SUMMER 2012 PRELIMINARY DRAFT

[IMPORTANT NOTE: June 29, 2012 – This version of the draft incorporates comments and scientific input provided by the Technical Advisory Committee as well as stakeholders over the past several months. As additional comments are received, the City will consider these as the document is revised further. Maps and tables are currently being updated.]

CITY OF TUCSON

AVRA VALLEY HABITAT CONSERVATION PLAN

To be submitted to the United States Fish and Wildlife Service pursuant to Section 10(a)(1)(B) of the Endangered Species Act

Prepared by

The City of Tucson's Office of Conservation and Sustainable Development
with input from many others

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Acronyms and Abbreviations

ac	Acre
AZGFD	Arizona Game and Fish Department
BOMA	Burrowing Owl Management Area
WBO	Western Burrowing Owl (*Athene cunicularia hypugaea*)
C	Celsius
CAVSARP	Central Avra Valley Storage and Recovery Project
CFPO	Cactus Ferruginous Pygmy-owl (*Glaucidium brasilianum cactorum*)
CFR	Code of Federal Regulations
CIP	Capital Improvement Project
City	City of Tucson
cm	Centimeter

DS	Development Standard
DT	Desert Tortoise (Sonoran Population) (*Gopherus agassizii*)
EA	Environmental Assessment
EIS	Environmental Impact Statement
ESA	Endangered Species Act
F	Fahrenheit
FR	Federal Register
ft	Feet
GIS	Geographic Information System
ha	Hectare
HCP	Habitat Conservation Plan
HDMS	Arizona Game and Fish Department's Heritage Data Management System
in	Inches
km	Kilometers
L	Liter
LLNB	Lesser Long-nosed Bat (*Leptonycteris curasoae yerbabuenae*)
LUC	Land Use Code
m	Meter
MBTA	Migratory Bird Treaty Act
mi	Mile
NEPA	National Environmental Policy Act
NPPO	Native Plant Preservation Ordinance
OHV	Off Highway Vehicle
Permit	Endangered Species Act section 10(a)(1)(B) Incidental Take Permit
PRA	Protected Riparian Area
PTBB	Pale Townsend's Big-eared Bat (*Corynorhinus townsendii pallescens*)
SAVSARP	Southern Avra Valley Storage and Recovery Project
sq	Square
TAC	Technical Advisory Committee
TSNS	Tucson Shovel-nosed Snake (*Chionactis occiptalis klauberi*)
USFWS	United States Fish and Wildlife Service
WERR	Watercourse Environmental Resource Report
WG	Western groundsnake (*Sonora semiannulata*)
WYBC	Western Yellow-billed Cuckoo (*Coccyzus americanus occidentalis*)

SUMMARY

The City of Tucson (City) owns over 20,000 acres of land west of the City limits in the Avra Valley area of Pima County. These former farm lands were purchased in the 1970s and 1980s with City Water Department (Tucson Water) ratepayer bond funds to secure the water rights, preserve the groundwater for urban use, and allow for the future development of water infrastructure supply projects. Over the decades since their purchase, some of these formerly cleared and cultivated lands have recovered to a more naturally vegetated state and now support native plants and animals, including some federally recognized species. As a means to comply with the Endangered Species Act (ESA) in a proactive, comprehensive manner, the City began work on this Avra Valley Habitat Conservation Plan (HCP) in 2004 which covers most of these former farmlands and is referred to hereinafter as the HCP Permit Area. Once approved by the U.S. Fish and Wildlife Service (USFWS) and an associated ESA Section 10 Incidental Take Permit (Permit) is issued, the City will be guided by these documents during the 50-year duration of the Permit.

To develop the HCP, the City regularly engaged the biological input of an ad-hoc Technical Advisory Committee (TAC). Among other tasks, this TAC determined which species to include for coverage by the Permit, helped the City develop habitat models for the species to be addressed or "covered" under the HCP, informed the amount of habitat set-aside that would be sufficient to mitigate for impacts to modeled habitat, and provided guidance on monitoring and management activities. Species proposed for coverage by this HCP include the following seven species:

- Lesser Long-nosed Bat (*Leptonycteris curasoae yerbabuenae*; LLNB also used hereinafter);
- Pale Townsend's Big-eared Bat (*Corynorhinus townsendii pallescens*; PTBB also used hereinafter);
- Western Yellow-billed Cuckoo (*Coccyzus americanus occidental*; WYBC also used hereinafter);
- Cactus Ferruginous Pygmy-owl (*Glaucidium brasilianum cactorum*; CFPO also used hereinafter);
- Western Burrowing Owl (*Athene cunicularia hypogea*; WBO also used hereinafter);
- Desert Tortoise (Sonoran population) (*Gopherus agassizii*; DT also used hereinafter), and;
- Tucson Shovel-nosed Snake (*Chionactis occipitalis klauberi*; TSNS also used hereinafter).

Pursuant to City policies related to wildlife habitat protection, Tucson Water desires to allow these former farm lands to recover to a more naturally vegetated condition in areas where the covered activities – such as additional water supply infrastructure – described below are not planned to occur. Activities that assist in achieving this goal beyond what is described in this HCP for ESA compliance are encouraged even though the City has not explicitly committed to them within this document. Where possible, the City will avoid impacting biological corridors, modeled habitat, and other sensitive areas when planning and implementing covered activities that would directly or indirectly affect covered species.

The activities that may impact these seven species and that are covered by the HCP ("covered activities") include water infrastructure supply development, operation, and maintenance activities. Other activities that may occur on these lands that are not considered to have a net negative impact to species and require mitigation include: biological research, habitat restoration or enhancement (e.g., burrowing owl management areas), invasive species removal, non-vehicular recreation, educational activities, and others. For quantifying impacts to species, these effects are described in habitat terms, not species terms as allowed by USFWS guidance.

The City is uncertainty if, when, and where the covered activities will occur within the HCP Permit Area. Therefore, the HCP is structured to allow Tucson Water the flexibility to develop anywhere within the

HCP Permit Area as long as all applicable federal, state, and local regulations are followed and the City complies with the mitigation, monitoring, and stewardship activities described herein. If a covered activity is planned to occur that will permanently and negatively impact habitat, then the City must permanently set-aside modeled habitat elsewhere to mitigate for these impacts.

The amount of habitat set-aside is determined by mitigation ratios (e.g., 3 acres set-aside for every 1 acre impacted) and the maximum amount of new development within the Permit Area that is allowed by the HCP is 8,000 acres (x percent of the Permit Area). If more land is planned for development, the City must either amend the HCP or comply with the ESA through other means, such as through an individual ESA Section 7 consultation.

The HCP outlines several ecological effectiveness monitoring activities as well as activities for stewardship, management, stakeholder involvement, and reporting. Cost estimates for these activities as well as a summary table of City's commitments under the HCP can be found in Chapter 6.

CHAPTER 1 – OVERVIEW AND BACKGROUND

1.1 City philosophy regarding its Avra Valley Holdings

Since purchasing the Avra Valley farm land in the 1970s and 1980s, the City has engaged in several planning efforts for these lands and has developed City-wide policies applicable to these lands, including the 1981 Alternative Use Plan for City of Tucson Land, Avra Valley, Arizona (University of Arizona 1981), the 1984 Avra Valley Land Use Study (City of Tucson 1984), and the 1996 Avra Valley Land Use Study for City of Tucson Property Holdings (City of Tucson 1996). Goals from the 1996 land use study for these lands include the following:

> *1. To encourage appropriate land uses for the City-owned property in Avra Valley that preserve the water quality and quantity of the underground aquifer and preserve the water rights associated with the acquisition.*
>
> *2. To encourage land uses and associated management practices which are beneficial to the interests of Tucson Water customers and are cost effective.*
>
> *3. To assure that the City of Tucson continues to be a good neighbor by considering the compatibility of potential land uses with existing and future land uses under other ownership.*

More recently, the City's voter-approved General Plan of 2001 (City of Tucson 2001) includes several policies directly applicable to these lands. Related to water resources, these policies include:

- *Element 8, Policy 13: Continue to pursue appropriate land uses for City-owned retired farmland in the Avra Valley*
- *Element 8, Policy 14: Pursue water plans and policies that protect and benefit natural ecological systems* (City of Tucson 2001).

Related to environmental planning and conservation, these policies include:

- *Element 14, Policy 1: Continue to identify and protect environmentally sensitive natural areas and encourage the preservation of vegetation and wildlife within these areas.*
- *Element 14, Policy 2: Improve coordination and promote partnerships between City departments, other governmental agencies, neighborhoods, and community organizations that contribute to the management of environmentally sensitive areas.*
- *Element 14, Policy 3: Implement methods to conserve and enhance habitat when development occurs (City of Tucson 2001).*

Based on all of the above policy guidance, Tucson Water desires to balance the community's long-term water supply needs with the needs of native plants and wildlife. Tucson Water has and will continue to do this by allowing, and in appropriate circumstances, actively encouraging, the recovery of its former farm lands in Avra Valley to a more naturally vegetated state, supporting the plants and animals native to the region. In addition, Tucson Water will continue efforts to protect the lands and resources within from unnatural degradation, including vehicular and human trespass, vandalism, illegal activities, spread of

non-native invasive species, and others threats. While doing this, Tucson Water will comply with all applicable federal, state, and local regulations relating to the environment.

1.2 Purpose and Need for the HCP

The Avra Valley HCP has been prepared in support of the City's application for a Permit in conformance with Section 10 of the ESA. Through this HCP, the City is committing to implement certain actions that will avoid, minimize, and mitigate the impacts of any "incidental take" of covered species that could occur as a result of future Tucson Water projects necessary to meet the community's water and renewable energy needs. It is anticipated that the Permit will expire 50 years from issuance. The HCP addresses proposed development activities on extraterritorial City-owned lands in unincorporated Pima County, Arizona, west of the City, in the area known as Avra Valley (Figure 1.1-1).

The Avra Valley HCP Permit Area (Figure 1.1-2), which totals approximately 19,020 ac (7,697 ha), includes parcels of land that may be developed for water supply projects. The need for an HCP for this Permit Area is driven by these possible future activities and their potential impacts on federally protected and other non-ESA listed species proposed for coverage. For example, portions of the City-owned lands in Avra Valley support the life cycle needs of the Lesser Long-nosed Bat, a species currently listed as endangered (62 FR 10730 and 58 FR 49875) under the ESA. Chapter 2 includes a list of the seven species proposed for coverage by the Permit along with relevant biological information.

The City's proposed Avra Valley HCP will mitigate, to the maximum extent practicable, the anticipated effects of covered activities, while striving to balance the protection and conservation of unique natural resources on City of Tucson-owned lands in Avra Valley with the community's need for a long-term water supply. The City recognizes that the quality of life of its citizens is dependent upon an integrated environment, which balances the needs of vulnerable species and their habitats with human needs.

Figure 1.2-1. Location of the Avra Valley HCP Permit Area in Pima County, Arizona, USA (Please see figures at the end of the document)

Figure 1.2-2. City of Tucson Avra Valley Habitat Conservation Plan Permit Area (Please see figures at the end of the document)

1.3 Regulatory Framework

1.3.1 Endangered Species Act

The ESA and its implementing regulations prohibit the take of any fish or wildlife species that are federally listed as threatened or endangered unless evaluated and permitted through the appropriate ESA process, including Section 7 or Section 10(a)(1)(b). The ESA defines take as to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or to attempt to engage in any such conduct. Code of Federal Regulations (CFR) 50-17.3 further defines the term harm in the take definition to mean any act that actually kills or injures a federally listed species, including significant habitat modification or degradation.

Section 10(a) of the ESA establishes a process for obtaining a Permit, which authorizes non-Federal entities to incidentally take federally listed wildlife or fish, subject to certain conditions. Incidental take is defined by the ESA as take that is incidental to, and not the purpose of, the carrying out of an otherwise lawful activity. Preparation of an HCP is required for all Section 10(a) Permit applications. The U.S. Department of the Interior's U.S. Fish and Wildlife Service (USFWS) and the U.S. Department of Commerce's National Oceanographic and Atmospheric Administration's National Marine Fisheries Service (NOAA Fisheries) have joint authority under the ESA for administering the incidental take program. For species to be covered under the Avra Valley HCP, the USFWS has authority.

Section 10(a) also was intended by the U.S. Congress to authorize the USFWS to approve HCPs for unlisted as well as listed species. Therefore, if an HCP treats an unlisted species as if it were already listed, additional mitigation will not be required within the area covered by the HCP upon the listing of that species. The "No Surprises" policy, 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, even if the needs of the species changes over time (63 FR 8859). Species to be covered under the HCP are not added to the Permit until they are listed under the ESA.

Section 7 of the ESA requires all Federal agencies to ensure that any action they authorize, fund, or carry out is not likely to jeopardize the continued existence of any species listed under the ESA, or to result in the destruction, or adverse modification, of its habitat. Technically, the issuance of a Permit is an authorization for take by a Federal agency. Consequently, in conjunction with issuing a Permit, USFWS must conduct an internal Section 7 consultation on the proposed HCP. The internal consultation is conducted after an HCP is developed by a non-Federal entity and submitted for formal processing and review. Provisions of Sections 7 and 10 of the ESA are similar, but Section 7 requires consideration of several factors not explicitly required by Section 10. Specifically, Section 7 requires consideration of the indirect effects of a project and effects on federally listed plants. It also requires consideration of effects on Critical Habitat, which the ESA defines as "(i) the specific areas within the geographical area occupied by the species, at the time it is listed in accordance with the provisions of section 4 of this Act, on which are found those physical or biological features (I) essential to the conservation of the species and (II) which may require special management considerations or protection; and (ii) specific areas outside the geographical area occupied by the species at the time it is listed in accordance with the provisions of section 4 of this Act, upon a determination by the Secretary that such areas are essential for the conservation of the species." The ESA requires that the USFWS identify Critical Habitat to the maximum extent that it is prudent and determinable when a species is listed as threatened or endangered. The internal consultation includes preparation of a USFWS Biological Opinion describing whether or not implementation of the HCP will result in jeopardy to any listed species or will adversely modify Critical Habitat.

1.3.2 Permit Area, Holder, and Term

The City-owned land in Avra Valley is located in unincorporated Pima County, between the Tucson Mountains to the east and the Waterman and Roskruge Mountains on the west. The land consists largely of noncontiguous former agricultural parcels stretching for 31 mi (50 km) south to north and 11 mi (17 km) east to west, with large areas of non-City owned land in between. Using Tucson Water ratepayer bonds, the City purchased these lands during the 1970s and 1980s to acquire the water rights as part of future water supply planning efforts.

In determining HCP Permit Area boundaries, the USFWS HCP Handbook states that "Generally, HCP applicants should be encouraged to consider as large and comprehensive a plan area as is feasible and consistent with their land or natural resource use authorities" (USFWS 1996). Given this guidance, the

City is choosing to include most of its property within the HCP Permit Area, even if some of the land has already been developed. Of the approximately X acres that the City owns within Avra Valley, X acres will be included in the Avra Valley HCP Permit Area (figure 1.1-2). Lands to be included fall into three categories: 1) fully or partially developed land, 2) land with agreements that limit what can be done, 3) undeveloped land. The fully or partially developed land consists of the Southern Avra Valley Storage and Recovery Project (SAVSARP) and Central Avra Valley Storage and Recovery Project (CAVSARP) water infrastructure sites as well as the solar farm lease projects at the Chu and Lupori Farms. The lands with agreements that limit what can be done currently include the following:

- Lands allowed for Tucson Audubon Society (TAS) habitat restoration observation purposes only. No active restoration will occur there. Lands removed from the HCP Permit Area include areas where TAS habitat restoration is allowed to occur according to a right of entry agreement. To avoid the potential for double counting mitigation credits, these lands were removed from the Permit Area.
- Lands allowed for Tucson International Modelplex Park Association (TIMPA) activities according to right of entry agreements. TIMPA engages in model airplane flight activities.
- Lands protected as permanent open space. Currently, this includes portions of the SAVSARP and CAVSARP parcels as well as the Buckelew Farm. Additional lands are currently being identified for permanent protection as well.

The City will be the HCP Permit holder and, unless USFWS-approved cooperative mitigation agreements are made with other local jurisdictions, the City will be solely responsible for ensuring implementation of the measures outlined in the HCP. The HCP addresses proposed Tucson Water water supply projects in the Avra Valley HCP Permit Area. Based on Tucson Water's proposed timeline of possible projects outlined in the City's Tucson Water "Water Plan: 2000–2050" (City of Tucson 2004), the permit length will be 50 years from date of Permit issuance.

1.3.3 Habitat Conservation Plan Required Elements

The Section 10 process for obtaining a Permit has three primary phases, including HCP development, formal permit processing, and post-issuance. During the HCP development phase, the project applicant prepares a plan that integrates the proposed project or activity with the protection of listed species and, if desired, those species likely to be listed during the term of the Permit. An HCP submitted in support of a Permit application must include the following information as described in 50 CFR 17.32:

- Impacts likely to result from the proposed taking of the species for which permit coverage is requested. (Chapter 3 of this document address these);
- 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 (Chapters 4, 5, and 6 of this document address these);
- Alternative actions considered that would not result in take (Chapters 1 of this document and the Environmental Assessment associated with this HCP address these), and;
- Additional measures USFWS may require as necessary or appropriate for purposes of the plan.

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 draft; 2) a Permit application; and 3) a $25 fee from the applicant. USFWS must also publish a Notice of Availability of the HCP package in the Federal Register to allow for public comment. An Environmental Assessment (EA) or Environmental Impact Statement (EIS) serves as USFWS's record of compliance with the National Environmental Policy Act (NEPA) after a 60- to 90-

day public comment period on the document. No further NEPA review is required. An Implementing Agreement between the USFWS and the Applicant may be developed to support implementation of the HCP. However, based on discussions with local USFWS staff, the optional Implementing Agreement will not be developed for this HCP since there is one landowner involved.

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; and
- USFWS has received assurances, as may be required, that the HCP will be implemented.

During the post-issuance phase, the Permittee and other responsible entities implement the HCP, and the USFWS monitors the Permittee'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.

1.3.4 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. According to the USFWS, "The original 1918 statute implemented the 1916 Convention between the U.S. and Great Britain (for Canada) for the protection of migratory birds. Later amendments implemented treaties between the U.S. and Mexico, the U.S. and Japan, and the U.S. and the Soviet Union (now Russia)" (USFWS 2009). This act applies to all persons or organizations in the United States, including Federal and State agencies. The MBTA is administered by the USFWS, with regulation of ESA-listed migratory birds delegated to the USFWS Endangered Species Division and regulation of unlisted migratory birds delegated to USFWS Migratory Birds Division.

The MBTA provides no process for authorizing incidental take of MBTA-protected birds. All three avian species covered by this HCP – Cactus Ferruginous Pygmy-owl, Western Burrowing Owl, and Western Yellow-billed Cuckoo – are also protected under the MBTA. If 1) the HCP is approved and the USFWS issues an ESA Incidental Take Permit to the City of Tucson and 2) these avian species are listed under the ESA, the terms and conditions of the Permit will also constitute a Special Purpose Permit under 50 CFR 21.27 for the take of the species covered by this HCP. Otherwise, until the species are listed, the HCP does not constitute an MBTA Special Purpose Permit and the City's mitigation measures for those species must be consistent with the MBTA in addition to the HCP.

1.4 National Environmental Policy Act and HCP Alternatives

The issuance of a Permit by the USFWS constitutes a Federal action. Therefore, the National Environmental Policy Act (NEPA) process requires that Federal agencies analyze the environmental impacts of their actions (in this instance, issuance of a Permit) and include public participation in the planning and implementation of their actions. The NEPA process helps Federal agencies make informed

decisions with respect to the environmental consequences of their actions and ensures that measures to protect, restore, and enhance the environment are included, as necessary, as a component of their actions. NEPA compliance is obtained through one of three actions: 1) preparation of an EIS; 2) preparation of an EA; or 3) a categorical exclusion (allowed for low-effect HCPs).

For the Avra Valley HCP, Council on Environmental Quality (CEQ) and USFWS documents provided guidance on the appropriate approach to NEPA compliance in terms of whether to pursue an EA or an EIS. According to the CEQ's Regulations for Implementing NEPA (40 CFR 1501), "Agencies shall prepare an environmental assessment (Sec. 1508.9) when necessary under the procedures adopted by individual agencies to supplement these regulations as described in Sec. 1507.3." Furthermore, according to 516 DM 6 Appendix 1, Fish and Wildlife Service (Federal Register Vol. 62, No. 11, pp. 2380-2382):

> *1.5 Actions Normally Requiring an EA*
> *A. Proposal to establish most new refuges and fish hatcheries; and most additions and rehabilitations to existing installations.*
> *B. Any habitat conservation plan that does not meet the definition of "low effect" in the Section 10(a)(1)(B) Handbook.*
> *C. If, for any of the above proposals, the EA determines that the proposal is a major Federal action significantly affecting the quality of the human environment, an EIS will be prepared. The determination to prepare an EIS will be made by a notice of intent in the Federal Register and by other appropriate means to notify the affected public.*

In accordance with the above and based on guidance provided by local USFWS staff, an EA will be developed for the Avra Valley HCP.

The proposed action and alternatives that will be described in the EA will be assessed against the No Action/No Project alternative, which assumes that some or all of the current and future projects proposed by the City would be implemented individually (i.e, one at a time), and be in compliance with the ESA. Other alternatives considered in the EA include issuance of a Permit for some subset of proposed covered species and/or covered activities. Alternatives considered in the EA are briefly summarized below.

1.4.1 Alternative A (HCP Preferred Alternative)

Under Alternative A, which is the preferred alternative and the subject of this HCP, seven species would be covered by the Permit, including the Lesser Long-nosed Bat (LLNB), Pale Townsend's Big-eared Bat (PTBB), Western Yellow-billed Cuckoo (WYBC), Cactus Ferruginous Pygmy-owl (CFPO), Western Burrowing Owl (WBO), Desert Tortoise (DT), and Tucson Shovel-nosed Snake (TSNS). With this Alternative, the City would be taking a proactive, comprehensive, landscape approach to species conservation and ESA compliance. It would also provide the City with a high level of regulatory certainty under the 50-year term of the Permit.

In early stages of the HCP development process, the City considered including the Western Groundsnake (valley form) (*Sonora semiannulata; WG*) as a covered species. However, given its high relative abundance combined with its current lack of any Federal status , the TAC concluded that it is unlikely that this species will become listed during the 50-year Permit term. By not covering a species that is unlikely to be listed, the City will not engage in potentially costly mitigation, monitoring, and management activites for this species. Within the HCP Permit Area, WG is known to occur primarily along the Blanco Wash in areas with mesic conditions as well as in the south-central area of Avra Valley. For these areas that are also within the HCP Permit Area, they will likely be protected through adherence to floodplain regulations if any development is planned to occur in those areas.

1.4.2 Alternative B (No Action)

Alternative B is the No Action/No Project Alternative, which implies that the impacts from these potential projects on listed 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 if there is a Federal nexus. 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.

1.4.3 Alternative C

Under Alternative C, only those species currently listed or candidate species under the Endangered Species Act would be covered by a Permit. This alternative would cover the following four species: LLNB, WYBC, DT, and TSNS. Under this alternative, the City would be taking a proactive, landscape level approach to species conservation and ESA compliance. However, should species of concern like the WBO become listed under the ESA during the 50-year term of the Permit, the City's Permit would not cover those species. In that case, and at the request of the City to amend their HCP and Permit, the USFWS may determine that current conservation measures outlined in the HCP may adequately protect habitat for this previously uncovered species, and the species could be covered. However, the USFWS may also determine that conservation measures for the covered species would not be adequate to mitigate for impacts to the uncovered species.

Given the habitat requirements of the WBO, it is unlikely that mitigation measures for the four species above would adequately protect its habitat. Thus, the City may choose to amend the HCP and add additional measures, or go through a separate ESA Section 7 consultation with the USFWS where a project involves a Federal nexus. If the WBO and the CFPO are not included as covered species in the Avra HCP and later become listed, the Permit will not serve as a special use permit under the MBTA.

1.4.4 Alternative D

Under Alternative D, eight species would be covered by the Permit, including both listed and non-listed species. These would include the LLNB, PTBB, WYBC, CFPO, WBO, DT, TSNS, and WG. With this alternative, the City would be taking a proactive, comprehensive, landscape approach to species conservation and ESA compliance. For the Covered Activities described in this HCP, this alternative would also provide the City with the greatest ESA regulatory assurances under the 50-year term of the Permit. Should any of the currently unlisted covered species become listed, they will automatically be included in the Permit, which also serves as a special use permit of the MBTA.

1.5 Planning and Public Involvement

To make this proactive and comprehensive effort possible, the City, in partnership with the Arizona Game and Fish Department (AZGFD), has received Federal endangered species planning grant assistance and fulfilled requirements associated with these grants. August 2004 marked the official kickoff for the City's HCP process. At that time, the City-owned lands in Avra Valley composed a sub-area of one HCP document. Since that time, the HCP has been split into two, separate documents and the City has worked on both efforts simultaneously. The Greater Southlands Habitat Conservation Plan is the City's other

HCP development effort. In early 2010 through the middle of 2011, HCP development was on hiatus due to staff reductions and changes in priorities resulting from City fiscal deficits.

ADVISORY GROUPS

Since the effort began, both stakeholder and technical committees have been involved in the development of the HCP. In 2006, the ad-hoc Stakeholder Advisory Committee was replaced by the Mayor and Council Resource Planning Advisory Committee (RPAC). However, due to staffing constraints, the RPAC has not met since late 2010. In addition to the stakeholder committee, the ad-hoc Technical Advisory Committee (TAC) has guided the City's Avra Valley HCP process. The TAC is composed of biologists, ecologists, range management experts, and others from various wildlife- or conservation-related agencies and organizations, including the USFWS, the Arizona Game and Fish Department, the University of Arizona, Tucson Water, and non-profit conservation organizations. Two independent, ecological consultants are also on the TAC. The Plan Implementation Chapter (6) provides details on the TAC's role after Permit issuance as well as the City's desire for on-going stakeholder involvement through the City's Citizens' Water Advisory Committee.

PUBLIC OUTREACH

In the spring of 2009, the City worked with the USFWS to inform the public and request comments on the City's Avra Valley HCP efforts to-date. This was accomplished during a 60-day scoping period (March 18 – May 18, 2009) and a public open house. USFWS and City staff developed a list of stakeholders with input from the City's HCP TAC. Information about the HCP, public comment period, and open house was distributed to the stakeholders and the general public through various outreach activities. These outreach activities are listed in Table 2 of the Scoping Report, which is available on the City's HCP web pages at www.tucsonaz.gov/ocsd/HCP. Media outlets were also informed of the scoping period and open house via two media releases. Additional efforts were made to inform residents of Avra Valley by posting flyers in community centers and local library branches as well as through publishing notices in community (e.g., Robles Junction/Three Points Community Newsletter) and utility newsletters (e.g., Trico Electric Cooperative).

The public open house was held on Thursday, April 16, 2009 from 6:30 to 8:00 p.m. at Ryan Airfield in Avra Valley. USFWS and City staff delivered PowerPoint presentations that provided information on the ESA, HCPs in general, the City's Preliminary Draft Avra Valley HCP, and how to comment as part of the NEPA process. USFWS and City staff members also provided informational handouts and maps.

In early 2012, the City requested input on the draft HCP from the Coalition for Sonoran Desert Protection (CSDP). Also, additional outreach is planned for residents in Avra Valley during the summer of 2012.

1.6 Environmental Setting and Biological Resources

1.6.1 Physical Setting

Avra Valley lies in the Sonoran Desert region of the southwestern United States. The area is part of the Basin and Range physiographic province where broad, alluvial basins separate rugged, fault-block, north-south trending mountain ranges (Malcom Pirnie, Inc. 2005). Avra Valley is bordered by the Waterman and Roskruge Mountains to the west and the Tucson Mountains to the east, which are "comprised of metamorphic and intrusive igneous rocks, consisting mostly of rhyolites, andesites and basalts, and sedimentary rocks (Malcolm Pirnie, Inc. 2005). There are a few bedrock outcrops in Avra Valley, although none are located within the Avra Valley HCP Permit Area. Soils are deep alluvial deposits and

consist of varying proportions of sand, loam, and gravel (SWCA 2003). Detailed soils information can be found within Natural Resource Conservation Service Soil Surveys, including "Soil Survey of the Tucson-Avra Valley Area, Pima County, AZ" (USNRCS 1972). Elevations within the Avra Valley HCP Permit Area range from approximately 1,884 ft (574 m) at the northern end to 2,655 ft (809 m) at the southern end (Figure 1.5.1-1).

Avra Valley forms a portion of the upper Santa Cruz River Basin, which encompasses approximately 750 sq mi (1,943 sq km). The major drainage through Avra Valley is Brawley Wash, which is a complex braided system with many small tributaries. Brawley Wash is the downstream continuation of Altar Wash, and is a major tributary of the Santa Cruz River. The Brawley Wash system is joined by two major washes: Black Wash from the Snyder Hill region and Blanco Wash from the Roskruge-Waterman mountains region. According to Rosen (2008), who conducted an ecological reconnaissance of Avra Valley, large portions of Brawley Wash are highly degraded barrens with adobe soils and low perennial plant diversity. The Blanco Wash contains a higher proportion of relatively intact natural environments (i.e., more intact soils due to less scour and erosion) than the Brawley Wash (Rosen 2008b). Because it is generally flat, floodwater drainage throughout most of Avra Valley is by sheet flow, which collects in a few tributaries of Brawley Wash, or impounds behind human-made structures, such as roads and berms.

