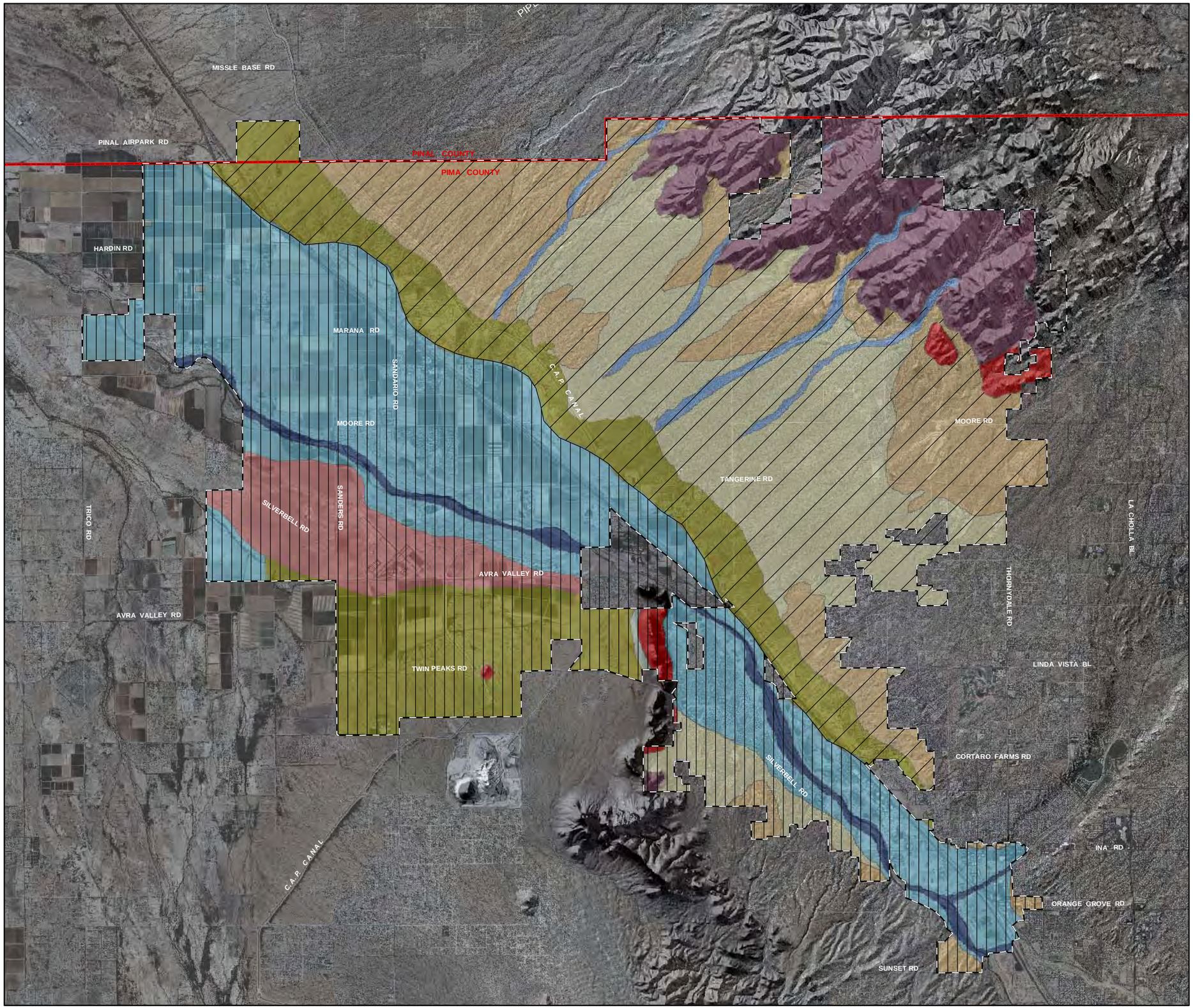

FIGURE 3.1 MAJOR LANDFORM FEATURES OF THE TOWN OF MARANA

- Floodplains
- Drainageways
- Santa Cruz River
- Mountains
- Hills with Moderate Relief
- Non-dissected Alluvial Plains
- Dissected Bajadas and Fans
- Non-dissected Bajadas and Fans
- Terraces
- Tortolita Fan
- Valley Bottom Lands
- Marana Town Limits
- County Line

Background Imagery:
July 2007 NAIP Aerial Photography

File: U:\PW_Environmental\HCP\
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Features of the Town of Marana.mxd
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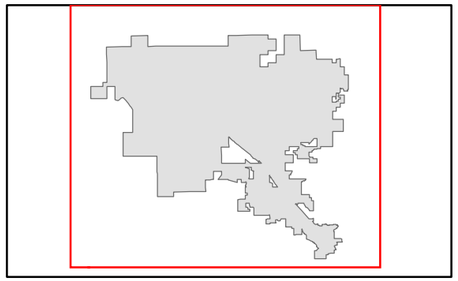

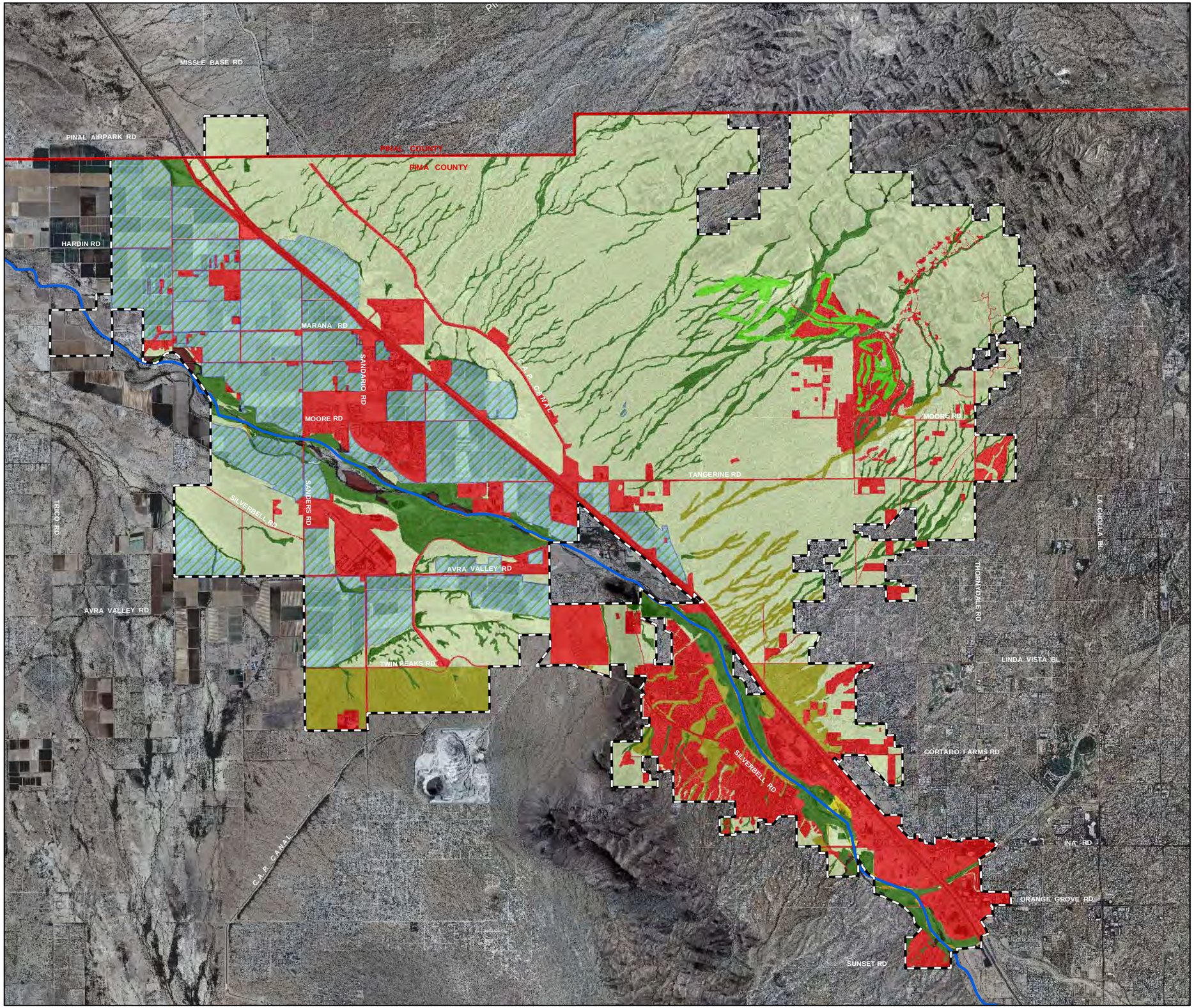

Figure 3.2
Vegetation Communities

- Agriculture
- Annual
- Cottonwood - Willow
- Creosote - Bursage
- Developed
- Golf Course
- Mesquite
- Paloverde - Mixed Cacti
- Xeroriparian
- Santa Cruz River
- Marana Town Limits
- County Line

This data represents ground conditions - July 2007.
Vegetation data derived from an update of the 2003 Marana HCP based on July 2007 imagery.

Background Imagery Data Source:
July 2007 USDA NAIP aerial photography

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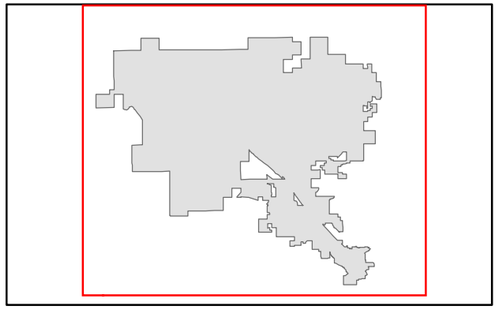

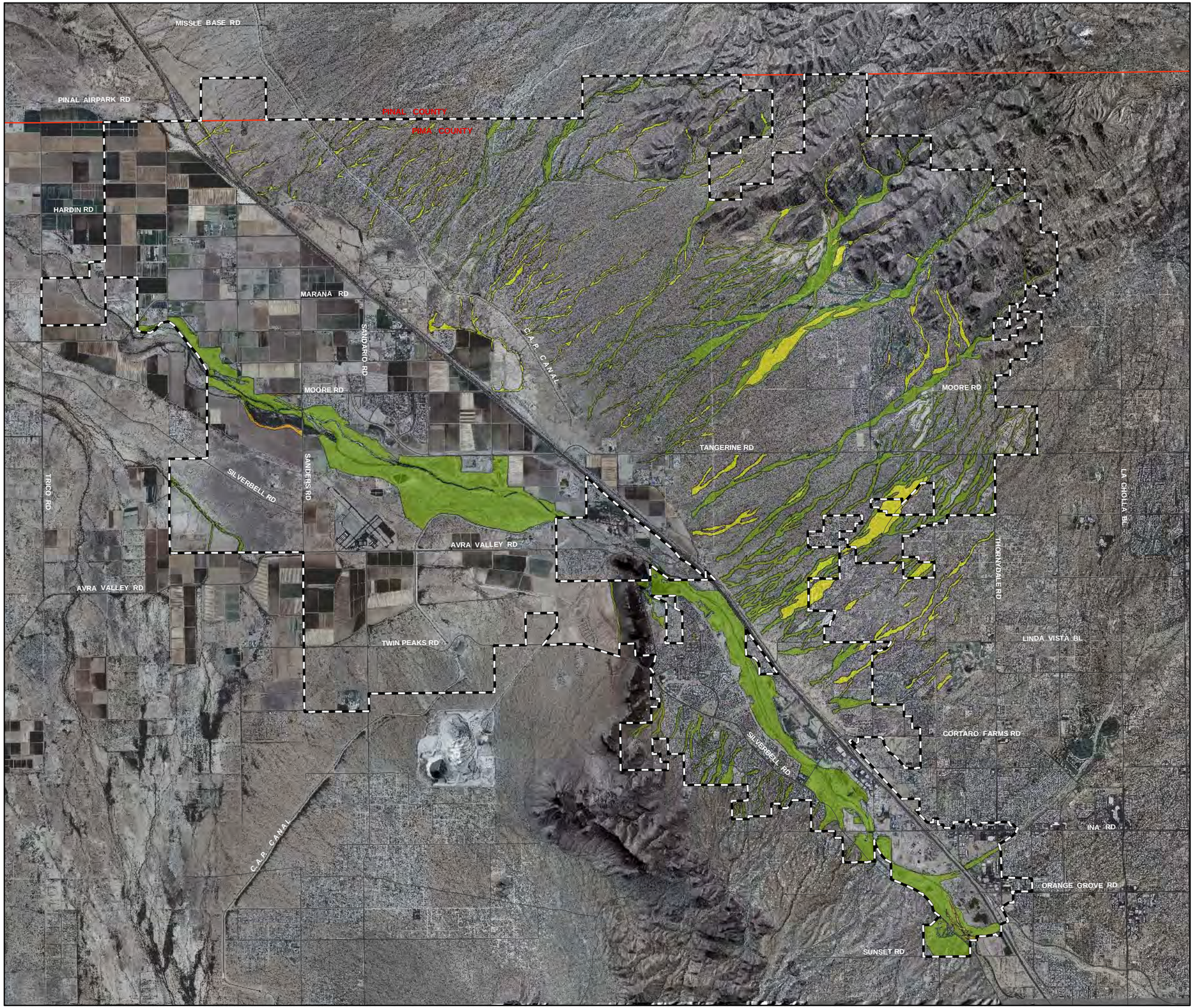

Figure 3.3
Town of Marana
Riparian Habitat

- Xeroriparian C
- Hydromeso Riparian
- Important Riparian Areas
- HCP Permit Area
  Marana Town Limits

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Background Imagery:
July 2007 USDA NAIP Aerial Photography

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Figure 3.3 Town of Marana Riparian Habitat.mxd
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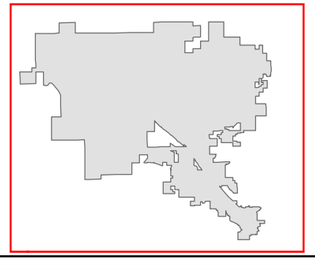

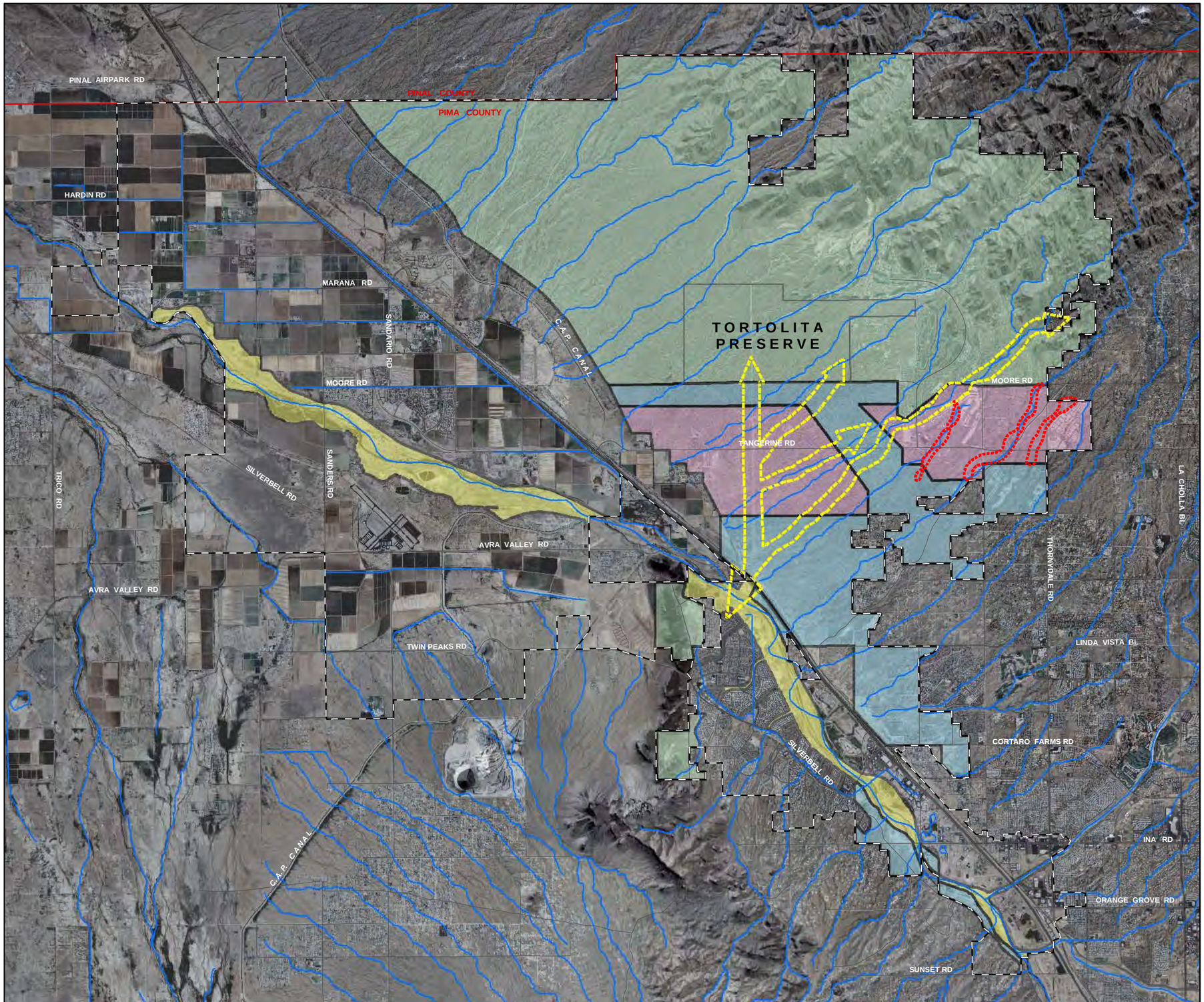

Figure 4.1
HCP Conservation Zones and Wildlife Linkages

- Zone 1
- Zone 2
- Zone 3
- Zone 4
- Proposed Corridors
- Existing Corridors
- Washes
- Marana Town Limits HCP Planning Area
- County Line

Background Imagery:
July 2007 NAIP Aerial Photography

File: U:\PW_Environmental\HCP\final_figs\November_08\12_15_08_for_CH\Figure 4.1 HCP Conservation Zones and Wildlife Linkages.mxd

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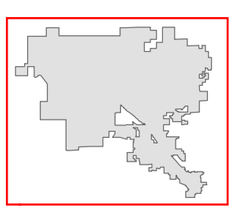

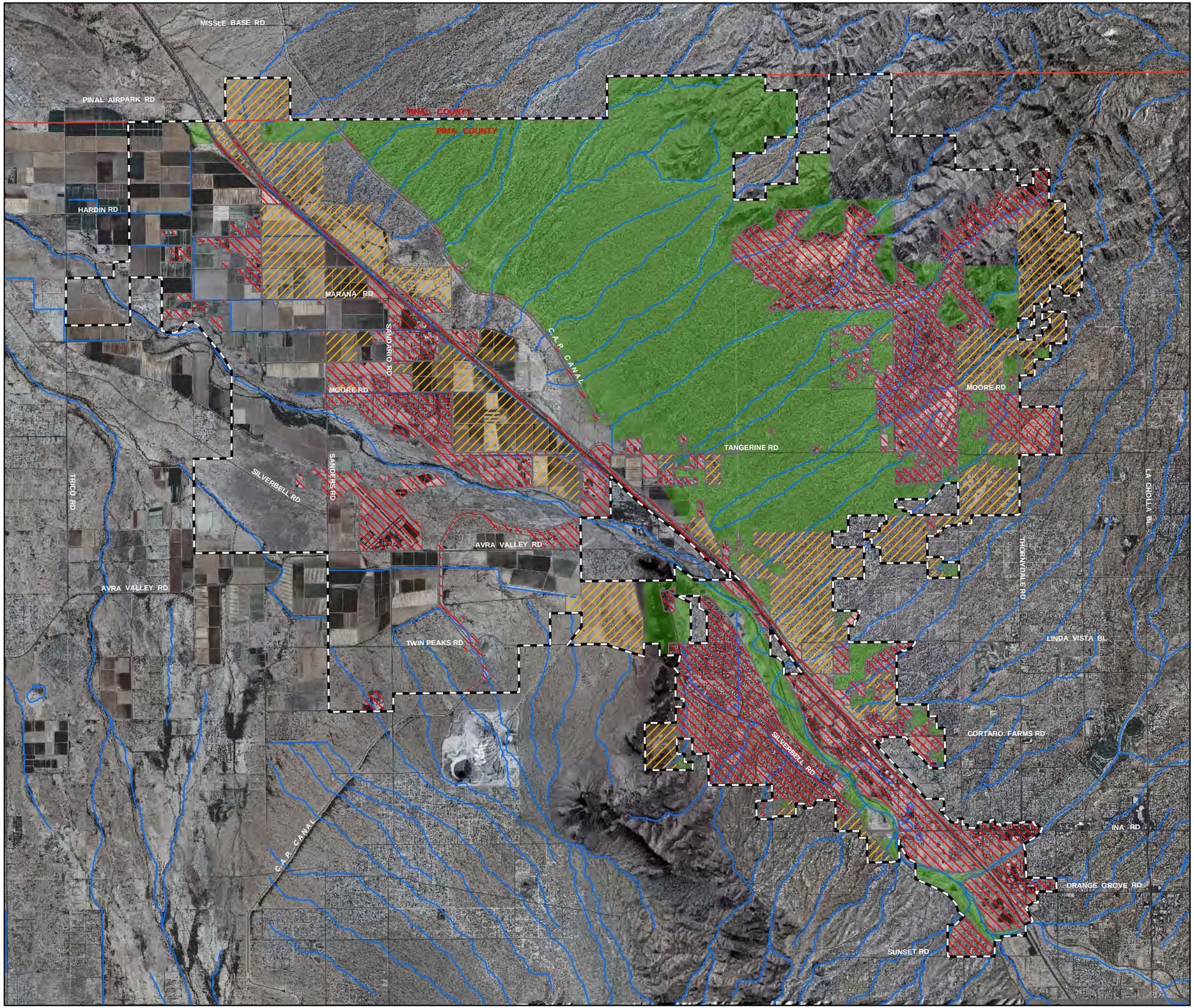

Figure 4.10 Cactus Ferruginous Pygmy-owl Potential Habitat and Development

Cactus Ferruginous Pygmy-owl Potential Habitat - 25,693 Acres

Developed Land

Entitled Land

Washes

HCP Permit Area
Marana Town Limits

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Background Imagery:
July 2007 USDA NAIP Aerial Photography

File: U:\PW_Environmental\HCP\final_figs\November_08\Figure 4.10 Cactus Ferruginous Pygmy-owl Potential Habitat and Development.mxd

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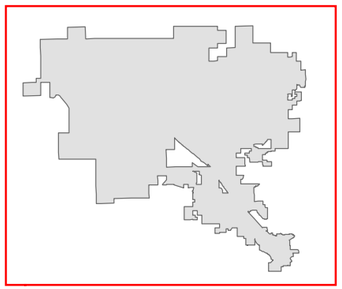

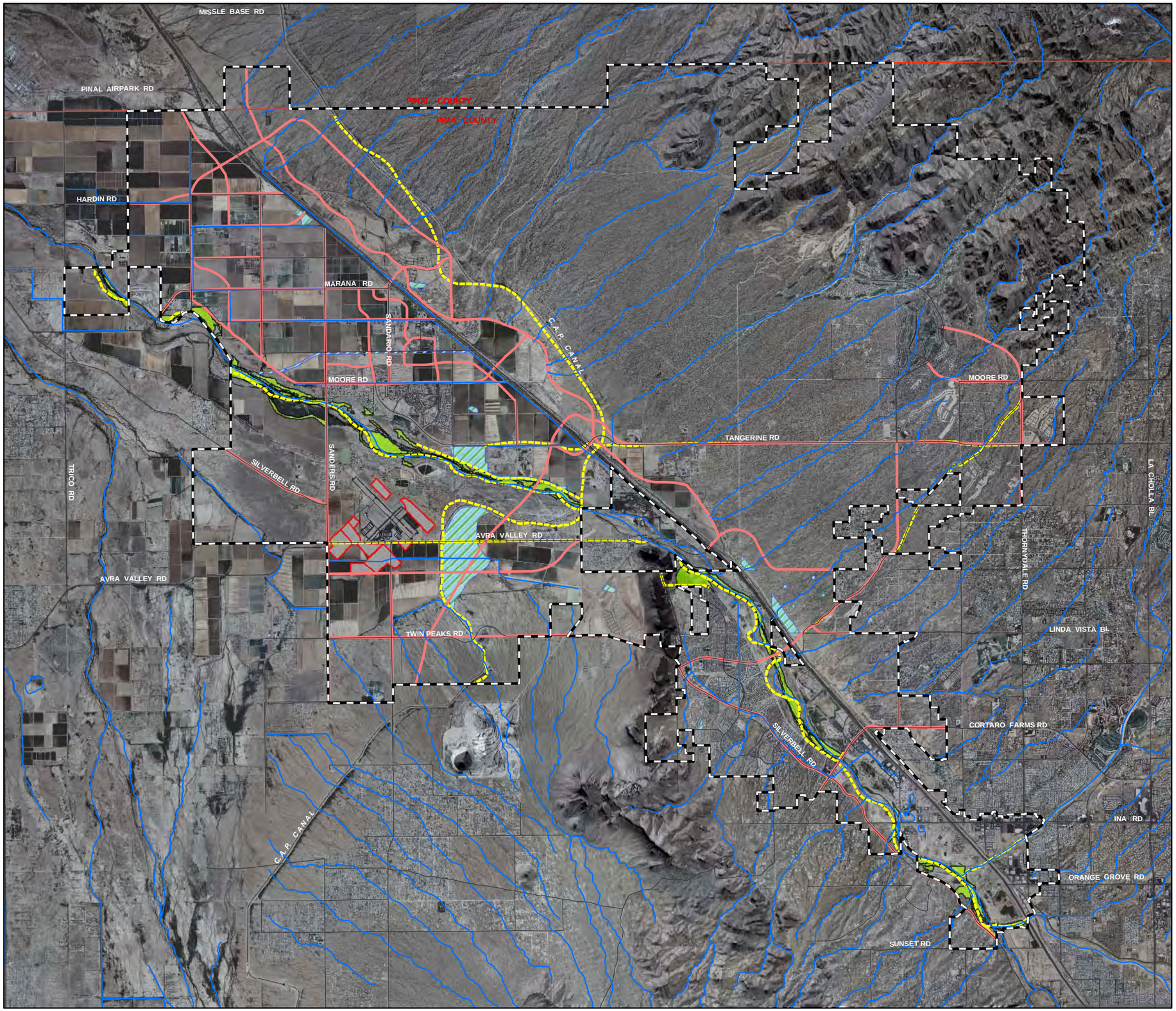

FIGURE 4.11 SOUTHWESTERN WILLOW FLYCATCHER POTENTIAL HABITAT AND CIP

- Southwestern Willow Flycatcher Potential Habitat 1,141 Acres
- Proposed Trails 75 Acres Impact
- Proposed Parks 11 Acres Impact
- Airport Development 0 Acres Impact
- Barnett Channel 2 Acres Impact
- Proposed Streets 22 Acres Impact
- Washes
- HCP Permit Area Marana Town Limits

N W E S

0 0.5 1 2 3
Miles

Background Imagery:
July 2007 NAIP Aerial Photography

4.11 Southwestern Willow Flycatcher Potential Habitat and CIP.mxd
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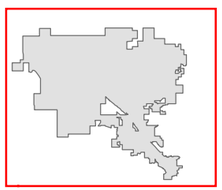

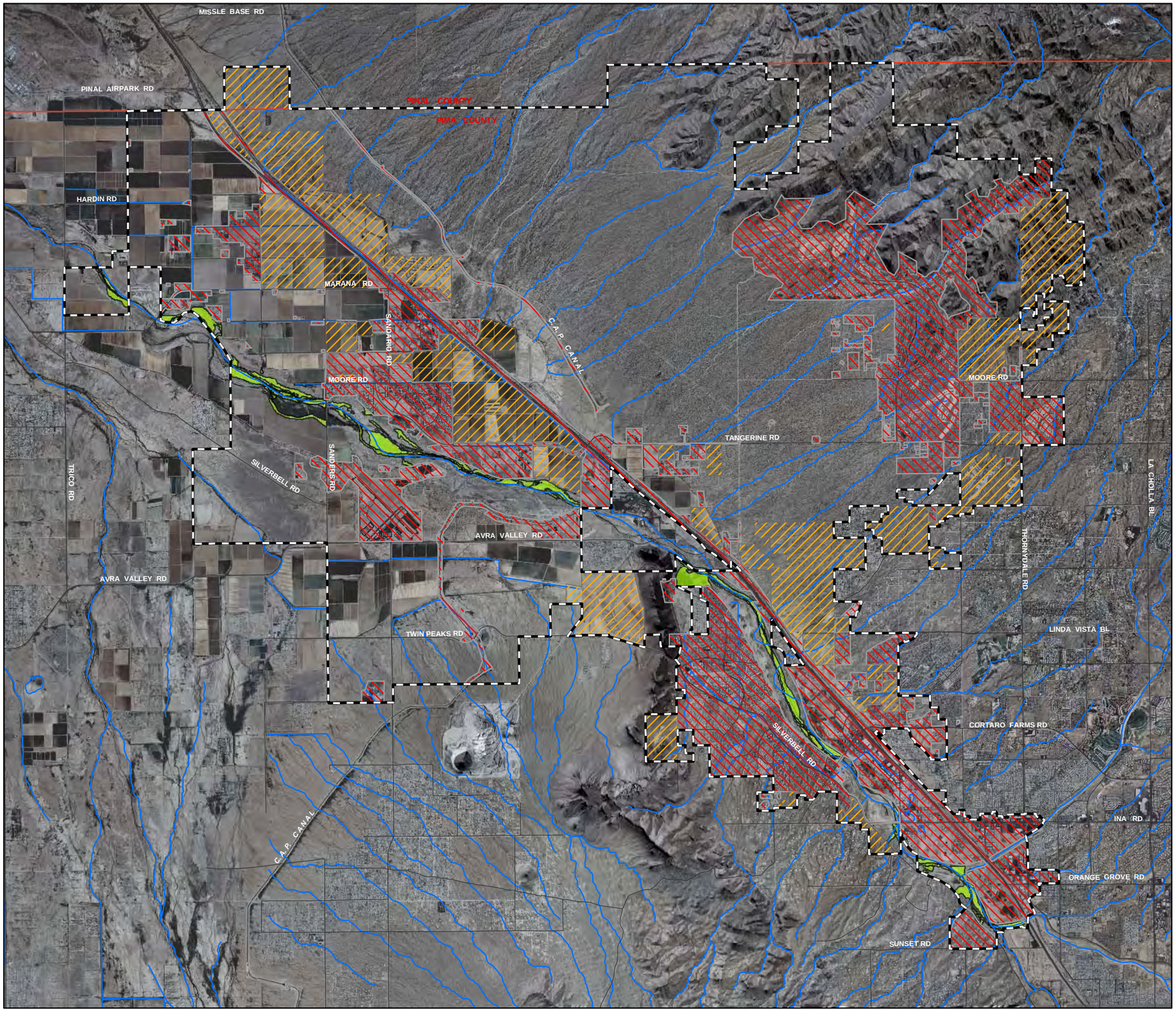

FIGURE 4.12 SOUTHWESTERN WILLOW FLYCATCHER POTENTIAL HABITAT AND DEVELOPMENT

Southwestern Willow Flycatcher Potential Habitat 1,141 Acres

Entitled Land

Developed Land

Washes

HCP Permit Area
Marana Town Limits

N
W E
S

0 0.5 1 2 3
Miles

Background Imagery:
July 2007 NAIP Aerial Photography

File: U:\PW_Environmental\HCP\final_figs\November_08\Figure 4.12 Southwestern Willow Flycatcher Potential Habitat and Development.mxd

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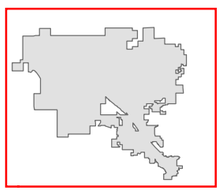

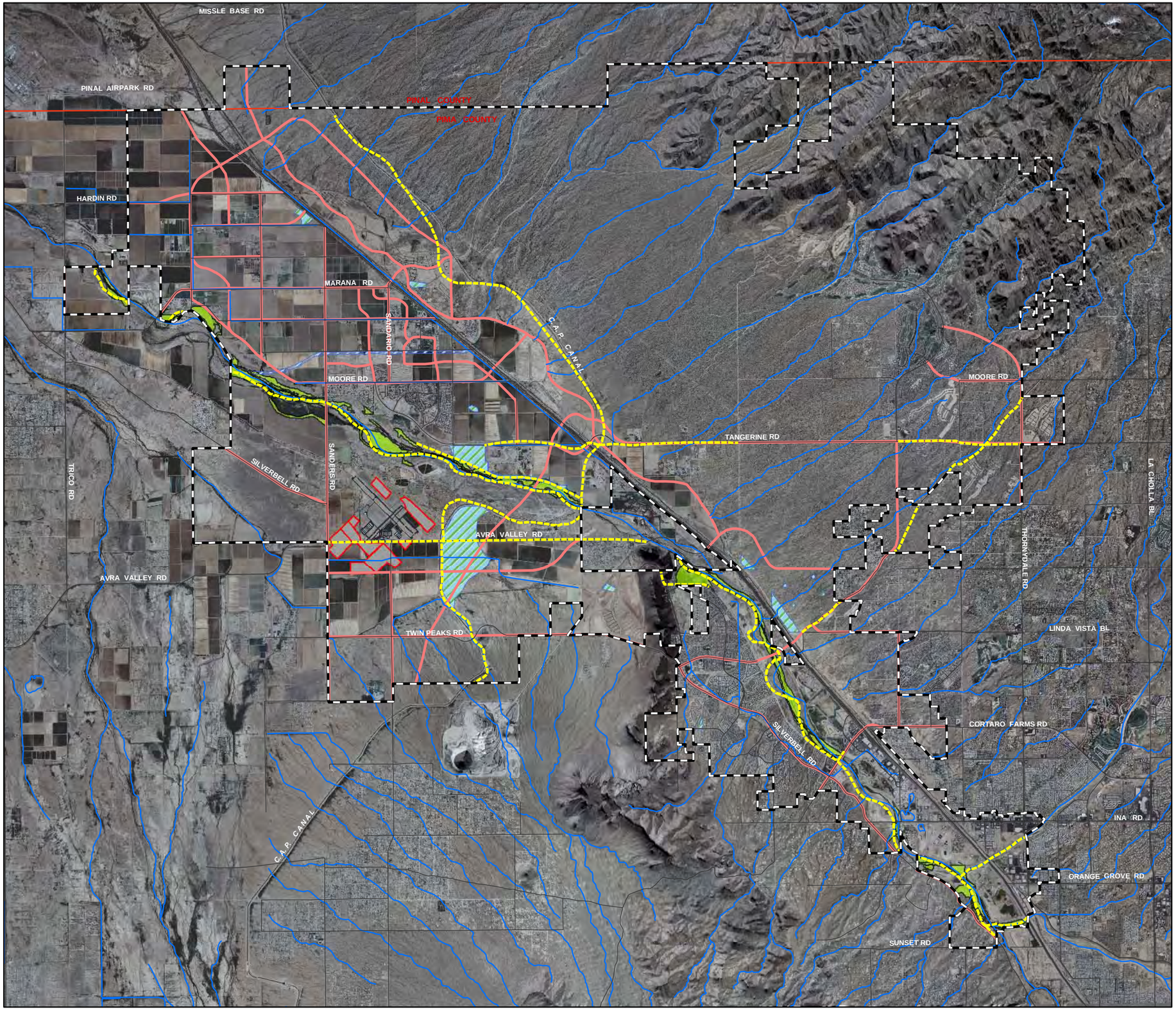

FIGURE 4.13 WESTERN YELLOW-BILLED CUCKOO POTENTIAL HABITAT AND CIP

- Western Yellow Billed Cuckoo Potential Habitat 1,141 Acres
- Proposed Trails 75 Acres Impact
- Proposed Parks 11 Acres Impact
- Airport Development 0 Acres Impact
- Barnett Channel 2 Acres Impact
- Proposed Streets 22 Acres Impact
- Washes
- HCP Permit Area Marana Town Limits

N W E S

0 0.5 1 2 3
Miles

Background Imagery:
July 2007 NAIP Aerial Photography

File: U:\PW_Environmental\HCP\final_figs\November_08\Figure 4.13 Western Yellow-billed Cuckoo Potential Habitat and CIP.mxd

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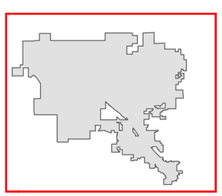

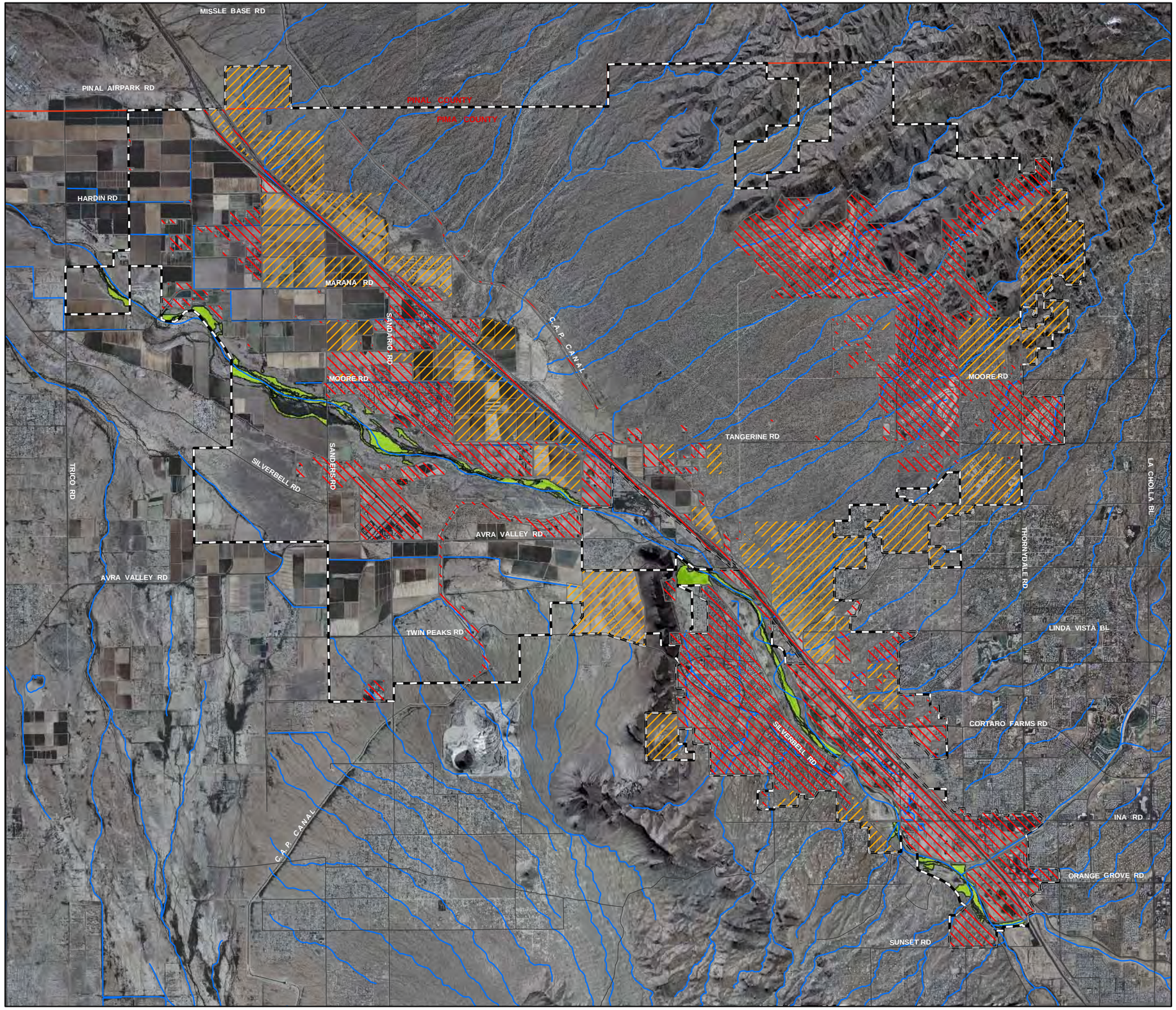

FIGURE 4.14 WESTERN YELLOW-BILLED CUCKOO POTENTIAL HABITAT AND DEVELOPMENT

Western Yellow-billed Cuckoo Potential Habitat 1,141 Acres

Entitled Land

Developed Land

Washes

HCP Permit Area
Marana Town Limits

N
W E
S

0 0.5 1 2 3
Miles

Background Imagery:
July 2007 NAIP Aerial Photography

File: U:\PW_Environmental\HCP\final_figs\November_08\Figure 4.14 Western Yellow-billed Cuckoo Potential Habitat and Development.mxd

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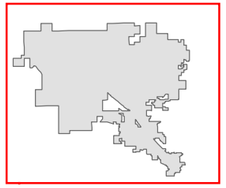

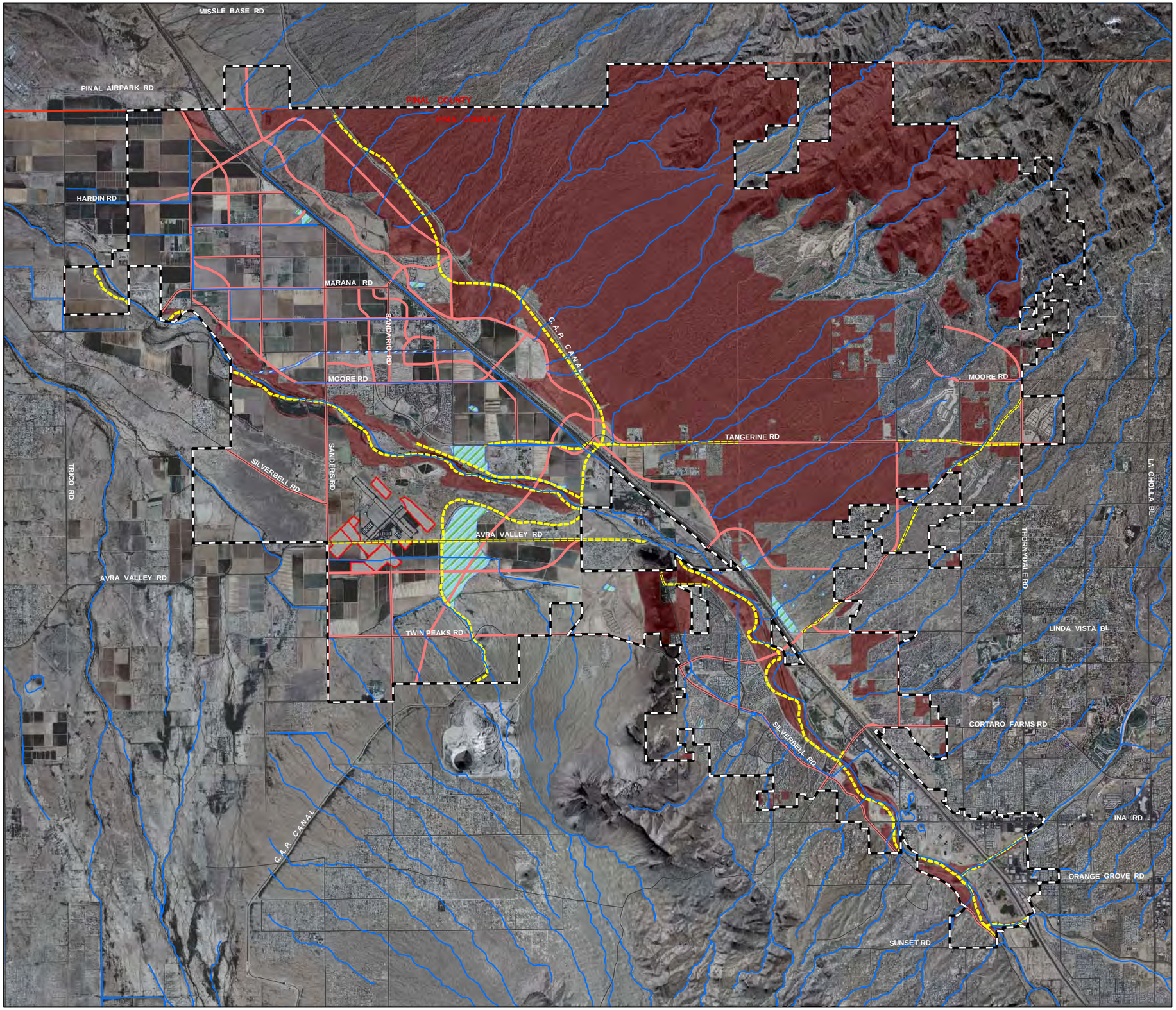

FIGURE 4.15
LESSER LONG-NOSED BAT POTENTIAL HABITAT AND CIP

- Lesser Long-nosed Bat Potential Habitat 32,094 Acres
- Proposed Trails 164 Acres Impact
- Barnett Channel 8 Acres Impact
- Proposed Parks 11 Acres Impact
- Airport Development 0 Acres Impact
- Proposed Streets 925 Acres Impact
- Washes
- HCP Permit Area Marana Town Limits

N W E S

0 0.5 1 2 3
Miles

Background Imagery:
July 2007 NAIP Aerial Photography

File: U:\PW_Environmental\HCP\final_figs\Figure 4.11 Lessor Long-Nosed Bat Modeled Habitat.mxd
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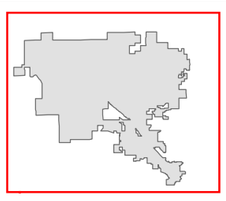

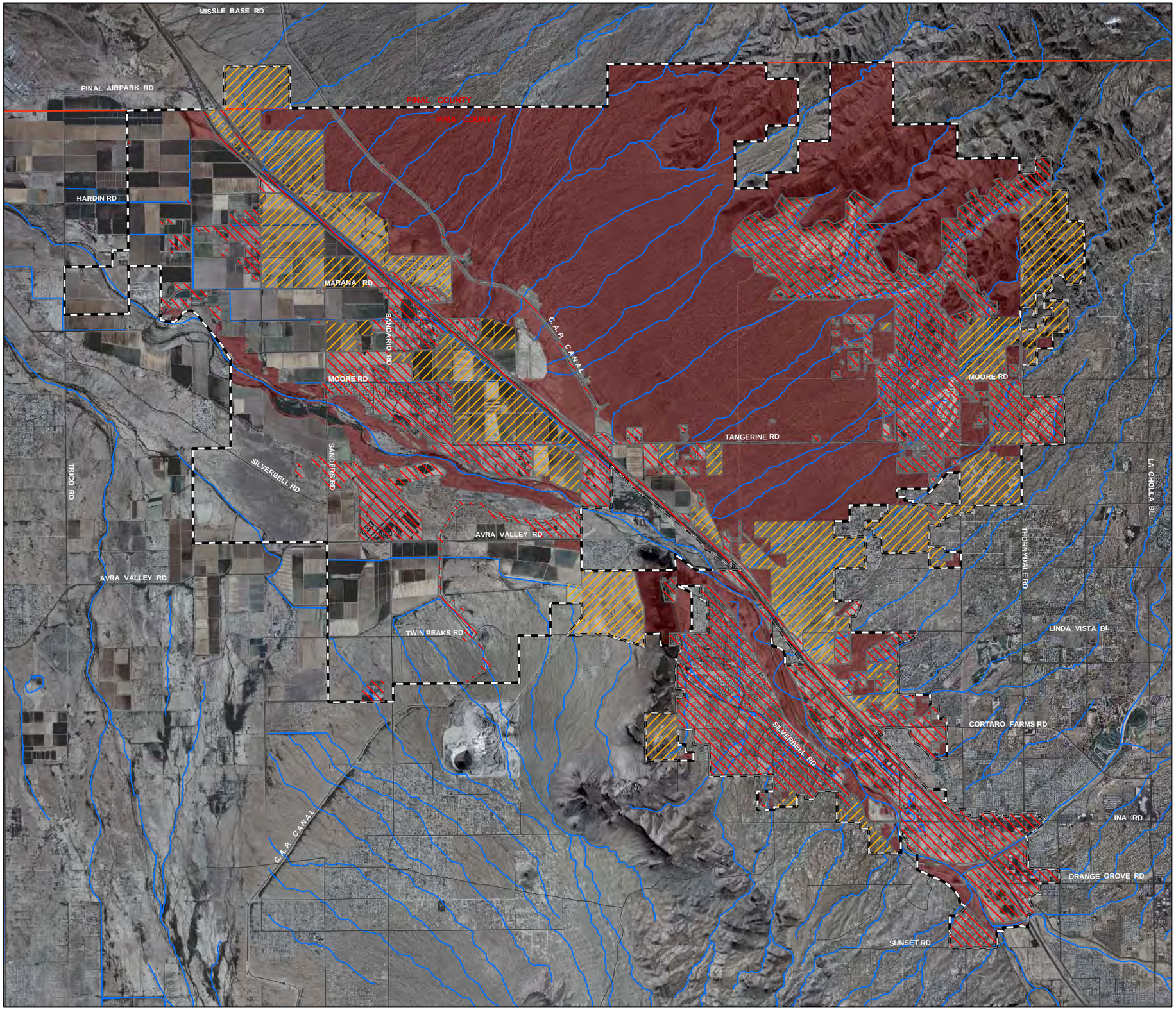

FIGURE 4.16
LESSER LONG-NOSED BAT POTENTIAL HABITAT AND DEVELOPMENT

Lesser Long-nosed Bat Potential Habitat 32,094 Acres

Developed Land

Entitled Land

Washes

HCP Permit Area
Marana Town Limits

N
W E
S

0 0.5 1 2 3
Miles

Background Imagery:
July 2007 NAIP Aerial Photography

File: U:\PW_Environmental\HCP\final_figs\November_08\Figure 4.16 Lessor Long-nosed Bat Potential Habitat and Development.mxd

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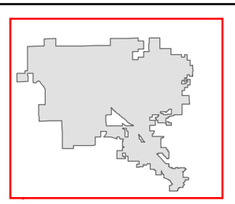

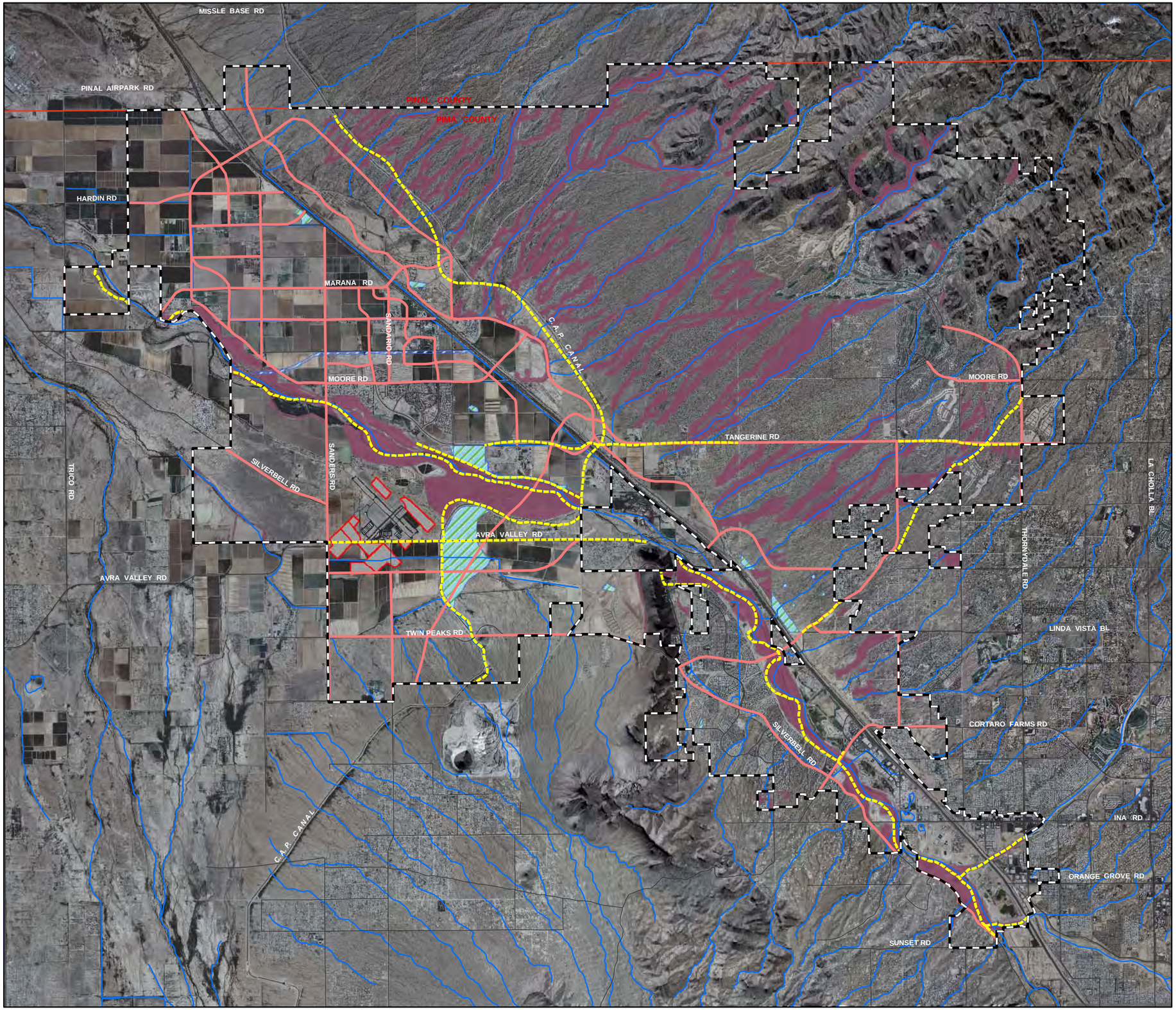

FIGURE 4.17
MERRIAM'S MESQUITE MOUSE POTENTIAL HABITAT AND CIP

- Mesquite Mouse Potential Habitat 11,392 Acres
- Proposed Trails 146 Acres Impact
- Proposed Parks 17 Acres Impact
- Airport Development No Impact
- Proposed Streets 257 Acres Impact
- Washes
- HCP Permit Area Marana Town Limits

N W E S

0 0.5 1 2 3
Miles

Background Imagery:
July 2007 NAIP Aerial Photography

File: U:\PW_Environmental\HCP\final_figs\November_08\Figure 4.17 Merriam's Mesquite Mouse Potential Habitat and CIP.mxd

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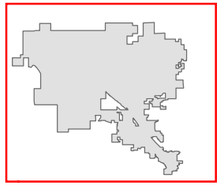

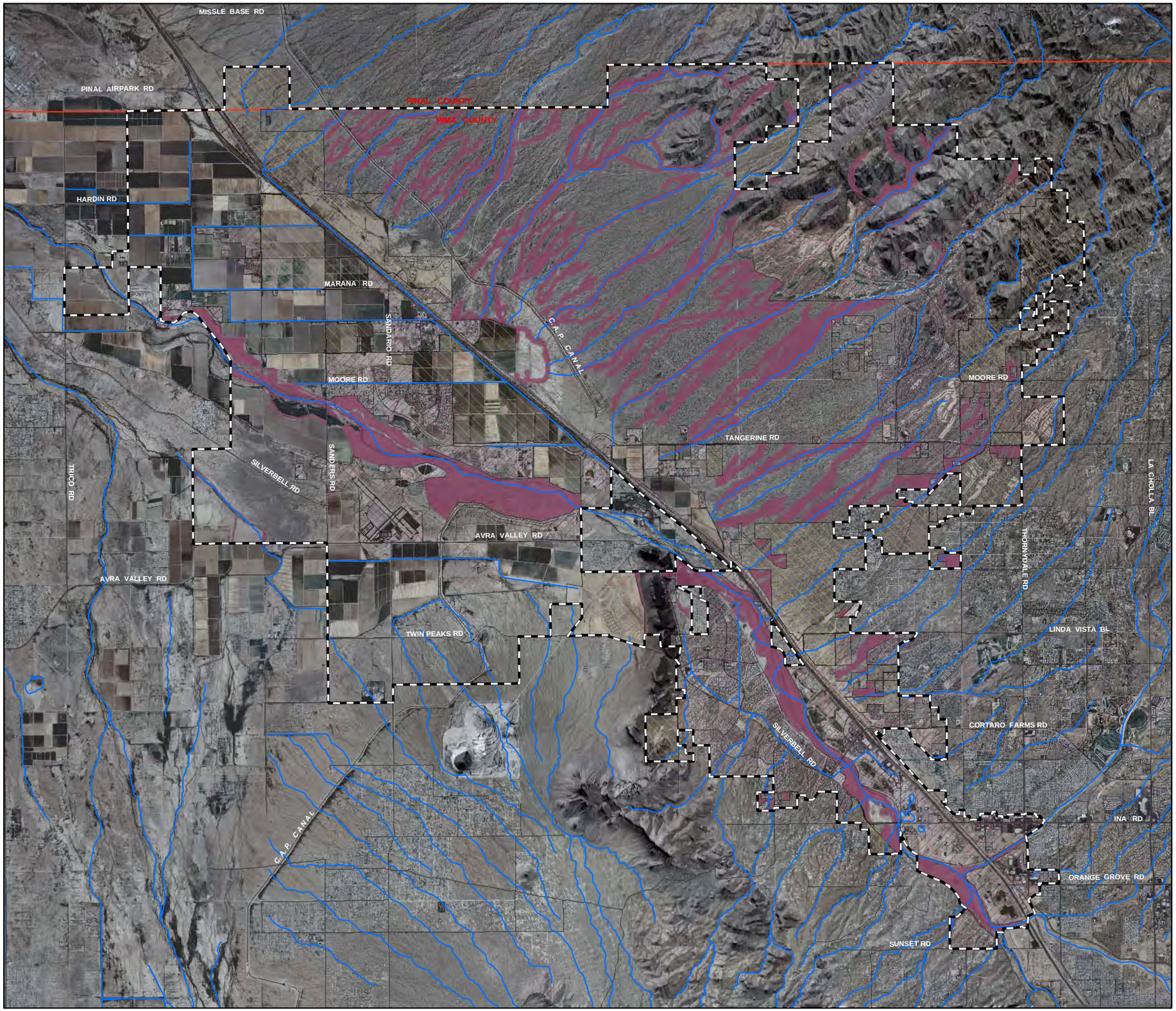

FIGURE 4.18
MERRIAM'S MESQUITE MOUSE POTENTIAL HABITAT AND DEVELOPMENT

Merriam's Mesquite Mouse Potential Habitat - 11,392 Acres

Entitled Land

Developed Land

Washes

HCP Permit Area
Marana Town Limits

N
W E
S

0 0.5 1 2 3
Miles

Background Imagery:
July 2007 NAIP Aerial Photography

File: U:\PW_Environmental\HCP\final_figs\November_08\Figure 4.18 Merriam's Mesquite Mouse Potential Habitat and Development.mxd

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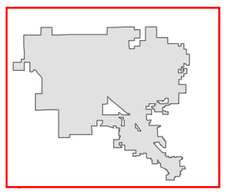

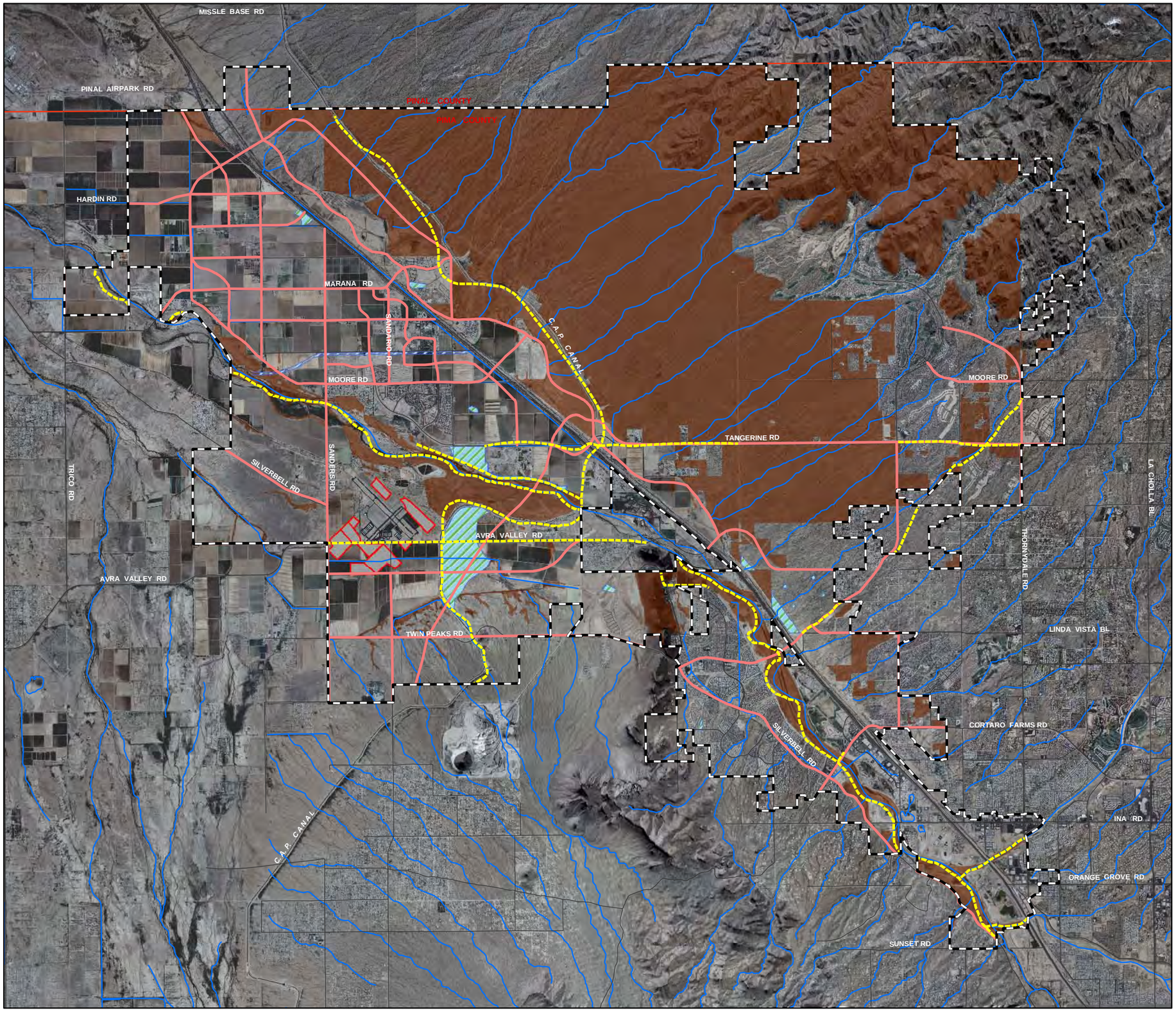

FIGURE 4.19
PALE TOWNSEND'S BIG-EARED BAT POTENTIAL HABITAT AND CIP

- Pale Townsend's Big-eared Bat Potential Habitat 44,528 Acres
- Proposed Trails 153 Acres Impact
- Proposed Parks 92 Acres Impact
- Barnett Channel 7 Acres Impact
- Airport Development 0 Acres Impact
- Proposed Streets 934 Acres Impact
- Washes
- HCP Permit Area Marana Town Limits

N W E S

0 0.5 1 2 3
Miles

Background Imagery:
July 2007 NAIP Aerial Photography

File: U:\PW_Environmental\HCP\final_figs\November_08\Figure 4.19 Pale Townsend's Big-eared Bat Potential Habitat.mxd

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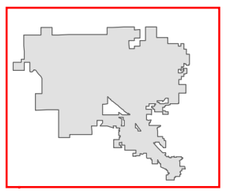

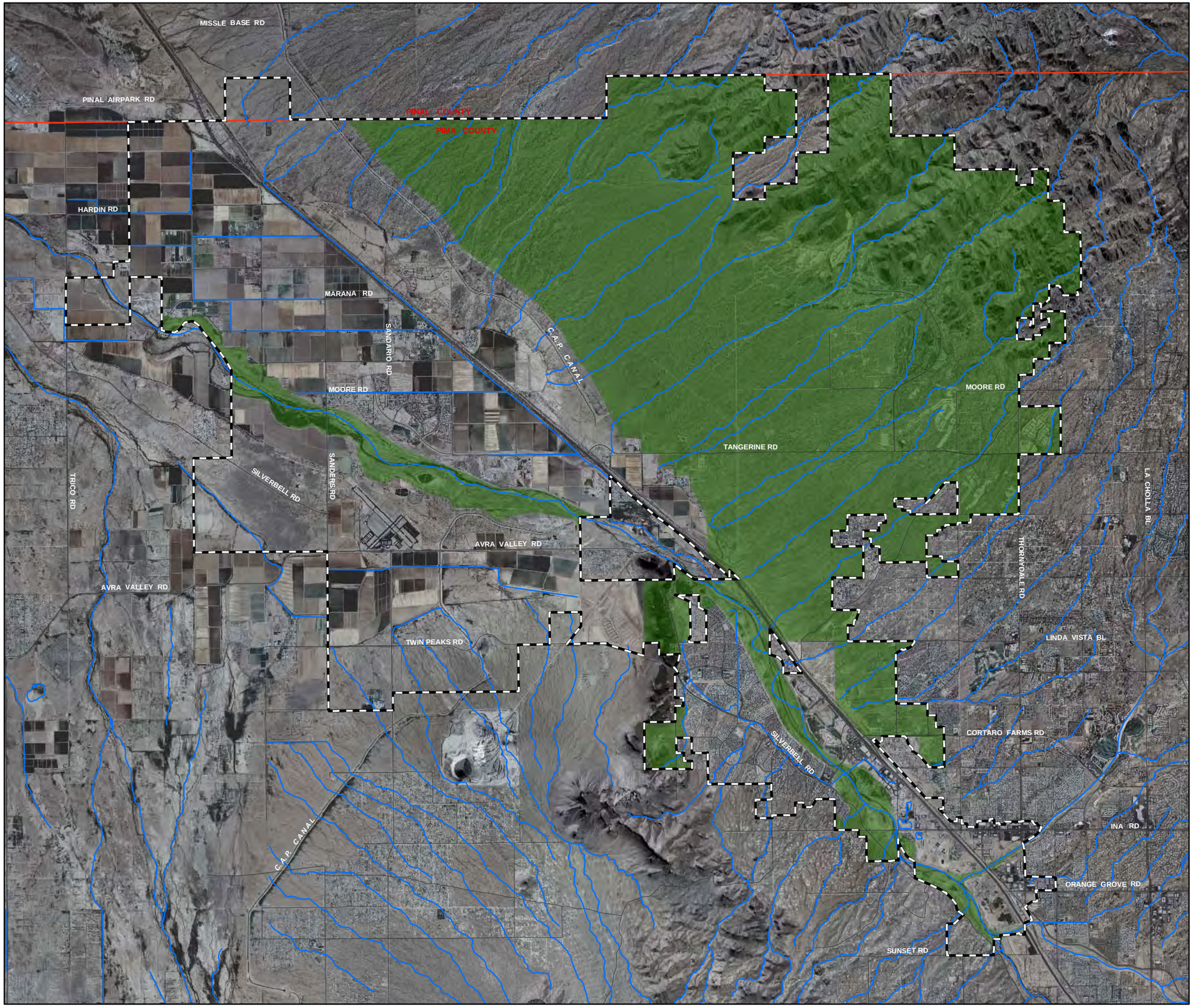

Figure 4.2 Environmentally Sensitive Lands in the Town of Marana

Environmentally Sensitive Lands

HCP Permit Area Marana Town Limits

Washes

County Line

N
W E
S

0 0.5 1 2 3 Miles

Background Imagery:
July 2007 NAIP Aerial Photography

File: U:\PW_Environmental\HCP\final_figs\November_08\12_15_08_for_CH\Figure 4.2 Environmentally Sensitive Lands in the Town of Marana.mxd

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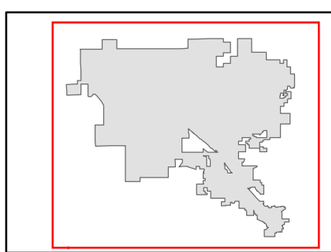

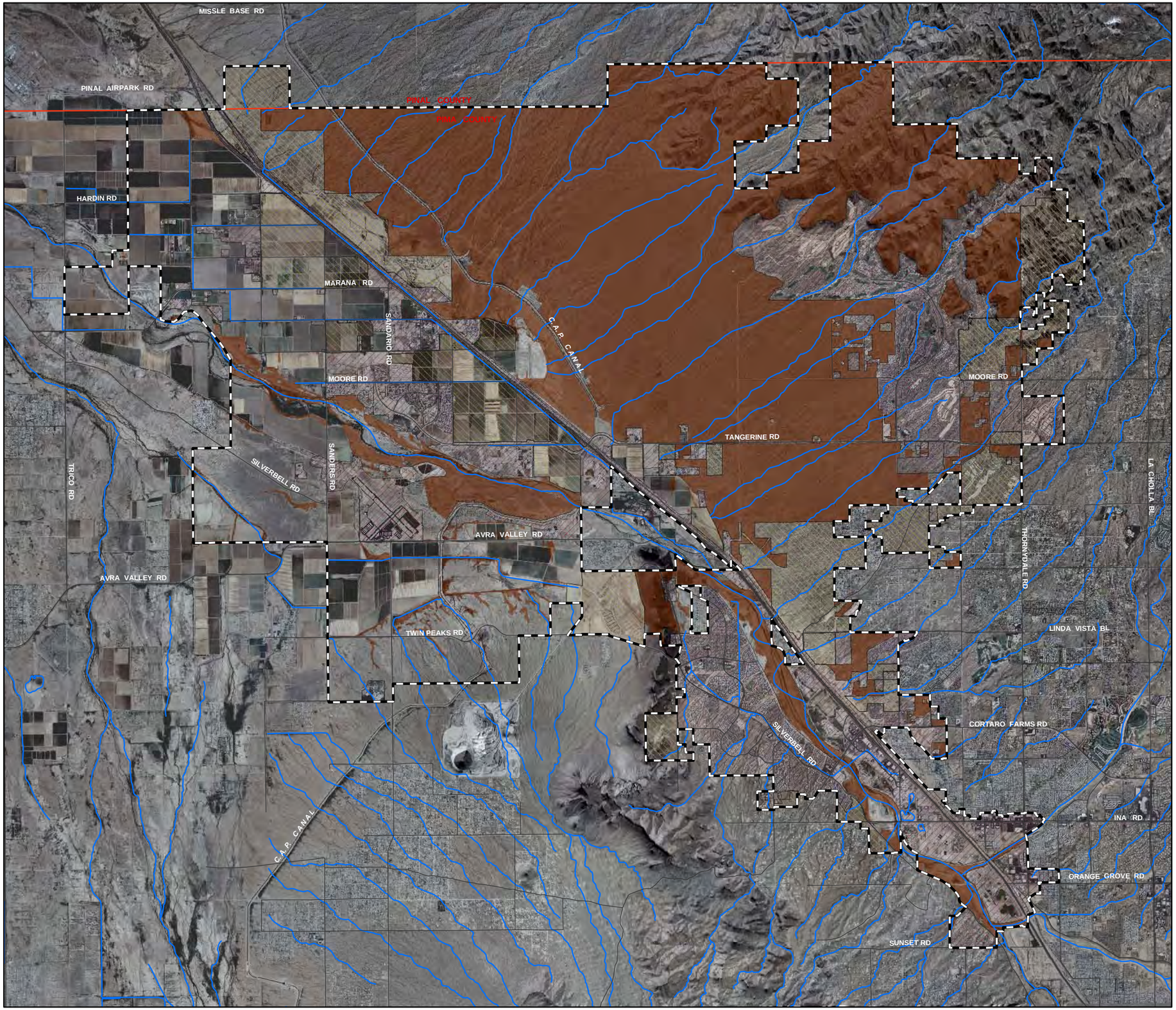

FIGURE 4.20
PALE TOWNSEND'S BIG-EARED BAT POTENTIAL HABITAT AND DEVELOPMENT

- Pale Townsend's Big-eared Bat Potential Habitat 44,528 Acres
- Entitled Land
- Developed Land
- Washes
- HCP Permit Area Marana Town Limits

N W E S

0 0.5 1 2 3
Miles

Background Imagery:
July 2007 NAIP Aerial Photography

File: U:\PW_Environmental\HCP\final_figs\November_08\Figure 4.20 Pale Townsend's Big-eared Bat Potential Habitat and Development.mxd

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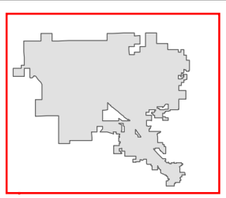

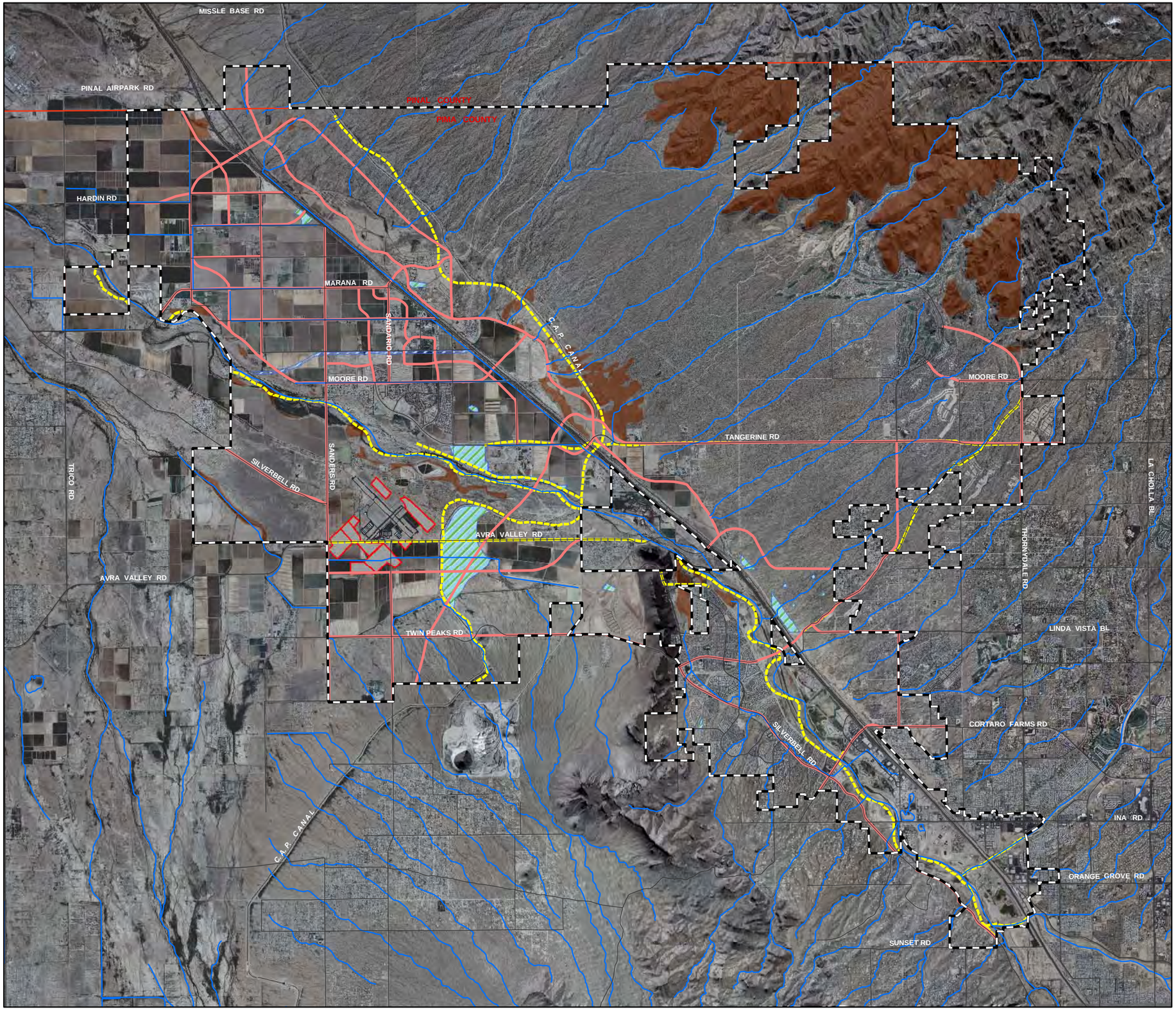

FIGURE 4.21 GROUND SNAKE POTENTIAL HABITAT AND CIP

- Ground Snake Potential Habitat, 7,480 Acres
- Proposed Trails 21 Acres Impact
- Proposed Parks 0 Acres Impact
- Airport Development 0 Acres Impact
- Barnett Channel 0 Acres Impact
- Proposed Streets 171 Acres Impact
- Washes
- HCP Permit Area Marana Town Limits

N W E S

0 0.5 1 2 3
Miles

Background Imagery:
July 2007 NAIP Aerial Photography

File: U:\PW_Environmental\HCP\final_figs\November_08\Figure 4.21 Ground Snake Potential Habitat and CIP.mxd

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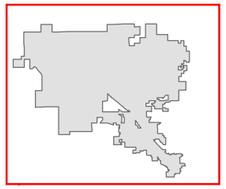

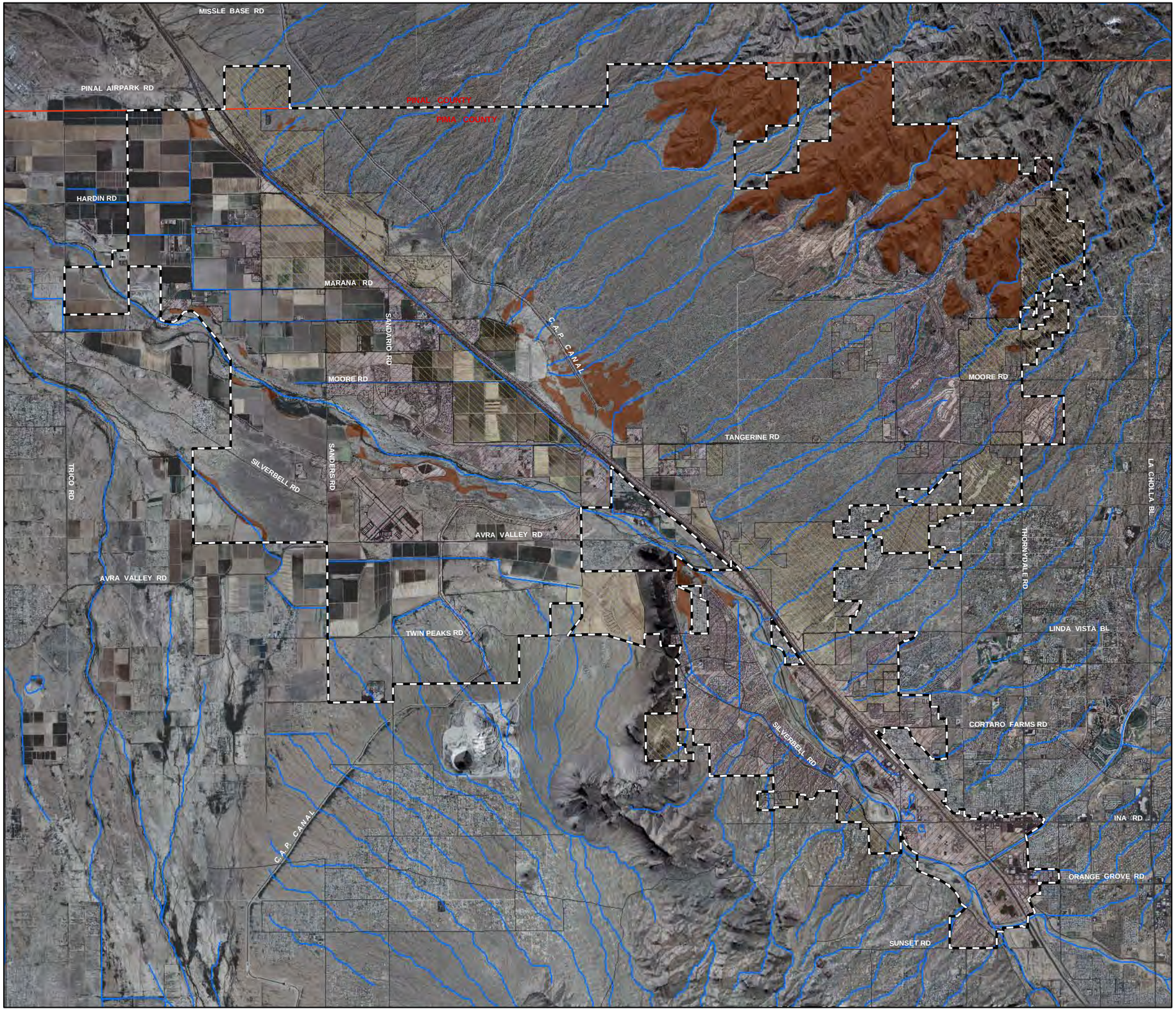

FIGURE 4.22
GROUND SNAKE POTENTIAL HABITAT AND DEVELOPMENT

- Ground Snake Potential Habitat 7,480 Acres
- Entitled Land
- Developed Land
- Washes
- HCP Permit Area
  Marana Town Limits

N
W E
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0 0.5 1 2 3
Miles

Background Imagery:
July 2007 NAIP Aerial Photography

File: U:\PW_Environmental\HCP\
final_figs\November_08\Figure 4.22
Ground Snake Potential Habitat
and Development.mxd

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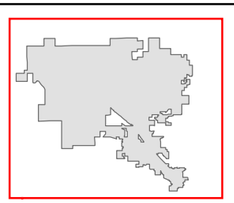