More than 70 percent of the Avra Valley HCP Permit Area is within Federal Emergency Management Agency (FEMA) designated 100-year floodplains (Figure 1.5.1-2). Major flood events occurred in this area in 1983 and 1993, with water remaining for several months on some of the Avra Valley Permit Area parcels. Evidence of flooding in Avra Valley includes areas of bare ground and deep silt deposits within the floodplain. Following the 1993 floods, some impediments to surface flow (i.e. berms) were removed and some drainage ditches were constructed. These actions may help to reduce future flood impacts to these lands.

There is no naturally occurring perennial surface water within the Avra Valley HCP Permit Area or elsewhere within Avra Valley. However, the Central Arizona Project (CAP) canal conveys Colorado River water north-to-south through Avra Valley. CAP water recharge basins have been constructed within the Permit Area in Sections 5 and 8, Township 14 South, Range 11 East. Adjacent to the northernmost lands of the HCP Permit Area is the Santa Cruz River, an effluent-dominated perennial stream.

Within the Permit Area, there are several water catchments (e.g,. former stock tanks or impoundments) that hold water for extended periods and provide habitat and resources for a variety of wildlife species.

1.6.2 Climate

While a detailed description of the region's climate is beyond the scope of this HCP, it can generally be characterized as arid, with high temperature and precipitation variability. Cooler temperatures occur in November through March and a long, hot season occurs from April to October. According to the National Weather Service (2012), average high temperatures for December in Tucson were 64.8° and for June were 100.3° from 1981 – 2010. Precipitation is generally bi-modal, with winter rainfall resulting from large-scale low pressure systems that draw mosition from the Pacific Coast having a relatively large areal extent and low intensity. In contrast, the summer "monsoon" rains result from convective thunderstorms that have limited areal extent but high intensity. From 1981 – 2010, annual rainfall averaged 11.59" (National Weather Service 2012). Of this, over half (on average) fell in just three months – July, August, and September. Given Avra Valley's close proximity to Tucson and its similar elevation, the climate is also comparable. A description of Arizona's climate can be found in Crimmins 2007.

Figure 1.6.1-1. Elevation within the HCP Permit Area. (Please see figures at the end of the document)

Figure 1.6.1-2. Major watercourses and FEMA 100-year floodplains. (Please see figures at the end of the document)

1.6.3 Vegetation

Vegetation communities within the Avra Valley HCP Permit Area include upland and riparian, both of which have been extensively modified by human activities. Upland vegetation communities include semidesert grassland, Sonoran desertscrub, and Sonoran vacant or fallow land. Riparian vegetation communities include Sonoran desertscrub xeroriparian and Sonoran riparian deciduous woodland. General characteristics of these communities are described below while information on the vegetation characteristics from each former farm can be found in SWCA 2003 and Tucson Audubon Society 2006.

Semidesert grassland is present at the south end of the Permit Area (Buckelew Farm and Duval/ Pennzoil Farm parcels) at an elevation range of approximately 2,300 to 2,655 ft (701 to 809 m). The dominant tree in this community is the velvet mesquite (*Prosopis velutina*), and the dominant shrub is creosote bush (*Larrea tridentata*). Additional shrub species include burroweed (*Isocoma tenuisecta*) and snakeweed (*Gutierrezia sarothrae*). Native grass species include, among others, spidergrass (*Aristida ternipes*), purple threeawn (*A. purpurea*), needle grama (*Bouteloua aristidoides*), feather fingergrass (*Chloris crinita*). Non-native grass species that occur in the Permit Area include Lehmann lovegrass (*Eragrostis lehmanniana*), and buffelgrass (*Pennisetum ciliare*).

Sonoran Desertscrub is the most prevalent, natural vegetation community within the Avra Valley Permit Area, occurring on land that has not been used previously for agricultural production. The dominant vegetation in this community is dependent, to a large degree, on slope, soils, and exposure. Creosote bush and triangle-leaf bursage (*Ambrosia deltoidea*) are dominant on lower elevation lands that are flat and generally have very deep, fine alluvial soil. The vast majority of the undisturbed upland vegetation within the Permit Area is dominated by these two species. Foothill palo verde (*Parkinsonia microphyllum*), triangle-leaf bursage, and various cacti dominate the higher elevation rocky slopes located at the edges of Avra Valley. Very few saguaros (*Carnegiea gigantea)* are currently present within the Permit Area (i.e., one is documented on Reeves Farm South and four on the Clearwater Project parcels) (SWCA 2003). However, through natural succession, saguaros may become established in the Permit Area over time.

In terms of acreage, the most extensive vegetation community in the Permit Area is retired agricultural land. Rosen (2005) concluded that many or most former agricultural lands owned by the City are transitioning toward viable natural habitat conditions supporting diverse plant communities. Plants commonly established here include velvet mesquite, burroweed, desert broom (*Baccharis sarothroides*), desert globe mallow (*Sphaeralcea ambigua*), silverleaf nightshade (*Solanum elaeagnifolium*), western tansymustard (*Descurainia pinnata*), and shaggyfruit pepperweed (*Lepidium lasiocarpum*). Non-native prickly Russian thistle (*Salsola tragus*), or tumbleweed, also occurs. On some of the City-owned lands, non-native grasses such as buffelgrass were planted in the 1980s for erosion control purposes and remain established on several of the Permit Area farms despite various control efforts.

Mapped vegetation communities are shown in figure 1.6.3. Note that this classification is dated and does not reflect development within the Permit Area within the past decade.

Figure 1.6.3. Classified vegetation communities (Please see figures at the end of the document)

1.6.4 Wildlife

Despite a history of extensive modification by ranching, agriculture, floodplain modifications, Off Highway Vehicle (OHV) use, wildcat dumping, and other human activities, the Permit Area supports a wide variety of wildlife. The riparian areas are of particular importance because of the relatively high species and structural vegetation diversity as well as the connectivity that these contiguous, vegetated corridors provide.

There are numerous wildlife species known to occur in the Permit Area. For example, reptile species include Sidewinder (*Crotalus cerastes*), Western Diamondback Rattlesnake (*Crotalus atrox*), Common Gopher Snake (*Pituophus melanoleucus*), Western Whiptail (*Cnemidophorus tigris*), Desert Iguana (*Dipsosaurus dorsalis*), Zebra-tailed Lizard (*Callisaurus draconoides*), and Tree Lizard (*Urosaurus ornatus*). In June 2003, Rosen compiled a comprehensive list of reptiles and amphibians observed on the Avra Valley floor during road-cruising surveys for the Tucson Shovel-nosed Snake, which can be found in Table 2 of Rosen 2003b.

Common breeding bird species include Curve-billed Thrasher (*Toxostoma curvirostre*), Verdin (*Auriparus flaviceps*), Ash-throated Flycatcher (*Myiarchus cinerascens*), Cactus Wren (*Campylorhynchus brunnei-capillus*), Northern Mockingbird (*Mimus polyglottos*), Greater Roadrunner (*Geococcyx californianus*), White-winged Dove (*Zenaida asiatica*), and Mourning Dove (*Zenaida macroura*).

Mammals common to the area include the Round-tailed Ground Squirrel (*Spermophilus tereticaudus*), White-throated Woodrat (*Neotoma albigula*), Kangaroo Rat (*Dipodomys* spp.), Pocket Mouse (*Perognathus* spp.), Desert Cottontail *(Sylvilagus audubonnii*), Black-tailed Jackrabbit (*Lepus californicus*), and Coyote (*Canis latrans*). Rosen (2005) found Antelope Jackrabbit (*Lepus alleni*), a southwestern endemic species, to be abundant on City-owned properties south of Ajo Way at Three Points.

CHAPTER 2 – COVERED SPECIES

The City's HCP TAC recommends coverage of the following seven species for the Avra Valley HCP:

Table 2.1. Species Included in the City's Avra Valley HCP.

Species	Federal (ESA)	State (AZGFD)	Notes
Lesser Long-nosed Bat (*Leptonycteris curasoae yerbabuenae; also referred to as LLNB hereinafter*)	Listed, Endangered	WSC	-
Pale Townsend's Big-eared Bat (*Corynorhinus townsendii pallescens; also referred to as PTBB hereinafter*)	Not listed, Species of Concern	-	-
Western Yellow-billed Cuckoo *(Coccyzus americanus occidentalis; also referred to as WYBC hereinafter)*	Not listed, Candidate	WSC	Subject to MBTA
Cactus Ferruginous Pygmy-owl (*Glaucidium brasilianum cactorum; also referred to as CFPO hereinafter*)	Not listed	WSC	Subject to MBTA
Western Burrowing Owl (*Athene cunicularia hypugaea; also referred to as WBO hereinafter*)	Not listed, Bird of Conservation Concern (USFWS 2008)	-	Subject to MBTA
Desert Tortoise (Sonoran Population) (*Gopherus Agassizii: also referred to as DT hereinafter*)	Not listed, Candidate	WSC	
Tucson Shovel-nosed Snake (*Chionactis occiptalis klauberi; also referred to as TSNS hereinafter*)	Not listed, Candidate	-	

Key: ESA = Endangered Species Act; MBTA = Migratory Bird Treaty Act; WSC = Wildlife of Special Concern

This chapter provides species-specific information regarding these proposed covered species and includes Avra Valley HCP-specific biological goals and objectives for each species. In terms of how biological goals should be characterized, the USFWS suggests that "The biological goals and objectives may be either habitat or species based. Habitat-based goals are expressed in terms of amount and/or quality of habitat. . . Although the goals and objectives may be stated in habitat terms, each covered species that falls under that goal or objective must be accounted for individually as it relates to that habitat" (USFWS 2000).

2.1 Lesser Long-nosed Bat (*Leptonycteris curasoae yerbabuenae*; LLNB)

2.1.1 Population Range, Distribution, Status, and Threats

RANGE AND DISTRIBUTION

The range of the LLNB extends from El Salvador, in Central America, through western Mexico, and to southern Arizona and southwestern New Mexico (USFWS 2005). In Arizona, the LLNB is found from the Picacho Mountains in the north to the Agua Dulce Mountains in the southwest and the Galiuro and Chiricahua Mountains in the southeast (Hinman and Snow 2003) .

POPULATION STATUS AND THREATS

Range-wide Population Status and Threats. The LLNB is currently federally listed as endangered and is a species designated as Wildlife of Special Concern in Arizona by the AZGFD. Federal listing in 1988

(USFWS 1998) 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 roost exclusion and disturbance (Hinman and Snow 2003). Additionally, it was believed that the LLNB might have been negatively affected over large areas of northern Mexico by reductions in the availability of native agaves from harvesting for local manufacture of mescal and tequila (USFWS 2007). 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 (USFWS 2007). However, despite the listing of the species, Cockrum and Petryszyn (1991) found little evidence to indicate a long-term decline in *Leptonycteris* populations in Arizona, New Mexico and Sonora. More recent surveys have indicated that population sizes are much larger than those reported in the 1980s (Hinman and Snow 2003). According to the USFWS (2005), "The current population numbers of LLNBs exceed the levels known and recorded at the time of listing in 1988. In general, the trend in overall numbers has been stable or increasing in both the United States and Mexico."

Arizona Population Status and Threats. Arizona is at the extreme northern edge of the LLNB distribution. Within the state, LLNBs are known to occur from the international border with Mexico north to the Picacho Mountains, and from the Chiricahua Mountains west to the Agua Dulce Mountains (AZGFD 2011). Loss of agaves by grazing, agricultural harvest, and development have reduced foraging habitat for LLNBs in Arizona (USFWS 2007). Loss and disturbance of roost sites also pose a significant threat to LLNBs and can occur through recreational caving and mine exploration, closure of abandoned mines for hazard abatement, renewed mining, vandalism; and exclusion of bats (USFWS 2007). In some locations, efforts are underway to protect known and potential roosts (USFWS 2007).

White-nose Syndrome poses a significant potential threat to the LLNB and is a disease named for the fungus that appears on the muzzle and other body parts of hibernating bats. Since first identified in 2007, White-nose Syndrome has caused the death of more the 5.5 million bats in eastern North America from 20 states and four Canadian provinces (USFWS 2012).

2.1.2 Ecology

LIFE HISTORY

LLNBs are migratory and do not hibernate (AZGFD 2011). According to Hinman and Snow (2003)

> *They migrate in September /October to Mexico, where they breed and spend the winter. Females arrive in Arizona pregnant and as early as the second week in April. They join other females in maternity colonies late in pregnancy sometime in April or early May. Maternity colonies may number in the hundreds to the thousands and in a few places in the tens of thousands. Males form separate, smaller colonies. One young per female per year is born during May. Young can fly by the end of June. Maternity colonies generally break up by the end of July.*

HABITAT REQUIREMENTS

Habitat associations of the LLNB vary seasonally in Arizona. From April to July, the LLNB is known to occupy Semidesert Grasslands and Sonoran Desertscrub at elevations below 3,500 ft (1,067 m) (AZGFD 2011). From July to late September or early October, LLNB migrate to Madrean evergreen woodland (oak transition regions) at elevations up to 5,500 ft (1,676 m) (AZGFD 2011). Within these plant communities, LLNBs require two critical resources: Suitable day roosts and sufficient concentrations of food plants. The distribution of these resources will determine where these bats specifically occur.

In Arizona, LLNB feed on flowers and the fruits of saguaro and organ pipe cactus (*Stenocereus thurberi*) in early summer. Later in the summer and early autumn, the species feeds on agave flowers – Palmer's agave *(Agave palmeri)*, Parry's agave *(A. parryi)*, desert agave *(A. deserti)*, and amole *(A. schotti)* (AZGFD 2011; USFWS 2005). Nectar, pollen, and fruit of columnar cacti 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). A few insects may be eaten incidentally when feeding on nectar (Hinman and Snow 2003). LLNB have been reported to visit hummingbird feeders at night in the Huachuca, Chiricahua, and Santa Rita Mountains (Hinman and Snow 2003), as well as the Greater Tucson metropolitan area (Lowery *et al.* 2009). During winter in Mexico, primary food plants as identified by pollen appear to be *Ceiba*, *Bombax*, and *Ipomoea* (AZGFD 2011). The spring migration of the LLNB from central Mexico northward is thought to follow the sequential south to north blooming of certain flowers (AZGFD 2011).

LLNB leave daytime roosts about an hour after sunset to feed (AZGFD 2011). After feeding, they fly to night roosts, which may be different from day roosts, to rest and groom (AZGFD 2011). As they groom, 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 (AZGFD 2011). LLNB can travel long distances (up to 40-plus miles each night) to use available forage resources. For day roosts, LLNB use caves and mine tunnels (USFWS 2005). It appears to be the most dependent of the North American bat species on the availability of inactive mines, and most Arizona records are from inactive mines. During their 2006-2008 study, Lowery *et al.* (2009) identified four day roosts within the Tucson basin region, including the Saguaro National Park roost, the Aqua Caliente roost, the Catalina roost, and the Empire roost. No LLNB day roosts were found in the Avra Valley HCP Permit Area or Avra Valley generally. Documented LLNB roosts are found within foraging distance of the Avra Valley, approximately 25 miles to the east and 30-40 miles to the west.

Characteristics that render potential roost sites "suitable" for LLNB 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). Another factor that may influence roost suitability is interactions with other bat species. LLNBs have been documented sharing roost sites with up to four other bat species; however, it typically roosts separately from the other bats, such as by moving deeper into the cave or mine to roost (USFWS 1995). At the Patagonia bat cave, LLNB do not arrive in significant numbers until late July, after a large maternity colony of Cave Myotis (*Myotis velifer*) has moved on from the site (USFWS 1995).
Like many other bats, individuals of *Leptonycteris* use night roosts for digesting their meals. According to the USFWS (1995), night roosts can be the same roosts used during the day or bats may use other caves or mines, or even rock crevices, trees and shrubs, and occasionally, abandoned buildings. In their 2006-2008 study, night roosts included a large, non-native tree (Tamarisk), dark carports, porches, dark portions of a vaulted entrance to a residence, an abandoned house, a barn, and eaves of a church building (Lowery *et al.* 2009).

The choice of roost sites and migration routes are also influenced by proximity to foraging habitat. The availability of any roost site is likely the most critical consideration; however, the suitability of that site and its ability to support bat populations over the long-term depends on the availability and persistence of sufficient foraging habitat nearby (USFWS 2005). During their study of the Greater Tucson region, AZGFD researchers found that, of the LLNB they tracked, movements were between 1.5 to 25 mi (2.4 km to 40 km) each way. However, they note that other studies have shown the species to commute a total of 62 mi (100 km) per night (Lowery *et al.* 2009).

2.1.3 Permit Area Baseline Conditions

PERMIT AREA POPULATION STATUS AND IMPORTANCE TO THE SPECIES

According to the AZGFD Heritage Data Management System (HDMS) (AZGFD 2011), there are no known roost sites within the Avra Valley HCP Permit Area. Moreover, there is very little potential for colonies to occur in the Permit Area given the lack of mines and caves along with a minimal number of structures to serve as roosts. In early 2007, USFWS staff addressed the TAC with regard to the status of LLNB within the Avra Valley HCP Permit Area. Scott Richardson of the USFWS reported that the species does occur within the Permit Area and that there is potential for incidental "take" to occur. He added that in terms of take, the needs of LLNB are: 1) roost sites (maternity, transition, night roosts); 2) foraging resources (pollen, nectar, saguaro fruits, agave nectar and pollen, and hummingbird feeders); and 3) habitat connectivity (ability to move between forage resources and roosts). Mr Richardson said that any disturbance that prevents or inhibits LLNB use of movement corridors, currently the primary use of the Permit Area by LLNB considered in the HCP, such as through fragmentation of washes and drainages, would constitute "take" (City of Tucson 2007). LLNB roosts are located west and east of the Pemit Area within foraging distance of the species and forage resources are found in the mountain ranges and bajadas adjacent to the Pemit Area. Therefore, it is reasonable to predict that the species will use the Permit Area to access available roost and forage resources.

MODELED HABITAT

The LLNB habitat model for the Avra Valley HCP Permit Area is based on the presence of contiguous xeroriparian vegetation needed for movement between forage and roost resources outside of the Permit Area. As documented by AZGFD (Lowery *et al.* 2009) and according to Scott Richardson, LLNB move through native vegetation within riparian areas (City of Tucson 2007). The Avra Valley HCP habitat model for the LLNB was developed through discussions with TAC members and USFWS personnel. To create this habitat model, detailed aerial orthophoto images were used to identify lands in the HCP Permit Area that provide sufficient riparian corridors for LLNB movement. The LLNB habitat model is the same for three other covered species that use riparian areas and totals 2,040 ac (826 ha).

2.1.4 HCP Biological Goals and Objectives

Implementation of the proposed covered activities could result in the loss of potential LLNB movement habitat in the HCP Permit Area. As there are no known LLNB roosts within the Permit Area, the potential for direct take of LLNB is very low. Take in the form of harm or harassment is anticipated related to the bats having to travel longer distances and the associated increase in energetic demands for bats as they seek alternative foraging sites, or simply through the loss of access to available forage and roost resources. Specifically, the City's biological goal for LLNB is to contribute to maintaining regional populations. The City's specific objectives for LLNB are to maintain long-term availability of movement corridors and minimize potential for mortality

2.2 Pale Townsend's Big-Eared Bat (*Corynorhinus townsendii pallescens*; PTBB)

2.2.2 Population Range, Distribution, Status, and Threats

RANGE AND DISTRIBUTION

The range of PTBB includes most of western North America from southern British Colombia south along the Pacific coast to southern California, from the Black Hills of South Dakota to western Texas, and through the Mexican uplands to the Isthmus of Tehuantepec in southern Mexico (Hinman and Snow 2003). However, it is not known to occur within the Baja California Peninsula and isolated occurrences in the southern Great Plains, Ozark Mountains, and Appalachian Mountains are considered to be relict populations (Hinman and Snow 2003).

While the species is widespread throughout Arizona, it is not considered common anywhere (see Arizona Population Status and Threats section below). In Arizona, it is least common in northeastern grasslands and southwestern desert areas (Hinman and Snow 2003). It has been found from 550 to 7,520 ft (168 to 2,294 m) in elevation. Most records, however, come from above 3000 ft (915 m) (Hinman and Snow 2003). In Arizona, PTBB have been reported in Cochise, Coconino, Gila, Graham, La Paz, Maricopa, Mohave, Navajo, Pima, Pinal, Santa Cruz, Yavapai, and Yuma counties (AZGFD 2003).

PTBB is one of five subspecies currently recognized under *C. townsendii* (AZGFD 2003; BISON-M 2009a). Three of the subspecies, *C. t. virginianus* (Virginia Big-eared Bat), *C. t. ingens* (Ozark Big-eared Bat), and *C. t. australis*, do not occur in the western U.S. (BISON-M 2009a; Kunz and Martin 1982). *C. t. townsendii*, known variously as the Pacific Western Big-eared Bat or Western Big-eared Bat, occurs in Washington, Oregon, California, Nevada, Idaho, and possibly northwest Utah and southwest Montana (BISON-M 2009a). *C. t. pallescens* is found in the same states as *C. t. townsendii* and also occurs in Arizona, Colorado, New Mexico, Texas, and Wyoming (BISON-M 2009a). However, taxonomic understanding of this complex is still evolving, and somewhat recent work suggests that *C. t. pallescens* will likely become *C. t. townsendii*. *C. t. pallescens* will be designated as the subspecies restricted to northern New Mexico and Colorado, while *C. t. townsendii* will be the subspecies in Arizona (Piaggio and Perkins 2005).

Although there are areas in which only one of the two western subspecies apparently occurs, the two subspecies intergrade throughout much of their range and, in these intergrade zones, individuals cannot easily be assigned to subspecies (BISON-M 2009a; Pierson and Rainey 1998). As a result, some authors do not distinguish between the two western subspecies, instead choosing to lump them into a single taxon, *C. t. townsendii* or the Townsend's Big-eared Bat (Hutson *et al.* 2001; Pierson and Rainey 1998).

POPULATION STATUS AND THREATS

Range-Wide Population Status and Threats. The two eastern subspecies, *C. t. virginianus* and *C. t. ingens*, were listed as endangered in 1979, primarily as a result of severe population declines and restriction of breeding habitat to only a few caves (USFWS 1979). In 1994, *C. t. pallescens* and *C. t. townsendii* were recognized as Category 2 Federal Candidates, now referred to as Species of Concern (BISON-M 2009a).

The overall population status and trend of the PTBB is uncertain. For the purposes of this HCP, no studies within the last 10 years have been found that document range-wide trends. To estimate population trends for bats, USGS researchers suggest that major improvements are needed (O'Shea *et al.* 2003). They state:

"With the possible exception of certain small colonies in which individual bats can be completely counted, attempts to estimate bat population trends in the United States and territories have relied heavily on use of indices at local sites. The use of indices and "convenience sampling" to estimate population size and trends in animals in general is inferior to more statistically defensible methods and can lead to incorrect inferences (Thompson *et al.* 1998, Anderson 2001). New techniques must be explored and modern statistical designs applied in order to improve the scientific basis for conclusions about future bat population trends."

The PTBB is threatened by human disturbance at major maternity roosts; mining, closure and sealing of abandoned mines; vandalism at maternity and hibernation sites; loss of foraging habitat; and possibly, exposure to pesticides (AZGFD 2003). PTBB are extremely sensitive to human disturbance, and simple entry into a maternity or hibernation roost can result in the abandonment of the site or increased potential for mortality (Hinman and Snow 2003).

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). Based on historical information, Pierson *et al.* (1999) described 13 maternity roosts in Arizona. These 13 sites represented 10 separate colonies, totaling about 1,000 adult females. More than one-half of the sites were in mines, and only four were known to contain more than 200 individuals (Recon 2002). According to a report from 2002, only five to seven maternity colonies, ranging in size from 100 to several hundred bats, were currently known (Recon 2002). According to the USFWS, a relatively new maternity roost has been discovered within the proposed Rosemont Mine footprint in the northeast cornder of the Santa Rita Mountains (Richardson 2012). The largest colony in Arizona, Stanton's Cave in the Grand Canyon, disappeared in the 1970s shortly after the roost site was gated to protect archaeological and paleontological remains. After the gate was modified in the mid-1980s, several bat species (but not *C. townsendii*) were observed inside the site (Recon 2002). As of 2003, bat use of these sites was not known (AZGFD 2003).

Maternity sites for the species have been found at Agua Caliente Cave, Dixie Mine, Crystal Cave, Stanton's Cave in Grand Canyon National Park, the Chiricahua Mountains, a cave in Sycamore Canyon, a cave near Union Pass, and a cave in Hereford, although not all these sites remain in use (BISON-M 2009b; Castner *et al.* 1994; Dalton and Dalton 1994). PTBB hibernacula have been located within the Gold Button Mining Claim in Prescott National Forest (one site) and along the Bill Williams River (two sites) (Castner *et al.* 1994; Snow *et al.* 1995).

As with LLNB, White-nose Syndrome could become a significant threat to hibernating PTBB, if it spreads west from eastern North America.

2.2.2 Ecology

LIFE HISTORY

PTBB are active in summer and hibernate in winter (AZGFD 2011). 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 non-breeding. 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) (Hinman and Snow 2003). In summer, females form maternity colonies of 12 to about 200, while male roosting is thought to be solitary (Hinman and Snow 2003).

According to Hinman and Snow (2003), "In Arizona, females are pregnant in April, with maternity colonies reported in late April. Indirect evidence (near term embryos and presence of newborns) indicates the single young is born in June in Arizona. Dates of birth vary considerably throughout the bat's range, anywhere from late April to mid-July. In Arizona, most young are flying by the end of July. . . Nursery colonies begin to disperse during August." Banding studies indicate high roost and group fidelity and colonies will, if undisturbed, use the same site indefinitely. Most, if not all, females return to their natal group each breeding season resulting in multi-generational, matrilineal colonies (Pierson and Rainey 1998).

In terms of mortality rates, the average number of yearling females that return to their natal site in the following breeding season is between 38 and 45 percent. In succeeding years, the survival rate rises to around 75 percent (BISON-M 2009b; Pierson and Rainey 1998). Five years is the average age of PTBB within a population. Band recoveries suggest a maximum longevity of 16 years (AZGFD 2011). Little is known about the causes of mortality in PTBB; however, predation of the bats by Domestic Cats (*Felis catus*), Black Rats (*Rattus rattus*), and Ringtails (*Bassariscus astutus*) has been observed. Interspecific competition and disease are not considered to significantly impact populations of this species (BISON-M 2009b). Since PTBB is easily disturbed, arousal during winter hibernation could lead to starvation of a bat from the expenditure of 10 to 30 days of fat reserves (BISON-M 2009b).

The species forages by echolocation, capturing insects in flight and sometimes from leaves along forest edges (BISON-M 2009b; Hinman and Snow 2003). Studies of stomach contents from bats in the Southwest have revealed that their diet consists primarily of Lepidopterans, with small quantities of Coleoptera, Diptera, Hemiptera, Hymenoptera, Homoptera, Neuroptera, Trichoptera, and Plecoptera (BISON-M 2009b). Small moths, 0.12 to 0.39 in (3 to 10 mm) are the primary food of these bats (AZGFD 2003).

The species forages over desertscrub, riparian habitats, wetlands or open water, typically within 15 mi (24 km), and often within 4 to 5 mi (6.5 to 8 km) of the roost sites (AZGFD 2003; Hinman and Snow 2003). However, studies by Rick Sherwin indicate that *C. townsendii* may travel large distances while foraging, including movements of over 93 mi (150 km) during a single evening (Piaggio *et al.* 2009). Following a late-night peak of activity, they usually go to a night roost. They may forage again in the early morning, as they are reported not to return to their daytime roosts until shortly before sunrise (AZGFD 2003).

HABITAT REQUIREMENTS

In Arizona, summer day roosts include caves and mines in areas of desertscrub, oak woodland, oak/pine woodland, piñon/juniper woodland, and coniferous forest (Hinman and Snow 2003). PTBB prefer to hang from open ceilings at roost sites; they do not use cracks or crevices. According to Hinman and Snow (2003), "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." For PTTB, night roosts are often abandoned buildings (AZGFD 2003) and, more generally, for Townsend's Big-eared Bats, night roosts occur at a variety of sites, including caves, open buildings, rock shelters, bridges, cement culverts, beneath roads, and mines (Pierson *et al.* 1999).

In winter, big-eared bats hibernate in cold caves, lava tubes, and mines. Of all North American bats, this species seems to be the most dependent on availability of abandoned or inactive mines for roost sites (BISON-M 2009b). 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 than summer roosts (i.e., usually singles or small groups, and in Arizona occasionally as many as 50) (Hinman and Snow 2003). For hibernation, they prefer roost sites where the temperature is 54° F

(12° C) or less and these sites may be near entrances or in well-ventilated areas of the roost (Hinman and Snow 2003). During the winter, the bats may rouse themselves and move to other locations in the roost to be in areas of stable cold temperatures (Hinman and Snow 2003). Roost selection appears to be limited by the temperature within potential sites (BISON-M 2009b).