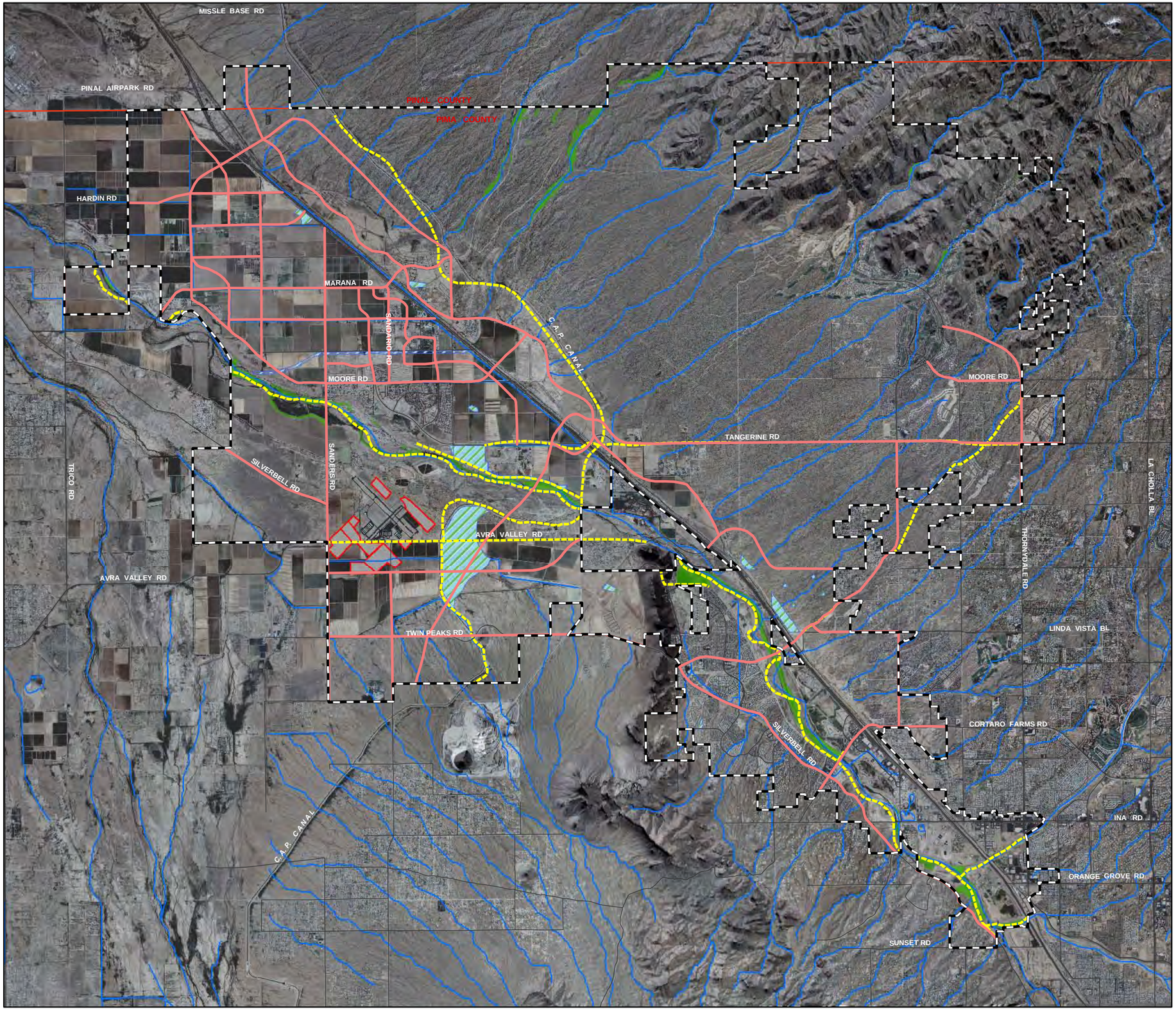

FIGURE 4.23
MEXICAN GARTER SNAKE POTENTIAL HABITAT AND CIP

- Mexican Garter Snake Potential Habitat - 1,120 Acres
- Proposed Trails 59 Acres Impact
- Proposed Parks 9 Acres Impact
- Airport Development 0 Acres Impact
- Barnett Channel 0 Acres Impact
- Proposed Streets 11 Acres Impact
- Washes
- HCP Permit Area Marana Town Limits

N W E S

0 0.5 1 2 3
Miles

Background Imagery:
July 2007 NAIP Aerial Photography

File: U:\PW_Environmental\HCP\final_figs\November_08\Figure 4.23 Mexican Garter Snake Potential Habitat and CIP.mxd

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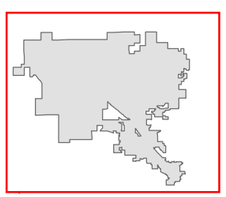

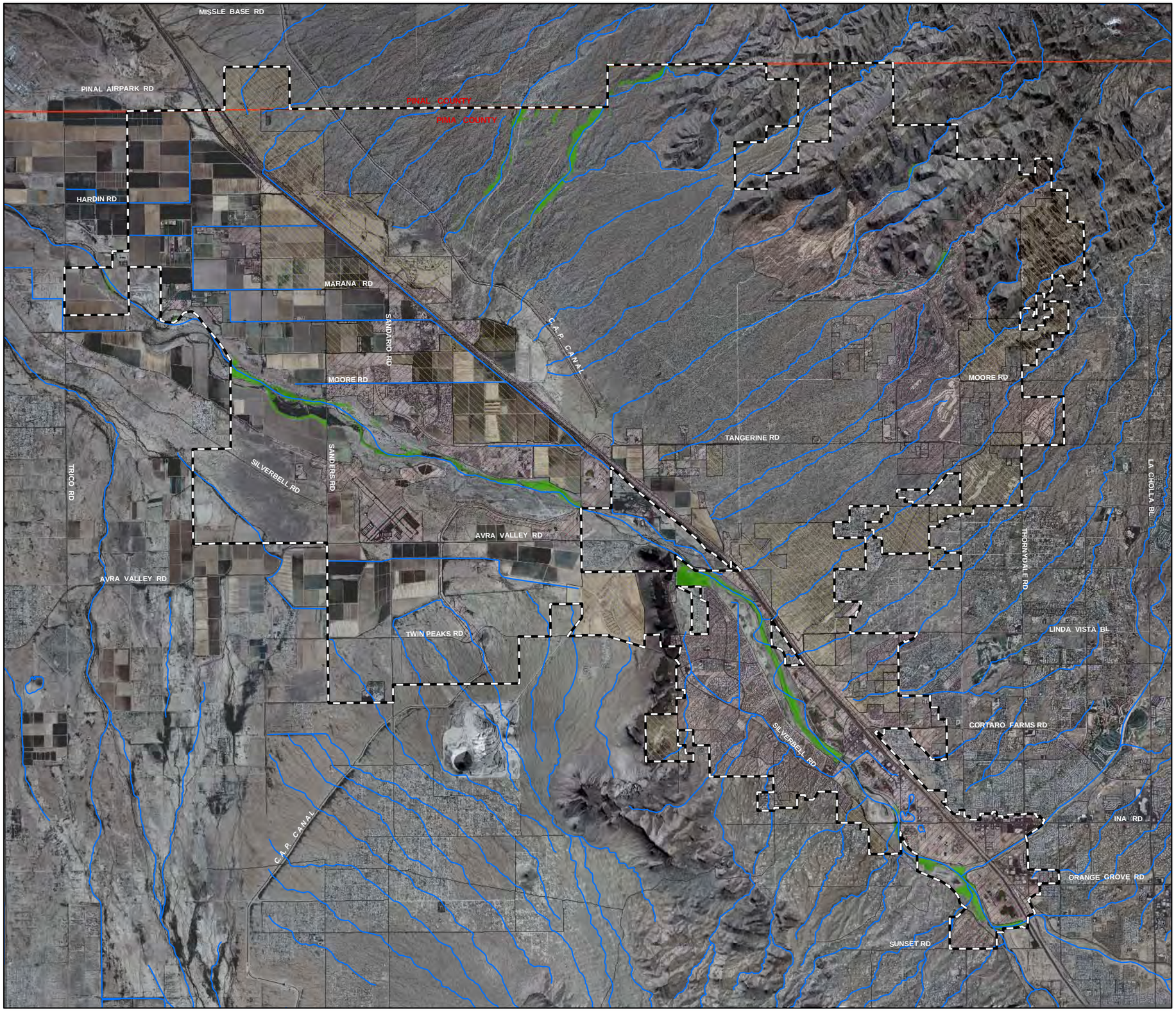

FIGURE 4.24
MEXICAN GARTER SNAKE POTENTIAL HABITAT AND DEVELOPMENT

- Mexican Garter Snake Potential Habitat - 1,120 Acres
- Entitled Land
- Developed Land
- Washes
- HCP Permit Area Marana Town Limits

N W E S

0 0.5 1 2 3
Miles

Background Imagery:
July 2007 NAIP Aerial Photography

File: U:\PW_Environmental\HCP\final_figs \November_08\Figure 4.24 Mexican Garter Snake Potential Habitat and Development.mxd

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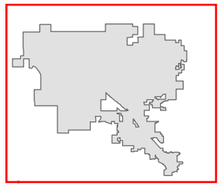

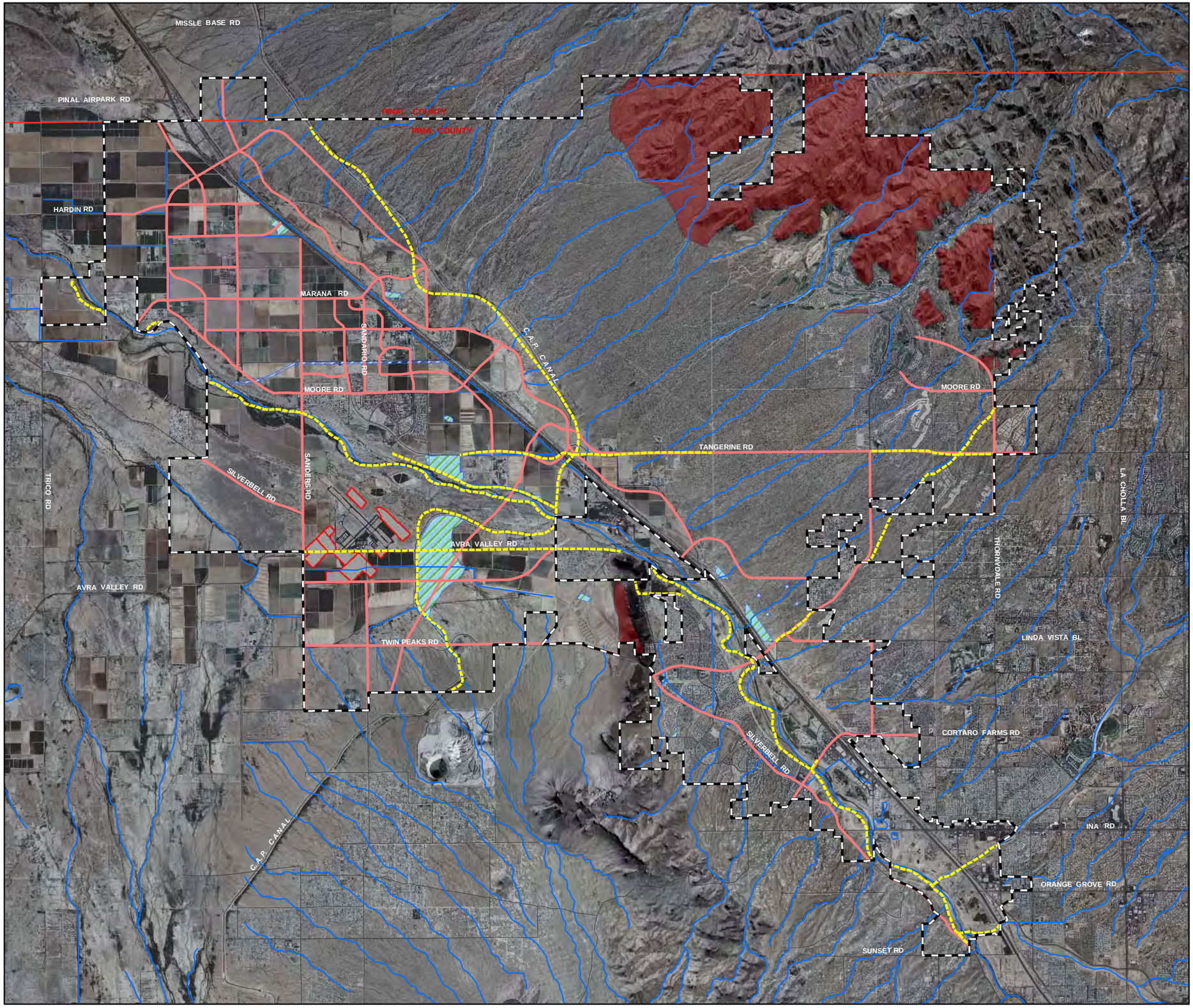

Figure 4.25 Sonoran Desert Tortoise Potential Habitat and CIP

- Desert Tortoise Potential Habitat - 7,413 Acres
- Proposed Trails 0 Acres Impact
- Proposed Parks 0 Acres Impact
- Barnett Channel 0 Acres Impact
- Airport Development 0 Acres Impact
- Proposed Streets 4 Acres Impact
- Washes
- HCP Permit Area Marana Town Limits

N W E S

0 0.5 1 2 3 Miles

Background Imagery:
July 2007 NAIP Aerial Photography
File: U:\PW_Environmental\HCP\final_figs\November_08\Figure 4.25 Sonoran Desert Tortoise Potential Habitat and CIP.mxd
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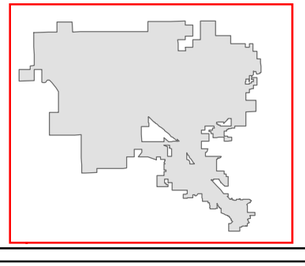

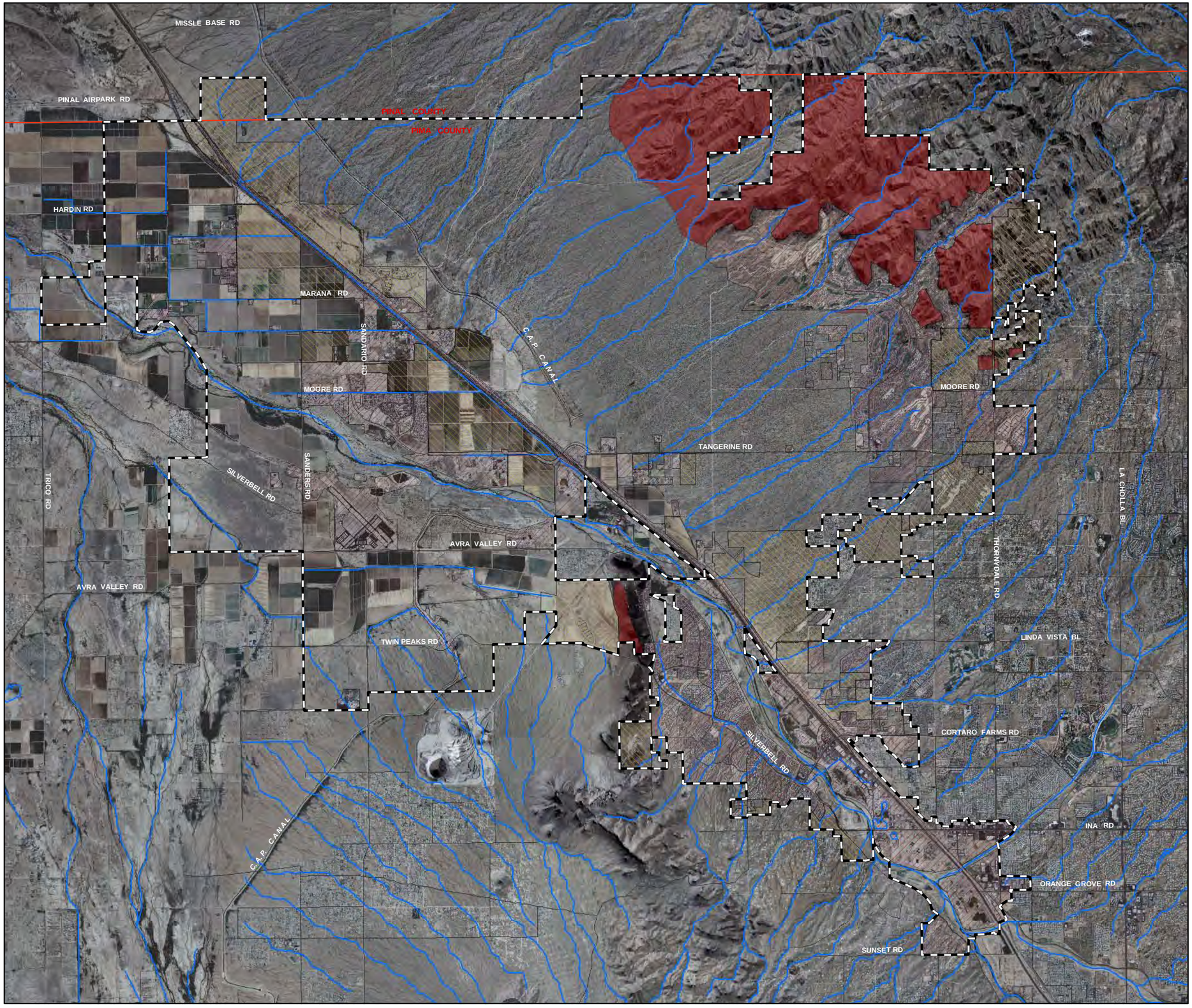

Figure 4.26
Sonoran Desert Tortoise Potential Habitat and Land Development

- Desert Tortoise Potential Habitat - 7,413 Acres
- Developed Land
- Entitled Land
- Washes
- HCP Permit Area
  Marana Town Limits

N
W E
S

0 0.5 1 2 3 Miles

Background Imagery:
July 2007 NAIP Aerial Photography

File: U:\PW_Environmental\HCP\final_figs\November_08\Figure 4.26 Sonoran Desert Tortoise Potential Habitat and Development.mxd

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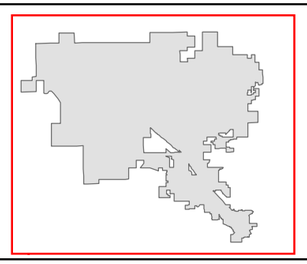

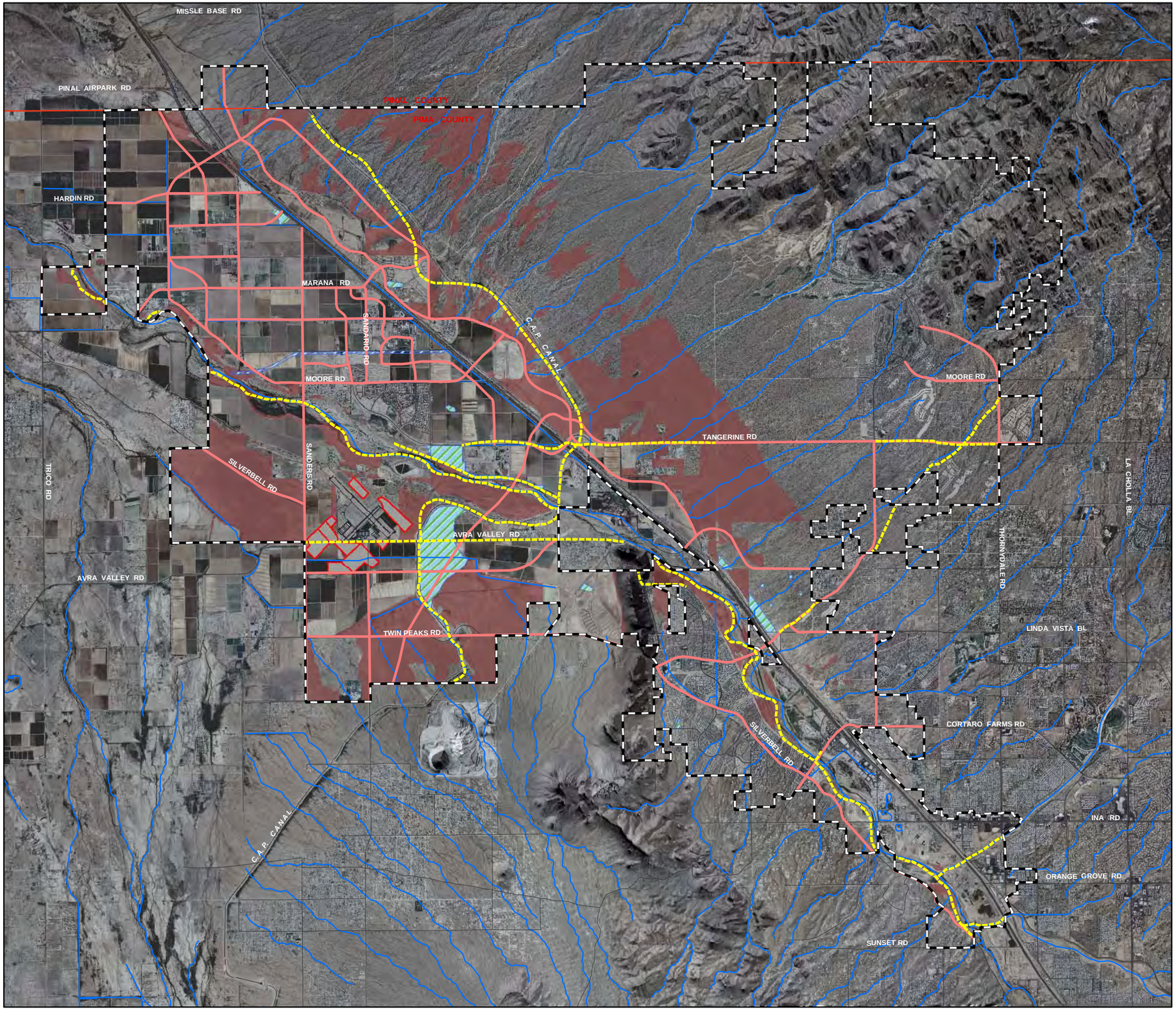

FIGURE 4.27
TUCSON SHOVEL-NOSED SNAKE POTENTIAL HABITAT AND CIP

- Tucson Shovel-nosed Snake - 12,870 Acres
- Proposed Trails 96 Acres Impact
- Proposed Parks 188 Acres Impact
- Barnett Channel 5 Acres Impact
- Airport Development 48 Acres Impact
- Proposed Streets 793 Acres Impact
- Washes
- HCP Permit Area Marana Town Limits

N W E S

0 0.5 1 2 3
Miles

Background Imagery Data Source:
July 2007 USDA NAIP Aerial Photography

File: U:\PW_Environmental\HCP\final_figs\November_08\12_15_08_for_CH\Figure 4.27 Tucson Shovel-nosed Snake Potential Habitat and CIP.mxd

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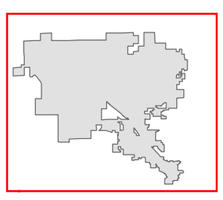

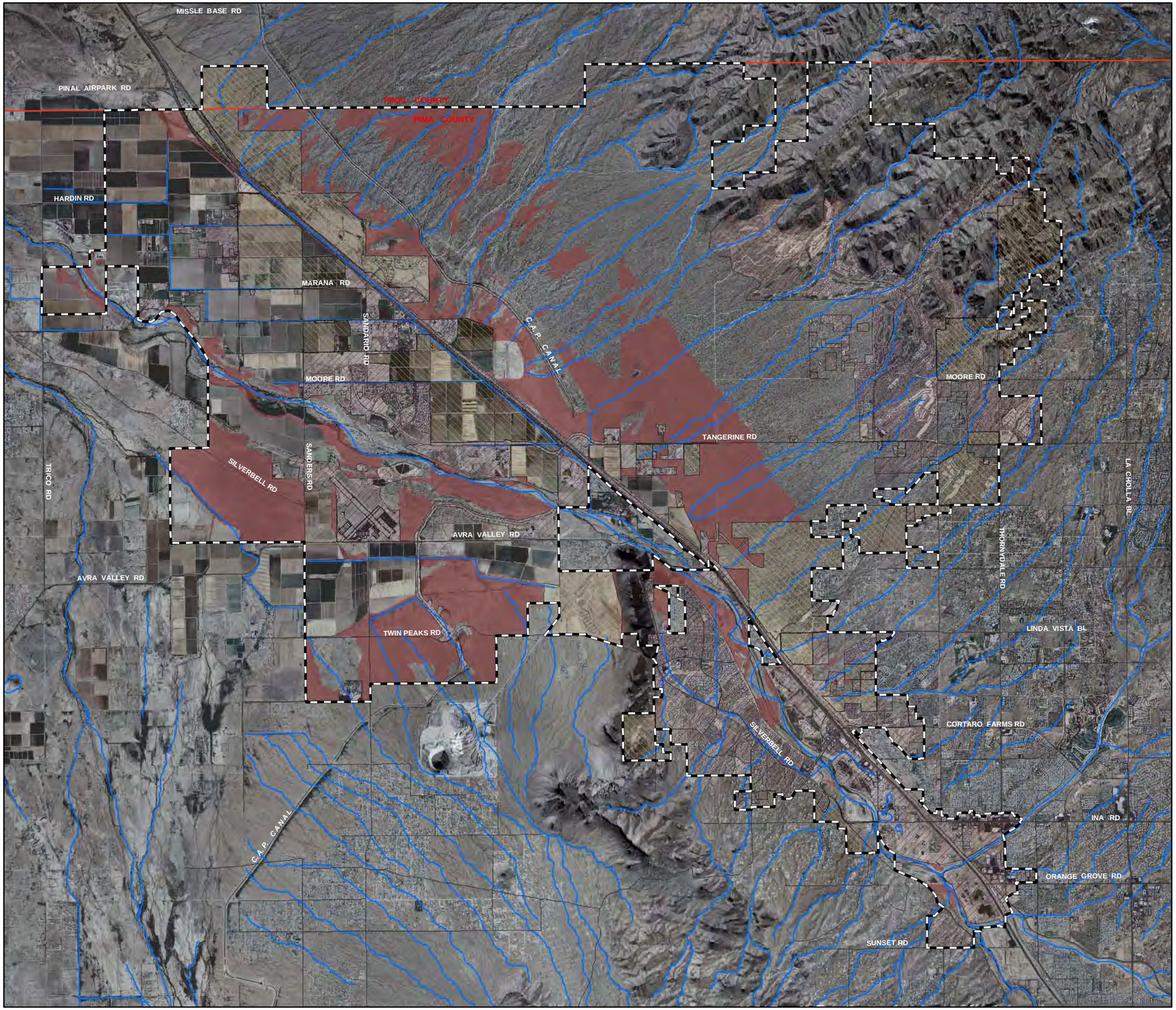

FIGURE 4.28
TUCSON SHOVEL-NOSED SNAKE POTENTIAL HABITAT AND DEVELOPMENT

- Tucson Shovel-nosed Snake - 12,870 Acres
- Developed Land
- Entitled Land
- Washes
- HCP Permit Area Marana Town Limits

N W E S

0 0.5 1 2 3
Miles

Background Imagery Data Source:
July 2007 USDA NAIP Aerial Photography

File: U:\PW_Environmental\HCP\final_figs\November_08\12_15_08_for_CH\Figure 4.28 Tucson Shovel-nosed Snake Potential Habitat and Development.mxd

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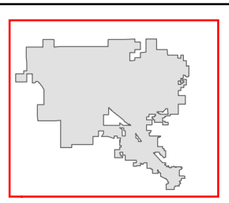

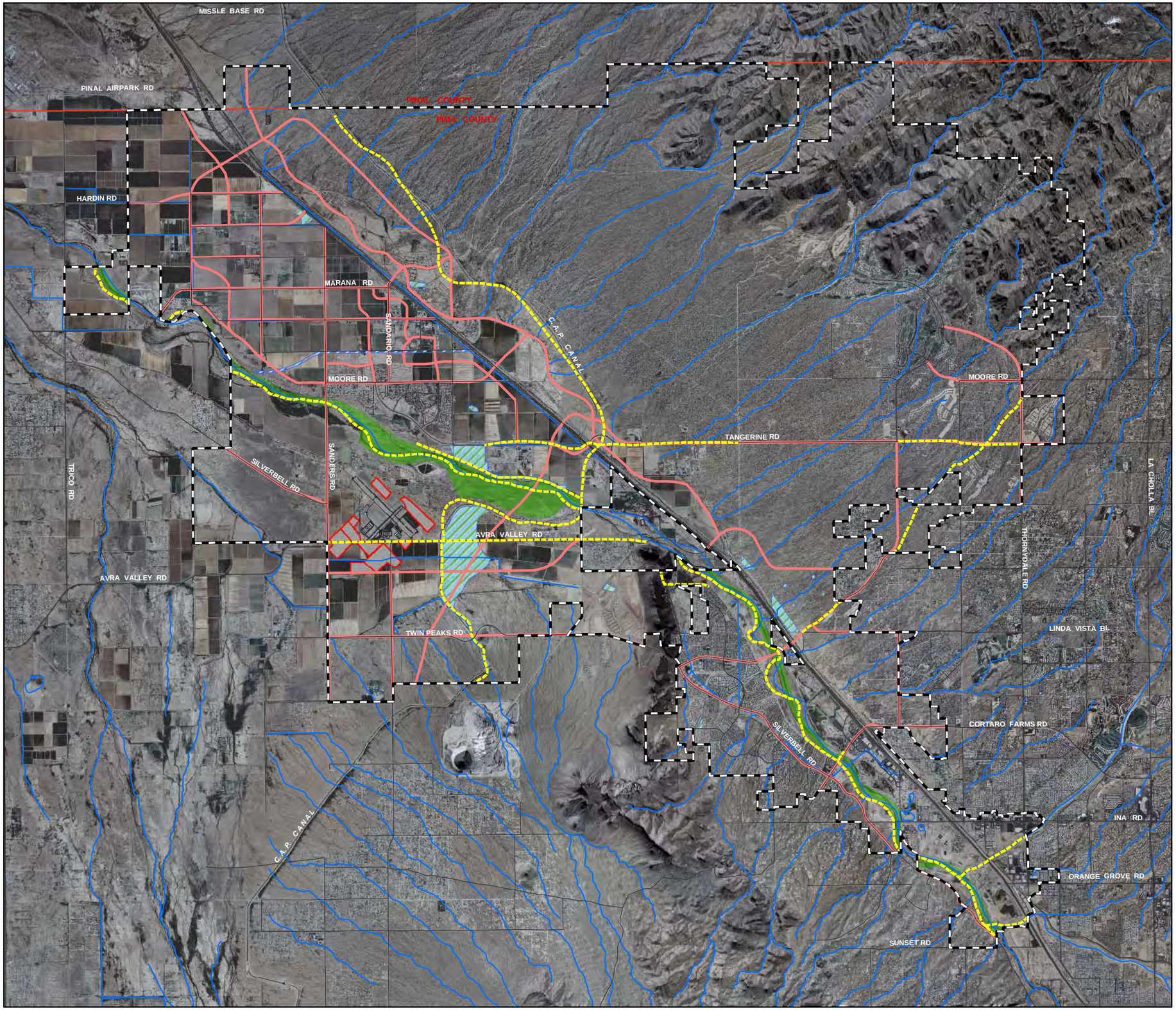

FIGURE 4.29
LOWLAND LEOPARD FROG POTENTIAL HABITAT AND CIP

- Lowland Leopard Frog 1,680 Acres
- Proposed Trails 74 Acres Impact
- Barnett Channel 0 Acres Impact
- Proposed Parks 12 Acres Impact
- Airport Development 0 Acres Impact
- Proposed Streets 17 Acres Impact
- Washes
- HCP Permit Area Marana Town Limits

N W E S

0 0.5 1 2 3
Miles

Background Imagery Data Source:
July 2007 USDA NAIP Aerial Photography

File: U:\PW_Environmental\HCP\final_figs\
November_08\12_15_08_for_CH\
Figure 4.29 Lowland Leopard Frog
Potential Habitat and CIP.mxd

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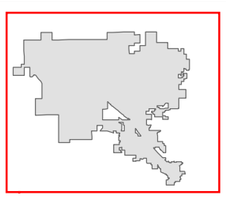

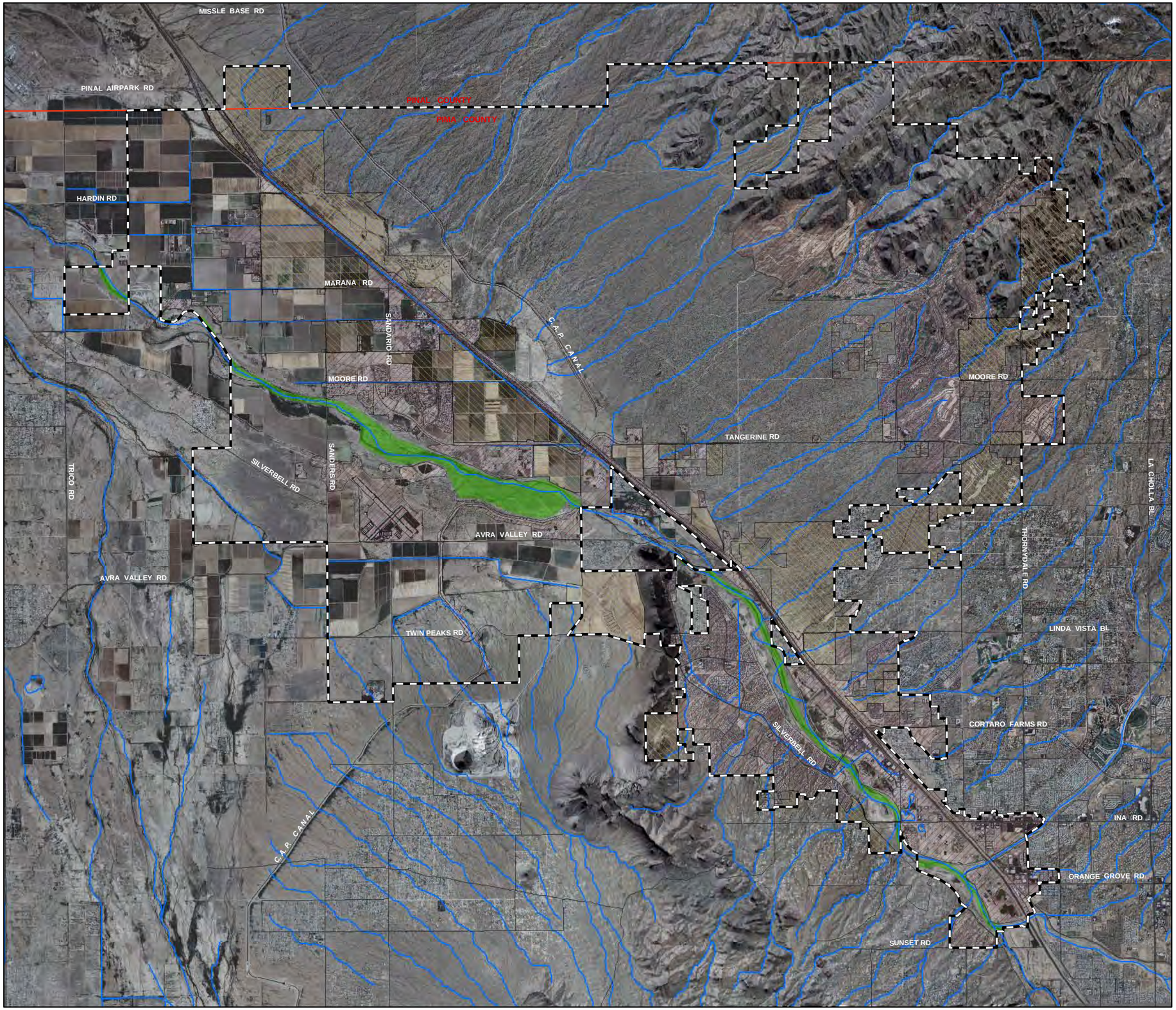

FIGURE 4.30 LOWLAND LEOPARD FROG POTENTIAL HABITAT AND DEVELOPMENT

- Lowland Leopard Frog 1,680 Acres
- Developed Land
- Entitled Land
- Washes
- HCP Permit Area Marana Town Limits

N W E S

0 0.5 1 2 3
Miles

Background Imagery Data Source:
July 2007 USDA NAIP Aerial Photography

File: U:\PW_Environmental\HCP\final_figs\November_08\12_15_08_for_CH\Figure 4.30 Lowland Leopard Frog Potential Habitat and Development.mxd

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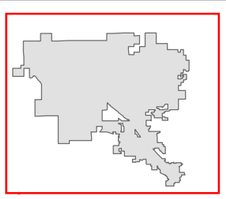


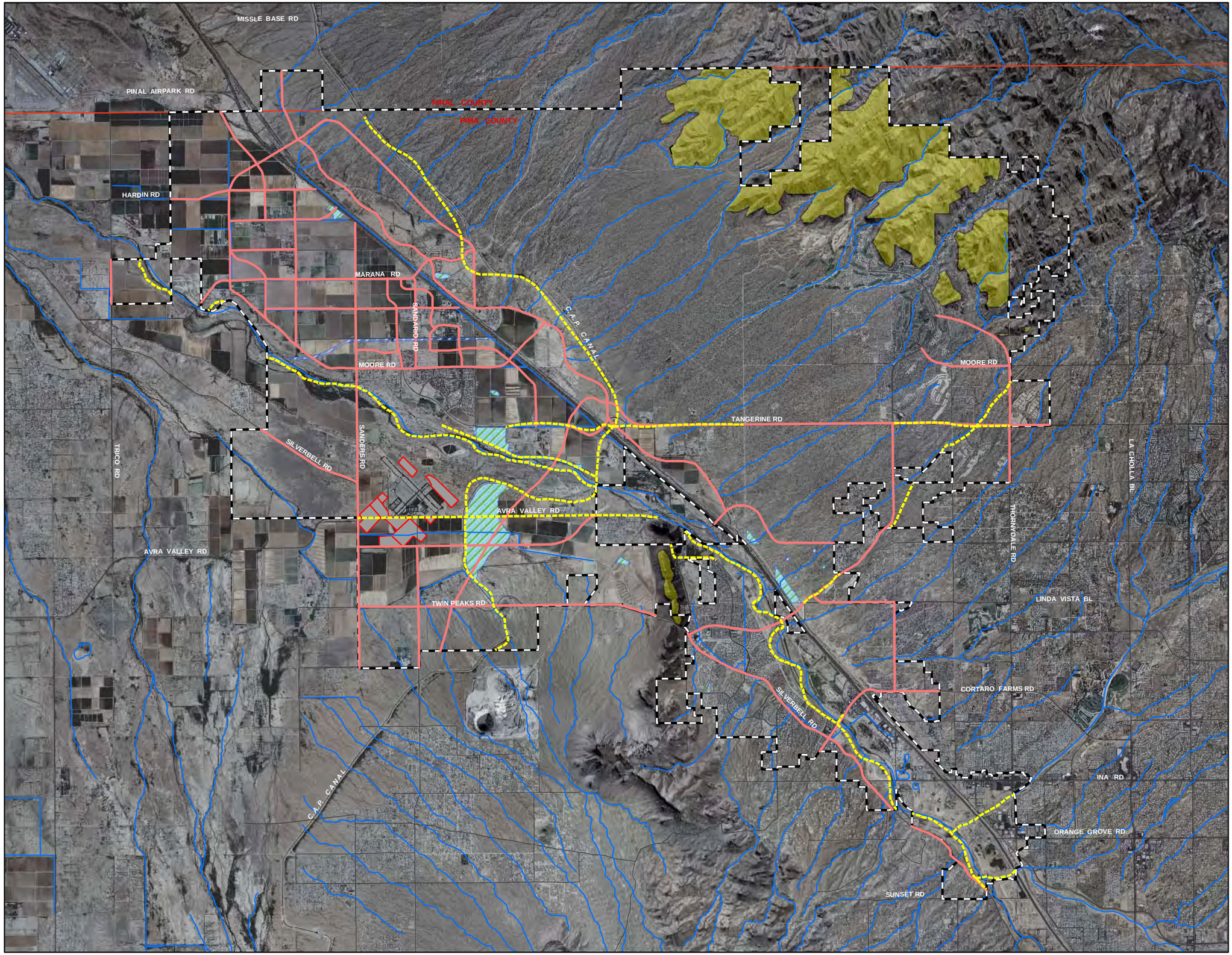


FIGURE 4.31
TALUS SNAIL POTENTIAL HABITAT AND CIP

- Talus Snail Potential Habitat 6,380 Acres
- Proposed Trails 0 Acres Impact
- Proposed Parks 0 Acres Impact
- Barnett Channel 0 Acres Impact
- Airport Development 0 Acres Impact
- Proposed Streets 0 Acres Impact
- Washes
- HCP Permit Area Marana Town Limits

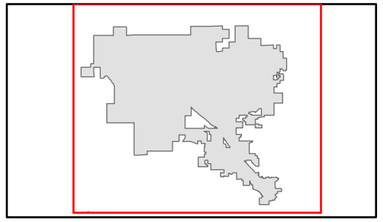
N W E S

0 0.5 1 2 3
Miles

Background Imagery Data Source:
July 2007 USDA NAIP Aerial Photography

File: U:\PW_Environmental\HCP\final_figs\November_08\12_15_08_for_CH\Figure 4.31 Talus Snail Potential Habitat and CIP.mxd

© 12-08 Town of Marana



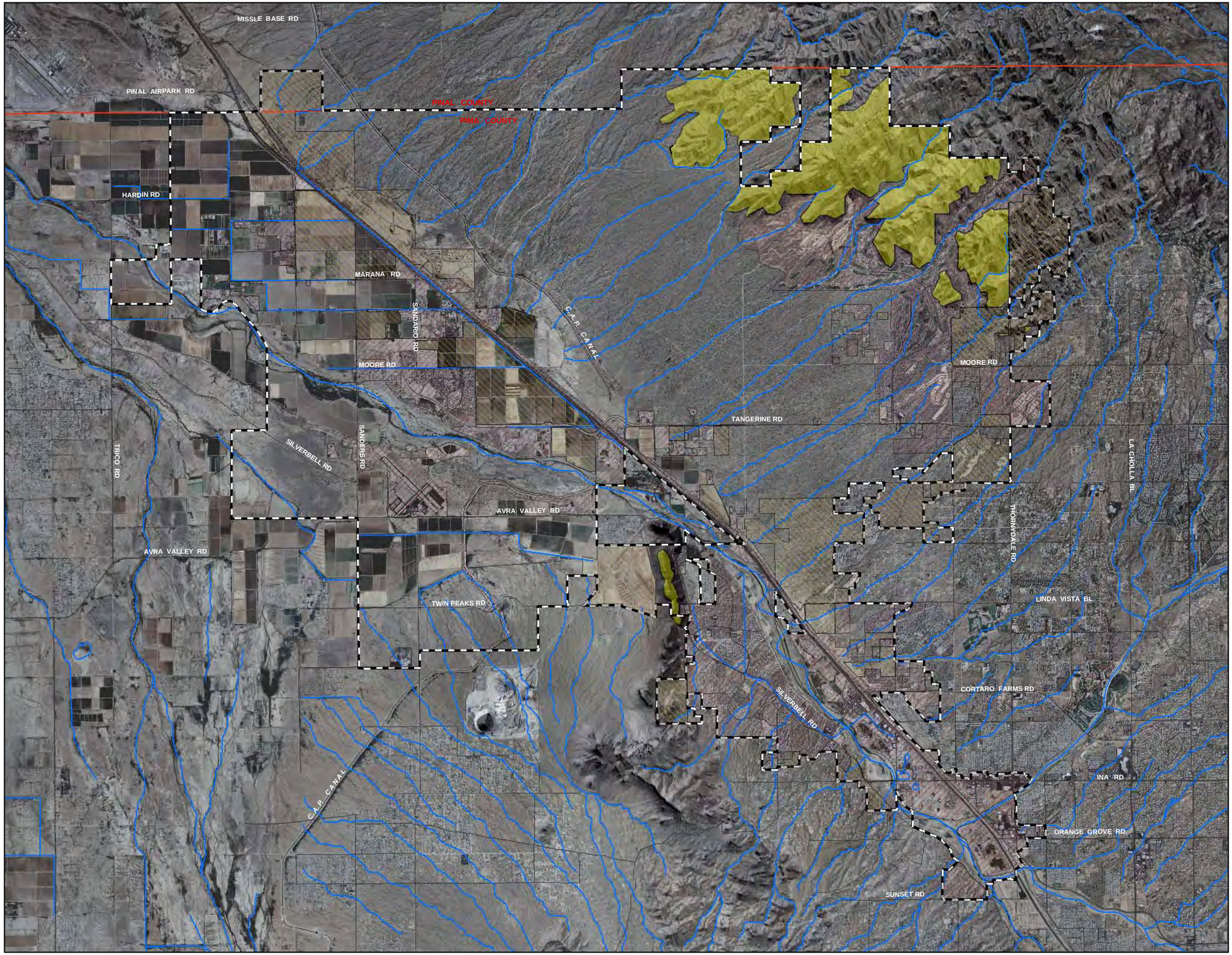


FIGURE 4.32
TALUS SNAIL POTENTIAL HABITAT AND DEVELOPMENT

- Talus Snail Potential Habitat - 6,380 Acres
- Developed Land
- Entitled Land
- Washes
- HCP Permit Area
  Marana Town Limits

N
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Miles

Background Imagery:
July 2007 NAIP Aerial Photography

File: U:\PW_Environmental\HCP\final_figs\November_08\12_15_08_for_CH\Figure 4.32 Talus Snail Potential Habitat and Development.mxd

© 12-08 Town of Marana

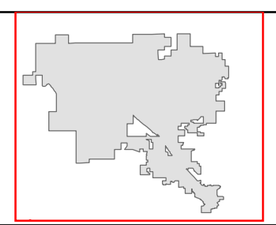

Figure 4.4 Burrowing Owl Sightings Near and Within the Town

- April 2008 Town of Marana
- Other Sightings
- Summer 2006 Arizona Game and Fish
- Winter 2005 Arizona Game and Fish
- HCP Permit Area Marana Town Limits
- County Line

Background Imagery Data Source:
July 2007 USDA NAIP Aerial Photography
File: U:\PW_Environmental\HCP\final_figs\November_08\12_15_08_for_CH\Figure 4.4 Burrowing Owl Sightings Near and Within the Town, 2005-2008.mxd
© 12-08 Town of Marana

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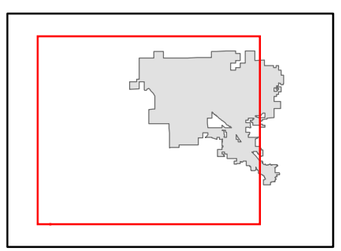

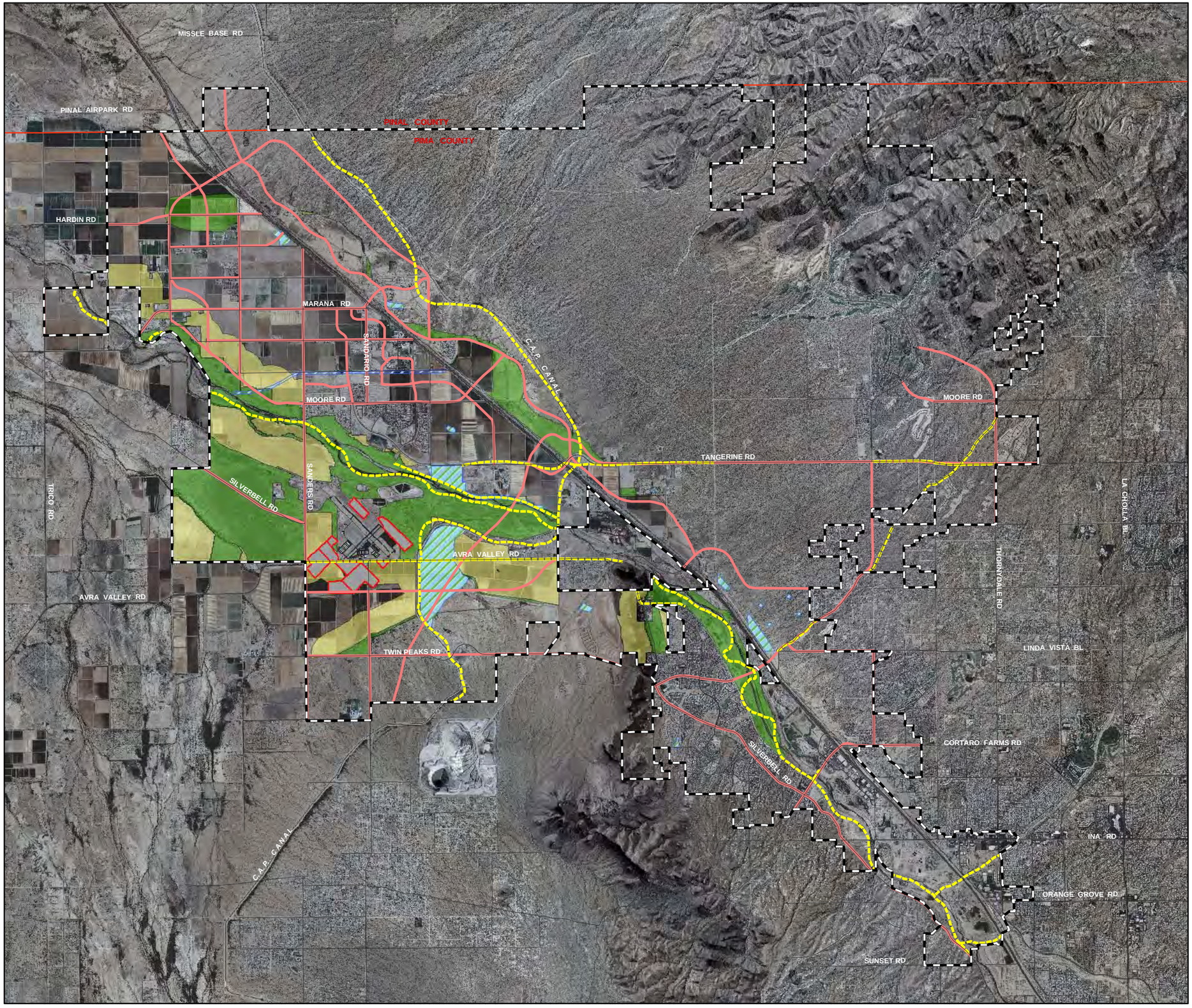

Figure 4.5
Burrowing Owl Potential Habitat and CIP

- Forage - 4,608 Acres
- Nest & Forage - 5,858 Acres
- Proposed Trails
  32 Acres Impact Forage
  93 Acres Imapact Nest & Forage
- Proposed Parks
  440 Acres Impact Forage
  51 Acres Imapact Nest & Forage
- Barnett Channel
  11 Acres Impact Forage
  13 Acres Imapact Nest & Forage
- Proposed Streets
  173Acres Impact Forage
  206Acres Imapact Nest & Forage
- Airport Development
  156 Acres Impact Forage
  36 Acres Imapact Nest & Forage
- HCP Permit Area
  Marana Town Limits

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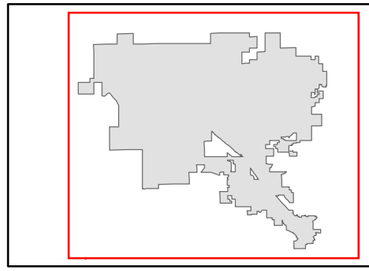
0 0.5 1 2 3 Miles

Background Imagery Data Source:
July 2007 USDA NAIP Aerial Photography

File: U:\PW_Environmental\HCP\final_figs\November_08\Figure 4.5 Burrowing Owl Potential Habitat and CIP.mxd

© 11-07 Town of Marana



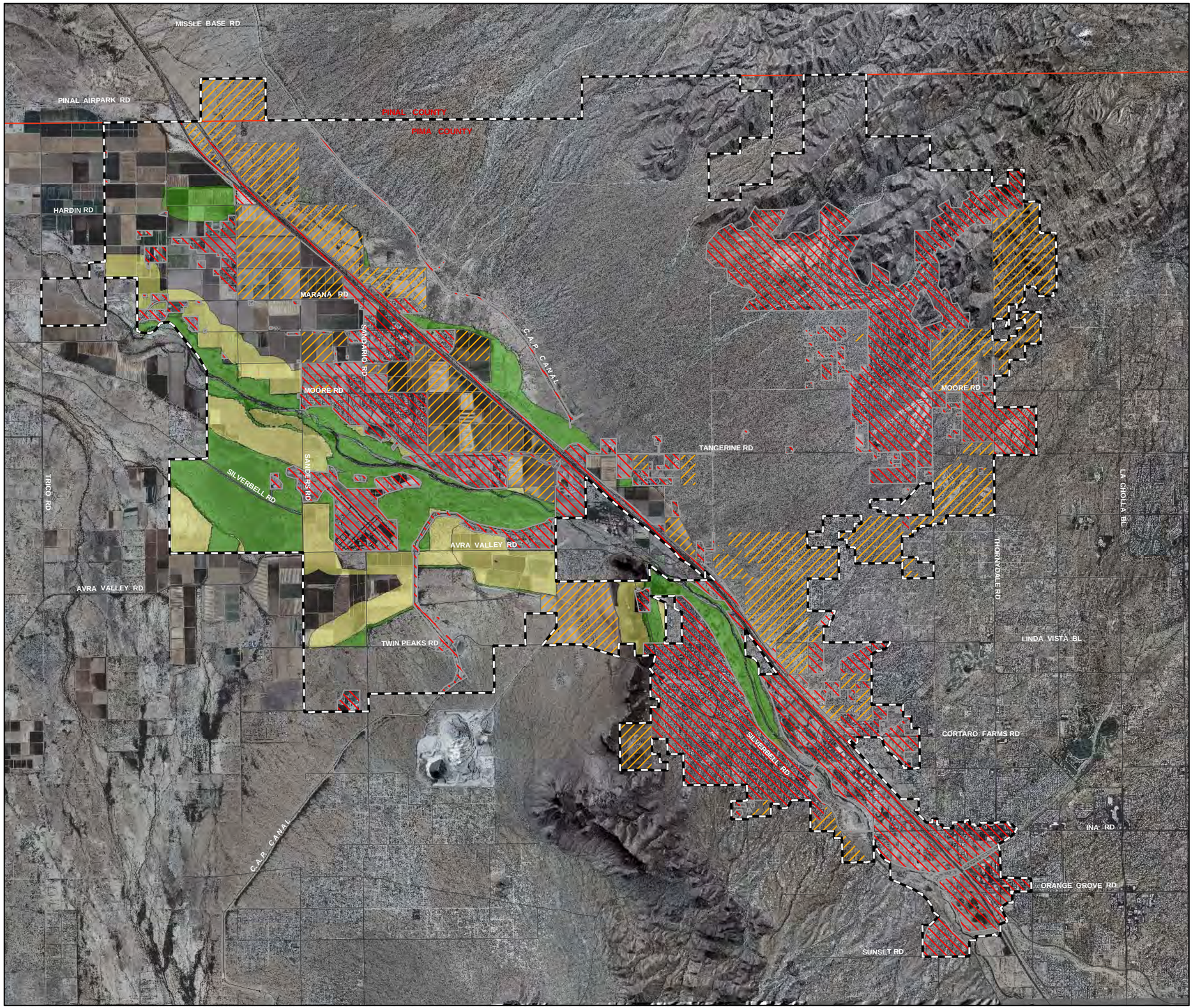


Figure 4.6 Burrowing Owl Potential Habitat and Development

- Forage - 4,608 Acres
- Nest & Forage - 5,858 Acres
- Entitled Land
- Developed Land
- HCP Permit Area Marana Town Limits

N W E S

0 0.5 1 2 3 Miles

Background Imagery:
July 2007 USDA NAIP Aerial Photography

File: U:\PW_Environmental\HCP\final_figs\November_08\Figure 4.6 Burrowing Owl Potential Habitat and Development.mxd

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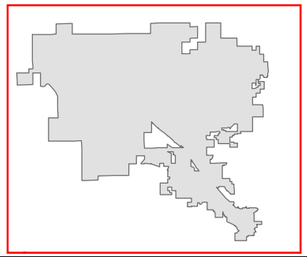

Figure 4.7
Burrowing Owl Management Areas

Potential Burrowing Owl Management Area

Floodway

HCP Permit Area
Marana Town Limits

County Line

Background Imagery:
July 2007 USDA NAIP
Aerial Photography

File: U:\PW_Environmental\HCP\final_figs\
November_08\Figure 4.7 Burrowing Owl
Management Areas.mxd
© 11-07 Town of Marana

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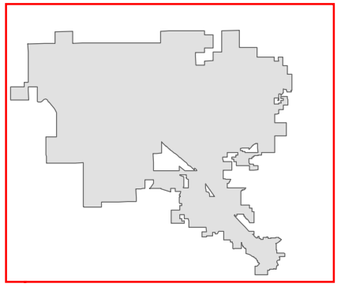

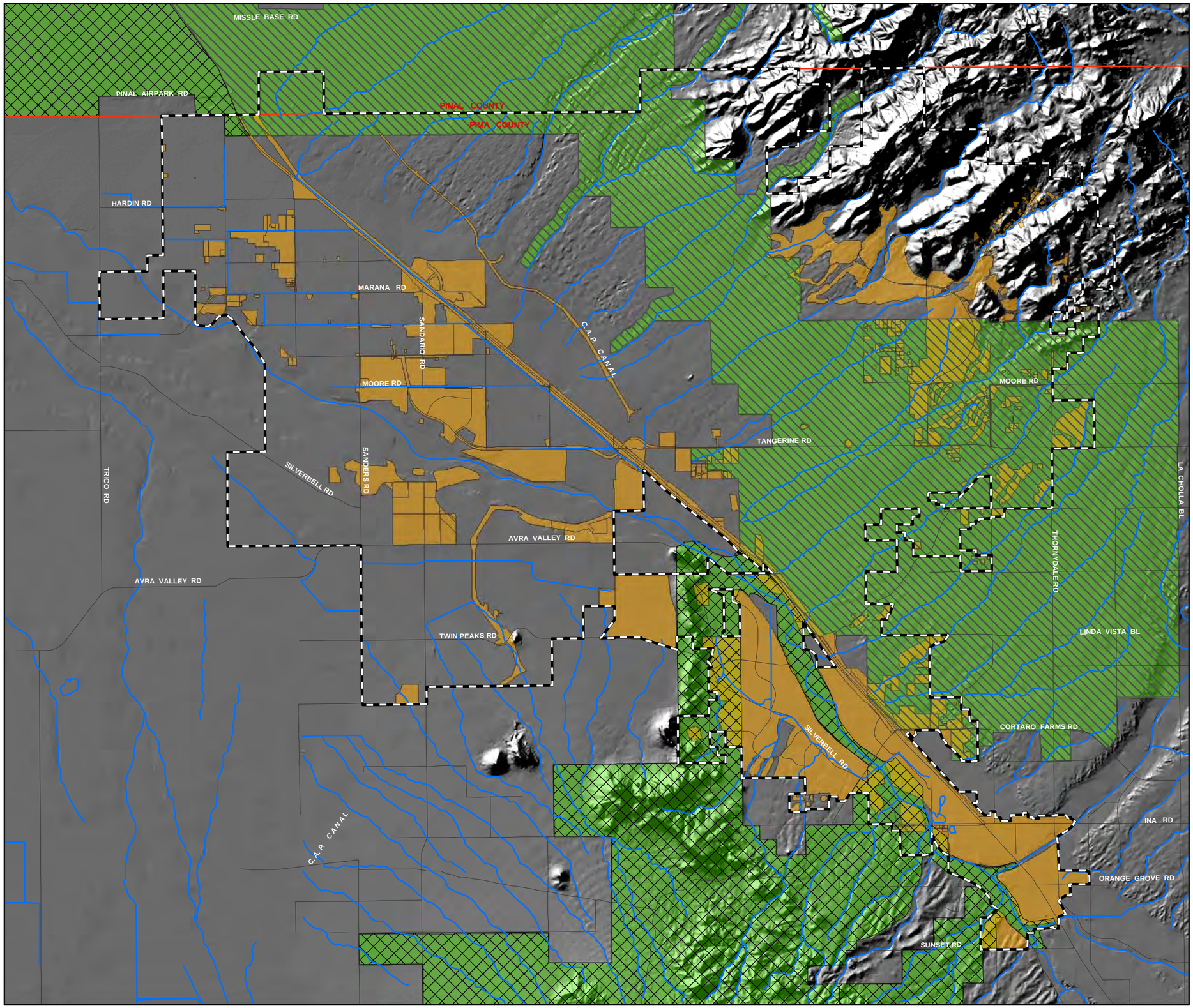

Figure 4.8
Formerly Proposed Pygmy-owl Critical Habitat in Marana

- Pygmy Owl Critical Habitat
- Pygmy Owl Critical Habitat Unit 2
- Pygmy Owl Critical Habitat Unit 3
- Existing Development
- HCP Permit Area
  Marana Town Limits
- Washes
- County Line

N
W E
S

0 0.5 1 2 3 Miles

Background Imagery:
July 2007 USDA NAIP Aerial Photography

File: U:\PW_Environmental\HCP\final_figs\November_08\Figure 4.8 Formerly Proposed Pygmy-owl Critical Habitat in Marana.mxd

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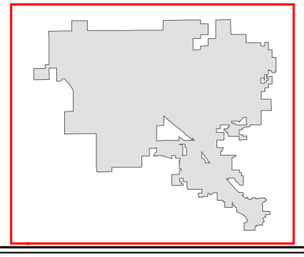

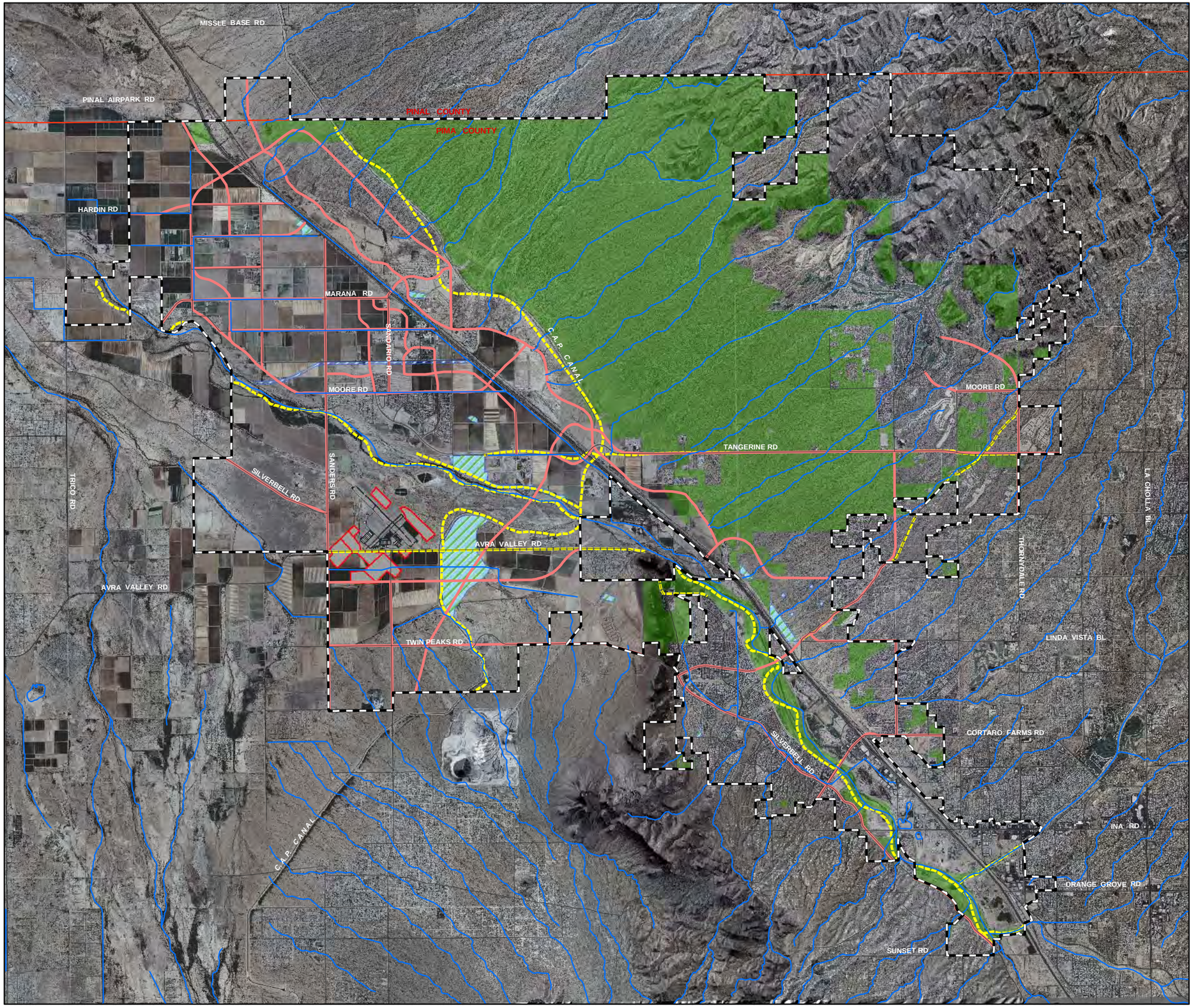

Figure 4.9 Cactus Ferruginous Pygmy-owl Potential Habitat and CIP

- Cactus Ferruginous Pygmy-owl Potential Habitat - 25,693 Acres
- Proposed Trails 96 Acres Impact
- Proposed Parks 1 Acres Impact
- Barnett Channel 0 Acres Impact
- Airport Development 0 Acres Impact
- Proposed Streets 360 Acres Impact
- Washes
- HCP Permit Area Marana Town Limits

N W E S

0 0.5 1 2 3 Miles

Background Imagery:
July 2007 USDA NAIP Aerial Photography

File: U:\PW_Environmental\HCP \final_figs\November_08\Figure 4.9 Cactus Ferruginous Pygmy-owl Potential Habitat and CIP.mxd

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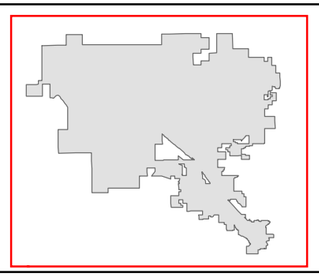

APPENDICES

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APPENDIX 1A

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TOWN OF MARANA HABITAT CONSERVATION PLAN
STAKEHOLDER WORKING GROUP CHARTER

Purpose Statement

The Stakeholder Working Group (SWG) members share a common interest in balancing the biological integrity of natural ecosystems with economic development interests through regional conservation planning. Efforts to coordinate conservation actions among local, State, and Federal agencies, organizations and private landowners are well established in Pima County. The Marana habitat conservation planning effort seeks to continue coordination among interested parties and to establish a framework for collaborative conservation planning within the attached planning area (Exhibit A).

Goals

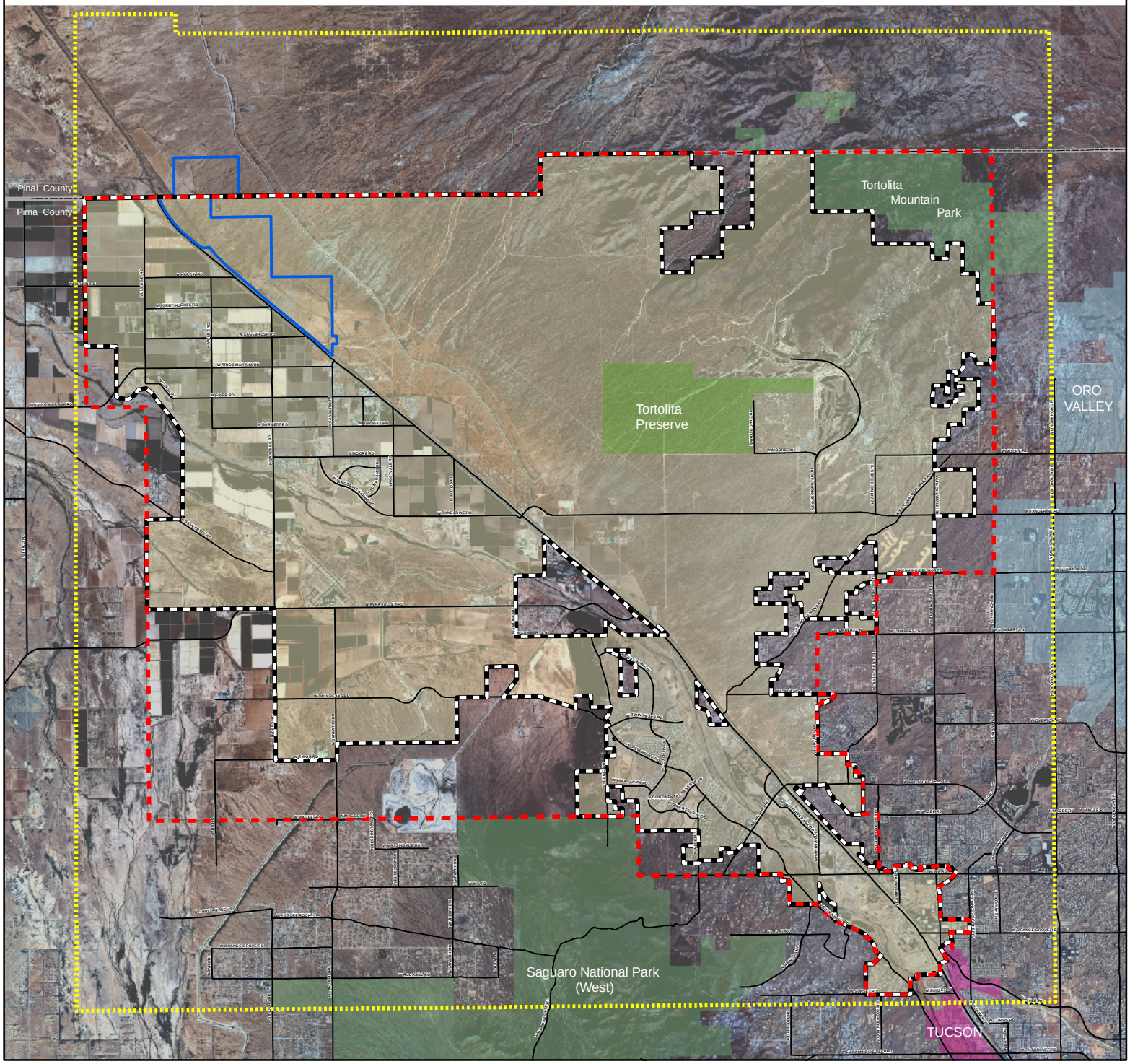
The SWG, with input from the Technical Biology Team (TBT) and the public, will make recommendations to the Town of Marana and other interested jurisdictions regarding a conservation reserve design and associated implementation and funding measures to accomplish the following goals:

a) Facilitate compliance with Federal Endangered Species Act Section 10 (a) permit requirements for the Town of Marana and other jurisdictions in the planning area, as requested;
b) Recommend potential lands that merit inclusion within a scientifically-based conservation reserve designed to provide long-term protection for multiple species and key natural communities (conservation targets) along with appropriate mechanisms to conserve these lands over the long-term;
c) Provide for regional economic objectives including the orderly and efficient development of certain lands, recognizing property rights and legal and physical land use constraints;
d) Contribute to regional conservation planning efforts in eastern Pima County by achieving consistency in conserving biological resources across jurisdictional boundaries.

SWG Composition, Responsibilities and Operating Principles

a) Lead entity for the SWG is the Town of Marana. SWG members, their affiliation, and alternates are listed on Exhibit B.
b) The Town of Marana established a Technical Biology Team (TBT) that will work in coordination with the SWG. The members of the TBT are listed as Exhibit C.
c) The TBT shall integrate Sonoran Desert Conservation Plan (SDCP) information with additional technical information to formulate conservation strategies for the covered species. These strategies will provide a scientific foundation for Habitat Conservation Plan(s) developed by the Town of Marana and other interested jurisdictions and include additional conservation recommendations as appropriate (Exhibit D).
d) The SWG shall use the technical information and conservation strategies developed by the TBT to design appropriate and lasting funding mechanisms, an implementation plan, and alternatives.

e) The SWG shall seek to standardize and integrate mitigation/compensation measures for public and private development actions that will guide the Town of Marana and other jurisdictions, if they choose, when applying for a Section 10(a) permit.
f) The SWG and TBT shall use a consensus approach, defined as Levels 1-4 on Exhibit E, to decision-making and shall be assisted by a designated facilitator.
g) The Town of Marana and their consultant will provide technical support to the SWG and TBT, including meeting facilitation, writing and finalizing meeting minutes, and preparing proposals and other HCP-related documents for review.
h) The SWG shall ensure that the public is afforded sufficient opportunity to provide input into the planning effort.
i) The SWG meetings will be open to SWG members, their alternates, invited guests, and members of the public. Oro Valley, Pinal County, the U.S. Fish and Wildlife Service, and the City of Tucson will participate as Ex-officio members.
j) All SWG and TBT meetings will include general meeting summaries and shall be distributed to members of the two groups and their alternates, respectively.
k) Meeting membership, agendas, and minutes will be available on the Town of Marana's website.



PLANNING BOUNDARIES

- Permit Area Boundary
- Final Planning Area Boundary
- Villages of Tortolita Specific Plan
- Marana Town Limits
- County Line
- Major Streets

4

0 1 2 4
Miles

Data Disclaimer: The Town of Marana provides this map information "As Is" at the request of the user with the understanding that it is not guaranteed to be accurate, correct or complete and conclusions drawn from such information are the responsibility of the user. In no event shall The Town of Marana become liable to users of these data, or any other party, for any loss or direct, indirect, special, incidental, or consequential damages, including but not limited to time, money, or goodwill, arising from the use or modification of the data.
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EXHIBIT B
Stakeholder Working Group Membership

Member (Alternate)	**Organization/ Jurisdiction**
Mike Reuwsaat Town Manager (Gilbert Davidson) Deputy Town Manager	Town of Marana
Jaimie Galayda (Michele Muench)	Arizona State Land Department
David Mehl President (Bill Hallinan)	Cottonwood Properties
Gerry Perry Regional Supervisor (Joan Scott) Habitat Program Manager	Arizona Game and Fish Department
Jason Meininger Program Associate, Land and Water Policy Program	Sonoran Institute
Jenny Neeley Southwest Representative	Defenders of Wildlife
Carolyn Campbell Executive Director (Christina McVie)	Coalition for Sonoran Desert Protection
Mike Zipprich Principal (Gary Jones)	Sun American Group
Diana Freshwater Executive Director	Arizona Open Land Trust
Gary Abrams	Abrams Airborne Manufacturing
Ex-officio members	
Sherry Barrett Assistant Field Supervisor for Southern Arizona (Scott Richardson)	USFWS
Leslie Liberti Director, Office of Conservation and Sustainable Development	City of Tucson
Sarah More, Planning and Zoning Administrator	Town of Oro Valley

Kent Taylor Senior Parks and Recreation Planner (Steve Abraham) Senior Planner	Pinal County
Town of Marana Staff	
Jennifer Christelman Environmental Engineering Division Manager	Town of Marana
Kathleen Kennedy Environmental Projects Coordinator	Town of Marana

EXHIBIT C
TECHNICAL BIOLOGY TEAM MEMBERS

Jim Tress, WestLand Resources, Inc.
Sherry Ruther, Pima County
Philip Pearthree, Arizona Geological Survey
Julia Fonseca, Pima County Flood Control District
Trevor Hare, Sky Island Alliance
John Windes, Arizona Game and Fish Department
Rich Glinski, Private Consultant
Scott Richardson, U.S. Fish and Wildlife Service
Dennis Abbate, Arizona Game and Fish Department

EXHIBIT D
TECHNICAL BIOLOGY TEAM PLANNING PROCESS

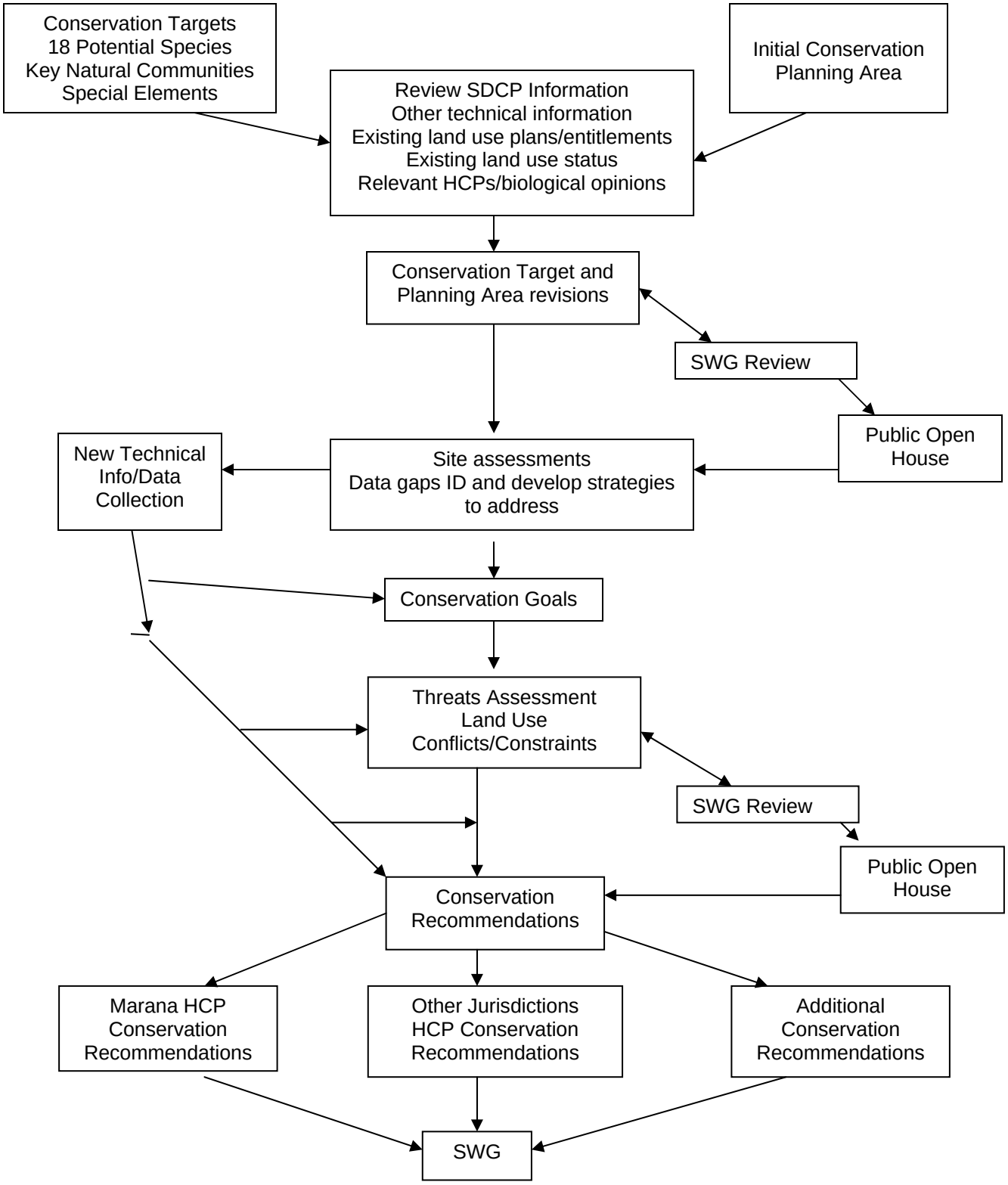

EXHIBIT D
TECHNICAL BIOLOGY TEAM PLANNING PROCESS CONTINUED

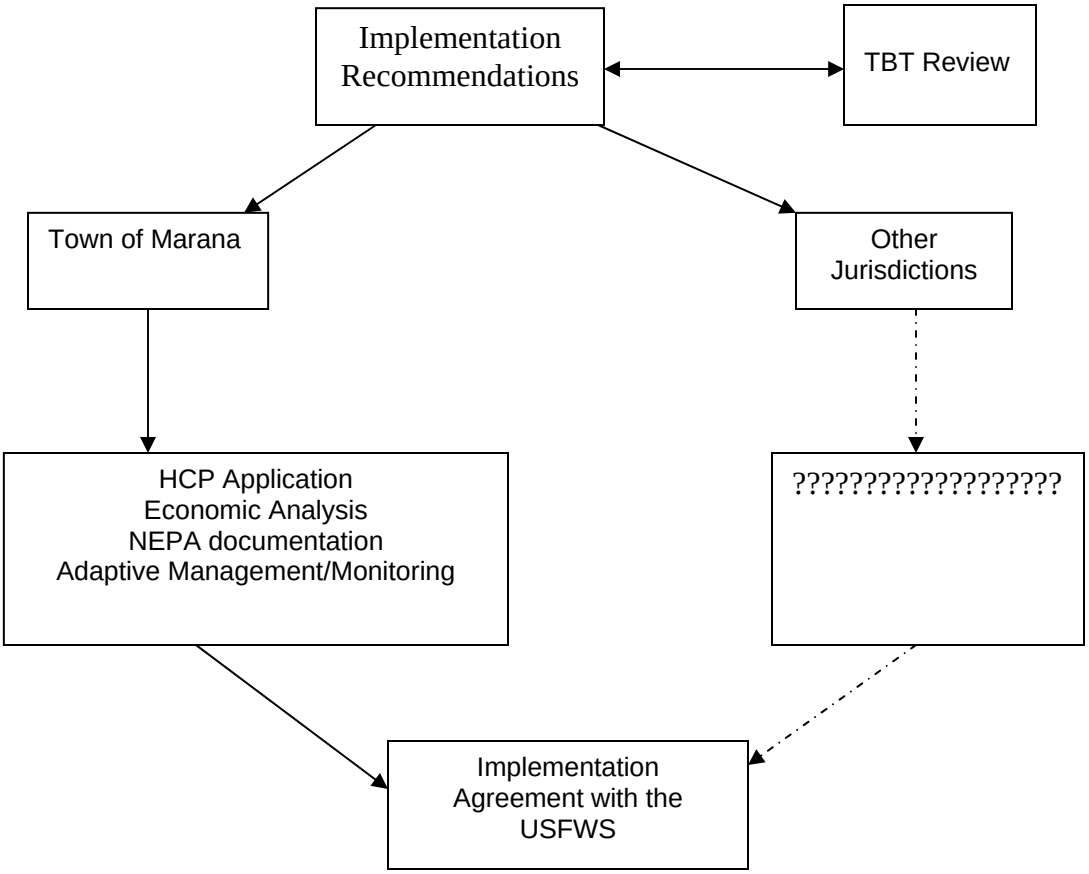

EXHIBIT E
LEVELS OF CONSENSUS

Consensus is achieved if all participants indicate they are at Level 1 through 4 (not Levels 5 or 6).

The *Levels of Consensus* are:

1. I can say an **unqualified 'yes'** to the decision. I am satisfied that the decision is an expression of wisdom of the group.

2. I find the decision **perfectly acceptable**. It is the best of the real options we have available to us.

3. I can **live with** the decision. However, I'm not especially enthusiastic about it.

4. I do not fully agree with the decision and need to register my view about it. However, I do not choose to block the decision and will **stand aside**.

5. I do not agree with the decision and I feel the need to **block** the decision being accepted as consensus.

6. I feel we have no clear sense of unity in the group. We need to **do more work** before consensus can be achieved.

APPENDIX 1B

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TOWN OF MARANA HABITAT CONSERVATION PLAN
TECHNICAL BIOLOGY TEAM CHARTER

Purpose Statement

To bring the best available science to bear on the development of conservation recommendations that will assist the Stakeholder Working Group (SWG) with attaining the goals they have established for the Town of Marana Habitat Conservation Planning project (Exhibit A). Specifically, these recommendations will provide the SWG, the Town of Marana and other jurisdictions, at their discretion, with the technical information to assist with the development of a Habitat Conservation Plan, and other appropriate land use policies.

Objectives

a) Define conservation targets (species and natural communities). Species which will be considered in the planning effort are:
   - Federally endangered, threatened, proposed, or candidate species occurring in the planning area or having a likelihood of occurring within the planning area as a result of habitat restoration activities.
   - Species whose population numbers are generally declining throughout their range such that there is a reasonable likelihood that these species could be federally listed within the next 5-10 years and for whom conservation in the planning area will make a significant contribution to their long-term conservation.

b) Provide technical review and general guidance to the Town of Marana and their consultant during the course of the planning process outlined in Exhibit B.

c) Develop specific conservation recommendations, including a conservation reserve design, adaptive management guidelines, monitoring recommendations, recommendations on NEPA Alternatives, and alternative conservation strategies for use by the SWG who is chartered with developing implementation (policy and funding) recommendations to the Town and other jurisdictions, as appropriate.