2.2.3 Permit Area Baseline Conditions

PERMIT AREA POPULATION STATUS AND IMPORTANCE TO THE SPECIES

According to the AZGFD HDMS, there are no known roost sites within the City HCP Permit Area (AZGFD 2003). Given the low elevations and relatively flat topography of the Permit Area, there is also little potential for undocumented roost sites (Scott Richardson, pers. comm.). 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 2000). A maternity roost has also been discovered in the Santa Rita Mountains at the proposed Rosemont Mine site (Richardson 2012).The level of use and potential importance to PTBB of habitats in the Avra Valley HCP Permit Area is uncertain. However, given the distances this bat may travel while foraging, the entire Permit Area is within potential foraging distance of several known roosts. Thus, the importance of the Permit Area for the species is as a potential movement and foraging corridor.

MODELED HABITAT

The PTBB habitat model was developed with the input of the City's HCP TAC and their understanding of PTBB foraging needs. Given the species' foraging preference for small moths (some Geometrid moth larvae forage on mesquite, making that resource a valuable souce of forage), the TAC recommends that protection of the xeroriparian vegetation and associated watercourse channels. These areas provide a high level of vegetation species diversity as well as ecotones between and adjacent to patches of vegetation within wash corridors. The Avra Valley HCP habitat model for the PTTB was developed through discussions with TAC members and USFWS personnel. To create this habitat model, detailed aerial orthophoto images were used to identify lands in the HCP Permit Area that provide sufficient foraging corridors for the PTBB. Based on this model, 2,040 ac (826 ha) of potential PTBB habitat occurs in the Avra Valley Permit Area. This is the same habitat footprint as that of the LLNB, WYBC, and CFPO.

2.2.4 HCP Biological Goals and Objectives

Implementation of anticipated covered activities may result in the loss of potential PTBB foraging habitat in the HCP Permit Area. Direct take of foraging bats is not likely. Mortality, resulting from impacts of maintenance or treatment activities, may occur when bats are occupying architectural elements of structures (e.g., eaves of a maintenance building) as night roosts. The indirect effects of this development may impact the bat through the reduction in its native prey base, predation by domestic animals, and disturbance by humans. Specifically, the City's biological goal for PTBB is to contribute to maintaining regional populations. The City's specific objectives for PTBB are to maintain potential foraging and movement opportunities and minimize potential for direct take.

2.3 Western Yellow-Billed Cuckoo (*Coccyzus americanus occidentalis*; WYBC)

2.3.1 Population Range, Distribution, Status, and Threats

RANGE AND DISTRIBUTION

Two subspecies of the Yellow-billed Cuckoo are currently recognized in North America by the American Ornithologists' Union (AOU 1957), one in the east and one in the west. WYBC, the only subspecies of Yellow-billed Cuckoo that occurs in Arizona, was formerly 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, the WYBC is known to breed in California, Arizona, New Mexico, extreme western Texas, Sonora, Chihuahua, and south irregularly to Zacatecas, Mexico (Howell and Webb 1995; Hughes 1999; Russell and Monson 1998). It winters in north and central South America east of the Andes (Hughes 1999).

POPULATION STATUS AND THREATS

Federal Status. The USFWS considers the Western population of Yellow-billed Cuckoo a distinct population segment based on the physical, ecological, and behavioral discreteness of the population segment and determined that listing this distinct population segment as threatened is warranted but precluded by higher-priority listing actions (USFWS 2001). The species is currently a candidate species under the ESA.

Range-Wide Population Status and Threats. Like many riparian obligate species, the breeding distribution and number of WYBC has declined in the past 80 years throughout Western North America (AZGFD 2002). It disappeared from British Columbia in the 1920s, from Washington in the 1930s, from Oregon in the 1940s, and from northernmost California in the 1950s. It is extremely rare in the interior West. The only remaining Western "strongholds" are three small populations in California, scattered populations in Arizona (especially on the San Pedro River) and New Mexico (especially the Gila River), and an unknown number of birds in northern Mexico (BISON-M 2009b). The primary cause of WYBC declines is loss of riparian forest habitat throughout the west (USFWS 2005).

Arizona Population Status and Threats. Arizona probably contains the largest remaining WYBC population among states west of the Rocky Mountains and is therefore considered critically important since breeding populations throughout the West have been extirpated or greatly reduced (Recon 2002; USFWS 2001). In a 1998-1999 study (Corman and Magill 2000), WYBC were detected along 25 main drainages in Arizona, with the major concentrations occurring along the Agua Fria, San Pedro, and Verde Rivers, and the 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 destruction of riparian gallery forests (AZGFD 2002). Loss of mature cottonwood-willow riparian habitat through degradation, modification, and fragmentation is the primary threat to the remaining populations of WYBC in central and southern Arizona (AZGFD 2002; Recon 2002). Major threats to this habitat include reclamation, flood control, and irrigation projects, urbanization and agricultural activities, and livestock grazing and OHV use within riparian habitats.

2.3.2 Ecology

LIFE HISTORY

The WYBC is a member of the family Cuculidae (cuckoos and roadrunners) in the order Cuculiformes, members of which share the common feature of zygodactyl feet. Of the six species of Cuculidae that breed in the U.S., two species, WYBC and the Greater Roadrunner, breed west of the Continental Divide (USFWS 2001).

The WYBC 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-June through August (Johnson *et al.* 2008). Breeding may be triggered by an abundance of insects (caterpillars) or other large prey, which form the bulk of the species' diet (AZGFD 2002; Recon 2002). Populations vary substantially in response to fluctuations in caterpillar abundance (BISON-M 2009b). Prey abundance may lead to the production of excess eggs and thus to brood parasitism, where the WYBC's excess eggs are laid in other birds' nests (Recon 2002).

Both male and female WYBC build the nest, generally from 4 to 30 ft (1.2 to 9.1 m) 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 surrounding foliage, and consists of an unkempt stick platform, thinly lined with leaves, mesquite, and cottonwood strips, grass, and catkins, with a depression to hold the eggs (AZGFD 2002; Ehrlich *et al.* 1988). The clutch size is usually two or three 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 early fledglings, while the female feeds the late fledglings (Ehrlich *et al.* 1988).

Caterpillars form the main component of the diet of WYBC, with cicadas, grasshoppers, birds' eggs, frogs, lizards, ants, beetles, wasps, flies, and fruit being consumed in smaller amounts (Ehrlich *et al.* 1988; Howe 1986; Hughes 1999).

HABITAT REQUIREMENTS

WYBC appears to require large blocks of riparian habitat for nesting (USFWS 2005), particularly woodlands with Fremont cottonwoods and Goodding willows (USFWS 2001). In Arizona, the species occurs from 90 to 6,710 ft (27–2,045 m) above mean sea level, preferring streamside cottonwood/willow groves and larger velvet 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 sub-canopy layer, provide the best shade of any riparian habitat against the extremely high midsummer temperatures. Salt cedar and open mesquite bosques are inadequate in buffering lethal temperatures. In addition, standing water in many cottonwood-willow groves may help to lower air temperature by evaporative cooling. Thus, the decline in WYBC populations may be attributed largely to the removal of necessary thermal cover (Rosenberg *et al.* 1991). This speculated importance of cooler microclimates was supported by a 2007 study of 40 sites along the Lower Colorado River and its tributaries, in which the authors found that ". . . , yellow-billed cuckoos did use habitats that were consistently cooler during the day and more humid at all times compared to unoccupied habitats" (Johnson *et al.* 2008).

WYBC may be found in less than optimal habitat during migration. Even though such habitats do not support breeding, they are still important for survival of the species (Magill and Halterman 1999). Potential migration habitat includes areas of Sonoran Riparian Deciduous Forest, Cottonwood-Willow Series and Sonoran Riparian Scrub with large mesquites that are less well developed than those in breeding habitat. No minimum size for migration habitat has been determined, and it is possible that only a few trees would be sufficient for migrating birds (T. Corman, AZGFD, pers. comm.).

2.3.3 Permit Area Baseline Conditions

PERMIT AREA POPULATION STATUS AND IMPORTANCE TO THE SPECIES

Riparian vegetation associated with the Brawley and Blanco Washes provides potential migratory stopover habitat for WYBC within the Avra Valley HCP Permit Area. Portions of City-owned parcels bisected by the effluent dominated Santa Cruz River have potential breeding habitat, although no breeding has been documented. However, these hydroriparian areas are outside of the Avra Valley HCP Permit Area.

MODELED HABITAT

Based on the current understanding of the WYBC's habitat preferences, there is no potential breeding habitat within the Avra Valley HCP Permit Area. All of the WYBC reported in the Permit Area are assumed to be migratory, using existing riparian patches as stopover habitat as they pass through the area. Natural conditions are not likely to produce any riparian areas of sufficient size and structure to support breeding birds. However, riparian vegetation throughout the Permit Area may be used for WYBC migratory stop-over habitat, which is the basis for the TAC's model. The Avra Valley HCP habitat model for the WYBC was developed through discussions with TAC members and USFWS personnel. To create this habitat model, detailed aerial orthophoto images were used to identify lands in the HCP Permit Area that provide sufficient potential migratory stopover habitat for the species. Based on this habitat model, 2,040 ac (826 ha) of WYBC habitat occur in the Avra Valley HCP Permit Area. This is the same potential habitat footprint as that of the LLNB, PTBB, and CFPO.

2.3.4 HCP Biological Goals and Objectives

As described above, the current level and pattern of use of the Avra Valley Permit Area by WYBC is unclear. A few WYBC have been documented migrating through or near the Permit Area, but specific use of habitats in the Permit Area for migration has not been verified. Based on this information, the City's biological goals and objectives for WYBC in the Permit Area primarily relate to providing conditions to support migration. Specifically, the City's biological goal for the WYBC is to contribute to maintaining local and regional populations. The City's specific objectives for WYBC are to maintain long-term availability of migratory stop-over habitat, and minimize potential for mortality.

2.4 Cactus Ferruginous Pygmy-owl (*Glaucidium brasilianum cactorum*; CFPO)

2.4.1 Population Range, Distribution, Status, and Threats

RANGE AND DISTRIBUTION

The Ferruginous Pygmy-owl (*Glaucidium brasilianum*) has a range that extends from the southern U.S. (Arizona and Texas) south to central Argentina (Cartron *et al.* 2000a). CFPO, a subspecies of *Glaucidium brasilianum*, has a distribution described as "south of central Arizona and southern Texas in the United States, south through the Mexican States of Sonora, Sinaloa, Nayarit, Jalisco, Colima, and Michoacan on the west and Nuevo Leon and Tamaulipas on the east" (USFWS 2011).

Knowledge of the current distribution of CFPO in Arizona is limited. Historically, CFPO occupied areas of south-central Arizona from New River (approximately 35 mi (56 km) 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 100 mi (161 km) northeast of Tucson) (USFWS 2003a; Cartron *et al.* 2000a). Based on surveys in the 1990s, the Arizona population appeared to have a patchy distribution, with most CFPOs 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 patchy, dispersed nature of the CFPO population in Arizona suggests that the overall population may function as a metapopulation, with local groups of owls functioning as subpopulations (USFWS 2003a).

POPULATION STATUS AND THREATS

In March 1997, the Arizona population of the CFPO was federally listed as endangered and as a distinct population segment (USFWS 1997). However, on May 15, 2006, the CFPO was delisted as a result of litigation and subsequent USFWS review (USFWS 2006). In 2011, prompted by another petition to list the species, the USFWS determined that listing the species was not warranted because the species is not in danger of extinction now or within the foreseeable future throughout all or a significant portion of its range based on currently available information (USFWS 2011). However, the pygmy-owl remains a species of concern for the USFWS and is listed on the Arizona Game and Fish Department's list of Wildlife of Special Concern in Arizona (AZGFD 1996).

Losses and fragmentation of upland vegetation from large-scale residential and commercial developments have been identified as an important threat to CFPO in Arizona (USFWS 2003a). 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).

CFPOs are susceptible to predation from a variety of species that occur in the wild, such as Great Horned Owls (*Bubo virginianus*), Harris' Hawks (*Parabuteo unicinctus*), Cooper's Hawks (*Accipiter cooperi*), and Screech Owls (*Otus* sp.). Other potential threats include direct and indirect human-caused mortalities, such as collisions with cars, glass windows, fences, and power lines (USFWS 2003a). The spread of non-native, invasive buffelgrass and the resultant degradation of native vegetation communities and increased risk of wildfire also pose a threat to the species. The USFWS states that: "The impacts of buffelgrass establishment and invasion are substantial for the pygmy-owl in the United States and Sonora because conversion results in the loss of all important habitat elements, particularly columnar cacti and trees that

provide nest sites" (USFWS 2011). Additional 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, and concentration of recreational birding activities at remaining known locations (USFWS 2002, 2003b). Human activities near nest sites at critical periods of the nesting cycle also can cause CFPOs to abandon their nests (USFWS 2003a), although there is currently no known evidence to support this. Due to the CFPO's short-distance, low-level flight behavior, habitat also can be compromised by the presence of barriers to movement, including wide, high traffic roads with inadequate cover and perch structure on either side, interstate highways, canals, certain types of fencing, and alterations of functional drainages (Pima County 2001).

2.4.2 Ecology

LIFE HISTORY

CFPOs are primarily diurnal with crepuscular tendencies – most activity occurs during daylight hours, with peaks at dawn and dusk (USFWS 2011). A CFPO typically flies in quick bursts, moving only a short distance from one perch to another (Cartron *et al.* 2000b). The CFPO typically hunts from perches in trees with dense foliage, using a perch-and-wait strategy. The CFPO also hunts by inspecting tree and saguaro cavities for other nesting birds. Its diverse diet includes birds, lizards, insects, and small mammals. However, the owls use different groups of prey species on a seasonal basis (USFWS 2011).

CFPOs are considered non-migratory throughout their range (USFWS 2011). They are highly territorial, with territory sizes between 7.5 and 57 ac (3 and 23 ha) during the breeding season and winter home ranges as large as 279 ac (113 ha) (Pima County 2001; USFWS 2003a). A 280-ac (113-ha) home range is currently considered necessary for CFPOs to meet their life history requirements on an annual basis (USFWS 2003a).

CFPOs have been documented nesting as yearlings, although it is unknown whether or not this is typical. Both sexes breed annually thereafter (USFWS 2011). Territories normally contain several nest-roost cavities from which a responding female selects a nest. Hence, cavity density could be a fundamental criterion for territory selection (USFWS 2011). In the wild, CFPO lifespan has been documented from 7 to 9 years and 10 years in captivity (USFWS 2011).

HABITAT REQUIREMENTS

CFPOs are secondary cavity nesters, mostly using cavities created by woodpeckers in giant cacti, but also in trees (USFWS 2011). Historically, CFPOs in Arizona nested in Fremont cottonwood-mesquite forests and woodland sites (USFWS 2011). More recently (1996 – 2008), all but two known pygmy-owl nest sites were in saguaro cacti (USFWS 2011).

CFPOs 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).

In their search for mates, food, or territories, dispersing CFPOs may stop temporarily in appropriate over-wintering habitats. For CFPOs, over-wintering habitats are defined as riparian areas that are more extensive in size and support higher vegetation densities – thereby providing greater cover and prey densities – than dispersal habitats. Although saguaros may be present in the vicinity, the presence of saguaros is not a requirement of either over-wintering or dispersal habitats (S. Richardson, USFWS, pers. comm.).

2.4.3 Permit Area Baseline Conditions

PERMIT AREA POPULATION STATUS AND IMPORTANCE TO THE SPECIES

There have been no CFPO breeding or over-wintering territories documented within the Avra Valley HCP Permit Area. The only recorded use of the Permit Area is a 2005 AZGFD record of an unmated dispersing female on the Duval/Pennzoil Farm parcel in the Permit Area. The Duval/Pennzoil and Buckelew Farm properties fall within Unit 1 of what was once considered Critical Habitat for CFPO while it was listed as endangered. Portions of the Central Avra Valley Storage and Recovery Project property (CAVSARP) fall within what was once considered Critical Habitat Unit 2. Currently, the closest documented CFPO nest sites to the Permit Area are approximately seven miles west on the bajada of the Roskruge Mountains. The USFWS recognized that much of this area, including City-owned property, has been heavily impacted by grazing, agriculture, mining, and other uses and does not likely support breeding habitat for the CFPO. Retired agricultural lands in Avra Valley are considered by USFWS as providing habitat connectivity and potential dispersal corridors for CFPOs (USFWS 2002).

MODELED HABITAT

The Avra Valley HCP habitat model for the CFPO was developed through discussions with TAC members and USFWS personnel. To create this habitat model, detailed aerial orthophoto images were used to identify lands in the HCP Permit Area that provide sufficient vegetation density for dispersing and, perhaps, over-wintering CFPOs. Based on the City's habitat model 2,040 ac (826 ha) acres of potential dispersal / over-wintering habitat occur in the Avra Valley HCP Permit Area. This same model is used for the LLNB, PTBB, and WYBC.

2.4.4 HCP Biological Goals and Objectives

The City's biological goal and objectives for the CFPO relate to ensuring that covered activities within the Permit Area do not contribute to the permanent loss of the CFPO in the region. Specifically, the City's biological goal for the CFPO is to: Contribute to maintaining local and regional populations. The City's specific objectives for the CFPO are to maintain long-term availability of potential dispersal / over-wintering habitat, reduce barriers to movement, and minimize potential for mortality.

2.5 Western Burrowing Owl (*Athene cunicularia hypugaea*; WBO)

2.5.1 Population Range, Distribution, Status, and Threats

RANGE AND DISTRIBUTION

The WBO has a breeding range that extends from southern Canada, east to western Minnesota and eastern Texas, and south through Mexico, Central America and over most of non-rain forest South America to Tierra del Fuego (Howard 1996). The breeding range includes 13 of 15 Arizona counties, with no confirmed nesting in Gila and Santa Cruz Counties (Corman and Wise-Gervais 2005). Arizona also supports wintering WBOs, as documented during surveys in 2005 and 2006 (Grandmaison and Urreiztieta 2006). However, little is known about the winter range of the subspecies because of a limited number of banding recoveries.

POPULATION STATUS AND THREATS

Range-Wide Population Status and Threats. Estimates of population trends for many regions are inconclusive as result of high data variability and small sample sizes (Klute *et al.* 2003). Breeding Bird Survey trend estimates have shown population decreases in the northern half of the Great Plains and increasing populations in some southwestern deserts and the northwest interior of the U.S. However, small sample sizes, and inadequate sampling across the species' range limit the reliability of the Breeding Bird Survey data for this species (Klute *et al.* 2003).

Population declines have been associated with habitat loss due to urbanization as well as rodent control programs (Johnsgard 1988). While conversion to agricultural uses has also been associated with habitat loss (Johnsgard 1988), it should be noted that WBO relocation efforts by the non-profit organization, Wild at Heart, indicate that the presence of active agriculture in close proximity to natural or artificial burrows is desirable. According to Wild at Heart, translocated WBO tend to remain at sites near to active agriculture more often than at sites without active agriculture (City of Tucson 2008b). Fragmentation of existing habitat also poses a risk to owl populations. Fragmentation of habitat may result in reduced opportunities for unpaired owls to find mates, increased predator populations and vulnerability to predation, higher mortality rates among dispersing fledglings, and increased home range sizes (Klute *et al.* 2003). Although WBOs are relatively tolerant of human activity, there are human-related impacts, such as shooting and burrow destruction that adversely affect the owls (Haug *et al.* 1993; Zarn 1974). The tendency of these owls to fly low to the ground makes vehicle strikes a significant threat to the species (Klute *et al.* 2003).

Arizona Population Status and Threats. The WBO is widely distributed, but generally uncommon in Arizona (Brown 2001b). Relatively larger breeding populations in Arizona occur in the Tucson and Yuma regions (Estabrook and Mannan 1998), Casa Grande Ruins National Monument, and surrounding agricultural areas support a small population of WBO (Conway and Ellis 2004b). Within southern Arizona, WBO routinely nest in three distinct areas, including on open, flat ground of Davis-Monthan Air Force Base (AFB), within burrows along the banks of the Santa Cruz River, and along edges of agricultural fields near Marana and Coolidge (Conway and Ellis 2004a).

To the City's knowledge, no statewide population status assessment – other than the Breeding Bird Survey (Sauer *et al.* 2011) – has been attempted since the early 2000s and the results of these efforts are inconclusive. Brown and Mannan (2002) found that in the 2001 breeding season survey effort, burrowing owls were not found in 82.3 percent of the locations where they formally nested in Arizona. The authors did not extrapolate these results to be a decline throughout the state since the survey was limited to one year, was not state-wide, and there were limitations with the survey technique given the use of road transects and one-time visits (Brown and Mannan 2002). The 2003 USFWS Status Assessment for the species did not provide any more recent information other than a reference to Breeding Bird Survey results of no significant trends over any survey periods (Klute *et al.* 2003). More recently, Breeding Bird Survey estimated population trends for Arizona indicate a non-significant ($p > 0.1$) decreasing trend of 0.1 percent per year between 1966 and 2009 and a non-significant increasing trend ($p > 0.5$) of 4.5 percent per year between 1999 and 2009 (Sauer *et al.* 2011).

Brown (2001a) identified several threats to WBOs in Arizona, some of which include 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, overgrazing of rangelands resulting in a more woody species composition and destruction of burrows, reduction in prey, maintenance programs of agricultural irrigation and water resources canals that destroy burrows, urbanization – which increases

predation by domestic and/or feral animals and the potential for vehicle strike, reduction in prairie dog and ground squirrel populations may increase predation on WBO, and agricultural pesticides.

2.5.2 Ecology

LIFE HISTORY

Breeding and Reproductive Success. The WBO often lives in colonies, with many pairs nesting 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 (Terres 1980), although in California, courtship may begin as early as late December (Thomsen 1971 in Klute *et al.* 2003). Eggs are laid from late March to July (Terres 1980) and clutch size averages 6.5 eggs, with a range of 4 to 12 eggs (Haug *et al.* 1993 in Klute *et al.* 2003). In Tucson, nests on Davis-Monthan AFB had an average clutch size of 7.6 eggs and nests along washes averaged 6.6 eggs. Nests in agricultural areas near Casa Grande and Coolidge had mean clutch sizes of 8.8 eggs (Conway and Ellis 2004a). If a female's first clutch is lost, she may re-nest (Haug *et al.* 1993) as has been documented by AZGFD in 2008 (D. Abbate pers. comm. 2008).

Young are born altricial and fledge in late summer to fall (Coulombe 1971). Young owls are capable of running and foraging at four weeks and can make sustained flights by six weeks of age. Beginning when the chicks are 3 to 4 weeks of age, WBO families often change burrows every 10 to 15 days until the young begin to disperse in early fall, usually moving to nearby burrows (Klute *et al.* 2003). Moving the chicks to satellite burrows and the use of dung, in some areas, to line burrow entrances are both thought to reduce the risk of predation (TNC 1999).

Diet and Foraging. WBO are opportunistic feeders whose diets largely reflect prey availability (CDOW 2003). They primarily eat arthropods, small mammals, birds, amphibians, and reptiles, with seasonal shifts in the relative amounts of each type of item consumed. WBO have been reported foraging in agricultural areas (both active and fallow fields), along roads and ditches, and in native grassland and pastures (CDOW 2003; Gervais *et al.* 2000).

Mortality and Predation. Little is known about the average life span or rates of mortality among WBO. The longest documented life span for a WBO was 8 years, 8 months (Anderson *et al.* 2001 in CDOW 2003). Annual survival rates, calculated based on return rates of adult banded birds to breeding sites, were estimated to be at least 29 to 58 percent (Haug *et al.* 1993). Annual survival rates for a non-migratory population in California were 81 percent for adult owls and 30 percent for juveniles (Thomsen 1971 in CDOW 2003). In Oklahoma, annual mortality rates have been estimated at 62 percent (Butts 1973 in Klute *et al.* 2003). Adult females in Saskatchewan were found to have a higher annual survival rate (62 percent) than adult males and juveniles, 48 and 45 percent, respectively (Clayton and Schmutz 1997 in CDOW 2003). Common predators of WBO are badgers, bobcats, weasels, skunks, coyotes, domestic cats and dogs, snakes, and raptors such as Swainson's (*Buteo swainsoni*), Ferruginous (*Buteo regalis*), Cooper's, and Red-tailed Hawks (*Buteo jamaicensis*), Northern Harriers (*Circus cyaneus*), Merlins (*Falco columbarius*), Prairie (*Falco mexicanus*) and Peregrine Falcons (*Falco peregrinus*), Great Horned Owls, and American Crows (*Corvus brachyrhynchos*) (Haug *et al.* 1993; Leupin and Low 2001 in Klute *et al.* 2003).

Site Fidelity and Juvenile Recruitment. This species exhibits moderate to high levels of site fidelity to 1) general breeding locations, 2) specific nest sites (i.e., a prairie dog colony), and 3) particular nest burrows (Klute *et al.* 2003). In Tucson, Conway and Ellis (2004a) found that 63 percent of banded adult WBO found on Davis-Monthan AFB were re-sighted the next year, and 77 percent of birds that nested along surveyed washes returned in the following year. One hundred percent of the WBO identified in

2002 that returned to Tucson in 2003 returned to the same environment (i.e., Davis-Monthan AFB versus Tucson washes) they had occupied the previous year. Fifty-one percent of those birds returned to the same burrow they had used in the previous year, with burrow fidelity the same at Davis-Monthan AFB (50 percent) and along washes (51 percent) (Conway and Ellis 2004a). Return rates for males was the same for surveyed washes and Davis-Monthan AFB (80 and 81 percent, respectively), but females were much more likely to return for a second year along the washes (73 percent) than to Davis-Monthan AFB (47 percent). They also that found that 17 percent of Davis-Monthan AFB juveniles and 28 percent of young from burrows along washes returned in 2003 to the site they had occupied during the previous breeding season (Conway and Ellis 2004a).

HABITAT REQUIREMENTS

Breeding Habitat. WBO 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 (Haug *et al.* 1993). Habitat preferences include soils that are well drained and slightly sloping, a predominance of bare ground or sparse vegetation, and the presence of mammal burrows or natural or man-made cavities (Klute *et al.* 2003). In Arizona, WBO have been documented in Great Basin, Semidesert, and Plains Grasslands; Sonoran and Mojave Desertscrub; piñon and Ponderosa pine habitats; riparian woodlands in the lower Colorado River valley; and urban, agricultural, rangeland, and vacant/barren areas (Klute *et al.* 2003).

Burrows are a habitat requirement for WBO. They use burrows for nesting and also require access to alternate burrows to provide escape cover for adults and fledglings. Because they seldom excavate their own burrows, these owls are dependent on fossorial mammals, such as badgers, ground squirrels, and prairie dogs, to create burrows. Owls have also been reported to use coyote, fox, woodchuck (*Marmota monax*), and tortoise burrows (TNC 1999). In Arizona, WBO often inhabit areas supporting prairie dog and Round-tailed Ground Squirrel populations (Brown 2001b; deVos 1998). WBO on Casa Grande Ruins National Monument mostly nest in old ground squirrel burrows, followed by coyote burrows, badger burrows, and burrows of unknown origin (Conway and Ellis 2004b). These burrowing mammals usually inhabit open environments and create the burrows the owls require (deVos 1998). If the number of natural burrows is limiting, WBO may instead use natural cavities, such as rock and lava cavities (Klute *et al.* 2003), and man-made features, including drainage tiles, culverts, and rock piles.

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). Bare ground was the predominant cover type at 87.7 percent of these active burrows. The predominant cover surrounding the remaining burrows was grass (62.5 percent), forbs (20.1 percent), shrubs (11.4 percent), and litter (6.0 percent). Overall, active burrow sites had significantly less visual obstruction by vegetation than nearby inactive burrows that appeared to be potential nest sites (Estabrook and Mannan 1998). In a statewide survey of known WBO locations, Brown and Mannan (2002) identified micro- and macro-habitat features surrounding active nesting sites. Active breeding burrows were predominantly found in agricultural areas, particularly along irrigation canals and among prairie dog towns. In their WBO demography study in Southern Arizona, Conway and Ellis (2004a) found that nesting density of WBO in south-central Tucson was 2.13 nests per square km.

Wintering Habitat. Less is known about the habitats used by WBO for wintering (Klute *et al.* 2003). Some authors have reported that agricultural fields with culverts are used more heavily in some locations (Haug *et al.* 1993). Owls in Louisiana have been found to winter in dunes and beaches, in or near vegetation and woody debris, and in pastures and agricultural fields (Klute *et al.* 2003). In Texas, one study found that 77 percent of winter roosts were road culverts (Woodin *et al.* 2007). In Nevada and Arizona, a large percentage of WBO are non-migratory and use the same sites, and even the same

burrows, in winter that they use during the breeding season (Conway and Ellis 2004a; Hall *et al.* in review in Klute *et al.* 2003). Migratory tendencies by sex and age class were studied in Southern Arizona by Oganowski and Conway (2009). They found that ". . . hatch-year owls were more likely to migrate than adults, the probability of migrating decreased with age in owls of both sexes, and adult males were significantly less migratory than females at all ages." They also found individual WBO sometimes changed their migratory status, with nearly half of adult owls over-wintering one year and nearly one hundred percent over-wintering the next (Oganowski and Conway 2009).

Little information is available on home range size and foraging distances for these owls. What is known and reviewed for this HCP includes the following information. During the day, WBO typically remain close to their burrows, foraging farther from the nest at night. Wellicome (pers. comm. in Dechant *et al.* 1999) suggests that diurnal ranges can be used to estimate nesting area requirements and nocturnal activity provides a basis for determining foraging activity. Home range and foraging area may overlap between different pairs, with only the burrow being actively defended (Coulombe 1971; Johnsgard 1988). Rosenberg and Haley (2001) found that WBO typically foraged in areas close to burrows, with more than 80 percent of observations within 1,968 ft (600 m) of burrows. This finding is similar to that of Haug and Oliphant (1990), who found that 95 percent of theWBO telemetry coordinates they gathered were within this distance of a burrow. Depending on the method used to estimate home range size, average home range sizes vary from 83 to 595 ac (34 to 241 ha).

2.5.3 Permit Area Baseline Conditions

PERMIT AREA POPULATION STATUS AND IMPORTANCE TO THE SPECIES

In November 2005, AZGFD personnel evaluated 35 City-owned Avra Valley properties of the HCP Permit Area for WBO nesting habitat potential, characterizing each property according to vegetation density, presence of concrete irrigation canals, and availability of usable burrows (Grandmaison and Urreiztieta 2006). During the breeding season, they revisited 292 sites. WBO were present on nine properties, and suitable burrows were detected on 16 of them. Based on their results, Grandmaison and Urreiztieta (2006) concluded that "The City of Tucson's Avra Valley properties have high burrowing owl wintering and breeding habitat potential given the abundance of burrows and the predominance of short vegetation across many of the parcels."

MODELED HABITAT

To model habitat, Arizona Game and Fish Department (AZGFD) staff qualitatively evaluated the Permit Area properties for nesting potential. Properties were characterized by the availability of usable burrows, vegetation density, and presence of concrete irrigation canals. Details of the habitat model can be found in Grandmaison and Urreiztieta 2006. Based on AZGFD's habitat assessment, 4,775 ac (1,932 ha) of WBO habitat were identified in the Permit Area.

2.5.4 HCP Biological Goals and Objectives

Based on AZGFD's qualitative habitat evaluation and subsequent winter and breeding surveys in the Permit Area, the City's biological goals and objectives for the WBO relate to providing conditions to support breeding, over-wintering, and migration. Specifically, the City's biological goal for the WBO is to contribute to maintaining local and regional populations. The City's specific objectives for WBO are to maintain habitat, consider opportunities to enhance habitat, and minimize potential for mortality.

2.6 Desert Tortoise (Sonoran Population) (*Gopherus agassizii*; DT)

2.6.1 Population Range, Distribution, Status, and Threats

RANGE AND DISTRIBUTION

The distribution of Desert Tortoise covers the broadest range of latitude, climate, habitats, and biotic regions of any North American tortoise (Germano *et al*. 1994 and Berry *et al*. 2002 in AZGFD 2010). The tortoise ranges from northern Sinaloa north to southern Nevada and southwestern Utah, and from south central California east to southeastern Arizona. The Desert Tortoise is divided into two populations for purposes of the ESA: the threatened Mojave population occurs north and west of the Colorado River, and the candidate Sonoran population occurs south and east of the Colorado River (AZGFD 2010).

Within Arizona, the Mojave population includes all tortoises north and west of the Colorado River, west of the Beaver Dam Mountains, north of the Virgin Mountains, and in the Pakoon Basin in extreme northwest Mojave County (AZGFD 2010). The Sonoran population includes those tortoises south and east of the Colorado River, from locations near Pearce Ferry in Mojave County, to the south beyond the International Boundary, and at many scattered locations in between (AIDTT 2000 in AZGFD 2010). The northeastern-most tortoise records in Arizona occur along the Salt River near Roosevelt Lake in Gila County, although populations have not been confirmed with recent observations (AZGFD 2010). The middle San Pedro River drainage in Cochise County harbors the easternmost substantial tortoise populations. Desert tortoise observations have been confirmed in extreme southeastern Cochise County, but probably represent released captives (pets) (AZGFD 2010). Tortoises have been found as far southwest as the Barry M. Goldwater Range, Yuma Proving Ground, and the Cabeza Prieta National Wildlife Refuge (AZGFD 2010).

POPULATION STATUS AND THREATS

Status. The genus *Gopherus* contains four extant species in the southern U.S. and Mexico (Crumly 1994). Although not recognized as being taxonomically distinct, the USFWS has found extensive scientific evidence that the Sonoran Desert Tortoise differs significantly from either the Sinaloan or Mojave populations in terms of behavior, ecology, morphology, and genetics (USFWS 2010a). Therefore, the USFWS recognizes the Sonoran Desert Tortoise as a distinct population segment. Based on numerous ways that the Sonoran Desert Tortoise is negatively impacted by a variety of threats (see below), the USFWS has determined that it is warranted for listing under the ESA. However, since there is currently no evidence that any existing population is threatened with extinction in the near future, listing is precluded by higher priority actions to amend the Lists of Endangered and Threatened Wildlife and Plants (USFWS 2010a). Since the 2010 USFWS determination, researchers have used a suite of characters to diagnose the Mojavian and Sonoran populations. From their findings, they distinguish these populations as separate taxa and name a new species (Murphy *et al*. 2011).

Based on distance-sampling surveys of DT in Saguaro National Park, Tucson Mountain District, density was estimated to be 0.62 tortoises per acre (0.25 per ha). When pooled with survey results from Saguaro National Park, Rincon Mountain District, the estimated density increases to 0.77 tortoises per acre (0.31 per ha) (Zylstra 2008).

Threats. The DT faces various threats, including those related to destruction, modification, and fragmentation of habitat. The spread of non-native invasive plant species is one such threat. In particular, the non-native, invasive perennial buffelgrass outcompetes native vegetation, reducing floral diversity.

The spread of buffelgrass also increases wildfire risk as it fills interspaces between native plants. Buffelgrass is a highly ignitable fuel in ecosystems evolved within fire regimes characterized by long return intervals and patchy burns (USFWS 2010a). Wildfires not only destroy Sonoran desertscrub habitat but can also directly injure or kill DT. In addition to the spread of non-native invasive species and associated increases in wildfire risk, urbanization is also detrimental to habitat. As the human population of Arizona continues to increase, homes, commercial and industrial buildings, roads, and other structures are built to accommodate this growth, resulting in the direct loss and fragmentation of desertscrub habitat. The increased prevalence of barriers to DT movement from human-made structures can lead to problems for genetic exchange (USFWS 2010a). Additional threats to the DT include those from OHVs, cattle grazing, undocumented human immigration, illegal collection, disease (e.g., upper respiratory tract disease), unnatural sources of predation (e.g., from free-roaming dogs), handling by researchers leading to bladder evacuation, vehicle strikes, ingested balloons and trash, and climate change (USFWS 2010a).

2.6.2 Ecology

LIFE HISTORY

DT activity begins in the spring as temperatures warm, decreasing as the season moves into the summer drought in May and June, when DT are inactive in burrows, conserving water and energy (AZGFD 2010). The onset of the summer monsoon season then signals the beginning of peak tortoise activity, which is typically from late June through September (USFWS 2010a). Surface activity decreases as early as late September and ends in mid-December when hibernation is likely cued by photoperiod and temperature (USFWS 2010a). However, some individuals may bask, move, or even forage on warm winter days. Females may then terminate hibernation as early as late February, while some males may remain inactive through the entire spring (AZGFD 2010).

Mating typically occurs during the summer monsoon season (AZGFD 2010). Females begin laying eggs, which are fertilized by sperm stored from the previous summer's mating, just before or during the onset of the summer rains, in late June or early July (AZGFD 2010). They lay only one clutch of about six eggs, but three to 12 eggs in a clutch have been reported. The proportion of females reproducing is related to the amount of recent rainfall and vegetation available for forage. Females usually lay their eggs inside burrows with adequate soil development, and many remain at and defend their nests against predators (AZGFD 2010). Some hatchlings emerge from the nest in late summer, but others may over-winter in the nest before emerging during the following spring. Little information exists on survivorship of young tortoises, but given adult longevity and their capacity to produce more offspring than necessary to replace mortalities in the population, juvenile survivorship is probably very low (AZGFD 2010). Tortoises grow relatively rapidly early in life and reach about half their maximum size at five to 10 years (AZGFD 2010). The growth rate tapers off as individuals slowly approach their maximum size. After 10 to 20 years, tortoises reach sexual maturity at about 8.7 in (22 cm) carapace length. Males reach larger sizes than females in some populations, but not in others (AZGFD 2010).

The adult tortoise carapace provides protection against potential predators, contributing to their high survivorship. Mountain lions (*Puma concolor*) appear to be the primary natural predator on adult tortoises in the Sonoran Desert, but lions usually have not contributed to elevated rates of mortality in studies so far (USFWS 2010a).

The Sonoran Desert Tortoise is an herbivore known to eat 199 species of plants. These include herbs (55.3 percent), grasses (17.6 percent), woody plants (22.1 percent) and succulents (5 percent), with the diet varying among populations based on seasonal availability of plant species (USFWS 2010a).

HABITAT REQUIREMENTS

Adequate shelter is one of the most important habitat features for DT in the Sonoran Desert (USFWS 2010a). DT use burrows for nesting, protection from predators, and thermoregualation as they escape extreme temperatures (USFWS 2010a). DT require loose soil in which to excavate (usually shallow) burrows below rocks and boulders, but they may also use rock crevices. DT occasionally burrow under vegetation; less often, they dig soil burrows on more or less open slopes and also use caliche caves in incised wash banks (especially in the Lower Colorado River Valley subdivision). They will also rest directly under live or dead vegetation without constructing a burrow (AZGFD 2010).

The Sonoran population of the DT occurs primarily on rocky slopes and bajadas of Mojave and Sonoran Desertscrub, but may also use intermountain valleys for dispersal and as part of their home ranges (USFWS 2010a). The species generally occurs at elevations ranging from 510 to 5,300 ft (155 to 1,615 m (USFWS 2010a). The Sonoran population can be found in a variety of biotic communities within or extending from the Sonoran Desert, but most often occurs in paloverde-mixed cacti associations (AZGFD 2010). DT are found in the Arizona Upland and Lower Colorado River Valley subdivision of the Sonoran Desert, desert grassland, and ecotonal areas consisting of Sonoran Desertscub with elements of Mojave Desertscrub and Juniper Woodland, Interior Chaparral, and Desert Grassland (AZGFD 2010).

Home ranges sizes vary with precipitation levels in response to the availability of forage plants, but can be as small as 6.4 ac (2.6 ha) or as large as 640 ac (258 ha). Riedle *et al*. (2008) estimated mean home range sizes of 82.5 ac (33.4 ha) for males and 44 ac (17.8 ha) for females. For DT in the Tucson region, a mean yearly home range size of 39 ac (15.7 ha) was calculated based on radio telemetry data gathered from 2000 to 2002 for a portion of the Saguaro National Park, Rincon Mountain District (Stitt *et al.* 2003c in Zylstra and Swann 2009).

2.6.3 Permit Area Baseline Conditions

PERMIT AREA POPULATION STATUS AND IMPORTANCE TO THE SPECIES

No surveys have been conducted for this species specific to the HCP Permit Area. However, surveys have been conducted in the Tucson Mountain District of Saguaro Nationa Park (see Zylstra and Swann 2009 and Powell *et al*. 2007) as well as in the Ironwood Forest National Monument (IFNM). In their study of the distribution and density of Desert Tortoises at IFNM – which is west of the Permit Area – the authors developed a habitat categorization and associated map for the species (Averill-Murray and Averill-Murray 2002). The former Trust 205 farm and the Flying E Bar farm are the only Permit Area properties adjacent to IFNM. However, neither is adjacent to modeled habitat. The Flying E Bar property abuts the IFNM along its southern boundary where there is no modeled habitat. The western border is separated by approximately 0.25 – 0.5 mi (0.4 – 0.8 km) of private, residential land. The Trust 205 farm is approximately 2.5 mi (4 km) from category 3 (lowest value of 3 categories) modeled habitat.

Based on current knowledge of the DT and the Permit Area, the TAC advised the City that the Permit Area does not contain the bajada rockslope or incised washes with caliche caves that provide habitat for the species. Although valley bottoms may be used by the species, the degradation of the lands from past agricultural practices make use of the lands by the tortoise marginal, accidental, or infrequent for long-distance movement between populations in adjacent mountain ranges.

2.6.4 HCP Biological Goals and Objectives

City's biological goal and for the Desert Tortoise is to contribute to maintaining local and regional populations of Desert Tortoise. The City's specific objective for Desert Tortoise is to reduce the potential for direct mortality to Desert Tortoises that may be crossing Avra Valley

2.7 Tucson Shovel-Nosed Snake (*Chionactis occipitalis klauberi*; TSNS)

2.7.1 Population Range, Distribution, Status, and Threats

RANGE AND DISTRIBUTION

The historical range of the Tucson Shovel-nosed Snake (TSNS), a subspecies of the Western Shovel-nosed Snake (*Chinactis occipitalis*), is believed to have occurred in a narrow band from southeastern Maricopa County through southwestern Pinal County to northern Pima County, inclusive of the City (Recon 2002). According to the USFWS (2010b), "The subspecies was historically known from Pima County in the Avra and Santa Cruz valleys (Rosen 2003, p. 4) and from western Pinal and a portion of eastern Maricopa counties (Klauber 1951, p. 196)." Currently the range is thought to include the area between the Phoenix and Tucson metropolitan area (USFWS 2010b).

POPULATION STATUS AND THREATS

A petition was filed in December 2004, requesting that the TSNS be considered for listing under the ESA (USFWS 2010b). In 2010, the USFWS announced that listing the species is warranted but precluded by higher priority actions, thus putting it on a list of candidate species (USFWS 2010b). Northern Avra Valley, in the vicinity of the Permit Area, is one of the few areas that have been extensively surveyed. As late as the mid-1970s, surveyors were observing TSNS as many as two to three times per night (Rosen 2003b). However, the last verifiable record of the species in Pima County was in 1979 (USFWS 2010b). Rosen (2003b) surveyed for the subspecies in and around the Town of Marana and Avra Valley in 2003 and 2007. He and his team failed to detect any TSNS within the Permit Area, although three were detected in 2007 in Pinal County on the margins of the Santa Cruz Flats (Rosen 2008a). In a 2008 TSNS study, AZGFD deployed trap arrays at the Florence Military Reservation north of Florence in Pinal County. During three 15-day periods, 28 TSNS were documented (Mixan and Lowery 2008).

The primary threat to the TSNS, and likely cause of the subspecies' presumed decline, is the loss of habitat through agricultural and urban development (USFWS 2010b) as well as due to habitat destruction or range curtailment due to road construction, solar power facilities and transmission corridors, and wildfires (USFWS 2010b). Grading and farming of former habitat alters soil conditions and removes native vegetation, thereby eliminating essential habitat components for this species. Specifically in the Avra Valley Permit Area, Rosen (2008b) states, "Entrenchment of the Brawley Wash system has apparently led to massive erosion and export of sandy-silty soil components in many areas, leaving behind hard abode soils poorly suited to sand-adapted snakes and largely unsuitable for most other species of many ecological types."

Another potential factor in the decline of TSNS populations may be competition from the morphologically, ecologically, and behaviorally similar Banded Sand Snake (*Chilomeniscus cintus*) (Rosen 2003b). Drawing an analogy from the relationship between Desert Horned Lizards (*Phrynosoma platyrhinos*) and Regal Horned Lizards (*Phrynosoma solare*), Rosen suggests (2003b and 2008b) that the Banded Sand Snake population and distribution may be expanding at the expense of shovel-nosed snakes. The Banded Sand Snake was not recorded on the floor of Avra Valley until 1983, after which it appears to have increased in abundance. This time frame coincides with the marked decline in TSNS, from reasonably abundant during the 1970s to undocumented after 1979. Whether the Banded Sand Snake is contributing to the decline of the TSNS or simply invading altered habitat following extirpation of the TSNS is uncertain.

2.7.2 Ecology

LIFE HISTORY

The Western Shovel-nosed Snake is adapted to moving quickly through loose sand and loamy soils. This movement has been described as sand swimming (Stebbins 2003; Rosen 2003b). This small 9.8 to 16.7 in (25 to 42.5 cm) Coral Snake mimic uses venom to subdue its prey, which includes insects, scorpions, spiders and centipedes (Stebbins 2003; Rosen 2003b). The shovel-nosed snake feeds frequently and, as a result, is thought to actively forage from at least April through October (Rosen *et al.* 1996 in USFWS 2010b). The shovel-nosed snake is thought to breed in May and June. Only a quarter of females surveyed during the breeding season were found to be reproductively active, indicating that all females do not breed each year (Goldberg 1997). The species is oviparous and has a clutch of two to four eggs in the summer (Stebbins 2003). Western shovel-nosed snakes are primarily nocturnal (Stebbins 2003), although on cool days they may also be active in the late and early evening (Warren 1953 in Recon 2002) and recent reports indicate that morning activity can be more common than previously recognized (Rorabaugh 2007). Rosen (2003b) researched the seasonal activity cycle of the TSNS and discovered that observed activity peaks during May and decreases rapidly through late June. There is residual observed activity in early July and almost no observed activity after that. Shovel-nosed snakes also appear to be more active after warm summer or hot spring days and on days with higher relative humidity (Rosen *et al.* 1996). Daily observed activities appear to occur both above and below the surface. According to Norris and Kavanau (1966), "Surface activity in the species apparently is confined to a relatively small fraction of the day, in aggregate probably no more than a total of four or five hours, and may be dependent upon available thermal conditions."

HABITAT REQUIREMENTS

The Western Shovel-nosed Snake is known from the Lower Sonoran life zone, primarily on valley bottoms and gently sloping bajadas, usually in areas with sand dunes or soft sandy loams. For the TSNS, Rosen (2003b) suggests that populations in Avra Valley centered on the valley floor, with only fringes of the distribution extending into adjacent bajadas. He also notes that the species appears to prefer creosote bush-mesquite floodplains, but also may occur in areas of open upland creosote (Rosen 2003b). The species prefers soils containing little or no gravel (Rosen 2003a).

2.7.3 Permit Area Baseline Conditions

PERMIT AREA POPULATION STATUS AND IMPORTANCE TO THE SPECIES

The last known record of the TSNS in the vicinity of the Permit Area was at Sanders Road and Avra Valley Road in 1979 (Rosen 2003b, USFWS 2010b). It is unknown whether the species persists within the Avra Valley HCP Permit Area. It was not observed during species-specific surveys conducted in and

around Marana in 2003 and 2007. The previously mentioned records of TSNS observed in Pinal County near the Santa Cruz Flats demonstrate that the species is not regionally extinct, and may still inhabit the Avra Valley (Rosen 2008a).

The range of the subspecies under consideration here extends from southeastern Maricopa County through southwestern Pinal County to northern Pima County, inclusive of a portion of the Avra Valley Permit Area. It is possible that the TSNS genotype might only be available for long-term conservation in the area of Mobile, Arizona (Rosen 2003b).

MODELED HABITAT

When developing the TSNS habitat model for the Town of Marana HCP, Dr. Rosen concluded that elevation and soil taxonomy and condition provide the best overall predictors of potential habitat for this species. Elevations greater than 2,300 ft (700 m) were eliminated because existing records do not include observations of the species above that elevational limit in the HCP Permit Area. Active agricultural lands and developed areas were eliminated as potential habitat because soils in these areas are no longer suitable for use by this species. Lands classified as either high or moderate habitat potential were combined to determine the amount of habitat within the Permit Area, which total 2,240 ac (906 ha). However, because these lands were retired from farming 20 to 30 years ago, they cannot be ruled out as future snake habitat as long as they have appropriate soil types and occur within the elevational range of the species. Due to the potential recovery of snake habitat in these areas, these former farmlands are considered as possible restoration areas for the species in the City's TSNS habitat model.

2.7.4 HCP Biological Goals and Objectives

Although the current TSNS population status within the Avra Valley HCP Permit Area is unknown, the Permit Area contains approximately 2,240 ac (906 ha) of potential TSNS habitat. Implementation of the proposed covered activities will result in the loss of potential habitat in the HCP Permit Area. Direct take of Shovel-nosed Snake individuals may occur as a consequence of development-associated ground disturbance activities. Long-term indirect effects may include fragmentation of habitat and isolation of habitat patches. For these reasons, the City's biological goal for the TSNS is to contribute to maintaining local and regional populations. The City's specific objectives for TSNS are to maintain long-term availability of habitat and minimize loss of individuals.

CHAPTER 3 – IMPACTS OF THE HABITAT CONSERVATION PLAN

3.1 Activities Proposed for Coverage under Permit

In determining which activities should be covered by the Permit, according to the USFWS HCP Handbook guidance, "The applicant should be encouraged to include in the HCP a description of all actions within the Permit Area that: (1) are likely to result in incidental take; (2) are reasonably certain to occur over the life of the permit; and (3) for which the applicant or landowner has some form of control" (USFWS 1996). In addition, City staff considered the following guidance when determining which projects to include for Permit coverage. According to the HCP Handbook (USFWS 1996) "Generally, applicants should be encouraged to include as comprehensive a set of activities in the HCP as is practicable. This will maximize the permittee's long-term planning assurances, broaden legal coverage, and minimize the possibility that some future activity will not be covered by an issued permit."

Activities to be covered by the City's Avra Valley HCP and Permit include any activities carried out or authorized (i.e., allowed by contract or agreement) by the City within the HCP Permit Area that may result in take of covered species. Described below, these activities can be grouped into four categories, consisting of 1) Tucson Water development activities related to governmental uses of the land (e.g., public water supply infrastructure development), 2) operation, maintainence and repair of these facilities, 3) land management, stewardship, and restoration activities, and 4) minimal impact activities that might occur on the lands. Only those activities that permanently and negatively impact species habitat will be mitigated with permanent actions as described in Chapter 4. Such activites are described below under water supply infrastructure development.

3.1.1 Water Supply Infrastructure Development

The development of public water infrastructure within the HCP Permit Area may occur over the next 50 years. In 2004, Tucson Water completed a 50-year water resources plan, entitled *Water Plan* 2000-2050 (City of Tucson 2004) as well as an update to this plan in 2008 (City of Tucson 2008a). Many of the future activities in Avra Valley are dependent on decisions still to be made by the community and the City's Mayor and Council regarding enhanced treatment for mineral content (salinity control) and the utilization of effluent. While the individual projects that will be required to implement these future decisions are not specifically known, the listed activities below encompass the range of potential projects that may be required to meet the community's future water needs. These include, but are not limited to:

- Recharge basins for CAP groundwater percolation
- Water treatment plants
- Reservoirs for water storage
- Boosters for water transmission
- Transmission main pipelines and other pipelines for water transmission
- Wells for groundwater extraction, water testing, or research
- Evaporation ponds and brine disposal
- Gas pipes and electricity lines for energy distribution
- Wetlands for tertiary treatment of effluent
- Flood-control projects such as berms and basins
- Administrative buildings and facilities
- Maintenance yards for project-related equipment and vehicles
- Roads to access all facilities
- Energy generation facilities (e.g., gas engines,

landfills for water quality enhancement	solar photovoltaic panels) to provide power to water supply infrastructure projects

Based on long-range planning documents such as the "Water Plan 2000 – 2005" (Water Plan) and the 2008 update, an estimate was made of the maximum areal footprint required should all of these activities be necessary. This would include up to 5,600 ac (2,266 ha) for brine disposal, 1000 ac (405 ha) for the expansion of water recharge facilities, and 700 ac (283 ha) for a treatment plant and well-field. Additional recovery wells associated with recharge facilities may be required and would be anticipated to encompass up to 100 by 100 ft (30.5 by 30.5 m) sites. Pipelines conveying recovered, treated, or brine water may be required, with determination of location and length dependent on future decisions of the community and the City's Mayor and Council. However, given uncertainty about the specific technologies that will be used and the water quality standards that will be determined by the community throughout the duration of the Permit, the areal extent of each project component will be determined as they occur, during construction planning phases. Given this uncertainty, the City is proposing a maximum additional disturbance footprint of 8,000 ac (3,237 ha) for all covered activities in this category, regardless of the specific acreages per project element. These 8,000 acres are in addition to the acreage that has already been developed within the Avra Valley HCP Permit Area.

3.1.2 Operation, Maintenance, and Repair Activities

Operation of facilities can involve a diverse range of tasks including, but not limited to, driving to and from facilities, using heavy machinery within the vicinity of the project, walking on the land to inspect facilities, and others. Maintenance can also include a diverse range of tasks. For example, this may include activities associated with pipelines and valves such as 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. One or two person crews with light trucks, one ton or less, generally perform these activities quarterly. 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 two to ten 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. Other maintenance and repair activities, beyond pipeline and valve repairs, would likely be required at sites with other covered activities.

3.1.3 Land Management, Stewardship, and Restoration Activities

The spread of non-native invasive species, trespassing, illegal dumping, vandalism, and flooding are all examples of threats that impact land within the HCP Permit Area. To address these threats, the City or its contractors will need to continue to undertake land management and stewardship activities, such as: fence installation and fence repair, invasive species removal, maintenance or drainage repair, garbage removal, property monitoring, and other miscellaneous land management activities. The City may also engage in efforts to restore or enhance habitat values of these lands. This may include, but is not limited to:

- Planting and irrigating of native seeds and nursery stock
- Contouring of the landscape to slow, sink, and spread rainwater and runoff to irrigate native plants
- Installation of artificial burrow clusters for burrowing owls

3.1.4 Minimal Impact Activities

This category is meant to capture all activities that might occur within the Permit Area that would have minimal, if any, impact to the land. These activities could include all non-vehicular based passive recreation (e.g., bird watching) or biological studies, educational programs, and tours. Hunting may be allowed within the Permit Area as required by State law. However, to comply with Federal regulations related to the ESA, hunting should be heavily regulated on these lands to avoid directly or indirectly impacting covered species. Regulations should prohibit the following: Vehicular access, camping, fires, nighttime hunting, playback of recorded game calls, and use of firearms within habitat set-aside areas.

It is also possible that the City may designate lands for permanent habitat protection apart from the requirements of the Avra Valley HCP. This may occur if the City is asked to provide mitigation land for another entity. Since these activities would not negatively impact habitat, they would not require mitigation.

3.2 Activities Not Covered by the Permit

Activities authorized by public or private parties other than the City are not covered by the Avra Valley HCP and Permit unless identified above.

3.3 Direct Effects on Covered Species

Guidance provided by the USFWS informs the City's approach to determining direct effects on covered species and anticipated incidental take levels. Section 3.14 of the USFWS HCP Handbook (USFWS 1996) states:

> *d. Determining Anticipated Incidental Take Levels. In determining the amount of incidental take that will be authorized during the life of the permit, three things must be determined: (1) how incidental take will be calculated; (2) the level of incidental take and related impacts expected to result from proposed project activities; and (3) the level of incidental take that the section 10 permit will actually authorize.*
>
> *The first depends on the ability of HCP participants to determine, to the extent possible, the number of individual animals of a covered species occupying the project or land use area or the number of habitat acres to be affected. Depending on this information, proposed incidental take levels can be expressed in the HCP in one of two ways: (1) in terms of the number of animals to be "killed, harmed, or harassed" if those numbers are known or can be determined; or (2) in terms of habitat acres or other appropriate habitat units (e.g., acre-feet of water) to be affected generally or because of a specified activity, in cases where the specific number of individuals is unknown or indeterminable. The latter is typically expressed as all individuals occupying a given area of habitat, in whatever habitat unit is being used.*

While determining that amount of incidental take that will occur, the Avra Valley HCP emphasizes habitat and corresponding mitigation actions. Thus, take is described in habitat terms, not species terms. Mitigation will be based only on habitat impacts, not on species-specific impacts, but will adequately cover take of each individual species proposed for coverage under the HCP.

3.3.1 Habitat Take

The location of the potential covered activities listed above will be determined on a project-by-project basis and the maximum acreage that the City is seeking HCP Permit coverage for is 8,000 ac (3,237 ha) of additional land disturbance over the 50-year duration of the Permit. Effects of habitat take for each species are described below. Actions to avoid, minimize, and mitigate impacts to habitat are described in Chapter 4. The habitat models developed for each species and reviewed by the TAC will inform both where impact is planned to occur as well as where habitat should be permanently protected to mitigate for these impacts. Generally, impacts to modeled habitat can only be mitigated with set-aside of modeled habitat elsewhere in the Permit Area. It is assumed that all of the modeled habitat is considered important for the species and is worthy of permanent protection. However, prior to mitigation, the City will request concurrence from the USFWS about the habitat value of the proposed permanent set-aside.

LESSER LONG-NOSED BAT

The loss of potential movement habitat for LLNB in the Avra Valley HCP Permit Area due to impacts from covered activities has the potential to result in take of LLNB. Construction of these projects will create long-term disturbance to habitat from operation of these facilities and the covered activities may, depending on their location and configuration, result in fragmentation of the remaining LLNB movement habitat within these properties.

PALE TOWNSEND'S BIG-EARED BAT

Impacts to PTBB foraging habitat from covered activities has the potential to result in take through long-term disturbance as well as through potential fragmentation of the modeled habitat in the Permit Area.

WESTERN YELLOW-BILLED CUCKOO

The loss of potential migratory stop-over habitat for Western Yellow-billed Cuckoo (WYBC) in the Avra Valley HCP Permit Area due to impacts from covered activities has the potential to result in take. Construction of these projects will create long-term disturbance to habitat from operation of these facilities and the covered activities may, depending on their location and configuration, result in fragmentation of the remaining potential migratory stop-over habitat within these properties.