Operating Principles and Responsibilities

a) TBT members are identified in Exhibit C.

b) Meetings will be open to the general public. Formal public comment will be accepted at the end of each meeting.

c) Agendas and previous meeting summaries will be developed in advance of meetings and distributed to TBT and interested parties. It is essential that the decision points be memorialized and any differences among team members identified.

d) The TBT is self-policing. TBT participants are expected to be objective, constructive, solution-oriented, fair and respectful. The TBT is authorized to ask a participant to remove themselves from the team if at anytime these expectations are not met.

e) The TBT can invite other experts to assist them in their work provided that they have clear areas of expertise relevant to the team's work.

f) The TBT will fill any vacancies that may occur throughout the planning period.

g) The TBT will be assisted by a designated facilitator provided by the Town of Marana.

h) A planning consultant and Town staff shall develop all technical work products.
i) The TBT shall designate at least one representative to make two, in-progress presentations to the SWG prior to submittal of conservation recommendations and to attend two public open houses during the technical phase of the planning process.
j) TBT members are specifically appointed and alternates are not available except by prior approval of the TBT.
k) The TBT shall use a consensus approach to decision-making, defined as Levels 1-4 on Exhibit D.

EXHIBIT A
TOWN OF MARANA HABITAT CONSERVATION PLAN
STAKEHOLDER WORKING GROUP CHARTER

Purpose Statement

The Stakeholder Working Group (SWG) members share a common interest in balancing the biological integrity of natural ecosystems with economic development interests through regional conservation planning. Efforts to coordinate conservation actions among local, State, and Federal agencies, organizations and private landowners are well established in Pima County. The Marana habitat conservation planning effort seeks to continue coordination among interested parties and to establish a framework for collaborative conservation planning within the attached initial planning area (Exhibit A).

Goals

The SWG, with input from the Technical Biology Team (TBT) and the public, will make recommendations to the Town of Marana and other interested jurisdictions regarding a conservation reserve design and associated implementation and funding measures to accomplish the following goals:

a) Facilitate compliance with Federal Endangered Species Act Section 10 (a) permit requirements for the Town of Marana and other jurisdictions in the planning area, as requested;
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EXHIBIT B
TECHNICAL BIOLOGY TEAM PLANNING PROCESS

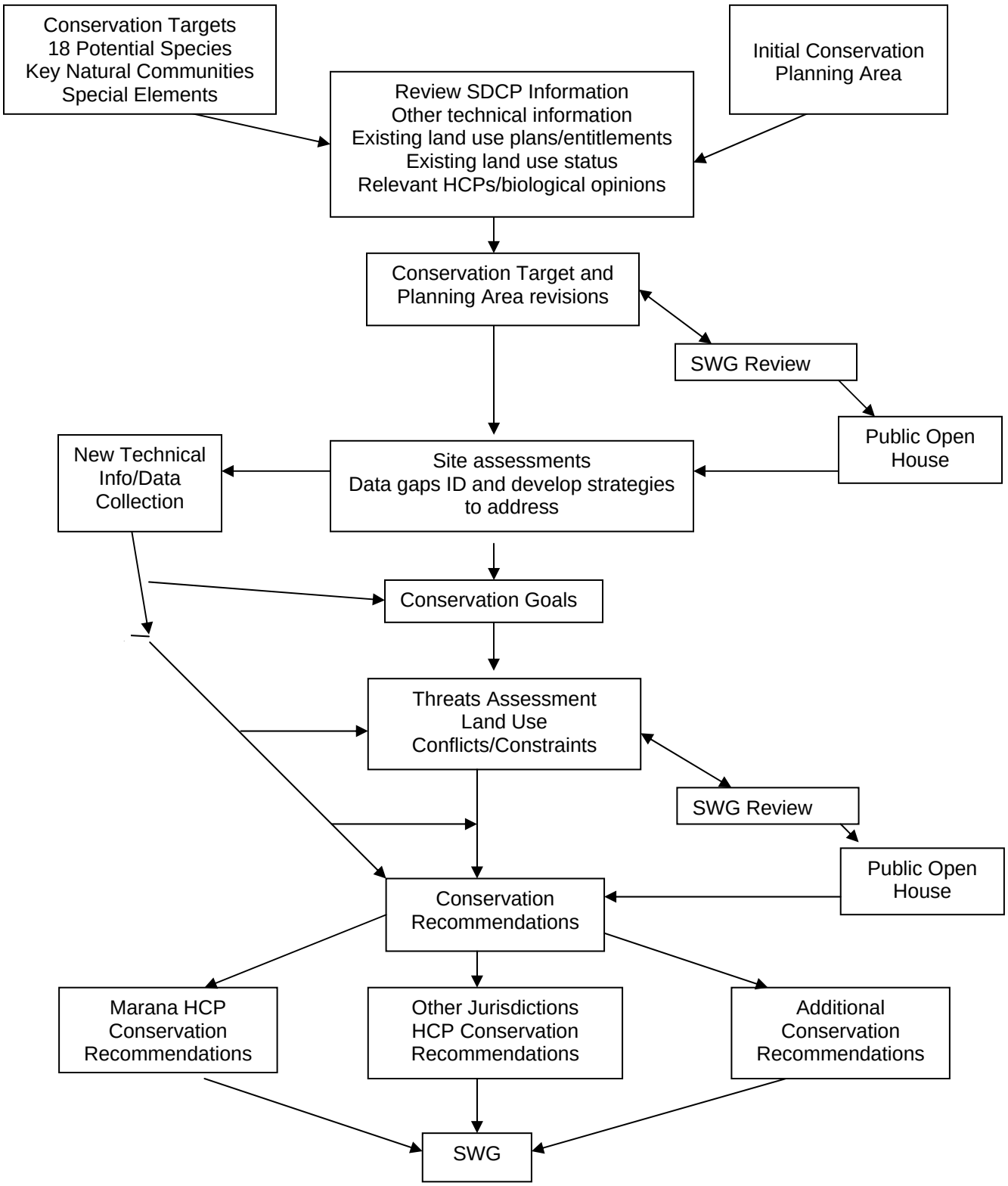
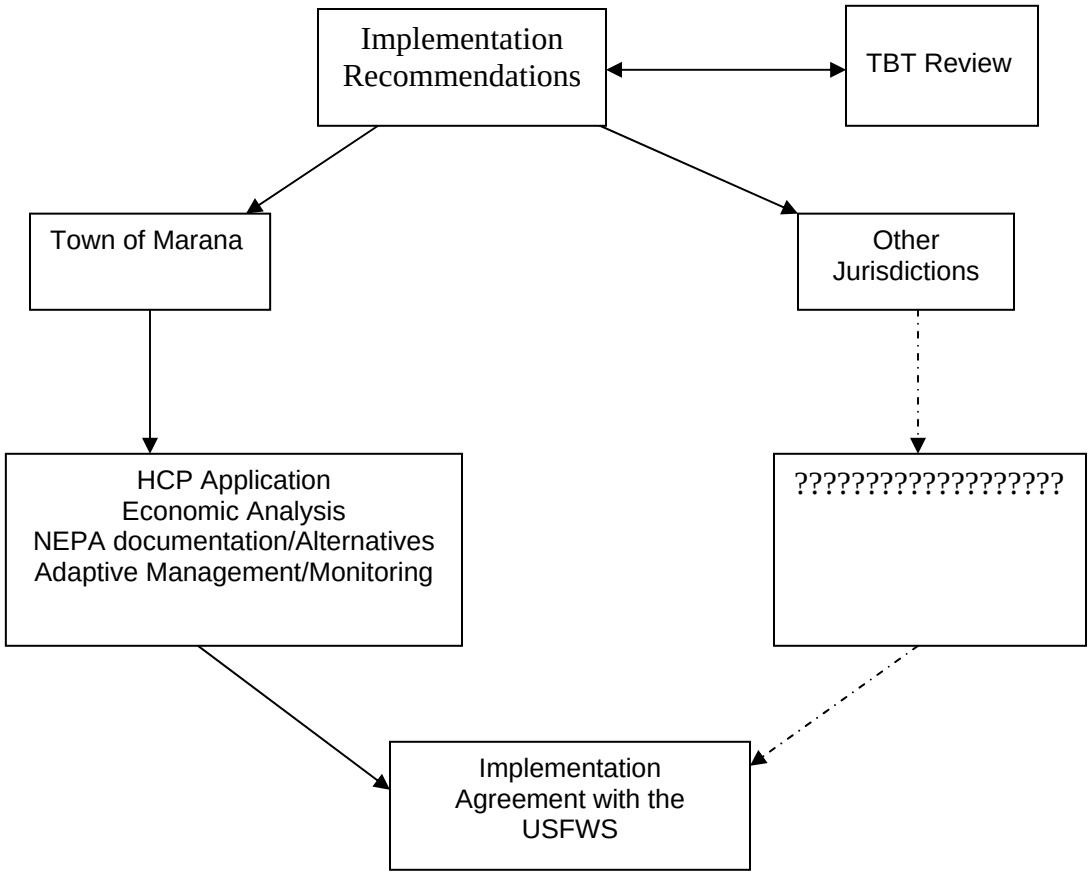


EXHIBIT B
TECHNICAL BIOLOGY TEAM PLANNING PROCESS CONTINUED



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4. I do not fully agree with the decision and need to register my view about it. However, I do not choose to block the decision and will **stand aside**.

5. I do not agree with the decision and I feel the need to **block** the decision being accepted as consensus.

6. I feel we have no clear sense of unity in the group. We need to **do more work** before consensus can be achieved.

EXHIBIT C
Technical Biology Team Membership

Member (Alternate)	**Organization/ Jurisdiction**
Philip Pearthree (Ann Youberg)	Arizona Geological Survey
Dennis Abbate (Shawn Lowery)	Arizona Game and Fish Department
Julia Fonseca (Neva Connolly)	Pima County Flood Control District
Sherry Ruther (Tedra Fox)	Pima County
Trevor Hare	Coalition for Sonoran Desert Protection
Rich Glinski	Private Consultant
Scott Richardson	US Fish and Wildlife Service
Jim Tress (Tom Strong)	WestLand Resources, Inc.
John Windes (Cathy Crawford) (Joan Scott)	AZ Game and Fish Department

APPENDIX 2

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DEPARTMENT OF THE INTERIOR

Fish and Wildlife Service

Receipt of an Application for an Incidental Take Permit for Construction of the Fire Station/ Emergency Medical Services (EMS) 11 Facility in Charlotte County, FL

AGENCY: Fish and Wildlife Service, Interior.

ACTION: Notice.

SUMMARY: We, the Fish and Wildlife Service (Service), announce the availability of an incidental take permit (ITP) and Habitat Conservation Plan (HCP). Charlotte County Facilities Construction and Maintenance (applicant) requests an ITP pursuant to section 10(a)(1)(B) of the Endangered Species Act of 1973, as amended (Act). The applicant anticipates taking about 4.56 acres (1.85 hectares (ha)) of Florida scrub-jay (*Aphelocoma coerulescens*) (scrub-jay) foraging and sheltering habitat incidental to lot preparation for the construction of the Fire Station/EMS 11 facility and supporting infrastructure in Charlotte County, Florida (project). The applicant's HCP describes the mitigation and minimization measures proposed to address the effects of the project on the Florida scrub-jay.

DATES: We must receive your written comments on the ITP application and HCP on or before July 23, 2007.

ADDRESSES: See **SUPPLEMENTARY INFORMATION** section below for information on how to submit your comments on the ITP application and HCP. You may obtain a copy of the ITP application and HCP by writing to the South Florida Ecological Services Office, Attn: Permit number TE108859–0, U.S. Fish and Wildlife Service, 1339 20th Street, Vero Beach, FL 32960–3559. In addition, we will make the ITP application and HCP available for public inspection by appointment during normal business hours at the above address.

FOR FURTHER INFORMATION CONTACT: Ms. Trish Adams, Fish and Wildlife Biologist, South Florida Ecological Services Office (see **ADDRESSES**); telephone: (772) 562–3909, ext. 232.

SUPPLEMENTARY INFORMATION: If you wish to comment on the ITP application and HCP, you may submit comments by any one of the following methods. Please reference permit number TE108859–0 in such comments.

1. Mail or hand-deliver comments to our South Florida Ecological Services Office address (see **ADDRESSES**).

2. E-mail comments to *trish_adams@fws.gov*. If you do not receive a confirmation that we have received your e-mail message, contact us directly at the telephone number listed under **FOR FURTHER INFORMATION CONTACT**.

Before including your address, phone number, e-mail address, or other personal identifying information in your comments, you should be aware that your entire comment—including your personal identifying information—may be made publicly available at any time. While you can ask us in your comment to withhold your personal identifying information from public review, we cannot guarantee that we will be able to do so.

Construction for the Fire Station/EMS 11 HCP will take place within Section 16, Township 40 South, Range 23 East, Punta Gorda, Charlotte County, Florida, at 2403 Highlands Road, in the Harbor Heights Subdivision. This lot is within scrub-jay occupied habitat.

The lot encompasses about 4.56 acres (1.85 ha), and the footprint of the project facility, infrastructure, and landscaping precludes retention of scrub-jay habitat on this lot. In order to minimize take on site, the applicant proposes to mitigate for the loss of 4.56 acres (1.85 ha) of scrub-jay habitat by restoring and managing 9.02 acres (3.65 ha) of a conservation easement that they have acquired for scrub-jays.

We have determined that the applicant's proposal, including the proposed mitigation and minimization measures, will have a minor or negligible effect on the species covered in the HCP. Therefore, the ITP is a ''low-effect'' project and qualifies as a categorical exclusion under the National Environmental Policy Act (NEPA), as provided by the Department of the Interior Manual (516 DM 2 Appendix 1 and 516 DM 6 Appendix 1). Low-effect HCPs are those involving (1) minor or negligible effects on federally listed or candidate species and their habitats and (2) minor or negligible effects on other environmental values or resources. Based on our review of public comments that we receive in response to this notice, we may revise this preliminary determination.

We will evaluate the HCP and comments submitted thereon to determine whether the application meets the requirements of section 10(a) of the Act (16 U.S.C. 1531 *et seq.*). If we determine that the application meets the requirements, we will issue the ITP for incidental take of the Florida scrub-jay. We will also evaluate whether issuance of the section 10(a)(1)(B) ITP complies with section 7 of the Act by conducting an intra-Service section 7 consultation. We will use the results of this consultation, in combination with the above findings, in the final analysis to determine whether or not to issue the ITP.

Authority: We provide this notice pursuant to Section 10 of the Endangered Species Act (16 U.S.C. 1531 *et seq.*) and NEPA regulations (40 CFR 1506.6).

Dated: June 8, 2007.

Paul Souza,

Field Supervisor, South Florida Ecological Services Field Office.

[FR Doc. E7–12001 Filed 6–20–07; 8:45 am]

BILLING CODE 4310–55–P

DEPARTMENT OF THE INTERIOR

Fish and Wildlife Service

Habitat Conservation Plan, Town of Marana, AZ

AGENCY: Fish and Wildlife Service, Interior.

ACTION: Notice of intent to prepare an environmental impact statement (EIS); announcement of public scoping meeting; request for comments.

SUMMARY: We, the U.S. Fish and Wildlife Service (Service), advise the public that we intend to prepare an EIS to evaluate the impacts of, and alternatives to, the proposed issuance of an incidental take permit (ITP), pursuant to section 10(a)(1)(B) of the Endangered Species Act of 1973 (Act), as amended, to the Town of Marana (Applicant), in Pima County, Arizona. The Town of Marana intends to apply for an ITP through the development and implementation of a Habitat Conservation Plan (HCP), as required by the Act. We also announce a public scoping meeting and public comment period.

DATES: We must receive written comments on alternatives and issues to be addressed in the EIS on August 20, 2007. We will hold public scoping meetings on July 9, 2007 from 6 p.m. to 8 p.m. at the Marana Operations Center (5100 W. Ina Road, Tucson, Arizona, 85743), July 11, 2007 from 6 p.m. to 8 p.m. at the Marana Municipal Complex (11555 W. Civic Center Dr., Marana, Arizona, 85653), and on July 24, 2007 from 6 p.m. to 8 p.m. at the Marana Municipal Complex. We will accept written comments at these meetings.

ADDRESSES: Written comments should be sent to Mr. Steven L. Spangle, Field Supervisor, U.S. Fish and Wildlife Service, 2321 West Royal Palm Road, Suite 103, Phoenix, AZ 85021.

Public Availability of Comments

Before including your address, phone number, e-mail address, or other personal identifying information in your comment, you should be aware that your entire comment—including your personal identifying information—may be made publicly available at any time. While you can ask us in your comment to withhold your personal identifying information from public review, we cannot guarantee that we will be able to do so.

FOR FURTHER INFORMATION CONTACT: For further information on the EIS, contact Mr. Scott Richardson, U.S. Fish and Wildlife Service, Tucson Suboffice, 201 N. Bonita Ave., Suite 141, Tucson, Arizona 85745, at 520–670–6150 x 242.

For further information on the HCP, contact Ms. Jennifer Christelman, Town of Marana, 11555 W. Civic Center Dr., Marana, Arizona 85653 or Ms. Lori Woods, RECON, 525 West Wetmore Road, Suite 111, Tucson, Arizona 85705.

Information regarding the HCP can also be obtained on the Internet at *http://www.marana.com/hcp.*

SUPPLEMENTARY INFORMATION: This notice advises the public that the Service intends to gather information necessary to determine the impacts and formulate alternatives for the EIS related to the issuance of a proposed ITP to the Town of Marana and the development and implementation of the HCP, which will provide measures to minimize and mitigate the effects of incidental take of federally listed species.

Section 9 of the Act and its implementing regulations prohibit the ''taking'' of threatened and endangered species. However, the Service, under limited circumstances, may issue permits to take listed wildlife species incidental to, and not the purpose of, otherwise lawful activities.

We provide this notice under section 10(c) of the Act (16 U.S.C. 1531 *et seq.*) and its implementing regulations (50 CFR 17.22), and the National Environmental Policy Act (42 U.S.C. 4371 *et seq.*) (NEPA) and its implementing regulations (40 CFR 1506.6).

Background: The Town of Marana in southern Arizona, including its recent annexation of 21,500 acres of State Trust lands along the Tortolita Fan, contains unique natural resource values within much of its undeveloped lands, including ironwood-dominated Arizona Upland and xeroriparian plant communities along the bajadas (fans) and slopes of the Tortolita Mountains and along portions of the Santa Cruz River Corridor.

The Town of Marana is also one of the fastest growing communities in Arizona and recognizes the need to provide a solid economic base and desirable quality of life for its citizens. Given the Town of Marana's rapid growth rate and desire to develop its economic interests, the Town leaders have acknowledged the need to balance economic, environmental, and human interests by implementing a community-wide conservation planning effort. The overall goals of this conservation planning effort are to: identify federal, State Trust, county, and private lands that merit inclusion within a scientifically-based conservation reserve designed to provide long-term protection for multiple species of concern and key natural communities; identify appropriate mechanisms to best conserve these lands over the long-term; provide for regional economic objectives including the orderly and efficient development of certain private and State Trust lands and associated public and private infrastructure; contribute to regional conservation planning efforts in eastern Pima County; and facilitate compliance with the Act's Section 10(a)(1)(B) permit requirements.

Purpose and Need for Action

The purpose for which this EIS is being prepared is to respond to the Town of Marana's application for an ITP for the proposed covered species related to activities that have the potential to result in take of species listed pursuant to the Act. The Town of Marana's proposed HCP will mitigate to the maximum extent practicable the anticipated effects of the covered activities, while striving to balance the protection and conservation of Marana's unique natural resources with on-going economic development and urbanization. The Town of Marana recognizes that the quality of life of its citizens is dependent upon an integrated environment which balances the needs of listed species and their habitats with human needs. The HCP will protect and conserve the covered species and their habitats for the continuing benefit of the people of the United States and provide a means and take steps to conserve the ecosystems depended on by the covered species. The HCP will ensure the long-term survival of the covered species through protection and management of the species and their habitats and ensure compliance with the Act, NEPA, and other applicable laws and regulations.

The need for this action is based on the potential that activities proposed by the Town of Marana on lands under their jurisdiction could result in take of covered species, thus requiring an ITP. The proposed permit would allow approved incidental take that is consistent with the conservation guidelines in the Town of Marana's HCP.

Section 10(a)(1)(B) of the Act contains provisions for issuing ITPs to non-federal entities for take of endangered and threatened species, provided the following criteria are met: The taking will be incidental; the applicant will, to the maximum extent practicable, minimize and mitigate the impact of such taking; the applicant will ensure that adequate funding for the Plan will be provided; the taking will not appreciably reduce the likelihood of the survival and recovery of the species in the wild; and any other measures that the Service may require as being necessary or appropriate for the purposes of the HCP. The development and implementation of the HCP will ensure that the Town of Marana meets the provisions for issuance of the ITP.

Proposed Action

The proposed action is the issuance of an ITP for listed and sensitive species in Pima County, pursuant to section 10(a)(1)(B) of the Act. The Town of Marana will develop and implement the HCP, as required by section 10(a)(2)(A) of the Act. The HCP will provide measures to minimize and mitigate the effects of the taking on listed and sensitive species and their habitats. The biological goal of the HCP is to provide long-term protection for multiple species of concern and key natural communities through maintaining or improving the habitat conditions and ecosystem functions necessary for their survival and to ensure that any incidental take of listed species will not appreciably reduce the likelihood of the survival and recovery of those species.

The purpose of the scoping meetings are to brief the public on the background of the HCP, alternative proposals under consideration for the draft EIS, and the Service's role, as well as the steps that we will take to develop the draft EIS for this conservation planning effort. At the scoping meeting, there will be an opportunity for the public to ask questions and also to provide written comments.

Activities proposed for coverage under the proposed ITP include lawful activities that would occur consistent with the Town of Marana's General Plan and include, but are not limited to, maintenance of Town's operations, implementation of capital improvement projects, and issuance of land-use related permits, including those for

residential and commercial development.

The Town of Marana is expected to apply for an ITP for 13 vulnerable species that would be protected within the proposed permit area. The 13 species include the federally listed lesser long-nosed bat (*Leptonycteris curasoae yerbabuenae*) and the federally listed southwestern willow flycatcher (*Empidonax traillii extimus*). In addition, the Town of Marana will seek to address and cover the yellow-billed cuckoo (*Coccyzus americanus* spp. *Occidentalis*), a candidate for listing. The Town of Marana is also seeking to address and cover additional rare and/or sensitive species that occur within the planning area, including the cactus ferruginous pygmy-owl (*Glaucidium brasilianum cactorum*), lowland leopard frog (*Rana yavapaiensis*), talus snails (*Sonorella* spp.), Tucson shovel-nosed snake (C*hionactis occipitalis klauberi*), ground snake (*Sonora semiannulat*a), Sonoran desert tortoise (*Gopherus agassizii*), Merriam's mouse (*Peromyscus merriami*), Mexican garter snake (*Thamnophis eques megalops*), burrowing owl (*Athene cunicularia*), and the pale Townsend's big-eared bat (*Corynorhinus townsendii*). Unlisted species included in the list above that are considered as if they were listed, and that the Service finds are adequately conserved by the HCP, will be automatically permitted for incidental take should they be listed as federally threatened or endangered species in the future. Numerous other listed and sensitive species for which the Town of Marana is not seeking permit coverage will also benefit from the conservation measures provided in the HCP through protection of similar or overlapping habitat conditions and ecosystem functions.

Alternatives—The proposed action and alternatives that will be developed in the EIS will be assessed against the No Action/No Project alternative, which assumes that some or all of the current and future projects proposed in the Town of Marana would be implemented individually (i.e, one at a time), and be in compliance with the Act.

The No Action/No Project alternative implies that the impacts from these potential projects on sensitive species and habitats would be evaluated and mitigated on a project-by-project basis, as is currently the case. For any activities involving take of listed species due to non-Federal projects/actions, individual Section 10(a)(1)(B) permits would be required. A coordinated, comprehensive ecosystem-based conservation approach for the region would not be developed to more efficiently address the conservation of listed species, and unlisted candidate and sensitive species would not receive proactive action intended to preclude the need to list them in the future. A landscape level approach to conservation and mitigation would not occur to help Federal and non-Federal agencies work toward recovery of listed species. Current independent conservation actions would continue, although some of these are not yet funded.

Other alternatives that may be considered in the EIS include issuance of an incidental take permit for some subset of proposed covered species and/or covered activities. Voluntary participation in the HCP to obtain ITP coverage for certain private development actions that have no further discretionary action by Marana is being considered. In addition, alternatives may consider varying levels of take anticipated and amount, type, and location of mitigation.

Additional Information: The Service anticipates that the Town of Marana will request a permit duration of 25 years. Implementation of the HCP will result in the establishment of measures that will provide for the conservation of covered species and their habitats in perpetuity. Monitoring and adaptive management will be used to facilitate the accomplishment of these measures.

We will conduct an environmental review that analyzes the proposed action, as well as a range of reasonable alternatives and the associated impacts of each. The EIS will be the basis for the Service's evaluation of impacts to the species and the range of alternatives to be addressed. The EIS is expected to provide biological descriptions of the affected species and habitats and an analysis of the socioeconomic effects of the proposed action.

After the environmental review is complete, we will publish a notice of availability and a request for comment on the draft EIS, draft HCP, and the Town of Marana's permit application. The draft EIS is expected to be completed and available to the public by December 2008.

C. Todd Jones,

Acting Regional Director, Region 2, Albuquerque, New Mexico.

[FR Doc. E7–12009 Filed 6–20–07; 8:45 am]

BILLING CODE 4510–55–P

DEPARTMENT OF THE INTERIOR

National Park Service

Final General Management Plan and Environmental Impact Statement, Flight 93 National Memorial, PA

AGENCY: National Park Service, Department of the Interior.

ACTION: Notice of availability of the Final Environmental Impact Statement for the General Management Plan, Flight 93 National Memorial.

SUMMARY: Pursuant to section 102(2)(C) of the National Environmental Policy Act of 1969 (Pub. L. 91–190, as amended), the National Park Service announces the availability of the Final General Management Plan and Environmental Impact Statement (GMP/EIS) for Flight 93 National Memorial, in Somerset County, Pennsylvania. Consistent with Federal laws, regulations, and National Park Service policies, the Final GMP/EIS describes the proposed Federal action to establish a programmatic framework in the form of a General Management Plan to accomplish the objectives set forth in the Flight 93 National Memorial Act (Pub. L. 107–226; 116 Stat. 1345).

The Final GMP/EIS evaluates alternatives to guide the development and future management of the national memorial over the next 15 to 20 years. Alternative 1—No Action provides a baseline evaluation of the existing resource conditions, facilities and management at the Flight 93 National Memorial. Alternative 2, the agency's preferred alternative, focuses on the final selected design from the Flight 93 National Memorial International Design Competition. The Final GMP/EIS describes the affected environment and evaluates the potential environmental consequences of developing a new national memorial in Somerset County, Pennsylvania. Impact topics evaluated include historic and cultural resources, natural resources, land use, transportation, socioeconomic impacts, visual and aesthetic impacts, energy requirements, and public health and safety.

On June 16, 2006, a ''Notice of Availability'' announcing the public availability of the Flight 93 National Memorial Draft General Management Plan/Environmental Impact Statement was published in the **Federal Register** (71 FR 34964). This public review period extended for 60 days from June 16 to August 15, 2006. On July 20, 2006, the National Park Service conducted an open house style public meeting at the Shanksville-Stonycreek School in Shanksville, Pennsylvania.

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APPENDIX 3

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A.3.1 Burrowing Owl (*Athene cunicularia hypugaea*)

Population Status and Ecology

Range and Distribution

Burrowing owls are distributed throughout much of the western United States. The species' breeding range extends from southern Canada into the western half of the U.S., and south into Baja California and central Mexico. The winter range is similar to the breeding range, except most owls from the northern areas of the Great Plains and Great Basin migrate south (Haug et al. 1993).

Arizona supports breeding and wintering birds (deVos 1989). Burrowing owls have been reported from 13 of 15 counties with breeding confirmed in 12 counties (Brown 2001b). Currently, the two major breeding populations in Arizona are in the Tucson area and the Yuma area (Brown 2001a). In Pima County, burrowing owls were reported in 5 United States Geological Survey quadrangles between 1993 and 1999: Childs Mountain, Cat Mountain, Palo Verde Camp, Tucson SW, and west of Marana (Arizona Breeding Bird Atlas 2000).

Seasonal movements by burrowing owls that breed in Arizona are unclear. Owls that breed in northern Arizona are thought to migrate in winter while in other portions of the state, owls may be year-round residents (Brown 2001b). Recent studies indicate that less than 40 percent of the burrowing owls present in Arizona during the summer spend the winter in Arizona (Brown and Mannan 2002). Owls from Canada and northern U.S. may winter in southern Arizona or migrate through this area on their way to overwintering areas in Mexico (James and Ethier 1989).

Population Status and Threats

Range-wide Population Status and Threats

Burrowing owls have declined in abundance throughout most of their range (Haug et al. 1993). In the western states, 54 percent of 24 jurisdictions reported burrowing owl populations decreasing; there were no reported increases. Local populations are especially prone to extinction in this species (Haug et al. 1993). The species is listed as endangered or sensitive in 14 states in the U.S. and as threatened or endangered in four provinces in Canada. It has been petitioned for state listing in California.

Burrowing owls have declined through much of their range because of habitat loss associated with urbanization, agricultural conversion, and rodent control programs (Johnsgard 1988). Pesticides, predators, and vehicle collisions also have contributed to

their decline (Haug et al. 1993; James and Espie 1997). Survival and reproductive success can be adversely affected by spraying insecticides over nesting colonies (James and Fox 1987). Burrowing owls also have been incidentally poisoned and their burrows destroyed during eradication programs aimed at rodent colonies (Collins 1979; Zarn 1974). Although burrowing owls are relatively tolerant of human activity, there are human-related impacts, such as shooting, burrow destruction, and the introduction of non-native predators, that adversely affect the owls (Zarn 1974; Haug et al. 1993). Populations of native predators (e.g., gray foxes and coyotes) artificially enhanced by development (i.e., availability of artificial food sources and shelter) and introduced predators (e.g., red foxes, cats, and dogs) near burrowing owl colonies adversely impact this species (see e.g. Milsap 2002).

Arizona Population Status and Threats

Burrowing owls are widely distributed, but generally uncommon in Arizona (Figure A.3.1) (Brown 2001b). James and Espie (1997) estimated the burrowing owl population in Arizona to be between 100 and 1,000 birds, although this estimate was based on questionnaires rather than a systematic survey. Burrowing owls are believed to have declined in abundance in Arizona (Brown 2001b; James and Espie 1997) principally as a result of the decline in the population of Gunnison's prairie dog (*Cynomys gunnisoni*) in northern Arizona and the extirpation of black-tailed prairie dogs (*Cynomys ludovicianus*) in southeastern Arizona (Brown 2001a). Loss of habitat resulting from shrub encroachment also has contributed to declines in parts of Arizona (Brown 2001a). Grazing practices and prairie dog control programs likely have encouraged shrub encroachment (Brown 2001a).

The breeding range of the owl in Arizona appears to be have been relatively stable in the 1990s (Arizona Breeding Bird Atlas 2000). Currently, there are two major breeding populations in Arizona, one in the Tucson area at Davis-Monthan Air Force Base and west branch Santa Cruz River flood plain (Estabrook and Mannan 1998) and one in the Yuma area where high numbers of burrowing owls have been reported along the irrigation canals. The urbanized area of Tucson typically supports 80 to 110 active burrows with the numbers varying seasonally and annually (Estabrook and Mannan 1998). The size of the population in Yuma has not been estimated. Six nests were reported in the Phoenix Metro Area in 1994, 3 in 1995, and 5 to 6 in 1996 (Brown 2001a).

Brown (2001a) identified the following threats to burrowing owls in Arizona:

- Reduced habitat availability because of prairie dog and ground squirrel control programs
- Bubonic plague indirectly limiting habitat availability through effects to prairie dogs and ground squirrels
- Conversion and urban development of natural habitat and agricultural lands

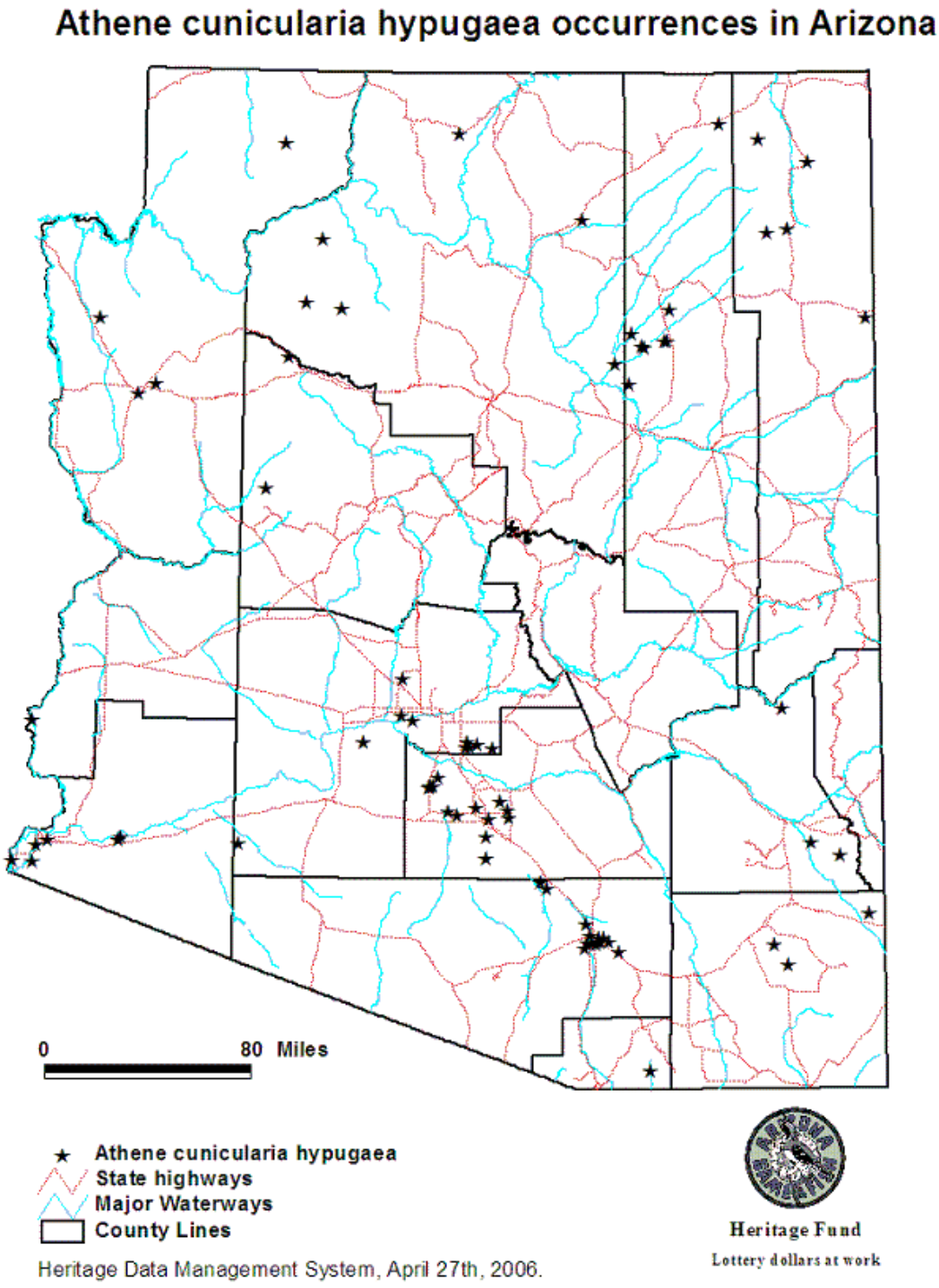

FIGURE A.3.1
Burrowing owl occurrences in Arizona

- Overgrazing of rangelands resulting in a more woody species composition and destruction of burrows
- Reduction of prey
- Maintenance programs of agricultural irrigation and water resources canals destroying burrows
- Urbanization increasing the risk of contracting *Trichomoniasis* from doves
- Urbanization increasing predation by domestic and/or feral animals or children, and potential for vehicle strikes
- Reduction in prairie dog and ground squirrel populations may increase predation of burrowing owls
- Agricultural pesticides

Life History

Burrowing owls often live in colonies with many pairs nesting in burrows in close proximity. They are monogamous and generally produce one brood per season. Not all individuals capable of breeding do so every year. Breeding is initiated in early March. Eggs are laid from late March to July (Terres 1980). Clutch size averages 7 to 9 (Terres 1980). Young are born altricial and fledge in late summer to fall (Coulombe 1971). If the first clutch is lost, females may renest.

Hatching success has been reported to range from about 90 percent in Idaho to about 55 percent in California. Fledging success has ranged from 2.9 to 4.9 young per successful nest (Haug et al. 1993). Estabrook and Mannan (1998) found 62.5 percent of 72 nests studied to be successful and 16.7 percent to have failed. The outcome of the remaining 20.1 percent was unknown.

Burrowing owls in northern Arizona generally migrate south during the winter, while in southern Arizona, many are year-round residents (Phillips et al. 1964). In the Tucson area, it appears that some burrowing owls are year-round residents while others are migratory (Estabrook and Mannan 1998).

Habitat Requirements

Burrowing owls inhabit open areas such as grasslands, pastures, coastal dunes, desert scrub, and the edges of agricultural fields. They also inhabit golf courses, airports, cemeteries, vacant lots, and road embankments or wherever there is sufficient friable soil for a nesting burrow (Haug et al. 1993). In the Tucson area, nearly all (97 percent) of the burrows used for breeding were in undeveloped areas that had been cleared of native vegetation (Estabrook and Mannan 1998).

Burrows are a critical habitat requirement for burrowing owls. Owls use burrows for nesting and also require access to alternate burrows to provide escape cover for adults and fledglings. Estabrook and Mannan (1998) found that areas with many large burrows supported more owls than areas with fewer and/or smaller burrows. Because they do not excavate their own burrows, burrowing owls are dependent on fossorial mammals such

as badgers (*Taxus taxidae*), ground squirrels, and prairie dogs to create burrows. In Arizona, burrowing owls often inhabit areas supporting prairie dog (*Cynomys gunnisoni*) and round-tailed ground squirrel (*Spermophilus tereticaudus*) populations (deVos 1998; Brown 2001b). These burrowing mammals usually inhabit open environments and create burrows that the owls require, as well as maintain vegetation at a short height (deVos 1998).

Burrowing owl nesting density appears to be strongly dependent on local burrow distribution and also may be influenced by foraging habitat quality. Reported nesting densities are highly variable, ranging from as dense as 1.2 ha (3.1 ac) per pair to 4,600 ha (11,366 ac) per pair (Table A.3.1). Although somewhat colonial, burrowing owls maintain an exclusive area around their nest burrows. Reported nearest neighbor distances are more consistent than nesting densities and range from 60 to 240 m (197 to 787 ft) (A.3.2). Assuming a circular nesting territory, reported nearest neighbor distances translate into nesting territories ranging from 0.3 to 4.5 ha (0.7 to 11.1 ac) (Table A.3.2).

TABLE A.3.1
DENSITY OF BURROWING OWLS IN VARIOUS AREAS

Location	Density (Acres/pair)	Reference
Lower Colorado River	3.1	Brown (1998, cited in TNC 1999)
Bay Area, California	5.9	Trulio (1997)
Oklahoma[a]	10	Zarn (1974)
Minnesota	14	(Grant 1965, cited in Milsap and Bear 2000)
Imperial Valley, California	30	Rosenberg and Haley (2001)
Florida	36	Milsap and Bear (2000)
Imperial Valley, California	29 to 53	Coulombe (1971)
Oklahoma[b]	11,366	Zarn (1974)

[a] In prairie dog towns
[b] More than 1 mile from a prairie dog town

TABLE A.3.2
NEAREST NEIGHBOR DISTANCES BETWEEN BURROWING OWL NESTS

Location	Distance Meters (Feet)	Hectares (Acres)[d]	Reference
Oakland, CA	60 m (197 ft)	0.3 (0.7)	Thomsen (1971)
Nebraska	105 m (344 ft)[a]	0.8 (2.1)	Desmond et al. (1995)
Oregon	110 m (361 ft)	0.9 (2.3)	Green and Anthony (1989)
Nebraska	125 m (410 ft)[b]	1.2 (3.0)	Desmond et al. (1995)
Saskatchewan	160 m (525 ft)	2.0 (5.0)	Haug (1985, cited in Desmond et al. [1995])
New Mexico	166 m (545 ft)	2.2 (5.4)	Martin (1973)
Imperial Valley, CA	166 m (545 ft)	2.2 (5.4)	Rosenberg and Haley (2001)
Florida	176 m (577 ft)	2.4 (6.0)	Milsap and Bear (2000)
Nebraska	240 m (787 ft)[c]	4.5 (11.1)	Desmond et al. (1995)
Median	160 m (525 ft)	2.0 (5.0)	

[a] Large prairie dog towns (≥35 ha)
[b] Small prairie dog towns (<35 ha)
[c] Badger burrows not in prairie dog towns
[d] Based on a circle with radius one-half the nearest neighbor distance

Home range and foraging area may overlap between different pairs, with only the burrow being actively defended (Coulombe 1971; Johnsgard 1988). Little information is available on home range size and foraging distances for burrowing owls. Rosenberg and Haley (2001) found that burrowing owls typically foraged in areas close to burrows with more than 80 percent of observations within 600 m (1,968 ft) of the burrow. This finding is similar to that of Haug and Oliphant (1990) who found 95 percent of telemetry points within this distance of a burrow. Depending on the method used to estimate home range size, average home range sizes range from 34 to 241 ha (83 to 595 ac) (Table A.3.3). Rosenberg and Haley (2001) reported that home ranges overlapped by about 30 percent.