CACTUS FERRUGINOUS PYGMY-OWL

The loss of potential dispersal / over-wintering habitat for CFPO in the Avra Valley HCP Permit Area due to impacts from covered activities has the potential to result in take. Construction of these projects will create long-term disturbance to habitat from operation of these facilities and the covered activities may, depending on their location and configuration, result in fragmentation of the remaining habitat within these properties.

WESTERN BURROWING OWL

Construction related to the covered activities described above has the potential to permanently alter WBO habitat. In addition, facility operation and maintain has the potential to cause long-term habitat disturbance.

DESERT TORTOISE

There is no modeled habitat for this species within the Permit Area and, therefore, no habitat take is anticipated.

TUCSON SHOVEL-NOSED SNAKE

Once habitat with relatively undisturbed soil conditions is graded for development, its potential value to this species is lost. Construction of the covered activities described above could permanently impact potential TSNS habitat in the Avra Valley Permit Area due to grading and clearing as well as the long-term operation of the facilities. These impacts could also result in habitat fragmentation.

3.3.2 Lethal Take

For all the covered species, a biological objective is to minimize direct mortality so that few or no individuals are killed during the 50-year term of the HCP. However, given the characteristics of some of the species proposed for coverage under the HCP, implementing the covered activities does have the potential to result in lethal take. For example, construction activities could cause lethal take of WBO or TSNS that are below the ground surface during excavation. Or, these same species may be struck by vehicles during construction or maintenance activities. Initially, the City developed a table of estimated lethal take of individuals. However, based on guidance provided to the City by the USFWS in October 2011, the lethal take table has been removed. This guidance is as follows:

> *1) We do not need a lethal take table for covered actions for which we are using habitat-based take as a surrogate for all take. In other words, any direct or indirect take that is incidental to the proposed action is covered by the ITP for acres disturbed. Our BO will discuss actual numbers of covered species we expect to be killed, harmed, or harassed.*
>
> *2) Lethal take that is direct (intentional) through monitoring and surveying activities can either be covered by research permit [10(a)(1)(A)] or under your HCP. In the latter example, a lethal take table would be appropriate and that lethal take would be considered additive to that anticipated under the surrogate in Item 1* (Jeff Servoss 2011)

Since no intentional direct take is planned or requested for coverage, no estimate of individual lethal take is necessary. This HCP uses habitat impacts as a surrogate for all take anticipated as a result of implementation of covered activities. Therefore, as confirmed by the TAC, the avoidance, minimization, and mitigation measures – particularly the permanent protection of habitat – described in Chapter 4 are adequate to cover all anticipated take, including lethal take. Anticipated lethal take will be quantified and evaluated in the context of the USFWS's Intra-Service ESA Section 7 consultation on the issuance of the Permit. That evaluation will consider the anticipated take in relation to jeopardizing listed species and whether recovery of listed species would be precluded.

LESSER LONG-NOSED BAT

The most likely cause of lethal take would be roost disturbance. Since there are no roosts within the Permit Area, no take of LLNB at roosts is anticipated. However, given that nectar feeding bats are less agile than insectivorous species, collisions with high fences or suspended wires are another potential form of lethal take within the Permit Area. Suspended wires (e.g., electrical wires) or high security fences may be installed as part of the covered activities and could potential result in take of a small number of individual bats over the 50-year term of the Permit.

PALE TOWNSEND'S BIG-EARED BAT

This species uses structures for establishing roosts and roost disturbance or distruction is the most likely form of take. However, given that the Permit Area is primarily vacant, former farmland, chances of removing a structure that has a bat roost are minimal.

WESTERN YELLOW-BILLED CUCKOO

In the Avra Valley HCP Permit Area, lethal take of WYBC would likely be due to collision with power lines or tall structures since no breeding habitat occurs.

CACTUS FERRUGINOUS PYGMY-OWL

Lethal take within the HCP Permit Area would most likely be due to a collision with a City or City-authorized vehicle on a private road within the Permit Area.While no breeding habitat currently exists, the retired farmlands and riparian areas may recover to a level that provides breeding habitat. In that case, nest disturbance or distruction could cause lethal take.

WESTERN BURROWING OWL

Construction activities related to the covered activities have the potential to directly kill or injure WBO by filling in or collapsing burrows. Given the friable nature of the soils in Avra Valley, areas of high burrow density should be avoided by heavy machinery that has the potential to collapse burrows. Pre-construction clearance surveys must be performed in areas of modeled habitat or in areas with burrows. The City will follow the guidelines established in the Burrowing Owl Project Clearance Protocol (Burrowing Owl Working Group 2009) or more recent guidelines published around the time pre-construction clearance surveys are needed. The 2009 protocol calls for up to two surveys (depending on the time of year) prior to construction activities, and potentially involves relocating owls and collapsing burrows within the construction area to prevent WBO from returning prior to completion of construction as part of a covered activity.

Vehicle strikes are another potential cause of direct mortality to WBO. Only facility driveways and maintenance roads will be constructed and, therefore, vehicles will travel slowly. Also, since only City employees or those authorized to enter the property may use roads, the volume of traffic will be very low.

DESERT TORTOISE

While there is no modeled DT habitat within the Permit Area, it is possible that DT may make long-distance movements between mountain ranges. Therefore, construction, operation and maintenance activities related to the covered activities have the potential to directly kill or injure DT by vehicles inadvertently striking them.

TUCSON SHOVEL-NOSED SNAKE

Ground disturbance activities and road mortality are the most likely causes of lethal take of this species within the Avra Valley HCP Permit Area. Given how small and secretive this species is, lethal take may not be detectable as part of ground disturbance activities. However, impacts from maintenance vehicles on private roads within the Permit Area would be detectable. Only facility driveways and maintenance roads will be constructed and, therefore, vehicles will travel slowly. Also, since only City employees or those authorized to enter the property may use roads, the volume of traffic will be very low.

3.4 Indirect Effects on Covered Species

LESSER LONG-NOSED BAT

LLNB can be adversely affected indirectly by land development. Since the Permit Area does not support roost sites for the species, potential indirect effects would be limited to LLNB movement. Noise and artificial light associated with covered activities could cause individual LLNB to alter movement patterns, potentially increasing energetic demands or blocking access to available roost and forage resources. Application of pesticides to control non-native invasive species should not adversely affect any LLNB using the Permit Area to move across the landscape unless such activities inadvertently decrease the health of native vegetation within riparian corridors.

PALE TOWNSEND'S BIG-EARED BAT

Indirect effects from covered activities include noise and artificial lighting as well as construction-related disturbance that could cause individual PTBB to move to other foraging areas, potentially increasing the energetic demands of bats or blocking access to available roost and foraging resources. However, since these bats forage at night or at dawn when construction activities typically are not being conducted, there is little potential for these types of effects. Application of pesticides to control non-native invasive species should not adversely affect any PTBB foraging in the Permit Area unless such activities inadvertently decrease the health of native vegetation within riparian corridors.

WESTERN YELLOW-BILLED CUCKOO

Short-term construction disturbances as well as long-term operations, should they occur within WYBC habitat, would include noise, dust, traffic, and other human activities that could result in deterring WYBC from using the area. Habitat impacts also could affect future use of the area by the WYBC. The level of use of habitat in the Permit Area by migratory WYBC is unclear. If the Permit Area is used by WYBC during migration from within and outside of Arizona, then reductions and/or modifications of habitat could contribute to reductions in cuckoo populations elsewhere. However, the number of cuckoos affected and the impact on local and regional populations is unclear. Application of pesticides to control non-native invasive species should not adversely affect WYBC using the Permit Area unless such activities inadvertently decrease the health of native vegetation within riparian corridors.

CACTUS FERRUGINOUS PYGMY-OWL

In Arizona, CFPOs have rarely been documented making flights greater than 100 ft (30.5 m) and they appear to avoid large open areas such as golf courses (USFWS 2003b). Therefore, any vegetation clearing and construction related to covered activities that is greater than 100 ft (30.5 m) can act as impediments to CFPO movement (USFWS 2003b). Wide roadways can also result in CFPO flying directly into the path of oncoming vehicles. However, no wide, public roads are included as covered activities in this HCP.

The potential loss of modeled habitat within the Permit Area could reduce the maximum number of breeding pairs in southern Arizona primarily through fragmentation of potential dispersal / over-wintering habitat. Habitat on lands in the Avra Valley Permit Area provides connectivity between breeding areas. There is evidence, though limited, that CFPO periodically move through Avra Valley, though not necessarily within the Permit Area. However, given that there are known nesting pairs of CFPO to the west of the Permit Area, and there has been historical occupancy by CFPO to the east, it is not unreasonable to anticipate that there will be CFPO use of the Permit Area.

Application of pesticides to control non-native invasive species should not adversely affect CFPO using the Permit Area unless such activities inadvertently decrease the health of native vegetation within riparian corridors.

WESTERN BURROWING OWL

The WBO population could be adversely affected through indirect mechanisms facilitated by or resulting from land development associated with the covered activities. Potential indirect adverse effects to WBO from land development include increased disturbance from maintenance activities associated with water infrastructure projects. Any tall structures, poles, electrical lines, etc. that are installed could provide perching structures for WBO predators. Vehicle strikes also can cause owl mortality.

There are also potential indirect effects that could result from non-native, invasive plant species management, with pesticide spraying a particular concern. For WBO in the Avra Valley HCP Permit Area, the potential indirect threat of glyphosate bioaccumulation has been researched as part of a City commissioned study (Garcia and Conway 2007). This research suggests that the use of products that include glyphosate should not cause significant adverse effects for the WBO in the Avra Valley Permit Area. However, since the researchers had a small sample size, more research is desireable to confirm this conclusion. Buffelgrass management efforts, such as the spraying the plant with pesticide, may decrease cover in the short-term, which could lead to changes in the prey base available for the WBO.

DESERT TORTOISE

As there is no modeled DT habitat within the Permit Area, indirect effects on the Desert Tortoise would be minimal. Should any DT make rare, long-distance movements between mountain ranges any additional human-made structures such as roads, fences, and facilities could add additional barriers to movement to those that already exist throughout Avra Valley.

TUCSON SHOVEL-NOSED SNAKE

TSNS that are displaced by construction activities could experience higher mortality while searching for unoccupied habitat. Roads and increased traffic on roads can increase mortality of snakes from vehicle strikes. Because it is not known whether this species persists in the HCP Permit Area, the population effects of the City's proposed covered activities are unknown.

3.5 Effects on Critical Habitat

No Critical Habitat has been designated for any of the proposed covered species and, therefore, no effects on Critical Habitat (as currently designated) are anticipated.

CHAPTER 4 – ACTIONS TO AVOID, MINIMIZE, AND MITIGATE IMPACTS

This chapter of the City's Avra Valley HCP outlines species-specific conservation strategies designed to: 1) avoid, minimize and mitigate the potential impact of the proposed covered activities to the maximum extent practicable as required by Section 10 of the ESA, and 2) contribute to the long-term persistence of these species on a regional and/or local level.

4.1 Avoidance and Minimization

4.1.1 Pre-construction clearance surveys

The HCP TAC, with input from outside experts, has determined that pre-construction clearance surveys would not be effective for all covered species. According to Dr. Phil Rosen (2008), due to the difficulty in detecting the TSNS, species-specific surveys will have little value. Where construction is planned to occur, attempts to save individual animals remain infeasible for such secretive, small animals (2008). Moreover, due to the difficulty in tracking foraging bats or bats using the Permit Area for movement between foraging and roosting habitats, pre-construction clearance surveys have not been recommended by the TAC for the LLNB or PTBB. The transitory use of movement and foraging habitat within the Permit Area reduces the likelihood of direct injury or mortality.

Pre-construction clearance surveys will be conducted for the three avian species as part of MBTA compliance. Since the Permit Area is not known to provide breeding habitat for the CFPO or the WYBC, the TAC has advised the City that surveys will have little biological value since the animals will simply fly away once construction begins. Therefore, if these two species become listed and are added to the Permit, pre-construction clearance surveys will no longer be conducted as the ESA Section 10 Incidental Take Permit will become a special purpose permit for MBTA compliance (see Chapter 1 for further explanation). In the event that these two species are found to breed within the Permit Area as determined by the USFWS, the City will continue to conduct pre-construction clearance surveys.

Due to the more intensive use of the Permit Area by WBO, including potential breeding activity, pre-construction clearance surveys will always be conducted for this species, regardless of whether or not the species is listed. The pre-construction clearance survey protocols that will be used for each of the three bird species will be the latest protocols recommended by the USFWS. For example, the document entitled "Burrowing Owl Project Clearance Guidance for Landowners" (Burrowing Owl Working Group 2009) is, as of this writing, the latest pre-construction clearance guidance recommended by the USFWS.

Pre-construction clearance surveys will also be conducted for the DT according to the latest USFWS recommended protocols.

4.1.2 Regulations other than the ESA

For the covered activites described in Chapter 3, the City will comply with other regulations applicable to these extra-territorial City-owned lands, including those of the City, Pima County, the State of Arizona, and the U.S. Government. In addition to local land use regulations, several sets of regulations will have the effect of minimizing impacts to covered species and their habitat. These include regulations related to the following topic areas and are described below:

- Native Plant Preservation
- Landscaping and Screening
- Floodplain and Erosion Hazard Areas
- Air Quality
- Water Quality
- Outdoor Lighting
- Cultural Resources
- Noise

If such regulations are revised by the applicable governmental agency during the term of the Permit, the City will comply with the officially adopted regulations at the appropriate time in the project planning process.

LAND USE REGULATIONS

Although the HCP Permit Area lies within unincorporated Pima County, the fact that the land is owned by the City makes jurisdiction unclear in some situations. This is because governmental uses on government land are often exempted from another jurisdiction's regulations. According to Arizona Revised Statute 9-401:

> *Acquisition of land by city; extent and notice of city jurisdiction*
> *A. A city or town may purchase, lease or rent land, whether contiguous or noncontiguous, lying outside its corporate limits, for its purposes and uses, and any violation of an ordinance of the city or town occurring within the territorial limits of the land may be punished by the city or town having control thereof to the same extent and with like effect as if the violation occurred within the corporate limits.*

Therefore, determination as to whether or not a proposed use is subject to either City or Pima County land use regulations must be conducted on a case-by-case basis. Nevertheless, X percent of the land is currently within Pima County's Rural Homestead (RH) Zoning Code, which allows governmental uses. In addition, the Pima County Zoning Code includes land use exceptions for public utilities per section 18.07.040. For example, the Code states that "B.1. Nothing in this code shall prevent the location, erection, alteration, or maintenance of pipes, poles, wires, and similar installations necessary to distribute public facilities; B.2. In addition to other provisions of this code, the uses of this subsection shall be permitted in any zone and shall not be subject to the minimum lot area requirements." Therefore, depending on the situation and the applicable jurisdiction, the City may comply with its own regulations or voluntarily comply with Pima County regulations. For example, in the draft EA for the SAVSARP Recovered Water Pipeline, the City complied with its Native Plant Preservation Ordinance (NPPO) on the City-owned portions of the project (SWCA 2008). For SAVSARP, the City also complied with the City's NPPO by contracting for the completion of an Environmental Resources Report, which is a requirement of the City's NPPO (SWCA 2007).

NATIVE PLANT PRESERVATION

The City's NPPO (City Land Use Code, Division III, Division 8) – to which Pima County has an analog – is intended to encourage preservation-in-place of healthy native plants. This is through sensitive site design which minimizes the disruption of areas within the site containing native plants, while allowing for salvage and transplanting plants on the site that are likely to survive. These regulations apply to all new development and the expansions of existing development. Plants currently protected under these

regulations include: Pima pineapple cactus (*Coryphantha scheeri* var. *robustispina*), needle-spined pineapple cactus (*Echinomastus erectocentrus* var. *erectocentrus*), saguaros, and all other cacti; blue and foothill paloverde, Fremont cottonwood and Goodding willow, desert ironwood (*Olneya tesota*), velvet and screwbean mesquite (*Prosopis pubescens*), and other native tree species; and catclaw and whitethorn acacia (*Acacia constricta*), desert hackberry (*Celtis spinosa*), and other native shrubs; and ocotillo (*Fouquieria splendens*) and soaptree yucca (*Yucca elata*). Plant preservation requirements can be determined using one of four approved methodologies, including 1) Plant Inventory, 2) Plant Appraisal, 3) Set Aside, and 4) a combination approach.

Under the Plant Inventory Methodology, all native plants on site must be inventoried and preservation must meet specified minimum percent protections for these plants. A minimum of 100 percent of endangered species and "crested saguaros," 50 percent of saguaros and ironwoods, and 30 percent of all other protected native plant species must be preserved-in-place or salvaged and transplanted on-site. Any plants that are removed from the site or salvaged and transplanted on-site must be mitigated at ratios ranging from 1 to 3 additional plants for each individual removed or transplanted. A credit towards this mitigation requirement is provided for preservation-on-site of plants at a ratio of 1 to 4 credits for every individual preserved in place. In the Plant Appraisal Methodology, the monetary replacement value for each individual of the protected species that are removed from the site is calculated to purchase an equal value of native plants of the same species to be planted on site. The Set Aside Methodology allows provisions of the NPPO to be met through permanent protection of at least 30 percent of the site as undisturbed open space. This set aside should consist of the area(s) on site with the highest resource value. In addition, 100 percent protection of all federally endangered plant species, saguaros, and ironwoods is required through preservation-in-place or salvage and transplantation on-site.

LANDSCAPING AND SCREENING

The City's landscaping and screening requirements (City Land Use Code, Article III, Division 7) are intended to help conserve energy, water, and other natural resources through the use of xeriscape landscaping principles, to promote air quality, to improve community aesthetics, and to protect the public health, safety, and welfare. Compliance with the requirements should:

1. Help acheive City water conservation goals through the use of drought-tolerant plantings and xeriscape principles in landscape design.
2. Reduce air pollution and dust by encouraging the use of vegetation for air filtration and absorption of carbon dioxide and production of oxygen.
3. Reduce the heat and glare radiated by the built environment.
4. Reduce soil erosion by slowing stormwater runoff.
5. Assist in ground water recharge.
6. Limit the use of allergenic, pollen-producing plants.

For projects required to comply with these regulations, water harvesting principles are often incorporated such that 1) stormwater detention/retention basins are landscaped to enhance the natural configuration of the basin, and 2) grading, hydrology, and landscape structural plans are integrated to make maximum use of site stormwater runoff for supplemental on-site irrigation purposes. The landscape plan shall indicate use of all runoff, from individual catch basins around single trees to basins accepting flow from an entire vehicular use area or roof area. Since on-site runoff is directed to native plant vegetated detention/retention basins and/or landscaping areas, the additional water can establish and maintain relatively dense pockets of native vegetation providing wildlife habitat.

FLOODPLAINS AND EROSION HAZARD AREAS

The City is under State and Federal mandates to regulate stormwater and floodplain development and has a long-standing commitment to preserving watercourses in their natural state. Watercourses left in their natural state support plants and wildlife, help safely convey stormwater through the landscape, improve stormwater quality, and promote groundwater recharge. The City has codes, ordinances, development standards, and policies that apply to floodplains and riparian habitat.

The City's Floodplain and Erosion Hazard Area Regulations (City Code, Chapter 26, Article 1, Division 1) provide for the management of uses and development in floodplains to protect the public from flooding and to protect riparian habitats. All proposed developments within the 100-year floodplain must be reviewed for compliance with these regulations. Any development in the 100-year floodplain requires a Floodplain Use Permit that must be approved by the City Engineer. All watercourses with a 100-year discharge of 100 cubic feet per second or more are regulated under the Floodplain and Erosion Hazard Management Code (Chapter 26). The Floodplain and Erosion Hazard Area Regulations address the requirements for setbacks to structures and reference the City's 1998 Standards Manual for Drainage Design and Floodplain Management in Tucson, Arizona for determining how to calculate setback distances.

Per the provisions of CityDevelopment Standard 9-06, properties on which there is a regulated watercourse may be required to complete a Watercourse Environmental Resources Report (WERR) if the developer proposes to encroach within the regulated area of the watercourse. In the WERR, the developer – in this case, the City – must detail the location and composition of, and impacts to, any riparian vegetation that is present within the regulated area. This riparian vegetation is known as the Protected Riparian Area (PRA). Additional site-specific information including wildlife detected in and near the site is also required in the WERR. Utilities may be considered necessary development that may cross PRA. Other encroachments into the PRA may be allowed if necessary to accomplish site development. A Mitigation Plan must be submitted to address any proposed impacts within the PRA. A Development Standard Modification Request must be submitted requesting permission to undertake the proposed encroachment. Voluntary revegetation, restoration, or enhancement of habitat inside the PRA is not considered encroachment and is allowed, with submittal of a Restoration Plan.

AIR QUALITY

For any covered activity, the City must comply with Title 17 of Pima County Code of Ordinances related to the Pima County Air Quality Control District. The Pima County Air Quality Control District was created in accordance with ARS 49-474B, 49-474, and 49-475 and applies to all "types, kinds, and sizes of air pollutant emission sources in Pima County pursuant to ARS 49-402" (Pima County Code, Title 17). For example, Pima County Code states that:

> *The owner or operator of any stationary or portable source of air pollution which burns any material, except natural gas, shall keep complete records of the materials used as fuel. The owner or operator of any stationary or portable source of air pollution which incinerates any material shall keep complete records of all materials incinerated.*

and

> *Any facility described in Section 17.16.010C utilizing any fuel source or incinerating any material which the operator has any cause to believe may be a hazardous waste shall test such material to determine if the material is a hazardous waste prior to burning or*

incinerating the material. If the material is a hazardous waste, the facility shall comply with Section 17.16.150.

In addition, rule 202 of the State Implementation Plan states that:

A person who plans to erect, install, or replace an emission source which may cause, emit, contribute to, or control air pollution; or who plans to expand or modify any source in such a manner that the potential or actual emission rate would increase or decrease by virtue of the expansion or modification; or who plans to engage in an activity which may cause or contribute to air pollution – except as specifically exempted herein-shall obtain an Installation Permit from the Control Officer. The permit shall be obtained prior to beginning construction or modification of the source, commencement of the activity, or before entering into a binding agreement related to construction of the planned emission operation or activity which cannot be cancelled or modified without substantial loss to the person, whichever occurs first in time. (Pima County, undated)

WATER QUALITY

To protect surface water quality as part of any construction projects, the City requires that a grading permit be obtained from the Planning and Development Services Department prior to any grading or grubbing per Development Standard 11-01.0. In addition, the City has a Municipal Stormwater Permit as authorized Federal and State regulations (40 CFR 122.26 and ARS Title 49, Ch. 2, Article 3.1) that enables the City "to comply with all applicable stormwater quality provisions of Federal, State, and local laws and regulations to ensure the future health, safety, and general welfare of the citizens of Tucson, as well as the protection and preservation of the local environment." (City Code, Chapter 26, Article II). This City code also describes prohibited and non-prohibited discharges and requirements such as a surface water pollution prevention plan.

OUTDOOR LIGHTING

The City and Pima County have ennacted an outdoor lighting code (City ordinance 10135, Attachment A) with the purpose of preserving the relationship of the residents of Tucson and Pima County to their unique desert environment through protection of access to the dark night sky. According to the ordinance, intended outcomes include:

Continuing support of astronomical activity and minimizing wasted energy, while not compromising the safety, security, and well being of persons engaged in outdoor night time activities. It is the intent of this Code to control the obtrusive aspects of excessive and careless outdoor lighting usage while preserving, protecting, and enhancing the lawful nighttime use and enjoyment of any and all property. It is recognized that portions of properties may be required to be unlit, covered, or have reduced lighting levels in order to allow enough lumens in the lighted areas to achieve light levels in accordance with nationally recognized recommended practices.

Most of the HCP Permit Area is within the restrictive "Lighting Area E1c," which includes a circular area thirty-five miles in radius, the center of which is the Kitt Peak National Observatory. Given the potential sensitivity of LLNB to light pollution (Lowery *et al.* 2009) as well as the proximity of Avra Valley to National parks, monuments, and observatories, more restrictive lighting area requirements (e.g., E1a) may be considered if compatible with the overall purpose of the covered activity. Table 5.1.1 of the City's outdoor lighting code indicates the lumen maxima per lighting area designation (e.g., E1c) in mean lumen

per net acre. This information will be referenced and used when complying with the outdoor lighting code.

CULTURAL RESOURCES

Representing approximately 12,000 years of human settlement, Pima County has a wealth of cultural resources (Pima County 2001). Just within the Avra Valley HCP Permit Area, significant archaeological sites have been documented. For example, in her archaeological survey of the City's Simpson Farm property, Stevens (2001) states that:

> *AZ AA:11:12 (ASM), also known as the Pig Farm, Five Bridges, and Silverbell site, lies on an elevated area between the floodplains of the Santa Cruz River and the Los Robles Wash. The site consists of several areas of very high artifact density surrounded by a low-to-medium artifact desnity scatter. Central portions of the site are heavily potted, revealing adobe structures and burials, both inhumations and cremations. Surface features include several deflacted trash mounds. Based on ceramic identification, the site dates to the Rillito, Rincon, and Tanque Verde phases. An early ceramic component may also be present.*

Ruble (2005), in her assessment of the City's Santa Cruz Farm, recorded a total of 20 features, five of which were prehistoric in age and the remaining 14 were historic-period in age.

To protect and enhance this cultural heritage, City staff is directed to comply with all applicable laws and regulations governing protection of historical and archaeological resources (City Administrative Directive 1.07-7 Protection of Archaelogical and Historical Resources in City Projects). These include:

1. National Historic Preservation Act
2. State Historic Preservation Act
3. Arizona Antiquities Act
4. State Laws – Human Burials – ARS 41-844 and ARS 41-865
5. City of Tucson Resolutions No. 12443 and 16548

Furthermore, "departments shall ensure that no land leveling, grading or excavation occurs on City projects, and no designated historic structures or potentially historic structures are altered or demolished, without first receiving clearance for such activities in accordance with the provisions of the directive. Departments shall seek this clearance during the earliest stages of project planning, so that any potential impacts can be identified and resolved without causing project delays or unplanned increases in project budgets" (City Administrative Directive 1.07-7). Thus, for any covered activities planned to occur as part of this HCP, compliance with all applicable cultural resource regulations and policies will occur.

NOISE

Although activities or operations of governmental units or agencies are exempted from noise restrictions, to the extent practicable, covered activities will comply with the City's excessive noise ordinance (Tucson Code, Chapter 16, Article IV, Section 16-31 – Excessive Noise). The ordinance establishes maximum permissible sound levels (Table 4.1.2) so that no person shall conduct or permit any activity that produces A-weighted decibels (dB(A)) beyond that person's property line exceeding the levels specified in the table below.

Table 4.1.2. City noise ordinance maximum sound levels (in dB(A))

Use of Property Receiving the Sound	7:00 a.m. to 10:00 p.m.	10:00 p.m. to 7:00 a.m.
Residential	70	62
Commercial	72	65
Industrial	85	70

4.2 HCP Permit Area Mitigation

4.2.1 Permanent Protection of Existing Modeled Habitat within the HCP Permit Area

The majority of land within the HCP Permit Area consists of former agricultural fields that were purchased by the City in the 1970s and 1980s. As a result, habitat quality is highly variable within the Permit Area. For example, while there are undisturbed riparian corridors, there are also many uncultivated and formerly cultivated lands that have been impacted in varying degrees by agricultural practices, livestock grazing, the proliferation of invasive species, off highway vehicle use, and human pedestrian traffic. The rate of recovery of the former farmland depends on various factors, such as intensity of farming efforts, soil type, and proximity to watercourses. For species such as the TSNS, it is unknown at which point farm fields made unsuitable by native species removal and soil compaction will have recovered sufficiently to become habitat.

The primary strategy for conservation of the covered species in this HCP is the protection of existing habitat (Figure 4.2.2). Table 4.2.2-1 lists the amount of modeled habitat for each species within the HCP Permit Area, except the Desert Tortoise which does not have modeled habitat within the Permit Area. The total footprint of modeled habitat is 7,590 ac (3,072 ha), leaving 11,430 ac (4,625 ha) of the Permit Area as non-modeled habitat. Because of the Permit Area's history of intensive agricultural use prior to the City's purchase of these lands, only 40 percent of the Permit Area currently provides potential habitat for the covered species.

The seven covered species use the Permit Area in different ways. The focus of this measure is to preserve those species-specific habitat functions that currently exist within the Permit Area, specifically to:

- Maintain existing LLNB movement habitat;
- Maintain existing PTBB foraging/movement habitat;
- Maintain existing WYBC migratory stop-over habitat;
- Maintain existing CFPO potential dispersal / over-wintering habitat;
- Maintain existing WBO breeding, migrating, and over-wintering habitat,
- Prevent direct mortality of any DT making long-distance, inter-mountain movements, and;
- Maintain existing TSNS year-round habitat.

Figure 4.2.2. Avra Valley HCP modeled habitat for the six covered species. (Please see figures at the end of the document)

Table 4.2.2-1. Covered species modeled habitat within the HCP Permit Area

Species	Modeled habitat in HCP Permit Area
Lesser Long-nosed Bat[1]	2,040 ac (826 ha)[1]
Pale Townsend's Big-eared Bat[1]	
Western Yellow-billed Cuckoo[1]	
Cactus Ferruginous Pygmy-owl[1]	
Western Burrowing Owl	4,775 ac (1,932 ha)
Desert Tortoise	None
Tucson Shovel-nosed Snake	2,240 ac (906 ha)
Total habitat footprint (overlapping habitat merged)	*7,590 ac (3,072 ha)*
Remaining Permit Area with no modeled habitat	*11,430 ac (4,625 ha)*

[1]The footprint of modeled habitat is the same for Lesser Long-nosed Bat, Pale Townsend's Big-eared Bat, Western Yellow-billed Cuckoo, and Cactus Ferruginous Pygmy-owl

MITIGATION RATIOS

Given the variability of the HCP Permit Area's importance for each of the covered species, the City proposes to set-aside habitat at different ratios for each species. These ratios indicate the amount of habitat set-aside for every acre that is proposed for impact. For example, a 3:1 mitigation ratio requires that 3 acres are set-aside for every 1 acre that is developed. Given that the "currency" for mitigation is not species, but habitat, the mitigation ratios are not additive (i.e., that several species have the same modeled habitat does not require summing the ratios for all the species). Thus, while the first four species listed in table 4.2.2-2 below share the same habitat footprint (although they use these areas differently), encroachment into that habitat requires mitigating at 3:1 elsewhere within the Avra Valley HCP Permit Area. This 3:1 ratio for four species incorporates the overlapping and, therefore, higher biodiversity of the modeled habitat, but also reflects the relatively low importance of the Permit Area for all four species. If the modeled habitat were not to overlap, a lower mitigation ratio would be appropriate given the factors described above.The rationale for each of these mitigation ratios is described below for each species.

Table 4.2.2-2. Mitigation ratios for covered species

Species[2]	Mitigation Ratio (Protected habitat: Developed habitat)
Lesser Long-nosed Bat[1]	3:1[1]
Pale Townsend's Big-eared Bat[1]	
Western Yellow-billed Cuckoo[1]	
Cactus Ferruginous Pygmy-owl[1]	
Western Burrowing Owl	1:1
Tucson Shovel-nosed Snake	2:1

[1]The footprint of modeled habitat is the same for Lesser Long-nosed Bat, Pale Townsend's Big-eared Bat, Western Yellow-billed Cuckoo, and Cactus Ferruginous Pygmy-owl

[2]The Desert Tortoise is excluded from this table as there is no modeled habitat for the species within the Permit Area.

Lesser Long-Nosed Bat

The LLNB is listed as a federally endangered species and is anticipated to use the Permit Area to travel between foraging resources and roosting habitats. Although there is no known breeding habitat within the Permit Area, the conservation strategy focuses on preservation of the potential movement corridors. Given that the species shares modeled habitat that has the same areal extent as three other species, a combined mitigation ratio of 3:1 is appropriate for not only the movement habitat of this species, but also CFPO over-wintering/dispersal habitat, WYBC dispersal and possible breeding habitat, and PTBB foraging habitat.

Pale Townsend's Big-Eared Bat

This species is not currently listed under the ESA. The primary threat to the PTBB relates to availability of breeding and wintering roosts. While there are no potential roost sites within the Permit Area, the bat may use the HCP Permit Area as foraging habitat. Since the species typically forages within 15 mi (24 km) of roost sites, use of the HCP Permit Area by this species is likely to be low. However, given that the species shares modeled habitat that has the same areal extent as three other species, a combined mitigation ratio of 3:1 is appropriate for the movement habitat of this species as well as the CFPO over-wintering/dispersal habitat, WYBC migratory stopover habitat, and LLNB movement habitat.

Western Yellow-Billed Cuckoo

The WYBC is designated by the USFWS as a candidate species for listing under the ESA. It may use the riparian corridors in the HCP Permit Area as migratory stopover habitat. The only nearby potential breeding habitat occurs adjacent to the Santa Cruz River at the City's Simpson North farm, Santa Cruz farm, and Martin farm properties, which are primarily outside of the Permit Area. Given that the species shares modeled habitat that has the same areal extent as that of three other species, a combined mitigation ratio of 3:1 is appropriate for this species as well as the CFPO, PTTB, and LLNB.

Cactus Ferruginous Pygmy-Owl

This species is not currently listed under the ESA. There is no breeding habitat for this species within the Avra Valley HCP Permit Area, only potential over-wintering and dispersal habitat. There have also been few recorded instances of CFPO dispersing through Avra Valley and no records of over-wintering. Based on these factors, the TAC recommends a 3:1 mitigation ratio for the areal footprint that includes the modeled dispersal/potential over-wintering habitat for the species.

Western Burrowing Owl

WBOs are not currently a federally or State-listed species. However, population numbers may be declining within their range, and it is clear that large areas of WBO habitat are being converted for urban development, particularly in the Phoenix area. There are a number of known populations in the Tucson basin; however, the population size and trend are not known. WBO do use the HCP Permit Area. A survey completed in 2006 (Grandmaison and Urreiztieta 2006) found 34 owls in the wintering season and four apparently unpaired owls in the breeding season. In addition, that survey found 1,836 suitable burrows within the Permit Area, but only 292 (16 percent) showed any signs of recent or past use, and 40

percent of those were destroyed by flooding between the winter and spring surveys. More recently as part of WBO surveys conducted on the Chu Farm in 2011 and 2012, 11 burrows were observed with appropriate entrance dimensions, but no sign of WBO or WBO use of the burrows was observed (Westland Resources 2012a). On the Lupori Farm, WBO surveys were conducted in 2011 and 2012 as well, with 16 burrows of appropriate entrance dimensions found (Westland Resources 2012b). Initially, no sign of WBO or their use of these burrows was observed. However, in a follow-up survey on this property in October 2011, a WBO was observed flying away from a burrow. These results confirm the low, variable use of these lands by this species since the entire Chu Farm was modeled as WBO habitat while the Lupori Farm was not.

The current, relatively low numbers of WBO may be a result of several factors, including a limited prey base due to extensive pesticide use on these former agricultural lands and adjacent, active agricultural fields. Another potential factor may include a lack of suitable, stable burrows. Given these factors, a mitigation ratio of 1:1 is proposed for this species.

Tucson Shovel-Nosed Snake

The TSNS is a candidate for Federal listing under the ESA. This species occupies a fairly restricted range in south-central Arizona, including into northern Pima County. However, no TSNS have been observed within Pima County since 1979. Given these factors, a mitigation ratio of 2:1 will be followed for this species.

4.2.2 Phasing and Set-aside Site Determination

Implementation of any of the covered activities is uncertain both in scope and in timing. To address this uncertainty, mitigation will be contingent on planned implementation of individual projects. Since the scope and location of proposed covered activities are not yet known, more detailed requirements will be determined at the time that individual projects are implemented.

Once a project is planned that will impact covered species habitat, the City will make a preliminary determination of where habitat will be permanently set-aside as mitigation. For example, when determining optimal locations for WBO habitat set-aside, one characteristic to consider is proximity to perch structures for raptors, which prey on the species. This determination will include a map with an aerial orthoimage and digitized proposed boundary line along with the Geographic Information System (GIS) polygon layer of the species modeled habitat from the HCP. The City will share this map with the USFWS and request informal review and concurrence with the proposed set-aside location. Once the USFWS has provided comment, the City will proceed with the legal requirements for setting aside the land.

The City has the option of permanently setting-aside land prior to any planned impacts to species habitat and receiving HCP mitigation credit to be banked and applied for future use when needed. This may be desirable if the City anticipates that impacts may occur in the future and that it would be cost effective to set-aside additional land earlier in the process, such as when required migitation set-asides are being legally protected. This may also be advantageous for other reasons, such as for boundary marking and fencing, signage posting, and habitat monitoring.

4.2.4 Maximum Impact Permitted and Associated Habitat Protection / Enhancement

Based on the area of modeled habitat and the TAC's recommended mitigation ratios, table 4.2.4-1 indicates the total amount of modeled habitat that could be impacted in the Permit Area. Since there are several options for WBO mitigation, table 4.2.4 provides specific information related to that species and the amount of habitat impacts and set-aside allowed. Numbers in the tables show that although the covered activities are anticipated to disturb a maximum of 8,000 ac (3,237 ha), less than half of this impact (3,643 ac) could occur within modeled habitat given the constraints of the habitat set-aside migitation ratios. For example, regarding the combined LLNB, PTBB, WYBC, and CFPO habitat model footprint and the mitigation ratio of 3:1, a maximum of 510 acres of the 2,040 modeled habitat acres can be impacted, while the other 1,530 acres of habitat is permanently set-aside as mitigation (1,530 acres set-aside: 510 acres impacted).

Yet, since 11,430 ac (4,625 ha) of the 19,020 ac (7,697 ha) HCP Permit Area do not contain any covered species modeled habitat, it is possible that if the City needs to implement all covered activities, all of the 8,000 ac (3,237 ha) of disturbance could occur without impacting any modeled habitat. While avoiding modeled habitat would be ideal from the perspective of this HCP, other factors, such as proximity to current water infrastructure, environmental conditions, land use restrictions, and adjacent uses will also inform the most appropriate locations for the covered activities.

Table 4.2.4. Given mitigation ratios, maximum modeled habitat allowed for impact and corresponding set-aside (acres)

	A	B	C (B / (A +1))	D (B - C)
Species	**Acres of habitat protected for every acre impacted**	**Modeled habitat in HCP Permit Area** (acres)	**Maximum modeled habitat permitted for impact** (acres)	**Maximum set-aside given maximum impact to modeled habitat** (acres)
Lesser Long-nosed Bat[1]	3	2,040	510	1,530
Pale Townsend's Big-eared Bat[1]				
Western Yellow-billed Cuckoo[1]				
Cactus Ferruginous Pygmy-owl[1]				
Western Burrowing Owl[2]	1	4,775	2,387	2,387
Desert Tortoise	N/A	N/A	N/A	N/A
Tucson Shovel-nosed Snake	2	2,240	746	1,494
Total	N/A	9,055	3,643	5,411

[1]The modeled habitat footprint is the same for these species
[2]See table 4.2.4-2 for additional details

4.2.5 Preferred Impact and Mitigation Location – an Example Scenario

PRIORITY MITIGATION AREAS

As discussed in Chapter 3, the uncertain scope, location, and timing of City projects within the HCP Permit Area over the 50-year life of the Incidental Take Permit necessitate a flexible approach to maintaining habitat. The range of potential impacts will depend on community needs for water supply infrastructure. On one extreme, few new projects would occur within the Permit Area while on the other extreme, it is possible that all the covered activities will occur.

Although a flexible conservation program is necessary to preserve options for maintaining vital water and energy infrastructure for the community, City staff, in discussion with the TAC, has identified lands that would be most suitable for habitat set-aside. These Priority Mitigation Areas have been identified not only for their potential habitat value for the covered species, but also for other biological values. Factors used to identify Priority Mitigation Areas include:

- Proximity to landscape level biological corridors;
- Adjacency to a Federal preserve (i.e., Ironwood Forest National Monument) for increased habitat contiguity;
- Proximity or adjacency to Pima County open space acquisition priority lands;
- Proximity to riparian habitat;
- Proximity to lands being restored as wildlife habitat (e.g., Simpson Farm North and the Martin Farm), or;
- Proximity to lands previously used successfully as relocation sites for WBO (e.g., Simpson Farm South).

Because of these additional biological factors, the Priority Mitigation Areas also help meet regional goals for open space protection, habitat preservation, habitat connectivity, and the protection of sensitive species. Lands that are part of the Priority Mitigation Areas (Figure 4.2.5) include some of the modeled riparian habitat within the HCP Permit Area. Priority Mitigation Areas also include the Trust 205 Farm, the uncultivated portion of Buckalew Farm, and the northernmost lands within the Permit Area, including the Hurst, Martin, Santa Cruz, and Simpson South Farms). The Priority Mitigation Areas include modeled habitat for all of the covered species with modeled habitat in the Permit Area (i.e., all but the Desert Tortoise).

"CAVSARP COMPLEX"

While there is no certainty about where impacts will occur within the HCP Permit Area throughout the life of the Permit, the lands near the Central Avra Valley Storage and Recovery Project (CAVSARP) are most likely to be impacted by covered activities. This "CAVSARP Complex" of lands (Figure 4.2.5) consists of eight farms – Bowden, Cactus Milewide, Davidson, Jarvis North, Jarvis South, Nichols, Wallis, and Cactus Avra – totaling 7,334 ac (2,968 ha). Proximity to CAVSARP, natural gas distribution lines, and electrical transmission lines, along with the relative proximity to the City limits, elevate the value of these lands above others in the Permit Area for future development.

Figure 4.2.5. Priority Mitigation Areas and the CAVSARP complex of Permit Area lands (This map has not yet been revised)

4.3 Mitigation outside of the Permit Area but within Avra Valley

While all mitigation is planned to occur within the HCP Permit Area, it is desirable to leave open the option to allow credit for off-site mitigation in unique circumstances. Therefore, on a case-by-case basis and with the written approval from a USFWS field or regional office, permanent protection of covered species habitat within Avra Valley but outside of the HCP Permit Area may be considered. Such special circumstances may occur, for example, as part of a cooperative open space purchase of lands that contain species habitat. In such cases, a biological evaluation provided by an environmental consulting firm will be required to delimit the boundaries of covered species habitat within the off-site property. Based on the amount of habitat, the mitigation ratios within this HCP, and the City's role in the permanent protection of the land, the USFWS will determine how much mitigation credit can be applied. There are no guarantees of USFWS approval and/or agreement of the details described in the biological evaluation, nor are there any guarantees that the USFWS will provide any mitigation credit in such circumstances. Therefore, prior to agreeing to any transactions, the City or its partner in the open space protection should first fund a biological evaluation to map the species habitat and then submit the evaluation to the USFWS with a letter describing the proposed ownership, management and monitoring, and legal protection arrangement. Only after a written determination from the USFWS has been received describing the amount of mitigation that will be granted should the City agree to any off-site habitat protection efforts for HCP mitigation credit.

4.4. Allowing wildlife movement within impact areas

As part of the City's CAVSARP site, open space corridors between recharge basins have been protected to provide for wildlife movement across the site. For covered activies that result in permanent land disturbance, the City should consider wildlife movement in site planning. While permanent protection of wildlife corridors may not satisfy ESA requirements if not within modeled habitat, such protection may help satisfy other regulatory requirements such as those related to native plant protection, landscaping, and floodplains. Since the Avra Valley and portions of the City's HCP Permit Area therein bisect the large protected natural areas of IFNM, Saguaro National Park, and Tucson Mountain Park, protection of corridors will help wildlife move across Avra Valley to these natural areas.

CHAPTER 5 – MONITORING AND STEWARDSHIP

Monitoring the effectiveness of the avoidance, minimization, and mitigation measures and ensuring compliance with the terms of the conservation program are mandatory elements of an HCP (50 CFR 17.22, 17.32, and 222.307). The USFWS elaborates 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 requirements 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 following describes the City's commitments related to monitoring and stewardship activities triggered both by the issuance of the Permit, as well as any covered activities that occur in modeled habitat, requiring mitigation actions. Certain monitoring and stewardship activities will occur annually and will be documented for inclusion in annual reports regardless of whether or not mitigation is required. Once impacts to modeled habitat are planned to occur, this will trigger the need for mitigation in the form of permanent habitat set-aside. As a result of this set-aside designation, a higher level of monitoring and stewardship will be conducted in these areas.

5.1 Compliance Monitoring

If covered activities summarized in Chapter 3 are implemented, then compliance monitoring and reporting will be accomplished through the following:

- The City will submit annual reports to the USFWS documenting progress toward, and completion of the conservation commitments.

- The City will require that all City development plans within the Avra Valley HCP Permit Area contain a narrative discription documenting compliance with the avoidance, minimization, and mitigation measures outlined in this HCP. This statement shall include maps and other graphics and analyses necessary to document this compliance.

5.2 Ecological Effectiveness Monitoring

As recommended by the City's HCP TAC, the ecological effectiveness monitoring program for the Avra Valley HCP should:

- Inform progress toward meeting biological goals and objectives for each covered species.
- Be commensurate with the level of impacts (i.e., covered activities that occur within covered species modeled habitat). This acknowledges the uncertainty over whether or not any of the covered activities will actually occur during the term of the HCP. This is also consistent with the USFWS 5-points policy which states that "the scope of the monitoring program should be commensurate with the scope and duration of the operating conservation program and the project impacts" (USFWS 2000).

- Work towards consistency of monitoring efforts with other local agencies and jurisdictions as possible, practical, and cost-effective.

In determining whether or not species-specific or habitat-based indicators would be used for ecological effectiveness monitoring, the USFWS states that the "monitoring program should reflect the measurable biological goals and objectives" (USFWS 2000). In TAC discussions regarding the biological goals and objectives as well as the monitoring program, all agreed that habitat-based measures would be more effective for the covered species. Several factors influenced this decision-making process and are listed in table 5.2. Only the WBO met all three criteria. Yet, given that translocation of WBO to Pima County occurs from other parts of Arizona, species-specific measures may not accurately reflect habitat conditions of the Permit Area if confounded by an artificial influx of WBO to the region. Therefore, species-specific monitoring for the WBO is not recommended as a method to measure the efficacy of the City's habitat protection efforts.

Table 5.2. Examples of TAC criteria influencing whether or not species-specific surveys should be considered for long-term ecological effectiveness monitoring.

Species	Permit Area provides year-round or breeding habitat (i.e., the species is not just passing through)	Within Permit Area, species is relatively easy to detect via survey	Documented occurrence in Permit Area within past 5 years
Lesser Long-nosed Bat	No	No	No
Pale Townsend's Big-eared Bat	No	No	No
Western Yellow-billed Cuckoo	No	No	**Yes**
Cactus Ferruginous Pygmy-owl	No	No	No
Western Burrowing Owl	**Yes**	**Yes**	**Yes**
Tucson Shovel-nosed Snake	**Yes**	No	No
Desert Tortoise	N/A	N/A	N/A

5.2.2 Habitat and Threats Monitoring

RIPARIAN VEGETATION

For several of the HCP covered species, the xeroriparian areas of the watercourses within the Avra Valley HCP Permit Area serves as the modeled habitat. In contrast to terrestrial uplands where precipitation is the primary source of water for plants, riparian areas have higher vegetation diversity and density resulting from the multiple water inputs of precipitation, overland flow, subsurface flow, and groundwater recharge (Zaimes *et al.* 2007). With regard to habitat, riparian areas are subject to a high degree of variability. According to Green (2007):

> *Riparian habitats often experience significant change over time resulting in a large number of habitat patches of differing ages in a small spatial area. Variation of habitat over time is high due to the random nature of two abiotic drivers: floods and drought.*

To determine whether or not this riparian vegetation is adequately protected as habitat, TAC members initially recommended that vegetation structure be used as an indicator. However, based on further

discussion and closer review of the protocol in the context of the HCP, TAC members expressed concern about the ability to meaningfully detect any changes in vegetation structure due to 1) climate variability, 2) limitations of the protocol, 3) the low likelihood that vegetation structure will change during the term of the 50 years, and 4) whether or not a decrease in structure indicates declining habitat quality or simply that the canopy is maturing. Given this, the TAC recommended that the City use aerial orthoimagery in a GIS to calculate the areal footprint acreage of xeroriparian habitat and compare those values over time. Since vegetation change will occur slowly, the TAC has recommended that the data are gathered every five years. Steps in the data collection and analysis will involve the following:

1) Obtain the latest aerial orthoimagery that covers the entire Avra Valley HCP Permit Area. Source data may include the Pima Association of Governments triennial orthoimagery collection, USDA National Agriculture Imagery Program orthoimagery, private satellite orthoimagery, or others.

2) Overlay the latest 100-year floodplain polygon and wash line GIS layers. Classify the vegetation as either riparian or upland. Do this by digitally outlining (digitizing) the footprint of the riparian vegetation within the floodplains and adjacent to wash channels with characteristics of riparian vegetation. On the orthoimagery, riparian vegetation is noticeably darker and denser than upland vegetation.

3) Use on-the-ground data collection to test the accuracy of the riparian vegetation delineation. Randomly select (e.g., use the random tool in ArcGIS) 10 sites (i.e., the riparian vegetation on a selected parcel) in the HCP Permit Area. Drive and walk to these sites with a GPS unit to collect 30 georeferenced points at each site. Fifteen should be within riparian vegetation and 15 should be outside of the riparian vegetation, but within approximately 10 meters of the riparian vegetation boundary in the uplands (not unvegetated areas of the floodplain). A total of 300 points will be collected throughout the HCP Permit Area.

4) At the GIS-enabled computer, load the points onto the map file with the orthoimagery and habitat delineation. Use the appropriate tools to determine whether or not the on-the-ground points agree with the orthoimagery classification. Create an error matrix (example below) to determine the overall accuracy of the classification. If accuracy of less than 75% is obtained, repeat the process.

		True value as determined by on-the-ground GPS point collection		
		Riparian	Non-riparian upland	Sum
Classification (digitization) based on orthoimagery	Riparian	13	1	14
	Non-riparian upland	2	14	16
	Sum	15	15	27

Overall accuracy = sum of diagonal/total number of points = 27/30 = **90%**

Figure 5.2.2. Example of error matrix for determining GIS classification accuracy.

As the hypothetical example in figure 5.2.2 shows, 13 points were correctly classified as riparian and 2 were incorrectly classified as riparian. Fourteen points were correctly classified as non-riparian upland and one was incorrectly classified as non-riparian upland for an overall accuracy of 90%.

BURROWING OWL HABITAT

Within set-aside areas, habitat will be evaluated every five years using photo points to document the conditions of the property and whether or not they are being properly managed for the species. In addition, surveys will be conducted in these set-aside areas to georeference burrow locations. Attributes should be included with the data to record characteristics of the burrow that indicate whether or not there is evidence of use by WBO.

TUCSON SHOVEL-NOSED SNAKE HABITAT

TSNS habitat will be monitored using photopoints collected every 5 years to document that the conditions of the land have not degraded as a result of City negligence in protecting the biological values. In addition, optional arthropod surveys may be conducted every five years within habitat set-aside areas to assess prey abundance and diversity.

WEATHER DATA GATHERING AND COMPILATION

Weather data will play an important role in the ecological effectiveness monitoring for the Avra Valley HCP. These data will help explain observed vegetation responses to climate patterns. In particular, the TAC has suggested that two years of above average rainfall will likely trigger an increased fire threat to xeroriparian communities posed by extensive germination of annuals, such as red brome (*Bromus rubens*), London rocket (*Sisymbrium irio*), and common Mediterranean grass (*Schismus barbatus*). Therefore, the City will compile local climate data for inclusion in annual reports. This will include temperature highs, lows, and averages, precipitation event highs per month and year, and stream gage data. A weather station has been installed on City-owned land as part of the SAVSARP. Data from that station will be collected from this or other Permit Area locations throughout the 50-year duration of the Permit. Data will also be collected from other local weather stations such as Tucson International Airport, Ryan Airfield, and/or Marana Airport.

5.3 Stewardship

SITE SECURITY AND WILDLIFE FRIENDLY FENCING

The City will erect (where not already present) and maintain wildlife-friendly fences around all Avra Valley HCP Permit Area properties that contain modeled, covered species habitat to prevent unauthorized entry onto the properties by foot, vehicle, or grazing animals. This will help minimize 1) damage to existing vegetation, 2) the potential for wash degradation (e.g., headcutting, scour and erosion), 3) potential disturbance to covered species due to noise and proximity of humans, and 4) the potential for introduction of toxic materials, fire, or trash. Fence lines will be posted with appropriate signs (e.g., no firearms), depending on the activities allowed on the properties.

The City will monitor the fence lines of the Permit Area properties at least once per month, but more likely, once a week. This will help forestall illegal dumping, vandalism, and trespassing, all of which could degrade habitat or increase the potential for direct take, such as OHV-related mortalities to the TSNS or WBO.

INVASIVE SPECIES MANAGEMENT WITHIN HABITAT SET-ASIDES

Non-native invasive species, such as the African grass known as buffelgrass, may pose significant threats to habitat in the HCP Permit Area. According to Williams and Baruch (2000), "African grasses [including buffelgrass] have the potential to affect ecosystem function by 1) altering productivity or trophic structure, 2) altering microclimate and shifting the rates of consumption and supply of light, water and mineral nutrients, 3) increasing the frequency and intensity of fire, 4) altering competitive interactions, and 5) compromising ecosystem stability."Areas of dense buffelgrass or non-native annuals pose a fire hazard that is not typical of the normal fire regime of the Avra Valley HCP Permit Area. If any habitat set-asides are established for mitigation purposes, these areas will be actively targeted for invasive species control efforts, such as through hand-pulling or herbicide spraying of buffelgrass. Invasive species management and control efforts are expected to occur throughout the Permit Area and not just within the set-aside lands. However, this additional effort is not an HCP-related commitment.

OPTIONAL HABITAT RESTORATION AND ENHANCEMENT

Despite two or more decades that lands within the Permit Area have no longer been cleared, leveled, and tilled for agricultural purposes, only some of the lands have begun to return to a more naturally vegetated condition. These unrecovered areas include lands as part of the Altar/Brawley Wash system, which have been a concern to local resource managers for several decades. In 1992, the Soil Conservation Service (now NRCS), in cooperation with the Pima Natural Resource Conservation District, published a natural resource restoration plan for the Brawley Watershed. This report identified several issues of concern within the watershed including: 1) stream bank erosion and associated loss of riparian and range habitat along the Brawley Wash; 2) sheet, rill, and gully erosion and associated damages to rangeland and improvements; 3) sedimentation effects on downstream water quality, farmland, and county and state road crossings; 4) flash flooding and associated damages to roads, farmland, and local communities; and 5) loss of groundwater recharge due to accelerated flows within the incised wash (USDA 1992).

Prior to extensive cattle grazing in the late 1800s and early 1900s that stripped the watershed bare of protective cover, no gullies were evident in the valley floor. According to the USDA (1992), the axial stream was, over one hundred years ago, a floodplain covered with tall grass and one quarter to one half mile wide. A comparison of photos of Boundary Monument 144 from 1893 and 1983 show how grassland has given way to shrubs and small trees (USDA 1992).

In the mid-2000s, Dr. Phil Rosen of the University of Arizona was contracted by the City to assess the level of degradation to City-owned lands within the HCP Permit Area occurring due to past agricultural uses. He was also asked to evaluate the potential for natural recovery or restoration of these properties to a more natural and better functioning state. Dr. Rosen stated that:

> *Large portions of Brawley Wash…are highly degraded barrens with adobe soils and low perennial plant diversity…Restoration of the Brawley Flats that would be valuable enough to justify the effort and costs that would be likely should, in my evaluation, include especially the partial elimination of enhanced drainage of the flats, and the partial increase of "overbank flood storage" – the restoration of sheet flow and short-duration standing water on broad areas of the Brawley Floodplain (Rosen 2008b).*

To the extent that activities are cost effective, low risk to adjacent properties, and practical, the City desires to manage former agricultural lands and lands degraded by severe erosion so that they return to a more naturally vegetated state similar to adjacent or nearby undisturbed lands. Restoring the land has the potential to provide numerous benefits, including:

- Increased abundance of wildlife habitat,
- Decreased watercourse degradation,
- Increased flood control,
- Decreased spread of non-native, invasive plants, and,
- Decreased need to actively manage lands to control spread of non-native, invasive plants.

In 2001 and 2006, Tucson Audubon Society signed Right of Entry agreements with the City, allowing the organization to restore City-owned acreage immediately adjacent to the Santa Cruz River. This portion of the Santa Cruz River currently has perennial flow due to discharge of treated effluent that occurs upstream from the City's Simpson and Martin Farm properties. Since restoration is funded with Clean Water Act Section 404 in-lieu mitigation fees, these lands have been excluded from the City's HCP Permit Area to avoid double-counting mitigation. Tucson Audubon Society's work has not only involved installing container plants, but also experimenting with various seeding and passive rainwater techniques. These efforts will serve as small-scale trials and potential models, which the City can follow on degraded lands within the HCP Permit Area if restoration activities are planned. For summary information on this work, see Tucson Audubon Society 2007a and 2007b.

Input from other restoration studies could also inform any future habitat restoration efforts. For example, Bean *et al.* (2004) have specific recommendations for revegetating retired farmland in southern Arizona. They state:

> *We have found that the most effective way to revegetate retired cropland in southern Arizona is to transplant native species of at least a 3.8-l (1-gal) container size (6 to 9 mo old) at appropriate densities (250 plants/ha [100 plants/ac] in our situation) into fields that are drip irrigated for the first year following planting, while minimizing soil disturbance as much as possible. This technique virtually guarantees success by mitigating two of the most important constraints to vegetation recovery in arid lands: low and variable precipitation and limited propagule availability* (Bean *et al.* 2004).

All of the HCP covered species may benefit from these restoration efforts. The potential employment of land management strategies will be determined on a site-by-site basis according to planned land use and existing site conditions. Other areas could be restored to provide habitat, migration corridors, and an open space network (City of Tucson 1996). While habitat restoration efforts may continue to occur throughout

the Permit Area, the City is not committing to restore habitat as part of this HCP. As indicated in the Changed Circumstances table in Chapter 6, should the lands recover to a more naturally vegetated state within the term of the Permit such that additional habitat exists, the City may consult with the USFWS about the potential to allow mitigation credit for such lands. It will be at the discretion of the USFWS to determine whether or not mitigation credit would be allowed and at what level. Species-specific restoration considerations are described below.