TABLE A.3.3
HOME RANGE SIZES (MEAN ± 1 S.D.) OF BURROWING OWLS

Location	Size (acres)	Method	Reference
Imperial Valley, CA	112±45	Fixed kernel	Rosenberg and Haley (2001)
Imperial Valley, CA	454±161	Adaptive kernel	Rosenberg and Haley (2001)
Imperial Valley, CA	281±75	MCP[a]	Rosenberg and Haley (2001)
Saskatchewan	83±21	MCP	Sissons and Scalisi (2001)
Saskatchewan	123±34	Adaptive kernel	Sissons and Scalisi (2001)
Saskatchewan	595±170	MCP	Haug and Oliphant (1990)
Imperial Valley, CA	452	MCP	Gervais et al. (2000)

[a] MCP – minimum convex polygon

Burrowing owls eat a variety of different prey items, including rodents, frogs, small birds, terrestrial and aquatic invertebrates, and carrion (Zarn 1974; Johnsgard 1988; Gervais et al. 2000). During the summer in Arizona, predominant prey items in pellets from burrowing owls were scorpion, beetles, locusts, and small rodents (Haug et al. 1993). Also, Estabrook and Mannan (1998) reported mourning doves in the diet of burrowing owls in an urban setting.

A.3.2 Cactus Ferruginous Pygmy-Owl (*Glaucidium brasilianum cactorum*)

Population Status and Ecology

Range and Distribution

The ferruginous pygmy-owl (*Glaucidium brasalianum*) has a range that extends from the southern United States (Arizona and Texas) south to central Argentina (Cartron et al. 2000a). The cactus ferruginous pygmy-owl (*Glaucidium brasilianum cactorum*) is the northernmost occurring of several subspecies of the ferruginous pygmy-owl (Cartron et al. 2000a). The subspecies ranges from lowland central Arizona south through western Mexico to the states of Colima and Michoacan, and from southern Texas south through the Mexican states of Tampaulipas and Nuevo Leon (USFWS 2002a).

The current distribution of pygmy-owls within Arizona is poorly understood. Historically, pygmy-owls occupied areas of south-central Arizona from New River (about 56 km [35 mi] north of Phoenix), south to the U.S./Mexico border, west to southern Yuma County, and east to the San Pedro River and the confluence of the Gila and San Francisco rivers (approximately 161 km [100 mi] northeast of Tucson) (USFWS 2003a; Cartron et al. 2000a; Figure A.3.2). Currently, the Arizona population appears to have a patchy distribution, with most pygmy owls located in one of four general areas: northwest Tucson and southern Pinal County, Organ Pipe Cactus National Monument, the Tohono O'odham Nation, and Altar Valley (Richardson et al., 2000). The species may be extirpated from portions of its historic range, including the lower and middle Gila River, the Santa Cruz River near Tucson, the Rillito Creek, and the Salt River near Phoenix (Cartron et al. 2000c).

Population Status and Threats

Range-wide Population Status and Threats

The pygmy-owl population is divided into four distinct population segments: Texas, eastern Mexico, Arizona, and western Mexico (USFWS 1997). The eastern (Texas and east Mexico) and western (Arizona and west Mexico) populations are separated by the

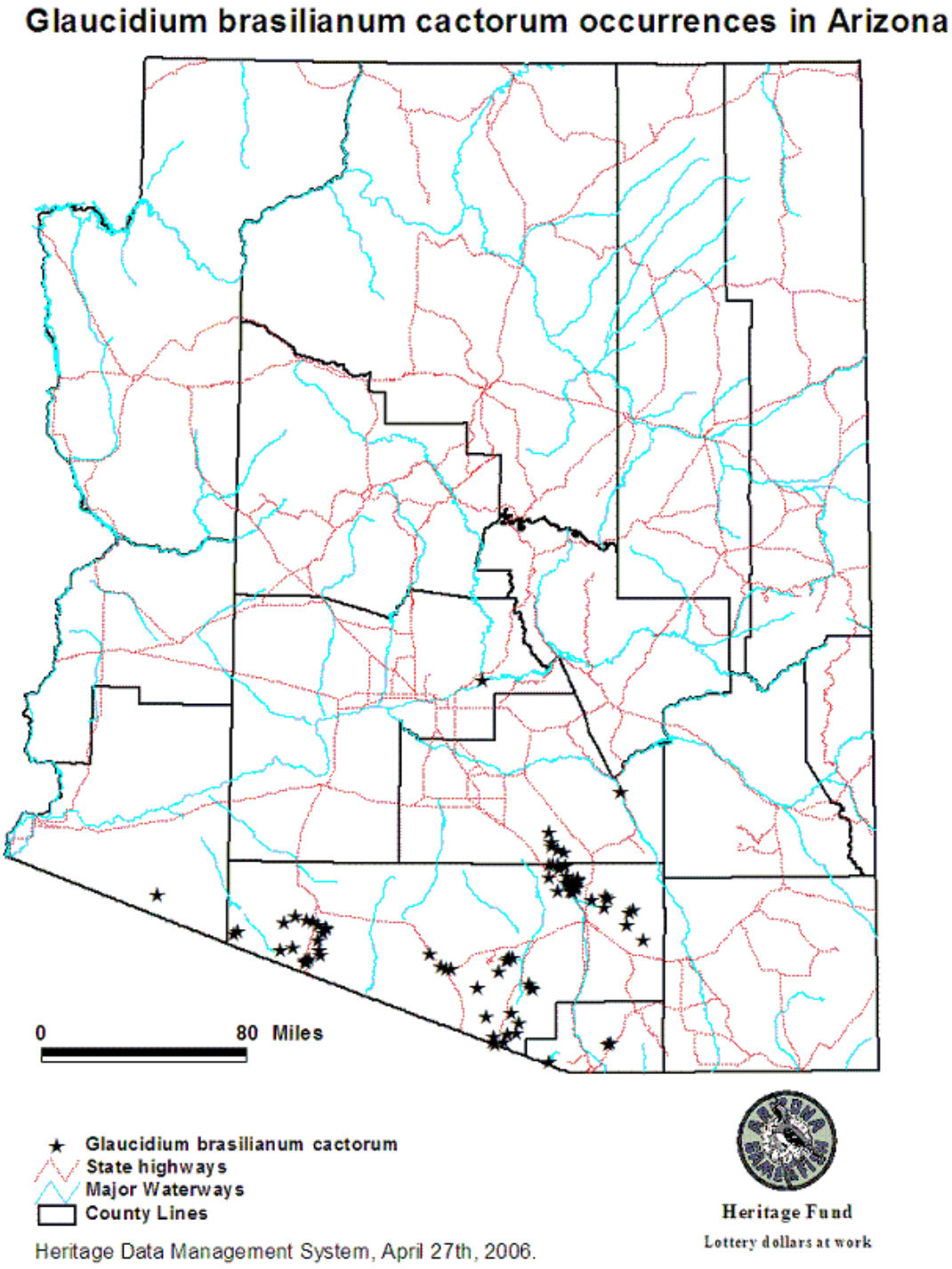

FIGURE A.3.2
Historic distribution of pygmy-owls in Arizona

basins and mountain ranges of the Chihuahuan desert in the United States; and by the Sierra Madre Occidental and Oriental ranges and the Mexican Plateau in Mexico (Cartron et al. 2000a).

Federal Status

The cactus ferruginous pygmy-owl, *Glaucidium brasilianum cactorum*, was listed as an endangered species in 1997. Following a series of lawsuits, the USFWS removed the pygmy-owl from the endangered species list in 2006. In 2007, the USFWS was petitioned to list the species again based on additional genetic, taxonomic, and threats information. Specifically, the petition relies largely on a recently proposed scientific reclassification of the pygmy-owl to *Glaucidium ridgwayi cactorum* based on Proudfoot et al. (2006a, 2006b) and Konig et al. (1999). This proposed reclassification recognizes the *cactorum* subspecies in southern Arizona, and Sonora and Sinaloa, Mexico, as distinct and defined by a smaller range than the subspecies recognized in 1997. In May 2008, the USFWS issued the 90-day finding in response to the petition and found that the pygmy-owl may warrant Federal protection under the ESA and initiated a 12-month status review (FR 73:31418-31424). The pygmy-owl still remains protected by the MBTA and ARS Title 17. Low population numbers, long-term drought, loss and modification of habitat, disease, and predation are thought to be the primary threats to pygmy-owls (FR 73:31418-31424).

Texas Population and Status

Although threatened status was proposed for the Texas population of pygmy-owls, this population was determined to be stable and have a lower level of threat than the Arizona population. Therefore, listing was not found to be warranted (USFWS 1997). One estimate of the pygmy-owl population in Texas suggests that, across Brooks, Kenedy, and Willacy counties, there are 1,308 owls occurring in live oak-mesquite habitat (Wauer et al. 1993). Another study estimates that between 745 and 1,823 individuals occur in Kenedy County alone (Mays 1996).

Mexico Population and Status

At the time of the listing, the USFWS noted that it would continue to review the status of pygmy-owl populations in Mexico and evaluate whether one or more of these populations should be proposed for listing (USFWS 1997). There is limited information about the population status of pygmy-owls in Mexico. Russell and Monson (1998) suggested that, based on their personal observations and anecdotal information, populations in Sonora, Mexico had not declined. Currently, the pygmy-owl is thought to be relatively abundant in northern Sonora. Flesch and Steidl (2000) looked at pygmy-owl populations just south of the U.S. border and throughout the State of Sonora, Mexico. They observed 240 owls (208 males and 32 females) on 191 transects surveyed

between February and March 2000, the early part of the breeding season. Another 22 possible detections were made during the surveys. Presence of a pair was documented at only 12 sites, with evidence of pair occupancy at another 5 sites. In all, only 4 occupied nest cavities were recorded. In addition to the survey results, another 39 incidental pygmy-owls detections were recorded. Eight of these owls were female and 31 were male. Three sites had confirmed pair occupancy, with two of these sites having occupied nest cavities. The densities of owls recorded during the survey ranged from 1.8 owls per 10,000 square hectares (ha^2) to 0 owls per 10,000 ha^2, with an average of 0.172 owls per 10,000 ha^2 (Flesch and Steidl 2000).

Arizona Population Status and Threats

There has been a historical decline in the species' range in Arizona (Pima County 2001). The extent of this population decrease is unknown, in part due to the lack of quantified historical records. Historically, pygmy-owls in Arizona were most commonly reported in cottonwood-mesquite forest and mesquite woodlands. In recent years, pygmy-owls have been observed primarily in the Arizona Upland subdivision of the Sonoran Desertscrub biome (USFWS 2003b).

The general understanding is that pygmy-owl populations in Arizona began to decline after about 1950, possibly as a result of the increasing loss of riparian habitat caused by lowered water tables, loss of perennial flows in many streams and rivers, invasion of exotic vegetation such as tamarisk (*Tamarix spp*.), and physical changes to river channels, banks, and floodplains. Many riparian areas, however, had not been surveyed prior to being impacted by human activities, so it is possible that the population decline started much earlier in the 20th century (Johnson et al. 2000).

Formal surveys for the pygmy-owl did not begin in Arizona until 1993. Pygmy-owl records in Tucson and Organ Pipe Cactus National Monument date back to 1872 and 1949, respectively; however for many other areas, such as on the Tohono O'odham Nation, little or no historical data exists (Johnson et al. 2000). Even after formal surveys began, the intensity of those efforts was insufficient to provide a good estimate of the number of owls in Arizona. Only after the listing in 1997 did survey efforts increase to the point that a better picture of the population status began to emerge (Richardson et al. 2000).

The total number of pygmy-owls in Arizona is still unknown. Survey and monitoring documented 37 adult pygmy-owls in 1999, 30 in 2000, 36 in 2001, and 29 in 2002, 21 in 2003, and 20 in 2004 (USFWS 2003b; Richardson, pers. com.). It is probable that there are more owls in Arizona, as large tracts of potentially suitable owl habitat have not been surveyed (USFWS 2002a; Richardson et al. 2000). In 1999, the last year for which pygmy-owl survey data was published, 28 owl territories were identified in Pinal and Pima counties. Eleven of these territories had documented breeding activity, with all nests successfully fledging young (although one nest failed after fledging). In total, 32 young successfully fledged in 1999, with 16 known to survive through dispersal (Abbate

et al. 2000). Surveys indicate that there are fewer than 50 territories in the state (outside of Tribal lands) (Richardson, pers. comm.).

Three general factors were identified as the basis for the listing of the Arizona population segment: (1) present or threatened destruction, modification, or curtailment of the species habitat or range; (2) inadequacy of existing regulatory mechanisms; and (3) other natural or man-made factors affecting its continued existence. Regardless of uncertainty related to habitat use by the pygmy-owl in Arizona, loss of habitat is generally regarded as the single largest contributor to the decline in owl populations. Anecdotal evidence from both Arizona and Texas indicates that population declines in both locations coincided with the loss of habitat. In addition, relatively large populations of owls can still be found in Texas in areas where owl habitat has been preserved (Johnson et al. 2000).

Although loss of riparian habitat may have been the primary threat to pygmy-owls in Arizona, the loss and fragmentation of upland vegetation from large-scale residential and commercial developments has also been identified as an important threat (USFWS 2003a). Development pressure is seen as the primary threat to conservation of habitat for this species in northwest Tucson (USFWS 2002a). Activities that may affect habitat include: clearing vegetation, indirect effects of urbanization, agricultural encroachment, road-building, high-impact recreation, water diversion or impoundment, channelization of drainages, groundwater pumping, livestock grazing, and hydrologic changes resulting from various land use practices (USFWS 2003a).

Little is known about the rate or causes of mortality in pygmy-owls or their life expectancy; however, they are susceptible to predation from a variety of species, such as great horned owls, Harris' hawks, Cooper's hawks, screech-owls, and domestic cats (USFWS 2002a, USFWS 2003a). Other threats include direct and indirect human-caused mortalities, such as collisions with cars, glass windows, fences, and power lines; illegal dumping of toxic waste; and wildfire (USFWS 2003a). In 1999, AZGFD reported three instances of adult mortality and 11 instances of actual or presumed juvenile mortality. One adult owl appeared to have broken its neck in a collision with a fence and the other two adults were suspected victims of predation (Abbate et al. 2000). The five confirmed juvenile deaths were from predation (1 juvenile), injuries resulting from wind damage to the nest saguaro (3 juveniles), and unknown causes (1 juvenile) (Abbate et al. 2000). Other natural and human induced factors that could affect the subspecies include low levels of genetic variation, possible contamination from pesticides, potential competition with other birds for nesting cavities, concentration of recreational birding activities at remaining known locations, disease (e.g. Trichomoniasis), and nest predation (USFWS 2002a; USFWS 2003a).

Human activities near nest sites at critical periods of the nesting cycle also can cause pygmy-owls to abandon their nests (USFWS 2003a). Pygmy-owl habitat also can be compromised by the presence of barriers to movement, including roads, interstates, canals, and alterations of functional drainages (Pima County 2001).

Life History

Pygmy-owls are primarily diurnal with crepuscular tendencies; i.e. most activity occurs during daylight hours, with peaks at dawn and dusk (USFWS 2003a). The pygmy-owl typically flies in quick bursts, moving only a short distance from one lookout point to another (Cartron et al. 2000b). Pygmy-owls typically hunt from perches in trees with dense foliage using a perch-and-wait strategy. They also hunt by inspecting tree and saguaro cavities for other nesting birds, and possibly bats. Their diverse diet includes birds, lizards, insects, and small mammals; however, the owls do utilize different groups of prey species on a seasonal basis (USFWS 2002a).

Pygmy-owlss are considered non-migratory throughout their range (USFWS 2002a). They are highly territorial with territory sizes between 1 and 23 ha (3 and 57 ac) during the breeding season and winter home ranges as large as 113 ha (279 ac) (Pima County 2001; USFWS 2003b). A 113 ha (280 ac) home range is currently considered necessary for pygmy-owls to meet their life history requirements on an annual basis (USFWS 2003b). Based on telemetry data, it appears that the larger winter range of pygmy-owls represents an expansion of the breeding territory and does not involve a seasonal shift of territory from one location to another (Richardson, pers. comm.).

Pygmy-owls typically nest as yearlings and both sexes breed annually thereafter. Territories normally contain several nest-roost cavities from which a responding female selects a nest. Hence, cavity density could be a fundamental criterion for habitat selection (USFWS 2003a).

In Arizona, the courtship and nesting period runs from February to May (USFWS 2003a; USFWS 2003b). Clutch sizes range from 3 to 7 eggs (Pima County 2001). One clutch per year is typical (USFWS 2003a); however, a second clutch may be laid if the first one fails (Pima County, 2001). Juveniles typically disperse from natal areas between July and August and do not appear to defend a territory until September. Direction of dispersal appears to be random (USFWS 2003a) and a juvenile pygmy-owl has been documented dispersing over 161 km (100 mi) (AZGFD, pers. comm.). Once dispersing male pygmy-owls settle in a territory, they rarely move out of their home range. Unpaired females may continue to move until the subsequent breeding season (USFWS 2002a). Pygmy-owls exhibit a high degree of site fidelity once territories and home ranges have been established (USFWS 2002a). Behaviorally, the option to seek alternative areas outside of the home range appears limited, particularly for males (USFWS 2003b).

Habitat Requirements

The habitat requirements of the pygmy-owl are not fully understood. Habitat use by the pygmy-owl varies from Arizona to Texas to Mexico. In Texas, they are typically found in coastal-plain oak associations, mesquite bosques, and Tamaulipan thornscrub. In eastern Mexico, they occur in lowland thickets, thornscrub associations, riparian woodlands, and second-growth forests. The pygmy-owl, in western Mexico, is commonly

found in Sonoran desertscrub, Sinaloan thornscrub, Sinaloan deciduous forest, riverbottom woodland, cactus forests, and thornforests. As discussed below, in Arizona, habitat use has included cottonwood and mesquite riparian woodlands, upland Sonoran desertscrub, and semidesert grasslands.

Although the plant communities in Texas and Arizona differ, their similarities may help identify those characteristics most significant for the pygmy-owl. The pygmy-owl is often associated with thickets and thicket edges in Texas and densely foliated non-native landscape vegetation in Arizona. Use of these associations could indicate that vegetation structure, rather than composition, is a critical factor in determining the preferred habitat of the owl. Another similarity between these diverse communities is the presence of thorny bushes (Cartron et al. 2000a).

Historically, pygmy-owls in Arizona were most commonly reported in cottonwood-mesquite forest and mesquite woodlands. These mesic riparian forests and associated mesquite woodlands have been nearly eliminated in southern Arizona over the last 100 years, and the reduction of these habitats is thought to have caused a decline in owls over that period (USFWS 2002a). There is some question as to whether the pygmy-owl was exclusively associated with riparian habitat. Early naturalists in Arizona tended to focus their efforts along rivers, so it is possible that the tendency for owls to be documented in riparian areas is primarily an artifact of where survey and collection work took place (Johnson et al. 2003). Advocates for this historic pygmy-owl-riparian association note that numerous cross-country expeditions crossed the south and central portions of Arizona without reporting the presence of pygmy-owls. In the late 1800s, noted ornithologists Charles Bendire and George Breninger made a distinction between elf owl nesting habitat (in upland saguaros) and pygmy-owl nesting habitat (in riparian cottonwoods and mesquites). There are, however, published historic records (1920s to 1950s) of pygmy-owls in areas with no permanent water source (Johnson et al. 2003). The lack of extensive and quantified historical records makes it unlikely that the debate will ever be fully settled (Richardson, pers. comm.).

In recent years, pygmy-owls have been primarily found in the Arizona Upland Subdivision of the Sonoran Desertscrub biome. The Arizona Upland Subdivision is described as a low woodland of leguminous trees with an overstory of columnar cacti and with one or more layers of shrubs and perennial succulents. Over the past several years, owls also have been observed in riparian and xeroriparian (dry washes) areas and in semidesert grasslands (USFWS 2003b).

The primary constituent elements of pygmy-owl habitat have been identified as:

1) elevations below 1,219 m (4,000 ft) within the biotic communities of: Sonoran riparian deciduous woodlands; Sonoran riparian scrubland; mesquite bosques; xeroriparian communities; tree-lined drainages in semidesert, Sonoran savanna, and mesquite grasslands; and the Arizona Upland and Lower Colorado River subdivisions of the Sonoran desertscrub

2) nesting cavities in trees including, but not limited to, cottonwood, willow, ash, mesquite, palo verde, ironwood, and hackberry with a trunk diameter of 15 cm (6 in) or greater (measured at 1.4 m [4.5 ft] from the ground), or large columnar cactus such as saguaro or organ pipe greater than 2.4 m (8 ft) in height

3) multi-layered vegetation (presence of canopy, mid-story, and ground cover) provided by trees and cacti in association with shrubs such as acacia, prickly pear, desert hackberry, graythorn, and ground cover such as triangle-leaf bursage, burro weed, grasses, or annual plants

4) vegetation providing mid-story and canopy-level cover in a configuration and density compatible with pygmy-owl flight and dispersal behaviors

5) habitat elements configured and human activity levels minimized so that unimpeded use, based on pygmy-owl behavioral patterns, can occur during dispersal and within home ranges (USFWS 2002a)

Studies of habitat use in Texas suggest that important habitat characteristics include moderate to dense understory cover (anywhere from 50 to 100 percent), the presence of trees large enough to provide cavities, and fewer small trees (Proudfoot et al. 2000). In Arizona, nest sites tend to have a higher degree of canopy cover and higher vegetation diversity than random sites (USFWS 2003a). Relatively dense understory cover could be important for foraging and survival of fledglings (Cartron et al. 2000a) as well as providing protection from extreme climatic conditions (Cartron et al. 2000b).

Preliminary studies suggest that pygmy-owls in northwest Tucson use areas with relatively high levels of structural diversity in the suburban/urban interface. Areas of highest concentration of pygmy-owls are commonly characterized by semi-open or open woodlands, often in proximity to forests or patches of forest (AZGFD unpublished data). Although pygmy-owls occupy the same general area year-round, the size of area used and the composition of vegetation may vary among seasons (USFWS 2003a).

Pygmy-owls are obligate cavity nesters, meaning that they almost exclusively utilize natural cavities or cavities created by other species (Cartron et al. 2000 b). Historically, pygmy-owls in Arizona used cavities in cottonwood, mesquite, ash trees, and saguaro cacti for nest sites (USFWS 2002a); although some evidence suggests that mesquite (a hardwood species) is less readily excavated by other species and, therefore, is less frequently used in riparian areas than softwood trees (Cartron et al. 2000b). Recently (1996 to 2002) all but two known nest sites were in saguaro cacti. Of the two non-saguaro nests, one was in an ash tree and the other in a eucalyptus tree.

The general conclusion from these studies is that, in order to support successful reproduction and rearing of young, home ranges should include trees and cacti of adequate size to provide cavities for nest sites and that are in proximity to foraging, roosting, sheltering, and dispersal habitats. Further, adequate cover is needed for

protection from climate and predators, and in an appropriate configuration in relation to the nest site.

Some preliminary investigations have been done to determine the degree of development that is found within the home ranges and/or breeding territories of pygmy-owls. In 2001, 83 percent of known pygmy-owl sites were in undeveloped areas with very little human activity and 17 percent of sites were in areas with some level of low-density development. No pygmy-owls have been documented in high-density commercial or residential developments. Pygmy-owl experts on the Recovery Team calculated the level of vegetation disturbance within the estimated home range (113 ha or 280 ac) at each nest site. The average percent disturbance was calculated to be 23 percent. More recent information from an analysis completed by the AZGFD showed an overall disturbance of 33 percent within breeding home ranges. There appears to be a difference in the tolerance of breeding versus non-breeding pygmy-owls to the level of vegetation disturbance (Richardson, pers. comm.).

Pygmy-owls require habitat linkages, within and among territories, for movement and dispersal. Habitat linkages consist of continuous cover or patches of trees and large shrubs spaced at regular intervals, to provide concealment and protection from predators and mobbing. These areas also provide shade and cover to moderate temperature extremes (USFWS 2003b).

Free-standing water does not appear to be necessary for the survival of pygmy-owls. Owls have never been observed directly drinking water; it is likely they meet much of their biological water requirements through the prey they consume (USFWS 2003b).

A.3.3 Southwestern Willow Flycatcher (*Empidonax traillii extimus*)

Population Status and Ecology

Range and Distribution

Total range of southwestern willow flycatcher occurs from southern Nevada, southern Utah, southern California, Arizona, New Mexico, western Texas, southwestern Colorado, and extreme northwestern Mexico (USFWS 1995). Breeding birds from southwestern Colorado show great individual variation and are intermediate between *E. t. extimus* and *E. t. brewsteri*. During the winter (*E. t. extimus* is a neotropical migrant), this subspecies is likely to be found in Mexico, Central America, and perhaps northern South America (AZGFD 2002).

Within Arizona, southwestern willow flycatchers breed locally along the Colorado River in the Grand Canyon near the mouth of the Little Colorado River, and south to Yuma; at

the Little Colorado River headwaters near Greer and Eagar; very locally along the middle Gila, Salt, and Verde rivers; middle to lower San Pedro River; and upper San Francisco River near Alpine (AZGFD 2002).

The AZGFD southwestern willow flycatcher 2001 survey and nest monitoring report documented this species along 11 drainages in Arizona. The major concentrations were found at elevations less than 1,115 m (3,658 ft) and occurred near the confluence of the Gila and San Pedro rivers, Alamo Lake, the Gila River (near Pima), Topock March, Big Sandy River, the lower Grand Canyon (river miles 246 to 268), and Camp Verde. Three high-elevation sites were also documented, 2 on the Little Colorado River near Greer and 1 on the San Francisco River near Alpine (Paradzick et al. 2001).

Arizona Game and Fish Department and cooperators spent 2,590 hours surveying 203 sites covering approximately 388 linear km (241 linear miles) of riparian habitat in 2006. Because survey effort was much reduced in some key areas (e.g., sites at the San Pedro River study area that have formerly supported relatively large numbers of flycatchers) in 2006, statewide results should not be compared to previous years. Surveyors documented southwestern willow flycatchers along 12 drainages in 2006. The major concentrations at low elevations <1,115 m (<3,658 ft) occurred at the Roosevelt Lake complex (Salt River study area and Tonto Creek study area), the San Pedro River/Gila River complex (San Pedro River study area and Gila River study area), and the Gila-Safford area. Resident flycatchers were documented at 3 high elevation (>2,400 m [7,874 ft]) sites: 2 on the Little Colorado River (River Reservoir and Greer Townsite) and 1 on the San Francisco River (Alpine Horse Pasture). Resident flycatchers were not documented at mid-elevation (between 1,115 m [3,658 ft] and 2,400 m [7,874 ft]) (Graber et al. 2007).

Population Status and Threats

Range-wide Population Status and Threats

Range-wide population status for southwestern willow flycatchers is difficult because the population presents a moving target, both spatially and temporally. Not all sites are re-surveyed in every year, making population estimates challenging. Population estimates should be qualified by the knowledge that numbers of birds at a given site fluctuate from year to year, that inter-site dispersal takes place, and that some occupied sites have been destroyed or damaged in recent years, causing the former residents to relocate and forego breeding. Also, survey and monitoring effort has increased substantially from 1993 to the present, but varies among regions. Another confounding factor is the taxonomic identity of willow flycatchers at the edge of the range of the southwestern subspecies (USFWS 2002).

When the southwestern willow flycatcher was listed as endangered in 1995, approximately 350 territories were known to exist (Sogge et al. 2001). As of the 2005 breeding season, the minimum known number of southwestern willow flycatcher

territories was 1,214 (Durst et al. 2006). Arizona, New Mexico, and California account for the greatest number of known southwestern willow flycatcher territories. Nevada, Colorado, and Utah account for about 11 percent of territories, primarily because the range of southwestern willow flycatchers includes only the southern extremes of these states, and there are few known breeding sites within this relatively limited geographic area. Texas is absent from the estimate because there were no recent survey data or other records to shed light on current status and distribution within the state (Durst et al. 2006).

Declining southwestern willow flycatcher numbers have been attributed to loss, modification, and fragmentation of riparian breeding habitat, loss of wintering habitat, and brood parasitism by the brown-headed cowbird. Habitat loss and degradation are caused by a variety of factors, including urban, recreational, and agricultural development, water diversion and groundwater pumping, channelization, dams, and livestock grazing. Fire is an increasing threat to southwestern willow flycatcher habitat, especially in monotypic saltcedar vegetation. Southwestern willow flycatcher nests are parasitized by brown-headed cowbirds, which lay their eggs in the host's nest. Feeding sites for cowbirds are enhanced by the presence of livestock and range improvements such as watering areas and corrals, agriculture, urban areas, golf courses, bird feeders, and trash areas. These feeding areas, when in close proximity to southwestern willow flycatcher breeding habitat, especially when coupled with habitat fragmentation, facilitate cowbird parasitism of nests (USFWS 2002).

The reasons for the decline of the southwestern willow flycatcher and current threats this species faces are numerous, complex, and inter-related. The major factors for decline vary in severity over the landscape and at any given locale, several are likely to be at work, with cumulative and synergistic effects. The most significant impact should be expected to vary from site to site (USFWS 2002).

Federal Status

The southwestern willow flycatcher was listed as endangered, without critical habitat, on February 27, 1995 (USFWS 1995). The southwestern willow flycatcher was determined to be endangered by threats causing loss of habitat, lack of adequate protective regulations, and other natural or man-made factors including brood parasitism by the brown-headed cowbird (USFWS 1995). The designation of southwestern willow flycatcher critical habitat was published in the Federal Register on October 19, 2005 (USFWS 2005). A final recovery plan for the southwestern willow flycatcher was signed by the USFWS's Region 2 Director in August 30, 2002, and was released to the public in March 2003 (USFWS 2002). The recovery plan describes reasons for endangerment and the current status, recovery actions, management needs, and recovery goals.

Arizona Population Status and Threats

Arizona contains the largest number of known southwestern willow flycatcher territories, 495 reported in 2005, among the three states (Arizona, New Mexico, and California) that contain the most known sites and territories (Durst et al. 2006). Southwestern willow flycatchers were detected along 12 major drainages within Arizona (Figure A.3.3) (Graber et al. 2007). The largest known populations in Arizona occur at Roosevelt Lake and along the lower San Pedro River. Within Pima County, and specifically the Tucson metropolitan area, there is currently no known occupied breeding habitat for this species.

The southwestern willow flycatcher is included on the AZGFD draft list of Wildlife of Special Concern in Arizona (AZGFD in prep.). The southwestern willow flycatcher is also one of the 56 species considered by Pima County to be a priority vulnerable species under the Sonoran Desert Conservation Plan. Within Arizona, the southwestern willow flycatcher is considered very threatened throughout its range. Major threats include riparian habitat loss and fragmentation, as well as brood-parasitism by brown-headed cowbirds. Other factors include diversion of water, draining of wetlands, channelization and levying of streambeds, construction of canals, drains and impoundments, livestock grazing, off-road vehicles, and the cutting of woodlands. Possible factors include predation and invasion of riparian habitat by exotic tamarisk (AZGFD 2002).

Arizona Game and Fish Department identified the most urgent management needs as: a better understanding of habitat requirements; public-private partnerships that focus on protection of existing willow-cottonwood thickets, and restoration where such habitats have already been destroyed along rivers and streams; continuation of ongoing statewide surveys and monitoring coordinated by AZGFD through Arizona Partners in Flight, a group of agency and nongovernmental organizations working together for non-game landbird conservation; and research into the relationship of nest predation and cowbird parasitism to willow flycatcher breeding success (AZGFD 2002).

Life History

The southwestern willow flycatcher is one of 4 subspecies of *E. traillii* recognized in North America. The southwestern willow flycatcher subspecies, *E. t. extimus*, is a medium-sized bird approximately 15 cm (5.75 in) long, including the tail. The body is brownish olive to grayish green on the upper parts with a pale olive breast, pale yellow belly, and whitish throat, with two white wing bars. An eye ring may be faint or absent. The bill is relatively large, the maxilla dark and the mandible usually entirely yellow or pale orange, and it often has a dusky tip. Both sexes are alike. This subspecies is most easily identified by its vocalizations (AZGFD 2002).

The southwestern willow flycatcher is a neotropical migratory bird that arrives on breeding territory by late April to early May. They typically migrate southward again in August or September. It is a highly territorial bird that uses vocalization to advertise its

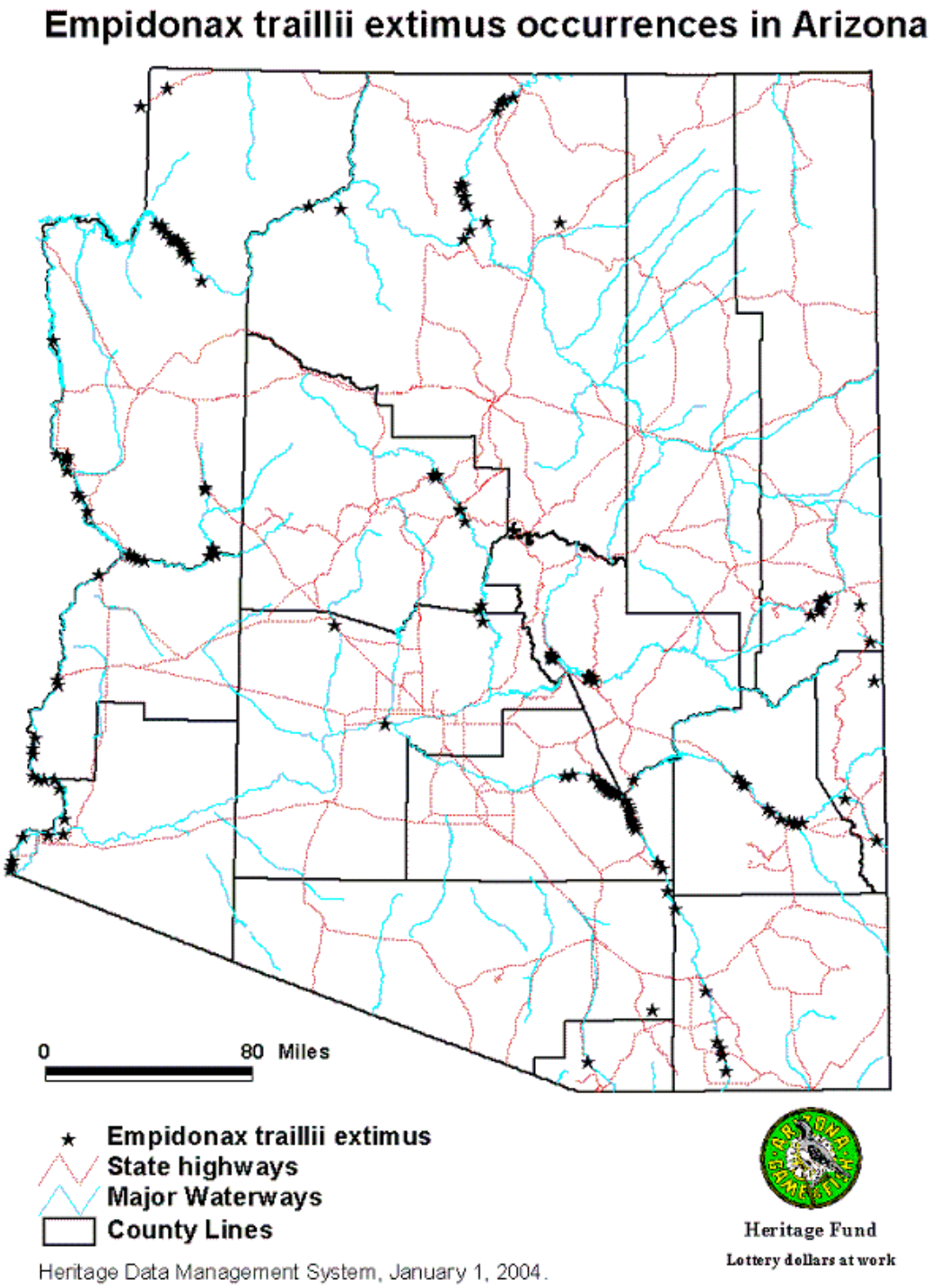

FIGURE A.3.3
Southwestern willow flycatcher occurrences in Arizona

territory. The pair forms and builds a compact cup built of shredded bark, cattail tufts, and grasses, and is lined with fine grasses and feathers. A clutch typically consists of 3 or 4 eggs laid from May through July and incubation lasts 12 to 13 days. Southwestern willow flycatchers usually have one brood per year but have been known to raise two broods. The young are tended by both parents and leave the nest after 12 to 15 days. Breeding colonies are usually 0.6 ha (1.5 ac), with densities of about 9 to 14 pairs per 41 ha (100 ac) (AZGFD 2002).

Brown-headed cowbirds parasitize the nest by laying an egg in the southwestern willow flycatcher nest. Cowbird eggs hatch sooner and often out-compete the host young. As a result, southwestern willow flycatcher nests parasitized by cowbirds usually produce only cowbirds (AZGFD 2002).

Southwestern willow flycatchers are insectivorous, collecting flying insects by sallying (flying out short distances from a perch) and, to a lesser extent, hovering and gleaning. They also may forage on berries and seeds.

Habitat Requirements

The southwestern willow flycatcher is a riparian obligate species. They prefer dense canopy cover, a large volume of foliage, and surface water during the midsummer months. They appear to avoid riparian areas found in steep, closed canyons (AZGFD 2002).

The preferred nesting habitat consists of mature cottonwood/willow (*Populus fremontii/Salix goodingii*) forests along still or slow moving watercourses at the lower elevations. Southwestern willow flycatchers are also found in tamarisk (*Tamarix pentandra*) thickets. At higher elevations this subspecies may be found in pure willow stands (*Salix* spp.) (AZGFD 2002).

Habitat characteristics identified in 2006 (Graber et al. 2007) found that most nest sites where southwestern willow flycatchers were documented shared certain landscape characteristics, although vegetation composition varied. Occupied sites were commonly in broad floodplains with dense riparian habitat where water or saturated soil was present sometime during the breeding season. General vegetation at most breeding sites were characterized as mixed native/exotic associations, however, the amount of tamarisk varied within and among sites. A few breeding sites were composed of dense monotypic stands of tamarisk, forming a nearly continuous closed canopy.

Tamarisk and Goodding's willow were the primary nesting substrates in Arizona (Graber et al. 2007). In 2006, the second record in Arizona of use of velvet ash (*Fraxinus velutina*) was documented as a nesting substrate. Also in 2006, 4 nests were found in snags, this was the third breeding season with records of snags as nesting substrate. Prior to 2006, snags were only documented as nesting substrate in 4 instances along the San Pedro River (in 2004 and 2005).

A.3.4 Western Yellow-billed Cuckoo (*Coccyzus americanus occidentalis*)

Population Status and Ecology

Range and Distribution

In the west *Coccyszus americanus occidentalis* was widespread and locally common in California and Arizona, locally common in a few river reaches in New Mexico, common very locally in Oregon and Washington, generally local and uncommon in scattered drainages of the arid and semiarid portions of western Colorado, western Wyoming, Idaho, Nevada, and Utah, and probably uncommon and very local in British Columbia (USFWS 2001). Currently, *C. a. occidentalis* is known to breed in California, Arizona, New Mexico, extreme western Texas, Sonora, Chihuahua, and south irregularly to Zacatecas, Mexico (Howell and Webb 1995, Russell and Monson 1998, Hughes 1999, Rappolle 2000).

C. a. occidentalis is the only subspecies of yellow-billed cuckoo that occurs in Arizona. It nests primarily in the southern and central portions of the state (Figure A.3.4)(Pima County 2001; AZGFD 2002). It has been extirpated from most lower elevation localities, especially the Colorado River valley (AZGFD in prep.) and most of the Santa Cruz River in Pima County (Corman and Magill 2000). *C. a. occidentalis* was documented along 25 drainages in Arizona in 1998 and 1999, with the major concentrations occurring along the Agua Fria, San Pedro, and Verde rivers and Cienega and Sonoita creeks (Corman and Magill 2000).

Population Status and Threats

Range-wide Population Status and Threats

Based on morphological characteristics, two subspecies of the yellow-billed cuckoo have been described, one in the east (*C. a. americanus)* and another in the west (*C. a. occidentalis)* (Ridgeway 1887). However, because the morphological characteristics are not 100 percent reliable in distinguishing the two subspecies, there has been past disagreement over whether they are sufficiently distinct to warrant recognition (see USFWS 2001 for a full account). In 2001, Pruett et al. determined that the subspecies could be diagnosed genotypically and that they diverged approximately 205,000–465,000 years ago, “supporting continued separation of the two subspecies and recognition of the western subspecies as an evolutionarily significant unit.” United States Fish and Wildlife Service considers the western population of yellow-billed cuckoo a DPS based on the physical, ecological, and behavioral discreteness of the population segment and determined that listing this DPS as threatened is warranted, but precluded by higher priority listing actions (USFWS 2001).