Lesser Long-Nosed Bat

For this species, USFWS staff recommends that restoration activities focus on lands immediately adjacent to or within the foothills of the Tucson, Roskruge, or Silverbell Mountains. These lands serve as a foraging habitat for the LLNB and would be particularly important areas for the natural establishment of saguaros where conditions are suitable. Also, off-site salvage and HCP Permit Area transplant of saguaros may be appropriate to consider as long as in compliance with all applicable regulations.

Pale Townsend's Big-Eared Bat

Restoration of lands should emphasize the importance of water to the species for both drinking and enhancing foraging resources. As the species is primarily a moth specialist, it feeds in the open along edge habitats such as streams and intermittent streams as well as along pastures, crops, and native vegetation (Pierson *et al.* 1999). Therefore, restoration and enhancement should focus on mimicking the foraging habitat characteristics described above. This may include installation of riparian plant species that can be supported by the site's depth to groundwater and surface flow regime. Prior to restoration or enhancement, such sites may not currently support native vegetation due to competition from exotic invasive species, lack of seed sources because of prior land uses, and other factors.

Western Yellow Billed Cuckoo

Restoration of WYBC migration habitat should focus on tall canopy cover. In the Permit Area, this is likely to consist primarily of mesquite bosques, given the limited amount of available water. Restoration of breeding habitat is already occurring passively on City-owned lands within the Permit Area and actively adjacent to the Permit Area as part of Tucson Audubon Society's work on the City's North Simpson, Santa Cruz, and Martin Farm properties.

Cactus Ferruginous Pygmy-Owl

USFWS personnel recommend that CFPO habitat restoration efforts involve mimicking the vegetation composition and structure in nearby areas of intact CFPO potential dispersal / overwintering habitat, such as mesquite bosques. As with LLNB, establishing saguaros on Permit Area lands within the foothills that contain suitable soils could eventually help support CFPO breeding opportunities.

Western Burrowing Owl

To provide guidance to the City's HCP development efforts for the WBO, a Burrowing Owl Working Group composed of AZGFD, USFWS, and Wild at Heart personnel gathered in 2007 to develop guidelines. This document entitled, "Burrowing Owl Management Guidelines for Municipalities" (Burrowing Owl Working Group 2007) provides specific recommendations that will be used by the City if Burrowing Owl Management Areas (BOMA) are established and managed within the Permit Area.

Desert Tortoise

While there is no modeled habitat within the HCP Permit Area, any efforts that return the degraded former farmlands adjacent to the mountain bajadas to a natural state with a diversity of native herbs, grasses, woody plants, and succulents, may provide additional potential foraging habitat for the species.

Tucson Shovel-Nosed Snake

According to Dr. Phil Rosen:

> *Although we lack a full, clear understanding of its habitat requirements in its range on the transition of Arizona Upland to Lower Colorado Valley Sonoran Desertscrub from Florence to Casa Grande to Marana, there is enough evidence to indicate that productive, mesquite-, catclaw acacia-, blue paloverde-, and creosotebush-dominated areas with sandy loam to very sandy soils are optimal. Productive swales and stabilized former dunes or sand lenses are characteristic formations that appear to enhance habitat suitability for the Tucson Shovelnosed Snake* (2008).

Thus, habitat restoration and enhancement should focus on recovery of native woody vegetation, as described by Rosen above, on sandy and sandy loam soils. For the Brawley Wash system, this could also, in appropriate situations, involve removal of drainage / channelization structures that preclude sheet-flow, braiding, and sediment deposition (sand and fine sandy loam) (Rosen 2008b). In addition, Dr. Rosen (2008) recommends that:

- *Processes that enhance the accumulation of patches of sand and soft soil should be favored.*
- *Creosotebush, mesquite-shrub complexes, and other shrubs that trap accumulations of wind-blow sand around themselves should be encouraged, and seeding of creosotebush in suitable areas of re-vegetating farmland could be considered.*
- *Digging animals that have significant effects on soil should be conserved, particularly large ones like the Bannertail Kangeroo Rat (which apparently occurs on Cactus Avra Farm), Merriam's Kangaroo Rat, and several smaller species of pocket mice in the kangaroo rat family (Heteromyidae).*

CHAPTER 6 – PLAN IMPLEMENTATION

6.1 Changed and Unforeseen Circumstances

Application requirements for Incidental Take Permits include assurances provided in case what are referred to by the USFWS as changed or unforeseen circumstances should occur (50 CFR 17.22). The USFWS describes "changed circumstances" as changes in circumstances affecting a species or geographic area covered by a conservation plan or agreement that can reasonably be anticipated by plan or agreement developers and the Service and that can be planned for (e.g., the listing of new species, or a fire or other natural catastrophic event in areas prone to such events) (50 CFR 17.3). According to 50 CFR 17.22:

> *If additional conservation and mitigation measures are deemed necessary to respond to changed circumstances and were provided for in the plan's operating conservation program, the permittee will implement the measures specified in the plan. If additional conservation and mitigation measures are deemed necessary to respond to changed circumstances and such measures were not provided for in the plan's operating conservation program, the Director will not require any conservation and mitigation measures in addition to those provided for in the plan without the consent of the permittee, provided the plan is being properly implemented.*

Given the dynamic nature of ecosystem processes and human activities that could impact the Permit Area, the TAC developed a table of potential changed circumstances that may occur during the 50-year term of the Permit. Should any of those changed circumstances occur, the City's proposed responses to the circumstance are included as part of the table (Table 6.1).

In contrast to changed circumstances, the USFWS defines unforeseen circumstances as changes in circumstances affecting a species or geographic area covered by a conservation plan or agreement that could not reasonably have been anticipated by plan or agreement developers and the Service at the time of the conservation plan's or agreement's negotiation and development, and that result in a substantial and adverse change in the status of the covered species. The responsibility for addressing unforeseen circumstances lies with the USFWS. According to 50 CFR 17.22:

> *In negotiating unforeseen circumstances, the Director 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 beyond the level otherwise agreed upon for the species covered by the conservation plan without the consent of the permittee. If additional conservation and mitigation measures are deemed necessary to respond to unforeseen circumstances, the Director may require additional measures of the permittee where the conservation plan is being properly implemented, but only if such measures are limited to modifications within conserved habitat areas, if any, or to the conservation plan's operating conservation program for the affected species, and maintain the original terms of the conservation plan to the maximum extent possible. 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 otherwise available for development or use under the original terms of the conservation plan without the consent of the permittee.*

Examples of unforeseen circumstances for the Avra Valley HCP include, but are not limited to, the following:

- Famine,
- Pandemic disease,
- War or large scale/widespread acts of terrorism occurring within the U.S.,
- State secession from the U.S. or formation of a new state that includes the Permit Area,
- Natural catastrophe, such as an earthquake, volcanic eruption, or meteoroid impact as well as flooding and tornado damage,
- Effects of climate change beyond those foreseen as changed circumstances,
- New, exotic game animals released in Southern Arizona,
- Widespread planting of non-native, invasive plant species (for grazing, perhaps) on lands near the Permit Area.

Effects on the HCP Permit Area related to these unforeseen circumstances could also include widescale poaching, cutting of trees for firewood, squatting, and population shifts. According to 50 CFR 1, Sect. 17.22, the Director of the USFWS has the burden of demonstrating that an unforeseen circumstance exists.

Table 6.1. Potential changed circumstances and the City's response

#	Circumstance	City response
1	De-listing of a covered species (e.g., the LLNB is removed from the list of endangered species).	Work with the USFWS to determine if and how this changes the HCP conservation program.
2	Covered species that was not listed at time of Permit issuance becomes listed under the ESA.	No response necessary. The USFWS will add the newly listed species to the City's Permit. As described earlier, for avian covered species, this listing may change survey requirements since the listing would make the Permit a special purpose permit under the MBTA.
3	New species listed (not a covered species) that occurs within HCP Permit Area.	Work with the USFWS, and possibly the TAC as well, to determine the habitat needs of this species and whether or not the currently modeled habitat for the Permit Area corresponds with that of any covered species. As necessary, mitigate appropriately.
4	Loss of known population of covered species that uses the Permit Area.	Work with the USFWS to determine if and how this changes the HCP conservation program.
5	New disease affecting a covered species occurs in Southern Arizona. An example of this could be the spread of White-nose Syndrome (WNS) from eastern North America. WNS affects hibernating bats.	Work with the USFWS, and possibly the TAC as well, to determine possible, voluntary course of action.
6	New Critical Habitat and/or Recovery Areas designated for covered species.	Work with the USFWS, and possibly the TAC as well, to determine any voluntary conservation actions or modifications to the HCP conservation program.

7	USFWS species recovery efforts change and may include release of experimental, captive-bred population of covered species (e.g., CFPO) within dispersal distance of the HCP Permit Area.	Work with the USFWS to determine if and how this changes the HCP conservation program. If habitat use of HCP Permit Area changes because of population augmentation (e.g., CFPO are found to nest), additional, voluntary conservation measures may be recommended by the USFWS. If nesting sites occur within the HCP Permit Area because of augumentation, the USFWS or AZGFD will notify the City of the location of this site to ensure that precautions can be taken to avoid take.

Table 6.1. Potential changed circumstances and the City's response (continued)

#	Circumstance (cont.)	City response (cont.)
8	CFPO and/or WYBC are found to nest within Avra Valley HCP Permit Area as determined by the USFWS. As of the drafting of the HCP, no breeding habitat exists.	Preconstruction clearance surveys will be required to avoid direct take. Work with the USFWS and TAC to determine other possible, voluntary conservation actions.
9	New invasive plant species occurs within HCP Permit Area.	Work with the USFWS, and possibly the TAC as well, to determine the threat posed to Covered Species habitat and possible eradication methods.
10	Severe freeze damages or destroys vegetation included within the footprint of modeled habitat for HCP covered species.	Photo document extent of freeze impacts. Work with the USFWS, and possibly the TAC as well, to determine what, if any, restoration should occur. Voluntary restoration activities are encouraged.
11	Severe drought persists over a period of years, stressing or killing vegetation as part of covered species habitat.	Work with the USFWS, and possibly the TAC as well, to determine any voluntary conservation actions or modifications to the HCP conservation program.
12	Fire damages or destroys modeled habitat for covered species.	Photo document extent of fire disturbance. Work with USFWS, and possibly the TAC as well, to determine what, if any, restoration should occur. Voluntary restoration activities are encouraged.
13	Flood damages or destroys vegetation within the footprint of modeled habitat for covered species.	Many acres of modeled habitat are within floodplains and, therefore, flooding is a natural process likely to impact vegetation within the Permit Area. Events considered 100-year floods or greater should be photo documented within modeled habitat areas.
14	Spread of non-native, invasive species is uncontrollable to the extent prescribed in the monitoring program.	Work with the USFWS, and possibly the TAC as well, to determine possible voluntary course of action, such as a limited, strategic grazing operation or mowing followed by herbicide spraying.
15	Major new or widened roadway proposed for Avra Valley HCP lands *with* covered species modeled habitat. (This is not a planned covered activity).	Impacts must comply with mitigation standards of the HCP. It will also be recommended that the lead agency (e.g., ADOT) work with the USFWS, and possibly the TAC as well, to determine any additional mitigation requirements, such as crossing structures.
16	Major new or widened roadway proposed for Avra Valley HCP lands *without* covered species modeled habitat. (This is not a planned covered activity).	Recommend lead agency consider mitigation for impacts to HCP covered species and other wildlife impacted.
17	Major new or widened roadway proposed for Avra Valley, although not within the HCP Permit Area. (This is not a planned covered activity).	Recommend lead agency consider mitigation for impacts to HCP Covered Species and other wildlife impacted.
18	Toxic spill into watercourses within or adjacent to Avra Valley HCP Permit Area causes die-off of vegetation as part of modeled habitat.	Work with the USFWS, and possibly the TAC as well, to determine any voluntary conservation actions or modifications to the HCP conservation program.
19	Increased trespass within HCP Permit Area is found to damage areas of modeled habitat	Increase patrols of problem areas. Repair damaged fence(s) and increase signage. Incorporate recommendations from USFWS or other agencies.

20	Increased residential development in Avra Valley results in high numbers of feral cats being detected in modeled habitat areas. High numbers detected on multiple visits suggests that coyotes and other predators are not keeping population in check.	Work with the USFWS, and possibly the TAC as well, to review proposed control effort that may involve coordination with Pima County Animal Control.

Table 6.1. Potential changed circumstances and the City's response *(continued)*

#	Circumstance (cont.)	City response (cont.)
21	Tucson Audubon Society proposes to expand habitat restoration work into the Avra Valley HCP Permit Area as part of its right of entry agreement for City-owned land.	Work with the USFWS, and possibly the TAC as well, to review proposed expansion and determine if this would result in a conflict of mitigation credits. Consider revising HCP Permit Area boundary if there is no conflict. Note that current Tucson Audubon Society restoration on City-owned land cannot be counted as HCP mitigation credit because these restoration efforts satisfy Clean Water Act Section 404 mitigation.
22	Boundary surveys result in minor changes to parcel boundaries and, therefore, changes to the HCP Permit Area boundary.	If 50 m (164 ft) or less of lateral boundary shift, City staff can make necessary adjustments to HCP Permit Area and modeled habitat boundaries. If greater than 50 m (164 ft), discuss proposed adjustments with the USFWS, and possibly the TAC as well, prior to making them.
23	City acquires, or agrees to manage and monitor, lands with covered species modeled habitat adjacent to or in close proximity to the Avra Valley HCP Permit Area.	Discuss mitigation credit amounts with the USFWS, and possibly the TAC as well.
24	City proposes to sell or lease lands *without* Covered Species modeled habitat.	No response necessary.
25	City proposes to sell or lease lands *with* Covered Species modeled habitat.	Contract must stipulate that new owner or lease holder must comply with terms of the HCP.
26	Changes to the type or total footprint of Covered Activities are proposed.	Work with the USFWS to determine what is allowable and/or required (e.g., amendment to HCP).
27	A large amount of data used for ecological monitoring trend analysis are found to be missing.	Consider repeating monitoring effort to replace lost data.
28	A small amount of data used for ecological monitoring trend analysis are found to be missing.	Use objective guidance from statistical references and document the justification and methods used (e.g., replace with mean).
29	A large shrub or tree along a vegetation monitoring transect is cut down by trespassers for fire wood.	Photo document vandalism and note as part of annual report to the USFWS as well as ecological effectiveness monitoring report. Consider replanting cut vegetation, increasing security patrols, or re-locating transect based on discussions with USFWS staff and possibly the TAC as well.
30	City voluntary habitat restoration or enhancement efforts efforts (e.g., dryland seeding, invasive species removal, etc.) within HCP Permit Area increases amount of habitat for covered species.	Work with the USFWS, and possibly the TAC as well, to determine if restored farmlands could provide mitigation credit.
31	The TAC Operating Principles and Responsibilities are found to be flawed.	The USFWS Tucson field office staff lead may approve changes in writing, based on her or his discretion, without requiring an amendment to the HCP.
32	Monitoring program is considered to be faulty (e.g., ineffective, inefficient, and/or inconsistent with other jurisdictions) and in need of modification.	Work wiith the USFWS, and possibly the TAC as well, to review the rationale for modifying the monitoring program, seek approval for these changes, and incorporate these changes into the HCP.

33	Hunting law changes call in question the ability of the City of Tucson to restrict hunting on HCP Permit Area lands, especially the habitat set-aside lands.	The City does not know all of the potential ramifications of opening these areas to hunting. Allowing for flexibility to make management changes and close or open areas based on early outcomes will be an important component for multiple uses.If hunting is to occur, it must be highly regulated to prevent direct and indirect effects on covered species. At least initially, the following should be prohibited: Vehicular access, camping, fires, nighttime hunting, playback of recorded game calls, and use of firearms within habitat set-aside areas.
34	Cooperative conservation efforts are discussed that involve the potential for shared mitigation credit.	Discuss this with the USFWS before proceeding and request written concurrence from the USFWS describing how mitigation credits would be shared.

6.2 Costs and Funding

Regarding Permit application requirements and in accordance with 50 CFR 17.22, the USFWS requires the applicant to include a description of the funding that will be available to implement steps to monitor, minimize, and mitigate impacts for which a Permit is being sought. The sections below list the estimated costs associated with such measures as well as the funding sources for these activities. Other than monitoring and stewardship activities as well as annual reporting that will occur throughout the duration of the Permit, costs will be commensurate with the level of impacts to covered species.

6.2.1 Avoidance, Minimization, and Mitigation Measures

HCP-related costs estimated for avoidance, minimization, and mitigation measures do not include activities that would otherwise be required in the regulatory compliance process for development (e.g., compliance with cultural resource regulations) as part of the covered activities. Costs are limited to activities related to permanent habitat set-aside as well as pre-construction clearance surveys. These estimated costs are incurred only if a covered activity is planned to impact modeled habitat and, therefore, all of the costs estimated below (Table 6.2.1) would be new costs not already budgeted and funded by Tucson Water, which operates as an enterprise fund (i.e., fee-based, self supporting) of the City.

Table 6.2.1. Estimated costs for permanent habitat protection and pre-construction clearance surveys

Activity/Item	Estimated cost per covered activity requiring habitat set-aside	Low total estimate (3 set-asides during 50 years)	Medium total estimate (8 set-asides during 50 years)	High total estimate (13 set-asides during 50 years)	Assumptions/notes
Legal fees (e.g., draft and record deed restriction or other protection mechanism)	$4,000	$12,000	$32,000	$52,000	Rough estimate per Tucson Water staff
Deed restriction set aside boundary survey and permanent marking	$8,000	$24,000	$64,000	$104,000	$5,000 - $8,000 estimated for each survey per Tucson Water staff.
Annual deed restriction compliance reporting	$980	$2,940	$7,840	$12,740	This would be conducted internally, but report will be included with annual report to USFWS. Includes costs for photographing all easement properties and drafting and submitting a report. Personnel costs = 3 days x $40 per hour Travel = 40 miles x $0.50 per mile.
Pre-construction clearance surveys for MBTA compliance	$1,800	$5,400	$14,400	$23,400	Highly variable depending on size of area, consultants used, and the number of species being surveyed. WBO clearance surveys would be required regardless of whether or not listed. CFPO and WYBC surveys would no longer occur if listed. A rough estimate is $90 per hour x 2.5 days = $1,800 per survey.
Subtotal	$14,780	$44,340	$118,240	$192,140	
Contingency (20%)	$2,956	$8,868	$23,648	$38,428	
TOTAL	$17,736	$53,208	$141,888	$230,568	
Annual total if spreading costs over 50 years		$1,064	$2,838	$4,611	

6.2.2 Monitoring, Stewardship, and Changed Circumstances

In recent years, the City funded at least two positions with one hundred percent of time dedicated to tasks related to land management activities for the City's Avra Valley holdings, including a Water Operations Superintendent position and an Environmental Inspector position. While these positions may become contract positions, the duties will be similar. As part of these positions, the City continues to budget for on-going inspections of all the properties to document any illegal activity such as trespassing, vandalism, and dumping. Funding for repair, replacement, or installation of fencing along the perimeter of each property is also budgeted annually. Funding commitments to address changed circumstances will be limited to $25,000 (in 2012 dollars). Additional funds may be expended, but are not required for this HCP. Throughout the term of the Permit, the City will continue to fund these activities through the annual budget process.

Several additional costs related to monitoring, stewardship, and changed circumstances will be incurred as a result of this HCP. These activities are listed in table 6.2.2 along with estimated costs. Funding for these activities will be included in Tucson Water budgets. Based on preliminary estimates, the costs for these activities will be nearly $164,000 per year. To cover these costs, the budgets for covered activities (e.g., expansion of groundwater recharge facilities) will be crafted so that these HCP-related expenses are built-in as part of regulatory compliance costs. Also, lease payments, such as those from the large solar farm installations at the Chu and Lupori Farms, may be used to help offset these HCP-related estimated expenses.

Table 6.2.2. Estimated monitoring, stewardship, and reporting costs[1] not currently budgeted by the City

Activity/Item	Estimated annual cost (rounded)	Estimated cost over 50-year term of Permit (50 x annual cost)	Assumptions/notes
Riparian vegetation GIS classification and GPS data collection (ground-truthing) every 5 years	$473	$23,650	GIS classification, comparison with field data, and reporting is estimated to take 3 days. Field data collection at ten randomly selected sitesis estimated to take up to 5 days. Personnel costs = eight days (64 hours) x $35 per hour = $2,240. Travel at 0.50 per mile x 50 miles per day = $125. Total = $2,365 every 5 years or $473 per year. Cost does not include costs of GIS software, computer, or GPS unit.
Photopoint gathering within habitat set-asides every 5 years	$585	$29,250	This will vary widely as determined by the number of set-asides that are established. For each set-aside, one field day and 1 office day (for reporting) are estimated (16 * $35 per hour = $560). Vehicle costs estimated at $25 (50 miles x $0.5 per mile). Total = $585 per set-aside every 5 years. Estimate does not include equipment costs (e.g., camera). For 5 set-asides over 50 years, the total cost would be $29,250
Burrowing owl burrow assessment on habitat set-asides every 5 years	$672	$33,600	This will vary widely as determined by the number of set-asides that are established. For each set-aside, one field day and 3 office days (for reporting) are estimated (Personnel = 32 * $35 per hour = $1,120). Vehicle costs estimated at $25 (50 miles x $0.5 per mile). Total = $1,145 per set-aside every 5 years. Estimate does not include equipment costs (e.g., probing camera). For 3 set-asides over 50 years (3 of 5 total set-asides), the total cost would be $33,600.
Invasive species management within habitat set-asides	$108,000	$5,400,000	This will vary widely as determined by the number and size of set-asides that are established. The annual per acre cost estimate for buffelgrass eradication with backback sprayer at Saguaro National Park is $200 - $600. Assume three consecutive treatments every 15 years or 9 treatments over 50 years. For 1,500 acres of set-asides at $400 per acre = $5,400,000.
Data analysis, reporting, GIS	$8,400	$420,000	Project Manager, Hydrologist, or Environmental Planner (0.1 FTE est. at $40 per hour with ERE).
Technical Advisory Committee meeting: Member honoraria	$1,700	$85,000	At most, meet annually. Optional honoraria at $100 per hour and meet for 3 hours. Additional $150 of travel time paid for those living an hour or more away from Tucson. Honoraria currently paid to 5 members.
Technical Advisory Committee meeting City staff time: Preparation, materials, attendance	$8,400	$420,000	Project Manager, Hydrologist, or Environmental Planner (Personnel = 0.1 FTE est. at $40 per hour with ERE).
Stakeholder engagement (e.g., CWAC) and USFWS report development	$8,400	$420,000	Project Manager, Hydrologist, or Environmental Planner (Personnel = 0.1 FTE est. at $40 per hour with ERE).
Subtotal	$136,630	$6,831,500	
Contingency (20%)	$27,326	$1,366,300	
TOTAL	$163,956	$8,197,800	

[1]*These are preliminary cost estimates in 2012 dollars for discussion purposes only.*

6.3 Summary of City commitments under the HCP

As described in Chapter 1, the City desires to allow the lands within the HCP Permit Area to return from retired agricultural uses to a more naturally vegetated state. Therefore, the City may engage in activities, such as habitat restoration, that are beyond the requirements of the HCP. To clarify the distinction between commitments that the City will make to fulfill requirements of the HCP and additional, non-HCP required activities, the commitments that the City will make as part of this HCP are summarized in table X below.

Table 6.3. Summary of City commitments under the HCP

Activity/Item	Location(s)	Frequency/Trigger
Avoidance/Minimization		
Whenever possible, avoid permanent impacts to modeled habitat from covered activities.		In the early planning stages for new facilities
Comply with all current, applicable environmental and cultural resource regulations, such as those related to floodplains and native plants (see Chapter 4 for a more complete list).	Extent of any contruction activities	Throughout the planning and development processes, as required.
Preconstruction clearance surveys for Migratory Bird Treaty Act compliance (applies to CFPO and WYBC only when not listed by the ESA).	Extent of any contruction activities	Prior to ground-disturbance according to USFWS/AZGFD clearance survey protocols
Preconstruction clearance surveys for the WBO.	Extent of any contruction activities	Prior to ground-disturbance according to USFWS/AZGFD clearance survey protocols
Preconstruction clearance surveys for the DT.	Extent of any contruction activities	Prior to ground-disturbance according to USFWS/AZGFD clearance survey protocols
Mitigation		
Permanently set-aside modeled habitat according to the mitigation ratios herein. Includes 1) boundary survey and 2) drafting and recording of legal documents.	Based on extent of proposed impact to modeled habitat	Early planning stages for new facilities
Set-aside site selection concurrence from the USFWS. As described in this HCP, it is assumed that the modeled habitat areas would be good candidates for set-aside. However, over time, site-specific factors (e.g., adjacent, non-City land uses) may make some modeled habitat areas better than others for set-aside.	Based on extent of proposed impact to modeled habitat	Early planning stages for new facilities
Ecological effectiveness monitoring		
Riparian vegetation classification and field verification.	All modeled riparian habitat within the HCP Planning Area	Every 5 years
Photopoint monitoring of set-asides.	All HCP habitat set-asides in HCP Planning Area	Every 5 years
Burrowing owl burrow assessments	All HCP burrowing owl habitat set-asides in HCP Planning Area	Every 5 years
Arthropod surveys on Tucson shovel-nosed snake habitat (optional)	All HCP habitat Tucson shovel-nosed snake habitat set-asides in HCP Planning Area	(Optional) Every 5 years
Land management and stewardship		
Property boundary inspections	Entire HCP Permit Area	Monthly (weekly is preferred)

Install or repair fencing, remove trash, address vandalism, repair perimeter roads and drainages, etc.	Entire HCP Permit Area	As needed
Invasive species management	All HCP habitat set-asides in HCP Planning Area	As needed based on annual field reconnaissance and photo monitoring results
Stakeholder involvement and compliance reporting		
Report on HCP status as part of Citizens' Water Advisory Committee or subcommittee		Annually
Report to the USFWS on HCP compliance		Annually (Submit report by March 31 for activities that occurred in prior year)

Activities that the City may undertake in addition to these commitments, but not as an HCP requirement include the following:

- Habitat restoration or enhancement
- Species surveys and studies
- Collaborative wildlife management efforts
- Installation of wildlife watering areas
- Permit Area-wide invasive species management and control efforts

6.4 Permit Amendments

Amendments to the Permit will occur in accordance with 50 CFR 13.23, which is referenced in the HCP Handbook (USFWS 1996). It states:

> *For FWS, amendment of existing permits may be requested by a dated letter signed by the applicant and referencing the permit number. The $25 application fee is required unless the applicant is fee exempt (see Appendix 10). Procedurally, a permit amendment application is treated in the same way as the original permit application. However, documentation needed in support of a permit amendment will vary depending on the nature of the amendment and the content of the original HCP. If the amendment involves an action that was not addressed in the original HCP, Implementing Agreement, or NEPA analysis, these documents may need to be revised or new versions prepared addressing the amendment submitted. If the circumstances necessitating the amendment were addressed in the original documents (e.g., a previously unlisted species adequately addressed in the HCP is subsequently listed), then only amendment of the permit itself is generally needed.*

6.5 Permit Revocation/Suspension

Once issued, a Permit may be revoked or suspended. Federal criteria for revocation are described in 50 CFR 13.28 and include reasons such as willful violation of laws, conditions of the Permit, or regulations governing the permitted activity. Other examples include a change in statute or regulation that prohibits the continuation of the Permit or that species covered under the Permit decline such that population recovery or maintenance would be hindered by the Permited activity(ies). Thus, it is in the City's best interests to create a conservation program under the HCP that adequately protects each covered species so that the Permit is not revoked as a result of impacts to covered species from covered activites. It is understood that Permit revocation will be subject to the Code of Federal Regulations as written at the time

of Permit issuance and the revocation procedures (e.g., written notification by certified or registered mail) will also follow those outlined in 50 CFR 13.28.

A Permit may be suspended for reasons listed in 50 CFR 13.27 that include lack of compliance with conditions of the Permit or with regulations or laws governing the conduct of the Permitted activity. A Permit may also be suspended for failure to pay costs, fees, or penalties owed to the Federal government. Procedures for suspension of a Permit are also described in 50 CFR 13.27.

6.6 Permit Renewal

As the 50-year term of the Permit nears expiration, the City may apply for a renewal of the Permit, an application for which must be submitted at least 30 days prior to its expiration as described in 50 CFR 13.22. In determining whether or not to reissue the Permit, the USFWS will consider several factors, including whether or not renewal of the Permit threatens a wildlife or plant population and whether or not the City has failed to provide timely, accurate, and valid reports. Other factors considered include whether or not any laws were broken, false statements were made, fines or fees were not paid, and other such factors listed in 50 CFR 13.21 and 50 CFR 13.22.

6.7 Permit Transfer

Permit transfer is only allowed according to criteria described in 50 CFR 13.25 through a joint submission by the permittee and the proposed transferee, such as in the case of a transfer of lands subject to a Permit. These include the requirement that the transferee provide written assurances that it will implement conditions of the Permit such as minimization and mitigation measures, and that it will provide sufficient funding for these and any other measures described in the HCP.