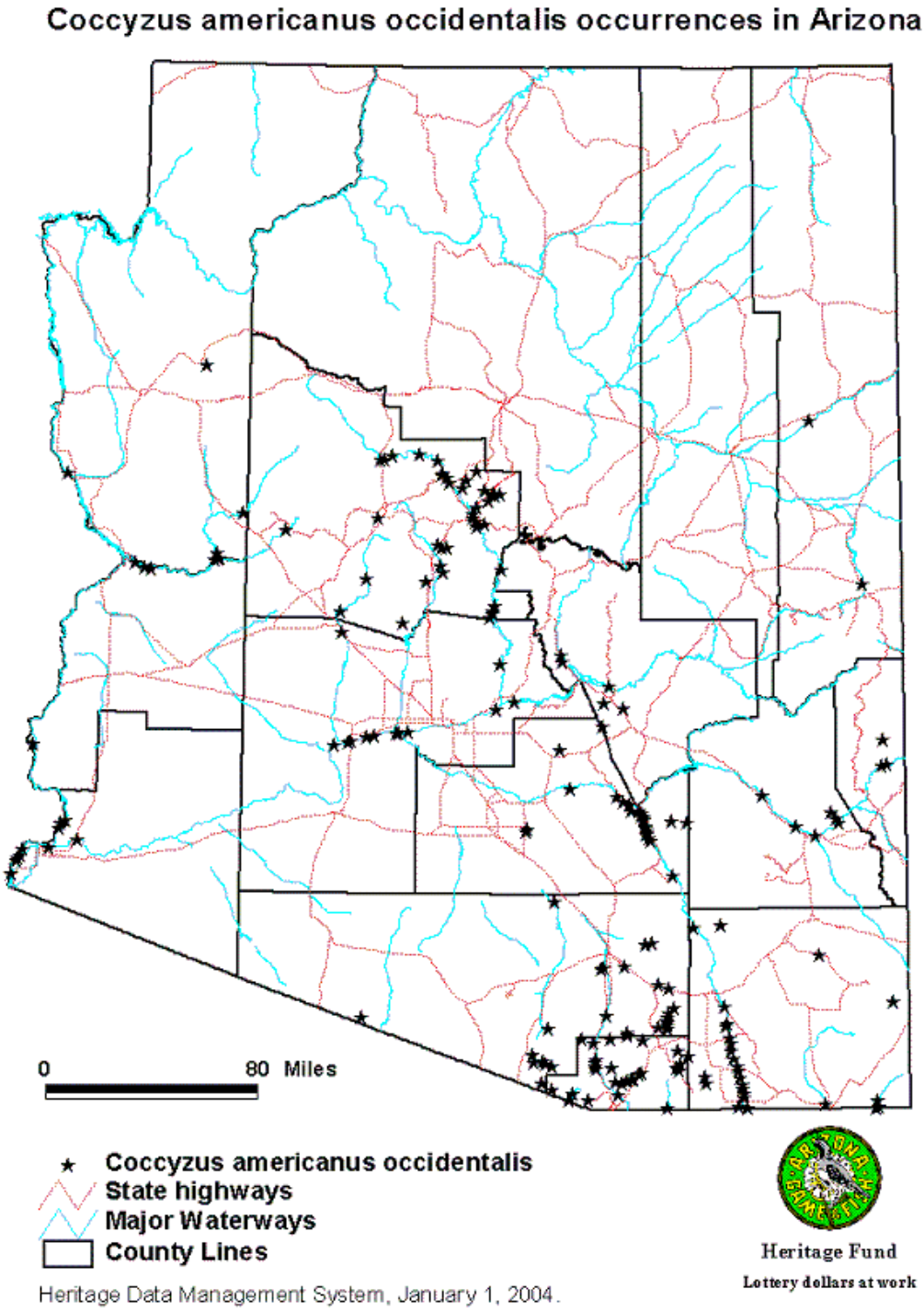

FIGURE A.3.4
Western yellow-billed cuckoo occurrences in Arizona

Like many riparian obligate species, the breeding distribution and number of western yellow-billed cuckoos have declined in the past 80 years throughout western North America (AZGFD 2002). The species was listed by the state of California as threatened in 1971 and was reclassified as endangered in 1987. The species has not been sighted in Oregon since the 1940s and is believed to be extirpated from Washington, where it has not been sighted since the 1930s and is ranked as critically imperiled. In Nevada, the yellow-billed cuckoo is listed as State Rank S1 Nevada State Protected, meaning that the species is protected within the state and is considered critically imperiled due to extreme rarity, imminent threats, and/or biological factors. Throughout the other states within its range west of the Continental Divide, the yellow-billed cuckoo is generally uncommon to extremely rare (USFWS 2001).

Federal Status

The USFWS considers the western population of yellow-billed cuckoo a DPS based on the physical, ecological, and behavioral discreteness of the population segment and determined that listing this DPS as threatened is warranted but precluded by higher priority listing actions (USFWS 2001).

Arizona Population Status and Threats

Arizona probably contains the largest remaining yellow-billed cuckoo population among states west of the Rocky Mountains and is critically important, since breeding populations throughout the West have been extirpated or greatly reduced (Pima County 2001; USFWS 2001). In a 1998/1999 study (Corman and Magill 2000), yellow-billed cuckoos were detected along 25 main drainages in Arizona, with the major concentrations occurring along the Agua Fria, San Pedro, and Verde rivers and Cienega and Sonoita creeks.

It is considered a Species of Special Concern within the state because it has been extirpated from most Lower Sonoran localities, especially the Colorado River valley, by unmitigated destruction of riparian gallery forests (AZGFD in prep.). Loss of mature cottonwood–willow riparian habitat through degradation, modification, and fragmentation is the primary threat to the remaining populations of yellow-billed cuckoos in central and southern Arizona (AZGFD in prep.; Pima County 2001). Major threats to this habitat include:

- Reclamation, flood control, and irrigation projects
- Urbanization and agricultural activities
- Invasion of non-native saltcedar (*Tamarix ramosissima*) into riparian areas
- Exposure to pesticides and other contaminants on wintering and breeding brounds

- Livestock grazing and OHV use within riparian habitats

Life History

The yellow-billed cuckoo is a member of the avian family Cuculidae, members of which share the common feature of a zygodactyl foot, in which two toes point forward and two toes point backward. Six species of Cuculidae breed in the United States, two species of which breed west of the Continental Divide, the yellow-billed cuckoo and the greater roadrunner (USFWS 2001).

The western yellow-billed cuckoo arrives on the breeding grounds beginning in mid- to late May, initiating nesting activity in early to mid-June (southern California) through August and frequently into September (southeastern Arizona) (Corman and Magill 2000). Nesting peaks in mid-July and early August, and breeding may be triggered by an abundance of insects or other large prey which form the bulk of the species' diet (AZGFD 2001; Pima County 2001). Prey abundance may lead to the production of excess eggs and thus to brood parasitism, where the cuckoo's excess eggs are laid in other birds' nests (Pima County 2001).

Both male and female yellow-billed cuckoos build the nest, generally from 1 to 9 m (4 to 30 ft) above the ground, often in willow or mesquite thickets (AZGFD 2002). West of the Continental Divide, nesting occurs almost exclusively close to water, and biologists have hypothesized that the species may be restricted to nesting in moist river bottoms in the west because of humidity requirements for successful hatching and rearing of young (Rosenberg et al. 1991). The nest is well concealed by the surrounding foliage and consists of an unkempt stick platform, thinly lined with leaves, mesquite and cottonwood strips, grass, and catkins, with a little depression to hold the eggs (Erlich et al. 1988; AZGFD 2002). The clutch size is usually 2 or 3 eggs, and the development of the young is very rapid, with a breeding cycle of 17 days from egg-laying to fledging of young (USFWS 2001). The male feeds the first fledglings while the female feeds the second fledglings (Erlich et al. 1988). Their diet consists of hairy caterpillars, bird eggs, frogs, lizards, ants, beetles, wasps, flies, berries and fruit, with the parents feeding their young by regurgitating insects (Erlich et al. 1988; Hughes 1999).

Habitat Requirements

The western yellow-billed cuckoo appears to require large blocks of riparian habitat for nesting, particularly woodlands with cottonwoods (*Populus fremontii*) and willows (*Salix goodingii*) (USFWS 2001). In Arizona, the species occurs from 27 to 2,045 m (90 to 6,710 ft), preferring streamside cottonwood-willow groves and larger mesquite bosques for migrating and breeding. It is rarely observed as a transient in xeric desert or urban settings (AZGFD 2002). Rosenberg et al. (1991) speculated that in the Lower Colorado River Valley, mature cottonwoods with willows forming a subcanopy layer provide the best shading of any riparian habitat against the extremely high midsummer

temperatures; saltcedar and open mesquite bosques are inadequate in buffering lethal temperatures. In addition, standing water in many cottonwood–willow groves may help lower air temperature by evaporative cooling, and thus the decline of cuckoo populations may be attributed largely to the removal of necessary thermal cover (Rosenberg et al. 1991).

The couckoo has been found in mature Sonoran Riparian Deciduous Forest, Cottonwood–Willow Series, and Sonoran Riparian Scrub in well developed mesquite bosques (Corman and Magill 2000). Areas where cuckoos have been found in recent years comprised at least 15 ha (37 acr)) including 3 ha (7 ac) or more of closed canopy, with canopy heights of 5 to 30 m (16 to 100 ft) and understory height of 1 to 6 m (3 to 20 ft) (Hughes 1999). Active cuckoo nests found in Arizona during the 1998 and 1999 seasons (n=6) were found in Arizona alder (1), tamarisk (1), Fremont cottonwood (2), and Goodding willow (2) (Corman and Magill 2000).

A.3.5 Lesser Long-nosed Bat (*Leptonycteris curasoae yerbabuenae*)

Population Status and Ecology

Range and Distribution

The total range of lesser long-nosed bats varies somewhat depending on which taxonomic classification is used. *Leptonycteris sanborni* (the former species name for the lesser long-nosed bat) is listed as occupying the lowland deserts of Mexico from Oaxaca and Veracruz through western Mexico to Baja California, and northward to south-central and southeast Arizona and southwest New Mexico. *L. curasoae* is listed as occupying essentially the same range but extending southeasterly through Guatemala to El Salvador.

In Arizona, the lesser long-nosed bat is found from the Picacho Mountains to the Agua Dulce Mountains in the southwest and the Galiuro and Chiricahua mountains in the southeast (Figure A.3.5). There are also two late-summer records of immature individuals from the Phoenix area and one from the Pinaleno Mountains.

Population Status and Threats

Range-wide Population Status and Threats

The lesser long-nosed bat is Federally listed as endangered. Populations are believed to have declined significantly, and Federal listing was based on the reduction of the number of maternity colonies and declines in the size of remaining maternity colonies in Arizona and Sonora as a result of exclusion and disturbance. Additionally, lesser long-

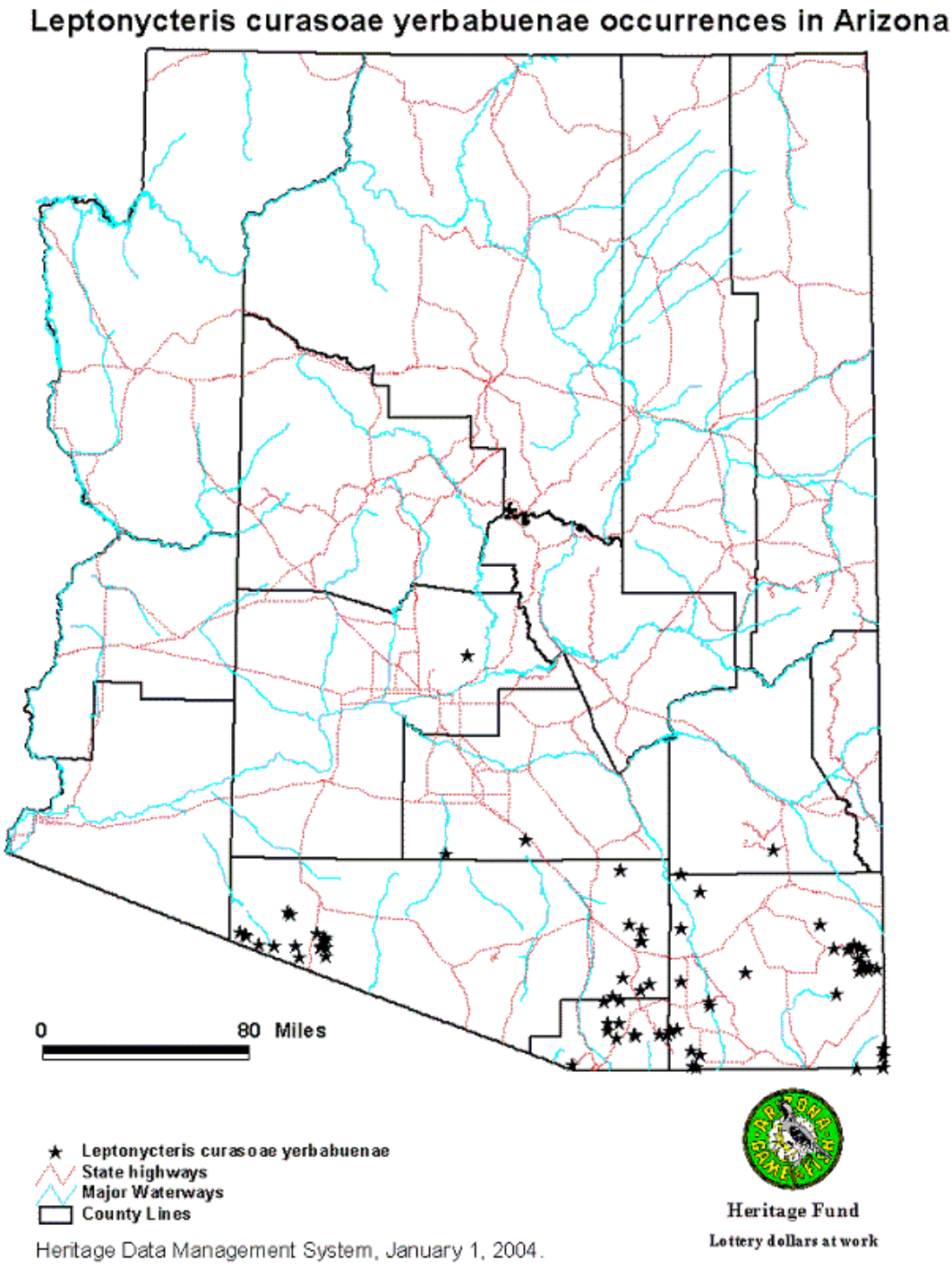

FIGURE A.3.5
Habitat range and occurrence of the lesser long-nosed bat in Arizona. Points represent all occurrences of 1 or more individuals, including netting records.

nosed bats are thought to be negatively affected by reductions in the availability of native agaves over large areas of northern Mexico from harvesting for local manufacture of mescal and tequila. Heavy browsing on newly emergent flower stalks of agaves by both cattle and deer also has been suggested as possibly decreasing foraging opportunities and thus contributing to declines in these bats. Although the population is believed to have declined, recent surveys have indicated that population sizes are much larger than those reported in the 1980s (Hinman and Snow 2003).

Arizona Population Status and Threats

Arizona is at the extreme northern edge of the lesser long-nosed bat's distribution. It is a state endangered species. Loss of agaves by grazing, agricultural harvest, and development has reduced foraging habitat for lesser long-nosed bats in Arizona and elsewhere in its range. Loss and disturbance of roosts sites also pose a significant threat to lesser long-nosed bats and can occur through

- Recreational caving and mine exploration,
- Closure of abandoned mines for hazard abatement,
- Renewed mining,
- Vandalism, and
- Exclusion of bats from roosting areas.

Efforts are underway in some locations to protect known and potential roosts. At three large maternity colonies occurring in Arizona, measures have been applied to protect the roosts.

Several caves and mine adits in southeastern Arizona have been gated with interpretive signs placed nearby in an effort to protect the suitability of these sites for roosting. Colossal Cave at the base of the Rincon Mountains is developed for tourism, but recently steps have been taken to restore parts of the cave in an effort to attract lesser long-nosed bats to use it as a maternity roost as they did until the 1960s.

Life History

Lesser long-nosed bats are migratory, since they do not hibernate and cannot withstand prolonged exposure to cold temperatures. In September and October, they migrate to Mexico, where they breed and spend the winter. Females return to Arizona pregnant as early as the second week in April. In late April through late July, pregnant females congregate at traditional roost sites, give birth and raise their young. Maternity colonies may number in the hundreds or thousands and in a few places in the tens of thousands. Males form separate, smaller colonies. Females give birth to one young each year in May. Young can fly by the end of June. Maternity colonies break up by the end of July at

which time females and young move to higher elevation areas (up to about 1,678 m [5,500 ft]) where they feed on agave flowers. Neither maximum nor mean lifespan are known; however, one banded individual was at least 4 years old when recaptured.

Habitat Requirements

Habitat associations of the lesser long-nosed bat vary seasonally in Arizona. During April until July, the lesser long-nosed bat is known from semidesert grasslands and Sonoran desert scrub at elevations below 1,067 m (3,500 ft) (AZGFD 2003). From July to late September/early October, this bat moves up to Madrean evergreen woodland (oak transition regions) at elevations up to 1,676 m (5,500 ft) (AZGFD 2003). Within these plant communities, lesser long-nosed bats require two critical resources: (1) suitable day roosts and (2) sufficient concentrations of food plants. The distribution of these resources will determine where these bats specifically occur.

In Arizona, lesser long-nosed bats feed on nectar and pollen from flowers of saguaro and organ pipe cactus in early summer and agave later in the summer and early autumn. Its consumption of nectar and pollen produced by paniculate agave flowers is well known. Also important are nectar, pollen, and fruit produced by a variety of columnar cacti. Flowers and fruits of two to three species of columnar cacti (*Pachycereus pringlei, Carnegia gigantean, and Stenocereus thurberi*) provide nearly all of the energy and nutrients obtained by pregnant and lactating females roosting in the Sonoran desert in the spring and early summer (USFWS 1995). They may feed on ripe cactus fruits at the end of the flowering season and also may take a few insects incidentally when feeding on nectar. Lesser long-nosed bats have been reported to visit hummingbird feeders at night in the Huachuca, Chiricahua, and Santa Rita mountains. During winter in Mexico, primary food plants, as identified by their pollen, appear to be *Ceiba, Bombax*, and *Ipomoea*. Their spring migration from central Mexico northward is thought to follow the sequential blooming of certain flowers from south to north.

Lesser long-nosed bats leave daytime roosts to feed about an hour after sunset. After filling their stomachs, sometimes to the point of appearing pregnant, they go to night roosts, which may be different from day roosts, to rest and groom. As they groom themselves they remove the pollen sticking to their fur with their claws and then lick it off their claws. This ingested pollen provides proteins and other nutrients not obtainable from nectar.

The lesser long-nosed bat is considered an important pollinator of various agave species, columnar cacti and other Mexican plant species. Pollen collects on their heads and shoulders (sometimes making them look yellow) when they stick their head into a flower to get nectar. As they move from plant to plant, pollen is rubbed off on the pistils at each flower thus pollinating them. It is not yet clear just how important this bat is as a pollinator of saguaro and the agave species with which it is associated in Arizona, since some populations of these plants also exist well outside the known range of this bat.

For day roosts, the lesser long-nosed bat uses caves, mine tunnels, and occasionally old buildings. This bat appears to be the most dependent on the availability of inactive mines of the North American bat species. Most Arizona records are from inactive mines. Proximity to humans does not necessarily pose a threat to this species (USFWS 1995). Characteristics that render potential roost sites "suitable" for lesser long-nosed bats are unclear, but maternity roosts tend to be very warm and poorly ventilated, at least where the young are actually raised. These characteristics could reduce the energetic requirements of adult females while they are raising their young (USFWS 1995).

Like many other bats, individuals of Leptonycteris use night roosts for digesting their meals. Night roosts can be the bats' day roosts or other caves, mines, rock crevices, trees and shrubs, and occasionally abandoned buildings (USFWS 1995). The extent to which night roosts represent essential habitat in this species is currently uncertain.

A3.6 Merriam's Mesquite Mouse (*Peromyscus merriami*)

Population Status and Ecology

Range and Distribution

Merriam's mesquite mouse populations were historically found in the large mesquite forests along rivers throughout Pinal, Pima, and Santa Cruz counties in Arizona and into Sonora, Mexico. In Arizona, this mouse has been found in the south central part of the state, from just north of Florence at the north, southeast of Tucson to the east, Lukeville to the west, and Nogales to the south. In Pima County, this mouse has been found in areas of Organ Pipe Cactus National Monument, Sabino Canyon, Arivaca, Baboquivari Mountains, San Xavier, and Fort Lowell (Hoffmeister 1986, Pima County 2001).

Most areas where mesquite mice were historically present have been altered. Trapping efforts within historical habitat indicated that the species had been lost from these sites. Historical habitat in Pima County includes the Santa Cruz River (in the San Xavier area) and Wilmot Station southeast of Tucson (Pima County 2001).

Population Status and Threats

Range-wide Population Status and Threats

Federal Status

Merriam's mesquite mouse has no status under the Federal Endangered Species Act. Range-wide threats to this species include the decline of mesquite bosques in some parts of Arizona and northern Mexico. Areas of this community type are said to have

historically represented one of the most abundant riparian communities in the southwest, but are now reduced to remnants of what they once were. Threats to mesquite bosques include cutting of firewood, livestock grazing, ground water pumping and surface water diversion, and channelization or other alterations/destruction along both permanent and intermittent riparian areas (AZGFD 2001, SWCA 2006).

Arizona Population Status and Threats

Arizona Game and Fish Department lists Merriam's mesquite mouse as a "sensitive element" but it has no special status under Arizona law or regulations. It is one of the 56 species considered by Pima County to be a priority vulnerable species under the Sonoran Desert Conservation Plan.

An evaluation of the mesquite mouse conducted in 2006 (SWCA 2006) indicated that this species was not uncommon in the appropriate habitat within Pima County, which appears to be mesquite-dominated vegetation of several types on floodplain soils. In addition, mesquite mice were found to be geographically widespread in eastern Pima County. They were found near the northern, southern, and eastern boundaries of their historically known range, where potentially suitable habitat could be sampled (SWCA 2006).

Within Arizona, the greatest threat to mesquite mice is loss and degradation of mesquite-forest habitat. Loss of habitat has occurred through cutting of firewood or clearing for grazing or other development. Groundwater depletion in many places has resulted in the loss of formerly lush riparian areas with large mesquite trees or dense vegetation. Re-establishment and re-generation of suitable habitat for this species may be precluded by groundwater depletion (Pima County 2001).

Life History

Merriam's mesquite mouse is difficult to distinguish in the field from the cactus mouse (*Peromyscus eremicus*), which is slightly smaller and is found in rocky habitats, especially on hillsides. The mesquite mouse has ocher-buff colored underparts overlaid with dusk, producing a dull gray overall appearance. The underparts are whitish with a buff or tawny wash. The tail is bicolored, dusky above and whitish below, and is more than half the total length of the mouse. The head and body of this mouse are 97 to 102 mm (3.8 to 4.0 in) long and the tail is 102 to 122 mm (4.0 to 4.8 in) long (Burt and Grossenheider 1980).

Merriam's mesquite mouse is typically found in mesquite-dominated floodplain vegetation at elevations ranging from 488 m (1,600 ft) to 1,174 m (3,850 ft) (AZGFD 2001). This mouse is primarily nocturnal and active throughout the year. The diet of the mesquite mouse is not fully understood; however, they are thought to be granivores, herbivores, and invertivores. Their diet is probably similar to that of the cactus mouse,

which feeds on fruit, flowers, seeds of shrubs, insects, and some green vegetation (NatureServe 2007).

Mesquite mice may breed throughout the year and are thought to have a gestation period of approximately 21 days. There are 2 to 4 young per litter that are born naked, blind, and totally dependent on maternal care (Hoffmeister 1986).

Habitat Requirements

Mesquite mice are inhabitants of heavy, forest-like stands of mesquite (*Prosopis* spp.) in riparian or low desert habitats (AZGFD 2001, Hoffmeister 1986). These mice have been found not only in large mesquite bosques, but also in several different vegetation associations, including: Semidesert grassland, xeroriparian scrub; Sonoran desertscrub, xeroriparian scrub; and Sonoran Riparian Deciduous Forest and Woodlands, Mesquite Series (all of these associations had mesquite as the dominant tree were evaluations occurred, but did not appear to be exclusively remnants of old bosques) (SWCA 2006). At Wilmot Station southeast of Tucson, mesquite mice were trapped in thick stands of mesquite, cholla (*Opuntia* spp.), prickly pear (*Opuntia* spp.), paloverde (*Parkinsonia* spp.), and grasses. Mesquite mice seem heavily dependent on the presence of riparian woodland and dense mesquite forests with dense brush (AZGFD 2001, Hoffmeister 1986).

A.3.7 Pale Townsend's Big-eared Bat (*Corynorhinus townsendii pallescens*)

Population Status and Ecology

Range and Distribution

The pale Townsend's big-eared bat ranges throughout western North America from southern British Colombia south through the Pacific Northwest and southern California on the west, and the Black Hills of South Dakota and West Texas on the east, through the Mexican uplands to the Isthmus of Tehuantepec in southern Mexico. It is not known from the Baja California peninsula. Isolated occurrences in the southern Great Plains, Ozark Mountains and Appalachian Mountains are considered to be relict populations.

The species is widespread throughout Arizona, although not considered common anywhere, and is least common in northeastern grasslands and southwestern desert areas. It has been found from 168 to 2,294 m (550 to 7,520 ft) in elevation. Most records, however, come from above 915 m (3,000 ft) (Hinman and Snow 2003). In Arizona, pale Townsend's big-eared bats have been reported in Cochise, Coconino, Gila, Graham, La Paz, Maricopa, Mohave, Navajo, Pima, Pinal, Santa Cruz, Yavapai, and Yuma counties (AZGFD, unpublished records accessed 2007; Figure A.3.6).

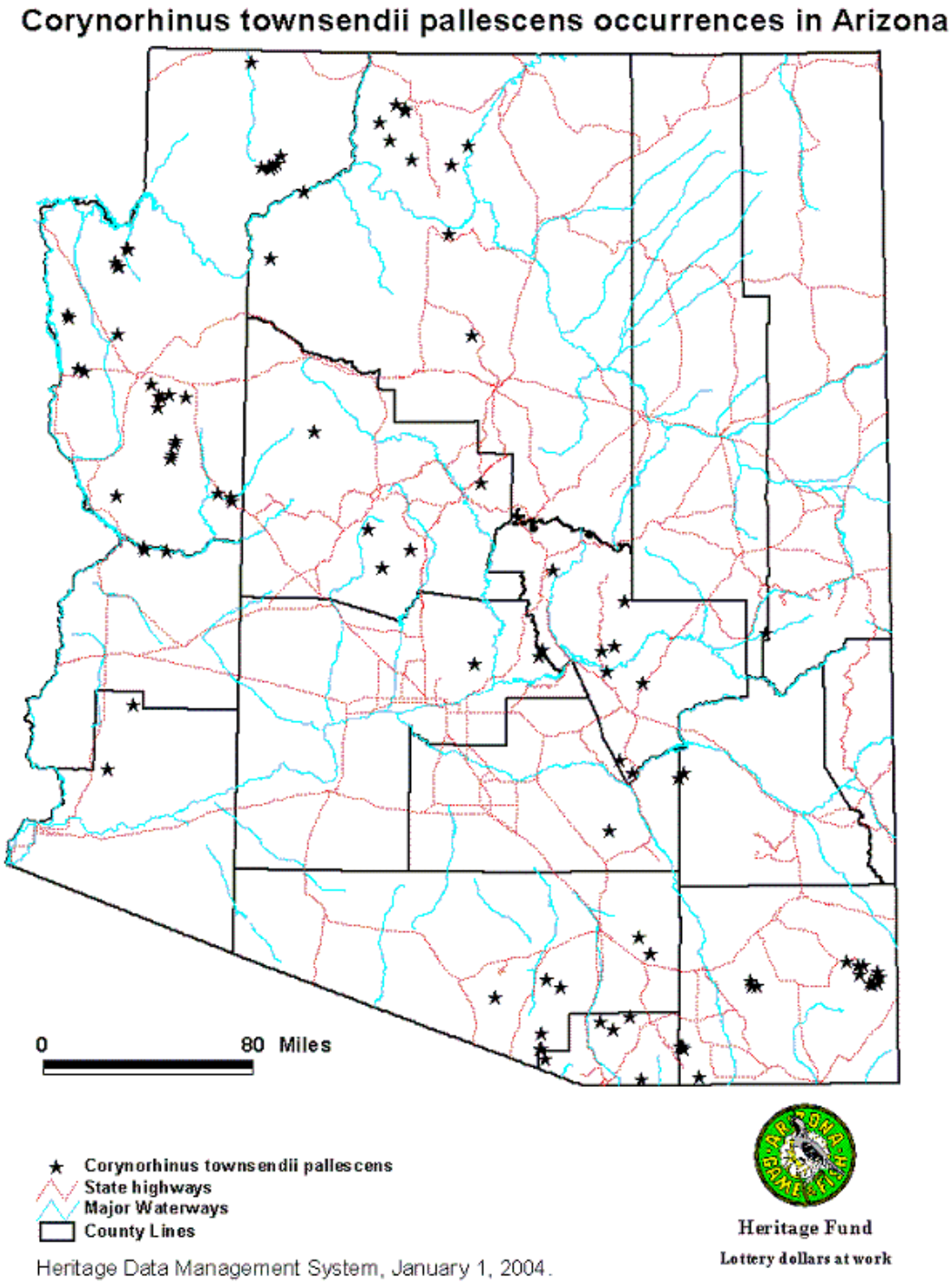

FIGURE A.3.6
Habitat range and occurrence of Townsend's big-eared bat in Arizona. Points represent maternity colonies, roosts of 5 or more individuals, sites where 5 or more males have been netted, and sites where pregnant or lactating females have been netted.

Population Status and Threats

Range-wide Population Status and Threats

The overall population status and trend of pale Townsend's big-eared bat is uncertain, but the species is believed to have declined in parts of its range. A survey by Pierson and Rainey (1994) suggested that substantial population declines in pale Townsend's big-eared bats have occurred in California over the last 40 to 60 years. Evidence for substantial declines consists of a

- 52 percent loss in the number of maternity colonies
- 44 percent decline in the number of roosts
- 55 percent decline in the number of animals
- 32 percent decrease in the average size of remaining colonies in California

The lower Colorado desert along the Colorado River, an area that experiences heavy recreational use, is one of three areas in California in which marked declines in the numbers of pale Townsend's big-eared bat colonies have taken place.

The pale Townsend's big-eared bat is threatened by

- human disturbance at major maternity roosts
- renewed mining
- closure and sealing of abandoned mines naturally or for hazard abatement
- vandalism at maternity and hibernation sites
- loss of foraging habitat, and possibly
- exposure to pesticides (AZGFD 2003)

Pale Townsend's big-eared bats are extremely sensitive to human disturbance, and simple entry into a maternity roost can result in the abandonment of the site (Pierson et al. 1991). This bat feeds heavily on noctid moths, which require wetland habitats; declines in wetland habitats also could contribute to bat population declines.

Arizona Population Status and Threats

Population trends for Townsend's big-eared bats in Arizona are unclear, but losses of and reductions in bat numbers at maternity colonies have been reported (Hinman and Snow 2003). In Arizona, five to seven maternity colonies have been found with numbers of 100 to several hundred bats. The largest colony disappeared in the 1970s shortly after

the roost site was gated to protect archeological and paleontological remains. After the gate was modified in the mid-1980s, several bat species (but not *C. townsendii*) were observed flying inside the site. Current bat use of these sites is not known (AZGFD 2003).

Life History

Pale Townsend's big-eared bats are active in summer, but hibernate in winter. They mate in autumn and winter and sperm is stored in the female's reproductive tract until spring. Fertilization occurs at the time of ovulation. Males produce few sperm in their first autumn and are considered to be largely sterile and probably nonbreeding. In contrast, females breed in their first autumn and bear young the following summer. Gestation varies from 56 to 100 days after fertilization depending on climatic conditions and the resultant metabolic rates of the females (i.e., development slows when females go into daily torpor).

In summer, males and females congregate in same sex groups. Females form maternity colonies of 12 to about 200. In Arizona, females are pregnant in April and maternity colonies have been reported in late April. Indirect evidence (near term embryos and presence of newborns) indicates the single young are born in June in Arizona. Dates of birth vary considerably throughout their range, being reported from late April to mid July. In Arizona, most young are flying by the end of July and nursery colonies begin to disperse during August. Band recoveries in California suggest a maximum longevity of at least 16 years.

Habitat Requirements

In Arizona, summer day roosts include caves and mines in areas of desertscrub; oak woodlands; and oak/pine, pinyon/juniper, and coniferous forests. Pale Townsend's big-eared bats prefer to hang from open ceilings at roost sites and do not use cracks or crevices. At maternity roosts, these bats apparently prefer the dim light near the edge of the lighted zone. In Arizona, emergence times and especially return times and patterns probably vary, as they do elsewhere depending on insect activity and development stage of young. Night roosts are often in abandoned buildings.

In winter, big-eared bats hibernate in cold caves, lava tubes and mines. In Arizona, hibernation sites are mostly in upland and mountainous areas from the vicinity of the Grand Canyon to the southeastern part of the state. Winter roosts generally contain fewer individuals (usually singles or small groups, and in Arizona, occasionally as many as 50) than summer roosts. For hibernation they prefer roost sites where the temperature is 12°C (54°F) or less. Such sites may be near entrances or in well-ventilated areas of the roost. The bats may arouse and move to other spots in the roost during the winter so as to be in areas of stable cold temperatures (Hinman and Snow 2003).

Foraging occurs over desert scrub, riparian habitats, wetlands or open water, typically within 24 km (15 mi) of the roost sites. Small moths, 3 to 10 mm (average of about 6 mm), are the primary food of these bats. Neuropterans, coleopterans, dipterans and hymenopterans are also sometimes taken. These bats are reported to take prey from leaves and while in flight along forested edges. Following a late night peak of activity they usually go to a night roost. Pale Townsend's big-eard bats may forage again in the early morning, since they are reported not to return to their daytime roosts until shortly before sunrise (Hinman and Snow 2003).

A.3.8 Ground Snake (valley form) (*Sonora semiannulata*)

Population Status and Ecology

Range and Distribution

This range of the ground snake extends from southwestern Idaho south through western and southern Arizona; eastward through much of west and central Texas including nearly all of Oklahoma; and south through north-central Mexico. It is found from sea level to around 1,830 m (6,000 ft) (Stebbins 1985).

The ground snake has distinctive and potentially isolated forms throughout its range. RECON (2002) describes three forms (e.g., varieties, morphs, subpopulations, and populations) as occurring within Pima County. The ground snakes in the Marana area are described as the valley form. The degree of genetic separation among local populations is unknown. The population's (valley form) range in the Marana region is described as extending from the Marana area northwest to Eloy (RECON 2002). Rosen (2003a) uses the term "population segment" in referring to this population. Rosen (2004) provides a map (Figure A.3.7) of the species' known distribution in Pima County and adjoining areas.

Population Status and Threats

The population status of this species in Arizona and Pima County is unknown. This species is not tracked by the AZGFD HDMS. Recent surveys have confirmed that the species persists within the range of the valley form (Rosen 2004), but its population status is unknown. Rosen (2003a) believes habitat destruction, particularly in Pinal County, could be adversely affecting the local population. Other threats are likely to be similar to those for other snakes, and include:

FIGURE A.3.7
Distribution of Ground Snake (*Sonora semiannualta*) in eastern Pima County and adjoining areas, Arizona, based on plotable museum records, 1900-2004, and observations and reliable records obtained by the author. Records occur in two environments: valley flats (mesquite- and grass-dominated desertscrub) and lower mountain slopes (semi-desert grasssland and upper edge of Arizona Upland desertscrub). Base image from TOPO! digital mapware. (Reproduced from Rosen 2004)

- Agriculture and urban development
- New road construction
- Increased traffic on new and existing roads
- Off road vehicle activity
- Scientific and commercial collection

Life History

The ground snake is a small, harmless snake whose prey includes insects, scorpions, centipedes, crickets, and grasshoppers (Rosen 2003a, Stebbins 1985). Unlike other closely related snakes, the ground snake is not morphologically adapted to digging (Rosen 2004). It is a secretive nocturnal snake. Clutches of 4 to 6 eggs are laid in June through August. This species is active during April through October and hibernates in underground dens during the winter (Stebbins 1985).

Habitat Requirements

The ground snake occupies desert valleys on hard clays and silts that digging snakes, such as shovel nosed snakes, cannot readily dig into (Rosen 2003a). Over its range, the species occurs in river bottoms, desert flats, sand hummocks, and rocky hillsides where there are pockets of loose soil. Vegetation is typically sparse as in creosote bush desertscrub, but along the lower Colorado River this snake occurs in thickets of mesquite (*Prosopsis* spp.) (Stebbins 1985). Rosen (2004) described the valley form's habitats as valley flats of mesquite and grass-dominated desertscrub, and lower mountain slopes of semi-desert grasssland and upper edge of Arizona Upland desertscrub.

In the Phoenix metropolitan area, ground snakes are known to occupy urban environments. It does best in open areas with established vegetation, including landscaped areas that are untended by typical landscape management practices (Rosen, personal communication). However, there is no evidence that valley form of the species occupies urban environments in Pima County (RECON 2002).

A.3.9 Mexican Garter Snake (*Thamnophis eques megalops*)

Population Status and Ecology

Range and Distribution

The historical distribution of the Mexican garter snake in the United States was constrained largely to Arizona and, to a lesser degree, New Mexico. There have been a number of inventory, monitoring, and/or survey efforts in the United States, most of which occurred in Arizona (which encompasses the vast majority of the historical distribution of Mexican garter snakes in the United States). Fewer survey data were found in the literature for Mexico and New Mexico. In Arizona, the historical distribution once included the Santa Cruz, San Pedro, Colorado, Salt, Agua Fria, Rio Yaqui, and Verde River watersheds and presumably the Gila River watershed based on historically suitable habitat and geographic proximity to formerly extant populations (USFWS 2006a).

In New Mexico, the Mexican garter snake was once extant in the upper Gila River watershed in Grant and Hidalgo Counties. In 1977, approximately 100 Mexican garter snakes were located in and around three small ponds on private land southwest of Mule Creek Village, New Mexico. This population was considered a stronghold for the species in New Mexico. In 1994, the site was re-visited during favorable conditions and only one specimen was found. This represents a major decline in a stronghold population. It is suspected that Mexican garter snakes are currently extirpated from New Mexico based on several factors, including limited historical distribution in that state, modification and loss of suitable habitat, non-native species introductions, and the lack of protections offered to non-listed, but declining native species on private land (all known records of Mexican garter snakes in New Mexico are on private land) (USFWS 2006a).

This subspecies is also historically known from the Sierra Madre Occidental and the Mexican Plateau in the Mexican states of Sonora, Chihuahua, Durango, Coahila, Zacatecas, Guanajuato, Nayarit, Hidalgo, Jalisco, San Luis Potosí, Aguascalientes, Tlaxacala, Puebla, Mexico, Veracruz, and Queretaro (USFWS 2006a).

The current distribution of Mexican garter snakes within the United States is now generally believed to be limited to four geographic areas in Arizona: (1) Middle/upper Verde River—lower Tonto Creek; (2) Black River watershed; (3) upper Santa Cruz/San Pedro watersheds; and, (4) the San Bernardino National Wildlife Refuge in the upper Rio Yaqui watershed (AZGFD 2001; USFWS 2006a).

Population Status and Threats

Range-wide Population Status and Threats

The United States comprises the northern portion of the Mexican garter snake's distribution. Within the United States, the Mexican garter snake historically occurred predominantly in Arizona with a limited distribution in New Mexico that consisted of scattered locations throughout the Gila and San Francisco headwater drainages in western Hidalgo and Grant counties. United States Fish and Wildlife Service's analysis of the best available data on the status of the Mexican garter snake in the United States indicated that its distribution has been significantly reduced and it is now considered extirpated from New Mexico. The USFWS concluded that the Mexican garter snake has been extirpated from 85 to 90 percent of its historical distribution in the United States (USFWS 2006b).

Range-wide threats to the Mexican garter snake include: predation from non-natives (particularly bullfrogs); significant reductions in prey base from predation/competition associated with non-native species; improper grazing; recreation; development resulting in destruction and modification of habitat; groundwater pumping; water diversions; channelization; dewatering; road construction/use; wildfires; intentional harm; borderland security/undocumented immigration; contaminants; dams; and prey base reductions. It is important to recognize that in most areas where Mexican garter snakes historically or currently occur, two or more threats may be acting synergistically in their influence on the suitability of those habitats or on the Mexican garter snake itself (USFWS 2006b).

Federal Status

The Mexican garter snake was placed on the USFWS list of candidate species as a Category 2 species in 1985. Category 2 species were those for which existing information indicated that listing was possibly appropriate, but for which substantial supporting biological data to prepare a proposed rule were lacking. In the 1996 Candidate Notice of Review (USFWS 1996), the use of Category 2 candidates was discontinued, and the Mexican garter snake was no longer recognized as a candidate. On January 4, 2006, the USFWS published a 90-day finding on a petition to list the Mexican garter snake (USFWS 2006a). On September 26, 2006, the USFWS published a 12-month finding stating that on the basis of the best scientific and commercial information available, USFWS found that proposing to list a Distinct Population Segment for the Mexican garter snake in the United States was not warranted (USFWS 2006b). The USFWS later withdrew its initial finding and initiated a new status review (73 FR 30596) consistent with the legal guidance it received about determining the extinction danger of a species throughout a significant portion of its range. On November 24, 2008, USFWS announced that the listing of the Mexican garter snake was warranted but precluded. Until a proposed rule can be prepared, the Mexican garter snake will be classified as a candidate species (USFWS News Release, November 24,2008).

Arizona Population Status and Threats

Within Arizona, the historical distribution of the Mexican garter snake ranges from 40 to 1,875 m (130 to 6,150 ft) in elevation and spread variably based on the relative permanency of water and the presence of suitable habitat (Figure A.3.8). The Mexican garter snake historically occurred within several perennial or intermittent drainages and disassociated wetlands. Its range within Arizona occurs in the southeastern corner of the state from the Santa Cruz Valley east and generally south of the Gila River. Recent valid records (post 1980) occur from the San Rafael and Sonoita grasslands area and from Arivaca. This species is also known from the Agua Fria River, Oak Creek, the Verde River, and from several upper Salt/Black River sites, including smaller tributaries (AZGFD 2001).

United States Fish and Wildlife Service's review of the best available information indicates the Mexican garter snake is likely extant in a fraction of its historical range in Arizona. The USFWS defined populations as ''likely extant'' when the species is expected to reliably occur in appropriate habitat as supported by recent museum records and/or recent (i.e., less than 10 years) reliable observations (USFWS 2006b).

The Mexican garter snake is listed as a Wildlife of Special Concern in Arizona (AZGFD in prep). AGFD management concerns for the Mexican garter snake include predation by introduced bullfrogs and predatory fishes, urbanization and lowered water tables, and habitat destruction, including that due to improper grazing (AZGFD 2001). The Mexican garter snake is one of the 56 species considered by Pima County to be a priority vulnerable species under the Sonoran Desert Conservation Plan.

Life History

The Mexican garter snake may occur with other native garter snake species and can be difficult to identify. The Mexican garter snake reaches a maximum known length of 112 cm (44 in), with females measuring larger than males. It is stout bodied and ranges in background color from olive to olive-brown to olive-gray with three stripes that run the length of the body. The middle dorsal stripe is yellow and darkens toward the tail. The pale yellow to light-tan lateral stripes distinguish the Mexican garter snake from other sympatric (co-occurring) garter snake species because a portion of the lateral stripe is found on the fourth scale row, while it is confined to lower scale rows for other species. Paired black spots extend along the olive dorsolateral fields and the olive-gray ventrolateral fields. A conspicuous, light-colored crescent extends behind the corners of the mouth (USFWS 2006b).

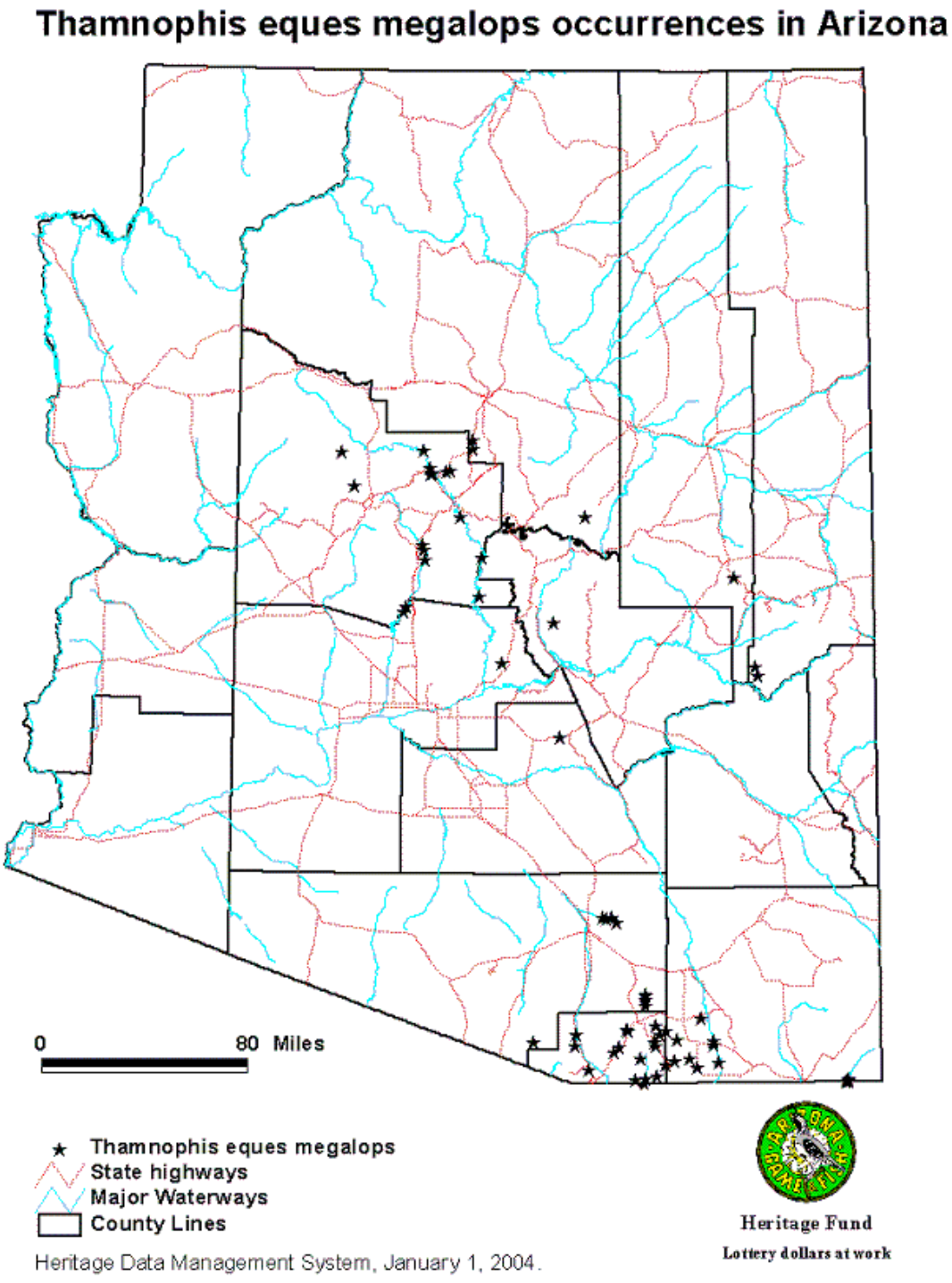

FIGURE A.3.8
Mexican garter snake occurrences in Arizona

Throughout its range-wide distribution, the Mexican garter snake is usually found between 914 to 1,525 m (3,000 and 5,000 ft) but may reach elevations of 2,593 m (8,500 ft). The Mexican garter snake is considered a riparian obligate species (restricted to riparian areas when not engaged in dispersal behavior) (AZGFD 2001).

The Mexican garter snake is active during the warmer months of the year. They may be observed foraging along watercourses, but are quick to seek shelter in streamside vegetation or in the stream. When threatened, they will flatten their heads and bodies and will strike repeatedly. They will also emit a foul-smelling musk from glands at the base of the tail when handled roughly (AZGFD 2001).

Males typically reach sexual maturity at 2 years of age and females at 2 or 3 years. Female Mexican garter snakes begin reproducing at 53 to 70 cm (21 to 28 in) in length. Gravid females typically move several meters from water to warmer microenvironments where young are born, clutch sizes range up to 26 live-born young, which are born from June through August. Only about half of all females in a population bear young in any one year (AZGFD 2001).

The Mexican garter snake is a diurnal predator, preying primarily on frogs (including leopard frogs), tadpoles, and native fish. Lizards, earthworms and small mammals may be taken as well (AZGFD 2001).

Habitat Requirements

In Arizona, the Mexican garter snake is most abundant in densely vegetated habitat surrounding cienegas, cienega-streams, stock tanks, and in or near water along streams in valley floors and generally open areas, but not in steep mountain canyon stream habitat. The Mexican garter snake occurs chiefly in the following general habitat types: (1) Source-area wetlands such as cienegas (mid-elevation wetlands with highly organic, reducing [basic or alkaline] soils) and stock tanks (small earthen impoundment); (2) large river riparian woodlands and forests; and (3) streamside gallery forests (as defined by well-developed broadleaf deciduous riparian forests with limited, if any, herbaceous ground cover or dense grass) (USFWS 2006b, AZGFD 2001). Vegetation characteristics vary based on the type of habitat. For example, in source-area wetlands, dense vegetation consists of knot grass (*Paspalum distichum*), spikerush (*Eleocharis*), bulrush (*Scirpus*), cattail (*Typha*), deergrass (*Muhlenbergia*), sacaton (*Sporobolus*), Fremont cottonwood (*Populus fremontii*), Goodding's willow (*Salix gooddingii*), and velvet mesquite (*Prosopis velutina*) (Rosen and Schwalbe 1988).

In riparian woodlands consisting of cottonwood and willow or gallery forests of broadleaf and deciduous species along larger rivers, the Mexican garter snake may be observed in mixed grasses along the bank or in the shallows. In small streamside riparian habitat, this snake is often associated with Arizona sycamore (*Platanus wrightii*), sugar leaf maple (*Acer grandidentatum*), velvet ash (*Fraxinus velutina*), Arizona cypress (*Cupressus arizonica*), Arizona walnut (*Juglans major*), Arizona alder (*Alnus*

oblongifolia), alligator juniper (*Juniperus deppeana*), Rocky Mountain juniper (*J. scopulorum*), and a number of oak species (*Quercus* spp.) (USFWS 2006b). In general, this species requires dense riparian vegetation communities along permanent water that is free from bullfrog infestation (Pima County 2001).

A.3.10 Desert Tortoise (*Gopherus agassizii*)

Population Status and Ecology

Range and Distribution

The range of the desert tortoise encompasses most of the Mohave (= Mojave) and Sonoran Desert of the southwestern United States and northwestern Mexico. This area includes much of southeastern California, southern Nevada, extreme southwestern Utah, western and southern Arizona, and western Sonora and northern Sinaloa, Mexico (Stebbins 1985; Germano et al. 1994). Given the relatively wide range of desert tortoises, it is not surprising that morphological differences have been described for the species. The species can be divided into at least two distinct populations: one primarily in the Sonoran Desert (south and east of the Colorado River) and one in the Mohave region (north and west of the Colorado River) (USFWS 1994). Even though they are very similar, Sonoran tortoises tend to be narrower anteriorly and wider, or more flared, posteriorly than Mohave tortoises (unpublished data *in* Barret and Johnson 1990). The extent of habitat in Arizona for the Sonoran desert tortoises is an estimated 17,220 sq km (10,700 sq mi) (Palmer and Ladehoff 1991).

In Arizona, Sonoran desert tortoises range from the Kingman area in Mohave County south to the Chocolate Mountains and southeast to the San Pedro River area (Figure A.3.9) (Johnson et al. 1990; Palmer and Ladehoff 1991). They have been recorded from as low as 158 m (520 ft) to over 1,600 m (5,250 ft) (Palmer and Ladehoff 1991), although they are more typically found between 300 and 1,070 m (990 and 3,500 ft) (Johnson et al. 1990).

Population Status and Threats

The Mohave desert tortoise was listed as threatened species in 1990 (USFWS 1990). The Sonoran population was determined to not warrant such listing in 1991, but was retained as a candidate for Federal listing in Category 2 (USFWS 1991). However, the USFWS has discontinued use of the Category 2 designation. The USFWS was recently petitioned (October 2008) to list the Sonoran desert tortoise and to designate critical habitat. In the petition, WildEarth Guardians and Western Watersheds Project citied severe declines in the Sonoran desert tortoise population.

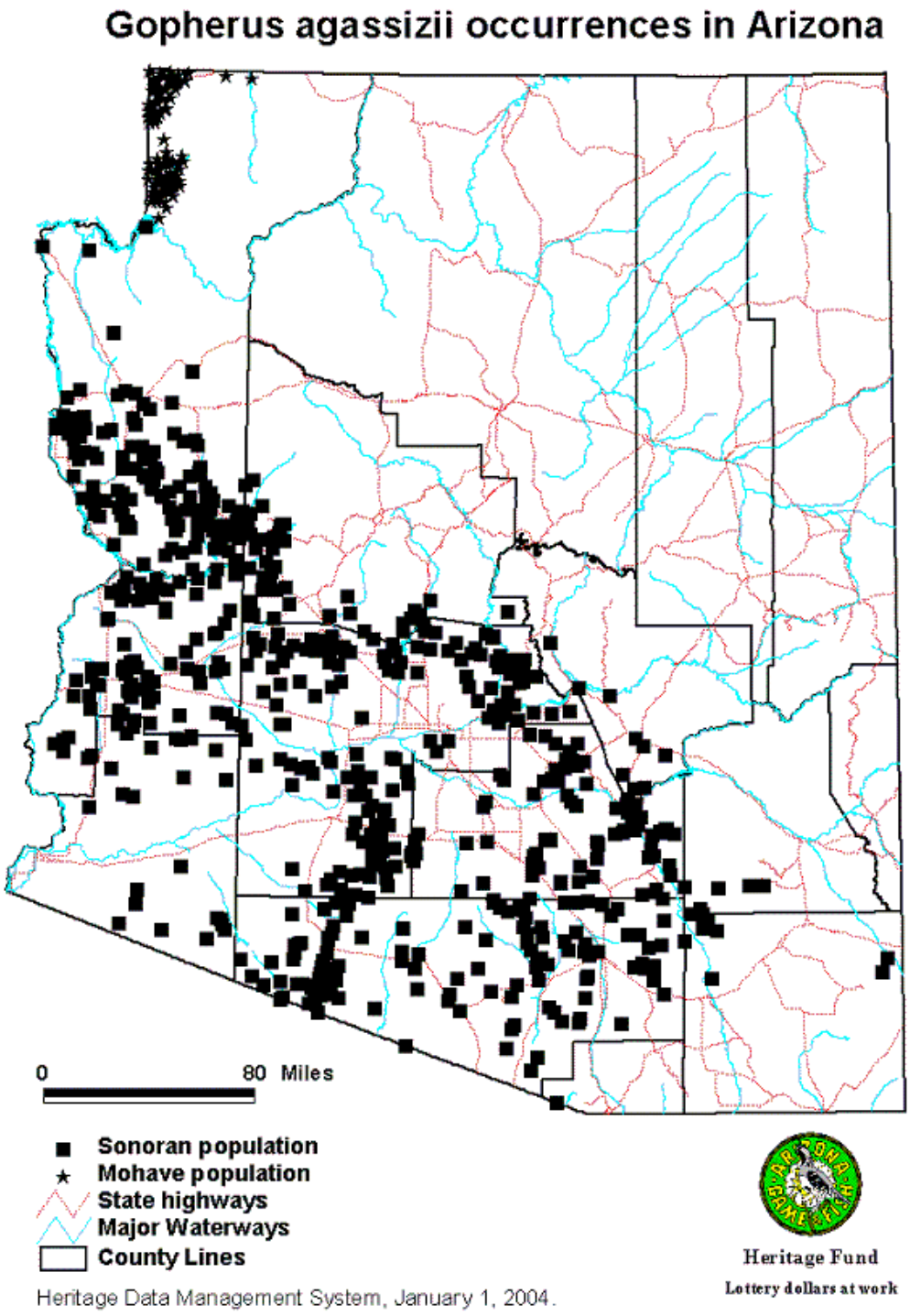

Figure A.3.9
Sonoran desert tortoise occurrences in Arizona

The Sonoran desert tortoise is a Wildlife of Special Concern as determined by the AZGFD (in prep.).

Threats to this species include direct and indirect human-caused mortality. Impacts such as destruction, degradation, and fragmentation of habitat due to urbanization, agricultural development, livestock grazing, mining, roads, vehicle-oriented recreational use, and direct losses from human activities and disease have contributed to population declines (USFWS 1994).

Life History

The desert tortoise is a completely terrestrial species, distinguished by a high-domed shell with prominent growth rings on both the carapace (upper portions of the shell) and the plastron (lower portion of the shell). Its flattened forelimbs covered with thick conical scales are adaptations for digging. Their head, short tail, and stocky limbs can be drawn partly or completely within the shell for protection from predation (Stebbins 1985). Adult desert tortoises typically reach a length in excess of 30 cm (12 in); hatchlings (less one year) are generally around 5 cm (2 in) in length. At approximately 18 cm (7 in) in length, males can be distinguished from females by the presence of a shallow, concave depression at the posterior of the plastron.

Desert tortoises are long-lived species with estimates of maximum age in the 50–60 year range (Germano 1994), although some may live longer (Woodbury and Hardy 1948; Barrett and Johnson 1990; Germano 1994). Eggs and hatchlings are vulnerable to predation; however, adults are well protected by the hard outer shell and are therefore much less vulnerable.

Desert tortoises are herbivores and are known to eat a wide variety of grasses, forbs, shrubs, and cacti, especially the succulent vegetation and flowering parts (Luckenback 1982; Stebbins 1985). Tortoises also ingest bones, stones, and soil (Esque and Peters 1994). Rainfall and temperature are important factors in determining tortoise activity, Tortoise activity frequently increases after rains. Sonoran desert tortoises are typically active during the spring, and most active after summer rains from early July through October. Home range size for Sonoran desert tortoises have been estimated in the 2,000-acre range at the Picacho Mountains (Barrett 1990).

Activity patterns of the desert tortoise are closely tied to ambient temperatures, moisture, and forage availability. Desert tortoises spend much of their lives in burrows. They are active through the spring and portions of the summer through late fall. Their active season is typically defined as March 1 through October 31.

The reproductive patterns of the Sonoran desert tortoise are not well known (Barrett and Johnson 1990; Germano 1994). Females are estimated to reach maturity at about 11 to 20 years (Barrett and Johnson 1990; Germano 1994) at a maximum carapace length of greater than 180 mm. Eggs are laid at the onset of monsoon rains in early June and July

(Johnson et al. 1990). Annual reproductive success is likely to be highly variable and dependent on rains and forage availability.

Habitat Requirements

The northwest portion of the Arizona range is within the Mohave Desert while the remainder is within the Sonoran Desert (Turner and Brown 1982; Germano et al. 1994). In the Sonoran Desert, tortoises appear to be most abundant in the Arizona Upland subdivision where they occupy mountain slopes, hills, and upper bajadas (Barrett 1990; Germano et al. 1990). In contrast to Mohave desert tortoises, Sonoran desert tortoises appear to be absent from the flat intermountain basins of the Sonoran Desert (Lowe 1964; Johnson et al. 1990; Barrett 1990; Germano et al. 1994).

While tortoises construct burrows throughout their range (Germano et al. 1994), they also use of other kinds of sheltersites. Sheltersites are any structure that is used by tortoises for shelter including burrows (constructed by tortoises), rock cavities, rock overhangs, or caves (Johnson et al. 1990). Sonoran desert tortoises appear to make greater use of non-constructed sheltersites than Mohave desert tortoises. This could be due to the greater availability of rocky sheltersites in upland habitats occupied by Sonoran tortoises (Germano et al. 1994).

A.3.11 Tucson Shovel-Nosed Snake (*Chionactis occipitalis klauberi*)

Population Status and Ecology

Range and Distribution

The range of the western shovel-nosed snake (*Chionactis occipitalis*) encompasses most of the Mohave and Sonoran desert region of the southwestern U.S. and a small portion of contiguous Mexico. This species' range extends from below sea level to about 1,430 m (4,700 ft) (Stebbins 1985). In Arizona it is associated with valley floors below 610 m (2,000 ft) (Lowe 1964). Rosen (2003b) described shovel-nosed snakes as being abundant in the great dunes of the Gran Desierto, Lower Colorado Valley, and Mohave Desert.

The taxonomy of the western shovel-nosed snake is not well known. Four subspecies have been described and it appears likely that smaller genetic units may constitute valid subspecific taxa (Rosen 2003b). The Tucson shovel-nosed snake's (*C. o. klauberi*) historical range has been described as extending in a narrow band from southeastern Maricopa County through southwestern Pinal County to northern Pima County, inclusive of the Town (RECON 2002). As currently mapped, this range encompasses the margin of the Arizona Upland subdivision of the Sonoran Desert including portions of

Scottsdale, Florence, Casa Grande, Avra Valley, and the Town of Marana (Rosen 2003b). Snakes with characteristics considered intermediate between Colorado Desert shovel-nosed snakes (*C. o. annulata*) and Tucson shovel-nosed snake may occupy the northeastern edge of the Tohono O'odham Nation, Sonoran Desert National Monument near Mobile, and in the vicinity of Ajo (Rosen 2003b).

Population Status and Threats

Loss of habitat has been the primary threat identified for this subspecies' presumed decline, both through agricultural and urban development. Grading former habitat alters soil conditions, thereby eliminating an essential habitat component for this species. Rosen (2003b) concluded that the Tucson shovel-nosed snake population has severely declined in the Avra Valley, including that portion in Marana since the 1960s and 1970s, and may now have been extirpated from the area. The last record of the Tucson shovel-nosed snake in the near-vicinity of the Town was at Sanders Road and Avra Valley Road in 1982. It is unknown whether the species persists within the Town boundaries. It was not observed during surveys in 2003 initiated during the latter half of the species seasonal activity cycle (Rosen 2003b). Rosen reported a 2006 photo-voucher specimen of a Tucson shovel-nosed snake from south of Picacho Reservoir (2008a). In 2007, during surveys in northeastern Pima County and southeastern Pinal County, Arizona, three shovel-nosed snakes were found in Pinal County; two north of Picacho Peak, and one on the lowest bajada north of the West Silverbell Mountains (Rosen 2008b).

No Tucson shovel-nosed snakes were documented within Marana during a full season of surveys in 2007, or during 2008 surveys in Avra Valley (Rosen, unpublished data). In 2008, one shovel-nosed snake was found near Ajo, Arizona, one was found in the Sonoran Desert National Monument on State Route 238, and one was found on a dune in the Pinacate Biosphere Reserve, Mexico (Rosen 2008a).Rosen (2003a) speculates that urban expansion and agricultural development have severely impacted or extirpated populations in that area of Scottsdale, Florence, and Casa Grande. Identified threats include:

- Agriculture development
- Urban development
- New road construction
- Increased traffic on new and existing roads
- Off-highway vehicle activity
- Scientific and commercial collection of the subspecies

Federal Status

In 2004, the USFWS was petitioned to list the Tucson shovel-nosed snake and to designate critical habitat. The Center for Biological Diversity cited in its petition the potential threats to the shovel-nosed snakes, including urban development, the inadequacy of existing regulations, drought, and climate change. The USFWS issued its 90-day finding (73 FR 43905) in response to the petition in July 2008 and found that the shovel-nosed snake may warrant federal protection as endangered or threatened under the ESA and has initiated a 12-month status review.

Life History

The shovel-nosed snake is adapted to move quickly through loose sand and loam. This movement has been described as sand swimming (Stebbins 1985, Rosen 2003b). They are small snakes that use venom to subdue their prey, but are harmless to humans (Rosen 2003b). Their prey includes insects, scorpions, spiders and centipedes (Stebbins 1985, Rosen 2003b). The species is oviparous and has a clutch of 2 to 4 eggs in the summer (Stebbins 1985).

Western shovel-nosed snakes are primarily nocturnal (Stebbins 1985), although on cool days they may also be active in the late and early evening (Warren 1953 *in* RECON 2002). Rosen (2003b) researched the seasonal activity cycle of the Tucson shovel-nosed snake as part of a recent survey effort. Activity peaks during May with rapidly decreasing activity through late June. There is residual activity in early July and almost no observed activity after that.

Habitat Requirements

The western shovel-nosed snake is known from the Lower Sonoran life zone primarily on valley bottoms with sand dunes or soft sandy loams. In Marana, this means the shovel-nosed snake is (or was) to be found on sandier soils on the lowermost bajadas or possibly on sandy areas deposited by the large arroyos or in parts of the Santa Cruz River (Rosen 2003a).

A.3.12 Lowland Leopard Frog (*Rana yavapaiensis*)

Population Status and Ecology

Range and Distribution

Historically, the lowland leopard frog ranged from northwestern Arizona through central and southeastern Arizona, southwestern New Mexico, and northern Sonora, Mexico. Populations were also known from southwestern Arizona and southeastern California along the lower Colorado River and in the Coachella Valley. This frog is currently found in central and southeastern Arizona below the Mogollon Rim, southwest New Mexico (Gila River and Rio San Francisco), and probably northern Sonora and northwestern Chihuahua, Mexico (AZGFD 2006).

In Arizona, the lowland leopard frog is found in central and southeastern parts of the state, with close to 60 percent of all localities occurring in Gila, Maricopa, and Yavapai counties, within central Arizona below the Mogollon Rim (Figure A.3.10) (AZGFD 2006). This species is now absent from the lower Colorado River and adjacent portions of southeastern California, and have declined significantly in southeastern Arizona. Although no records exist for the lower Gila River downstream of the Phoenix area, they almost certainly occurred there historically, but have likely been replaced by the Rio Grande leopard frog and bullfrog. This species is still relatively secure in central Arizona; however, declines and extirpations have occurred in that region as well (Rorabaugh 2006).

Population Status and Threats

Range-wide Population Status and Threats

The lowland leopard frog is apparently extirpated from many portions of its historic range in the southwestern United States. Populations seem to be declining everywhere except central Arizona. Information is currently not available for Mexico. Leopard frogs in southwestern Utah, southeastern Nevada, and extreme northwestern Arizona were difficult to properly identify. Leopard frogs in these areas, particularly frogs of the Virgin River downstream into the Black Canyon of the Colorado River below Hoover Dam in Nevada, are now considered to be relict leopard frogs (*Rana onca*). The lowland leopard frog has apparently been extirpated from the Imperial Valley in California and along the lower Colorado River, Arizona-California. The overall United States population trend for this species is considered moderately declining (NatureServe 2007).

The greatest threat to lowland leopard frogs is habitat alteration and fragmentation and the introduction of non-native predatory and competitive fishes, crayfishes, and frogs. Habitat alteration is the result of agricultural practices, livestock grazing, development,

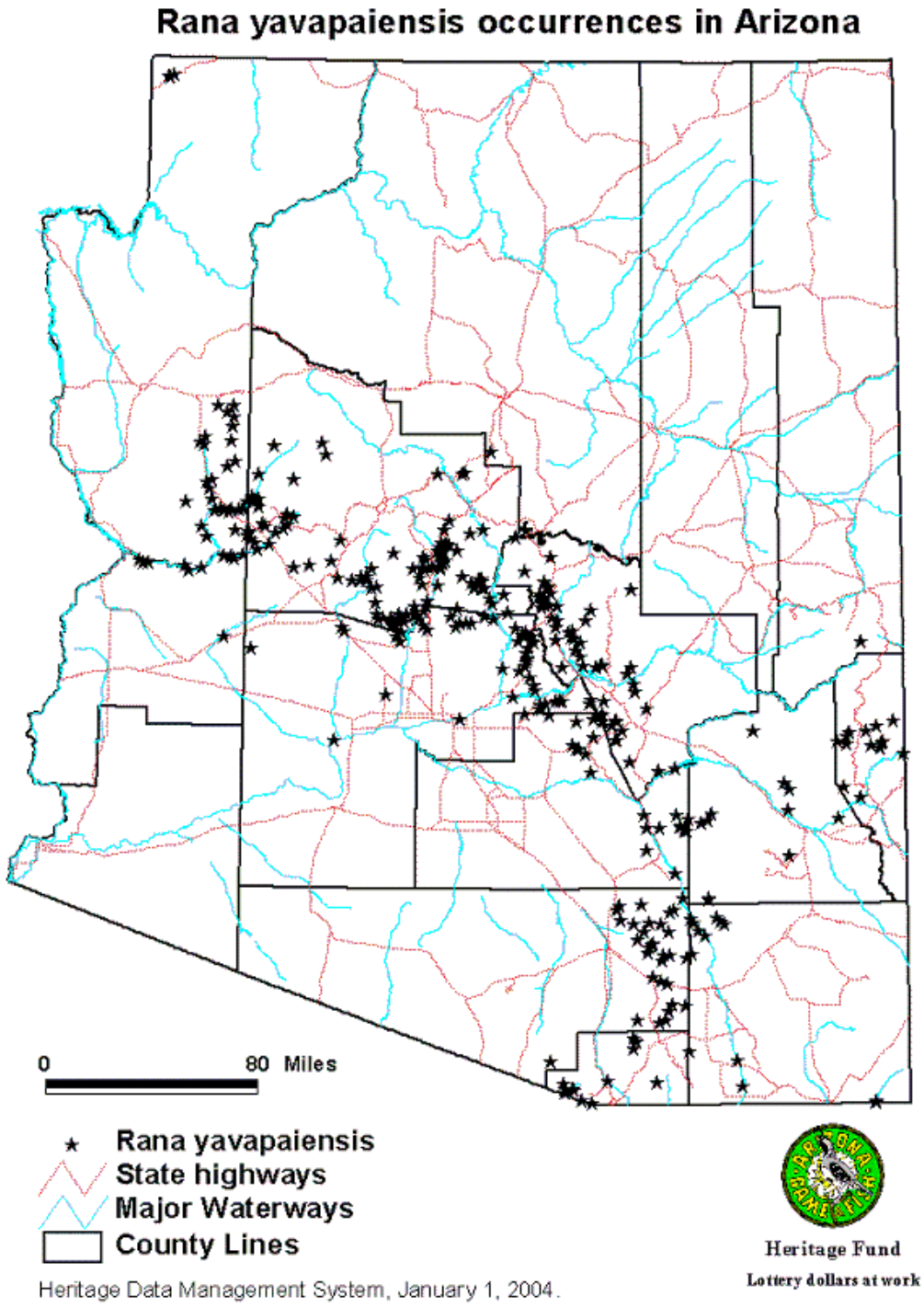

FIGURE A.3.10
Lowland leopard frog occurrences in Arizona. 56 species considered by Pima County to be a priority vulnerable species under the Sonoran Desert Conservation Plan.

and reservoir construction. Damming, draining, and diverting of surface waters has fragmented formerly contiguous aquatic habitats. In many areas, fragmentation has been accentuated by introduced predatory fishes, crayfish, and bullfrogs. The species has been replaced by introduced *R. berlandieri* along the Colorado and Gila rivers, Arizona. These factors result in the blockage of potential dispersal corridors for recolonization. Populations are also vulnerable to large-scale mortality on a frequent basis due to drought, disease, and sulphur toxicity (NatureServe 2007).

The lowland leopard frog was named under a Federal Register Notice of Review for potential listing as endangered or threatened in 1988. In 1991, this species was placed on the list of candidate species as a Category 2 species by the USFWS. Category 2 species were those for which existing information indicated that listing was possibly appropriate, but for which substantial supporting biological data to prepare a proposed rule were lacking. In the 1996 Candidate Notice of Review (USFWS 1996), the use of Category 2 candidates was discontinued, and the lowland leopard frog was no longer recognized as a candidate. The lowland leopard frog currently has no Federal status under the Endangered Species Act.

Arizona Population Status and Threats

The lowland leopard frog is listed as a Wildlife of Special Concern in Arizona (AZGFD in prep.). Current AZGFD hunting regulations lists the lowland leopard frog a species that is Protected, which indicates that this species may not be handled, collected, or killed, even with a hunting or fishing license. It is against Arizona State law to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect protected species or to attempt to engage in any such conduct (Rorabaugh 2007). The lowland leopard frog is one of the

A large number of occurrences still exist in central Arizona (the largest portion of United States range) and populations in this area are thought to be stable. Populations in southeastern Arizona have been on the decline where these frogs coexist with bullfrogs, predation by these larger frogs is suspected as a major factor in the decline. Data collected in Arizona suggest that lowland leopard frog populations are highly variable and that such variability is accentuated by catastrophic climatic and epizootic events, which can result in locally unstable populations (Biotic Information System of New Mexico 2007).

Federal Status

The greatest threats to lowland leopard frogs in Arizona are habitat alteration and fragmentation, accentuated by the introduction of non-native predatory and competitive fishes, crayfishes, and frogs (mainly bullfrogs) (AZGFD 2006). Causes of decline also include catastrophic flooding and scouring following severe fires, and chytridiomycosis, a fungal skin disease (AZGFD 2006, Rorabaugh 2007). Habitat fragmentation and water manipulation can lead to local extirpations by disturbing the metapopulation dynamics of

lowland leopard frogs in arid landscapes. Other prominent threat factors are water pollution and heavy grazing (AZGFD 2006).

Life History

The lowland leopard frog is a relatively small leopard frog, with a maximum length of about 8.6 cm (3.4 in). This leopard frog is distinguished from other Arizona leopard frogs by a combination of characters, including dorsolateral folds that are broken and inset towards the rear, a dark brown and tight reticulate pattern on the rear of the thigh, and usually no spots on the snout. Adult males lack prominent vocal sacs. The lowland leopard frog is typically a brown frog, although some are green, particularly on the head. There is often a yellowish wash to the groin area. Compared to other leopard frogs, the tadpoles are relatively dark, mottled, and stocky. They are similar to Chiricahua leopard frog tadpoles, but browner with a shallower tail. Tadpoles grow to >7.6 cm (>3 in) (Rorabaugh 2007). The lowland leopard frog is very similar to the relict leopard frog; however, the relic leopard frog has shorter hind legs (Brennan and Holycross 2006).

In Arizona, the lowland leopard frog is found at elevations ranging from 146 to 2,499 m (480 to 8,200 ft) but they are generally found below 1,951 m (6,400 ft). Range-wide, they are found from sea level to 1,817 m (5,960 ft) (AZGFD 2006). These frogs move overland and along drainages during summer monsoons. Lowland leopard frogs are generally active nearly year-round in desert areas (Rorabaugh 2007).

In Arizona, lowland leopard frogs breed primarily from January to May, with additional breeding occurring in some populations in summer or early fall after the onset of the summer rains. Male lowland leopard frogs attract a potential mate by emitting an airborne call consisting of a series of low pulses lasting 3 to 8 seconds. Females deposit spherical egg masses in shallow water attached to submerged vegetation, bedrock, or gravel. Egg masses have been observed to hatch in the wild in 15 to 18 days and larvae metamorphose occurs in as little as 3 to 4 months or as long as 9 months, and some over-winter (AZGFD 2006).

Adult lowland leopard frogs feed primarily on arthropods and other invertebrates. Larvae are herbivores and likely eat algae, organic debris, plant tissue, and minute organisms in the water (AZGFD 2006).

Habitat Requirements

Lowland leopard frogs inhabit aquatic systems from Sonoran Desertscub to Great Basin Conifer Woodland to Madrean Evergreen Woodland (Brennan and Holycross 2006). They are habitat generalists and breed in a variety of natural and man-made aquatic systems. Natural systems include rivers, permanent streams, permanent pools in intermittent streams, beaver ponds, cienegas (=wetlands), and springs. Man-made systems include earthen cattle tanks, livestock drinkers, canals, irrigation sloughs, wells, mine adits, abandoned swimming pools, and ornamental backyard ponds. Most

historical localities are small to medium sized streams and rivers. In lotic habitats, they are concentrated at springs, near debris piles, at heads of pools, and deep pools associated with root masses (AZGFD 2006).

The role of habitat heterogeneity within the aquatic and terrestrial environment is unknown, but likely important. Shallow water with emergent and perimeter vegetation provides basking habitat and deep water, root masses, undercut banks, and debris piles provide refuge from predators and potential hibernacula. In semi-permanent aquatic systems, lowland leopard frogs may survive the loss of surface water by retreating into deep mud cracks, mammal burros, or rock fissures (AZGFD 2006).

A.3.13Talus Snail (*Sonorella* spp.)

Population Status and Ecology

Range and Distribution

In general, talus snails are a rock snail, usually found in taluses or “slides” of coarse broken rock. There are about 60 species and subspecies of talus snails within Arizona and available evidence indicates that previously widespread taxa became localized by repeated episodes of isolation and dispersal during climate changes (Pima County 2001). Populations of talussnails in Pima County are probably relicts of a large population of snails that inhabited the Santa Cruz River Valley during a pluvial period during the late Pleistocene (NatureServe 2006).The total range of most of the known species of talussnails in and around Pima County is typically less than the land occupied by on moderate-sized house and are highly localized to talus slopes (Pima County 2001).

Population Status and Threats

Range-wide Population Status and Threats

Federal Status

One species of talus snail in Arizona, the San Xavier Talus snail (*Sonorella eremite*), was proposed for listing as an endangered species, but the proposal to list was withdrawn following a conservation agreement guaranteeing no disturbance of the species habitat (USFWS 1998). There are no species of talussnail in Arizona listed under the ESA at this time.

Potential range-wide threats to talus snails include urban development, vandalism, road construction or maintenance (USFWS 1998). Because the total known range of most talus snails in Arizona is typically a few hundred square meters, relatively minor

perturbations of the habitat may result in significant impacts to the population (Pima County 2001).

Arizona Population Status and Threats

Talus snails are not listed by the Arizona Game and Fish Department as Wildlife of Special Concern. The State of Arizona has placed the San Xavier talus snail on the 2001 Crustaceans and Mollusks Commission Order 42; this designation makes it illegal to collect or posses the species.

Threats to talus snails in Pima County are the same as the range-wide threats list above. The San Xavier talus snail and the Papago talus snail (*Sonorella papagorum*), both found in the Tucson area, have experienced threats that include potential extinction due to chance events such as human impacts from nearby campgrounds and associated trails, including potential removal or infilling of talus; development of habitat, including mine expansion and prospecting; activities that cause increased interstitial sedimentation (any development above the talus slopes); activities that may alter the moisture conditions in the talus slopes; herbicides applied above the talus slopes that may wash downhill where snails could encounter them; and predation by rodents (AZGFD 2003 and 2004).

Life History

Sonorella species comprise of helminthoglyptid snails with a depressed globose, heliciod shell, 12 to 30 mm (0.47 to 1.18 in) in diameter, umbilicate or perforate, with a wide, unobstructed mouth and a thin, barely expanded peristome. The shell is typically smoothish or slightly sculpted with growth lines, occasionally with fine oblique or spiral granulation and short hairs, lightly colored, and normally with a dark peripheral band. The shell is usually thin, globular, and is weakly differentiated between species. The shell is usually averages over half an inch tall and almost an inch wide.

Within Pima County, talus snails are known to occur in elevations ranging from 975 to 1,189 m (3,200 to 3,900 ft). These snails are desert adapted and attach to a rock by a mucus and calcium seal. In general, desert snails are known to protect themselves from drying out by crawling into deep, cool rockslides that are not filled with soil. Limestone rocks or other talus that contain calcium carbonate are crucial to the species as these areas provide minerals for shell deposition and neutralize carbonic acid that is produced during the talus snail's prolonged periods of estivation. Talus snails may remain in estivation for up to 3 years and in most years they are only active for several days when moisture conditions are suitable. Their lifespan is probably 7 to 10 years (AZGFD 2003).

After a rain, talus snails lay eggs, feed, and when they meet, they will mate. Fertilization and production of eggs takes several days. If rains are short-lived, eggs must be held until the next rain. Development in the shell takes approximately a month but eggs do not hatch until a soaking rain has occurred after their development is completed. In the

wild, it probably takes 3 or 4 years for talus snails to mature, depending on how often it rains. Talus snails in Pima County typically feed on fungus and decaying plant material with some young shoots when they are available (AZGFD 2003).

Habitat Requirements

Apparently all *Sonorella* species live in isolated, undisturbed areas of rocks, generally, but not exclusively, limestone, mostly, if not exclusively, on north-facing or trending slopes. Most species are usually found near hilltops or in rocky canyons (Pima County 2001). These snails are generally found in crevices one to several feet below the surface, sealed to stones by their mucus (AZGFD 2004).

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APPENDIX 4

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Survey Protocols

Burrowing owl

- Pre-construction surveys—most current survey protocol approved by USFWS
- BOMAs—AGFD *Burrowing owl management guidelines for municipalities in Arizona*

Cactus ferruginous pygmy-owl

- Pre-construction surveys—most current survey protocol approved by USFWS
- Town of Marana surveys—most current survey protocol approved by USFWS

Southwestern willow flycatcher

- Pre-construction surveys—most current survey protocol approved by USFWS

Western yellow-billed cuckoo

- Pre-construction surveys—most current survey protocol approved by USFWS

Lesser long-nosed bat

- Hummingbird feeder surveys—protocol from Marana website

Merriam's mesquite mouse

- No species-specific surveys

Pale Townsend's big-eared bat

- No species-specific surveys

Ground snake

- No species-specific surveys

Mexican garter snake

- Pre-construction surveys—most current survey protocol approved by USFWS

Sonoran desert tortoise

- Pre-construction surveys—most current survey protocol approved by USFWS
- When tortoises present—AGFD *Guidelines for handling desert tortoises during development projects*

Tucson shovel-nosed snake

- No species-specific surveys

Lowland leopard frog

- Pre-construction surveys—most current survey protocol approved by USFWS

Talus snail

- No species-specific surveys

APPENDIX 5

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Proposed Prohibited Plant Species List

Fountain grass (*Pennisetum setaceum*)

Buffelgrass (*Pennisteum ciliare*)

Johnson grass (*Sorghum halapense*)

Giant reed (*Arundo donax*)

Common crabgrass (*Digitaria sanguinalis*)

Pampas grass (*Cortaderia selloana*)

Mediterranean grass (*Schismus* spp.)

Red brome (*Bromus rubens*)

Tree of heaven (*Ailanthus altissima*)

African sumac (*Rhus lancea*)

Russian olive (*Eleagnus angustifolia*)

African rue (*Peganum harmala*)

Salt cedar/tamarisk (*Tamarix pertandra* and *T. ramosissima*)

Bermuda grass (*Cynodon dactylon*) excluding sod hybrid *Burmuda*

Lovegrasses (*Eragrostis* spp.) excluding Plains lovegrass (*Eragrostis intermedia*)

Iceplant (*Mesembryanthemem crystallinum*)

Arabian grass (*Schisums arabicus*)

Natal grass (*Melinins* (=*Rhynchelythrum) repens)*

Periwinkle (*Vinca major and Vinca minor*)

Aquatics

Eurasian watermilfoil (*Myriophyllum spicatum*)

Giant salvinia (*Salvinia molesta*)

Hydrilla (*Hydrilla verticillata*)

Water hyancinth (*Eichhornia crassipes*)

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