6.8 Reporting

To document the City's compliance with the HCP and Permit, the City will submit annual reports to the USFWS. The reports will focus on two aspects of monitoring: compliance and ecological effectiveness. For compliance monitoring, the City will quantify and describe any planned covered activities and their estimated amounts of take (e.g., acres of covered species modeled habitat) as well as the minimization and mitigation measures that will offset these impacts. For lands permanently set-aside, documentation of an annual site visit will be included in the report. To ensure that the terms of the permanent legal protection mechanism (e.g., deed restriction) have not been violated, the site visit report will include photos of the land, the date(s) the site was visited and inspected, and the signature and date of the person completing the report.

For ecological effectiveness monitoring, reports will include relevant items suggested in the USFWS 5-Point Policy (USFWS 2000). Reports will be filed by March 31 for the preceeding calendar year per 50 CFR 13.45. One City of Tucson staff person will be the designee responsible for ensuring compliance with the terms of the HCP, including completion of annual reports.

6.9 Technical Advisory Committee (TAC)

Throughout the development of the Avra Valley HCP, the purpose of the TAC has been to provide the City with the best available science related to all biological and ecological aspects of the document. After Permit issuance, the TAC may be reconvened to provide guidance in several areas, including changed circumstances, ecological effectiveness monitoring, or any aspect of the HCP that would benefit from

technical assistance. Unless an HCP amendment would be required or Permit revocation would be imminent, the TAC will be reconvened at the discretion of the City or recommendation of the USFWS. The following operating principles and responsibilities, which are based on the original charter, will apply to future TAC meetings.

6.9.1 Operating Principles and Responsibilities

1) The TAC shall be composed of between five and ten full members and must include one staff member from the USFWS and one from AZGFD. Other members may include experts from higher education institutions, non-profit environmental organizations, environmental consultants, or others considered experts by the TAC or USFWS local office staff lead (e.g., assistant field supervisor). *Ex-officio* members may include additional USFWS or AZGFD staff members.

2) Meetings will be open to the general public. Public comment will be accepted at the end of each meeting as part of the "Call to the Audience" portion of the agenda. Otherwise, only members, including *ex-officio* members and City staff may speak unless called upon.

3) An agenda will be distributed at least 24 hours in advance of the meeting to the TAC and interested parties. Meeting notes will be prepared to highlight decision points and any differences among committee members identified.

4) The TAC will be self-policing. TAC participants will be expected to be objective, constructive, solution-oriented, fair, and respectful. The TAC is authorized by majority vote to ask a participant to remove her or himself from the TAC if at any time these expectations are not met.

5) TAC members are appointed by City staff. Alternates must be approved by a majority vote prior to the date of the meeting.

6) The TAC can invite other experts to assist them in their work provided that they have clear areas of expertise relevant to the committee's work.

7) The TAC will fill any vacancies that may occur throughout the planning period. The City may also work with the USFWS to fill any vacancies.

8) Honoraria may be provided as allowable by the recipient's employer. Amounts may be based on 2012 hourly rates. If a TAC member lives more than 60 miles from Tucson, an additional amount for travel may be negotiated not to exceed one-and-a-half times the meeting time hourly rate. TAC members are responsible for completing any City Procurement Department requirements, such as registering as a vendor. Invoices must be sent by the TAC member to the appropriate City department within 90-days after the TAC meeting.

6.10 Stakeholder Involvement

The City desires to include the input of stakeholders in the implementation of the HCP to allow the City a forum to share information related to the implementation of the HCP as well as provide a forum for stakeholders to 1) communicate any concerns or suggestions and 2) maintain awareness of how the HCP is being implemented. The Mayor and Council Citizens' Water Advisory Committee (CWAC) has been suggested as an appropriate venue for stakeholder involvement. This could occur through a subcommittee with the appropriate scope, such as a conservation subcommittee.

CHAPTER 7 – REFERENCES

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CHAPTER 8 – CONTRIBUTORS

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In particular, the City wishes to thank both current and former members of the HCP TAC (listed below) who have been instrumental in developing this HCP.

8.1 Technical Advisory Committee (TAC; current and former members)

Current and former members include the following people along with the agencies or organizations that they represented during their time on the TAC:

Mr. Dennis Abbate (Arizona Game and Fish Department, Wildlife Contracts Branch)
Ms. Marit Alanen (U.S. Fish and Wildlife Service)
Ms. Ann Audrey (Tucson Audubon Society)
Ms. Cathy Crawford (Arizona Game and Fish Department)
Ms. Mima Falk (U.S. Fish and Wildlife Service)
Mr. Rich Glinski (Independent consultant)
Mr. Trevor Hare (Coalition for Sonoran Desert Protection)
Dr. Paul Green (Tucson Audubon Society)
Dr. Kendall Kroesen (Tucson Audubon Society)
Mr. Ries Lindley (City of Tucson – Tucson Water Department)
Mr. Ralph Marra (City of Tucson – Tucson Water Department)
Dr. Guy McPherson (University of Arizona)
Ms. Asia Philbin (City of Tucson – Tucson Water Department)
Dr. Brian Powell (Tucson Audubon Society)
Mr. Scott Richardson (U.S. Fish and Wildlife Service)
Dr. Phil Rosen (University of Arizona)
Dr. E. Linwood Smith (Environmental Planning Group, Inc.)

TORTOLITA MOUNTAIN PARK

MARANA

ORO VALLEY

10

IRONWOOD FOREST NATIONAL MONUMENT

SAGUARO NATIONAL PARK WEST

TUCSON MOUNTAIN PARK

TUCSON

TOHONO O'ODHAM NATION

ARIZONA 86

PASCUA YAQUI NATION

19

TOHONO O'ODHAM NATION SAN XAVIER DISTRICT

ARIZONA 86

ARIZONA 286

ArcGIS Online World Imagery

Location of the Avra Valley HCP Permit Area

- HCP Permit Area (21,740 ac.)
- Native American Jurisdiction
- Large Parks and National Forest Lands
- City of Tucson
- Other Incorporated Areas
- Unincorporated Pima County
- Major streets

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CITY OF TUCSON

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Avra Valley HCP Permit Area and Property Names

HCP Permit Area (21,741 ac.)

Major Streets

Town of Marana

Martin (79 ac.)
Santa Cruz (856 ac.)
Simpson South (314 ac.)
Hurst (463 ac.)
Gin (474 ac.)
Weinstein (141 ac.)
Glover (185 ac.)
Lupori (320 ac.)
Chu (303 ac.)
Kai (632 ac.)
Reeves North (401 ac.)
Levkowitz (159 ac.)
Tucker (601 ac.)
Comiskey (495 ac.)
Flying E Bar (702 ac.)
Reeves South (437 ac.)
Jarvis North (480 ac.)
Ed Anway (635 ac.)
Bowden (1024 ac.)
Anway (290 ac.)
Nichols (792 ac.)
Davison (647 ac.)
Trust 205 (348 ac.)
Cactus Avra (1612 ac.)
Jarvis South (633 ac.)
Cactus Milewide (1389 ac.)
98 (315 ac.)
Wallis (1003 ac.)
Growers Finance (1560 ac.)
Ruth Martin (38 ac.)
Morse (309 ac.)
Double Z.S. (481 ac.)
Hill (314 ac.)
Buckalew (1533 ac.)
Duval / Pennzoil (1513 ac.)

MARANA
W MARANA RD
W MOORE RD
N TANGERINE FARMS RD
W AVRA VALLEY RD
W EL TIRO RD
W SILVERBELL RD
N SANDERS RD
W MANVILLE RD
W MILE WIDE RD
S SANDARIO RD
S SIERRITA MOUNTAIN RD
ARIZONA 86
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ArcGIS Online World Imagery

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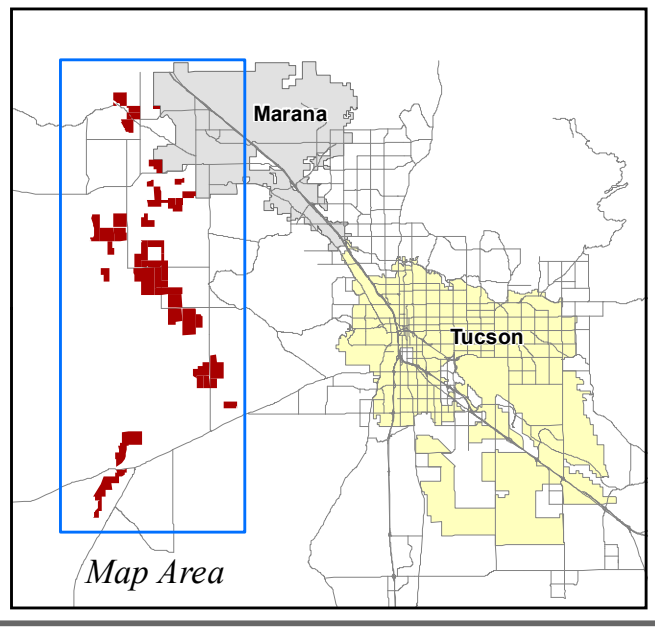
CITY OF TUCSON



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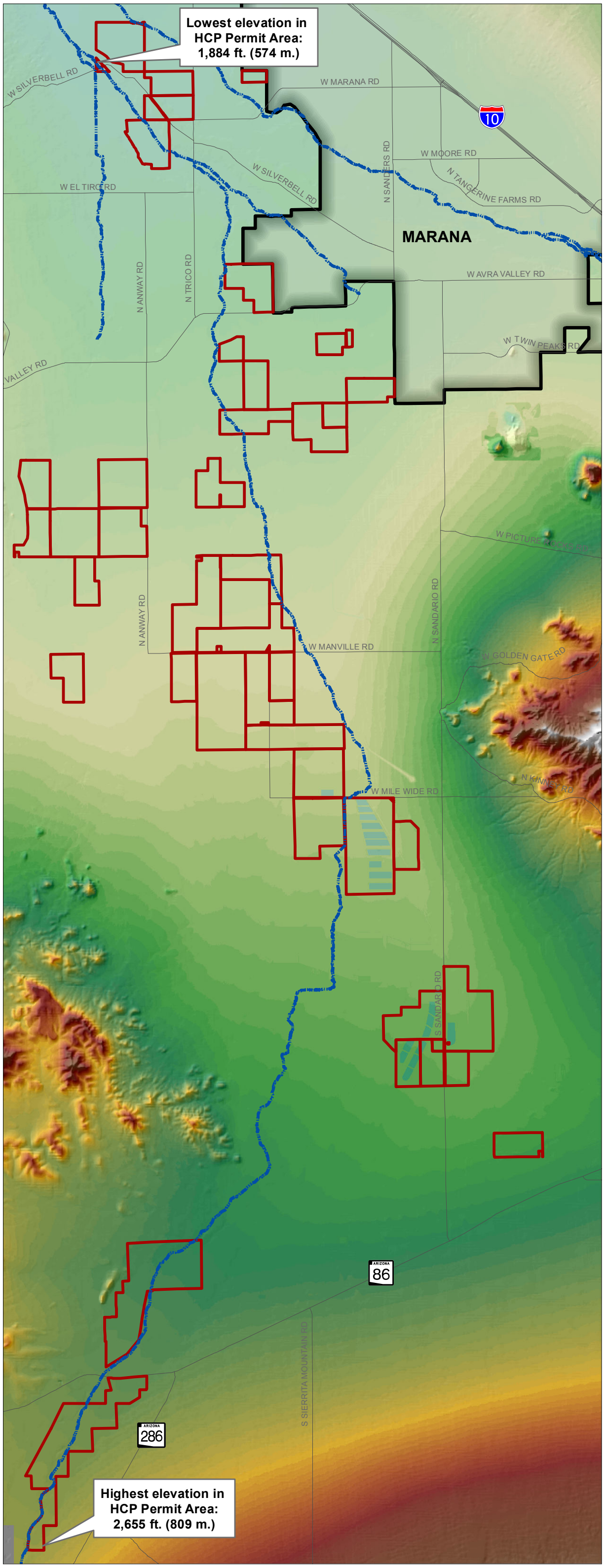

HCP Permit Area

Elevation

High: 4,688ft (1,429m)

Low: 1,847ft (563m)

Town of Marana

Major Streets

Major Wash

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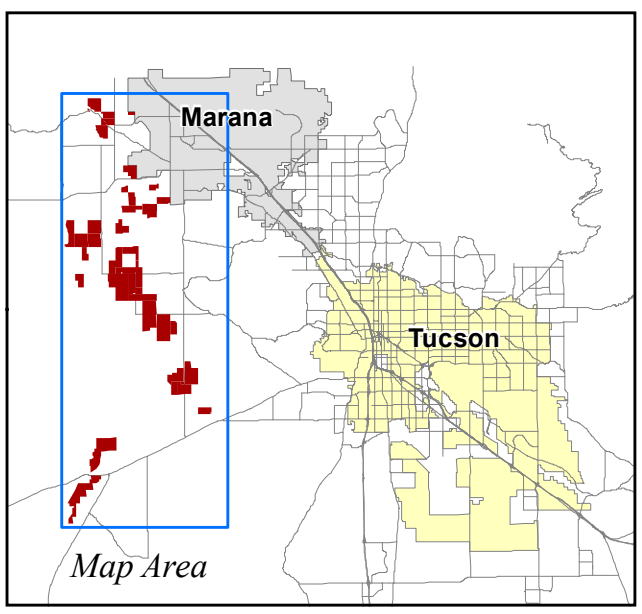
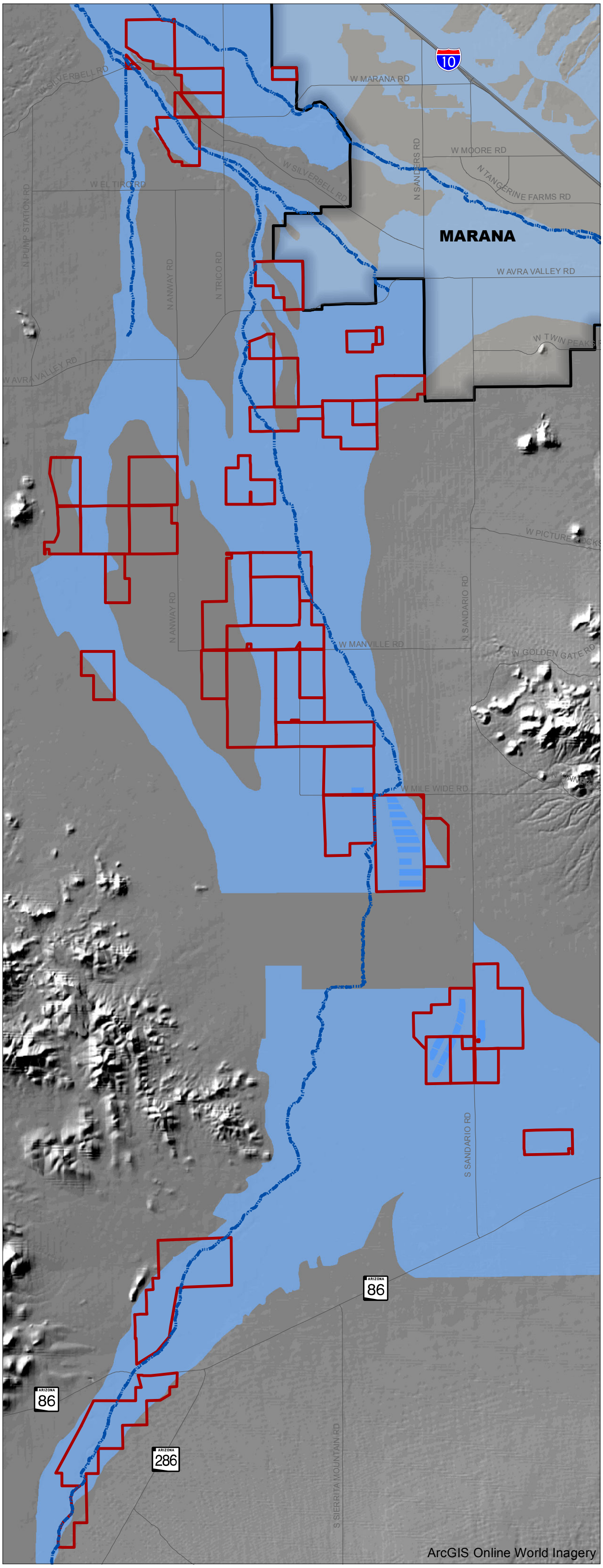
CITY OF TUCSON





Major watercourses and FEMA 100-year floodplains

- HCP Permit Area
- Floodplains*
- Town of Marana
- Major Streets
- Major Wash

* 15,967 ac. within HCP Permit Area. Excludes zones D and X as well as LOMR lands not incorporated into City / County GIS file "fp_dfirm"

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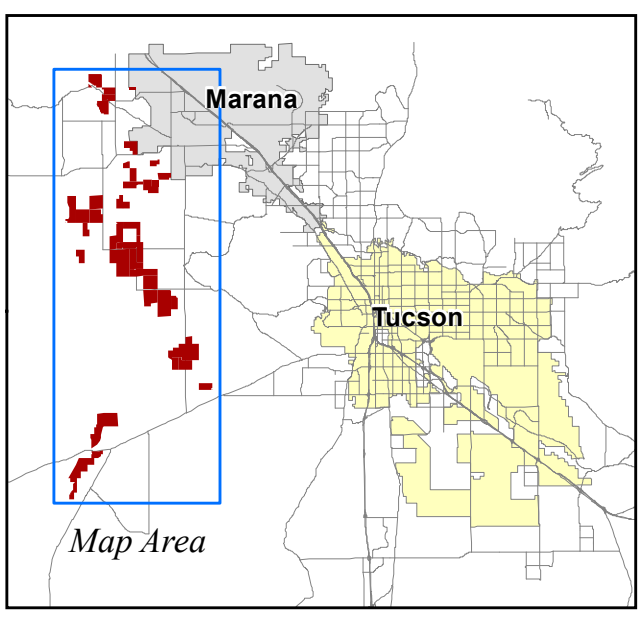
CITY OF TUCSON



Vegetation Cover

HCP Permit Area

*Vegetation (veg_covr)

- Delveloped; Agriculture; No Vegetation
- Tropical-Subtropical Desertlands; Sonoran Desert-Scrub; Paloverde-Mixed Cacti (Arizona Uplands) Series; Ambrosia deltoidea-Cercidium microphyllum mixed scrub Association
- Tropical-Subtropical Desertlands; Sonoran Desert-Scrub; Paloverde-Mixed Cacti (Arizona Uplands) Series; Larrea divaricata-mixed scrub Association
- Tropical-Subtropical Swamp and Riparian Scrub; Sonoran Deciduous Swamp and Riparian Scrub; Mixed Scrub Series; Prosopis velutina (velvet mesquite)-mixed scrub Association
- Tropical-Subtropical Swamp, Riparian and Oasis Forests; Sonoran Riparian and Oasis Forests; Cottonwood-Willow Series; Populus fremontii-Salix gooddingii Association
- Warm Temperate Forests and Woodlands; Madrean Evergreen Forests and Woodlands; Encinal (Oak) Series; Querrus spp.-Pinus cembroides - Juniperus spp. Association
- Warm Temperate Grasslands; Mixed Grass-Scrub Series; Mixed Grass-Acacia greggii Association
- Warm Temperate Grasslands; Mixed Grass-Scrub Series; Mixed Grass-Mixed Scrub Association
- Warm Temperate Grasslands; Scrub-Scrub Disclimax Series Haplopappus tenuisectus Association

Major Streets

Major Wash

*veg_covr displays the vegetation based on the Brown, Lowe and Pase classification system. The cover was created for the Pima County Wildlife Habitat Inventory, funded by the Arizona Game and Fish Heritage Fund. Analysis was performed by UA ART Lab.

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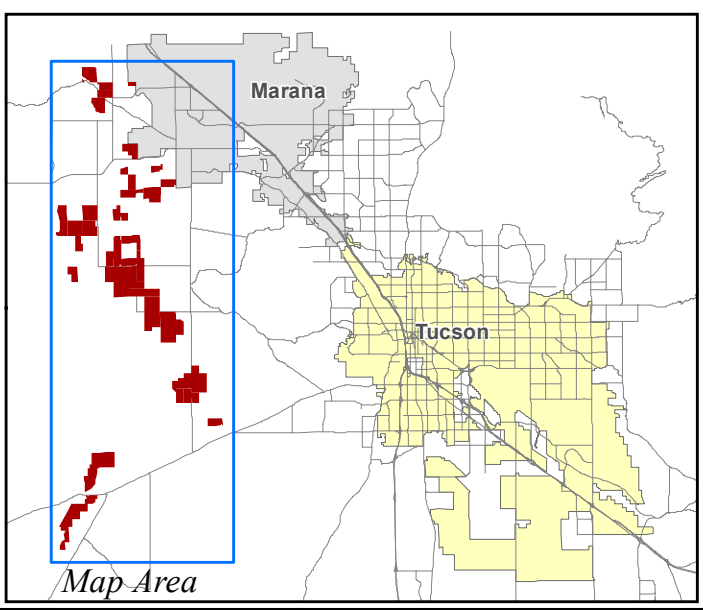
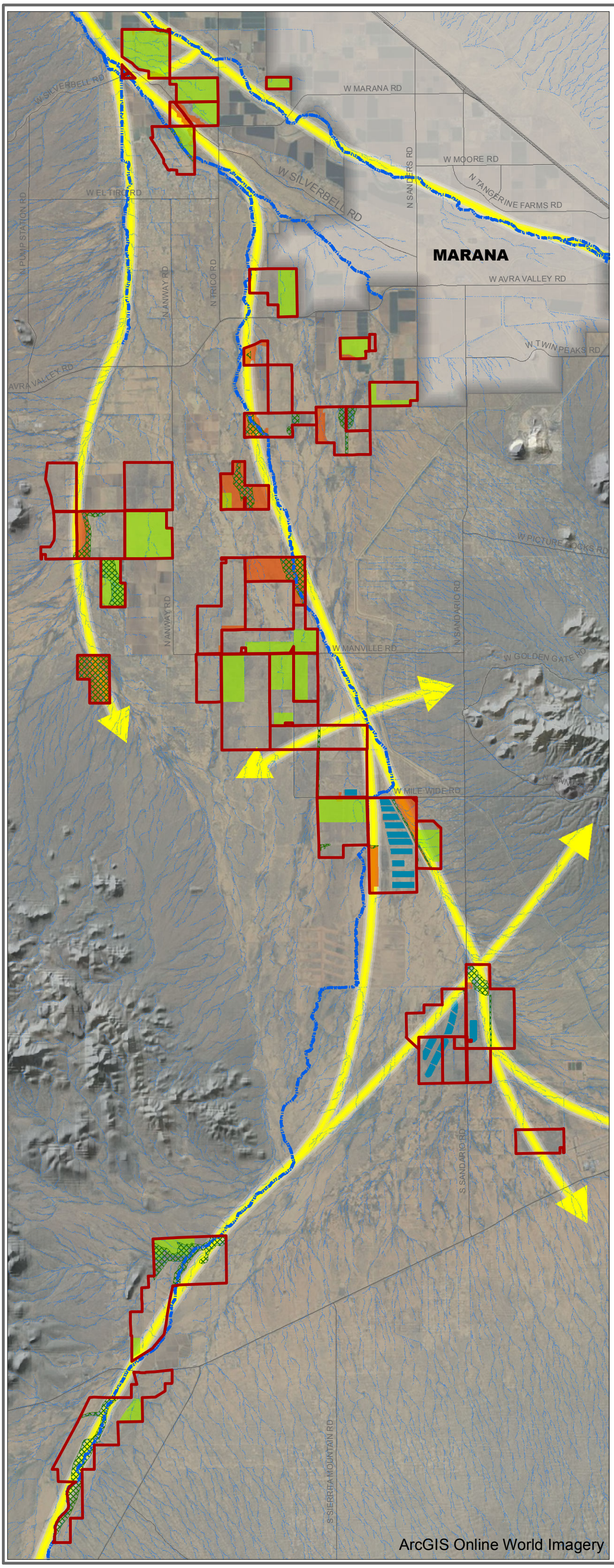


ArcGIS Online World Imagery



HCP *Modeled Habitat

- HCP Permit Area
- Habitat Connectivity Corridor
- LLNB, PTBB, WYBC, CFPO habitat (2,201 ac.)
- BUOW habitat (4,532 ac.)
- TSS habitat (2,458 ac.)
- Town of Marana
- Major Streets
- Major Wash

* The overlapping footprint of all modeled habitat is 7,590 ac. **UPDATE**

BUOW = Western burrowing owl
CFPO = cactus ferruginous pygmy-owl
LLNB = lesser long-nosed bat
PTBB = pale Townsend's big-eared bat
TSS = Tucson shovel-nosed snake
WYBC = Western yellow-billed cuckoo

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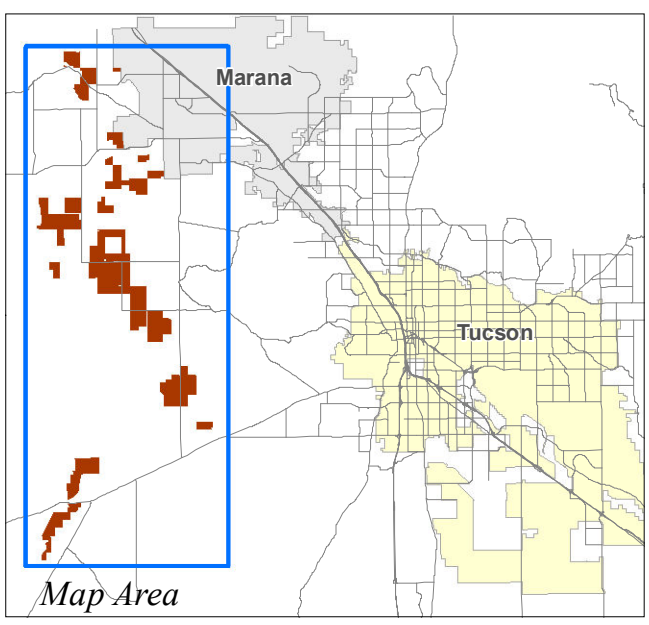

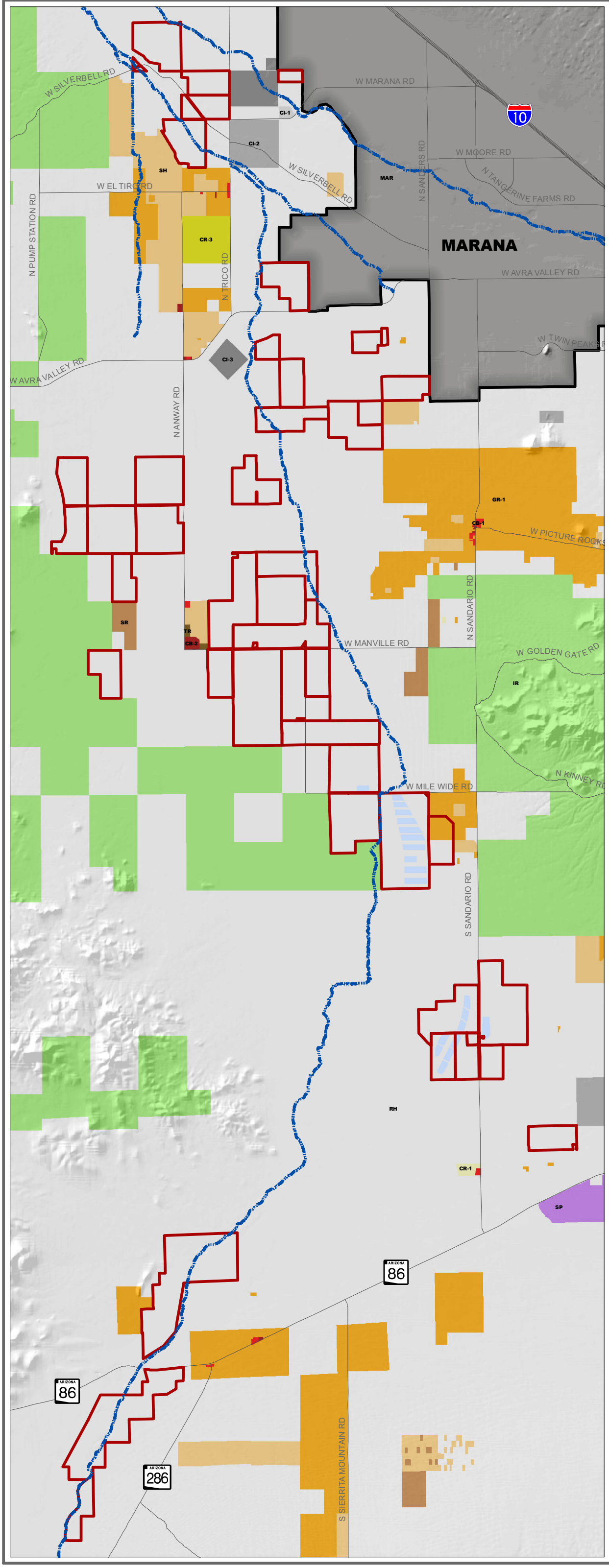

Zoning

HCP Permit Area

County Zoning

ZONE

- CB-1
- CB-2
- CI-1
- CI-2
- CI-3
- CR-1
- CR-3
- GR-1
- IR
- RH
- SH
- SP
- SR
- TR
- Town of Marana
- Major Streets
- Major Wash

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CITY OF TUCSON